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Simon E. Shnoll

COSMOPHYSICAL FACTORS

IN STOCHASTIC PROCESSES

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Cosmophysical Factors in Stochastic Processes

Translated from the first Russian edition of 2009
with some recent amendments containing
new experimental data and analytical results

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This monograph surveys the results of experiments
conducted by the author
that started in 1951 and continue until the present day

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Preface of the Editor

Commencing in 1951, Prof Simon Shnoll and his laboratory team produced dozens of thousands of unique experiments at the Institute of Biophysics (Pushino, Russia). Initially, the experiments were concerned with muscle proteins (1950-1960s). Then they were extended to other biological systems (1960-1980s), and even – to purely physical phenomena such as alpha-decay, beta-decay, and others (1990-2000s).

All the experiments manifested that the smooth Gaussian distribution of the observed signals has a fine structure which is dependent on various cosmic factors such as the daily and annual cycles, the appearance of different cosmic objects, and many other factors. The shapes of histograms of the observed time series manifested the effects with 99 percent probability.

While the possibility of an "internal structure" of the Gaussian distribution is under theoretical discussion, Shnoll's seminal experiments manifest that such a structure exists. This fact was also shown through absolutely different experiments – from processes from biology to physics – and attests to its universal origin.

Most probably, the fine structure of the stochastic distributions discovered by Shnoll, originates in the primordial structure of space-time itself. The phenomenon of the fine structures' alike manifestations in such different types of processes supports this conjecture.

I now present Shnoll's book to the reader as a purely experimental research report, without any theoretical analysis. This, to my mind, is the best way to approach this body of work. Let the theorists study this voluminous experimental background, (consider merely saying, it) and then give their considered opinion. So now, we pass the floor to Prof Shnoll, who will take the reader through his in-depth experimental research which is explained in every detail in his book.

15 August 2012 *Gunn Quznetsov*

Preface

This work commenced in the years 1951–1956 as an attempt to reduce the "scattering of results" obtained from maximally accurate measurements of the rate of ATP hydrolysis in an ATPase reaction catalyzed by muscle proteins and enzymes of the actomyosin complex.

More than 50 years have passed. The work of this time period resulted in the following findings:

- A "scattering of measurement results" that is difficult to explain and seems to be intrinsic to a large variety of different types of processes: ranging from biochemical reactions to radioactive decay. It is determined by cosmophysical causes;
- The amplitude of fluctuations (scattering of results) relative to a measured value varies depending on the type of process;
- The distribution's fine structure of fluctuation amplitudes, i.e., the shape of a corresponding histogram, is independent of the type of process;
- Histograms constructed from results of measurements made at the same geographical point and time record the same shapes independent of the type of process from which the measurements were derived;
- A histogram shape changes regularly in time;
- These changes are coupled with cosmophysical factors;
- From the entirety of the obtained results we conclude the following: discrete fluctuations of measured values may result from fluctuations of the space-time continuum, which are, in turn, caused by the motion of investigated objects in a nonhomogeneous gravity field. This inhomogeneity seems to result from the existence of "celestial bodies", mass thicknesses, in the ambient space;
- The motion of an object towards these bodies, in the nonhomogeneous gravity field, should give rise to gravity waves. Through waves interfering at each point of the space-time continuum, corresponding interference patterns seem to manifest themselves in the fine structure of the histograms that we analyze.

These rather general conclusions were formulated while our ideas on the nature of the phenomena studied were gradually changing. At first, we supposed the regularities found were specific to muscle proteins. After several years, we have discovered that they are inherent to all proteins. Later, however, we saw the same regularities in protein-free chemical reactions and, after a while, it became clear that we dealt with a nonspecific feature of any processes of all kinds. The only common "something" shared by all those processes was their occurring in the same space-time continuum, and so we reached the above conclusions.

Every step down this path required a lot of work. Psychological factors further complicated the problem: the phenomena were too unusual, which exacerbated our load of responsibility concerning the reliability of the resulting regularities.

Changes in our conception of results obtained do not devalue results from earlier research stages. Take for instance establishing the universal character of histogram shape changes over time would not depreciate the phenomena and regularities found in the experiments with proteins. One of the purposes of the book is to review all the stages of our research.

The book, therefore, consists of two parts. The first part describes the course of experiments that finally made us to change from the concept of "specific features of protein solutions" to the conclusion that the phenomenon has a general nature and the fine structure of a histogram does not depend on the type of process studied.

The second part reviews experimental grounds for the conclusion that the phenomena observed have cosmophysical causes.

Pushino, 19 August 2010 *Simon E. Shnoll*

Part 1

From Biochemical and Chemical Reactions to Radioactive Decay Processes. 1951–1997

> *Why were so many experiments in physics and chemistry undertaken?*
> *Why did such great men risk their lives in labors and trials?*
> *Whether only for the sake of someone, a great many things and matters were collected and piled in a heap, just to look at them, and to wonder about their great number, and not to think of the way they are arranged and put in order.*
>
> *Mikhailo Lomonosov*

> *Science is built up of facts, as a house is with stones. But a collection of facts is no more a science than a heap of stones is a house.*
>
> *Henri Poincaré*

Brief “chronology” of Part 1

The experiments of 1951–1970 included several years of work purposed to exclude methodical artifacts. This work led to the conclusion: the “anomalous scattering of results” is explained by reversible and synchronous in macrovolumes changes of the protein conformation — “conformational oscillations”, which take place in water solutions of proteins. These macroscopic oscillations are the result of conformational changes of single molecules synchronizing, which is achieved through “waves of structural reorganization” of water, that is, changes in the “structure” of a water solution filling in the space between protein molecules. The ability of muscle proteins to operate in the mode of such “conformational oscillations” stems from rhythmic cardiac and smooth muscular performance. In voluntary, somatic muscles, synchronization of conformational changes of macromolecules should provide for a high efficiency of the apparatus of biological motility [1–12].

With this hypothetical concept in mind, we had been conducting experiments for many years, testing the likelihood of our ideas about the waves of structural reorganization in water (water solutions) as the conditions for the synchronization of conformational changes of molecules in macrovolumes [12–19]. Moreover, we had begun to look for oscillatory regimes in various biological and chemical processes, which made a considerable contribution to this field [20, 21].

After E.P. Chetverikova's studies that had revealed similar "conformational oscillations" in solutions of creatine kinase [22–28], it became clear that the ability to undergo synchronous changes in macrovolumes was not a property solely attributable to muscle fibril proteins. In the 1970s we demonstrated that synchronous changes in macrovolumes could be a general feature of solutions of various proteins [16].

Our efforts to prove that the phenomenon of "conformational oscillations" of protein macromolecules is real came to the point of culmination through the experiments in the time period between 1960 and 1978. It was then that we simultaneously took samples from different points of a vessel and registered synchronous changes of the enzyme activity and SH-group titer over the entire vessel bulk [6, 7, 26–29].

These experiments also revealed a wonderful phenomenon that we could not immediately recognize: synchronous changes of enzyme activity and SH-groups titer in portions of the entire protein solution *placed into different vessels*. First we supposed the phenomenon to be an evidence of the stability of an oscillation regime that remained after the separation of a volume portion from the main volume. However, through a step by step process of investigating, an explanation of the phenomenon by some similar parallel effects of some external "forces" on the solution portion in different vessels seemed more appropriate to us.

Anyway, after about 25 years of investigations, in early 1979, we considered the reliability of the main phenomenon, namely the "synchronous and reversible conformational changes in a macrovolume solution of protein molecules" proved.

We nevertheless continued with investigations of another phenomenon: the discrete character of the distribution of results, that is, the existence of "permitted" and "forbidden" states of a measured value and the relevance thereof. Later it became clear that a fine structure of a distribution, a shape of a corresponding histogram, and an amplitude of the scattering of results may change independently from one another. Sometimes they result in distinctly discrete distributions, in histograms with a distinct fine structure at relatively small "fluctuation" amplitudes. Furthermore, conversely, at times smooth distributions, without distinctly expressed discrete states are obtained at a high amplitude. Thus, a discrete histogram shape alone cannot serve as a diagnostic feature of the presence of "synchronous conformation fluctuations of protein molecules in a macrovolume".

Studies from the years 1978–1983 demonstrated a histogram fine structure and its time changes to be an intrinsic property of many different types of processes [30–34]. The following years, up to the present one (2010), were mainly filled with investigations on the nature of histogram fine structures. I came to the conclusion that a histogram fine structure is determined by cosmophysical factors and reflects time-space fluctuations occurring through the movement in the inhomogenous gravity field.

These are the main steps of the investigations taken in this period. Let us explore their details more thoroughly.

Chapter 1.

I discovered a “scattering of results” in measurements of ATP-ase activity in actomyosin solutions that cannot be explained by trivial reasons (1951–1957). Special properties of muscle proteins explain the “scattering of results”. These properties refer to changes of the conformation of these protein macromolecules that are synchronous in their macro volume (1958–1970)

1.1 The beginning

On September 8, 1951, I started to work at the newly reorganized Department of Medical Radiology of the Central Institute for Physician Excellence (CIPE) – it was a “branch of the Atomic Project” established with the aim to educate researchers and physicians and to teach them how to apply isotope techniques in experiments and clinical practice [35]. I was to equip the laboratory and responsible for the storage of radioactive isotopes, to set up measuring devices and to develop a number of specialized techniques – for measurements, glassware cleaning and the conservation of waste products. Already in October, I also was to start lessons with military and civil physicians.

One of the first priorities was, among many others, the problem of calculation and accurate preparation of radioactive solutions. There was a high risk of exposure to radiation, and I must have been confident about the accuracy of my work. So I carefully determined possible errors at all the stages of standard procedures and noted, with satisfaction, that my total error – the “scatter of results” – amounted to about 1.5 % of the measured quantity.

Meanwhile I conducted my own research – on top of the official duties. After 15:00, when the official workday ended (which was very early, because of the hazardous character of the work), I began experimenting in my specialty field – biochemistry. I studied the interaction of radioactive amino acids with proteins (which became my PhD thesis) and enzymatic, ATPase activity of the proteins of the actomyosin complex. And now, when I measured this enzymatic reaction, my honed experimental skills became mysteriously dull. The “scatter of results” jumped significantly. When repeating experiments with other things being equal (the “ceteris paribus” principle), the rates of the reaction sometimes differed by the factor of two, and the mean square error exceeded 20 %.

Students are taught to make at least two identical measurements; these measurements are called “parallel samples”. If the results of the two measurements differ too much, students are recommended to make one more, third "parallel" measurement. Out of the three results, the two that lie closest to each other are selected, while the third is discarded as an "outlier".

Not wanting to discard results, I increased the number of "identical" measurements. I began to make 10 "parallel samples". What I saw was very strange: not only the rates of the reaction in different portions of the solution varied – the results were often divided into two or three groups. None of these groups was preferable to another. It was the first manifestation of the distributions of the results of measurements being discrete.

Consequently I increased the number of measurements to multiples of ten and then to a few hundreds, yet the discreteness just became more apparent. Instead of the expected "normal" distributions, I obtained histograms in which some values evidently dominated, whereas others were less probable.

For the first time, the understanding emerged: that the probes are not "parallel" but "consecutive". Hence, the properties of the protein solution must change in time. Could these changes be reversed? Are the states of the preparation discrete?

I must have ascertained that this was not a result of methodical errors, that these differences were not caused by a nonhomogeneity of the solution, or by a variation in the volume of the solution portions, protein concentration, temperature, the shape of test tubes or the quality of their glass. Proving this took many years of research.

The result of a typical experiment of those years, illustrating the phenomenon, is given in Fig. 1-1 and 1-2. In that experiment (conducted on October 5, 1957), ATPase activity was measured in the consecutively taken (with 15-second intervals) 173 equal portions of the actomyosin solution.

1. It can be seen that somewhere at the 40^{th} portion, ATPase activity of the preparation is getting lower, dropping almost to a half by the 66^{th} portion, and jumps again starting from the 70^{th} portion. Then it decreases at the region of the 120–145^{th} portion and rises again by the end of the series.
2. There are "preferential" values of the quantity measured. Values of enzymatic activity at the levels of 360 and 200 arbitrary units occur much more frequently than other values. The corresponding histogram does not look like a smooth "normal" distribution.

Figures 1-3 and 1-4 show the results of an analogous typical experiment carried out 20 years later, on May 30, 1978. At that time, we worked mainly with the diluted solutions of creatine kinase. Here, one can also see the fluctuations of the measured quantity, with their amplitude significantly

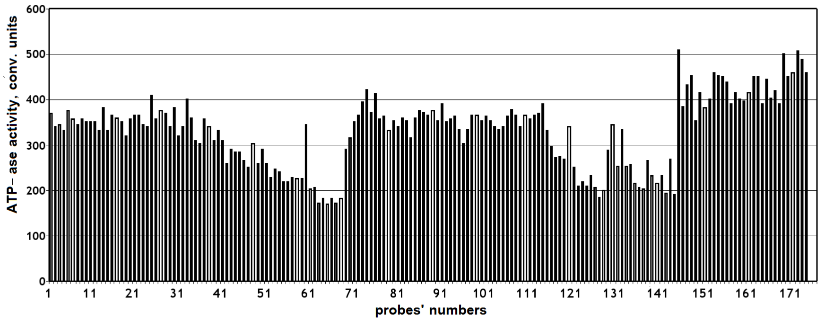

Figure 1-1: Illustration of spontaneous changes ("fluctuations" with high amplitude) of the enzymatic – ATPase activity in an actomyosin solution. Experiment of October 5, 1957. The root-mean-square amplitude of the "scatter of results" to the average size equals 23 %. On the abscissa axis, 15-second intervals lie between tests. The ordinate axis shows the enzymatic (ATPase) activity in conventional units.

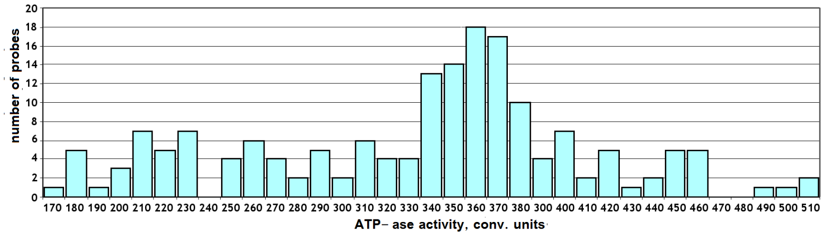

Figure 1-2: The histogram – distribution of realized values of the experiment depicted in Fig. 1-2.

exceeding the level of methodical errors (8.1 % as compared to 1.5 %). These figures illustrate two main phenomena:

a) the amplitude of the scatter of results of measurements is too high;

b) the distribution of values is discrete; there are "allowed" and "forbidden" states.

As became clear later on, the amplitude of the scatter of results and the shape of discrete distributions (the shape of the corresponding histograms) can change independently of one another.

In the 1950s, I had many interesting problems to explore. However, to tackle them with this scatter of results and these odd distributions seemed impossible. So I decided first to reveal the causes of these phenomena and

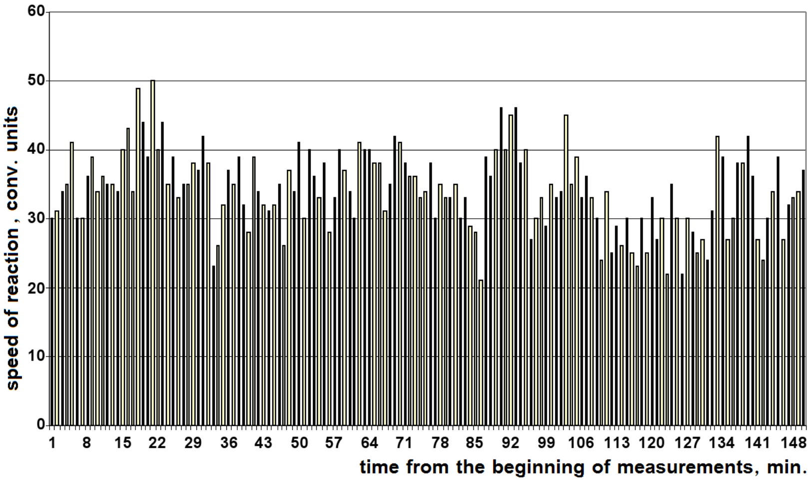

Figure 1-3: Illustration of "macroscopic fluctuations" reaction rates of ATP + creatine ⟶ creatine phosphate + ADP catalyzed by the enzyme creatine kinase. Experiment on May 30, 1978. The x-axis displays the time in minutes, and the y-axis the reaction rate in conventional units.

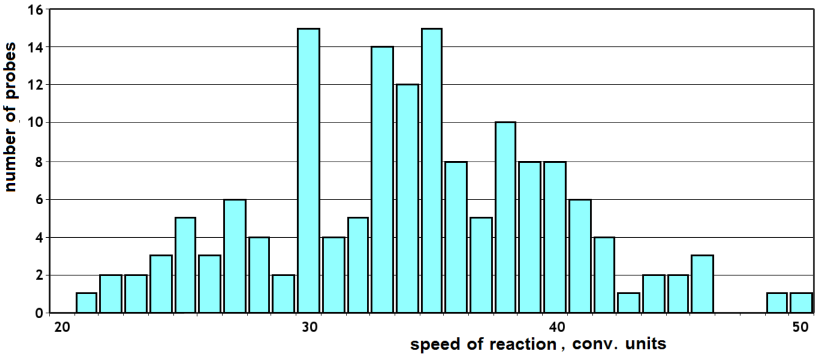

Figure 1-4: Typical discrete distribution. The discrete histogram of the measurement results is represented in Fig. 1-3. The y-axis of Figure 1-3 becomes the x-axis in this figure, and value ranges are counted over time, which are displayed on the y-axis.

only then to go into other, more interesting, problems. Fifty years have passed. "Revealing" is still in progress. What I discovered, however, may be of interest for future researchers. At the beginning, I considered these phenomena specific to the muscle proteins only. After 15 years of research, it turned out that this is a characteristic of any protein. By the early 1980s, the following had become clear:

1. The amplitude of the "scatter of results" and the shape of the corresponding histograms may be unrelated to each other; they may be associated with different causes. Protein molecules changing synchronously in the solutions represents an important feature, which can underlie many physiological processes.
2. Discrete distributions are intrinsic to any types of processes, from biochemical reactions to radioactive decay, and the shape of histograms reflects very general features of our world. Now I believe that these phenomena are caused by fluctuations of the space-time continuum, resulting from the movement of the Erath in the nonhomogeneous gravitational field.

I think it would be worthwhile to follow the course of experiments and change of concepts in this long-term research – from "special biochemistry" to general physics (the reader who is not a biochemist may skip this part and start reading from the description of the results of radioactivity measurements and fluctuations in stochastic processes).

1.2 "Conformational oscillations" of muscle proteins. Wave patterns in the restructuring of water

After several years of research, I drew a mental picture of the following, which could explain the odd "scattering of results" in the measurements of ATPase activity of the proteins of actomyosin complex [2, 7, 9, 10, 12].

These proteins exist in several almost equiprobable states, which represent different macromolecular conformations with different enzymatic activity. The conformational states keep switching from one to another as in the process of polymorphic crystallization – no one wins. Waves of structural reorganization, "conformational oscillations", spread in the preparation. The mediator providing synchronization of conformational changes over the entire bulk would be, as I thought, waves of structural reorganization of water, which originate from the exposure and hiding of hydrophobic and hydrophilic regions of macromolecules (upon "opening and closure" of "mouths-clefts" on the surface of protein macromolecules).

The "waves of structural reorganization of water" that I thought up in this way, consisted in the reorientation of water dipoles due to the change of the surface properties of a macromolecule – from hydrophilic to hydrophobic. These changes, this reorientation of the layer close to the surface should induce a reorientation of the next layer, and of further respective layers – until the wave of reorientation has reached the surface of another molecule. The conformational changes of one molecule should therefore become synchronized with the conformational changes of another molecule – similar to the behaviour of connected oscillators (e.g. pendulums hung to a common base). It could be an interesting problem to synchronize chaotically fluctuating oscillators in a three-dimensional medium.

For such "macroscopic conformational oscillations" to be realized, the state of the system must be close to a phase transition point (a "critical point" when the "radius of correlations of fluctuations is infinite").

The picture came out harmonious and could provide a basis for explaining the mechanism of important biological phenomena: enzymatic catalysis, biological motility, generation and perception of acoustic and electromagnetic waves (the latter because macromolecules – electrets – contain fixed electrical charges, whose movement will create electromagnetic fields).

Such transitions – from one state to another – of the muscle contractile proteins (proteins of the actomyosin complex) appeared quite natural to me exactly for the case of these specific proteins. With the proper structural organization, this ability of theirs could underlie the rhythmical activity of the heart and of insects' flight muscles, as well as the slow oscillations such as intestinal peristalsis.

These ideas were supported by *Sergey Evgenievich Severin*, *Lev Alexandrovich Blumenfeld* and *Gleb Mikhailovich Frank* and later became our research program in Pushino. G.M. Frank liked the image of enzyme protein molecules "chewing" substrates. This picture captivated *Dmitry Sergeevich Chernavsky*, and in 1966, the three of us (he, *Yury Isaakovich Khurgin* and me) formulated the "protein-machine" concept [36, 37].

These "spontaneous changes of the protein features", due to synchronization of fluctuations in the region of phase transition of a polymorphic system, were of interest to me for many years and became the subject of numerous publications. I would like to conserve some of them [2, 7, 9, 12, 15, 16] for the future.

Chapter 2.

Are we dealing with oscillations? Biological clock. Cardiac performance. Intestinal peristalsis. Particular muscle proteins in solutions show oscillating behaviour. The search for oscillating regimes in biochemical and chemical processes. The Belousov reaction. Conformal oscillations of protein macromolecules of the actomyosin complex are synchronous on the macro level

This image of "spontaneous" synchronous transitions of all molecules in a bulk from one possible state into another naturally led us to the problem of oscillatory regimes in biological and chemical systems.

The investigation of oscillatory regimes in biology is very important. They explain, amongst others, the striking phenomenon of the "biological clock" [38], the rhythmical activity of the heart, the intestinal peristalsis, the oscillations in the flight muscles of insects, as well as fluctuations in population sizes. I was captivated by the thought: in the solutions, muscle proteins reveal an intrinsic ability to change their state rhythmically. In the heart and intestine, this ability manifests itself; in the other muscles, it is suppressed, "overregulated". In the solutions, it is removed, and oscillatory regimes can be observed.

It was necessary to obtain evidence that these regimes exist at the molecular, biochemical (and not only on the physiological) level.

At that time, however, the possibility of oscillatory regimes existing in homogeneous systems seemed rather unreal to educated people. For this reason, the original paper, in which B.P. Belousov described his oscillatory reaction, which became famous later but had been rejected by the reviewers: they knew equilibrium thermodynamics well. Belousov's paper contained a detailed formula – the composition of the reaction mixture and the concentrations of the reagents – just mix them and you will see oscillations.... This, however, was insufficient in the eyes of the reviewers: why should they check a priori preposterous claims? I have already written about this situation "in every artistic detail" [35] – including my "nervous" assistance with the publication of B.P. Belousov's only paper [39].

In the 50s, in my first attempts to explain the odd scatter of results in the measurements of rates of biochemical reactions, there already existed an advanced theory of self-oscillating processes. This theory was put forward by Henry Poincare and developed by mathematicians and physicists. In 1911, Alfred Lotka, a Poincare's follower, suggested a system of differential equations that demonstrated the possibility of oscillations of two interacting variables (three, to be precise: the "food", i.e. the "prey" and the "predator"). This system was further developed by Vito Volterra: in 1920, who obtained a solution representing continuous oscillations [40, 41].

The idea of oscillation regimes – based on Lotka's work – was used in 1915 by P.P. Lazarev to explain physiological oscillatory processes [42].

In the Soviet Union, the theory was perfected by the school of L.I. Mandelstam and A.A. Andronov [41], and many practically important results in physics were obtained based on their work.

However, neither chemists nor biochemists knew this theory. With their views resting upon equilibrium thermodynamics, they considered oscillations in homogeneous solutions (systems) impossible: an assumption that most molecules can be at first in one and, in the next moment, in another state seemed highly unlikely.

For this reason, B.P. Belousov's report on a novel reaction was rejected by the reviewers and hence not published. For the same reason, a PhD thesis by I.E. Salnikov (a direct disciple of A.A. Andronov and D.A. Frank-Kamenetsky) was rejected: the thesis was devoted to possible mechanisms of chemical oscillatory reactions (Salnikov could not submit it at the Institute of Chemical Physics and defended it later, at the Institute in Gor'ky headed by Andronov) [43–45]. Ironically, it was the Institute of Chemical Physics, where oscillatory processes in heterogeneous systems* were studied and where D.A. Frank-Kamenetsky published his papers on the theory of chemical oscillatory processes in 1939-1941 [46–48].

At first, I too was not aware of the theory of oscillations and the works by Lotka, Volterra, van der Pol and Frank-Kamenetsky; neither was I aware of the outstanding book by F.M. Shemyakin and D.A. Frank-Kamenetsky [49]. These ideas, however, in one way or another conveyed themselves to me.

Naturally, I was interested in all types of oscillatory regimes, including those already described by the theory of oscillations. In my book [35], I have already told the history of the Belousov oscillatory reaction becoming accessible to and noted by the public and about the contribution A.M. Zhabotinsky made. This reaction is widely known in the scientific world as the "Belousov-Zhabotinsky (BZ) reaction" [50–52]. Demonstrating this reaction promoted the popularization of "auto-oscillatory and autowave ideas" in various scientific disciplines. On the whole, the 1960s-1970s were the time when the oscillation theory applications became popular. More and more attention was being paid to the problem of the "biological clock" [38], which, in turn, impacted on the discovery of oscillations in

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*With "cold flames", periodical flashes during the oxidation of phosphorus vapors are referred to; attempts to explain this phenomenon led to the creation of the theory of chain processes.

biochemical processes [35]. In particular, oscillatory processes in glycolysis and oscillations of the shape and function of mitochondria were revealed. This general feeling touched the concept of "conformational oscillations" as well. The concept became the main topic of my report at the 1^{st} Pushino "oscillatory symposium" on March 21, 1966 and met the approval of the audience [9].

2.1 "Oscillatory symposia" in Pushino

It should be noted that the dissemination of the "oscillatory ideology" was promoted by special symposia, which we held in Pushino.

The 1^{st} All-Union Symposium on the oscillatory processes in biological and chemical systems was held at our Institute of Biophysics on March 21–26, 1966. Right after the symposium, we published its proceedings as a separate book [53], which turned out to be quite popular (the book was rumored to be approved by and "was seen on the desk" of M.V. Keldysh, President of the USSR Academy of Sciences).

There were two other "oscillatory symposia" held in Pushino. Their main agenda was systems of differential equations as models of biological and chemical processes – an area of science that would later be referred to as "synergetics". The symposia gathered outstanding people.

The study of oscillatory regimes in biological processes became a respectable field of science. Here, the construction of mathematical models (systems of differential equations) combined well with their experimental validation. Meanwhile, I grew in my conviction that all this had nothing to do with my research. There were no proper oscillations in my experiments – only fluctuations. It would be impossible to describe the fluctuation processes I studied using differential equations. It took a while for me to realize this.

I was captivated by the idea of synchronous – in a macrovolume of the solution – conformational changes of protein macromolecules. The molecules, I imagined, behave like athletes in mass parade performances in the Red Square. I believed that in solutions, muscle proteins (the proteins of the actomyosin complex) would reveal their intrinsic ability for rhythmical oscillations – an ability that was evolutionally perfected in the heart and smooth muscles and "suppressed" in the cross-striped musculature.

That indeed was a beautiful aspect of physics – the synchronization of the conformational changes of single protein molecules mediated by the waves of structural reorganization of intermolecular water. . . .

A whole complex of problems arose when considering this picture. What are features of the protein molecules themselves – how do they change their conformation? How could one register these changes of the protein conformation that are synchronous in macrovolumes? What conditions would support the waves of structural reorganization of water? Furthermore, putting aside the answers for a moment – what about the questions themselves? How to formulate them correctly and give experimental estimations of their correctness? Those were the contents of my doctoral (ScD) thesis [12]. The procedure of my defense on March 11, 1970 was accompanied by dramatic events and lasted more than 7 hours. All the members of the Dissertation Board said "yes". The speeches of G.M. Frank, S.E. Severin, S.V. Konev, D.S. Chernavsky, V.O. Shpikiter in favor of the thesis were unforgettable. The thesis was based on the results of numerous experiments. I, however, was filled with doubts.

Do I really deal with changes of the conformation? Is it true that the changes of protein macromolecules are synchronous in a macrovolume? Are these changes proper oscillations and not casual fluctuations? Are these features characteristic for the muscle proteins only? Does water really play the key role in these phenomena? And if so, then how real is the view that there exist several water "structures" switching from one to another?

2.2 Changes of conformation?

Changes of the enzymatic (ATPase) activity do not necessarily result from changes of the conformation of an enzyme macromolecule. I had to find other indications of conformational changes. So I chose two other approaches: the determination of the ability to bind dyes and radioactive amino acids and measuring the number and accessibility of SH-groups. These experiments were analogous to those of D.N. Nasonov and V.Y. Alexandrov [54]. Alongside of dyes, I used amino acids labeled with radioactive isotopes [55]. Changes of conformation mean changes in the proportion between the exposed hydrophilic and hydrophobic amino acid residues and the accessibility of SH-groups on the surface of macromolecules for certain reagents. The experiments showed that the quantities of protein-bound neutral red, bromthymol (or bromphenol) blue and labeled amino acids fluctuated in the same manner as enzymatic activity. Analogous changes were observed for the titer of SH-groups in the selected portions of the protein solution. When these parameters were measured in the native protein solutions, a broad scatter of results was observed. The scatter, however, significantly decreased when the measurements were conducted after protein denaturation or after adding a "seeding agent".

These data confirmed the conclusion on the synchronous in macrovolumes changes of the conformation of protein macromolecules.

To explain synchronism in the changes of conformation of all the molecules in the solution, I thought up the abovementioned "waves of water structural reorganization", transferring conformational changes from molecule to molecule. In this hypothesis, the conformation of a macromolecule can be a seed, which will spread to other macromolecules. The picture is analogous to that observed in the case of polymorphic crystallization, with continuous transitions (near the equilibrium point), recrystallization, from one form to another. That was where the idea of "experiments with a seeding agent" stemmed from.

2.3 Experiments with a "seeding agent" confirmed the idea of polymorphic crystallization

In the "seeding" experiments, fluctuations in the solutions of muscle proteins ceased when mixing portions of the protein solution with a solution of ATP. The current state of the solutions at the moment of mixing became fixed, or captured. In different samples, these fixed states varied in the enzymatic activity and concentration of titratable SH-groups. The "seeds", accordingly, differed in quality. The "seeding effect" could be seen upon addition of a small portion of such a "fixed protein" solution to the main protein bulk. With the seed added, fluctuations in the bulk stopped: successive samples taken from the bulk had the same (with the accuracy of the method) enzymatic activity or SH-group titer. The values of enzymatic activity or the SH-group titer at which the fluctuations stopped differed for different seeds. The phenomenon of a "seeding agent" is illustrated by Fig. 2-1 (taken from [12]).

These experiments provided the best additional evidence that the fluctuations of protein properties had a non-methodical origin: the "scatter of results" (mean-square amplitude) without a seeding agent was, *ceteris paribus*, 20 % against 2–5 % in the presence of the seed. More important, they confirmed the main idea: all the protein solution bulk got fixed ("crystallized") in either one state or another, which was dependent on the seed. Many years later, an analogous picture of crystallization (taking a certain conformation depending on the seed) was suggested to explain the features of prions, proteins accumulating in the brain for some severe pathologies (kuru, Alzheimer's disease etc.).

2.4 Were changes of protein macromolecules truly synchronized over the entire solution?

The synchronism in the conformational changes of protein molecules followed from the very fact of the effects being "macroscopic": each por-

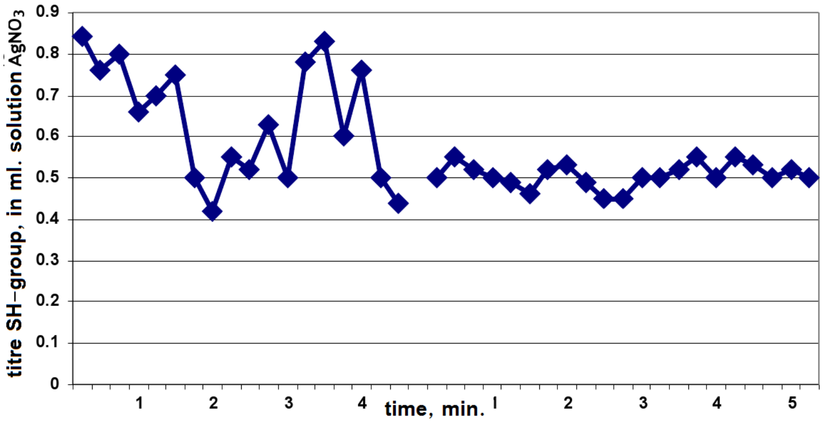

Figure 2-1: Illustration of the seeding effect or the phenomenon of a "seeding agent". Experiment of October 28, 1963. Titration of the number of available SH-groups in a solution of actin by 1.25×10^{-4} M $AgNO_3$. The left part of the figure is presented as a "control" – "the conformational fluctuations" ($\sigma =$ 21.6 %) with large amplitudes are visible. The right part of the figure represents the "experiment": the amplitude of fluctuations sharply decreases ($\sigma =$ 5.4 %) after preliminary addition of 1/4 volumes of the same solution of the protein, fixed $AgNO_3$ ("seeding agent"). All molecules of the protein appear to be in an identical condition, corresponding to the condition (titre of SH-groups) from seeding agents. Most importantly, different seeding agents with different titres of SH-groups can be discerned. The bulk of the protein titre appears to correspond with the titre of the seeding agents when these are added to the solution. For more details see reference [12].

tion of the solution contained an enormous number of protein molecules ($\approx 10^{17}$!). Mysterious, however, was the reversibility of those changes: all the molecules simultaneously turned either to one state or another. Was this possible? Furthermore, the transitions were suspiciously slow. With the characteristic times of conformational changes of a single molecule being 10^{-10} – 10^{-7} seconds, the synchronous in macrovolumes macromolecular fluctuations occurred on timescales of seconds.

Under such circumstances, a reliable proof that the phenomenon really exists is of utmost importance. A positive answer was obtained by measuring the enzymatic activity or SH-group titer in the portions of the protein solution collected from different parts or the solution bulk. Over almost a 15-year period from 1960 to 1975, I have returned to these experiments many times.

I started those experiments fascinated with the idea of oscillations, i.e., changes of the properties of protein molecules due to some "intrinsic, dynamic causes". I was unwilling to admit that the fluctuations observed may result from external causes. I rejected the thought – rejected because the possible effects of any "trivial" external causes (differences in temperature, illumination etc.) were excluded by a careful experimental set-up with the strict adherence to the principle *"ceteris paribus"*. Any more "exotic" external effects just did not occur to me at that time. The overall picture, however, was not simple, and the results of our experiments often could not be interpreted unambiguously.

The first experiments of that series were conducted on October 15 and November 1, 1960*. A solution of actomyosin was poured out from a common vessel into three test-tubes. Then, after incubating the test-tubes at 20^oC for 18 minutes, we began to collect aliquot portions from these three samples (every 15 seconds) and analyze them for the ATPase activity. The results were not quite definite, yet one could see a certain phase synchronism in the change of enzymatic activity of those three samples (Fig. Sh-1 and Sh-2 in [12]). I came to the following conclusion.

> Fluctuations of protein properties are, indeed, synchronized in macrovolumes of the protein solution, with the synchronism being maintained even if portions of the solution are placed into different vessels.

The highly concentrated, jellous preparations of actomyosin were poorly suited for such experiments. Two years later, after we finished setting up research facilities at the Department of Biophysics of the Physical Faculty, we switched to relatively diluted solutions of actin and, then, other proteins. The proteins were tested for SH-group titer using amperometric titration. In collaboration with Nina Andreevna Smirnova, we performed experiments, which directly indicated synchronous changes of protein properties over the entirety (macroscopic volume) of the protein preparation. Sergey Nikolaevich Chernov made a special "six-tail" pipette, which enabled one to collect six equal portions from the common vessel with a protein solution and fix them simultaneously in separate test-tubes containing the SH-group reagent (silver ammine solution). Synchronous changes of the SH-group

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*These were the last experiments I did at the Department of Medical Radiology CIPE: since December 20, I have been officially taken on the staff of Physical Faculty of Moscow State University.

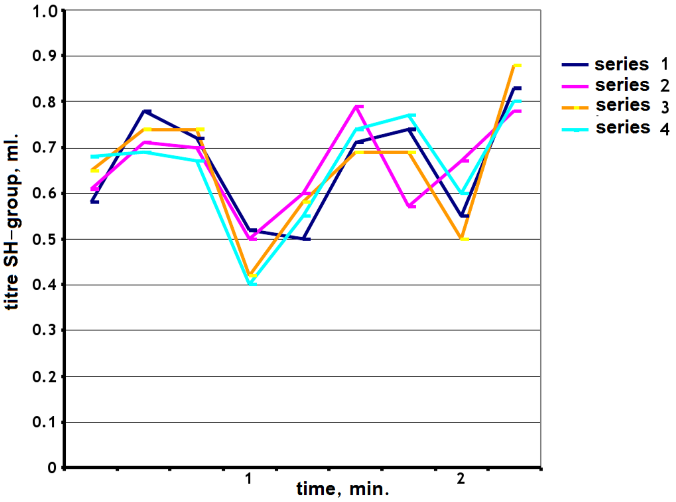

Figure 2-2: Illustration of synchronous changes of the SH-groups titre in different portions of the actin solution. Experiment of October 9, 1963. Time is displayed on the x-axis (in minutes). The y-axis shows the titre (in ml) of 1.25×10^{-4} M $AgNO_3$ solution [7].

titer were observed in all six (sometimes, four) portions of the solution. This can be seen in Fig. 2-2.

Not confused by the fact that the portions of the common protein solution ended up in separate vessels, I made a conclusion: "the changes, indeed, occur simultaneously over the entire macroscopic bulk of the solution"! It seemed to me quite plausible that oscillations should not "get out of rhythm", that they should continue in the same phase even if the common protein solution is poured out into separate vessels. In addition, there were experiments with temporal cooling of a part of samples, which also seemed to argue against the idea of oscillations resulting from an external cause. These were the "crowning" experiments. A solution of actin, which was kept at 37°C, was poured out into six test-tubes (6 ml per tube). Three of these samples were cooled to 0°C and heated again to 27°C 10 min later. Then, using the abovementioned six-tail pipette, we collected series of 0.5 ml portions from all the six test-tubes, with a 15 second interval between the series points. The collected portions were fixed in the ammonia buffer and assayed for the SH-group titer. As seen in Fig. 2-3, the quantity of titratable SH-groups in different vessels (!) with the same actin solution fluctuated synchronously. Temporal cooling changed the phase of the

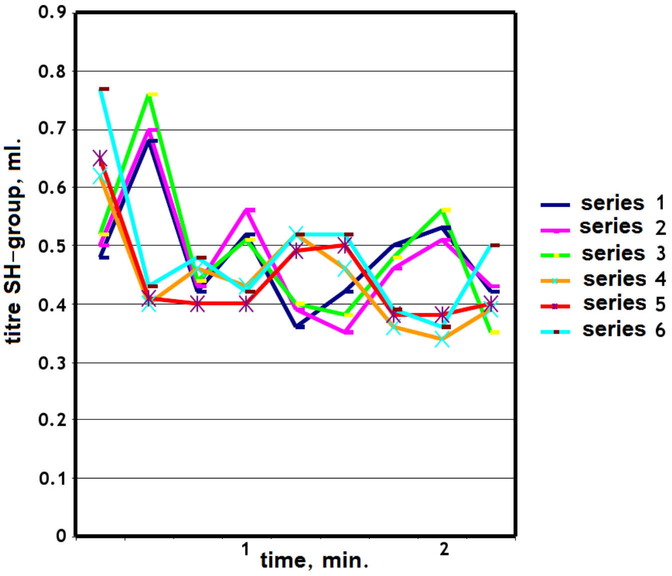

Figure 2-3: Synchronism of fluctuations of the number of titred SH-groups in 6 portions of the actin solution. Phase shift at temporary cooling of the solutions numbered 4–6. Time is displayed on the x-axis (in minutes). The y-axis shows the titre (in ml) of 1.25×10^{-4} M $AgNO_3$ solution [7].

oscillations; the protein, nevertheless, retained the ability to oscillate after being heated to 27^{o}C. Hence, fluctuations were not the result of external causes.

Still, there might be another explanation: the cooled protein was less (differently) subjected to the influence of external factors, and this lead to a shift in the oscillation phase. At that time, however, this alternative explanation did not come to mind.

Chapter 3.

Not only muscle proteins! Any proteins!

During the mid-60s the investigations of the phenomenon of the anomalous and astounding scattering of results of measurements of various properties of the actomyosin complex proteins seemed almost complete. The ability of the molecules to achieve synchronous transitions from one conformation to another seemed to make biological sense in systems of biological motility; in the rhythmic performance of the cardiac, wing and smooth muscles. A lot of questions about the mechanisms of the synchronous activity still remained unanswered. However, overall the situation seemed clear.

In that moment *Elizaveta Pavlovna Chetverikova* revealed an absolutely similar conformation in the oscillations from measurements of the creatine kinase reaction [22–26]. In contrast to the fibril proteins of the actomyosin complex, creatine kinase is a compact globular protein with very high catalytic activity. Its enzyme activity can be seen in extremely diluted solutions and at relatively great inter-molecule distances. We found all main signs of the "macroscopic fluctuations" to be present in the solutions of creatine kinase [26]:

Hence, the conformation of oscillations is not a property specific to actomyosin complex proteins.

It was quite natural to follow this up with similar measurements of reaction rates in solutions of all enzymes available up to that moment **(creatine kinase, pyruvate kinase, alkaline phosphatase, lactic dehydrogenase, acetylcholine esterase, tripsin)**. Conformation oscillations were found everywhere: in the fluctuations of rates of measured reactions and, accordingly, in the histograms of typical shapes [16, 19] (see Fig. 3-1).

In 1975 the following conclusion was formulated: reversible changes of macromolecules conformation that are synchronous in macrovolume and conformation fluctuations are a property of any protein. Discrete conformation states of protein macromolecules were evidenced by the discrete distributions of measurement results: histograms with two, three and more separate meanings of measured values.

From that moment on, the collaboration with E.P. Chetverikova caused creatine kinase to be our principal object of investigation in the time period 1973–1981. We reproduced all main results obtained previously with preparations of actomyosin complex proteins with solutions of this protein and actomyosin preparations and obtained a number of new effects.

In investigating this subject, the discussed phenomena were mostly demonstrated through the results of experiments with synchronous changes

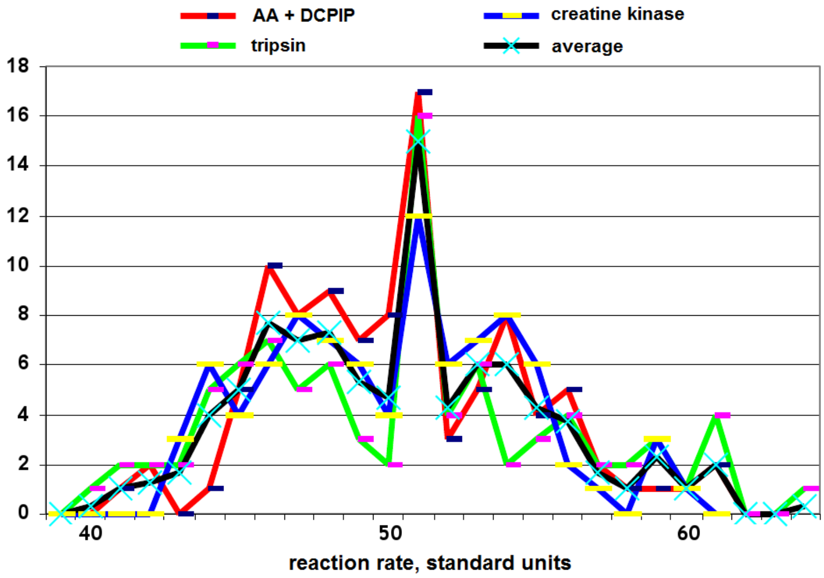

Figure 3-1: Illustration of the histogram shape similarity in experiments with AA + DCPIP (on January 18, 1979), tripsin (on January 31, 1979) and creatine kinase (on December 26, 1978). Histograms with a similar "shape idea" can be observed from changes of enzyme reaction rates catalyzed with tripsin or creatine kinase and of the reaction between ascorbic acid (AA) and dichlorophenylindophenyl (DCPIP).

of properties of solution portions withdrawn from different points of an entire volume or even from different vessels. Just these experiments were made with new objects and with new methodological approaches.

We worked with two-tailed pipettes now (only N.A. Smirnova could work accurately with a 6-tailed one). We measured the rates of enzyme reactions: the ATP-ase activity of actomyosin and the creatine kinase reaction of creatine kinase (E.P. Chetverikova and V.V. Rybina) or the SH-groups titer. We withdrew two aliquots from different points of the volume by this double pipette and transferred them into two empty tubes or tubes with solutions of enzyme substrates and after thorough simultaneous mixing (with a double mixer) we measured the rate of the corresponding reaction and the titer of SH-groups. Everything was reproducible: we could see synchronous changes of enzyme activity and the titer of SH-groups both in one common vessel and in different vessels. The "phenomenon" did not disappear.

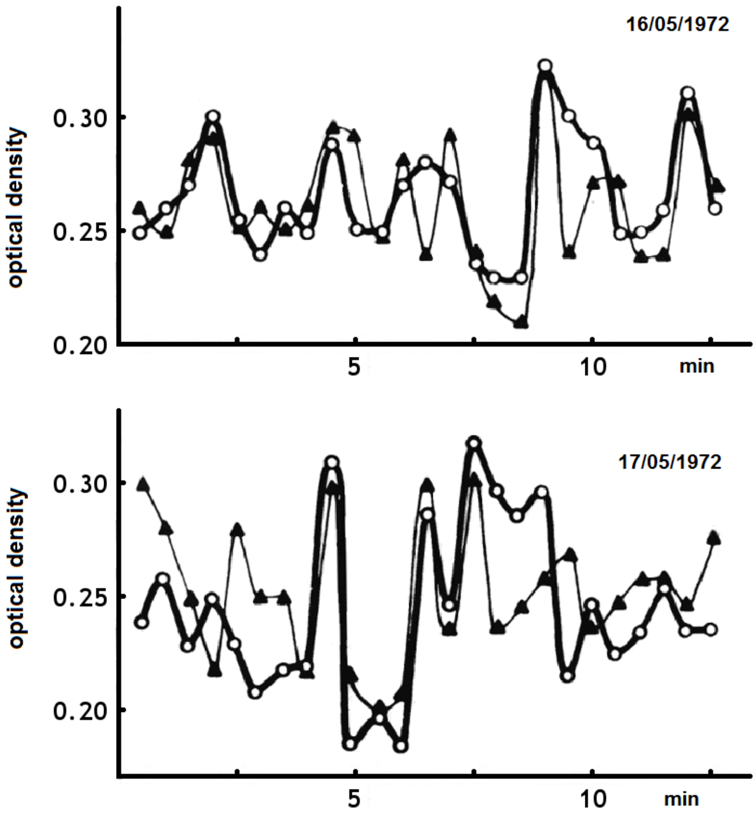

Figure 3-2: Synchronous change of ATP-ase activity in portions of a concentrated (12.5 mg/ml) actomyosin solution from different vessels [6]. X-axis is time (in minutes); Y-axis is the enzyme activity measure.

(Though in the early 1970s amplitudes of fluctuations were not high).

In experiments with an actomyosin solution, aliquots were transferred into empty tubes (many of them). Ten minutes later, we took two tubes, added solutions of substrates and measured the reaction rate in both. Tubes were matched randomly, independently of the time of the enzyme solution that was transferred into them.

Fig. 3-2 presents the results of two such experiments made on May 16 and 17, 1972. We measured the ATP-ase activity in portions of an actomyosin solution (the protein concentration was 12.5 mg/ml) and transferred it with a double pipette into empty tubes. 10 minutes later the ATP so-

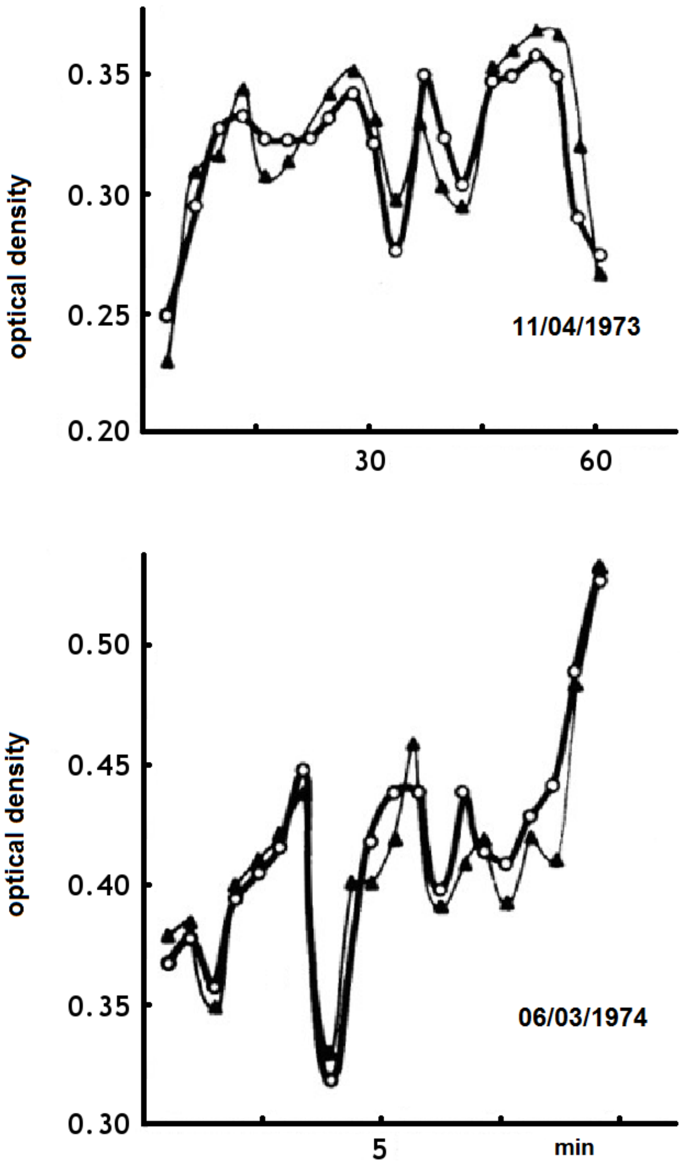

Figure 3-3: Synchronous change of the enzyme activity in a diluted (10^{-3} mg/ml) creatine kinase solution after sampled with a double pipette from the same vessel [6]. Axes are the same as in Fig. 3-2.

lution was transferred into another two tubes, also with a double pipette. Then, after incubation, the concentration of mineral phosphate formed during ATP hydrolysis, that is the level of enzyme activity was measured.

Fig. 3-3 presents the results of two similar experiments with the determination of the creatine kinase enzyme activity. The concentration of the protein in these experiments was 1×10^{-3} mg/ml (!). Fig. 3-4 presents a similar experiment of *Valentina Victorovna Rybina*, who determined the titers of SH-groups in solutions of creatine kinase at a concentration of 3 mg/ml of the protein [27].

> Maybe these experiments are "the centerpiece" of the investigations of synchronous conformation fluctuations in solutions of proteins. We can see really synchronous, reversible changes of proteins in macrovolumes of solutions. Now, more than 30 years later, I regret that we did not continue them: many problems remained unresolved here for many years of our investigations.

However, even then it seemed extremely questionable: long-standing synchronous fluctuations of conformation in individual distance separated tubes and without a direct interaction of molecules. Besides, the fluctuations had irregular shapes, and no somewhat distinct periods could be revealed in the long time series. Changes of protein properties through effects of some external forces seemed more probable.

3.1 Experiments with rabbits in 1952–1959

It is strange that the idea of some external causes affecting fluctuations of measurement results became more dominant in my mind so slowly. Peculiarly, because about 20 years before the experiments of the 1970s, in 1952–1959, I had obtained amazing results in experiments with rabbits [56]. In these experiments, we observed strikingly synchronous fluctuations of the phosphate concentration in the synchronously aliquoted blood of two by no means related (but sharing a somewhat common fate. . .) animals that had previously got an intravenous injection of a radioactive phosphate solution (Fig. 3-5).

In this experiment we simultaneously injected two rabbits with 50 μCi each through an ear marginal vein. Then we cautiously withdrew precisely measured aliquots of blood from marginal veins of the other ears and determined their radioactivity, that is, the index of the phosphate concentration in the circulation; all samples were taken simultaneously with 3-minute intervals. 2 hours later we injected 300 mg of medinal and 50 μCi

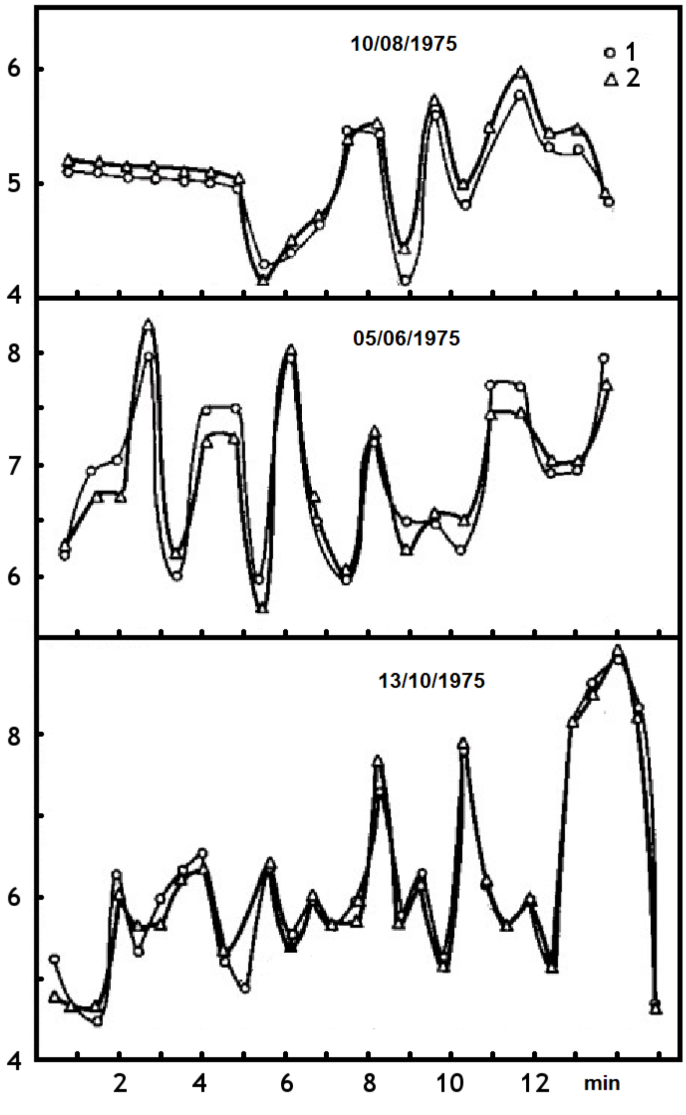

Figure 3-4: Synchronous change of the SH-group titer in a concentrated (3 mg/ml) solution of creatine kinase. Experiments of V.V. Rybina of sampling with a double pipette from the same vessel [27]. Axes are the same as in Fig. 3-2.

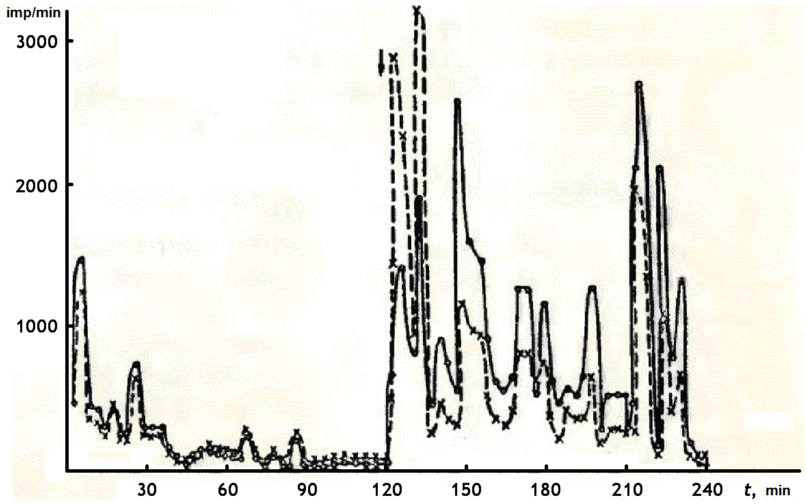

Figure 3-5: Experiment of November 30, 1958. Synchronous changes of the phosphate concentration in the blood circulation of two rabbits measured with the aid of ^{32}P-phosphate [56]. The arrow points to the moment when the second portion of the ^{32}P-phosphate solution and medinal were injected followed by an increase in the fluctuation amplitude. X-axis is time (in minutes); Y-axis is radioactivity (imp/min per 10 mg of blood).

of ^{32}P-phosphate to the same animals in the same way. Under the effect of medinal, the amplitude of fluctuations rose sharply. The synchronism (phase coincidence) did not disappear. This synchronism may be explained only by the effects of some external field acting on the animals.

Such an explanation came to my mind at that moment: these are charges at the surface of the endothelium of blood vessels that change under the effects of fluctuations of an external electrostatic field. This surface is so vast that blood moving through the vessels covers it with a thin film, of 0.2 mm in thickness. Hence, when charges of this surface change, the opposite charged ions begin to stick to and off the surface and their concentrations fluctuate in the solution.

This picture (similar to those "drawn" earlier) is rather probable but still (50 years passed!) has not been investigated by anybody else. Information about these experiments had been published in 1964 [56] and mentioned again in 1985 and 1987 [32, 33], but caused no response through all these years.... Our attempts to return to them in the 1990s failed: national grants for science stopped; isotopes became unavailable; and no appropriate advanced devices existed. . . .

> Thus, the investigations that went on over 20 years left me with the following conclusion: in water solutions of various (not only muscle) proteins, synchronous macrovolume changes of macromolecules occur. These changes are properties of native proteins only: they stop after a protein gets denatured or when an appropriate "primer" is added to a solution.

3.2 These are not oscillations, but fluctuations. Dynamical chaos and strange attractors

Up to the beginning of the 1970s, I had to decline the ideas of specific properties of just actomyosin complex proteins. I came to the conclusion that the observed phenomena are a property of various (maybe even all?) proteins. The "pure oscillating" ideology had to be rejected as well: observed time series did not contain regular periods; we were dealing not with "regular" oscillations, but with "random" fluctuations.

Approximately at the same point in history when E. Lorenz's work became well-known (see [57] for example); E. Lorenz had discovered dynamical chaos phenomena. Solving a system's equations containing only three differential equations may have absolutely random character, with non-regular and non-predictable changes of measured values in a successive series. The phenomenon caused great interest of theoreticians. A lot of conferences, articles, and books came to life. I got the hope to clarify the nature of the observed fluctuations in solutions of proteins.

However, it became clear rather quickly that the hope was wasted. As it often happens, an "inverse problem" cannot be solved here. A lot of versions of systems providing chaotic solutions can be constructed. Nevertheless, the shape of a random process provides no answer to the question: the interaction of what dynamic processes caused the chaotic fluctuations? And I was interested just in the mechanisms, the physics of molecule interaction leading to the macroscopic effects. Besides, the diagnosis "random" caused and still causes doubts. It is quite possible that the diagnosis is a result of more or less complicated overlapping of rather regular "signals". Then the task of experimenters lies in detecting these signals.

In any case, an observed "scattering of results" depends on several factors: the extent of the difference between different states (conformations) of macromolecules and the extent of the synchronization of these state changes in the entire macrovolume. This demands a lot of experimental work.

Hence, the “macroscopic oscillations” are not “oscillations”; they are non-regular macroscopic fluctuations. What an unpleasant combination of words: “macroscopic” and “fluctuations”.... Though, we know of situations when fluctuations are macroscopic. This can be during critical states: in more or less narrow zones of phase transitions. In response to this doubt I assumed the existence of several almost equal probable conformations, when the realization of one of them in the entire volume depends on the species of the randomly appeared primer. Experiments seem to confirm this pattern. Maybe this is just a case of the protein solutions.

> And here it became clear that “macroscopic fluctuations” can be observed without proteins...

3.3 Proteins are not necessary! Similar phenomena are expressed in the reaction between ascorbic acid and dichlorophenolindophenol

At first, the role of a protein seemed beyond doubt. Measurements with a preliminary denatured protein or after the addition of an appropriate “primer” to the solution are, as mentioned above, the most adequate evidence for this idea being correct. Here we followed the “all other things being equal” principle carefully and completely. This is a “pure” control, everything is the same: the measuring techniques, the labware, the reagents. As soon as a protein is modified, the “scattering of results” decreases dramatically. However, one more possibility remained: native, not denatured proteins are just indicators of some changes of a solution state occurring without proteins. To detect the role of only the protein molecules, we needed some “control”, some process developing without a protein.

In 1976 I decided to examine this version with the help of the reaction between ascorbic acid **(AA)** and dichlorophenolindophenol **(DCPIP)** blue dye. During this reaction AA reduces DCPIP and the dye fades; the reaction rate can be measured easily, by the decrease in the optic density.

In the first experiment, after 250 successive measurements of the reaction, I realized that the situation is more complex than had been expected (it is quite common for experimental work). The scattering of results was indeed less than that in experiments with proteins, but the shapes of histograms could not be distinguished by the eye from the discrete histograms in experiments with native proteins.

Two conclusions could be made:

1. native proteins are more sensitive indicators of changes occurring in solutions than reagents of a chemical reaction, and

2. the fine *structure of the distribution* of measurement results, the shape of a histogram, does not depend on the *amplitude* of the scattering of results.

The idea of a possible independence of these two phenomena, the amplitude of fluctuations and the spectrum of "permitted" states, realized during the fluctuations, had appeared earlier. Now it was confirmed.

> From that moment on, we directed our investigations in two directions: the search for the causes determining the anomalous high amplitude of fluctuations, and the causes determining histogram shapes.

The AA + DCPIP reaction appeared very convenient just for the second task: the investigation of histogram shapes. The reaction occurs in the neutral medium. The reagents are available and cheap (in contrast to enzyme preparations). Liters of solutions can be prepared and many hundreds of measurements conducted. Moreover, we managed to automate the experimental process. Sergey Ivanovich Borodin designed a SALAD (System of A Laboratory Automation Devices), automatically conducting all the previously manual operations: it precisely measured the volumes of reagent solutions, mixed them, switched measurements of the optical density, and conducted measurements, washed a cell and conducted the next measurement in a precisely set time interval. Measurement results were stored with a tape recorder [58].

Therefore, we conducted most of the further experiments (with a broad variety of purposes) in the form of AA + DCPIP reaction rate measurements.

As mentioned earlier, this interest in the AA + DCPIP reaction, to the detriment of experiments with proteins, could have been a mistake. Investigations of many wonderful expressions of protein properties remained incomplete. We should continue experiments with simultaneous sampling in different points of a common volume and experiments with primers. And we omitted to emphasize that non-methodically conditioned amplitudes of the results scattering in experiments with proteins were, as a rule, higher than the amplitudes of the resulting measurements of the AA + DCPIP reaction rate.

To explain the seemingly complete identity of the phenomenon in these experiments with proteins and with this reaction, I came to the conclusion that the previous supposition, "proteins are just indicators of changes of water (water solutions)" was true. These changes of water properties are manifested in the AA + DCPIP reaction as well.

3.4 The properties of protein fluctuations and of the AA + DCPIP reaction rate only reflect the changes of the properties of water (water solutions). Experiments with homologous alcohols series and D_2O

This supposition cost me "many years of my life": hundreds of experiments in which I tried to find out, in what way do changes of water solutions affect the macroscopic conformation fluctuations of proteins. With the assumption of defining the role of changes of water (water solutions) properties, detailed investigations on the dependence of the observed fluctuation amplitude from temperature, pH, salts concentration (ion strength), isotope composition of water, ions of heavy metals, urea, organic solvents, and illumination were made. We investigated the dependence of the fluctuation amplitude from concentrations of various aliphatic alcohols, members of the homologous sequence, from methanol to octanol especially thoroughly. All the results that were obtained up to 1969 are summarized in [12, 16]. The main body of results obtained after 1970 is published as well, see [16, 59].

We found (in line with our expectations) narrow zones of concentrations of alcohols corresponding to high amplitudes of fluctuations. These zones varied between alcohols. The pattern corresponded to ideas of zones of phase transitions. However, our object appeared very complicated. Rather reliable results of one group of experiments often distinctly contradicted the results of similar experiments obtained at another point in time. The contradictions could be explained by a number of reasons, the clarification of which would require extensive work.

I had a longstanding hobby: the investigation of isotope effects, including those of D_2O [60, 61]. Following this hobby we conducted many tens of experiments (for several years) on the effects of small concentrations of D_2O on the amplitude of fluctuations and the shapes of histograms from the measurements of enzyme reactions and AA + DCPIP reaction rates. We hoped to distinguish between its effects on the water solution and on protein molecules.

The general result of these experiments is that as low a concentration of D_2O as 1 % essentially affects both, the amplitude of fluctuations and the shapes of histograms (Figs. 3-6 and 3-7). The changes are not related with the effect of D_2O on the molecules of a protein: similar effects were obtained for changes of the AA + DCPIP reaction rate (Fig. 3-8).

The following conclusion could be made: combined with the results of experiments with homologous alcohols and the changes of the ion strength and temperature, experiments with D_2O display the soundness of the sup-

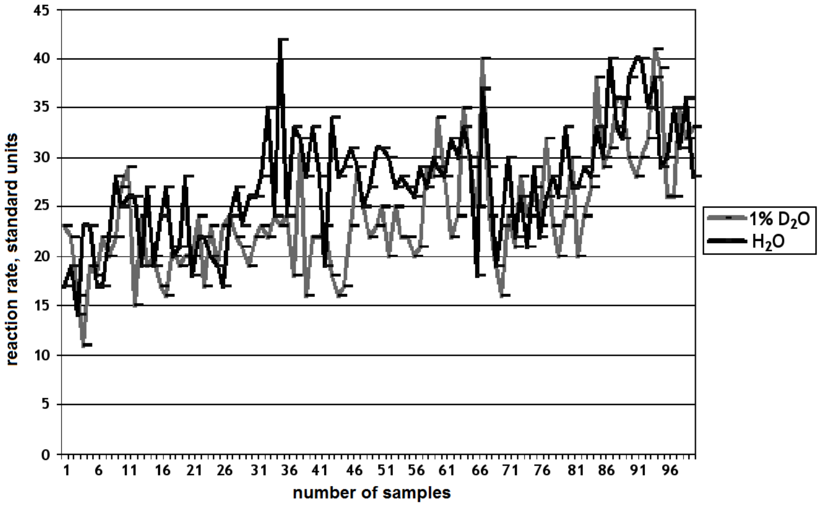

Figure 3-6: Time-changes of the rate of the creatine kinase reaction in H_2O and 1 % D_2O; the experiment was conducted on March 26, 1979.

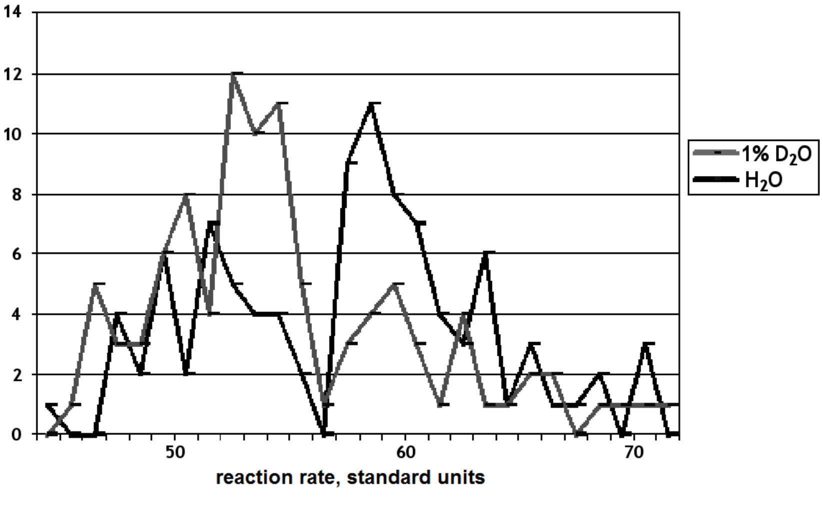

Figure 3-7: Shapes of histograms from measurements of reaction rates of creatine kinase in H_2O and 1 % D_2O; the experiment was conducted on March 26, 1979.

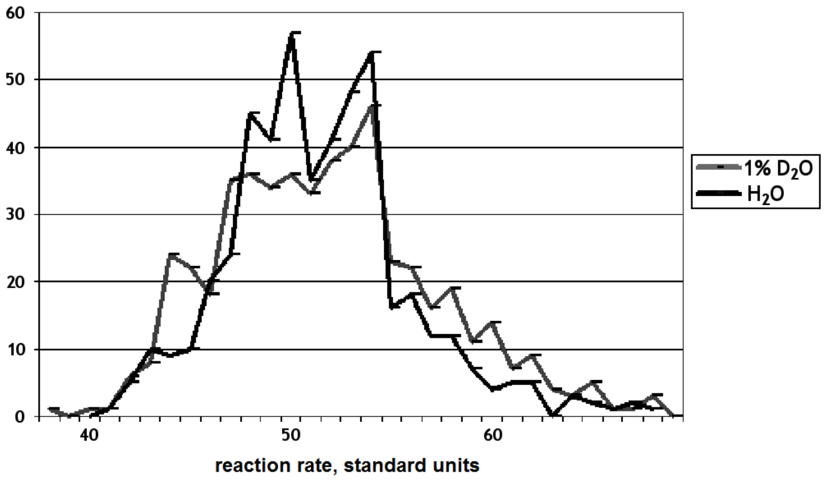

Figure 3-8: Change of a histogram shape upon a change of the AA + DCPIP reaction in 1 % D_2O rate. Experiments were conducted from January 31 to February 6, 1979.

position about the dominating role of the fluctuations of water properties in the phenomenon of macroscopic fluctuations of protein properties and other solved substances.

However, some time later we found a similar pattern with the AA + DCPIP reaction in 30 % ethanol. I doubt whether we could speak about fine effects of fluctuations of the structure of water in this case.

As mentioned above, the conclusion about conditioning the observed phenomena by some external effects first came to my mind during experiments with cophased changes in portions of a protein solution from different vessels. In this connection, we repeatedly conducted series of experiments over several months, trying to understand the possible nature of these external factors.

3.5 A possible effect of visible light on “macroscopic fluctuations” in protein solutions

In our routine experiments we tried to avoid trivial sources of possible artifacts: oscillations in the electric main, temperature, pH, etc. However, the possibility of some field effects and the effect of radiations on the results still remained. The first candidate for an external factor was *visible light*.

In 1965 during the *experiments of Irina L'vovna Lisovskaya* an essential (two-fold) decrease of the amplitude of the SH-groups titer in actin solutions was registered after a prior 30-second (before sampling) illumination with an incandescent lamp through a heat (water) filter. In 1966 we repeated many dozens of similar experiments with SH-groups titer measurements in actomyosin solutions. Prior 30-second illumination indeed strongly *decreased the amplitude of fluctuations in the protein solutions*. The most effective evidently was light with close to 540 nm wavelength. We assumed that such light discharges molecules.

> But the phenomenon does perplex: protein molecules have no chromophores absorbing light in the visible part of the spectrum!

3.6 We returned to these experiments 12 years later

In 1978 V.V. Rybina demonstrated that short-time (5 seconds) lighting of concentrated (15–40 mg/ml of protein) solutions of creatinine kinase and pyruvate kinase with visible and infrared light caused a sharp increase in the amplitude of SH-groups titer fluctuations.

A year later, in 1979, 10 large experiments with *diluted* solutions of creatine kinase showed that 5-second prior (!) lighting of the enzyme solution *decreased* the amplitude of fluctuations and the decrease persists for an hour or longer. However, the separation of the protein solution from light (by means of a dark paper screen) decreases the amplitude of fluctuations [62, 63].

We failed to analyze these effects and to know more about the nature of chromophores. Only one thing was clear: lighting affects the investigated process. The effect depends on many factors; a probable cause of the light effect may be the accumulation and the consumption of energy in some process essential for either changes of the conformation of individual molecules, or of the synchronization of these changes. The oxidation of SH-groups is quite a suitable candidate for it [64].

Reversible oxidation of SH-groups and changes of SH-groups to the S-S links ratio are frequent events in various biological processes. Supporting such a necessary ratio is an important condition of cell life. Measurements of SH-groups oxidation form the basis for many biochemical methods. As shown above, we used the titration of SH-groups as an index of the states of protein macromolecules. *Victor Vladimirovich Sokolovsky* proposed in the 1970s to use the reaction of SH-group oxidation in unithiol in the interaction with nitrite as an index of the effect of factors following changes of solar activity [65, 66]. The test had been used during investigations of cosmophysical correlations under various conditions, including during the

Arctic and Antarctic expeditions (see the references in the second part of the book).

Indeed, in these experiments (similar to earlier experiments with actin solutions [6]), distinct changes of a number of tittered SH-groups were found. The changes could be the consequence both of changes of their accessibility following a change of the macromolecule's conformation and of reversible oxidation. Reversible oxidation, the transition of SH-groups into S-S links, can follow the mechanism of chain free radical processes.

This proposition seemed to be worth an experimental verification.

> For this purpose, experiments with the addition of hydrosulfite, tiron (free radical scavenger) and experiments in an oxygen-free, nitrogen or argon, atmosphere were conducted. We did not obtain distinct effects. The free radical, oxidative hypothesis was not proved.

Nevertheless, I decided to make one more (extravagant) attempt to confirm the possible role of free radicals. Chain processes are known to be dependent on a vessel shape. Revealing such a dependence could allow a conclusion on the essential role of the chain processes in the macroscopic fluctuations phenomenon.

3.7 Dependence of the amplitude of "conformation fluctuations" in protein solutions on the shape of a vessel

The shape of a vessel could be important in the cases when macroscopic aggregates of protein molecules are formed in solutions; being subject to synchronous conformation fluctuations, the aggregates become generators of acoustic fluctuations. A vessel shape could be essential for the synchronization of conformation fluctuations of electric dipole protein macromolecules generating electromagnet waves in these fluctuations. The possibility of combined acoustic and electromagnet field effects also appealed to me. The results of pilot experiments conducted in the 1960s did not exclude that these suppositions may be reasonable. Indeed, the amplitudes of fluctuations and shapes of histograms were different when sampling the protein solution from a cylindrical tube, a round flask, or from a rectangular cell.

19 large experiments were completed in our laboratory between September 12 and October 13, 1967; we investigated the dependence between the fluctuations amplitude of the SH-groups titer of relatively silver ammines in an actomyosyn solution and the shape of vessels that contained the solution. We took: an approximately 170 ml spherical flask, a $3 \times 5 \times 1$ cm rectangular glass cell and a cylindrical glass with 4 cm height and 1.5 cm

radius. For each experiment, 20 protein aliquots were taken from each vessel and fixed in an ammonium buffer. Then the SH-groups were amperometrically tittered. From the resulting values the mean-square amplitude of fluctuation σ % was calculated; the value was related to the mean-square value of the SH-groups titer as a percentage.

To that moment we, together with *Valery Alexandrovich Kolombet*, demonstrated [16, 17] that histograms, which are the distributions of values, and here specifically the distributions of mean-square values of fluctuations (the "scattering of results") have shapes similar to those of the histograms of measured values. In this regard, we assumed that histograms constructed from σ % measurements characterize the state of an investigated object much more reliably than those constructed from measured values. The point is that each σ % value is usually calculated by many dozens of results of individual measurements and hence has a greater statistical weight. The σ % histogram shapes varied according to the shapes of the vessels containing the solutions, in which fluctuations of the SH-titer were measured. The mean amplitude of macroscopic fluctuations appeared minimal in the spherical flask (7.9 %), and maximal in the rectangular cell (10.5 %).

For the purpose of a more detailed analysis of a possible dependence between the studied characteristics of macroscopic fluctuations and the shapes of vessels, we made 154 big experiments between May 30, 1967 and June 28, 1968. We placed tubes with actomyosin into the centers of spherical flasks of the same shapes and of different volumes filled with water. In 88 of these experiments we took aliquots of solutions from these tubes and determined the titers of the SH-groups by silver ammine. In the other 66 experiments of the series we determined the ATP-ase activity in successive portions of the actomyosin solution. Each experiment had seven versions:

(1) (the control) a tube with a protein solution in a glass filled with cotton wool; (2) a tube with a protein solution fixed in a stopper of a 100 ml flask; the all spherical part of the flask was filled with water; the bottom of the tube was placed into the center of the flask.

Other versions (3-7) were similar to version 2, but the flask volumes were 250; 500; 1,000; 3,500 or 6,000 ml. In each experiment the titer of SH-groups or ATP-ase activity were measured in 10 portions of each solution. σ % of each experiment were calculated from these measurements. Fig. 3-9 presents the series of σ % histograms constructed from measurements of SH-groups; the tubes with the actomyosin solution were placed into spherical flasks of different volumes; experiments were made from May 30, 1967 to June 27, 1968.

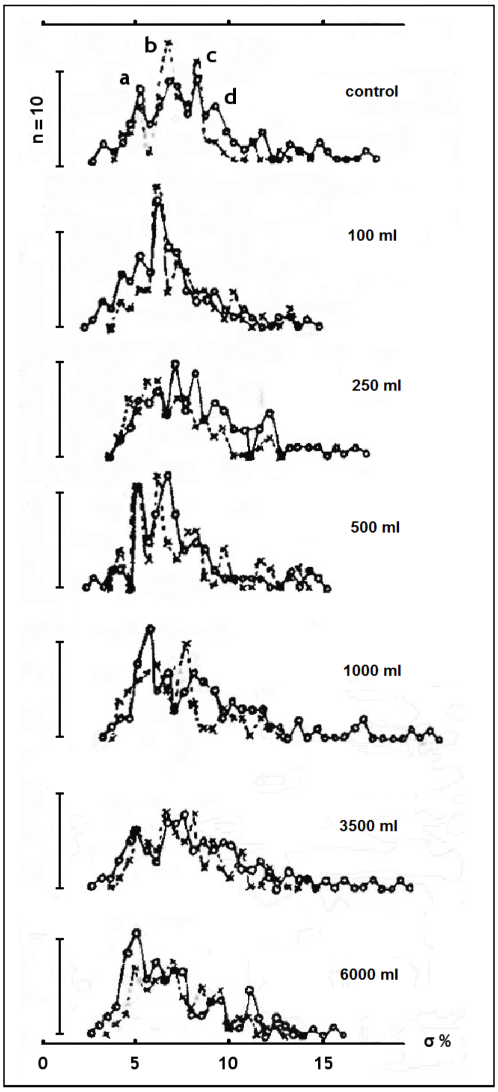

Figure 3-9: Dependence between histogram shapes of mean-square amplitudes of SH-groups titer (–o–o–) and ATP-ase activity (–x–x–) of actomyosin solutions and volume of spherical flasks with water surrounding the tubes with protein. Experiments were conducted between May 30, 1967 and June 27, 1968. X-axis is values of σ %; Y-axis is numbers of experiments corresponding to a given σ % value [32, 33].

In Fig. 3-9 one can see a definite dependence between the shapes of histograms and the radius (volume) of the outer water-glass screen. The reliability of this dependence follows from the coincidence (similarity) of histogram shapes constructed from measurement results of two different parameters of the actomyosin solution in flasks of the same size in experiments conducted at different times. Well resolved discrete states of two indices, the SH-groups titer and enzyme activity, with σ % maxima corresponding to the following meanings: "a" – 5, "b" – 6.5, "c" – 8 and "d" – 9 % can be seen. When a tube with a protein solution is placed into a 100 ml spherical flask with water, the shape of a σ % histogram changes sharply: the "b"-peak increases sharply and others stay almost unchanged. In a 250 ml flask with water as a screen, a histogram becomes smoother: there is no distinct discrete state. In a 500 ml flask all states can be seen. This is the most discrete, resolved spectrum between all versions. In a 1,000 ml flask a histogram shape changes again: a separate "b" state is almost absent, it merges with "a". In the 2,500 ml flask, similar to the 250 ml flask, the spectrum of states is almost non-discrete: "a", "b" and "c" states are little resolved. The "a" state is the main one in a 6,000 ml flask. The perimeter of a corresponding histogram can serve as a measure of the state spectrum discreteness in states of one type.

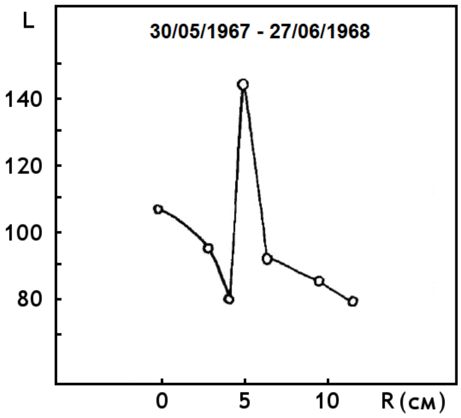

Figure 3-10: Changes in the discreteness of histograms of mean-square amplitudes of ATP-ase activity and SH-groups titer in actomyosin solution in dependence on radius (L) of a spherical flask with water surrounding a tube with a protein solution. L is the perimeter of a histogram. Experiments were conducted from May 30, 1967 to June 27, 1968.

In Fig. 3-10 the dependence between the length of a perimeter L, the average for histograms of SH-groups titer σ % and of ATP-ase activity σ %, and the sizes of the flask screens can be seen. In a 500 ml flask, a sharp resonance and maximal irregularity of correspondent histograms can be seen.

These experimental results may correspond to the hypothesis about the wave nature of the synchronization of conformation fluctuations of protein macromolecules. One might even say that the wavelength (wave being of an unknown physical nature) that determines (affects) the amplitude of the observed fluctuations is about 5 cm. We may also mention that electromagnetic waves of such length correspond to the range of heavy water absorption (3–10 cm), acoustic 5 cm waves in water correspond to 30 kHz frequency. Basically, the sound emission in the course of chemical and physicochemical processes seems quite real. The emission may be a result of the "repacking" of water molecules during their transition from one structure to another. It is wonderful that just these "disintegrations" and "integrations" of water molecules are responsible for the absorption of electromagnetic waves in the range of lengths of about 5 cm. The fitness of electromagnetic and acoustic wavelengths may result in original beatings: low-frequency acoustic modulation of high-frequency electromagnetic waves, dependent on the sizes of screen resonators.

Chapter 4.

Studying the causes of the variability in fluctuations amplitudes observed in different types of processes. External factors

As I noted in the introduction, the initial impulse that started all these studies was a strange "scatter of results", which was observed in diverse types of processes and could not be explained by methodical factors. Later, however, we discovered a very complicating factor, for the researcher: both the scatter itself and its amplitude were extremely variable. There seemed to be no regularity in this variability: both the mean amplitude and the shape of histograms changed unpredictably from one experiment to another. On different days, in different months and years, the mean-square amplitude of fluctuations was completely different. After several years of research, it had become clear that the amplitude of this "persistent" scatter of results, which we could not get rid of, depended on an external factor.

Indeed, repeating an experiment, in which all things (devices, glassware, preparations, solutions etc.) were the same, could have resulted in the amplitude of scatter to be halved or doubled. There were periods (over months and years) of "accurate" work, with low amplitudes of a scatter, and periods of "high amplitudes", namely with "large errors".

An example illustrating this situation is given in Fig. 4-1, which shows the results of two identical experiments conducted by V.V. Rybina and E.P. Chetverikova. They measured the number of titratable SH-groups in the solutions of creatine kinase. On February 12, 1970, the mean-square amplitude amounted to only 10% of the average level; on April 29, 1971, the amplitude rose to 41 % of the mean.

Such a situation – when something is measured, and the results go hither and thither – can create complicated psychological problems. You have mastered the methods, you have got precise devices and pure chemicals, you are obtaining quite plausible results, and then, suddenly – the measurements become poorly reproduced, no matter how devoted you are to the *"ceteris paribus"* principle.

What will chemists and biochemists do when the amplitude of the data scatter goes wild? They will grow suspicious about the quality of distilled water, the purity of chemicals etc. Physicists, on the other hand, will take screwdrivers and soldering irons and will search for (and sometimes will find) defects in the devices. There will be new papers, disproving the previous ones. A discussion will flare up. Meanwhile, one will eventually reach a new period of "accurate" work as well as results, when the amplitude of fluctuations will again be mockingly low.

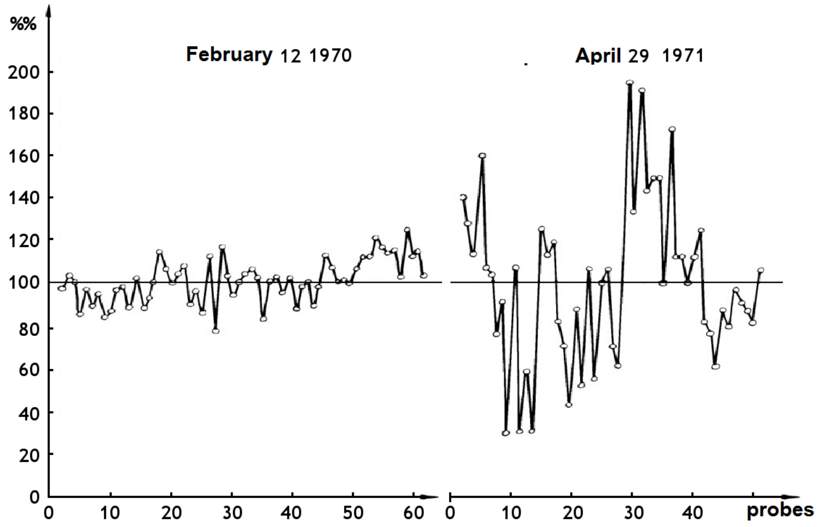

Figure 4-1: Under strict adherence of the principle of everything else being equal for the experimental conditions, in identical experiments, we can observe various results of sharply disruptive behavior in the fluctuations amplitude. Measurements of the creatine kinase reaction in experiments conducted on February 12, 1970 and on April 29, 1971. The number of consecutive probes is shown on the x-axis. The enzymatic activity in % relative to the arithmetic-mean value is given on the y-axis [28].

Between 1954 and 1958, the "scatter of results" in my measurements of ATPase activity of the proteins of the actomyosin complex was very high. It got lower in 1959 and grew again in 1961.

By 1967, however, the amplitude of "conformational oscillations" had again started to decline. It looked like the experimental technique and the experimenters' art had been getting better. In 1968–1970, the amplitude reached its minimum: we finally "learned how to work properly", and the phenomenon of "anomalous amplitudes" disappeared.

However, actually it did not. The amplitude of the data scatter started to grow once more in 1972, having reached high values by 1975–1976. By 1983–1986, it had decreased again.

These changes of the fluctuation amplitude seemed unexplainable from any rational point of view. By "rational" I mean "based on a controlled alteration of experimental conditions".

But if the cause is beyond the boundaries of the system examined, the natural method of research would be to search for correlations between the fluctuations observed and the changes of external factors. That is how I was gradually approaching the idea that we should pay attention to the external factors.

4.1 Giorgio Piccardi (1895–1972). A complicated thing it is, the psychology of research. . . The beginning of the search for cosmophysical correlations

In the 1950s, when I started this work, the Florentine scientist Giorgio Piccardi was studying virtually the same problem. He noticed that the process of $BiCl_3$ hydrolysis may, or, ceteris paribus, may not be accompanied by precipitation of colloidal bismuth hydroxide. There is a series of identical test-tubes (24 or 48, as many as the number of slots in the rack) with identical solutions, and some of them will contain precipitate, while the others will not. And if you repeat the experiment – day after day, at the same time – the number of test-tubes with precipitate will vary a lot; it may be a few of them or most of them. Piccardi kept repeating the experiment, increasing the number of test-tubes, and kept registering the amplitude of the data scatter [67].

We worked at different places – Piccardi at the Center for the Study of Fluctuating Phenomena (at the University of Florence) and I at the basement of the Laboratory for the Application of Radioactive Isotopes in Moscow. We knew nothing about each other and, nevertheless, we were doing essentially very similar experiments. He had a series of test-tubes with the solution of bismuth chloride; I had a series of test-tubes with the solution of actomyosin. . . .

Yet Piccardi was the first who came to the conclusion about the involvement of external, cosmophysical factors. I at that time was searching for internal, physico-chemical causes. I read about Piccardi's experiments in the Russian "Science and Life" journal. How he learned about my work – I do not remember (though probably, from A.P. Dubrov).

In the beginning of October, 1965, Piccardi sent me a letter, his book [67] and a number of reprints. He believed that it was cosmophysical causes, which underlay the fluctuations I studied: electromagnetic disturbances associated with the movement of the Earth in the cosmic space. In his book, Piccardi discussed the possible nature of the effect of cosmophysical factors on the Earth processes. He supposed the existence of a special kind of electromagnetic radiation, the effect of which is mediated by the change of water properties.

In Tomsk, Aurora Mikhailovna Opalinskaya in collaboration with

Ludmila Petrovna Agulova reproduced Piccardi's experiments and performed a thorough examination of the regularities observed. A.M. Opalinskaya showed, in particular, that the amplitude of data scatter decreased markedly when the experimental object was shielded from electromagnetic fields. L.P. Agulova found analogous effects when she studied agglutination of typhoid bacilli and oscillations in the Belousov-Zhabotinsky reaction [68-70].

However, we had not found a clear effect – a significant reduction of the amplitude of fluctuations upon shielding – in our own experiments with shields, which were conducted still in the 1960s. I wrote to Giorgio Piccardi that the phenomena we study seem to be a manifestation of the internal features of our objects, and I do not see reasons to suppose the influence of external factors.

After several years, however, I understood that he must have been right. I wrote a letter to him – that I agree with his general conclusion on the cosmophysical nature of the phenomena that both he and I were dealing with – but there was no answer. Giorgio Piccardi had not received my letter: he died in 1972. Several years earlier, in 1964, we lost A.L. Chizhevsky. One should not delay such letters. . . .

4.2 The possible influence of magnetic (electromagnetic) fields. Carmen Capel-Boute (1914-2003)

After Professor Piccardi's death, his work was continued by his collaborator Dr. Carmen Capel-Boute, who became the second President of the International Committee for the study of environmental phenomena (CIFA), an organization founded by Giorgio Piccardi. As many of us, she believed water to mediate those effects [71]. It should be noted that in the 1960s, the scientific community had a very emotional discussion about whether electromagnetic fields affect biological objects or not. An important argument in favor of the affirming answer was the book by *Alexandr Samuilovich Presman* [72]. The effect of electromagnetic waves on water – a so-called "electromagnetic treatment of water" – was a technological method to prevent the formation of sludge in the steam boilers. The technology was advanced by *Willy Ivanovich Klassen* [73]. However, those who believed in these effects were subjected to a sharp criticism [74]. A lot of papers and books were published, but nobody had a complete understanding of the phenomena: even the existence of the effect was challenged, not even mentioning the mechanism, which was unclear.

Following this stream of scientific ideas, I, too, thought that "macroscopic fluctuations" and, especially, the fact of their instability may well be explained by the effect of weak low-frequency electromagnetic fields – either artificial ("anthropogenic") or natural (cosmo/geo-physical). These ideas seemed to be supported by the results of experiments with the effect of visible light, and since then, we had been testing this hypothesis for many years, in hundreds of experiments. For the most part, our expectations proved to be wrong. We conducted a large variety of experiments, looking for the effect of electromagnetic fields of such a kind, but there was no a clear and definite relation between the amplitude of fluctuations and the shape of histograms.

The role of electromagnetic fields may, in principle, be revealed in two types of experiments: (1) those in which the experimenter uses shields, reducing the intensity of external fields, and (2) those, in which the object is subjected to the effect of artificial fields of a certain frequency and intensity.

4.3 Experiments with shields

The first experiments with shields were conducted in September-November, 1966. We performed 53 experiments, in which we measured the *amplitude* of the SH-titer fluctuations in the solution of actomyosin. Test-tubes with the solution were placed into either a thick-walled cast-iron block* or into similarly shaped *darkened* glass vessels filled with waver or cotton. In every experiment, we processed 15 samples for each of the experimental variation.

The results of these experiments did not meet our expectations. When the samples were shielded with cast-iron or water, *the amplitude of fluctuations increased* compared to the level observed in the cotton-shielded samples. Moreover, it increased approximately by the same value. Since cast-iron and water have very different dielectric characteristics, our supposition – that the factors determining the spectrum of states realized in the process of macroscopic fluctuations have an electromagnetic nature – was admitted to be unlikely.

The question was, however, why on earth does such an influence exist – an influence which does not depend on the nature of the shield? Systematic experiments with shields were resumed in 1978–1980, when we were measuring fluctuations of the enzymatic activity in the solutions of creatine kinase and fluctuations of the Asc/DCPIP reaction rate.

The main result of those experiments was the following: shields do have any effect, and there is no dependency on the material of the shield. These results were confirmed in hundreds of experiments with shields in the 1980s. With the examined solutions placed under steel, brass, aluminum

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[*] A cylinder of pure cast-iron, 21 cm high and 7.5 cm in radius, with test-tube sockets in the back end. The minimal thickness of the cast-iron shield – for the test-tubes lined along the peripheral circle – is 3 cm.

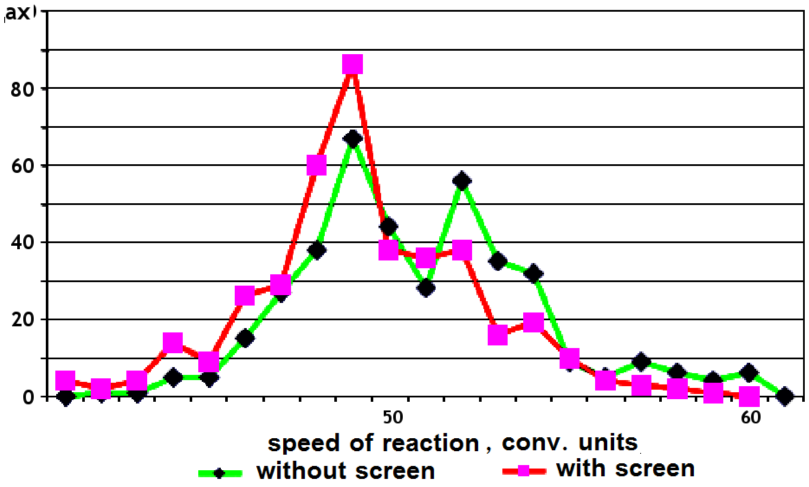

Figure 4-2: Change of the histogram shape for measurements of the creatine kinase reaction rate in the three-layer steel screen. Experiment conducted on June 18-21, 1979.

and plexiglass shields of the same shape, we observed similar changes of the histogram shape, which did not depend on the material of the shield. The changes consisted in diminishing the amplitude of fluctuations independently of the shield material (the aluminum shield was often more effective than other shields).

> The similar reproducible effects in the experiments with steel, brass and plexiglass shields and stronger shifts in the experiments with aluminum shields rule out the explanation that the effects are caused by shielding from external electromagnetic fields.

However, there were experiments in which shields almost did not influence the amplitude of fluctuations of the rate of chemical and biochemical reactions. A typical result from that series of experiments is shown in Fig. 4-2. A three-layer steel shield induces a shift of the histogram towards lower values of enzymatic activity. The shift does not depend on the shield material and is not a result of the shielding from light.

Thus, we failed to find a histogram shape typical for a certain shield. Now, after so many years, it does not seem surprising to me anymore. It was impossible to find a regularity taking only a single (for each experimental variant) histogram per day. The shape of histograms, as became clear later, is constantly changing. In this stream of shapes, one can only consider the probability of a certain shape to appear more frequently. More or less reliable conclusions can be drawn only from comparing many hundreds of successive histograms – this became possible only in the experiments with radioactivity or noise generators.

The biological effects of magnetic (electromagnetic) fields have been studied for many years at Simferopol University by *Nataliya Armenakovna Temuryants* and *Boris Mikhailovich Vladimirsky* (see [75]). They had a special "non-magnetic" room in the laboratory, which was shielded with a 3 mm permalloy shield.

Based on advice from *Vyacheslav Evgenievich Zhvirblis*, I got in contact with B.M. Vladimirsky and N.A. Temuryants, and on December 5-11, 1978, we had the unique opportunity to conduct synchronous measurements of creatine kinase activity in Simferopol and Pushchino. In Pushchino, I worked with the students Tanya Rebrik and Mikhail Kotyatse, while *V.A. Kolombet*, *Tatyana Yakovlevna Britsina*, *Ludmila Mikhailovna Ovchinnikova* and *Nadezhda Pavlovna Ivanova* experimented in Simferopol. The result was disappointing. With all the shielding – the measurements of the creatine kinase reaction being performed in that shielded room and the vessel with the protein solution being additionally placed in a desktop permalloy block – ...

... no influence could be seen; and neither the amplitude of the data scatter nor the histogram shape were affected. One could say that the absence (substantial weakening) of the external magnetic fields does not have an impact.

In the next step, we (T.Ya. Britsina, N.P. Ivanova, Tatyana Vladimirovna Perevertun and me) conducted "opposite" experiments in a completely unshielded building on July 16-20, 1979, with the kind assistance of *Sergey Mikhailovich Mansurov*. We measured the amplitude and fluctuations of the Asc/DCPIP reaction rate in a special "non-shielded house" at IZMIRAN* in Troitsk. This wooden house had no iron at all (the roof was made of brass). We observed a very high amplitude of fluctuations and well-resolved discrete extrema in the histograms. An especially high amplitude of fluctuations was registered on the night of July 17, 1979. One could attribute these results to the absence of shields, i.e., to the effect of external electromagnetic fields. However, placing the solution into a permalloy box did not lead to the expected changes.

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> After all, these findings could lead one to the conclusion that the experimental object is indeed affected by external fields, but they are not electromagnetic. At least it was established that these fields could not be shielded by a layer of permalloy.

In the time period from the 4^{th} to the 19^{th} of October in 1979, with the kind help of *Vladimir Anatolievich Perevertun*, we conducted a series of Asc/DCPIP experiments at the high-mountain station "Cosmos" near Alma-Ata. The measurements were conducted both with and without shields. No clear effects was obtained. At the very same time, *Dmitry Petrovich Kharakoz* together with *Luiza Leonidovna Alievskaya*, *V.V. Rybina* and *Mikhail Fyodorovich Chapliy* performed analogous measurements at the BBS of MSU (see p. 65).

Before these experiments, I and T.V. Perevertun conducted a series of Asc/DCPIP experiments in an old wooden stable at Belomorskaya Biostation of Moscow State University, which is located exactly at the Polar circle latitude. In contrast to what we observed in the other "completely non-shielded house" in Troitsk, we found no scatter of the results whatsoever, only some somewhat odd signals.

It was difficult to make definite conclusions from this collection of rather ambiguous results. We should have continued the experiments. A idea that came to mind was to study the effect of artificial electromagnetic fields.

4.4 The effect of artificial electromagnetic fields

The first experiments of this kind were performed with the participation of and on the initiative of *Vladimir Ivanovich Danilov* – five years earlier, on July 4-11, 1974, in Dubna. V.I. Danilov was convinced that low-frequency fields played the key role in biological phenomena [76]. We (N.P. Ivanova, T.Ya. Britsina, V.I. Danilov and me) measured the enzymatic activity of creatine kinase. The protein solution was subjected to the effect of a sawtooth impulse magnetic field. Using a Helmholtz coil, we generated short (20-sec) impulses of magnetic fields with the maximal intensity of 10 Oe, the total time of exposure being 5 min.

In all the experiments, we observed the effect expected by B.I. Danilov: *the mean enzymatic activity of creatine kinase either decreased or increased*, depending on the sign of the derivative of the magnetic field intensity. The *amplitude of fluctuations*, however, was not affected by the field...

On May 29-31, 1979, L.P. Agulova together with T.Ya. Britsina and N.P. Ivanova conducted 49 large-scale experiments in our laboratory, where they examined the effect of low-frequency variable magnetic fields of low intensity (0.1–1.0 Hz; $\approx$ 1000 Oe) on the enzymatic activity and the amplitude of the data scatter in the solutions of creatine kinase (200 measurements per experiment). L.P. Agulova proceeded from the possible generality of the factors responsible for "macroscopic fluctuations" and the factors underlying your own findings (the effects of such fields on bacterial agglutination and the BZ-reaction [68-70]). However, in the experiments conducted in our laboratory, the effects – even if they existed – were weak and unstable. An impression was formed that the effect would depend only on the laboratory location that the enzyme solution was put in.

From all these experiments: with protein solutions and Asc/DCPIP reaction, with artificial electromagnetic fields in Dubna and Pushino, with various shields and without them, in Simferopol, Pushino, Troitsk, BBS and Alma-Ata – one could draw the following conclusion.

Fluctuations of electromagnetic fields are hardly the cause of "macroscopic fluctuations". There are, nevertheless, external factors (apart from visible light), which seem to be essential for the phenomenon examined. The existence of these external factors is evidenced by inexplicable, "unmotivated" changes of the amplitude of the data scatter, which we observe from experiment to experiment in different types of processes.

Now I wonder whether, knowing A.L. Chizhevsky's work, I had been ignoring them for so long while trying to understand the nature of the "macroscopic fluctuation" phenomenon. As mentioned above, I had believed that the matter concerned some inner features of the objects I studied. I needed an impetus – the letter from J. Piccardi.

4.5 Alexandr Leonidovich Chizhevsky (1897–1964)

Unfortunately, it was the manifestation of a general tendency. Here, in the Soviet Union, the ideas of A.L. Chizhevsky formulated in 1920–1940 gained recognition and major development only after his death [35, 77-86]. The recognition was facilitated by the coming of the so-called "cosmic era": the first space flights, the support of cosmonauts etc. After his return from exile, Chizhevsky built a circle of followers around hin, who used to gather in his Moscow apartment. A wave of semi-official conferences and seminars went through a number of cities. Special thanks should be given to B.M. Vladimirsky, who played a major role in all this activity and under whose flag systematic studies of cosmophysical correlations commenced in Simferopol [84-87].

4.6 All-Union and International Symposia on Cosmophysical Correlations in Terrestrial Processes held in Pushino

As I already mentioned, the "world scientific community" is quite skeptical about data on the dependence of terrestrial processes on cosmophysical factors. The situation changed a little after the beginning of space programs. Chizhevsky's works were published, and also a new series entitled "Problems in Space Biology" started. The studies of cosmo-physical factors in diverse types of processes remained, however, beyond the scope of official science.

Our position slightly improved when we organized the 1^{st} All-Union (USSR) Symposium "Cosmophysical Correlations in Biological and Physico-Chemical Processes", which was held in Pushino, on the basis of our Institute of Biophysics of the USSR Academy of Sciences. The second symposium took place in 1990, and the third – already international – in 1993. The international symposium gathered researchers from various countries, especially CIFA members led by C. Capel-Boute. At this symposium, B.M. Vladimirsky was elected CIFA President (and N.V. Udaltsova was appointed General Secretary). The 4^{th} Pushino Symposium was held in 1996. The 5^{th} Symposium was organized under the flag of two institutes: our Institute of Theoretical and Experimental Biophysics RAS and the Institute of Space Research RAS – and took place in Pushino in April 2004. Again, as with previous symposia, the main reports were published in the journal "Biofizika" [87]. The publication became possible thanks to the policy of the journal, which was mainly shaped by the executive secretary N.G. Esipova and the assistant editor-in-chief L.A. Blumenfeld and was supported by the chief editors A.A. Krasnovsky and, later, E.E. Fesenko. It was a firm and courageous position – courageous, as the "strong opponents of pseudo-science" at the Academy of Sciences, being afraid of astrology, were extremely suspicious of any reference to an "extraterrestrial influence".

The proceedings of these symposia were published in the following issues of "Biofizika": Vol. 37, no. 3 and 4 (1992); Vol. 40, no. 4 and 5 (1995); Vol. 43, no. 4 and 5 (1998); Vol. 46, no. 5 (2001); Vol. 49, Suppl. (2004, only in English). These sources contain about 200 original papers on this subject. The publication in an official journal released under the aegis of the Academy of Sciences meant that the field was formally recognized by the official scientific community.

4.7 Boris Mikhailovich Vladimirsky. Crimean Seminars on Cosmophysical Correlations in Terrestrial Processes (V.S. Martynyuk, N.A. Temuryants et al.)

In the 1990s, regular meetings on "cosmophysical correlations" held in Crimea under the flag of B.M. Vladimirsky – see details in [124], played an important role.

4.8 Vyacheslav Evgenievich Zhvirblis (1936–2006)

While still a student at a Chemical Department, Vyacheslav Evgenievich Zhvirblis noticed a strange thing at an "optical activity" practical training session. In the procedure of "zero adjustment" of a polarimeter, the angle of the limb rotation differed depending on the time of the day. "Zero adjustment" is such a rotation of the limb when the illuminance of all three polarimeter fields is made even, and they merge into a united illuminated field. Vyacheslav Evgenievich began systematic measurements of the "polarimeter zero" and came to the conclusion that the fluctuations he observed were due to cosmophysical causes. He had been registering this parameter systematically for many years [88-90]. Later he admitted, following P.P. Lazarev [91], that this phenomenon might be affected by changes in the properties of the eye.

We made his acquaintance in 1978. He deeply impressed me by his confidence that the phenomenon he studied was due to external, cosmophysical causes. I constructed histograms from his data, and they were undistinguishable from those obtained in our experiments. Then the idea of an extravagant experiment was born: to make synchronous measurements. He would measure the "polarimeter zero" in Moscow and we, at the same time, the rate of enzymatic (creatine kinase) reactions in Pushino. In those experiments, we (T.Ya. Britsina, N.P. Ivanova and me) measured the rate of the following enzymatic reaction:

$$\text{ATP} + \text{creatine} \longrightarrow \text{creatine phosphate} + \text{ADP}$$

in 180 accurately sampled portions of creatine kinase (started at 10:00 a.m., for 3 hours, with 60-second intervals). At the very same time (on a broadcasted time signal), V.E. Zhvirblis started a 180-point series of "polarimeter zero" measurements. When I constructed histograms from the results of the first experiment of April 26, 1978, they looked very similar in the parallel series (Fig. 4-3A and B).

In total, there were 9 such experiments. In some of them, we also obtained similar histograms (for example, in the experiment of May 18, 1978,

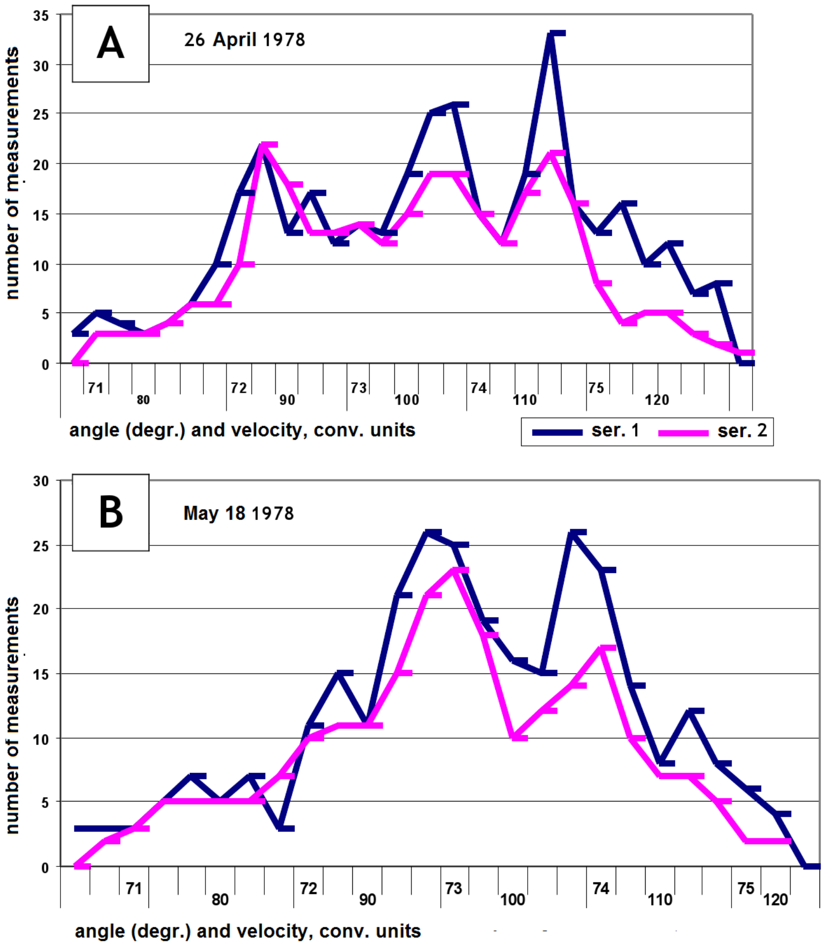

Figure 4-3: The histograms constructed from synchronous measurements of the rotation angles of a control polarimeter limb (1) (V.E. Zhvirblis, Moscow) and of the creatine kinase reaction rates (2) in Pushino appeared similar, both in the experiment of April 26, and of May 18, 1978 [92].

displayed in Fig. 4-3B). It was very difficult to admit these extravagant results to be objective. We were to prove that the similarity is not a figment of our imagination and that it is not just random. This took us many years of intense work, during which many hundreds of experiments were made.

At that time, a day of concentrated labor would yield only a histogram or two. To make a solid conclusion that the histograms are similar would however imply comparing hundreds and thousands of histogram pairs. Many years had passed before it became a reality. I shall describe the story in the 2^{nd} part of the book. Meanwhile, the idea of an "external force", which the histogram shape depends upon – irrespective of the type of process examined, had already entered my mind.

Chapter 5.

Cosmo-physical correlations of the “scatter of measurement results”

5.1 Summer of 1979. Belomorskaya Biostation of Moscow State University. Stable in the forest, “signals”

In August, 1979, along with a student of the Biophysical Department of MSU Physical Faculty T.V. Perevertun, we conducted a series of experiments at the Belomorskaya Biological Station (BBS) of Moscow State University. We had a (somewhat naive) objective to, as much as possible, get rid of external “technogeneous” effects. There was an old stable in the forest, a blockhouse which was constructed from pine balks, and which stood far from other buildings. The closest railway (Polyarny Krug station – Uzky halt – Poyakonda) was 15 km in distance; the nearest high-voltage line (the branch from the Poyakonda station to BBS) was approximately 1.5 kilometers away. Nevertheless, the stable had electric wiring and a connection, and we set up the necessary equipment (a photoelectrocolorimeter, amplifier and recorder). This was the standard experimental setup used by us at that time to measure the Asc/DCPIP reaction. Every 3 minutes, a portion of Asc was added while stirring to the cuvette with the blue dye DCPIP, and the recorder drew a curve (line) of the absorbance decrease.

In Pushino, we had been conducting such experiments daily for many years – together with T.Ya. Britsina and N.P. Ivanova. The technique had been perfected up to the tiniest detail, and T.V. Perevertun had been well trained.

The first experiments of August 1-3, 1979 were conducted synchronously in Pushino and BBS. The results of the BBS experiments were striking. From sample to sample – almost no fluctuations at all were discernible. The amplitude of the data scatter (σ %) was almost three times as low compared to that in the parallel measurements performed by T.Ya. Britsina and N.P. Ivanova in Pushino ($\leq$ 3.5 % versus 8–12 %). One could think that T.V. Pervertun worked much more accurately than T.Ya. Britsina and N.P. Ivanova (which was highly unlikely). The reaction rate, however, halved abruptly on August 1 at 12:01. Then, as abruptly as earlier, it jumped to a level which was two times higher than the average level and then dropped again – the recorder chart showed a sharp “signal”. After that, all came back to normal – no substantial fluctuations could be seen.

The next day, on August 2, the situation repeated itself. First, there were no marked fluctuations and then, at 11:42, the same and even a sharper signal was registered. And again, all settled down after that signal.

On the third day, August 3, we were already waiting for the signal,

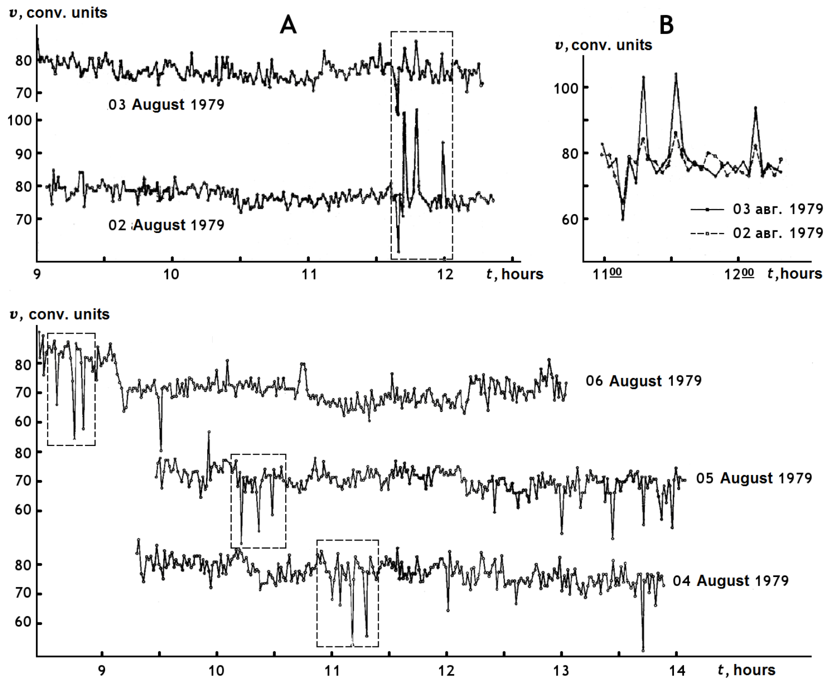

Figure 5-1: Sharp changes of the reaction rate of ascorbic acid with dichlorophenolindophenol under the influence of external “signals” of unknown nature. Experiments at BBS Moscow State University from August 2 to 13, 1979. Time is shown on the x-axis and the y-axis shows the reaction rate in conventional units. For comparison the signals of August 2 and August 3 of 1979 [89] are shown on the top right.

and it appeared again exactly at 11:42. On August 4, the signal had a somewhat different pattern and was registered at 11:00. In the next several days, the time when the signal appeared shifted back and forth: 10:13 on August 5, 8:40 on August 6, 11:05 on August 9. The experiment lasted 10 days. Results are shown in Fig. 5-1.

It was clear that the signal had an external origin. A certain “force” changed the rate of the Asc/DCPIP reaction (or maybe the characteristics of the measuring equipment?). The time of the signal appearance was not regular. BBS is situated exactly on the Arctic Circle, i.e., in the zone that is easily penetrated by the “solar wind”, a stream of protons and other charged particles of cosmic origin. A wooden house could not block this stream. To consider solar wind the cause of the phenomena observed would have been to early though. Besides, there remained, perhaps, the most important question: why is the amplitude of the data scatter so low – all the time except in the moments of "signals"? Solar wind penetrates, yet the amplitude of the scatter is low.... Well, one thing that was clear was that the experiments should be repeated.

In 2006, Alexandr Evgenievich Belyaev told me about a powerful radar installation at the Kola Peninsula, whose signals could affect the rate of our reaction or characteristics of the devices we used. I do not know if this installation existed in 1979. However, I cannot rule out the possibility that the signals we observed were of terrestrial, technogeneous origin. May it be that we indeed registered changes of the properties of water solutions induced by electromagnetic waves on the scale of centimeter length? Let us leave the question for future generations.

5.2 Fall of 1979. Synchronous experiments: Pushino – BBS MSU – Alma-Ata

Our next step – following the experiments at BBS MSU in August, 1979 – was the synchronous measurements of Asc/DCPIP reaction at three different geographical points: Pushino (at a latitude of $54^o42'$ North and longitude of $37^o38'$ East), Alma-Ata (at a latitude of 43^o North and longitude of $76^o55'$ East) and BBS MSU (at a latitude of 66^o North (Arctic circle) and longitude of 33^o East). Correspondingly, there were three groups of researchers: (1) T.V. Perevertun, L.M. Ovchinnikova and S.E. Shnoll; (2) V.A. Kolombet, N.P. Ivanova and T.Ya. Britsina; (3) D.P. Kharakoz, L.L. Alievskaya, V.V. Rybina and M.F. Chapliy.

In the experiments, we analyzed both the similarity of low-frequency trends in Asc/DCPIP reaction rates and the synchronism in the appearance of certain characteristic signals.

The comparison revealed a high correlation of low-frequency trends in Pushino and Alma-Ata, and an equally high, i.e. statistically significant, anti-correlation of the trends in BBS and Pushino, as well as BBS and Alma-Ata.

In the analysis of signals, we first (visually) chose a characteristic signal, which was called "canonical", and then ran it through each of the time series obtained, calculating correlation coefficients. Such an analysis revealed a large number of signals, whose shape was similar to that of the canonical one – in the Pushino experiments of August 1979 and in the Pushino, Alma-Ata and BBS experiments of October 1979. The signal that persisted in the October experiments, though, was not completely identical to the canonical signal. Sometimes, the signals overlapped – as expected. In the Pushino experiment of October 11, 1979, for example, the signal appeared at least 9 times within 3.5 hours, with the next signal often starting before the end of the previous one (the signal duration was about 30 min).

The synchronous measurements in Pushino, BBS and Alma-Ata indicated that the signals observed were not meaningless but carried certain information. What is their meaning? What do they point at?

During these synchronous experiments, I was in Pushino and, together with T. Perevertun, was measuring the rate of Asc/DCPIP reaction. Naturally, I was dying to know what the other groups were obtaining at the same time in Alma-Ata and BBS.

There was a special room in our institute, reserved for very important communications, with teletype (a special telegraph apparatus). At that time, teletype communication service was installed in all important state institutions. A teletype of "regional level" was also in Alma-Ata. With a letter from our director, V.A. Kolombet managed to obtain permission for using this teletype to communicate with Pushino. On the first day of our synchronous experiments, everything was like "in a movie". I had received a teletype listing of results from Alma-Ata. The results were organized in a table, containing several hundred of three-digit numbers. On the basis of these numbers, I constructed charts and looked for signals.

On the second day, however, data transfer suddenly ceased, and the apparatus showed a message: "the connection is terminated". I waited for some time – but to no avail. The teletype remained silent.

When our expeditions returned, V.A. Kolombet told me what happened that day. During the data transfer session, a KGB officer swiftly strode into the room and "confiscated" the table along with the results. The next day, the chief cryptographer of Kazakhstan, who had a sleepless night, returned the listing saying "These numbers have no meaning". Nevertheless, we were forbidden to get close to the teletype – just in case.

The conclusion made by the representatives of "competent authorities" could be doubly wrong. Wrong – if we registered signals of cosmic (as we believed) origin [92-94]. All the more wrong – if we unintentionally registered signals from radiolocational or other sources. In that case, the "authorities" ought to have become even more alerted.

Studying the "meaning of temporal signals" and their relation to cosmophysical events, elucidating the nature of these events could become another – along with the analysis of fluctuation amplitudes and histogram shapes – direction of our research. My mind was occupied with the idea that a complex superposition of such signals could create the impression of quite a "stochastic" process, and "stochasticity" itself may, in principle, be a superposition of regular signals.

> However, I feared that, carried away by this third direction of research, we would get distracted from the work we had already started, the work devoted to the regularities in the change of the fluctuation amplitude and the histogram shapes. So I decided to study the amplitude and histogram shape first and to return to signals later.

We published a number of papers on this subject in 1981 [92-95] and then stopped studying "signals".

A quarter of a century has passed, yet the first two tasks are still far from being solved, and hardly will we return to the study of "signals". In 2008 I thought that back then we were stuck in our search for electromagnetic fields that could be responsible for the "macroscopic fluctuations". We spent or, rather, devoted many years to this search – without definite results in the end. Day after day, in hundreds of experiments, with shields and artificial fields – the conclusions were very ambiguous. There is no reason to complain, though. Until the path is traversed, you never know what will be waiting for you at the end. . . . As mentioned above, a scientist would generally neglect "outliers", non-regular abrupt changes of the quantity measured. Indeed, such outliers can result from trivial causes: a break of contacts in electrical circuits, lightning discharges, or mechanical damage. In order to rule out such causes, very accurate and laborious work is needed, which would be based on a new, unconventional attitude towards extremal, or outlier, data points. Many years passed, and there began to appear studies indicating the nature of "signals" and "outliers" to be nontrivial. More and more results are being published, which suggest a non-electromagnetic nature of the factors that underlie those effects. A wonderful thing it is the "well-established scientific opinion". Those who believe that biological and physico-chemical processes are affected by weak electromagnetic fields are still under pressure of "opponents to pseudoscience", but they themselves consider "impossible" the reported effects of gravitational or – goodness gracious – "torsional" fields. Meanwhile, the matter essentially can be stated in one simple question: are the reports correct, are the observations true, were possible artifacts ruled out?

In this connection, we published a review of works in this nontrivial field [96] together with Victor Anatolievich Pancheluga. Not going into details here, I shall note four branches of work. First of all, there is laboratory work by O.A. Troshichev (Institute of the Arctic and Antarctic) [97-103], N.V. Klochek from the Irkutsk branch of IZMIRAN [104, 105], V.N. Smirnov from the Moscow Institute of Physics and Technology [106, 107] and Yu.A. Baurov and K.A. Trukhanov [108-113].

A review of these wonderful works would have to carefully consider the chronology: they were published 10 to 20 years after the events described in this chapter. So I refer the reader to the original pulications and shall continue the chronological story of our research.

5.3 Fluctuations of the amplitude of the data scatter in biochemical and chemical reactions correlate with changes of solar activity

We continued our everyday experiments, trying to understand the "inner mechanisms" of synchronous in macrovolumes fluctuations in the rate of biochemical and chemical reactions. Now we knew that many aspects of the phenomenon are determined by external factors. It seemed that these external factors had an "extraterrestrial" origin. This supposition became plausible in 1985, when L.P. Agulova analyzed the results of our measurements for 25 years. She established that the changes in the amplitude of the data scatter correlated with the alterations of solar activity. The mystery of the unfathomable change of fluctuation amplitude throughout days, months and years was gradually (very gradually, in the course of many years) becoming clearer: the amplitude of the data scatter substantially depends on "external factors". Fig. 5-2 illustrates this conclusion.

The figure shows how the amplitude of the data scatter varies from year to year. The variations correlate with changes in solar activity: the scatter of results is maximal in the years when solar activity changes considerably; it depends not so much on the level of the activity itself but rather on the value of its derivative.

After discovering the correlation between the amplitude of fluctuations and solar activity, we began systematic experiments to study the nature of the external factors that could determine the amplitude of the data scatter in enzymatic and purely chemical reactions.

To achieve this goal, we (I together with N.P. Ivanova and T.Ya. Britsina) measured the rates of these reactions in equal portions of the corresponding solutions, which were collected with certain intervals (15 or 30 seconds). On the basis of 250 successive measurements, a mean-square amplitude of fluctuations was calculated and a distribution (histogram) was constructed. The measurements were performed with high accuracy and punctuality: at the same time, day after day, year after year – over a 10-year period (from 1976 to 1986). Together with N.V. Udaltsova, we tried to answer if these two parameters (the fluctuations amplitude and the shape of histograms) correlate with some cosmo-physical characteristics (the state

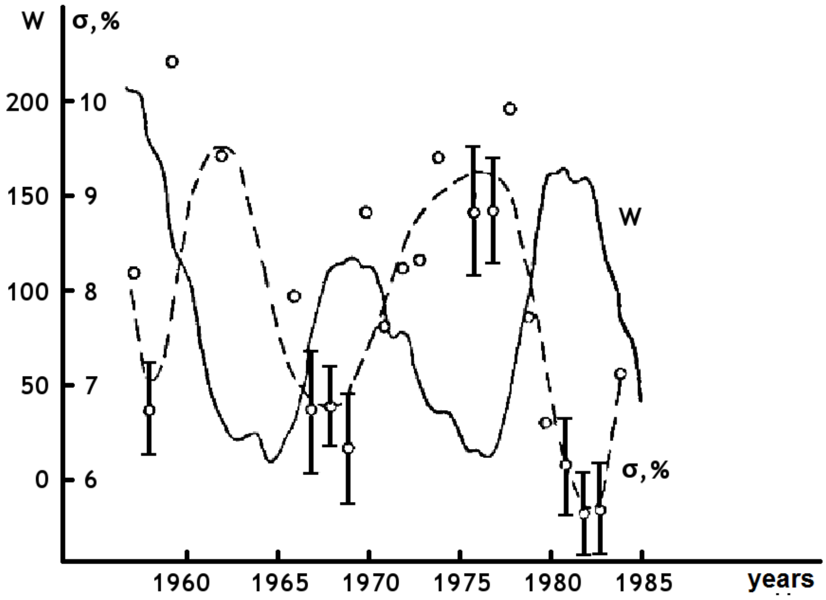

Figure 5-2: Comparison of amplitude changes of "macroscopic fluctuations" from measurements of the rates of biochemical and chemical processes (%) with changes in solar activity (Wolf number, W). Changes in the average size of fluctuation amplitudes are approximated by and fitted with a polynomial using the method of least squares. The 95% confidence intervals for σ are noted with percentages.

of the ionosphere and the interplanetary magnetic field, solar activity) or with certain experimental factors (the shield material, illumination).

Now that many years have passed, I can reiterate: we tried to solve an "unsolvable" problem! At that time, a day of hard work would yield only one histogram, which covered the time interval needed to process 150-240 Asc/DCPIP samples. Some information, however, was in fact obtained.

The results of those experiments are summarized in two lengthy reviews published in 1985 [32] and 1987 [33].

For example, N.V. Udaltsova examined the correlation between the average monthly amplitudes of the data scatter in biochemical and chemical reactions and the average monthly values of *Wolf numbers*.

These quantities were found to change in a complex antiphase (Fig. 5-3).

Comparing changes of the global geomagnetic activity (Ap index) with

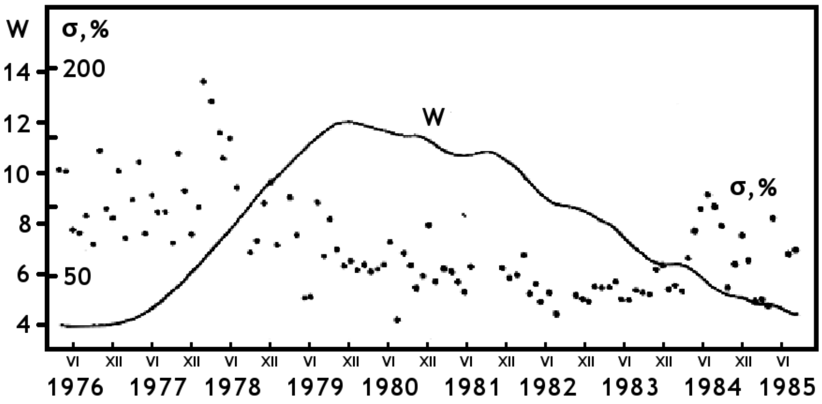

Figure 5-3: Comparison of the monthly average values of fluctuations amplitudes (the scatter of results) from measurements of reaction rates of AA + dichlorophenolindophenol with Wolf (W) numbers in 1976–1985 [92, 33].

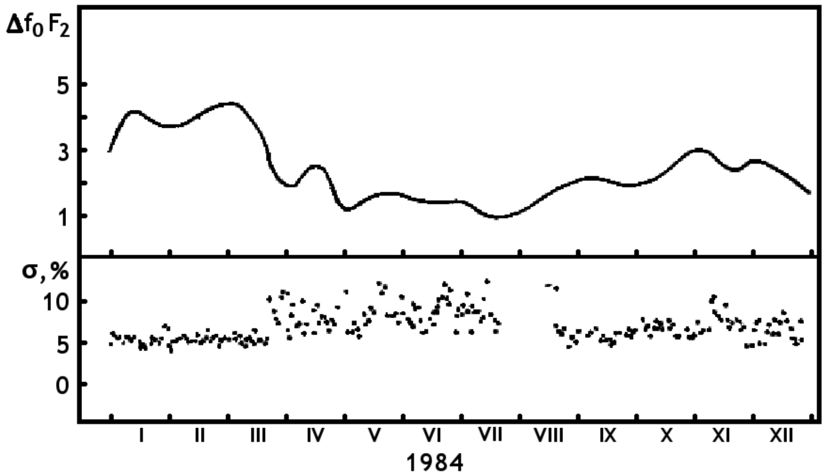

Figure 5-4: Comparison of daily values of the amplitude of fluctuations of AA + dichlorophenolindophenol reaction rates to the daily changes of frequencies of an ionospheric layer of F_2 [92,33].

changes of the average yearly amplitudes of the data scatter showed no statistically significant correlations in 1957-1984. In the period of 1977-1979, however, a good correlation of the average monthly values of these

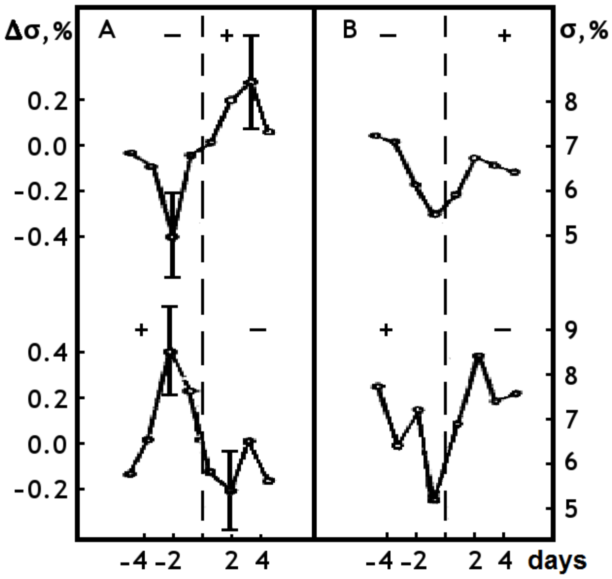

Figure 5-5: Change of the macroscopic fluctuations amplitude in biochemical and chemical reactions for days when a change in sign of the sector of an interplanetary magnetic field occurred. The subfigure labeled A displays the deviation σ % from the average value (1976-1984); subfigure B shows the values of fluctuations amplitudes for different days before a sign change (data from years with high solar activity: 1957-1958; 1968-1973; 1979-1981.). The x-axes show the number of days before a change in the sign of a sector. The y-axes display $\Delta\sigma$ % and σ % [92,33].

quantities was found.

The analysis of data obtained over the period of 1966-1980 revealed distinct periods in the change of the amplitude of the data scatter, which were equal to 1, 2 and 4 years.

Fig. 5-4 shows changes of the amplitude of the data scatter in the Asc/DCPIP reaction as compared to changes in the *ionosphere layer* F_2 (the data of 1984; analyzed daily by N.V. Udaltsova). The periods at which the amplitude of fluctuations grew corresponded to the phases of the decreased daily variation in the electron density of the F_2 layer (Fig. 5-4 [95]).

Perhaps, the most interesting results were obtained by N.V. Udaltsova when she compared changes of the amplitude of macroscopic fluctuations with changes in the *sign of the sector of the interplanetary magnetic field* (Fig. 5-5). She revealed statistically significant correlations, which differed in the years with high and low solar activity. Strikingly, the amplitude of fluctuations changed about 2 days before the change in the sign of the sector of the interplanetary magnetic field. It could mean that the amplitude of fluctuation changes simultaneously with the alterations that occur in the Sun itself, whereas the change in the sign of sectors is caused by the slowly propagating solar wind, a stream of charged particles running from the surface of the Sun.

Therefore, it is not the solar wind but the changes in the state of the Sun itself, which seem to be the relevant factor.

The figures represented here illustrate only a part of results of our measurements obtained over many years. My intention was to state that there is a statistically significant correlation between the amplitude of the data scatter and some cosmo-physical characteristics. Obviously, there will be a long path from establishing the correlation to understanding the physics of these relationships.

5.4 Fall of 1979. The histograms constructed from the results of radioactivity measurements are similar to the histograms obtained in enzymatic and chemical reactions

To understand the laws that govern changes of the histogram shape, we considered it very important to find a process in which histograms would have a smooth, or supposedly "normal" shape. And, as I mentioned earlier, between 1951 and 1960 my work was related to measurements of radioactivity [35].

Amongst lectures on the application of radioactive isotopes that I presented to the CIPE students were courses on the physics of radioactivity, the statistics of radioactive decay, and methods of statistical data manipulation. In the final experimental test, which illustrated Poisson statistics, my students submitted properly averaged and smoothed distributions. I, at the same time, obtained discrete distributions and peculiar histogram shapes in the experiments with protein solutions.

Surprising though as it may appear, at that time I did not think about examining the detailed structure of distributions constructed from the results of radioactivity measurements. It was evident a priori that radioactive decay obeys Poisson statistics. Calculation of mean-square deviations proved this true. That is why for almost a 10-year period (1951 to 1960), not even once had I compared histograms for biochemical and radioactive data. After our experiments with V.E. Zhvirblis, however, such a comparison seemed necessary. I thought there ought not to be any peculiar histogram shapes in the radioactivity experiments; after all, it is a quite stochastic process obeying Poisson statistics.

In September 1979, I asked the staff of the Isotope Laboratory in Building "A" of MSU (later to be known as the Belozersky's Institute of Molecular Biology) to make 250 measurements of ^{14}C radioactivity using an automatic (with no subjectivity involved) scintillation counter. Parallel to this experiment (approximately at the same time), we did 250 measurements of the rate of creatine kinase reaction in Pushino and. . . .

And the situation repeated itself – I mean the situation we had encountered earlier in the experiments with V.E. Zhvirblis. First of all, the histograms constructed from the results of radioactivity measurements were as jagged and discrete as those built from the chemical and biochemical data. One could say that in both cases, the shape of histograms is just a "play of chance", but the Moscow and Pushino histograms were clearly similar. It was something very difficult to comprehend: everyone knows that radioactivity is not affected by trivial factors and does not depend on environmental conditions. . . .

There were no plausible explanations of this result. It was yet another psychological shock. I had a lot of other things to do, so I just ceased the experiments. A whole year would pass before I returned to them.

One year later (on December 28, 1980) *Vadim Ivanovich Bruskov*, head of the Isotope Laboratory at the Institute of Biophysics (Pushino), prepared two identical (as identical as possible) preparations of ^{14}C and measured their radioactivity (250 successive measurements) using two independent automatic counters ("InterTechnique", France). We constructed histograms. They were improbably similar – see Fig. 5-6.

Today, when I look at this chart – as well as at the results of our first experiment with radioactivity in 1979 – I understand: Fortune smiled upon us. Such a similarity is not a given, it is realized with a certain probability. However, we were fortunate. The similarity of the results of separate measurements of two independent stochastic processes (and even more so, different types of processes) with all the possible artifacts completely ruled out – this would inevitably lead one to the conclusion that there exists an external "cause" that is common to various processes. Myself, much alike many other "normal" people, believed that this should be a certain "force", affecting the object under examination. But what "force" could equally affect the rate of a biochemical or chemical reaction and radioactive decay? Fantastic images were swirling in my head.

What is it? Unknown rays? Or maybe fluctuations of neutrinos, fluctuations of the "concentration of lepton gas"? For β-decay, this supposition did not seem completely crazy: β-decay is accompanied by the formation of neutrinos. May it be that the fluctuations of neutrino streams influence the

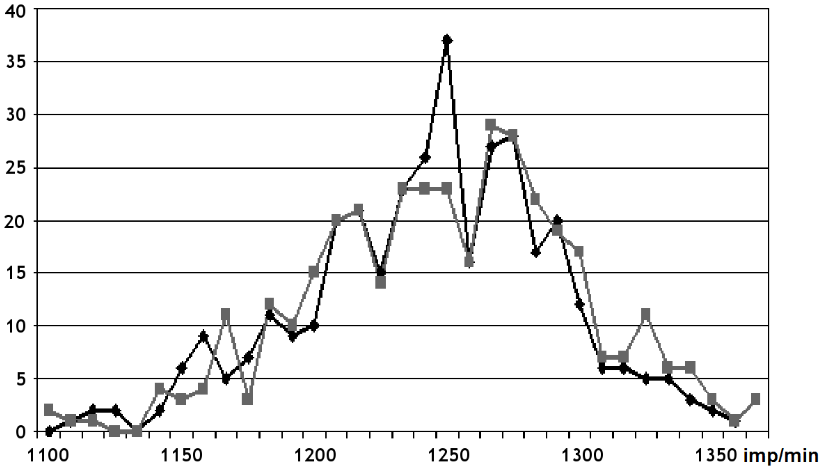

Figure 5-6: Experiment of December 28, 1980. The similarity of histogram shapes constructed from the results of synchronous measurements of beta activity of two preparations ^{14}C from two independent automatic installations (SL-30 and SL-40). V.I. Bruskov's measurements (Fig. 17 from [32]). On the x-axis, the measured size of the beta-activity (impulses per minute), and on the y-axis the number of measurements of this amount of activity are shown.

probability of β-decay? To imagine, however, that neutrinos would affect the rate of a chemical reaction. . . .

Well, at least one thing seemed clear: the "cause" that determines the similarity of histogram shapes is cosmo-physical, both in terms of scale and nature. It "influences" different types objects, which may be very far from each other. Naturally, our first thought was that the Sun could be the possible source of such an influence.

Now, 25 years later, I see how the course of our thoughts depended on the use of the word "influence". "Influence" implies that one is supposed to analyze the mean values of the quantity measured and the amplitudes of the data scatter. Behind this lie ages of scientific methodology; the basic question is always about how something influences, or affects the object being studied. The changes of the fine structure of histograms have never been the subject of research: the fine structure has been considered casual or random and, hence, it would be very strange if it were affected by something. And here we seemed to have evidence for the connection between the amplitude of the data scatter and the solar activity.

So we decided to check if the amplitude of fluctuations depended on the position of the Sun in relation to its position on the horizon. This question could best be answered by comparing the results of measurements at the moments of sunrise (sunset) with the data obtained, e.g., at noon.

In the period between May 18 and June 4, 1981, we conducted 14 large-scale experiments, measuring the rate of the Asc/DCPIP reaction during sunset. We collected data with 30 second intervals, for an hour before and an hour after the sunset. On the averaged graph, we saw an initial increase and then a substantial decrease of the reaction rate and the amplitude of the data scatter during sunset [33]. It was at the very time of sunset, when the Sun was going down on the horizon; before and after this, both the rate and the fluctuation amplitude were higher. This result gave V.A. Kolombet an idea: to perform a large series of measurements during the forthcoming total solar eclipse on July 31, 1981, which could be observed in the USSR territory.

5.5 Solar eclipse on July 31, 1981

As I mentioned above, by that time S.I. Borodin had designed and installed a very handy system of automatic laboratory devices (SALD). SALD replaced the man in many routine operations that required accuracy and uniformity; it sampled Asc and DCPIP solutions, mixed them in succession with a given interval between samples, turned on the photoelectrocolorimeter, plotted absorbance changes on the recorder chart, evacuated the reacted mixture, rinsed the cuvette and then started a new cycle (see [33]). Our lives became much easier. We only had to prepare the solutions and calculate the reaction rates at the end of the experiment. SALD made it possible to measure the rate of Asc/DCPIP reaction continuously for many days.

We supposed that shielding of the Sun by the Moon could affect the rate and, especially, the amplitude of fluctuations of the Asc/DCPIP reaction.

The experiment during the solar eclipse on July 31, 1981 was one of the most “large-scale” and labor-intensive experiments of our laboratory (maybe even at our Institute of Biophysics). Many men and resources were involved. It was hard work, both to organize all this and to conduct the measurements. Perhaps, the most laborious part was to process and analyze the data obtained. Was the game worth the candle? Who knows. . . .

By the administrative order and under the direction of S.I. Borodin, the workshop of the institute made 10 SALD sets. To perform measurements along the line of a total solar eclipse on the USSR territory, as well as South, North and West of the line, 10 research groups were formed (overall 28 researchers were involved). The measurements were performed within the zone of the total eclipse (Stanitsa Sernovodskaya in the Northern Caucasus; Tomsk, Bratsk and Nizhne-Angarsk at the Northern side of Lake Baikal; Alexandrov-Sakhalinsky in Sakhalin), southward (Samarkand), northward (Pushino, Moscow and BBS MSU on the White Sea) and westward (on the board of the "Academician Mstislav Keldysh" ship, in the Atlantic Ocean). In addition, a setup of measuring devices was installed in a research airplane IL-18, which took the air in Bratsk and had been flying in the shadow of the total eclipse for more than 8 minutes. About 90,000 measurements were performed, and the recordings were brought together in Pushino for further processing.

Now, with 25 years passed, I believe we did all we could. What a pity, though, that at that time we could not conduct automatic radioactivity measurements, as we can today! When we measured the rate of Asc/DCPIP reactions, it was very difficult to abide by the *ceteris paribus* principle – with all the merits of the SALD set and all the efforts put forth. A lot of calculations were necessary to "normalize" the results of measurements at different geographical points – to make adjustments for small differences in the concentration of reagents, temperature and time intervals.

So what were the results of this experiment?

First of all, it became clear that the reaction proceeded differently at different geographical points (at the same absolute time). Upon the eclipse in Samarkand, the amplitude of fluctuations was sharply changing; in Sakhalin, we registered a disappearance of the low-frequency trend (at the same hours); in Pushino, Tomsk and Bratsk, the amplitude of fluctuations was anomalously low (over the entire day), whereas on the White Sea, it was anomalously high. On those days, the change of the averaged reaction rate at middle latitudes was well correlated with the change of intensity of the neutron component of cosmic rays. In the low-latitude points (Samarkand, the Atlantic and the Caucasus), the shape of histograms abruptly changed on the night of July 31-August 1, 1981 – from patterns with multiple extremes to narrow, alike "Gaussian".

And what about the effect of the eclipse itself – in terms of the reaction rate and the mean square amplitude of fluctuations? Perhaps, only that it resembled the "effect of a sunset". Moreover, it made no difference how much the Sun was shielded: both before and after a sunset or an eclipse, the reaction rates and fluctuation amplitudes were approximately the same. During a sunset or an eclipse, though, there were "disturbances" in these parameters, statistically significant jumps, falls and returns to the initial level. A sunset, however, only lasts for about 2 minutes, whereas an eclipse lasts tens of minutes. The similarity of the effects would, therefore, be

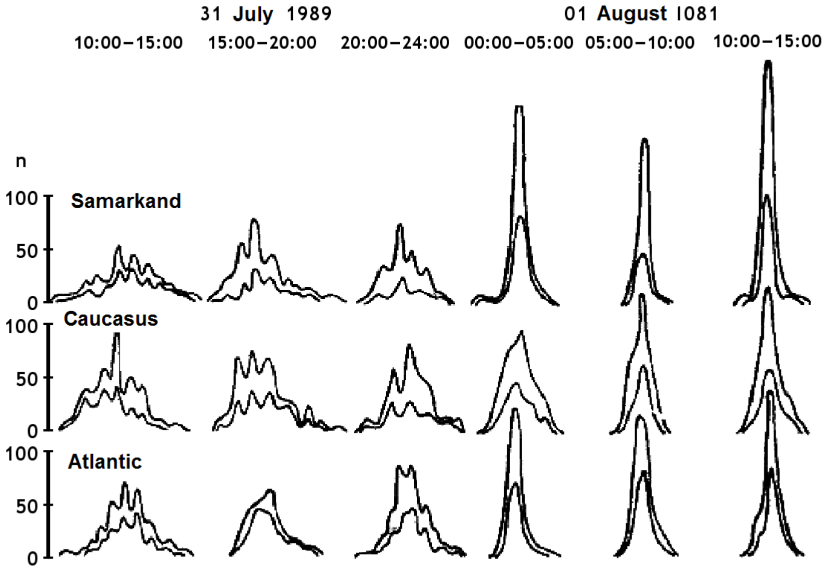

Figure 5-7: Simultaneous changes in histogram shapes constructed from measurements of AA + dichlorophenolindophenol reaction rates at different geographical locations (all around 420 NL): in Samarkand in the North Caucasus (the Art. Sernovodsky) and on a ship on the Atlantic Ocean in the night of July 31 to August 1, 1981 [33].

apparent only after adjusting the time scales.

The most dramatic effect of a solar eclipse was observed by G.I. Zadonsky in Moscow. He obtained two effects [33]: clear changes of the rate and a definite decrease in the amplitude of fluctuations of the Asc/DCPIP reaction. All these changes occurred within hours. We could not achieve a minute-scale resolution at that time, as we do now (see Part 2).

Well, laying the solar eclipse effects aside, we want to stress that we laid our hands on unique material of investigation, namely synchronous changes of the same process for 3 days at 10 geographical points. So we did our best to extract as much as possible from this material.

In addition to the search for correlations between the rate of Asc/DCPIP reaction and various cosmo-physical characteristics, we had got a chance to thoroughly analyze the dependence of the reaction parameters on the time of the day.

As turned out after all normalizations and adjustments, the changes of the mean square amplitude of fluctuations in the course of the day were

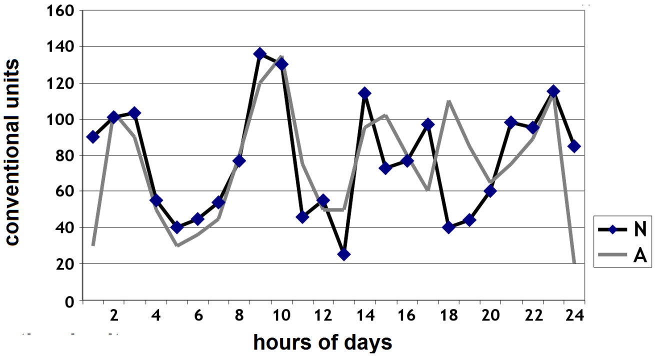

Figure 5-8: Comparison of the dependence on the time of day of the amplitude of the "scatter of results" of measurements of AA + dichlorophenolindophenol (σ) reaction rates and the manifestations of 11 types of diseases of a person (L.Ya. Glybin's data) [33].

very complex. The amplitude was relatively high in the period from 12 p.m. to 3 a.m., after that it began to decline and reached a minimum by between 5 a.m. and 7 a.m., then it grew until a time between 10 a.m. and 11 a.m., sharply fell after 11 a.m. and grew again after 13 p.m. (see Fig. 5-7).

It should be noted that despite an unusually complex character of these changes, the pattern is statistically significant. Every point on this graph was calculated from 1200-1500 measurements.

5.6 Leonid Yakovlevich Glybin (1942–2002)

The pattern I described above had taken on a deeper significance when comparing with the results obtained by *Leonid Yakovlevich Glybin*, who had analyzed, based on a different purpose than ours, 13,000 medical reports. L.Ya. Glybin discovered a strange regularity: the probability of the first symptoms of a disease varies substantially depending on the time of the day. It is maximal in the interval from 12 p.m. to 3 a.m., then decreases sharply in the interval from 4 a.m. to 6 a.m., then grows again and... well, just see our graph in Fig. 5-8. The similarity of L.Ya. Glybin's and our patterns was characterized by a correlation coefficient of 0.37, which implies a confidence probability* of 10^{-3} [116-119].

When Leonid Yakovlevich came to our "cosmo-physical" symposium in 1983, we juxtaposed the two graphs and were strongly delighted. The probability of a disease to manifest itself depends on the physiological state

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*The probability of a correlation to be accidental of the organism, and this state seemed to vary in the course of the day exactly as the amplitude of fluctuations in the Asc/DCPIP reaction did.

L.Ya. Glybin had studied medical and social aspects of his discovery for many years. He came to the conclusion that a "healthy lifestyle" should incorporate this regularity. He petitioned the government to change the basic schedule of social activity: to start workday at 5-6 a.m. and finish it by 2 p.m., to finish TV broadcast by 9 p.m.. . . . His colleagues, specialists in medical biochronology, were very skeptical towards him; he was not even given the floor at professional conferences. He wrote brochures and appeared on television, he submitted and defended his doctoral thesis. He had not been recognized officially and died on June 1, 2002. He deserves a special essay.

Studying the solar eclipse of 1981, we again went "ahead of time". If only we had had personal computers and automatic second-scale measurements of radioactivity. . . . It took us many months to process the data related to the solar eclipse of July 31, 1981.

5.7 Euphoric seasons of 1982–1984

I had managed to return to radioactivity measurements only by January, 1982. We started systematic experiments on comparing the histogram shapes obtained at simultaneous measurements of different processes. By the beginning of 1982, I had been firmly convinced by the reality of the phenomenon, convinced that the fine structure of distributions, i.e., the shape of the corresponding histograms, is not accidental but determined by an "external" cause, which is common to various processes. My belief was strong enough to speak about the phenomenon in a circle of radioactivity specialists, at a meeting of the seminar held by Prof. V.I. Ivanov at Moscow Institute of Physics and Technology (MIPT).

I wanted to set up measurements of α-decay, which is a result of "strong interactions" and which is a priori independent of any terrestrial conditions or of "lepton gas" concentrations. In those years, radioactive β-decay was often believed to depend on the "concentration of leptons", especially neutrinos. In addition, the methods for measuring α-activity made use of low-voltage semiconductor detectors and enabled one to exclude the influence of radioactive background and other similar difficulties.

The seminar meeting was, to put it mildly, emotional. Finally, I said: "Stop yelling at me. I am as much "radioactive" as you are. I came here because I have no α-sources. All I want is to ensure independence from the conditions of measurements, and it is much easier to achieve this with α-decay. Instead of yelling, why don't you just go to the lab and repeat

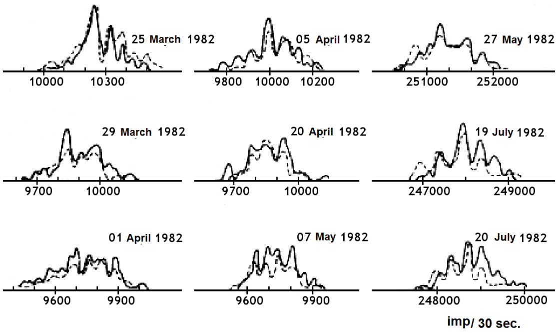


Figure 5-9: Experiments from March 25 – July 20, 1982. The shapes of histograms are similar for synchronous measurements of radioactivity (beta disintegration ^{3}H) (V.I. Bruskov and Yu.G. Ivanchenko) and ascorbic acid and dichlorophenolindophenol reaction rates (S.E. Shnoll, T.Ya. Britsina and N.P. Ivanova). (Fig. 18 from [32]). The x-axes display the results of measurements and the y-axes the number of cases or counts of the corresponding amounts (after smoothing).

our experiment?".

I returned to Pushino and received a late night call that two participants of the seminar, *Nikolay Borisovich Khokhlov* and *Mikhail Petrovich Sharapov*, did go to the lab and had reproduced the effect: they measured α-activity of two ^{239}Pu samples using two independent counters and obtained quite similar histograms. They were lucky as well.

For half a year (since February to July, 1982), we had conducted measurements simultaneously: N.B. Khokhlov and M.P. Sharapov measured α-activity of a ^{239}Pu sample in MIPT, in Moscow; ^{14}C or ^{3}H β-activity was registered in the laboratory of V.I. Bruskov in Pushino; and we measured the rate of Asc/DCPIP reaction in our laboratory.

Fig. 5-9 shows histograms for simultaneous measurements of 3H β-activity and the Asc/DCPIP reaction rate on different days of 1982. Most impressive was the similarity of histograms in the experiments of March 25 and April 5; the more detailed the histograms, the more evident was the similarity. Not all experiments, however, yielded histograms with such a high degree of similarity.

We had obtained a large body of evidence for the main phenomenon, and I presented these results at the Biophysical Congress on July, 1982 (instead of a previously announced report on another subject). My report said that the fine structure of histograms is not random; that it is similar in simultaneously measured diverse types of processes – even at large distances between laboratories; and that this fact indicates the "existence of a common universal cause determining the structure of histograms in the different types of processes".

The spring semester of 1982 (from the January report at MIPT to the July report at the Biophysical Congress) was full of strong emotions. We were excited every time – when once again we saw the similarity of histograms constructed from the simultaneous α- and β-activity measurements in Moscow and Pushino; when the β-activity histograms turned out similar to the Asc/DCPIP ones. The emotional stress was immense, and we also encountered flat rejections of these inexplicable phenomena by highly educated people. On the Physical Faculty of Moscow University, I used to meet the instructor of the atomic practical course B.G. and often had a friendly chat with him at the cafeteria over a cup of tea. The friendship came to an abrupt end when I asked him to give me the non-smoothed results of the radioactivity measurements that the students made every day to illustrate the correctness of the Poisson distribution. "No way," he said, "or I just couldn't pass them on"....

On April 8, 1982, while processing the results of measurements of ^{3}H β-activity and Asc/DCPIP reaction rates of April 5, I got rather agitated. The more detailed histograms I drew, the more similar they became. I called an old friend of mine, the mathematician A.M. Molchanov. "Fantastic! Here, in radioactivity, all is the same as in chemistry".... He interrupted me. "I...shall not...speak with you about radioactivity!". A burst of emotions, and our long friendship ceased....

Indeed, why on earth an educated mathematician should speak with me, a specialist in radioactivity measurements, when all educated people learn thoroughly that radioactivity cannot be affected.... I knew this as well. The matter, however, did not relate to any influence on radioactivity. That was the point my opponents refused to understand. Meanwhile, we were widening the range of processes to study.

Our collaboration with N.B. Khokhlov and M.P. Sharapov continued. They were registering ^{239}Pu α-activity in Moscow, in MIPT; we were working in Pushino, measuring β-activity of various isotopes, Asc/DCPIP reaction rates, the rate of movement of latex particles in the electric field, etc. Fig. 5-10 shows the results of two experiments of this kind, which were performed on February 2 and April 10, 1984.

In the figure, I would like to stress two moments: (1) the shape of histograms rapidly changes with time; (2) these changes occur, in principle, synchronously – in spite of the fact that the nature of the processes

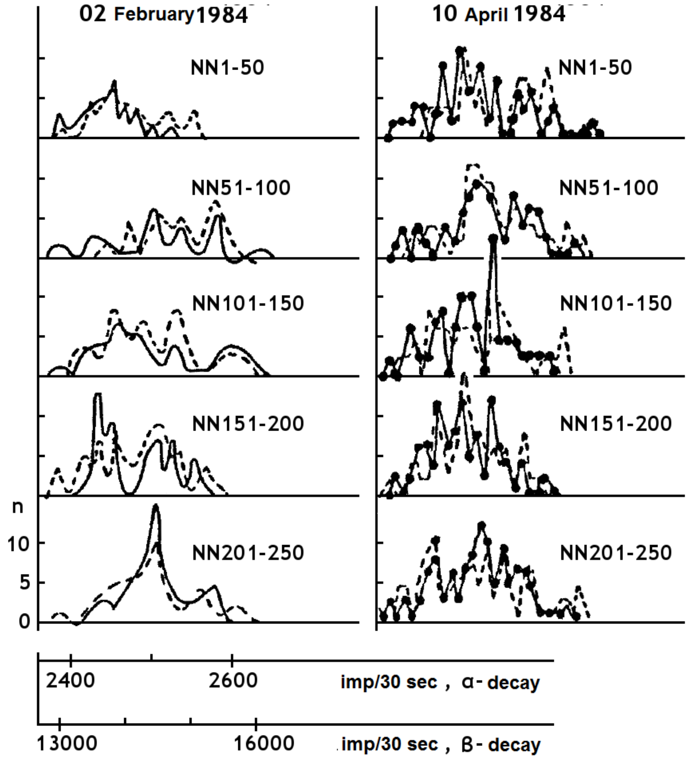


Figure 5-10: Experiments on February 2 and on April 10, 1984. Synchronous changes of histogram shapes, each constructed from 50 results of consecutive measurements of alpha activity of ^{239}Pu in Moscow (MIPhI, N.B. Khokhlov, L.S. Sharapov) and beta activity of ^{14}C in Pushino (V.I. Bruskov, Razhin E.L.). (Fig. 23 from [2, 9]). The average activity (N) of beta disintegration about 144000 imp/30 second and alpha decay about 2500 imp/30 sec. On the x-axes, the amplitude of fluctuations in $\sqrt{N}$ shared are displayed. The y-axes show the number of measurements. In the experiment of 02.02.84, the histograms are smoothed.

measured is different and the distance between them is about 100 km. The synchronous histograms of ^{239}Pu α-activity (Moscow) and Asc/DCPIP reaction rates (Pushino) are also similar (Fig. 5-11).

We obtained an analogous result when comparing ^{14}C β-activity and Asc/DCPIP histograms (Fig. 5-12). L.A. Blumenfeld was very impressed by this figure. He said that after this result, no more evidence for histogram

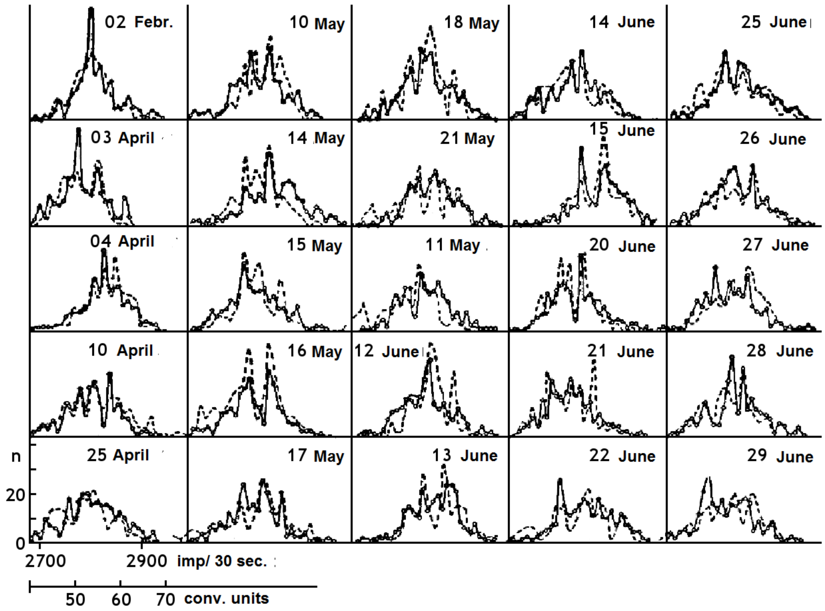


Figure 5-11: The shapes of histograms constructed from the results of 250 synchronous measurements of alpha activity in Moscow (MIPhI, N.B. Khokhlov, L.S. Sharapov) and AA + dichlorophenolindophenol reaction rates in Pushino (S.E. Shnoll, T.Ya. Britsina and N.P. Ivanova) are similar in different days in the year 1984.

similarity in independent processes would have been needed (I, as usual, did not follow his advice. . .).

More and more people became involved in our measurements: V.N. Morozov, A.V. Temnov, A.Yu. Sungurov, L.P. Agulova, D.P. Kulevatsky, G.S. Polubesov, A.V. Matyushin, V.A. Namiot – alongside the persons already mentioned.

Viktor Nikolaevich Morozov suggested to measure the time of discharge latency in a neon-lamp RC generator and immediately assembled the necessary circuit. These are relaxation oscillations: the lamp flashes and the time of the flash delay is determined by the product of capacitance and resistance (RC). The time fluctuates. The histograms constructed from these flash delay data (synchronous measurements) were similar to the Asc/DCPIP and β-activity histograms (Fig. 5-13).

Alexandr Viktorovich Temnov measured the electrophoretic mobility of cells using a high-tech automatic device "Parmaquant". The device au-

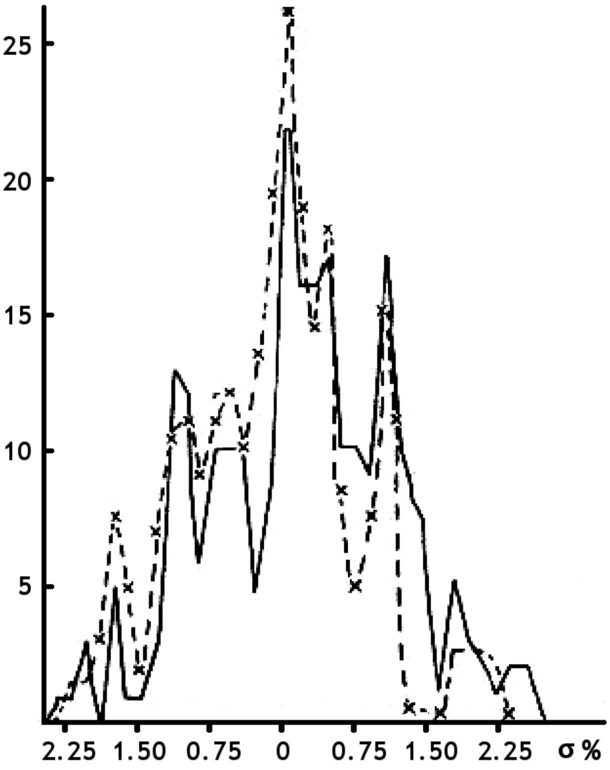


Figure 5-12: The histogram shape does not depend on the type of the process being measured. Beta activity measurements ^{14}C (V.I. Bruskov) and AA + dichlorophenolindophenol reaction rates (S.E. Shnoll, T.Ya. Britsina and N.P. Ivanova). Experiment of July 4, 1984. The x-axes of both processes show theroot-mean-square deviation (σ) (Fig. 19 from [32]).

tomatically registers velocity of cell movement in a constant electric field. When a sample is processed, the polarity of electrodes (and, correspondingly, the direction of cell movement) changes 10 times, and the averaged value of electrophoretic mobility is recorded. To avoid remarks about the complex biological processes involved, I asked A.V. Temnov to replace cells with latex particles. The histograms constructed from the synchronous measurements of electrophoretic mobility, radioactivity and Asc/DCPIP reaction were similar (Fig. 5-13).

Dmitry Pavlovich Kulevatsky – at that time a student of our Department of Biophysics (Physical Faculty MSU) – was doing his graduate work:

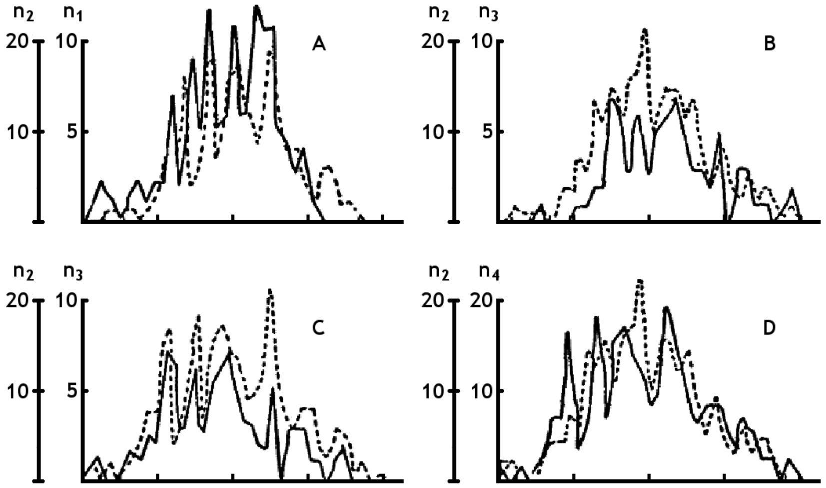


Figure 5-13: The illustration of the similarity of histograms constructed from measurement results of various processes on April 26, 1984. a) – the waiting time of the category of a neon lamp in the RC generator (V.N. Morozov) and electrophoretic mobility of latex particles (A.V. Temnov); b) – the time of a "cross-section" relaxation of protons of T_2 water (Dative Kulevatsky) and beta activity ^{14}C (V.I. Bruskov); c) – the time of a "cross-section" relaxation of protons of T_2 water (Dative Kulevatsky) and electrophoretic mobility of latex particles (A.V. Temnov); d) – electrophoretic mobility of latex particles (A.V. Temnov) and beta activity ^{14}C (V.I. Bruskov).

he was measuring, by the "spin-echo" method, the time of cross-relaxation of T_2 water protons in the alternating magnetic field. He was aware of our works and did not wonder that our measurements revealed a strange "scatter of results". We compared the histograms he obtained with the Asc/DCPIP histograms and, despite only a rough (!) synchronism and a distance of more than 100 km (Moscow-Pushino), found that they were quite similar (Fig. 5-13 and 5-14).

L.P. Agulova, who was working in Tomsk, studied a variety of things and in particular measured the fluctuations of the oscillation amplitude in the BZ-reaction. At first, we did not talk about synchronous measurements. She send me her results and I compared her histograms with ours obtained on the same days (though not synchronously). The picture was impressive (Fig. 5-15).

Alexandr Yurievich Sungurov performed measurements of ^{3}H β-activity in Leningrad, and we synchronously measured the rate of Asc/DCPIP re-

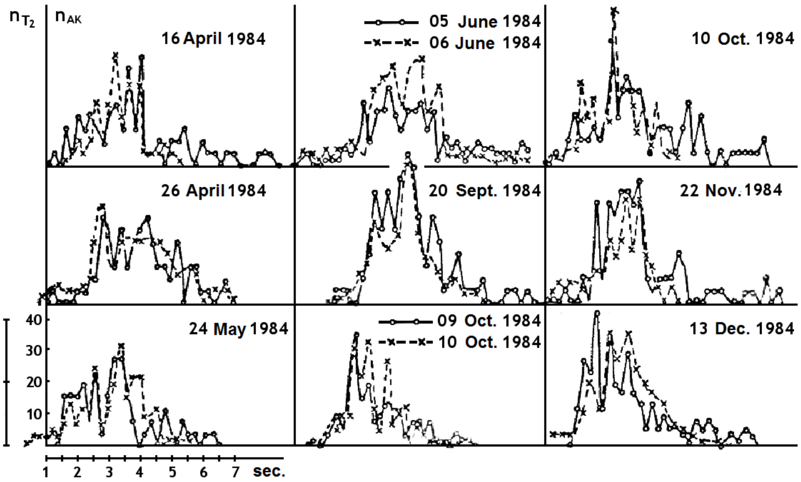


Figure 5-14: The histogram shapes constructed from measurements results in Moscow to the time of backs – spin relaxation T_2 of protons of water (to Dative Kulevatsky) is similar to the histogram shape constructed from the results of measurements in Pushino of the reaction rates of AA + dichlorophenolindophenol (S.E. Shnoll, T.Ya. Britsina and N.P. Ivanova).

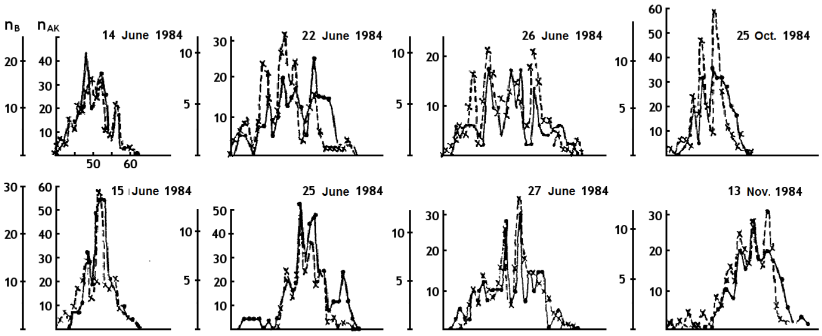


Figure 5-15: Comparison of the histogram shape constructed from the results of measurements in Tomsk of the amplitudes of fluctuations in the Belousov reaction (L.P. Agulov) and measurements in Pushino of AA + dichlorophenolindophenol reaction rates (S.E. Shnoll, T.Ya. Britsina and N.P. Ivanova) on different days in 1984.

actions in Pushino (Fig. 5-16). The expected effect – synchronous by local time change of the shape of histograms in different types of processes at

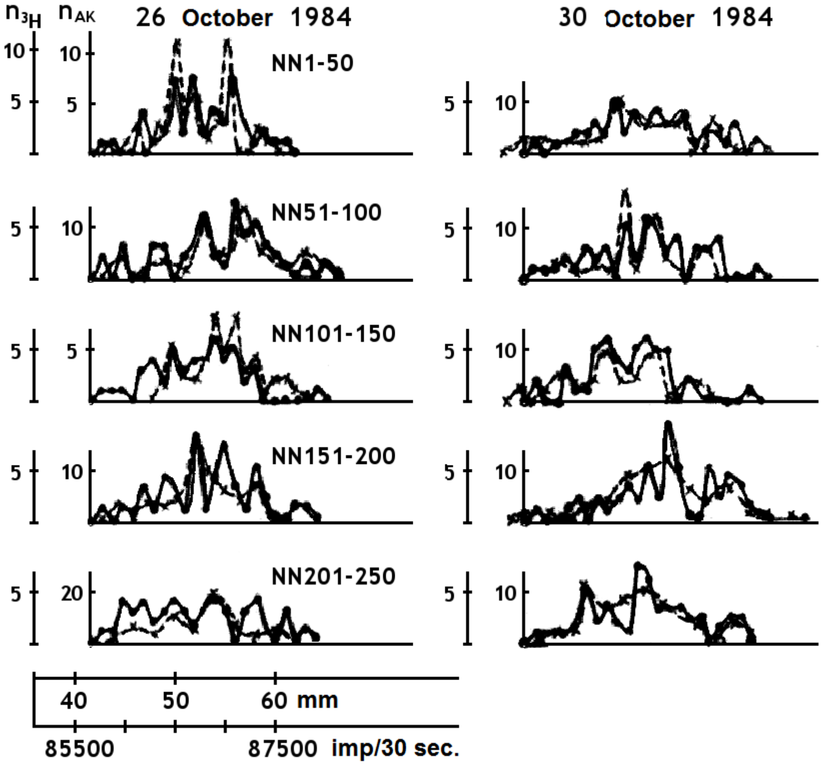


Figure 5-16: Experiments on October 26 and 30, 1984. Synchronous local time measurements of beta activity ^{3}H in Leningrad (59^{o}57' NL and 30^{o}12' EL) (A.Yu. Sungurov) and reaction rates of AA + dichlorophenolindophenol in Pushino (S.E. Shnoll, N.P. Ivanova and T.Ya. Britsina) (Fig. 25 from [32,33]).

distances of more than 600 km – was confirmed, in general. It was also obvious that the effect did not reach 100 %; one could only make statements about a high probability of the histogram shape to change synchronously.

In February 1982, still before our systematic collaborative measurements with N.B. Khokhlov and M.P. Sharapov, I got into contact with Gennady Stepanovich Polubesov from the Laboratory of X-ray Structure Analysis of the Institute of Protein Research (USSR Academy of Sciences). To calibrate the diffraction pictures obtained in the X-ray analysis of proteins, researchers use 5.9- and 6.3-keV X-ray quanta, which accompany the decay of ^{55}Fe by the mechanism of K-capture. Registration of radioactivity by

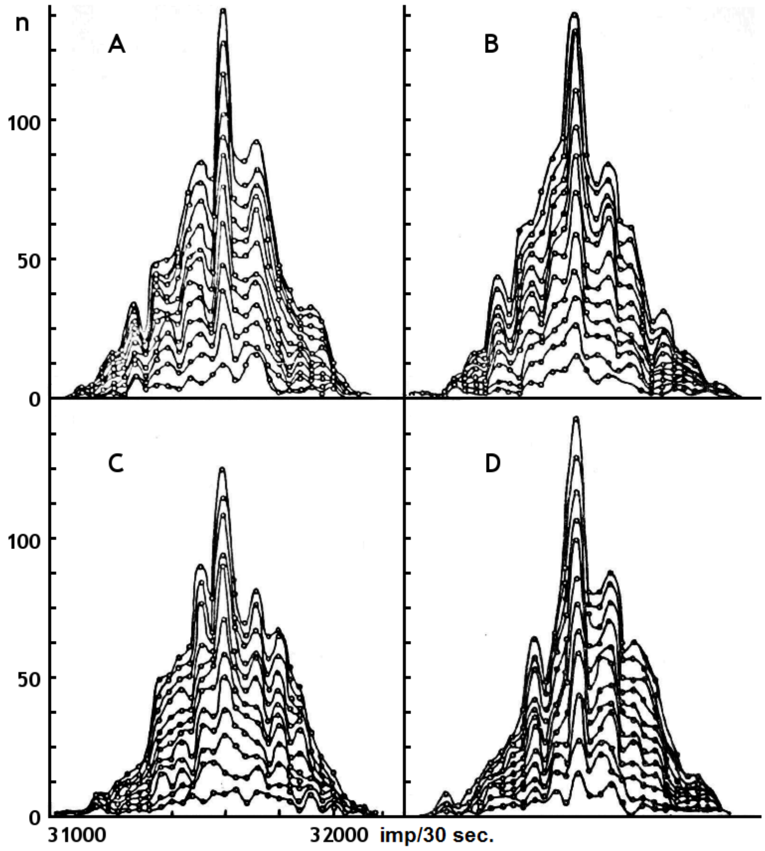


Figure 5-17: The "layered" histograms constructed from the results of measurements of radioactivity ^{55}Fe on 18-22 February 1982. "Layer lines" are drawn after every set of 100 measurements have been added without any shifting or smoothing. On the x-axis, radioactivity in imp/36 seconds is shown and the y-axis shows the number of the measurements of the corresponding value interval of radioactivity. The categories are hardened on 20 imp/36 second. The average activity is about 31500 imp/36 second (Fig. 32 from [32]).

monochromatic quanta, using a high-tech amplitude analyzer Ortex, at constant temperature ensured very "clear" measurements of radioactivity.

For four days, from February 18 to 22, 1982, G.S. Polubesov had been measuring ^{55}Fe radioactivity, with 36-second intervals. The results of these continuous measurements are shown in Fig. 5-17.

The histograms constructed from these non-overlapping time series were astounding. Each histogram included 1200 data points. The persistence of the "idea of shape" that these patterns followed and even more, a clearer and clearer manifestation of this idea as the number of measurements grew – were amazing. The latter seemed to contradict all canons: with the number of measurements increasing, all those jags and notches must have been disappearing. The textbooks on mathematical statistics, though, included special chapters on "statistical inertia" [120], and G.S. Polubesov saw no interest in all this. Yet here inertia was unlikely. Four independent histograms followed the same idea of shape – I thought no inertia could explain this.

For many years, I wished but had no time to consider the likeness of these "stratiform" lines. The likeness increases as the number of measurements grows – the structure is preserved even when the number of measurements reaches hundreds of thousands. I am sure this is not due to "statistical inertia", so I always place such pictures in the papers – for the researchers of the future.

The nature of the processes we studied in 1978-1985 was so diverse (biochemistry, chemistry, electricity, magnetism, β- and α-radioactivity) that we could conclude: the phenomenon is independent of the type of a process. Later on, we added to this list the dark current noise in photomultipliers and, more generally, noises of the electron noise generators, noise in gravitational antenna – this will be discussed in the 2^{nd} part of the book.

The emotional enthusiasm we were embraced with during this period resulted in our works with protein solutions being moved to the background. Many striking and mysterious phenomena remained, unfortunately, "underexplored".

Carried away as we were, we, nevertheless, continued our everyday experiments with the Asc/DCPIP reaction, trying to find regularities in the day-by-day change of the histogram shape and to test the hypothesis on the dependence of the results of measurements on the place in the laboratory ("effect of location or place").

5.8 A long-term experiment in search of the "effect of location"

In the experiments with shields, which led us to the conclusion that the amplitude of fluctuations and the shape of histograms were independent of the shield material, we observed a very high variability of the histogram shape. Yet the histograms we obtained in independent synchronous experiments were similar. Hence, we came to the conclusion that the amplitude of fluctuations and the shape of histograms changed regularly, in response to the effect of external, cosmo-physical factors. To prove the correlation between the amplitude of fluctuations and those factors statistically significant, we were to conduct long-term routine measurements, abiding by the ceteris paribus principle as much as possible.

And such measurements had been conducted – thanks to N.P. Ivanova and T.Ya. Britsina, who did a marvelous job. Every workday morning, at the same time and with a stopwatch in their hands, they started various measurements – and this lasted for about 25 years!

Systematic experiments on the "effect of location" were started on September 30, 1982. The last experiment from this series, no. 529, was performed on March 11, 1985. As mentioned above, these experiments were conducted because there was a supposition that the shape of histograms depended on the place of the solution on the laboratory tables. In the experiments, 5 vessels (each containing a portion of the ascorbic acid solution) were placed at 40 cm distance from each other. From these vessels, we successively (with the same intervals) collected 0.1 ml samples. Each sample was added to the photoelectrocolorimeter cuvette with a DCPIP solution, and the rate of the Asc/DCPIP reaction was measured. The whole series contained 50 samples per vessel. After the experiment, we plotted histograms for each of the 5 places (vessels), as well as one general histogram for all 250 points.

In every experiment, we observed substantial differences between histograms. It was impossible, however, to attribute these differences to the "effect of place" (rather than to a difference in time, for example). The hope to see the effect after summing up all 529 histograms for each place was also shattered – the place-averaged histograms turned out to be similar. However, the primary data with time series remained, and we planned to use them to reveal regularities in the appearance of similar histograms on different days, months and years.

Today, "twenty years later", I again see the naivety of our expectations back then, when we studied the "effect of location". For each location, we could only get one histogram per day. The shape of histograms continuously changes, however. It was impossible to distinguish between changes in time and changes that depended on the location of the solution on the laboratory table. Now, when we measure radioactivity and, especially, fluctuations in noise generators – continuously, twenty-four/seven – we again encountered this problem. We know now that our space-time is highly anisotropic and heterogeneous, so the "effect of location" seems probable. I shall consider this problem in the 2^{nd} part of the book.

On the whole, this work was not fruitless. There remain important things, which can be extracted from the data stored in the laboratory jour-

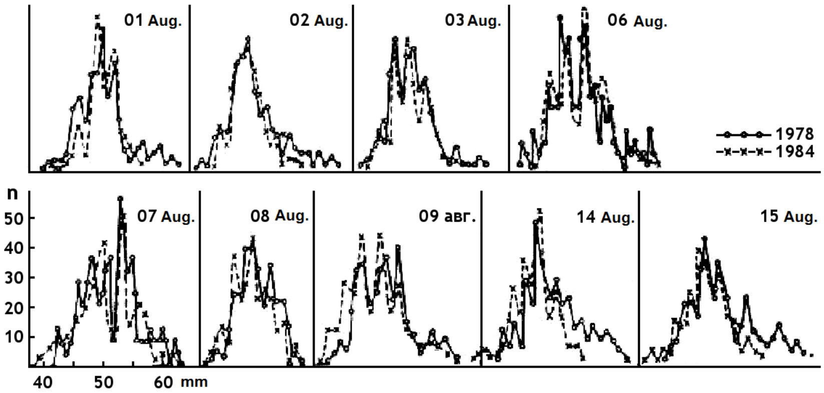


Figure 5-18: Series of similar histograms on the same dates and same hours exactly in 6 years: in 1978 of the measurement of the enzymatic activity of creatine kinase, and in 1984 of the measurements of AA + dichlorophenolindophenol reaction rates. 250 measurements were used to calculate each histogram.

nals and computer archives. One of them is the similarity of histogram shapes on the same days in different years.

The "extraction" is far from being complete. An example of such an "extraction from histograms with time delays between them" is Fig. 5-18, which shows two series of juxtaposed histograms. One series describes everyday measurements of creatine kinase activity of February 1-15, 1978; another corresponds to Asc/DCPIP measurements – on the same days but 6 years later, in 1984. One can see an overall similarity of these histogram series. This means that (1) the shapes of individual histograms are not accidental; (2) there may be a yearly periodicity in the appearance of similar histograms; (3) the shape of histograms does not depend on the type of process studied. "Twenty years later", in 2001–2005, I studied the yearly periodicity of similar histogram appearance in detail. The results are described in the 2^{nd} part of the book.

5.9 Albert Nikolaevich Zaikin. Measurements during sea expeditions

In 1986, V.A. Kolombet and A.S. Dansky consulted by V.N. Shestimirov, N.B. Khokhlov and M.P. Sharapov assembled a portable setup for α-activity measurements. The setup consisted of a semiconductor detector, a portable computing device "BK" and a cassette recorder. The results of measurements were stored on tape cassettes. Now we could conduct continuous

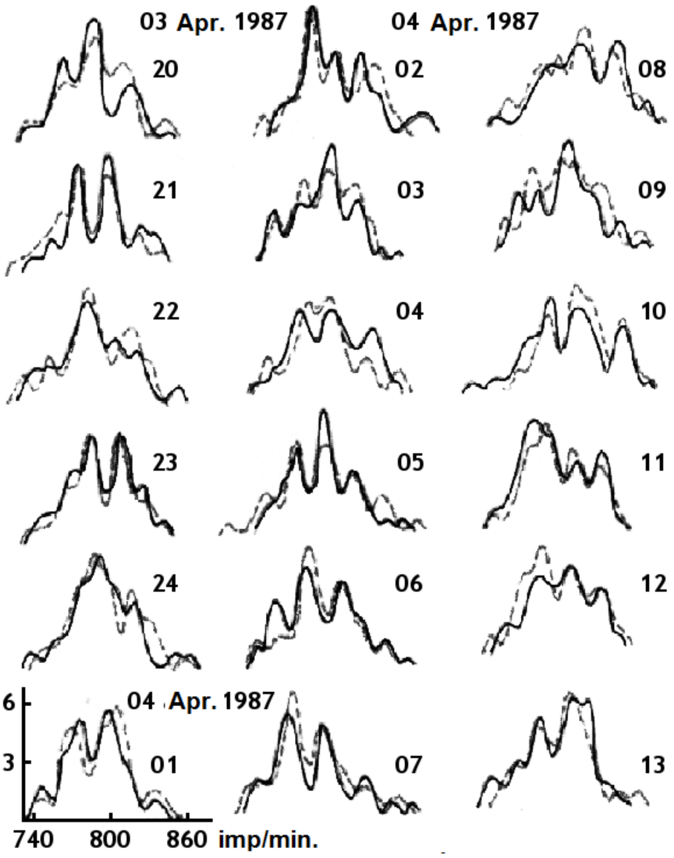


Figure 5-19: Comparison of the histograms constructed from the results of simultaneous measurements of ^{239}Pu alpha activity on 3-4 April 1987 on the ship "Professor Shtokman" on the Pacific Ocean around the Galapagos Islands (0°35' SL, 91° WL) (A.N. Zaikin) and in Pushino (V.A. Kolombet). Histograms are constructed from the results of 60 one-minute measurements (i.e. 1 histogram per hour). The distance between the laboratories was about 12,500 km, which corresponds to a difference in local time of about 9 h and 30 minutes. To the right of each pair, the time of day is specified in Moscow time (from [121]).

measurements lasting over several days during expeditions and transfer the results to laboratory computers later.

In 1987, A.N. Zaikin went on an expedition on the ship "Professor Shtokman" and brought along a portable setup for α-activity measurements. The expedition was organized by the Institute of Oceanology AS USSR. Of all the materials that A.N. Zaikin returned with, the measurements of April 3-4, 1987 (when the ship anchored near the Galapagos Islands) were the most interesting. As seen in Fig. 5-19, there was an evident synchronism in the changes of histogram shapes on the ship and in our Pushino laboratory at that moment. It was amazing – the synchronism by absolute time at a distance of 12,500 km and a difference in local time of 9.5 hours. It was a series of 18 successive histogram pairs.

Now, with many years passed, these results seem even more intriguing. Why should there be a synchronism by absolute time? For all 18 months of measurements obtained during the expedition, we obtained similar results. Apart from the fact that such a synchronism simply downright unbelievable: given the very low probability of coincidental similarity of two histograms, we now would have an estimate based on the product of all 18 probabilities. The probability of an accidental appearance of such a series of similar histograms is vanishingly small ("zerocely zero", in the words of the young ignoramus Mitrofanushka from Fonvisin's "The Minor"). Maybe, this "anomalous" result has something to do with anomalous geological features – there is a "crack", a joint of three oceanic plates in that region of the Pacific Ocean (A.N. Zaikin).

In the following year, 1988, A.N. Zaikin underwent the same expedition once more – now on the ship "Vityaz", sent by the same Institute of Oceanology AS USSR. This time their main destinations were situated in the Indian Ocean, and we again conducted continuous measurements of α-activity on the ship and in Pushino. When we compared the one minute histograms that we had obtained – we did this in our usual way at that time: by drawing them on tracing paper and superimposing them – we again discovered a synchronism in the change of histogram shapes, although not as evident as in the measurements of 1987. We returned to evaluating this data 10 years later, after E.V. Pozharsky had written his "Histogram Manager" software.

5.10 Similar histograms appear with a daily period. Thus, their shapes depend on the axial rotation of the Earth

As mentioned previously already, back then a personal computer was a rarity. Our databank archive of measurement results was stored on the large institute server. You could receive a hard copy of the archived data in the form of histograms printed on large paper sheets. The procedure of histogram comparisons meant redrawing the histograms on sheets of tracing paper with color markers and superimposing these drawings. It was

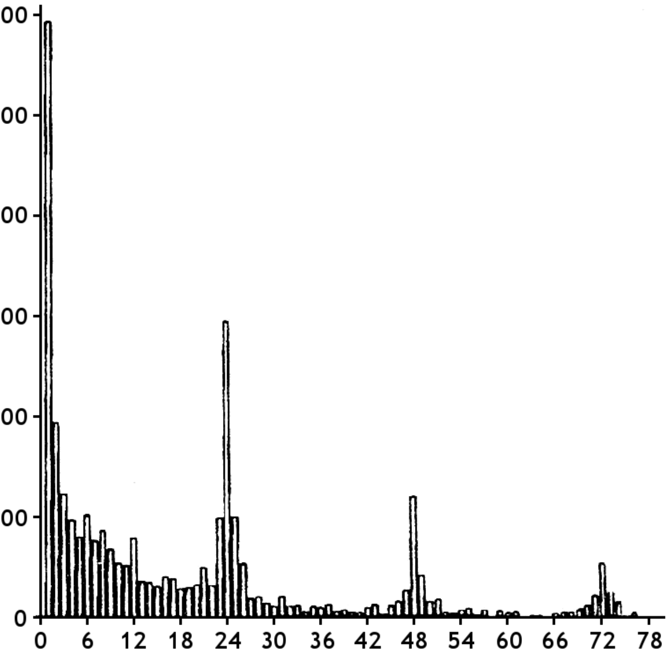


Figure 5-20: Dependence of the probability of histogram shape reoccurrence of histograms constructed from the results of measurements of ^{239}Pu alpha activity, on the size of the interval of time separating them (based on materials of 1986-1992). The x-axis shows intervals (hours) and the y-axis the number of similar pairs corresponding to the respective time interval. The near zone effect and the circadian period [122] is discernible.

a slow and laborious task. However, with the number of results growing larger, you could see general regularities.

In 1992, while being sick and staying at home for two weeks, I had processed the results of ^{239}Pu α-activity measurements over 6 years (1986–1992). The fragments of the databank I processed were long, uninterrupted series of continuous measurements. There were about 60,000 measurement points in total. I constructed 1-hour histograms, and their comparison confirmed, with high significance, the previously observed regularities: a high similarity of neighbor histograms (the "near-zone effect") and an evident close to one-day periodicity in the appearance of similar histograms (Fig. 5-20) [122].

Following from the picture, another conclusion took shape, namely the shape of histograms depended on the rotation of the Earth about its axis. This would also explain the synchronism in the appearance of similar histograms at different geographical points at the same local time, which we observed in a number of experiments. A striking example of such a synchronism is histograms constructed from the results of ^{239}Pu α-activity measurements from a ship on the Indian Ocean (A.N. Zaikin) and in our laboratory in Pushino (V.A. Kolombet) in the year 1988. After E.V. Pozharsky had written his "Histogram Manager" software, we analyzed these results once more and confirmed the conclusion obtained earlier (all details can be found in the 2^{nd} part of the book).

5.11 A possible correlation of histogram shape with the location of the Moon on the horizon

In August 1986, accompanied by the students of the Biophysics Department of the Physical Faculty of MSU, I went (as usual) to the Belomorskaya Biological Station (BBS MSU) and took along a very handy, portable α-counting setup constructed by A.S. Dansky and V.A. Kolombet. The setup included a semiconductor detector, a scaling microcircuit, a small TV, a computing device "BK" and a cassette recorder. Naturally, life on a sea shore will always adjust to the ebb and flow, high tide and low tide. Twice a day, huge water masses approached the laboratory, remaining on the shore of the Great Salma Strait. Tides are, of course, related to the Moon phases, and one day I experienced an "intuitive brain wave": why not examine the changes of the histogram shape during ebbs and flows? The procedure was easy: you just look outside to check the tide and the Moon position and then quickly build a ^{239}Pu α-activity histogram.

The simplest way to do it was to compare histograms at the moments of moonrise: the Moon appeared above the horizon, and the monitor showed the current histogram. These were not "momentary histograms", of course: I constructed histograms from 60 one minute measurements, i.e., the total time contained in a histogram was an hour. I found an obvious similarity between moonrise histograms.

When I came back home, I compared these BBS histograms with the moonrise histograms obtained in Pushino (the time of moonrise at the BBS and in Pushino is different). The histograms, nevertheless, turned out to be similar. Furthermore, I found a similarity between histograms from the moments of moonrise and the following moonset. The conclusion on the correlation between the shape of α-radioactivity histograms and the location of the Moon on the horizon is easy prey for "opponents of pseudoscience". I imagined how sarcastic and supercilious they would be if the rumor were to reach their ears. Luckily, they did not notice a small, in volume and print, report about these results published in 1989 in Biofizika (thank you to the editors!) [123] and later as an addition to our book (with N.V. Udaltsova and V.A. Kolombet) published in 1987 [33]. In that report, we together with N.V. Udaltsova carried out a statistical analysis and applied criteria of histogram similarity that she and V. Karpov had developed. Our conclusion was that the similarity of histograms obtained during the same location of the Moon on the horizon is not accidental and the confidence level of the conclusion is high enough.

A quantitative estimate of histogram similarity was made on the basis of a correlation criterion R suggested by N.V. Udaltsova and an empirical criterion T put forward by V. Karpov. The correlation criterion R was calculated for two histograms after a corresponding normal distribution was subtracted from each of them.

The R- and T-related 90-percent confidence intervals ($\mathsf{R} > \mathsf{R}_{0.9} = 0.51$ and $\mathsf{T} < \mathsf{T}_{0.9} = 2.3$) were determined for distributions of all the correlation coefficients obtained from comparing all possible histogram combinations.

The Karpov criterion was developed in an attempt to account for the particulars and peculiarities of histogram shapes.

Today I can only describe a general train of thought in the development of this criterion. The first thing assessed by an expert is the "general appearance" of histograms: similarity of the maximally smoothed shapes, their symmetry and skewness to the right or left. Then the number of "evident" extrema is taken into account, this following by evaluating the distance between them and the relative height of peaks and depth of hollows. A certain "weight" was assigned to each of these factors, and the sum of all the estimates provided the value of the criterion. The most difficult step was the adjustment of those "weights". Given necessary modifications, this criterion could be incorporated into an algorithm for automatic histogram comparison. Unfortunately, the work had not been completed aince V. Karpov moved to the USA.

The way that Fig. 5-21 is represented was changed, but the figure was derived from that paper. As an example, the figure shows eight superposed pairs of 1-hour histograms constructed from the results of ^{239}Pu α-activity measurements, which were conducted in Pushino during Moon rises and sets from May to June 1986.

Explanations for Fig. 5-21:

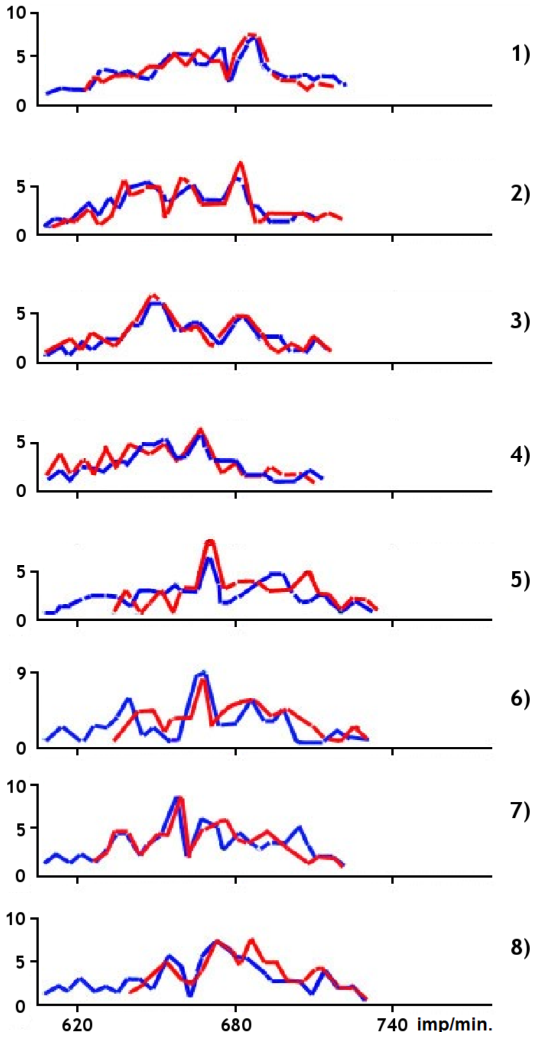


Figure 5-21: An illustration of the similarity of individual histogram records constructed from 60 measurement results at one-minute frequency of ^{239}Pu alpha activity in Pushino in May-June 1986, during rises and subsequent sets of the Moon. Correlations coefficient values were calculated by N.V. Udaltsova after subtracting the normal distribution are specified also. In five of eight cases, the similarity is discernible after one histogram was mirror inverted [32, 123].

1. 27 May 1986. Moonrise from 1 h 30 minutes to 2 h 30 minutes (the corresponding calendar time was 1 h 57 minutes). The Moonset occurred from 6:30 a.m. to 7:30 a.m. (calendar time: 7:35 a.m.). R=0.55; T=1.8. Histograms were combined through visual comparison. The similarity was assessed by the criteria of the idea of shape corresponding and the approximate goodness of fit.
2. 28 May 1986. The Moon rose between 1:30 a.m. and 2:30 a.m. (in calendar time: 2:47 a.m.). The Moon set from 8:30 a.m. to 9:30 a.m. (in calendar time: 9:11 a.m.). R=0.53; T=0.5. Histograms were again paired by visual comparison.
3. 29 May 1986. Moonrise at 2:30 a.m. to 3:30 a.m. (calendar time: 2:45 a.m.). Moonset from 10:30 a.m. to 11:30 a.m. (calendar time: 10:46 a.m.). R=0.72; T=0.9. Histogram pairs were formed by the method of visual comparison.
4. 3 June 1986. Moonrise from 2:30 a.m. to 3:30 a.m. (calendar time: 3:20 a.m.). Moonset from 16:30 to 17:30 (calendar time of 17 h. 37 minutes). R=0.46; T=2.7. By the criteria and according to Udaltsova and Karpov, the similarity is weak. “Approximate” similarity is satisfactory.
5. 4 June 1986. Moonrise from 2:30 p.m. to 3:30 p.m. (calendar time: 3:27 a.m.). Moonset from 18:30 to 19:30 (calendar time: 18:55). R=0.47; T=1.4. Different criteria have been used in the assessment.
6. 5 June 1986. Moonrise from 2:30 to 3:30 (calendar time: 3:35). Moonset from 19:30 to 20:30 (calendar time: 20:15). R=0.57; T=1.0. Histograms were paired by visual comparison. The statistical criteria rated the histogram similarity as high and the visual assessment classified the similarity as weak.
7. 6 June 1986. Moonrise from 3:30 to 4:30 (calendar time: 3:53). Moonset from 19:30 to 20:30 (calendar time: 21:26). R=0.41; T=2.2. Histograms were paired visually. According to the visual assessment the similarity is satisfactory.
8. On June 11, 1986 the moonrise from 6:30 to 7:30 (calendar time: 7:25). Moonset from 0:30 to 1:30 (calendar time: 1 h 14). R=0.44; T=2.2.

The figure legend states the exact date and time of the measurements (and the time of rises and sets in brackets). The correlation coefficients calculated by N.V. Udaltsova after subtraction of normal distributions are also given. In five out of eight cases, histograms remain similar after a mirror rotation of one of them [32, 123].

Even at that time, I understood the “naivety” of this work. The time frames of moonrises and moonsets were determined very roughly, “using a tear-off calendar”. The histograms were constructed on the basis of 60-minute time segments. The “objective” criteria of similarity were imperfect and needed improvement. The “impression” of visible similarity was, however, very strong. It seemed that only a little while was required until the criteria would have been improved and the problem of the automated histogram comparing would have been solved. About 20 years passed, and we came only a bit closer to the solution. Those years were full of many hundreds of moonrise and moonset histogram comparisons. We described a great many examples of amazing similarity of complex shapes – so complex that one could hardly imagine this similarity to be merely accidental (see the 2^{nd} part of the book).

In the end, we did not find a definite relation between the shape of histograms and the location of the Moon or Sun on the horizon. This will be described in the 2^{nd} part of the book.

Back then, in our old paper, we came to the following conclusion:

> “. . . changes of the histogram shape in time reflect changes of the 'gravitational situation', the most essential component of which is the position of the Moon towards the Earth and the Sun”.

This conclusion became a foundation for one of the main programs of my research over the next decades.

Chapter 6.

Results of our studying "macroscopic fluctuations" in the years 1951–1997

These results were briefly outlined in the Preface. In most of the cases described in the chapters above, I followed a similar course of our experimental work, which ultimately led to the final conclusions of this part of the book. Many aspects of our investigations are incomplete. It is obvious that we had conducted experiments for many years that in fact could not answer the questions raised. On the other hand, some directions of research were closed when important results still could be obtained (the experiments with protein solutions, with the "seed", with synchronous fluctuations in macro-volumes of solutions). Well, one cannot help it. We have only one life. And with all the imperfection of our experiments, by 1997 we had enough grounds to say that the regularities of the "scatter of results", which accompanies measurements of many types of processes, reveal marvelous things. They manifest some fundamental features of our world. Here is a brief list of them.

1. The amplitude of the "indestructible", or let's call it persistent scatter of results is a fundamental characteristic of different types of processes.
2. The fine structure of histograms is not casual, does not depend on the type of process studied and is determined by both a purely arithmetical and an external cosmo-physical (cosmogonic) cause.
3. At different geographical points, the shape of histograms changes synchronously in the respective local (and sometimes according to the absolute) time.
4. The histograms of near (neighbor) time intervals are similar in shape (the "near zone" effect).
5. There is a high probability of histogram similarity with close to one-day, close to one-month and, possibly, yearly periods.
6. There is a high probability of histograms to be reflection symmetric. Chirality is a basic feature of our world.

The only common factor for all the various processes we experimented with was their occurrence in the same space-time continuum. We conjectured that – we deal with space-time fluctuations caused by the inhomogeneity of gravitational fields.

Further development and proving of these conclusions became possible after Edwin Vladimirovich Pozharsky created, in 1997, an amazingly useful computer program, the so-called "Histogram Manager" (see the 2^{nd} part of this book). With this program, we increased the efficiency of our work by tenfold, and so began a new period of our research.

The results of our investigations in the period 1997-2008 are the subject of the 2^{nd} part of this book.

End of the 1st *part*

References of Part I

1. Shnoll, S.E., Kondrashova, M.N., Shol'ts Kh.F., Multiphase changes of the ATP-ase activity of actomyosin and myosin preparations under the influence of different factors, `http://www.ncbi.nlm.nih.gov/pubmed/13423141`, *Issues on Medical Chemistry (Voprosy medizinskoi himii)*, 3(1): 54–64, (in Russian).
2. Shnoll, S.E., A spontaneous synchronous conversion of actomyosin molecules in a solution from one state into another. *Issues on Medical Chemistry (Voprosy medizinskoi himii)*, 1958, 4(6):443–54, (in Russian).
3. Shnoll, S.E., Rudneva, O.A., Nikol'skaya, E.L., Revel'skaya, T.A. Changes of amplitudes of actomyosin preparation voluntary alterations at storage of preparations. *Biophysics*, 1961, v. 6, iss. 2, pp. 165–171, (in Russian).
4. Shnoll, S.E., Alterations of ATP-ase activity of actomyosin solutions. Theses of the 5^{th} International Biochemical Congress, Moscow, 1961, (in Russian).
5. Shnoll, S.E., Spontaneous complex alterations of actomyosin preparations, Theses of the 1st All-Union Biochemical Congress, iss. 1, 1964, (in Russian).
6. Shnoll, S.E., Smirnova, N.A., Oscillations of SH-groups concentrations in solutions of actomyosin, actin and myosin. *Biophysics*, 1964, v. 9, iss. 4, pp. 532–534, (in Russian).
7. Shnoll, S.E. Synchronous conformational oscillations of actin, myosin and actomyosin molecules in solutions, In: Molecular biophysics, Nauka, Moscow, 1965, pp. 56–81.
8. Shnoll, S.E. Non-specific multiphase dependence of amplitudes of actomyosin complex proteins conformational oscillations from various effects, in digest: *Biophysics of muscle contractions*, Nauka, Moscow, 1966, pp. 269-272, (in Russian).
9. Shnoll, S.E. Conformational oscillations of macromolecules, In: *Oscillation processes in biological and chemical systems*, Nauka, Moscow, 1967, pp. 22–41, (in Russian).
10. Shnoll, S.E. Effect of light and environmental properties of actomyosin. *Biophysics*, 1968, v. 13, iss. 5, pp. 853–858, (in Russian).
11. Kalinichenko L.P., Khristova M.L., Shnoll, S.E. Effects of aliphatic alcohols on amplitudes of myosin conformational oscillations and on

the rate of mitochondrial oxygen consumption, In digest: *Properties and functions of macromolecules and macromolecular systems*, Nauka, Moscow, 1969, pp. 89–106, (in Russian).

12. Shnoll S.E., Spontaneous reversible changes (conformational oscillations) of muscle proteins preparations, Doctoral theses, Pushino, Institute of Biophysics Academy of Sciences USSR, 1969, (in Russian).
13. Shnoll, S.E. Synchronous in macrovolume oscillations of ATP-ase activity in actomyosin concentrated preparations, In: Oscillation processes in biological and chemical systems, v. 2, Pushino, 1971, p. 22, (in Russian).
14. Shnoll, S.E. Conformational oscillations in solutions of actomyosin complexes proteins, Theses of 1st International Biophysical Congress, Moscow, August, 1972, (in Russian).
15. Shnoll S.E. Conformational oscillations in proteins macromolecules. In: *Biol. and Biochemical Oscillators*. E. Chance, Ed., Acad. Press, N.Y. 1973, pp. 667–669.
16. 16, Shnoll S.E. and Kolombet V. A. Macroscopic fluctuations and statistical spectral analysis and the state of aqueous protein solutions. In: *Sov. Sci. Rev.*, V.P. Skulachev, Ed., OPA, N.Y., 1980.
17. Kolombet, V.A., Britsina, T.Ya., Ivanova, N.P. and Shnoll S.E. Spectrum of macroscopic fluctuations of enzymatic activity of creatine kinase. *Biofizika*, 1980, v. 25, iss. 2, pp. 213–217, (in Russian).
18. Shnoll, S.E., Ivanova, N.P., Britsina, T.Ya. and Kolombet, V.A. Dependence of spectra of macroscopic fluctuations of creatine kinase enzymatic activity from pH of protein solution. *Biofizika*, 1980, v. 25, iss. 2, pp. 218, (in Russian).
19. Shnoll, S.E., Kolombet, V.A., Ivanova, N.P. and Britsina, T.Ya. Macroscopic fluctuations as common property of aqueous solutions of different enzymes and other substances. Statistical analysis of macroscopic fluctuations. *Biofizika*, 1980, v. 25, iss. 3, pp. 409–416, (in Russian).
20. *Proceedings of All-Union Symposium on Oscillation Processes in Biological and Chemical Systems*, Pushino-on-Oka, March 21-26, 1966, G.M. Frank, Ed., Nauka, Moscow, 1967. (in Russian).
21. Deshcherevskii, V.I., Zhabotiniskii, A.M., Sel'kov E.E., Sidorenko, N.P., Shnol., S.E. Oscillating biological processes at the molecular level. *Biofizika*, 1970, 15(2), pp. 225–34. Review, (in Russian).

22. Chetverikova, E.P. Variations in the activity of creatine kinase isolated from skeletal muscles. *Biofizika*, 1968, 13(5), pp. 864–9, (in Russian).
23. Chetverikova, E.P. Existence of several states of creatine kinase in solution, differing in enzymatic activity, *Biofizika*, 1971, 16(5), pp. 925–8, (in Russian).
24. Rybina, V.V., Chetverikova, E.P. Reactivity and oscillations of creatine kinase sulphydryl groups, In: *Oscillation processes in biological and chemical systems*, v. 2, Pushino, 1971, pp. 29–32, (in Russian).
25. Chetverikova, E.P. Oscillations in muscle creatine kinase activity. In: *Biological Biochemical Oscillators*, B. Chance, Ed., AP, 1973, pp. 347–362.
26. Shnoll, S.E. and Chetverikova, E.P. Synchronous reversible alterations in enzymatic activity (conformational fluctuations) in actomyosin and creatine kinase preparations. *Biochem. Biophys. Acta*, 1975, v. 403, pp. 89–97.
27. Shnoll, S.E., Chetverikova, E.P. and Rybina, V.V. Synchronous in macrovolume conformational oscillations in preparations of actomyosin complex proteins and in creatine kinase solutions, in digest: *Molecular and Cellular Biophysics*, Nauka, Moscow, 1977, p. 79–92, (in Russian).
28. Chetverikova, E.P., Shnoll, S.E. and Rybina, V.V. Uniformity of type of conformational oscillations of actomyosin complex and creatine kinase proteins macromolecules, in digest: *Biophysical grounds and regulations of muscle contraction processes*, Nauka, Moscow, 1977, p. 52–57, (in Russian).
29. Shnoll, S.E. Cosmophysical oscillations of chemical and biological reactions rates, *Proceedings of the 1st All-Union Biophysical Congress*, Nauka, Moscow, 1982, p. 119–120, (in Russian).
30. Shnoll, S.E., Namiot, V.A., Zhvirblis, V.E., Morozov, V.N., Temnov, A.V., Morozova, T.Ya. Possible generality of macroscopic fluctuations of biochemical and chemical reaction rates, cell electrophoretic mobility and fluctuations in measurements of radioactivity, optical activity and flicker noises. *Biofizika*, 1983, 28(1):153–6, (in Russian).
31. Shnoll, S.E., Namiot, V.A., Khokhlov, N.B., Sharapov, M.P., Udaltzova, N.V., Dansky, A.S., Sungurov, A.Yu., Kolombet, V.A., Kulevatsky, D.P., Temnov, A.V., Kreslavskaya, N.V. and Agulova, L.P. Discrete amplitude spectra (histograms) of macroscopic fluctuations

in processes of different nature. Preprint, ONTI NCBI, Pushchino, 1986, (in English).

32. Shnoll, S.E., Macroscopic fluctuations with discrete amplitudes distribution in various natures processes, in digest: *Scientific and technical summary, Molecular biology*, V.P. Skulachev, ed., 1985, v. 5, VINITI, Moscow, p. 130–200, (in Russian).
33. Udaltzova, N.V., Kolombet, V.A., Shnoll, S.E. Probable cosmophysical nature of macroscopic fluctuations in processes of different nature. ONTI NCBI AN SSSR, Pushchino, 1987, p. 96, (in Russian).
34. Shnoll, S.E., Kolombet, V.A., Udaltzova, N.V. and Bodrova N.B. Discrete macroscopic fluctuations in processes of different nature. *Biofizika*, 1989, v. 34(4), pp. 711–722, (in Russian).
35. Shnoll, S.E., Heroes, villains and conformists of Russian science, Kronpress, Moscow, 2001, pp. 588–593 and pp. 766–770, (in Russian).
36. Shnoll, S.E., Chernavsky D.S., Khurgin, U.I. Molecule of protein-enzyme as a mechanical system, in digest: *Oscillating processes in biological and chemical systems*, Nauka, Moscow, 1967, pp. 42–50, (in Russian).
37. Chernavsky, D.S., Khurgin U.I., Shnoll, S.E. On recoverable deformations of protein-enzyme. *Molecular biology*, 1967, v. 1, pp. 419–424, (in Russian).
38. Biological clock (collected articles), Mir, Moscow, 1964, (in Russian).
39. Belousov, B.P., Periodic reaction and its mechanism. In: *Collection of abstracts on radiation medicine*, 1958, Medgiz, Moscow, 1959, pp. 145–147, (in Russian).
40. Lotka, A.J. Contribution to the theory of periodic reactions. *J. Phys. Chem.*, 1910, v. 14, p. 271.
41. Andronov, A.A., Vitt, A.A., Khaykin, S.E., Theory of oscillations, Fizmatgiz, Moscow, 1959, (in Russian).
42. Lazarev, P.P., Investigations on ionic theory of excitation, Moscow, 1916, (in Russian).
43. Salnikov, I.E. Towards theory of periodic homogenous chemical reactions, PhD theses, Gorky university, 1948, (in Russian).
44. Salnikov, I.E. Thermokinetic oscillations are interdependent oscillations of reagents temperature and concentrations in a homogenous chemical system (Towards the semicentenary of introduction of this concept by D.A. Frank-Kamenetsky). *Journal of Physical Chemistry*, 1998, v. 72, iss. 7, pp. 1193–1195, (in Russian).

45. Salnikov, I.E. At the sources of the theory of chemical autooscillations, In: *Dynamics of systems; dynamics and optimization*. Interacademic collection of scientific papers, Nizhniy Novgorod, 1992, (in Russian).
46. Frank-Kamenetsky, D.A. Periodic processes in kinetics of oxidation reactions, *Proceedings of USSR AS*, 1939, v. 25, p. 9, (in Russian).
47. Frank-Kamenetsky, D.A. Periodic chemical processes *Uspekhi Khimii*, 1941, v. 10, p. 373, (in Russian)
48. Frank-Kamenetsky, D.A., and Salnikov, I.E. A note on the possible autooscillations in a homogenous chemical system at second-degree autocatalysis, *Journal of Physical Chemistry*, 1943, v. 17, p. 79, (in Russian).
49. Shemyakin, F.M., Mikhalev, P.F. Physico-chemical periodic processes. USSR AS Press, Moscow-Leningrad, 1938, (in Russian).
50. Zhabotinsky, A.M., Periodic oxidation of malonic acid in the solution (study of the Belousov reaction kinetics), *Biofizika*, 1964, v. 9, p. 306–311, (in Russian).
51. Zhabotinsky, A.M., Concentration autooscillations, Nauka, Moscow, 1974, (in Russian).
52. Oscillations and traveling waves in chemical systems. R.J. Field and M. Durger, eds., John Wiley and Sons, N.Y., 1985.
53. *Proceedings of All-Union Symposium on Oscillation Processes in Biological and Chemical Systems*, Pushino-on-Oka, March 21-26, 1966, G.M. Frank, ed., Nauka, Moscow, 1967, (in Russian).
54. Nasonov, D.N. and Alexandrov, V.Ya. Response of a live substance on external effects, Moscow - Leningrad, 1940, (in Russian).
55. Shnoll, S.E. Multiphase character of protein properties changes caused by weak effects (incorporation of labeled aminoacids by a protein as an index of protein molecules state). In: *Use of radioactive isotopes in clinical and experimental studies*, V.K. Modestov, ed., Moscow, 1958, pp. 199–208, (in Russian).
56. Shnoll, S.E. and Grishina, V.I. Complex periodic nature of changes of various blood substances concentrations. *Biofizika*, 1964, v. 9, iss. 3, pp. 367–381, (in Russian).
57. Danilov, Yu.A. Lectures on nonlinear dynamics, ComKniga, Moscow, 2006, (in Russian).
58. Borodin, S.I. System of a Laboratory Automation Devices (SALAD), In: *2nd All-Union Conference on complete integrated automation and*

mechanization of chemical and pharmaceutical production processes, February 5-7, 1974, MinMedProm Press, Leningrad, 1974, p. 54, (in Russian).

59. Kalinichenko, L.P., Khristova, M.L., Shnoll, S.E. Effects of aliphatic alcohols on amplitudes of myosin conformational oscillations and rate of mitochondrial oxygen consumption. In: *Properties and functions of macromolecules and macromolecular systems*, Nauka, Moscow, 1969, p. 89–106, (in Russian).
60. Roginsky, S.Z. and Shnoll, S.E. Isotopes in biochemistry, USSR AS Press, Moscow, 1963, (in Russian).
61. Roginsky, S.Z. and Shnoll, S.E. Possible explanation of anomalous biological isotope effects observed in D_2O and H_2O. *Proceedings of US Acadey of Sciences*, 1961, v. 137, pp. 706–709, (in Russian).
62. Shnoll, S.E. Effect of light and properties of the external medium on the amplitude of conformatiinal oscillations of actomyosin. *Biofizika*, 1968, 13(5):853–8, (in Russian).
63. Rybina, V.V. Oscillations of sulfhydryl groups titers in protein solutions, PhD theses, Pushino, Institute for Biophysics of USSR AS, 1979, (in Russian).
64. Rybina, V.V., Shnoll, S.E. Synchronous conformational oscillations in the titer of sulfhydryl groups in protein solutions. Reversible oxidation as a possible cause of this phenomenon. *Biofizika*, 1979, 24(6):970–6, (in Russian).
65. Sokolovsky, V.V., On biochemical mechanism of live organisms response on change of solar activity. In: *Problems of cosmic biology*, 1982, v. 43, pp. 180–193, (in Russian).
66. Sokolovsky, V.V., Accelerated oxidation of thiol compounds at increase of solar activity. In: *Problems of cosmic biology*, 1982, v. 43, p. 194–197, (in Russian).
67. Piccardi, G. The chemical basis of medical climatology. Charles Thomas, ed., Springfield (US), 1962, p. 146.
68. Agulova, L.P. Effect of weak magnetic fields on agglutination of typhoid bacteria (in vitro) and Belousov-Zhabotinsky autooscillation chemical reaction, PhD theses (biology), Pushino, 1985, (in Russian). Papers in *Biofizika* 1992, 1995, 1998 and 2004, (in Russian).
69. Opalinskaya, A.M. and Agulova, L.P. Effects of natural and artificial EMF on physico-chemical and basic biological systems, Tomsk University Press, Tomsk, 1984, (in Russian).

70. Opalinskaya, A.M. Correlation of Piccardi reaction and bacterial agglutination with cosmo-gelio-physical factors. Electromagnetic fields as possible mediators of the correlations. PhD theses, IBPh, Pushino, 1985, (in Russian).
71. Capel-Bout, C. Environmental factors responsible for oscillation phenomena. Difficulties that scientific community experience trying to realize related facts, *Biofizika*, v. 40, iss. 4, p. 732–736.
72. Presman, A.S. Electromagnet fields and live nature, Nauka, Moscow, 1968.
73. Klassen, V.I. Magnetization of water systems, Second edition, revised and supplemented, Khimia, Moscow, 1982, (in Russian).
74. Volkenstein, M.V. Pseudoscience Tratise, *Chemistry and Life*, 1975, iss. 10, (in Russian).
75. Temuryanz, N.A., Vladimirsky, B.M., Tishkin, O.G. Super low-frequency electromagnetic signals in biological universe, Naukova dumka, Kiev, 1992; papers in *Biofizika* 1992, 1995, 1998 and 2004, (in Russian).
76. Zinchenko, S.Iu., Danilov, V.I. Sensitivity of biological objects to the effects of the geomagnetic field. *Biofizika*, 1992, 37(4):636-42; other papers of V.I. Danilov et al. in *Biofizika* 1992, 1995, 1998 and 2004, (in Russian).
77. Chizhevsky, A.L. Physical factors of history, Kaluga, 1924, (in Russian).
78. Chizhevsky, A.L. Earth echo of solar storms, Mysl', Moscow, 1976, (in Russian).
79. Golovanov, L.V. The nature is so harmonic, Mysl', Moscow 1977, (in Russian).
80. Shnoll, S.E. Geliobiology: since Chizhevsky till now. New knowledge through barriers of the Past, *Priroda*, 1994, iss. 9, p. 3–14, (in Russian).
81. Vladimirsky, B.M. Solar activity and biosphere: interdisciplinary problem, *Priroda*, 1994, iss. 9, p. 15–19, (in Russian).
82. Solar activity and life, Riga, Zinante, 1967, (in Russian).
83. Effects of solar activity on Earth biosphere, M.N. Gnevyshev and A.I. Ol', eds., Nauka, Moscow, 1971, (in Russian).
84. Vladimirsky, B.M. and Temuryanz, N.A. Effects of solar activity on biosphere-noosphere, MNEPU Press, Moscow, 2000 (in Russian); (literature referenced in the book).

85. Sidyakin, V.T., Temuryanz, N.A., Makeyev, V.V., and Vladimirsky, B.M. Cosmic ecology, Naukova dumka, 1985, (in Russian).
86. Vladimirsky, B.M., Temuryanz, N.A., Martynyuk, V.S. Cosmic weather and our life. Fryazino Press, 2004, (in Russian).
87. *Biofizika*, 1992, iss. 3 and 4; 1995, iss. 4 and 5; 1998, iss. 4 and 5; 2004, special issue 7, (in Russian).
88. Zhvirblis, V.E. *Biology Bulletin*, 1982, iss. 3, p. 467, (in Russian).
89. Zhvirblis, V.E. On possible mechanism of Sun-biosphere relations, in: *Problems of cosmic biology*, Nauka, Moscow, 1982, v. 43, p. 197–211, (in Russian).
90. Zhvirblis, V.E. Application of circular interference for record of small oscillations of photoelectric detectors spectral sensitivity, *Proceedings of International Symposium "Correlation of biological and physico-chemical processes with solar activity and other environmental factors"*, Pushino, 1993, p. 219–220, (in Russian).
91. Lazarev, P.P. Primary and secondary adaptation of eyes at peripheral vision: fluctuation of adaptation; change of adaptation according to daytime, season and site of retina. In: *Studies in adaptation*, USSR AS Press, Moscow-Leningrad, 1947, p. 159–173, (in Russian).
92. Perevertun, T.V., Udaltzova, N.V., Kolombet, V.A., Ivanova, N.P., Britsina, T.Ya., Shnoll, S.E. Macroscopic fluctuation in aqueous solution of proteins and other substances as probable consequence of cosmogeophysical factors. *Biofizika*, 1981, v. 26, iss. 4, pp. 604–614, (in Russian).
93. Shnoll, S.E., Udaltzova, N.V. and Agulova, L.P. Correlations of amplitudes of macroscopic oscillations of various proteins and other substances water solutions properties with some cosmogeophysical factors, in: Physico-chemical bases of cells functioning, SCBR, Pushino, 1983, p. 21–29, (in Russian).
94. Shnoll, S.E., Udaltzova, N.V. and Agulova, L.P. Correlations of macroscopic oscillations in biological and physic-chemical processes with cosmogeophysical factors, in: *Electromagnetic fields in biosphere*, Nauka, Moscow, 1984, v. 1, p. 220–224, (in Russian).
95. Udaltzova, N.V. Probable cosmophysical conditionality of changes of biochemical and physicochemical processes parameters, PhD theses, Pushino, IBPh USSR AS, 1990, (in Russian).
96. Pancheluga, V.A. and Shnoll, S.E. Phenomenology of the local time effect in small space-time scales and in case of mobile sources of

oscillation. In: *Metaphysics*, Century XXI, iss. 2, Vladimirov Yu.S., ed., VINOM Press, 2007, p. 320–326, (in Russian).

97. Gorshkov, E.S., Shapovalov, S.N., Sokolovskii, V.V., Troshichev, O.A. Gravitational cause of fluctuations of the rate of oxidation of unithiol by nitrite ion. *Biofizika*, 2000, 45(4):631-5 (in Russian).
98. Shapovalov, S.N., Gorshkov, E.S., Borisova, T.D., Sokolovskii, V.V., Troshichev, O.A. Random fluctuations in readings of measurement devices: cosmophysic effects? *Biofizika*, 2001, 46(5):819-22 (in Russian).
99. Sokolovsky, V.V., Gorshkov, E.S., Ivanov, V.V., Shapovalov, S.N., and Troshichev, O.A. Relation of the regular gravitational field variations to biochemical processes observed in vitro and in vivo. *Biophysics*, 2004, v. 49, suppl. 1, p. S85–S91.
100. Troshichev, O.A., Gorshkov, E.S., Shapovalov, S.N., Sokolovskii, V.V., Ivanov, V.V., Vorobeitchikov, V.M. Variation of the gravitational field as a motive power for rhythmics of biochemical processes. *Advances in Space Research*, 2004, v. 34, p. 1619–1624.
101. Shapovalov, S.N., Gorshkov, E.S., Troshichev, O.A., Borisova, T.D., Frank-Kamenetsky, A.V. Effects of non-electromagnetic disturbances from the Sun in "computer time" instability. *Biophysics*, 2004, v. 49, suppl. 1, p. S79–S84.
102. Shapovalov, S.N., Gorshkov, E.S., Troshichev, O.A. Cosmophysical effects observed in impulses of the microphotocolorimeter current. *Biophysics*, 2004, v. 49, suppl. 1, p. S119–S122.
103. Gorshkov, E.S., Shapovalov, S.N., Sokolovskii, V.V., Troshichev, O.A. Detection of pulsed cosmic radiation. *Biofizika*, 2000, 45(5):947-9, (in Russian).
104. Klochek, N.V., Palamarchuk, L.E., Plusnina, L.A., Nikonova, M.V. Revisited unexplained cosmic effect. *Biofizika*, 1992, v. 37, iss. 4, p. 656–660, (in Russian).
105. Klochek, N.V., Palamarchuk, L.E., Nikonova, M.V. Preliminary data of studies of non-electromagnet cosmophysical emission effects on physical and biological systems. *Biofizika*, 1995, v. 40, iss. 4, p. 889–896, (in Russian).
106. Bogdanovich, B.Yu., Shedrin, I.S., Smirnov, V.N., and Egorov, N.V. Special way of mass rotating as a device for astrophysical studies, *MIPhI Scientific Sitting*, 2003, v. 7, p. 45–46, (in Russian).
107. Bogdanovich, B.Yu., Shedrin, I.S., Smirnov, V.N., and Egorov, N.V. Preliminary analytical evaluation of changes of rotating mass ki-

netic energy in dependence with coordinate-time location of Sun and Moon, *MIPhI Scientific Sitting*, 2003, v. 7, p. 47–48, (in Russian).

108. Trukhanov, K.A. Possible role of the Aharonov-Bohm effect in the biological action of a magnetic field, in: *Physico-mathmatical and biological bases of EMF effects and air ionization*, Nauka, Moscow, 1975, v. 1, p. 151–152, (in Russian).
109. Trukhanov, K.A. Probable role of the Aharonov-Bohm effect in the biological action of a magnetic field. *Kosm Biol Aviakosm Med.* 1978,12(3):82-3, (in Russian).
110. Baurov, Iu.A., Trukhanov, K.A. Probable role of cosmological vector potential as a factor of cosmo- and geliophysical relations. *Biofizika*, 1998, v. 43, iss. 5, p. 928–934, (in Russian).
111. Baurov, Iu.A. Structure of physical space and new energy production process, Krechet-Press, Moscow, 1998, (in Russian).
112. Baurov, Iu.A., Iakovenko, V.A., Komissarov, A.V., Verzhikovskii, V.G., Konradov, A.A. Study with a quartz resonator of a new natural informational channel associated with quantum properties of the physical space (vacuum). *Biofizika*, 2001, 46(5):823-8 (in Russian).
113. Baurov, Yu. A., Yakovenko, V.A., Komissarov, A.V., Verzhikovski, V.G., Baurov, A.Yu., Konradov, A.A., and Zenchenko, T.A. Preliminary investigation of a new informational channel in nature with the aid of quartz resonators' system. *Int. Journal of Scientific Research*, 2006, v. 16, p. 469–473.
114. Kolombet, V.A. Phenomenological investigation of "macroscopic" fluctuations at physical and biological systems. PhD theses. Pushchino, Institute of Theoretical and Experimental Biophysics, 1993, p. 24, (in Russian).
115. Ivanov, P.S. Stability of gramicidine channels state, PhD theses, MSU Physical Faculty, 1992, (in Russian).
116. Glybin, L.Ia. Diurnal rhythms of some diseases manifestation, Far West University-Press, Vladivostok, 1987, (in Russian).
117. Glybin, L.Ia. Cosmophysical aspects of diurnal rhythms. Concept of time organization of human society life. *Biofizika*, 1992, v. 37, iss. 3, p. 559–565, (in Russian).
118. Glybin, L.Ia., Sviatukha, V.A., Tsitsiashvili, G.Sh. Statistical approach to the validity of a diurnal cycle with periods of 4-6 hours. *Biofizika*, 1995, 40(4):829-33.
119. Glybin, L.Ia. Time to go to bed, Far West University-Press, Vladivostok, 1987, (in Russian).

120. van der Waerden, B.L. Statistical Theory, Inostrannaya Literatura, Moscow, 1960.

121. Shnoll, S.E., Kolombet, V.A., Udaltzova, N.V., and Bodrova, N.B. Discrete macroscopic fluctuations in processes of different nature. *Biofizika*, 1989, v. 34, (4), pp. 711–722, (in Russian).

122. Shnoll, S.E. Shapes of spectra of states realized at macroscopic fluctuations depend on Earth axial rotation. *Biofizika*, 1995, v. 40, iss. 4, p. 865–875, (in Russian).

123. Shnoll, S.E. Correlation between shapes of spectra of macroscopic fluctuations amplitudes and Moon location towards horizon. *Biofizika*, 1989, v. 34, iss. 5, p. 911–912, (in Russian).

124. International Crimean Conference "Cosmos and Biosphere", Partenit, Crimea, Ukraine, 1995–2005.

Part 2

Cosmophysical Regularities in Stochastic Processes

> *Before us gapes a well of stars -*
> *Stars infinite, well fathomless.*
>
> *M.V. Lomonosov*

Introduction

The first part of the book reviewed research that was initiated during the years 1951 to 1954. The purpose of the investigations was to provide explanations for peculiar scattering of results of measurements of enzyme (ATP-ase) activity in solutions of muscle proteins (an actin-myosin complex), which were found to be independent of the methods employed. Two factors called for clarification:

1. The higher than expected amplitude of this scattering.
2. The discrete nature of the analysis results. So-called "allowed" and "forbidden" ranges of measured values were identified, that is, a macroscopic quantization-like phenomenon manifested in the form of fine structures of statistical distributions and therefore also fine structures of corresponding histograms.

The first part of the book described initial investigations of the nature of these phenomena, which were conducted over 40 years, from 1957 until 1997. The second part presents results of further studies obtained mainly in the period of 1997–2010. Based on these results we were able to formulate a number of generalisations. In the following the main conclusions are presented:

1. **Based on the consistency of the "scattering of results" from measurements taken in sequence, it can be suggested that they may be a manifestation of fundamental properties of our universe. This "scattering" is a consequence of fluctuations in the space-time continuum caused by the movement of an object in the inhomogeneous gravitational field;**
2. **The fine structure of corresponding histograms represent the amplitude spectrum of the scattering of results. Patterns in the fine structure can be found in different processes. These**

patterns were found to be linked to the behavior of space-time continuum fluctuations caused by axial and circumsolar rotations of the Earth;

3. **The variation in the amplitude of this scattering depends on the type of process. A number of factors related to the investigated objects' properties of interactions determine the amplitude variations.**

These conclusions were facilitated by the program "Histogram Manager" (see [1]) developed by Edwin Vladimirovich Pozharsky in 1997 for the analyses of measurement results. In former times, to be exact in the pre-PC-era, we were able to retrieve about 250 accurate measurements of biochemical and chemical process rates in a working day. These results allowed the construction of 4–5 histograms, not more. In 1986 we started 6 seconds spaced measurements of radioactivity continuously during the entire day, yielding 240 histograms per day. Measurement results were collected and stored electronically on the only computer at the institute (?). At the end of a working day we obtained a "print-out" of histograms on big sheets of paper. To compare histograms, we redrew them on tracing paper and overlapped these drawings. This was a truly slow and laborious job.

Edwin Vladimirovich Pozharsky, graduate of FizTeh (Moscow Institute of Physics and Technology, University commonly known as PhysTech "FizTeh") solved a classical biophysical problem: the X-ray crystallographic analysis of proteins. When we first met he stated:

"My educational and professional background does not allow me to take your words seriously".

These words became part of our laboratory folklore. However, it was Edwin who, in spite of "his educational and professional background", made a core impact onto our work. First, he tried to replace the (human) expert by designing a neural network algorithm-based program for determining histogram similarity. The attempt failed. Then he developed the generalised mixture (GM) procedure, which automatically detected histogram differences and similarities. From this classification the expert merely needed to confirm this conclusion.

Through the histogram manager software by E.V. Pozharsky our work efficiency increased tenfold. Since 2000 our laboratory is equipped with I.A. Rubinstein devices; 2–4 of them work around-the-clock registering every second of the alpha-activity of 2–4 preparations of ^{239}Pu samples. Through this each expert can compare up to 20,000 histogram pairs daily. Results of the last 10 years obtained with the help of the Histogram Manager confirm the main conclusions arrived at in previous decades to be reliable.

Furthermore, new phenomena were revealed. A distinctive physical pattern emerges, which explains these phenomena. These new materials will be covered in the following chapters of Part 2.

Chapter 1.

Measurement techniques and topics investigated

1.1 Introduction

The universality of the "macroscopic fluctuations" phenomenon was the main result of the investigations that were conducted since the 1950s, as mentioned in the first part of the book. It was demonstrated that a spectrum of fluctuation amplitudes (profiles of corresponding histograms) is independend of the type of process under investigation. We were therefore able to draw our results from a variety of processes, selecting radioactive decay as the subject of choice. Radioactivity is practically independent from trivial factors: this is the main advantage of the subject. The second very important feature is that a radioactive decay process corresponds closely to Poisson statistics; its time realizations (using proper measurement procedures) are pure white noise. Another important made radioactive decay the main subject for our investigations, namely that measurements of various radioactivities were my routine duties during the first 10 postgraduate years. Measurements of radioactivity can easily be automated and can continue running for years. Histogram shape changes shorter than 10^{-2} seconds cannot be investigated because they would require very active preparations. This would cause radiation hazard and a lower speed of measuring system responses. Experiments with faster time-resolution may use various "noise" processes. This term is used for different types of processes [2].

1.2 Subjects of investigations and study participants

The phenomena have been discovered in different types of processes that were investigated. This process independence constitutes one of the main results of these studies. The conclusion was based on experiments with processes varying in time. The main subjects and authors directly involved in the parameter measurements are referenced below, whenever possible in historical sequence. The corresponding references can be found in the list of references.

1. **Biochemical reactions and enzyme activity.** (S.E. Shnoll, E.P. Chetverikova, V.V. Rybina, N.A. Smirnova, O.A. Rudneva, Kh.F. Sholtz, T.Ya. Britsyna, N.P. Ivanova and V.A. Kolombet, 1951–1985)
2. **Chemical reactions.** (S.E. Shnoll, T.Ya. Britsyna, V.A. Kolombet and T.V. Perevertun, 1973–1985)

3. **Measurements of ^{3}H and ^{14}C beta-radioactivity with independent automatic devices.** (V.I. Bruskov, A.Yu. Sungurov, V.D. Razhin, Yu.G. Ivanchenko, 1979–1983)
4. **Fluctuations of visual perception at a polarimeter adjusting.** (V.E. Zhvirblis, 1978–1983)
5. **Electrophoretic mobility of latex particles.** (A.V. Temnov, 1982)
6. **Time of protons relaxation in water in an alternating magnetic field.** (D.P. Kulevatsky, 1982)
7. **Waiting time of a neon-lamp EC-generator discharge.** (V.N. Morozov, 1982 -1983)
8. **Measurements of ^{239}Pu alpha-activity in MEPI.** (N.B. Khokhlov, M.P. Sharapov, 1982–1983)
9. **Measurements of ^{239}Pu alpha-activity with self-made devices.** (A.B. Dansky, V.A. Kolombet, A.N. Zaikin, 1983–2000)
10. **Measurements of fluctuations amplitudes in Belousov and Zhabotinsky oscillatory chemical reaction.** (L.P. Agulova, 1981–1987)
11. **Fluctuations of phospholipid membranes conductivity.** (P.S. Ivanov, 1989–1993)
12. **Computer models of processes complying with Poisson statistics.** (V.A. Kolombet, N.B. Bodrova, N.V. Udaltsova, P.S. Ivanov, A.A. Konradov and T.A. Zenchenko, 1980–2001)
13. **Radioactivity of various isotopes ^{239}Pu, ^{238}Pu, ^{226}Ra, ^{218}Po, ^{214}Po, ^{14}C, ^{60}Co, ^{55}Fe, ^{3}H et al.** (I.M. Zvereva, V.A. Kolombet and K.I. Zenchenko, 1995–2000)
14. **Measurements of ^{239}Pu alpha-radioactivity with I.A. Rubinstein constructed devices.** (K.I. Zenchenko, T.A. Zenchenko, V.A. Kolombet, S.N. Shapovalov, A.V. Makarevich and V.A. Pancheluga, 2000)
15. **Measurements of fluctuations of Earth crust emitted neutrons.** (B.M. Kuzhevsky)
16. **Measurements of ^{228}Ra alpha-activity.** (B. Vilken, Lindau, Germany 1999–2000)
17. **Fluctuations in Ulitka gravity-gradient antennae.** (Material is presented by V.N. Rudenko through A.A. Konradov. Processed by T.A. Zenchenko and S.E. Shnoll, 1999–2001)
18. **Measurements of beta-gamma radioactivity in Dubna and Troitsk.** (Yu.A. Baurov et al.)

19. **Fluctuations of dark noises in photomultipliers.** (V. L. Voyeykov, L.V. Belousov and N.V. Fyodorov, 1999–2002)
20. **Noises in Zener diodes and other semiconductor noise generators.** (A.V. Kaminsky and V.A. Pancheluga, 2005–2009)
21. **Global net of GCP noise generators.** (T.A. Zenchenko, S.E. Shnoll and V.A. Pancheluga, 2001–2009)

Since 1982 histograms constructed from the results of alpha-decay measurements were the main object of our investigations. Dealing with this subject involved some obvious advantages: the process does not require any "feeding". It occurs all by itself. Always. Its rate does not depend on trivial external causes. Hence, these causes cannot be left "holding the bag" of observed trends. The half-life period of ^{239}Pu is rather long ($T_{1/2} \approx 24$ thousand years), therefore changes in the average decay intensity (or frequency) may be neglected. Moreover, for the purpose of histograming, it is absolutely insignificant. However, the main advantage of radioactive decay became clear after 2002: it allows the examination of spatial effects. We found that the observed effects are no longer dependent from courses of alpha-particles in the case of radioactive decay. Their courses are directed in such a way that they simply "fly-out". Among all the wonders I encountered over the last years this was to me the most wonderful. Alpha particles fly over a short distance of several centimeters in the air. There are beta radioactive isotopes that can fly over distances of several meters, such as ^{32}P. However, this does not always materialise. Fine steric effects may be independent on a distance passed by a particle after a decay event. Beta decay has one more disadvantage: beta-particles possess different energies, while the energies of all alpha particles of a decay direction are the same. Thus, the advantages of alpha decay are beyond doubt. In the following I shall provide a more detailed description of measurements techniques for alpha-radioactivity only.

1.3 Measurements of alpha-radioactivity

From 1986 to 2000 we measured alpha-activity of ^{239}Pu samples with devices produced by our colleagues: A.B. Dansky and V.A. Kolombet in consultation with N.B. Khokhlov, M.P. Sharapov, and V.N. Shestimirov. These devices included solid-state detectors of alpha-particles that work at 9 Volts. These were connected with a counting circuit, a computer and a portable tape-recorder. The devices were suitable for solving our problems, namely the creation of time series for histogram analysis; compactness of the devices made them comfortable, but their work consistency was poor, as we could see low-frequency trends caused by the instability of the electronics. It should be noted that this instability and low-frequent trends did not affect the shapes of histograms constructed from relatively short time series. However, for the purpose of measurements conducted over months and years, more suitable and reliable devices were required.

The situation got much better after *Ilya Alexandrovich Rubinstein* (SINP MSU) designed and built devices very apt for alpha-activity measurements. Time series obtained with these devices were of the highest quality: they were pure "white noise", practically no low-frequent lines could be distinguished; the results of measurements fitted Poisson statistics.

We use I.A. Rubinstein devices for measurements at different geographical locations to solve various problems.

In 2002 I.A. Rubinstein modified the devices by collimators that allow the registering of alpha-particles emitted at radioactive decay and flying into a definite direction.

Usually measurements are conducted with two identical devices. Both have firmly positioned sources and detectors (photodiods). A collimator, canalizing the flow of radioactive decay alpha-particles, can be placed between a source and a detector. The distance between source and detector is 12 mm both with and without a collimator. When an alpha-particle flies over such a distance its energy becomes 10% lower, and, as a result, particles reach a detector with about 4 MeV. We set a registration threshold of approximately 1.6 MeV, preventing effects of a detector noise, and of air humidity and density shifts. Time intervals are digitized with a 131 MHz quartz generator. Source voltages of the digitizer are stabilized. The instability of registering devices in the temperature range -30^{o}C – +50^{o}C amounts to $\leq$ 6%.

The source of collimator equipped device is a plate with pits containing a radioactive preparation; the pits are arranged as a 10×10 grid with 1.6 mm spacings. The collimator is made up of a 11 mm thick organic glass plate with a grid of holes of 0.9 mm in thickness. Collimator holes and the source grid strictly overlap. In this way rather high counting rates can be reached in spite of the limitations due to the collimator [3–8].

1.4 Computer database (archive) of measurement results

All through these years I did my best to store the results of various experiments: I keep all experimental records in a special safe. However, I suppose I am the only one who can use the results of the first decades. Recently even I have mostly failed to process data sets from older measurements. Currently I consider to extract important measurements from these records in order to make them accesible for future investigations. Regular

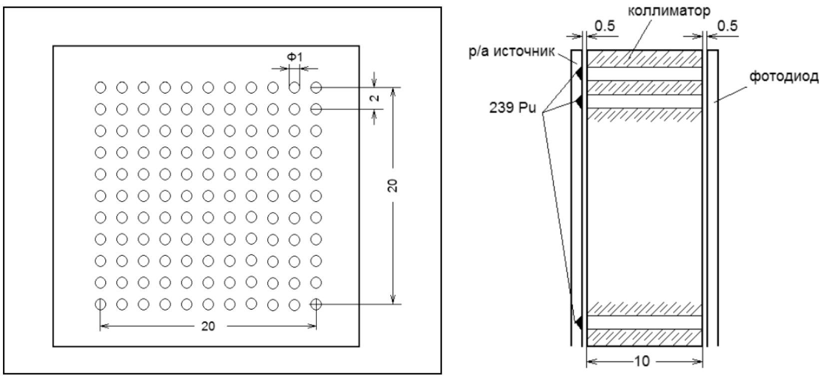


Figure 1-1: Scheme of a collimator-equipped device for alpha-activity measurements. Left: Collimator. 11 mm-thick organic glass plate with 0.9 mm holes. Top view. Right: Collimator assembled with sources of radioactivity and detector (photodiode). Side view.

radioactivity measuring changed the situation. Honestly speaking, at the beginning, when we stored our “databank” (data base) either on the public computer of the institute or on big tapes, it was very cumbersome to use. Then the techniques changed, and those materials became practically inaccessible; the availability of personal computers facilitated our work a lot. Our computer bank (archive) contains almost all (that is, as much as I managed) results of measurements of chemical and biochemical reactions rates from the 1980s, and results of systematic radioactivity measurements produced since 1986. Our most valuable results are every-second measurements of ^{239}Pu radioactivity. These started on July 7, 2007, with the beginning of our work employing A.I. Rubinstein devices. The data archive contains different types of measurements: without collimators; with differently oriented collimators; made in various geographical points and during expeditions. Through all this time the archive is being maintained and updated by T.A. Zenchenko. She has established a catalogue of archived information that is valuable for everyday practice and, moreover, for future investigators.

Chapter 2.

Methods for histogram creation and the study of histo gram shape similarities. “Histogram analysis”. The “striking” symmetry of histograms as a manifestation of a fundamental chirality. Criteria of shape similarity. The problem of an automatic search mechanism or algorithm for similarly shaped histograms. Estimation of the reliability of the frequency distribution of time differences between similar histograms

2.1 Introduction

Fig. 2-1 is an example of a time series from the results of successive measurements of α-activity of a preparation fixed on the semiconductor detector in the I.A. Rubinstein device. The X-axis represents time (in seconds); the Y-axis is the number of decay events, registered by a counter every second.

From the analysis we find the process completely stochastic by conventional criteria. This implies no preferred frequencies, that is, “white noise”. By all usual criteria (fitting criteria), the process corresponds to Poisson statistics, as expected. This is quite obvious from Figures 2-2 and 2-3. Figure 2-2 presents the distribution of all 352,980 measurements from Fig. 2-1 without smoothing and averaging.

The distribution corresponds closely to Poisson statistics. However, despite the large number of measurements (352,980), some structure can be seen in the figure. Present standard fitting criteria “do not notice” a fine structure in the “layer lines”. This means that standard smoothing procedures ignore the fine variations (fine structure) in the distribution

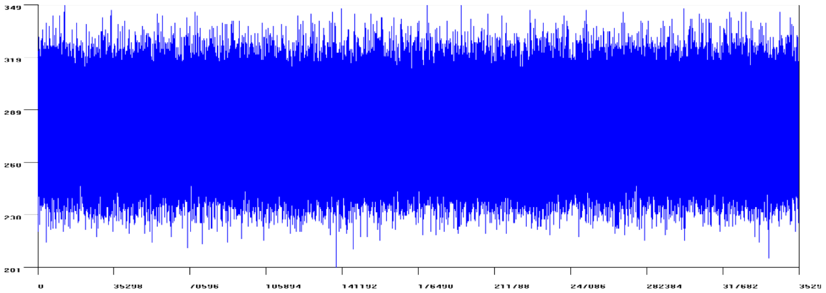


Figure 2-1: Time series: the results of 352,980 measurements of α-activity of a ^{239}Pu preparation fixed firmly on the solid-state detector; measurements were made between May 28, 2004 and June 01, 2004.

(layer histogram). The layer histogram was constructed by successively adding a fixed number of increments to the data and at each step drawing a new "layer line". One would expect that small variations around a smooth distribution would not become more pronounced, and average out instead, resulting in a smooth distribution as more and more measurements are added. However, the structure does not disappear with an increasing number of measurements. As mentioned earlier, this structure, that is, a smooth distribution, is usually considered to be a consequence of "statistical inertness". We shall not analyse the phenomenon further: additional investigations should be conducted on "layer line" similarity that perseveres over measurements of the order of magnitiude of billions (10^9) [see 9-18]. The fine structure cannot be distinguished any more if the distribution (the layer histogram) is smoothed, by moving averages, for example. This can be seen in Figure 2-3.

Not without compunction I shall leave the problem and details of the fine structure of these non-smoothed distributions of billions of measurement results to future investigators.

Histograms constructed by a comparatively small number of measurements are our main object of investigation. The number of measurements and the number or value ranges of the classes into which the measurements are classified ("bins"). Histograms are chosen consistently such that they are comparable. This histograming from a relatively small number of measurement results reveals important features of the studied phenomena. The histograming method and steps of the histogram analysis are illustrated in Figure 2-4. (I am obliged to E.V. Pozharsky and T.A. Zenchenko, who made this picture many years ago; since then it always serves to explain the "histogram method").

Histograms containing a comparable number of bins and a comparable number of measurements are named "inconsistent" [19–23]. In our case, 100 points are arranged into 80 bins. No regularities can be found for such histograms.

As can be depicted from Figure 2-4, contrary to distributions of billions of measurement results, these "inconsistent histograms" keep their typical discrete shapes despite smoothing. Moreover, these shapes become more evident and pronounced. This "fine structure of histograms" constitutes the main subject of all our investigations.

I want to repeatedly emphasize the following:

The realization of fine structures does not contradict the correspondence of the investigated process to Poisson-Gauss statistics.

This becomes apparent when the abovementioned fitting criteria are applied, since these are insensitive to such structures in principle.

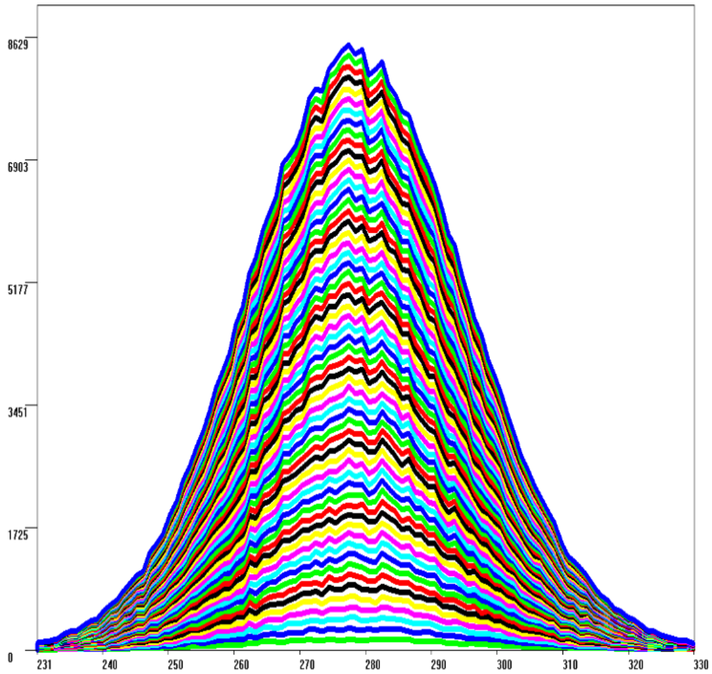


Figure 2-2: Non-smoothed distribution of 352,980 4-days-measurements of ^{239}Pu preparation α-activity: start date: May 28, 2004; end date: June 01, 2004. “Layer lines” are drawn after every 6,000 measurements. The X-axis denotes activity, i.e. the number of decay events per second (registered by a counter); The Y-axis shows the number of measurements corresponding to an activity value.

2.2 The fine structure of histograms and the spectrum of fluctuation amplitudes are non-stochastic

The best (and maybe quite profound) parallel can be found between the fine structure of fluctuation amplitude spectra and atomic spectra. The energy levels of atomic spectra are strictly determined by quantum numbers through the stochastic character of electron jumps, which are undetermined in principle. In view of this parallel, the “macroscopic fluctuations” phenomenon may be designated as “macroscopic quantization”. How far can we go with this parallel? Does a similarity of “macroscopic quantum numbers” really exist? The future will provide answers.

The non-stochastic nature of histogram fine structures imply that probabilistic methods do not apply to evaluating the degree to which

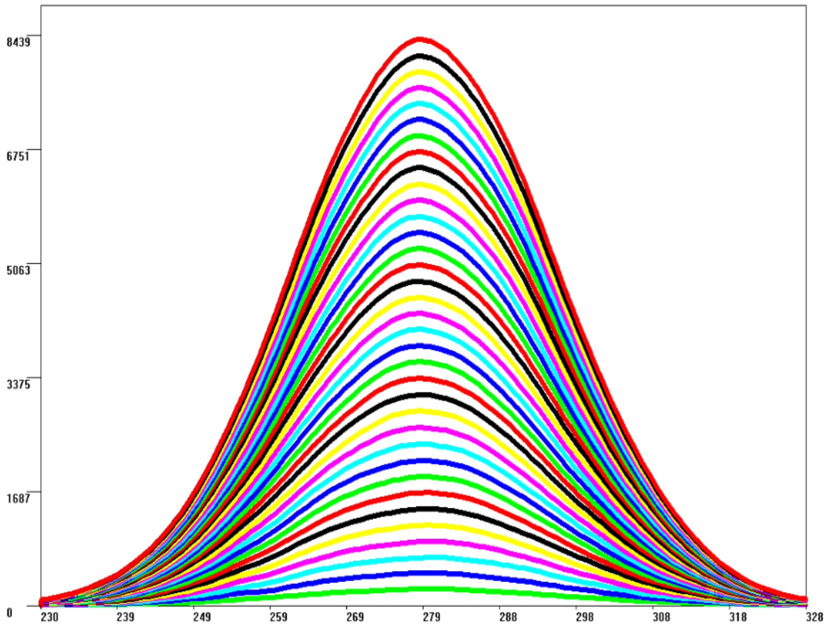


Figure 2-3: The same distribution as shown in Fig. 2-2 after smoothing 7 times with moving averages.

individual histogram shapes are similar. This can by no means be considered a conventional pattern recognition problem. It rather resembles the identification of a Plato-like "shape idea". For a long time I did not comprehend this distinction that is typical of pattern recognition problems. However, specialists from the popular "image recognition" field discarded these problems because of the lack of a computer program for histogram comparison. We continually address this problem in a somewhat dilettante fashion.

The identification of members of a band or beehive, an ant-hill, or a herd, etc. (friend-or-foe) is a very important part of the social life of animals. This identification, that is the recognition of other individuals, employs olfaction, vision, hearing, etc. Over the course of evolution, skills of animals have become "amazingly" adaptive and perfected to the requirements of their surroundings and their needs for survival. The evolution of our honorable ancestors (primates) preferred (for obvious reasons) the visual way of knowing friend from foe. This recognition served to transfer complex and complicated information. Our ability to distinguish letters really bears witness to our absolutely amazing "transcendental" capacity to make sense of those complex hieroglyphs while reading. Even more so, mimic muscles in the face developed to transfer complex information about emotional states, and, in essence, for the development of a face instead of a snout served a similar purpose. Appropriate brain sections developed accordingly. Thus, we are not surprised if we immediately recognize a person, whom we have not seen in a very long time, and who is moving by fast in an opposite escalator with a crowd of other passengers.

This wonderful process certainly does not involve a detailed comparison of shapes. Merely the "idea of a shape". This idea persists in a face from infancy to old age. Not all people possess the same capability of "Gestalt perception". My personal ability is better than the average. This becomes manifest, for example, in my "fast reading" capacity when a word is recognized "as a whole" without identifying the letters that it is composed of. On the opposite side of the reading ability spectrum there is illiteracy, wrong spelling, doubts on what letter to use or to place in a specific order... All in all, the ability to identify the idea of shape proved extremely useful for me.

The histogram "shape idea" becomes apparent upon smoothing of inconsistent histograms. This is shown in Fig. 2-5: the smoothing of "inconsistent histograms" by the method of moving averages leads to the appearance and stabilization of its inherent shape. The histogram is constructed from the results of 60-second and one-second measurements of α-activity, as is also depicted in Fig. 2-1.

Fig. 2-5 shows that in this case the 5- to 7-fold smoothing is enough to reveal a stable and typical shape of a histogram. Precisely these smoothed histograms are the main subject of our investigations.

Similar mirror histogram shapes created one of the first incisive impressions gained through the analysis of histogram series. The idea of this phenomenon is exemplified by Fig. 2-6, illustrating a core concept of the material investigated. The figure presents a fragment of a computer record of histograms derived from the spring equinox on March 21, 2005. The upper row shows a successive series of one-minute histograms, 718 minutes (and number of measurements), and the following subfigures show a series of histograms with a selection of steps along the smoothing procedure. Please note the similarity between histogram N720, shown in the upper row of Figure 2-6, and histogram N3 from the lower row. The time distance that separates them amounts to 718 minutes. Their shapes appear more similar after mirroring (see Fig. 2-7). The similarity of the selected histogram pairs becomes more convincing if compared to other pair combinations. For example, histogram N721 is completely different to histogram

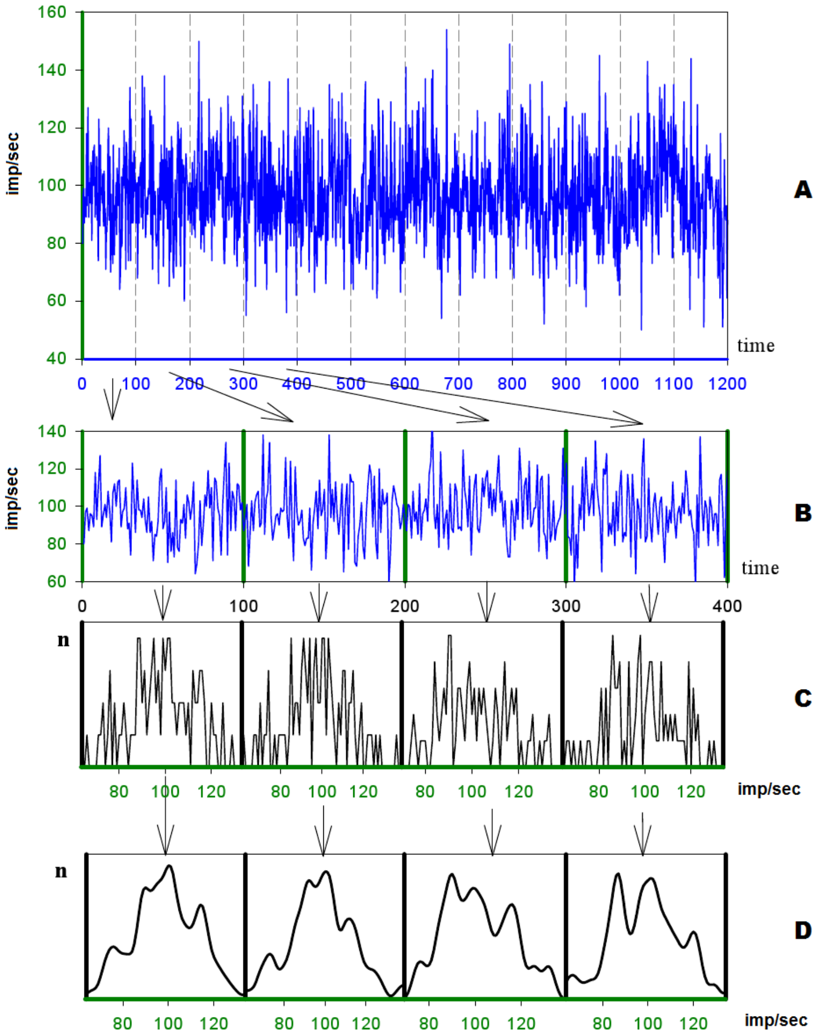


Figure 2-4: **Part 1 –** **A**: a "stretched" segment of the time series of α-activity measurements from a ^{239}Pu preparation; **B**: the time series is divided into non-overlapping intervals, each containing 100 successive measurements; **C**: from each interval a histogram is calculated (X-axis: range of activity values (imp./sec); Y-axis: the corresponding number of measurements for each bin, i.e. value range); **D**: regularities become evident after smoothing by "moving averages" with a "window" equal to 4, for example.

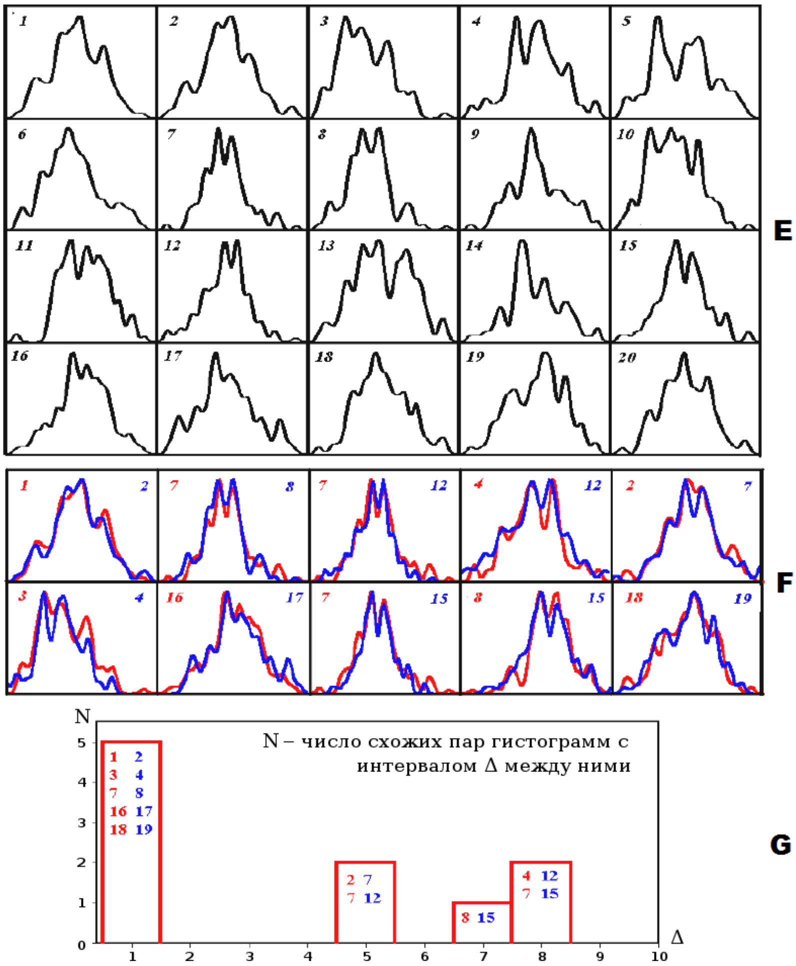
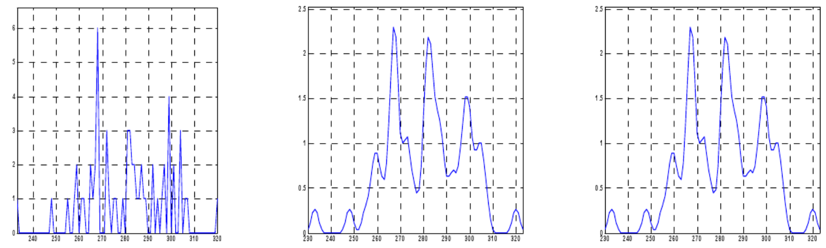


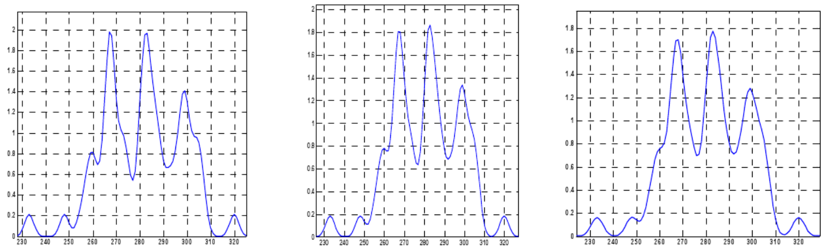
Figure 2-4: **Part 2 –** **E**: the time series of measurement results is replaced with a corresponding series of successive smoothed histograms, **F**: the shapes of all histograms are compared to each other. Similar pairs are selected. The similarity of histograms is assessed by overlapping histograms. Sometimes this overlapping is performed after one of the histograms that may form a similar pair has been "mirrored"; histograms may be compressed or stretched along the X-axis in the comparison process. This figure illustrates the selection of similar histograms by an expert. The evaluation results in histogram N1 found similar to N2; N3 to N4; N7 to N8; N2 to N7; N7 to N15, etc. **G:** a distribution of the time distance between similar histogram pairs is constructed, where the values of separating time-intervals between histograms are depicted on the X-axis. The Y-axis shows the number of similar histogram pairs for the time distances between them. An increased similarity of histograms that are close to each other in time, so-called nearest neighbors ("near zone effect"), can already be discerned. However, such a distribution only provides reliable results when a significant number of histograms are compared. We obtain such numbers by comparing and combining thousands of histograms, forming similar pairs.



not smoothed

smoothed 1 time

3 times



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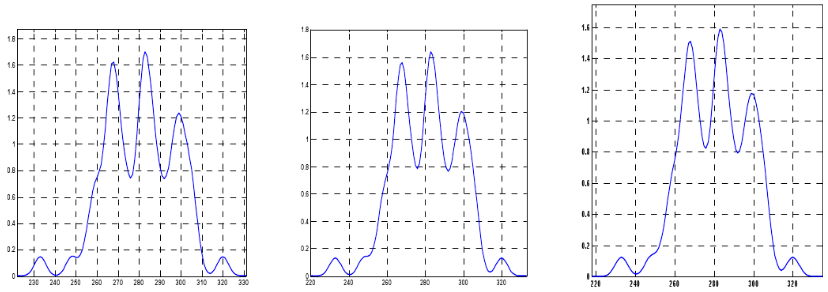

11 times

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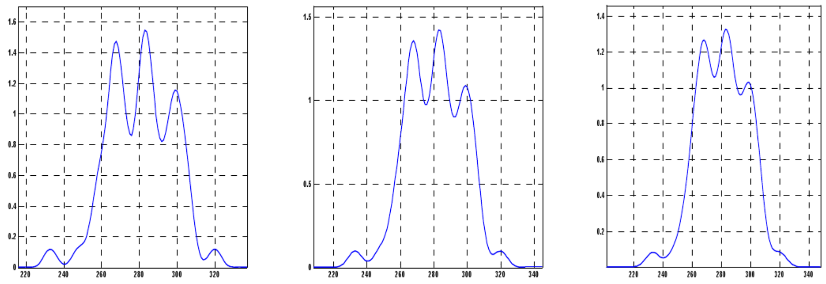

17 times

25 times

35 times

Figure 2-5: Manifestation of a certain shape of an inconsistent histogram after repeated smoothing by "moving averages". Successive steps of the smoothing procedure are indicated. X-axis denotes the number of counted alpha-particles; Y-axis shows the number of measurements corresponding to an alpha-activity value.

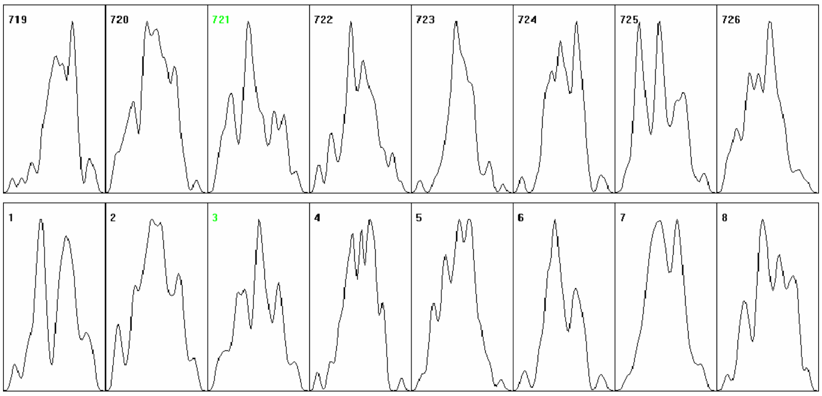

Figure 2-6: Illustration of histogram similarity from measurements taken on March 21, 2005 with 718 minutes time difference between respective histograms of top and bottom rows. The histograms N2 and N720; N3 and N721; N8 and N726 are similar after mirror inversion (see Fig. 2-7).

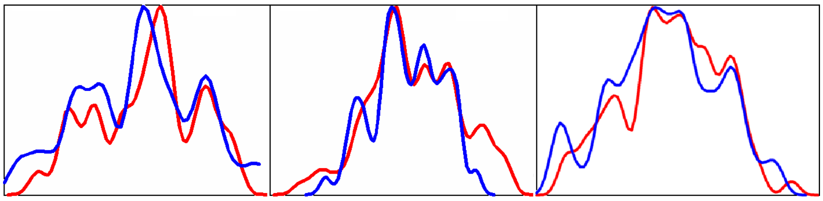

Figure 2-7: Histograms with a complex shape are similar after mirror inversion on the spring equinox (21^{st} of March, 2005) with a time distance between similar pairs of 718 minutes (respective pairs are: N721-N3; N726-N8; N720-N2).

N720, and similar to histogram N3 in terms of the details of its shape (after one of them has been mirror inverted). The same applies to histograms N726 and N8, which are similar after mirror inversion.

The expert who conducts the visual comparison evaluates the similarity more in terms of the "shape idea" rather than the exact details of the similarity. *For an expert comparison of histograms, employing E.V. Pozharsky's computer program Histogram Manager, compared histograms may be compressed and stretched, as well as overlapped after they have been mirror inverted around the Y-axis.* Many thousands of histograms should be compared in order to obtain reliable regularities in the time distances between histogram pair combinations.

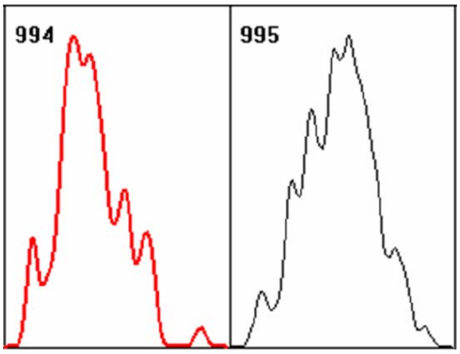

Figure 2-8: Another illustration of mirror similarity of histograms with a complex shape. Histograms N994 and N995 are constructed from measurements from adjacent non-overlapping segments of the time series; each illustrates the distribution of 60 results of one-second measurements of ^{239}Pu alpha-activity, on January 13, 2002.

The similarity of mirrored histograms, that is the existence of particular right and left shapes, deserves special attention. "Mirror reflection" similarity is a rather common phenomenon (at times up to about 1/3 of all similar pairs).

Even rather complex asymmetrical patterns may sometimes be mirror similar. Fig. 2-8 illustrates the concept of histogram shape similarity in relative and absolute terms. The figure shows once more that the crucial point is the similarity of a "shape idea", taking into account the noticeable mismatch in the histogram pattern. When looking at the absolute value of bin heights, which represent the counts of the number of occurrences in a value range, a difference can be discerned.

The underlying causes and inherent properties of this "chirality" seem as mysterious as they are important.

The left and central columns of Fig. 2-9 present pairs of mirror symmetrical histograms; the right hand side provides a graphical illustration of their overlapping after rotating around the Y-axis. The histograms stem from measurements of a conventional experiment of the alpha-activity of a ^{239}Pu sample. We note that sometimes complex patterns appear mirror similar.

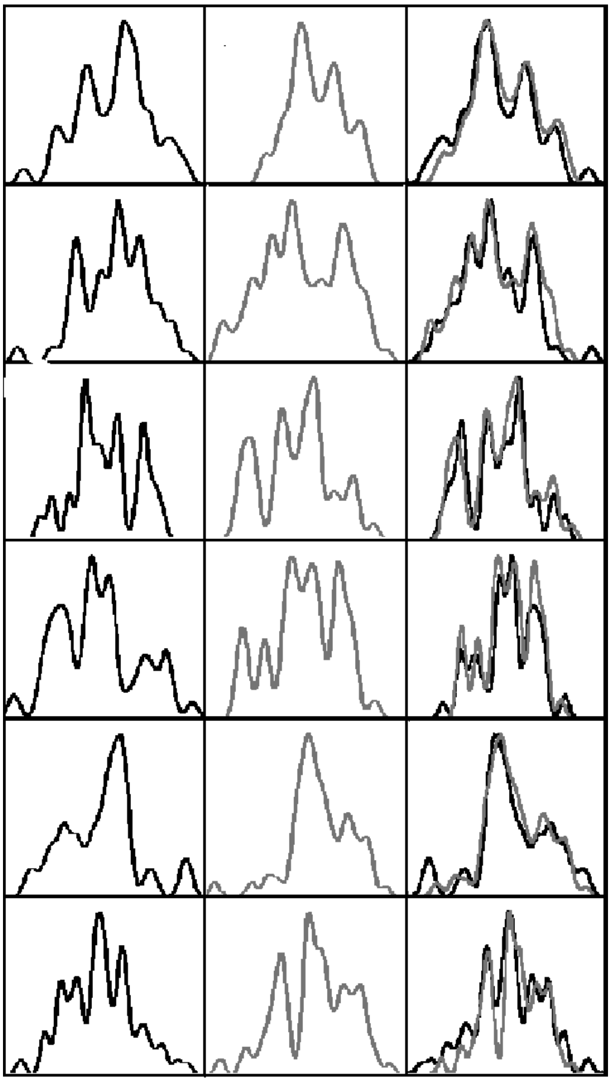

Figure 2-9: Illustration of the "mirror effect". Histograms result from measurements of a common experiment of alpha-activity of a ^{239}Pu sample. Each line contains two successive histograms and the results of their overlapping after Y-axial rotation.

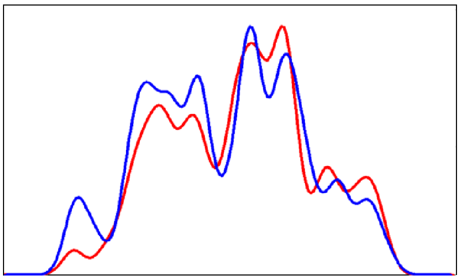

Figure 2-10: Histograms that are "obviously similar" for an expert may appear relatively less similar when an expert is replaced by a computer program.

2.3 The problem of designing a computer program for the comparison of histograms. The human factor in the expert comparison of histograms

The presented figures show, inter alia, the difficulties of replacing an expert with some automatic computer method for the visual comparison of histogram shapes. For example, Fig. 2-10 presents another pair of such *obviously* similar histograms, where a computer program would be less likely to classify the two shapes as similar.

The design of a computer program that could replace the visual evaluation of histogram similarity by an expert proved to be a difficult challenge. We have been trying to design such a program since the middle of 1980 and up to recent years these attempts have failed. One of the reasons was the "blurring" of patterns and the definition of suitable classification criteria: upon gradual change of the ordinates, one "shape idea" transforms smoothly into another. Employing cluster analysis appeared promising and extremely sophisticated. Furthermore, the possibility of "cluster formation", that is the replacement of the series of histogram patterns with sequences of their symbols, would mean a revolution in our methods: this incorporates applying a routine method from linguistic analysis of chains of letters, i.e., texts. The success of these methods is sufficiently exemplified by a discipline that recently emerged for the analysis of genetic texts, namely "bioinformatics". The first to attempt a cluster analysis of histogram series was E.V. Pozharsky. Despite the problems mentioned above, such as the "blurring" of cluster borders, we were able to obtain some interesting preliminary results: time changes of histogram shapes of different clusters follow different regularities [1]. However, this work was never continued, and these results were never confirmed. E.V. Pozharsky did not take it as his life-work. He had defended his thesis [24] and left for the USA.

Generally speaking, in spite of my comments on the fundamental problems, I suppose that the main reason for the lack of a suitable computer program for histogram comparison is a human element in the sense that started developments were not completed or taken further. In recent times some progress can be noted: *Vasiliy Vyacheslavovich Strelkov's* computer program [25]. However, similar as before, this program requires fine tuning.

1. The first attempts of mine commenced in the 1950-60s. I tried to use the Pearson fitting criterion (chi-square) and the Smirnov-Kolmogorov's criterion (lambda criterion). They failed for the reasons given above.
2. In the 1960s **Eduard Alexeyevich Lyamin** began developing a "signs criterion": the evaluation of histogram similarity according to the properties of the sequence of the sign of the derivative, where the shape of a smoothed histogram was characterized by a sequence of "plus", "minus" and "zero". The main problems were to determine the significant (and negligible) extremes in a histogram pattern and to develop and test the statistical significance of the results of the comparison. Unfortunately, this very interesting work was terminated by the early death of its author [26].
3. In the middle of the 1980s **Natalya Vyacheslavovna Udal'tsova** designed an original method for histogram comparison. This was based on calculating correlation coefficients for compared histograms after subtracting the normal (Gaussian) distribution calculated for each histogram by means of the arithmetic mean and the dispersion. Resulting diagrams were overlapped after small shifting along the X-axis up to the maximal values of correlation coefficients. The significance of the resulting values of these coefficients was evaluated after all coefficient distributions were obtained, and histogram series were randomized. Furthermore, fractiles of various mean levels were determined [28].

   N.V. Udal'tsova successfully employed the method to analyse regularities in the recurring realization of similarly shaped histograms. Those histograms were obtained from experimental results over many-years that were conducted through daily measurements of a chemical reaction rate (between ascorbic acid and dichlorophenolindophenol; refer to the first part of the book). The same method was used to compare shapes of histograms resulting from measurements of alpha-activity during moonrises and moonsets [47]. This method could be in good accordance with a number of our objectives. However, its application required some “customizing”, for example in the form of a set of assisting programs and command buttons for the user interface. N.V. Udal’tsova had defended her thesis and... left for the USA.

4. Similarly, in 1980, **Valeriy Anatolyevich Karpov** almost developed an empirical criterion for the similarity of smoothed histograms. His method was based on imitating the work of an expert. He tried to follow similarity criteria employed (almost unknowingly) by an expert during visual comparison. I participated as a “model” expert to select the following six parameters:
   a) histogram height/width ratio (the height is determined by the highest peak; the width by the number of bins and their corresponding value range);
   b) asymmetry of a histogram (the ratio between the number of histogram bins to the left of its highest peak and the total number of bins);
   c) number of peaks (a peak is any local maximum, exceeding nearest minimums by no less than some predefined value);
   d) sum of peak heights (with regard to the nearest minima);
   e) sequel of relative heights of peaks;
   f) succession of the distances between peaks (along the X-axis).
   This empiric criterion of histogram similarity as summarised by the 6 parameters and weighting factors were used, such as: 30, 25, 3, 0.5, 10. The Karpov criterion was almost “set to work”. The effectiveness of its application depended on the choice of the weighting factors. V.A. Karpov had no time for this laborious work – he left for the USA...

5. As any normal physicist, **Edwin Pozharsky** believed that the comparison of histograms “by eye” is not serious enough. Moreover, he believed that if a “macroscopic fluctuations” phenomenon existed, a computer program would be able to replace an expert and that such a program, beyond doubt, could be designed. Keeping in mind his words: “My educational and professional background does not allow me to take your words seriously” we can consider his further behavior as fantastic. He decided to make a program for histogram comparison and classification on the basis of a neural network algorithm. Based on these algorithms, computer programs recognize a man’s face even if only a small part of its photograph is available. I provided him with as many similar (according my judgment) histogram pairs as he required. Over two months he was “training” the computer to distinguish these histograms, as though imitating the selection process of

an expert. However, when we asked the computer to process a new set of histograms, it failed. The "device" differentiated between one- or two-peaked histograms, and that was all. The program failed. Any typical physicist would conclude undoubtedly: "So, there is nothing to be further pursued here". Edwin decided that in such a case he would develop a program that would assist me with and free me from the extremely laborious handwork of constructing, smoothing, rotating and stretching histogram patterns. In the end, only one function was left over to me: the final diagnosis to classify either "similar" or "non-similar". He worked on designing the program concurrently with his thesis on the X-ray analysis of proteins. In February, 1997, the GM program was completed. Its advantages are enormous, and this work of E.V. Pozharsky is extremely important for the entire further story. He left for the USA in 1999.

6. One more graduate of FizTech, **Alexander Sergeyevich Kutuzov**, worked with our laboratory some time. He also believed that such a program could be designed easily. His choice for modeling a histogram shape was the sorting of polynomials of various degrees. The patterns he obtained even for 9th degree polynomials and higher, were very much like our histograms. But he had no time to elaborate similarity criteria for them as he chose to pursue a career with a bank.
7. Our laboratory was very enthused by the appearance of a new PhD-student – a graduate of FizTech and the chair of nuclear physics from Voronezh University – **Maxim Valeryevich Fyodorov** – an enthusiast of wavelet analyses. It seemed, this time a program would be developed. The material of his thesis covered the results of synchronous measurements of dark noises in multipliers located at Moscow State University (Moscow)* and at Professor F. Popp's International Biophysical Institute (Neuss, Germany)†. Even though M.F. Fyodorov expected to be successful with wavelet analysis, he compared histograms for his thesis "by eye", at full mixing (**randomization using infinite cross-combinations**), not waiting for the program to work reliably. It almost started to work. Fyodorov had no doubts about this evaluation method and even published an article about its success with me as coauthor. However, the program was imperfect. Similar to previous cases it required "selecting parameters". Furthermore, the program did not include a user interface such that it would be readily available to other people except its author. I hoped that it would

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[*] Measurements were conducted by Professor V.L. Voyeykov.

[†] Measurements were conducted by Professor L.V. Belousov.

follow after the (early) defense of his thesis [29]. But immediately after his defense Maxim left for conferences to Spain and Italy. Then he began to prepare for a business trip to England. He never found the time and had left for England. He worked there successfully and soon defended his doctor thesis. Now he is in Germany. It remained unclear whether wavelet analysis is suitable for our purposes. Hence, wavelet analysis supplemented the list of uncompleted methods.

8. Against the background of all these examples for incompleteness, the purposefulness of **V.V. Strelkov** is especially remarkable. Primarily he limited his task to the design of a computer program for the comparison of the "near zone effect" histograms. He had previously discovered this effect in dynamic chaos [30]. This finding could be very important for the search for an algorithm that explores the properties of the "macroscopic fluctuations" phenomenon. It is wonderful, that this effect was reproduced when histograms were compared by the computer program. The program is based on semi-empiric criteria of similarity. Its successful functioning requires parameter selection. V.V. Strelkov managed to publish a detailed description in an elite magazine, having managed to overcome the traditional resistance of the reviewers [26]. However, also in this case a control panel would have been required, such that merely the author can use the program as of today. The list could be continued. There were some more attempts, where authors quit their efforts if they were unable to reach quick results. I want to emphasize again that all these failures are caused mainly by the non-probabilistic character of histogram shapes. Semi-empiric criteria may be very useful, but a comprehensive solution for the identification of the shape idea should be achieved by some other approaches.

2.4 Construction of the time distances distribution of the number of similar histogram pairs. Statistical evaluation of the reliability of histogram comparison results

As a routine final result of our analyses of experimental measurements, we retrieve a distribution of the time distances between similar histogram pairs. This time distances distribution shows the frequency with which histogram pairs were identified for different time values that separate them. After having obtained such a time distances distribution, the reliability of the observed regularities must be evaluated. We previously discussed that standard statistical criteria are not applicable to the results of histogram shape comparisons due to the non-probabilistic character of a histogram shape. For the purpose of evaluating regularities of resulting distributions, however, classical statistical methods can be used. As mentioned above, the calculation of interval values and the construction of the distribution of the number of similar pairs as a function of the separating time intervals can be achieved with the GM program.

Various methods can be used to evaluate the reliability (degree of randomness) of a given extreme ("peak") height in the distributions of the number of similar histogram pairs as a function of their separating time intervals. This is a typical Bernoulli type problem. We compare two series of histograms and find only **N** pairs of similar histograms. This is equivalent in principle to balls of any identical color combination. Let **K** denote the number of inter-histogram intervals for the pairs that were found similar. This corresponds to the number of boxes for balls of the Bernoulli problem. Balls are drawn randomly from a box, the average number of balls in a box is $N/K \pm \sqrt{N/K}$. For a peak height h, the probability of a random realization of the **h** value to $(\mathbf{P_i} \approx 1 \times 10^{-i})$ may be evaluated by Poisson:

$$i = \frac{h - \frac{N}{K}}{\sqrt{\frac{N}{K}}}.$$

The main benefit of this evaluation is the absence of an expert bias, that is, an expert shows no preference for any particular box. The evaluation of **i**-correlated variations in the probability P is presented in Table 2-1.

i	$\mathbf{P_i}$
1	0.32
2	0.05
3	0.003
4	6×10^{-3}
5	5×10^{-7}
7	1×10^{-12}

Table 2-1: Evaluation of changes of P_i (probability that a peak height occurs randomly) as a function of the i-value (value of peak height of the interval distribution above a random level in mean-square deviation units).

We used this simplified evaluation, and another stricter version based on the assumption of a hyper-geometric distribution of the results in a number of our publications. However, for most of our problems, the Poisson evaluation has proved to be quite sufficient. For this reason I will illustrate the evaluations based on the hyper-geometric distribution at a later stage. The $\sqrt{N}$ criterion based evaluation will supplement these, where appropriate.

To obtain a reliable distribution of histogram pairs and to answer any question that may arise from investigating our phenomena, many thousands of histogram shapes must be compared. At this point it is worth mentioning that the share of similar pairs usually amounts to only 5–10 % of the entire number of possible pair combinations. At the same time, however, practically all histograms are included into selected pairs. For example, while comparing "all-to-all" of 100 histograms, 10,000 different pairs are possible, but the number of similar pairs found by an expert may only be 300 (3%). Furthermore, these 300 pairs may include all 100 initial histograms.

At this point the question arises: how does a "subjective" method of selecting similar histograms affect the results of histogram comparisons? The distribution of the number of similar histograms as a function of the intervals is unbiased. A deliberate or unintentional choice of the expert is ensured when an expert does not know the real positions of compared histograms in the time series. For this purpose, the histogram sequence is randomized by means of a random number generator. Unfortunately, this dramatically increases the number of histograms to be compared.

We go ahead with the extremely laborious process of comparing randomized ciphered series of histograms. However, for most cases, an expert bias can be prevented in a less cumbersome way. The tradition of this method has been upheld for the last 400 years, following Francis Bacon: in the simultaneous fulfillment of "experiment and control", two versions of experiments are carried out under the same conditions, with all else being equal, *"ceteris paribus"*, except for one factor. One example of such investigations is the *comparison of two series of the same histograms, differing only by their ordering.*

Let us use the following example: we take measurement results obtained from the analysis of ^{239}Pu alpha-activity by S.N. Shapovalov between March 21, 2005 and March 22, 2005 at the Novolazarevsksya station (Antarctica). Intervals between measurements amount to 1 second. A histogram is constructed from 60 measurements that were obtained in the course of 1 minute. A day thus contains 1,440 minutes and histograms. A time series is divided into three segments of time series, of 720 histograms each: N1 refers to "day" histograms (between 6 am precise (longitudinal) local time and 6 pm on March 21, 2005); N2 refers to the "night" (from 6 pm on March 21, 2005 until 6 am on March 22, 2005); N3 is the same as the N2 histogram section of the time series, but with mirror-inversion, i.e. the histograms of the time series in reverse order).

The histograms were compared by the GM program as follows. Fourteen histograms are displayed in two lines of seven each. The upper line shows histograms of type N1; the lower one displays N2 (or N3) histograms. First, an expert compares all (seven) histograms of the upper line with the histograms of the lower one. Identified similar pairs are registered in a computer record. Then both lines are moved one step forward, and the last (right) cell becomes occupied with a new histogram (N8). A new upper histogram is compared with all lower ones, and the lower one is compared with all upper ones. Such movements are made step by step up to N720. The computer program constructs a distribution, that is, calculates the number of similar histogram pairs, that were classified into the respective value ranges of the separating time-intervals between them.

Comparison of series N1 with series N3	Comparison of series N1 with series N2
$-6 \longleftrightarrow 56$	$-6 \longleftrightarrow 45$
$-5 \longleftrightarrow 44$	$-5 \longleftrightarrow 59$
$-4 \longleftrightarrow 49$	$-4 \longleftrightarrow 41$
$-3 \longleftrightarrow 44$	$-3 \longleftrightarrow 41$
$-2 \longleftrightarrow 44$	$-2 \longleftrightarrow 40$
$-1 \longleftrightarrow 140$	$-1 \longleftrightarrow 50$
$0 \longleftrightarrow 136$	$0 \longleftrightarrow 52$
$1 \longleftrightarrow 68$	$1 \longleftrightarrow 33$
$2 \longleftrightarrow 47$	$2 \longleftrightarrow 42$
$3 \longleftrightarrow 51$	$3 \longleftrightarrow 28$
$4 \longleftrightarrow 53$	$4 \longleftrightarrow 56$
$5 \longleftrightarrow 40$	$5 \longleftrightarrow 51$
$6 \longleftrightarrow 40$	$6 \longleftrightarrow 46$

Table 2-2: Number of similar histogram pairs corresponding to a given interval value.

When comparing series N1 histograms with those of series N2, an expert selected 584 pairs of similar histograms. The comparison of series N1 histograms with those of series N3 provided 812 similar pairs. Table 2-2 and Fig. 2-11 present the resulting distributions.

This experiment shows that when day histogram series are compared with inverted series of night histograms, the probability of histograms with the same index, corresponding to the time interval from which a histogram was constructed (intervals –1, 0), being similar is extremely high: the height

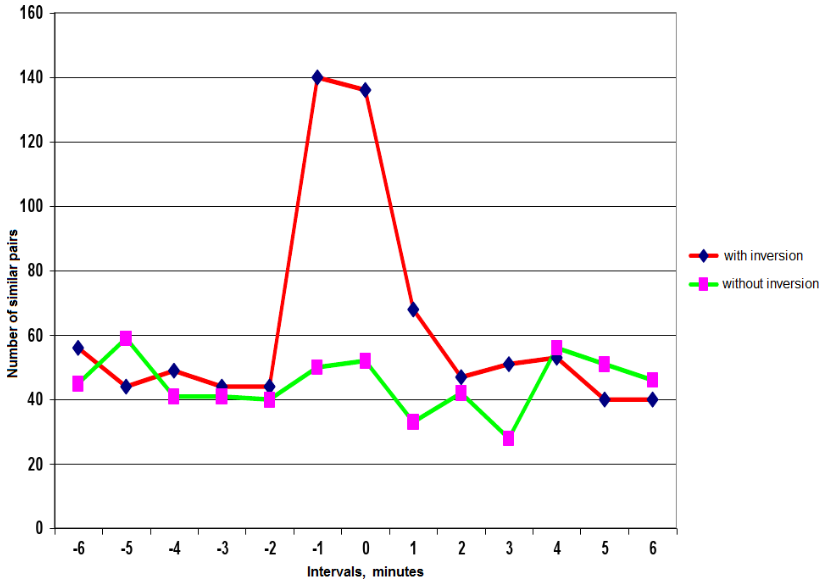

Figure 2-11: Novolazarevskaya st., March 21, 2005. Distribution of the number of similar histograms as a function of the values of separating time-intervals. When day histogram series are compared to the inverted series of night histograms, a palindrome effect can be found. This refers to the high probability of similarity of histograms placed on the same interval numbers (intervals corresponding to an extreme are 1 and 10). No similarity is observed when the same series is compared without inverting one of the series. Details can be found in the text.

of extremes amounts to 135–140 similar pairs. The number of similar pairs of the same histograms that are compared without inversion ranges from 28 to 59, corresponding to a mean-square scatter reading $\delta \approx \pm 3.3$. It is clear that the probability of the random realization of an extreme value of 140 similar pairs with an average level of 50 pairs is vanishingly small.

Chapter 3.

Proof of the reliability of histogram similarity when measuring different types of processes at the same and at different geographical locations

The first task we faced after E.M. Pozharsky had designed his GM program was the validation of the main phenomena obtained earlier (see the 1^{st} part of the book).

The task was accomplished mainly by Tatyana Alexandrovna Zenchenko, who compared histograms in ciphered randomized sequences.

T.A. Zenchenko, mainly a mathematician, graduated from FizTech in 1996. She first studied the mechanisms of enzyme catalysis in our laboratory with V.N. Morozov [31] as a scientific supervisor. After E. Pozharsky had completed his program, T.A. Zenchenko joined the studies of "macroscopic fluctuations".

The comparison of ciphered histogram series to assess their similarity is an extremely laborious process. Processing one large data set can take several days. During the comparisons an expert must uphold the same "stringency" of the tests. The ability of an expert to do this is of special advantage and also a rarity. I am bad at it. T.A. Zenchenko is a past master. For this reason we worked in parallel: she compared histograms after randomization, with ciphered numbers, not knowing their positions. I compared histograms of the same data sets without mixing them. Our results were basically the same. However, T.A. Zenchenko obtained better distributions: her extremes in the distributions (with mixed material!) looked like delta functions.

From the 1^{st} part of the book we remember that in 1988 A.N. Zaikin was a member of a routine "global cruise" of the "Vityaz" ship (for the Institute of Oceanology of the USSR Academy of Sciences). The main area that it covered was offshore of the Indian Ocean. A.N. Zaikin solved some other problems of his own, and also helped us in the same way as he had done while travelling in the Pacific Ocean in 1987: he took our portable alpha counter and brought us tape recorder cassettes with records of measurement results. Between November 8 and November 13, 1988, while the ship anchored near the island of Madagascar, he was making measurements around the clock, results of which I processed by hand before E. Pozharsky's GM program was available: by means of tracing paper and flomasters. I found that hour histograms resulting from measurements obtained on the ship and in Pushino changed synchronously. In 1997 T.A. Zenchenko compared these histograms after their randomization. As one

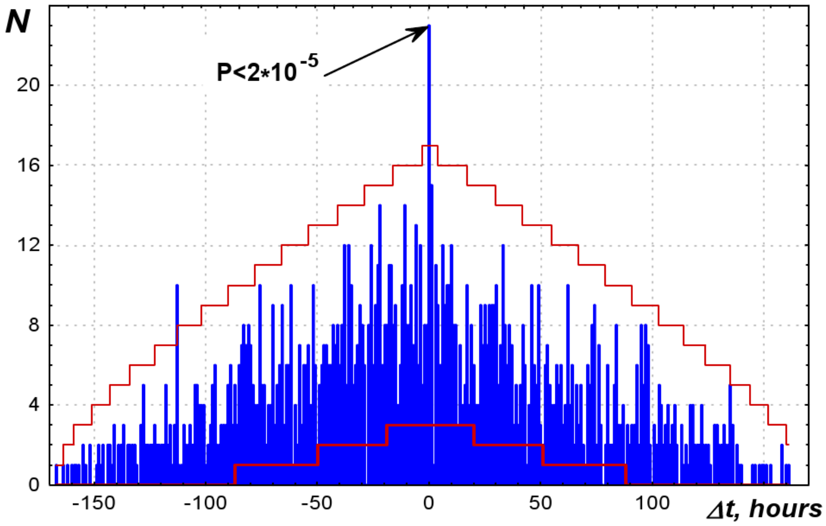

Figure 3-1: Synchronous changes of 1-hour histogram shapes, constructed from the results of 60 simultaneous measurements of ^{239}Pu alpha-activity from November 8 to November 13, 1988 on the Vityaz' ship near the Madagascar island in the Indian Ocean (15^o SL and 44^o EL) (A.N. Zaikin) and in Pushino (V.A. Kolombet). Distributions of intervals between similar histograms obtained from the comparisons by T.A. Zenchenko after randomization. P_1 is evaluated by the hypergeometric distribution.

can see from Figure , a reliable synchronism of similar histograms occurring was observed on the ship, which was about six thousand kilometers away from the Pushino laboratory. The probability of randomly obtaining such a result for a hyper-geometrically based evaluation is less than 10^{-5}. In this context I have to mention that the ship was located practically on the same meridian as Pushino. Thus, we have the same local time (with up to 1 hour interval accuracy). This result matched the one obtained earlier (see the 1st part of the book). However, our previous conclusion was based on the similarity of shapes of individual histograms, and now a probabilistic assessment based on comparing all histograms with all others, an "all-to-all" comparison, became available.

In 1995 a member of the Physics Faculty (SINP MSU) Irena Mikhaylovna Zvereva got to know our work. For a number of years she trained students of the Physical Faculty in the techniques of radioactivity measurements, and believed that the statements on the similarity of the fine

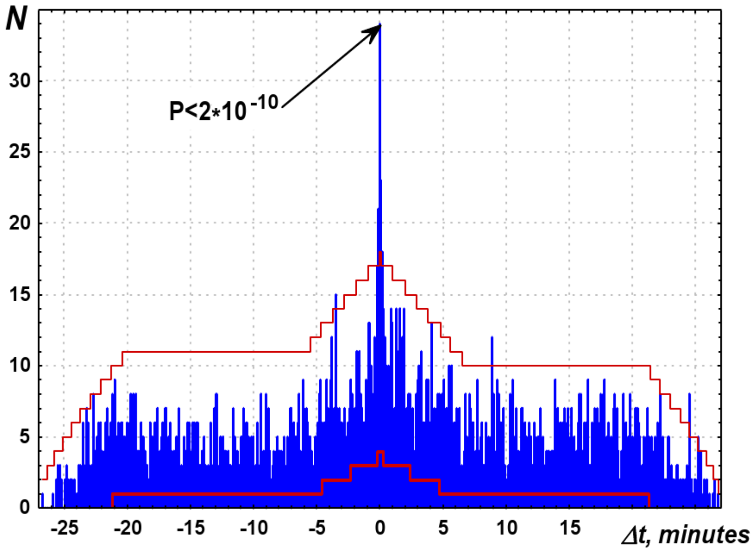

Figure 3-2: For measurements of the alpha activity of two ^{239}Pu preparations at the same laboratory obtained with independent counters, the probability of a synchronous occurrence of similar histograms is very high (X-axis value = 0 to denote no time difference). The duration of one measurement is 0.06 sec; each histogram contains 100 measurements; one histogram contains measurements from 6 seconds. The measurements were carried out on December 25, 1995 by I.M. Zvereva (SINP MSU). The comparison of histograms in randomized series was carried out by T.A. Zechenko. 32,500 comparisons were made and 2,681 similar pairs were selected. P_1 is evaluated by the hypergeometric distribution.

structure of the distributions of such measurement results were incorrect. We proposed to her (considering her doubts) to conduct an experiment. She measured alpha activity of two ^{238}Pu samples with two independent I.A. Rubinstein counters. T.A. Zenchenko randomized the resulting series obtained by I. M. Zvereva and compared them. Results of the comparison are presented in Fig. 3-2.

As one can see from this figure, the similarity of 6-second histograms obtained from independent simultaneous measurements is very high and also reliable. Similar data were also obtained in an analogous experiment in Pushino (see Fig. 3-3). Here T.A. Zenchenko compared ciphered histograms that were each constructed from 60 one-minute measurements (the total time window for each histogram is 1 hour) of the alpha activity of two ^{239}Pu preparations. Measurements were obtained with two independent

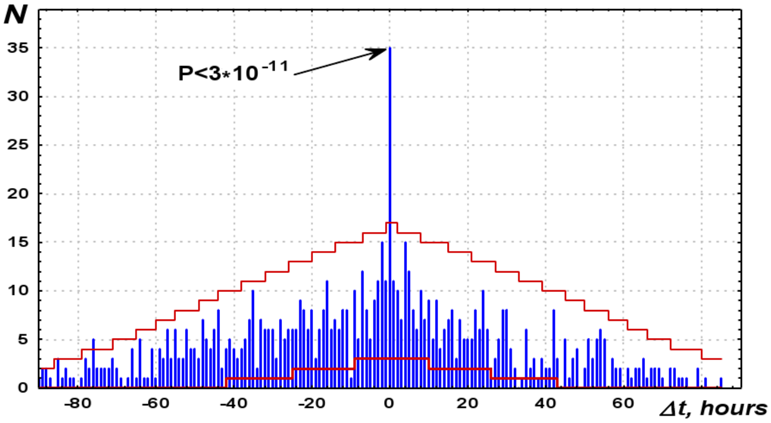

Figure 3-3: Distribution of the intervals between similar histograms. Synchronous shape changes of 1-hour histograms, which were constructed from the results of measurements of alpha activity of two ^{239}Pu-preparations obtained with two independent counters; measurements were carried out between January 15 and January 19, 1997; histograms are constructed by K.I. Zenchenko (ITEB RAS); the duration of a measurement is 1 minute; each histogram contains 60 measurements. The histogram comparison of the randomized series was carried out by T.A. Zechenko. P_1 is evaluated with the hypergeometric distribution.

counters.

This figure shows, amongst others, that the conclusion on synchronous changes of histogram shapes obtained from independent measurements with different devices is absolutely reliable.

The reliability of the statement on synchronous changes of histogram shapes from independent measurements in this experiment was similarly extremely high (the probability of randomly obtaining such a distribution is less than 10^{-11}, which is "vanishingly small").

The reliable synchronous changes of shapes of histograms, where histograms result from independent measurements at one and the same geographical point, present one main piece of evidence for the existence of some "external force" determining a histogram shape. We could not identify any trivial conditions that could cause or explain this phenomenon. The issue is not only the impossibility of any "effects" on the rate of alpha decay under laboratory conditions, but also the high discrimination threshold

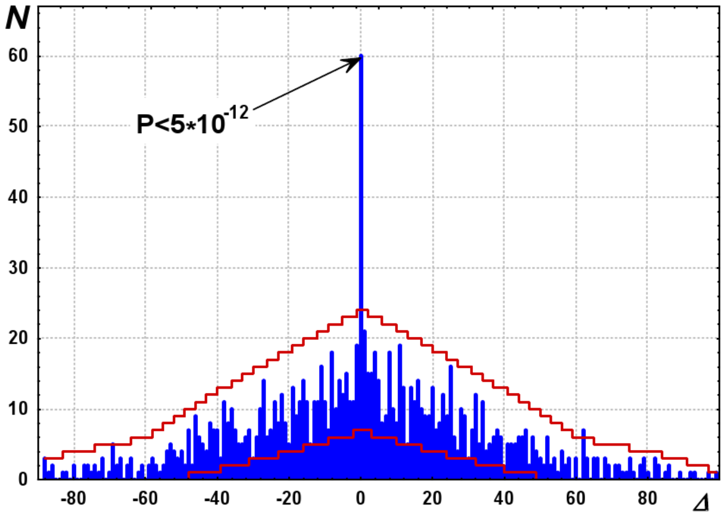

Figure 3-4: ^{226}Ra, ^{222}Rn, ^{218}Po, ^{214}Po, and ^{210}Po are from the radium-226 radioactive family. Each member of the family decays, in principle, independently and not consistently with the others. Nevertheless, the shapes of histograms constructed from the results of I.M. Zvereva (SINP MSU) change synchronously. She measured the alpha activity of^{218}Po and ^{214}Po with an amplitude analyzer that was equipped with a counter on June 10, 1996. One measurement was obtained each 1.8 seconds. Each histogram is constructed from the results of 50 measurements. The histogram comparison in randomized series was carried out by T.A. Zenchenko. P_1 is evaluated with the hypergeometric distribution.

cutting all sources of "noise". The exposure of a process or of the measurement procedure to any hypothetic effects may change only the average level, but not the fine structure of distributions, that is the fine structure of histograms. And the character of the distribution of the probability of the occurrence of similar histograms, which almost corresponds to the delta function, means the absence of external noise, as any "effects" may only cause such a distribution to be less distinct.

In this connection, I.M. Zvereva conducted another experiment. She measured the alpha activity of a $^{\mathbf{226}}\mathbf{Ra}$-preparation, which possessed a secular balance with products of its decay: $^{\mathbf{222}}\mathbf{Rn}$, $^{\mathbf{218}}\mathbf{Po}$, $^{\mathbf{214}}\mathbf{Po}$, and $^{\mathbf{210}}\mathbf{Po}$. It is clear that each of these daughter products of radium decay further decays independently. Therefore, the half-lives of these isotopes are sharply different (from 1,620 years for $^{\mathbf{226}}\mathbf{Ra}$ to 10^{-4} sec for $^{\mathbf{210}}\mathbf{Po}$). Different isotopes emit alpha particles with different energy, and this allows measuring their activity in the same sample separately, with the help of an amplitude analyzer. Series of smoothed histograms from the results of such measurements were obtained for each isotope. These histograms were randomized and compared by T.A. Zenchenko. From the comparison of these ciphered series we construct a distribution of the number of similar histogram pairs depending on the value of a separating time interval [35-42]. One of the resulting distributions is presented in Fig. 3-4.

Fig. 3-4 shows that the shapes of histograms of different isotopes, which independently decay at the same time (corresponding to zero on the X-axis) are similar, and this similarity is highly reliable.

These results were repeatedly obtained many times over. Figs. 3-5, 3-6, and 3-7 present the results of analogous experiments on the comparison of histograms of three isotopes: ^{226}Ra, ^{218}Po (polonium-1), ^{214}Po (polonium-2), ^{210}Po (polonium-3).

As mentioned above, we evaluate the reliability of the extremes of these distributions under a hypergeometric distribution law or, as a rougher generalizing evaluation, under the Poisson distribution law. The probability of randomly obtaining such high central extremes even under such more general evaluations is vanishingly small.

These illustrations of the synchronism of histogram shape changes in measurements of various processes are very impressive. The risk that an expert would make subjective choices while picking similar histograms is absolutely impossible here. **The main, fundamental scientific conclusion is: the existence of a general non-trivial cause determining a fine structure of the spectrum of measured value fluctuation amplitudes seems doubtless.**

The stronger the effect of results obtained by I.M. Zvereva's and processed by T.A. Zenchenko was, the more careful the Chair's leaders were. I.M. Zvereva could not use this material in her thesis. She was not allowed. Well, I hope that someday one of these figures together with portraits of Irena and Tatyana will be placed in the corridor of the fourth floor of the MSU Physical Faculty in the "Notable women physicists" series.

All these results, obtained from massive comparisons of thousands of histogram pairs, confirmed the conclusion of the years 1982-1996 on the high probability of the synchronous realization of similar fine structures of statistical distributions, which were constructed from independent measurements of different processes.

And this meant the confirmation of the conclusion on the existence of a common external cause ("force", as it was named in the 19th century) for different processes.

Results obtained in the 1980s from measurements of radioactivity in

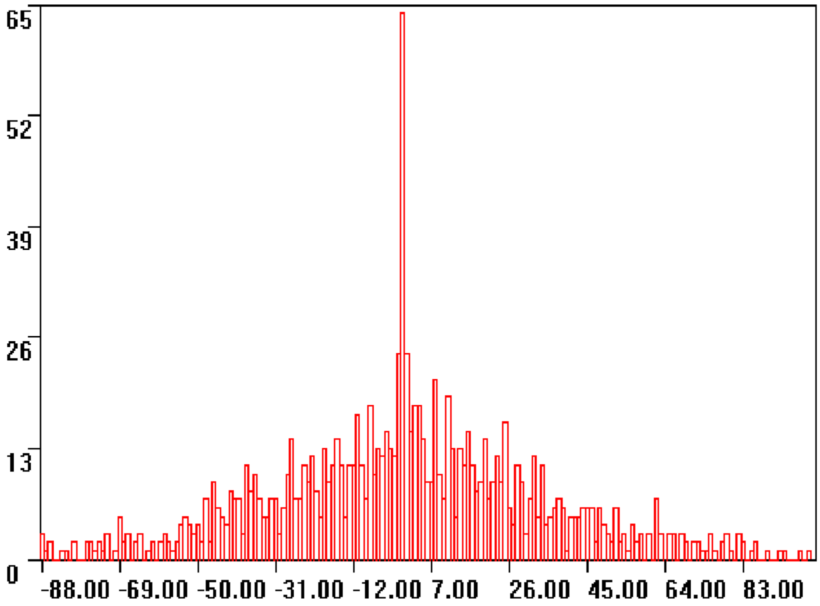

Figure 3-5: One more illustration of the synchronous changes of histogram shapes from measurements of the activity of independently decaying radium family isotopes. I.M. Zvereva's measurements on June 14, 1996. Each histogram contains 50 measurements obtained with a distance of 1.8 sec between them, which corresponds to 90 seconds in total. Comparison of fully mixed series of histograms, constructed for three isotopes: radium, polonium-1, and polonium-2 (T.A. Zenchenho). From the comparison of 17,200 pairs of histograms, 1,120 similar pairs were identified (6.5% of the theoretically possible amount). 64 pairs of the 220 possible were totally synchronous, which corresponds to a share of 29%.

Leningrad and the rate of the AA + DCFIF chemical reaction in Pushino (see the 1^{st} part) told that the synchronism of changes of histogram shapes is observed at the same local time. However, for our measurements on the ship in the Pacific Ocean and in Pushino (see Fig. 5-19 in the 1^{st} part) we observed an absolute-time synchronism. This alternative needed solving. We made appropriate experiments on various processes and at various geographical points for many years. The phenomena of local- and absolute-time synchronism are reviewed in detail in Chapter 7.

For many years, *Boris Mikaylovich Kuzhevsky* (1938–2005, SINP MSU) had been exploring the intensity of neutron flows falling on the Earth from

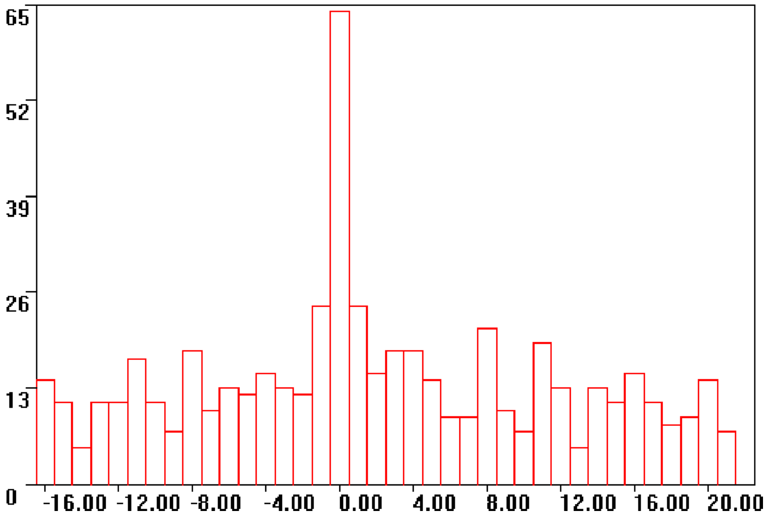

Figure 3-6: A scaled fragment of Fig. 3-5.

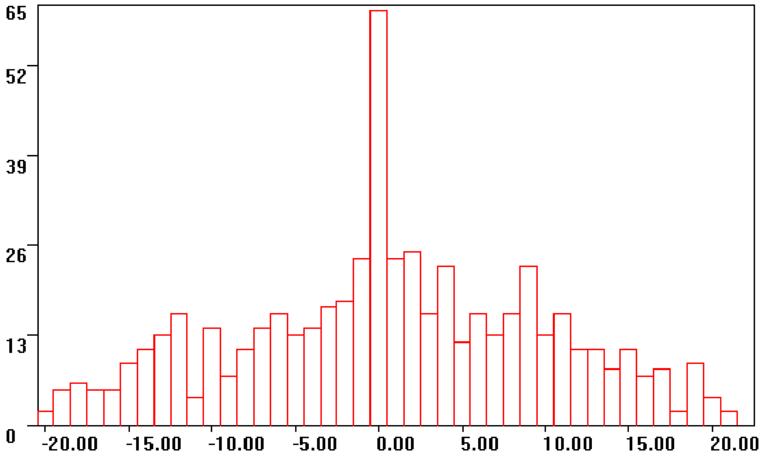

Figure 3-7: One more experiment. . . I.M. Zvereva's measurements dated 12 October, 1997. A histogram series was divided into 10 portions, 24 histograms of each isotope in a portion. We compared histograms for radium and polonium-1 after mixing. From 5,760 compared pairs, 563 similar pairs (9.8%) were identified. 61 of the 240 possible histograms (25.4%) occur synchronously.

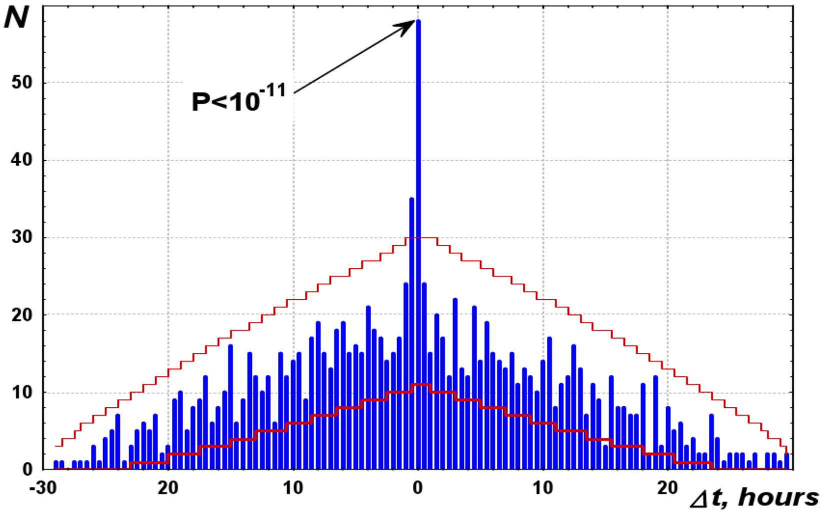

Figure 3-8: Synchronism of shape changes of one-hour histograms, constructed from measurements of the intensity of earth crust neutron flows at SINP MSU, Moscow (B.M. Kuzhevsky), and of ^{239}Pu alpha activity at ITEB RAS, Pushino (K.I. Zenchenko and V.A. Kolombet) between December 27 and December 31, 1997. The comparison of histograms in randomized series was carried out by T.A. Zenchenko [43]. P_1 is evaluated by the hypergeometric distribution.

outer space and of those emitted during nuclear reactions in the earth crust. We explored the shape of histograms constructed from the results of these measurements and compared them with those constructed from the results of synchronous measurements of alpha activity in Pushino. One-hour histograms were compared. Fig. 3-8 presents the complete, absolutely reliable synchronism. The distance between the laboratories is 100 km. It is worth mentioning that Pushino and Moscow are located on the same meridian, and their longitudinal difference, 37^{o}38' and 37^{o}31', are small, correspondingly. Furthermore, for an accuracy of one hour, this difference is not essential.

The synchronism of histogram shape changes became apparent in these measurements directly, "without statistics": fragments of time series could be revealed in two series with the identical idea of successive histogram shapes. So, Fig. 3-9 presents the similarity of histogram shapes of the same numbers, 8–15, for measurements of the earth crust neutron flow and of ^{239}Pu alpha activity.

The probability of random similarity of the number of successive his-

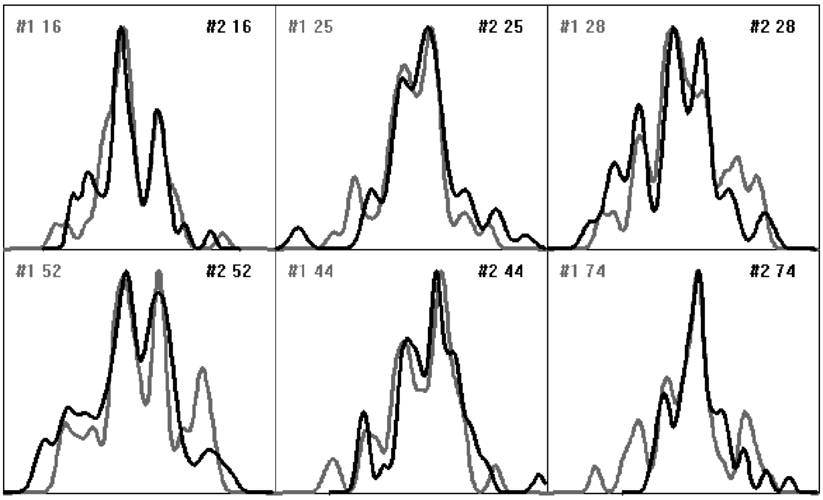

Figure 3-9: Illustration of the similarity of a "shape idea" in synchronous changes of the flow of neutrons in Moscow and of ^{239}Pu alpha activity in Pushino. Fragment of the histogram time series. Overlapping the same histogram numbers that were obtained from measurements of neutron flows in Moscow and from ^{239}Pu alpha activity in Pushino demonstrates their shape similarity at the same time (see Fig. 3-8).

togram pairs (similar as in Fig. 3-9) is a product of the probabilities of similarities for each individual pair, and this product is vanishingly small. Similar results were obtained from the comparison of one-hour histograms constructed from measurement results of ^{137}Cs gamma (beta) activity in Dubna and of ^{239}Pu alpha activity in Pushino (see Fig. 3-10). In this case local times at two geographical points are practically the same, too.

In 1988 we discussed our phenomena with the Director of the Max Planck Institute for Aeronomy, Professor Ya. Axford, and agreed to conduct synchronous measurements of radioactivity at his Institute (in Lindau, Germany), in Moscow and in Pushino. The difference between Lindau and Moscow local times as determined by the difference in longitudes is 109 minutes. We compared histograms constructed from alpha activity measurements conducted in Lindau by Dr B. Vilken with B.M. Kuzhevsky's histograms, which were constructed from measurements of the earth crust neutron flow and revealed an evident local-time synchronism (Fig. 3-11).

We could demonstrate a higher resolution local-time synchronism from the comparison of histograms constructed from measurements of photomul-

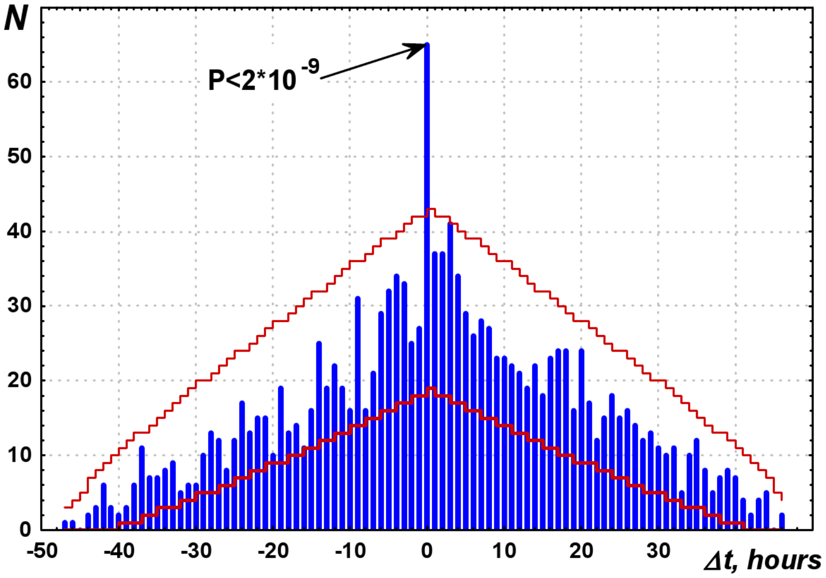

Figure 3-10: Synchronism of histogram shape changes in measurements of ^{137}Cs gamma (beta) activity in Dubna (JINR, Yu. A. Baurov et al.) and of ^{239}Pu alpha activity in Pushino (K.I. Zenchenko) between January 3 and January 19, 1999. Each histogram contains 60 one-minute histograms. Comparison of histograms in randomized series was carried out by T.A. Zenchenko. P_1 is evaluated by the hypergeometric distribution.

tiplier leakage current fluctuations conducted by L.V. Belousov in Neuss, Germany (at the International Biophysical Institute), and V.L. Voyeykov in Moscow (MSU) from September 25 to September 27, 1999. The leakage current was measured by the impulse score procedure. The duration of a measurement was 12 seconds. Each histogram was constructed from 30 measurements (total time of 6 minutes). The difference between longitudes corresponds to 124 minutes local time difference. Histograms in randomized series were compared by M.V. Fyodorov (Fig. 3-12).

This experiment demonstrates again that the analyzed phenomena do not depend on the type of process. The local-time synchronism is seen in this figure with an accuracy of 6 minutes.

The significant point of this series of experiments was the comparison of histograms constructed from measurements obtained by S. Benford and G. Talnagi of ^{137}Cs beta (gamma) activity (Nuclear Center, Columbus, USA) and K.I. Zenchenko's ^{239}Pu alpha activity measurements (Pushino)

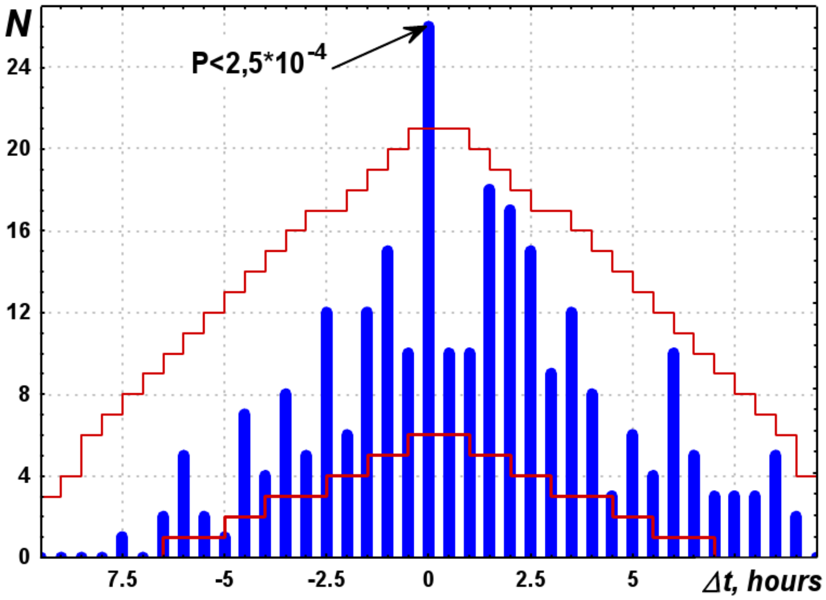

Figure 3-11: Synchronism of histogram shape changes constructed from Dr. B. Vilken's measurements of ^{228}Ra alpha activity decay (Max Planck Institute for Aeronomy, Katlenburh, Lindau, Germany) and by B.M. Kuzhevsky's measurements of earth crust neutron flows (SINP MSU, Moscow) from September 28 to September 30, 1999. Each histogram contains 30 one-minute measurements. Histograms in randomized series were compared by T.A. Zenchenko. (The x-axis shows the deviation from the local-time synchronism) [44].

between January 19 and January 21, and from February 18 to February 20, 2001. The duration of a measurement was 30 seconds. Each histogram contained 30 measurements (in 15 minutes). The difference of longitudes corresponds to 8 hours and 3 minutes local time difference. Histograms in randomized series were compared by T.A. Zenchenko. At about 12,000 km distance between laboratories, the local-time synchronism was revealed with an accuracy of 15-minute. Results of these experiments are presented in Fig. 3-13 and Fig. 3-14.

Results of these measurements were analyzed over and over again. I obtained analogous distributions of similar histograms comparing them without randomization, but only the comparisons of randomized histogram series can prove that the resulting distributions are not biased by the (unintentional) subjectivity of an expert.

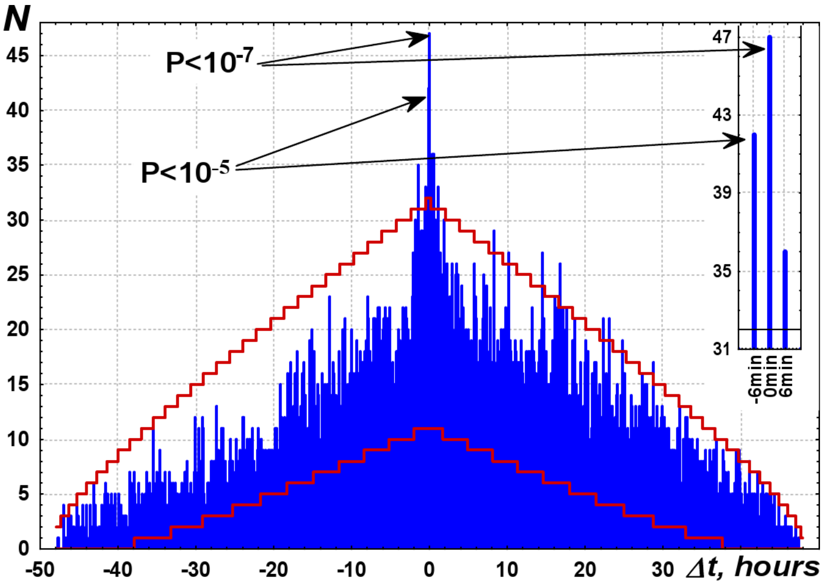

Figure 3-12: Local-time synchronism of histogram shape changes. Histograms were constructed from measurements of photomultiplier leakage current fluctuations conducted by L.V. Belousov in Neuss, Germany (International Biophysical Institute), and V.L. Voyeykov in Moscow (MSU) between September 25 and September 27, 1999. The duration of a measurement was 12 seconds. Each histogram contains 30 measurements (6 minutes in total). The Longitude difference corresponds to 124 minutes of the difference between the local times. Histograms in randomized series were compared by M.V. Fyodorov. P $= 10^{-3}$ borders are marked [45]. P_1 is evaluated by the hypergeometric distribution.

Thus, the following conclusion of our investigations from the 1970s to 1980s is confirmed: the spectrum of amplitude fluctuations and the shapes of corresponding histograms are similar when measurements of different types of processes are carried out at different geographical points at the same local times, and change synchronously by the local time. This synchronism had been confirmed through the comparison of alpha and beta decays rates, of dark-current noises of photomultipliers, of alpha decay and the flow intensity of neutrons.

Experiments on the comparison of histogram shapes constructed from measurements of radioactivity changes and noises in “Ulitka” gravity-gradient antenna (the antenna was constructed in the 1980-1990s at SAI MSU for the registration of gravity waves [46]), form a special area of our

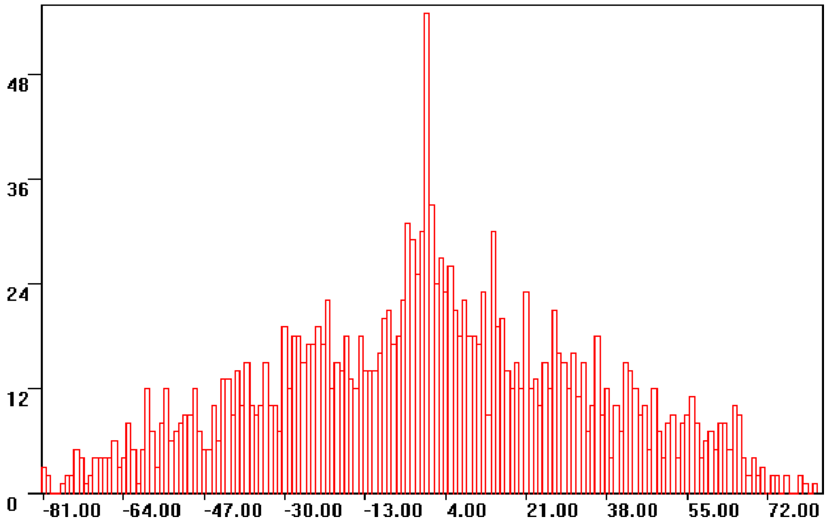

Figure 3-13: Local time synchronism of histogram shape changes in the measurements of ^{137}Cs beta (gamma) activity obtained by S. Benford and G. Talnagi (Nuclear Center, Columbus, USA) and K.I. Zenchenko's ^{239}Pu alpha activity measurements (Pushino) between January 19 and January 21, 2001. The duration of a measurement was 30 seconds. Each histogram contains 30 measurements (15 minutes in total). Both sets of histograms from Pushino and Columbus were divided into two portions: of 83 and 84 histograms. All histograms were completely mixed. There were 13,945 pairwise histogram combinations in total. 1,844 similar pairs, that is 13%, were identified. Histograms in randomized series were compared by T.A. Zenchenko. The difference between longitudes corresponds to 8 hours and 3 minutes local time difference. The X-axis displays the deviation from the local-time synchronism. Intervals are 15 minutes long.

investigations. As it turned out, the registration of these waves by this antenna required a sensitivity of several orders higher. However, the noises of piezo-sensors fixed on the body of a duralumin cylinder, a Weber antenna by itself, were being registered for several years. These series were extremely valuable to us: they present cosmophysical regularities of histogram shape changes that we study. It is because of the kindness of Professor V.N. Rudenko, who made it possible to compare the shapes of histograms obtained from measurements of “Ulitka” noises at SAI (Moscow) with the shapes of histograms obtained from ^{239}Pu alpha activity measurements in Pushino. First we got 10 minutes averaged mean-square amplitudes of these noise fluctuations. These data only allowed the construction of

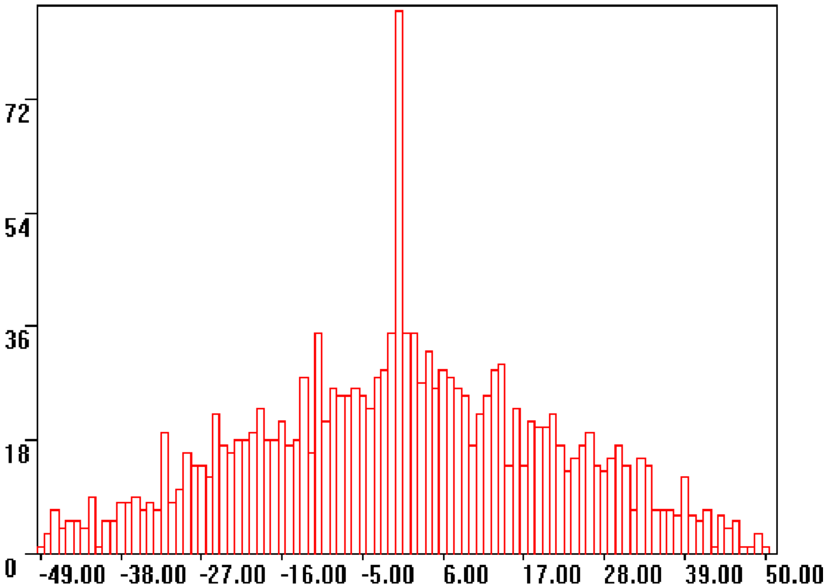

Figure 3-14: Local-time synchronism of histogram shape changes in the measurements of ^{137}Cs beta (gamma) activity obtained by S. Benford and G. Talnagi (Nuclear Center, Columbus, USA) and K.I. Zenchenko's ^{239}Pu alpha activity measurements (Pushino) between January 17 and January 18, 2001. The duration of a measurement is 30 seconds. Each histogram contains 30 measurements (in 15 minutes). Five portions of 15-minute histograms, 51, 51, 51, 51, and 53 histograms at each place. 13,005 pairwise combinations are possible in total. 1,631 similar pairs, that is 12.5%, were selected. All histograms were completely mixed. Histograms in randomized series were compared by T.A. Zenchenko.

histograms for a total of 6 hours. We coarsened the results of our measurements of alpha activity correspondingly: we constructed histograms with the same 6-hour intervals from the same dates as the SAI measurements. T.A. Zenchenko compared them after complete mixing and obtained the distribution presented by Fig. 3-15.

The distribution in Fig. 3-15 tells about the evident synchronism of changes of histogram shapes resulting from very different processes for a distance of more than 100 km between laboratories. The share of similar pairs of histograms is small. This synchronism becomes more expressed when coarsening the 6-hour intervals 4-fold, that is to 24-hours, or (day)-intervals (Fig. 3-16).

In the following, we returned again and again to the comparison of his-

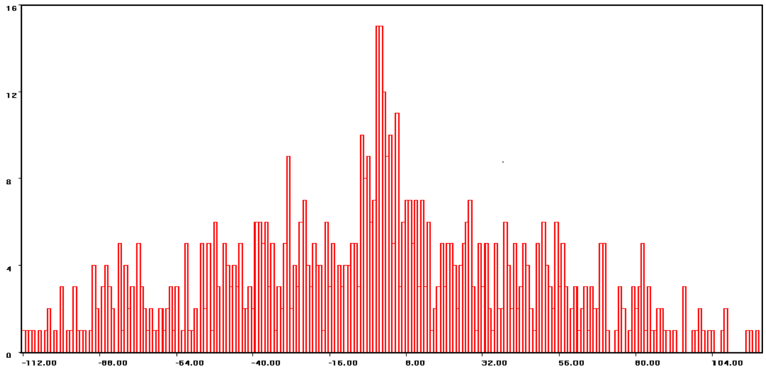

Figure 3-15: Results of the comparison of 6-hour histograms, obtained from measurements of noises at "Ulitka" gravimetric–gradient antennae at SAI (Moscow) and of ^{239}Pu alpha activity measurements in Pushino between July 18, 1997 and August 13, 1997. Each series contained 508 six-hour histograms. Only 684 were found to be similar, which is about 0.27% of all possible combinations. Compared after complete mixing (T.A. Zenchenko).

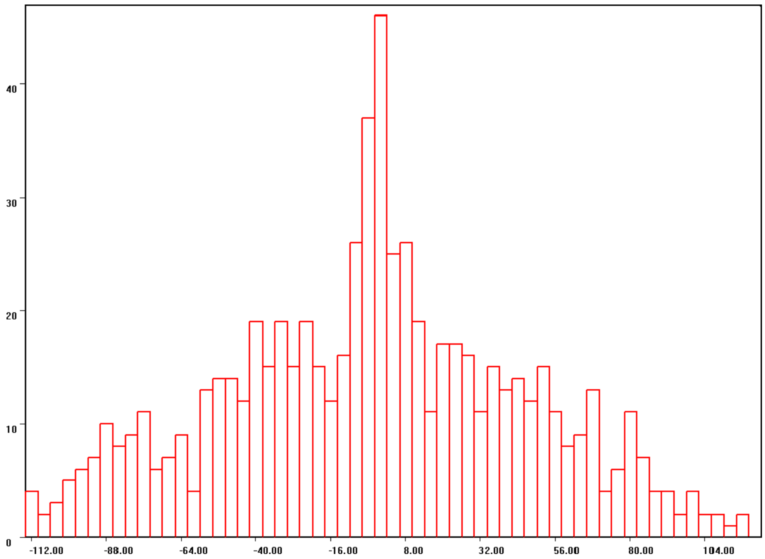

Figure 3-16: The same distribution as in 3-15, but after coarsening the intervals to up to 24 hours.

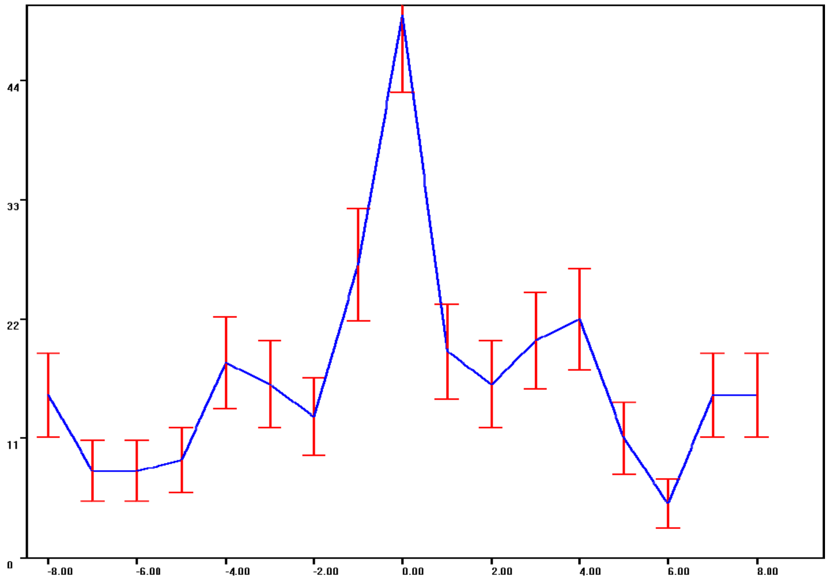

Figure 3-17: Synchronism of 1-hour histogram shape changes from measuring "Ulitka" (SAI, Moscow) noises and from measuring ^{239}Pu activity on March 22, 2001. The mean square errors are marked and based on the Poisson evaluation. Axes are the same as in earlier figures.

tograms resulting from measurements of gravity-gradient "Ulitka" antennae noises and from measurements of radioactivity. We got unsmoothed results of measurements with 1-second intervals, and compared them with the analogous results of radioactivity measurements. Fig. 3-17 presents one result from the comparison.

Such experiments as presented in Fig. 3-17 demonstrate the distinct synchronism of histogram shape changes in the measurements of "Ulitka" noises and of radioactivity. These results make special "psychological" sense as an illustration of the independence of effects from the energy changes scale shows: the difference of the order of these changes in the case of alpha decay and of gravitational antennae is huge, they differ by more than 10.

As indicated in the beginning of this chapter, the main purpose of the material covered in this chapter was to check the reliability of conclusions formulated earlier on the synchronous realization of similar histograms in measurements of different types of processes at different geographical points at one the same local time. This task has been completed; the reliability of the phenomenon became doubtless. It was very important. However, this did not make the phenomenon less important. And for many years, the effect of the local time remained a subject of our further investigations. Chapter 7 tells the story.

Chapter 4.

The near zone effect

4.1 What is the "near zone effect"

The near zone effect refers to the much higher probability for histograms that are nearest to each other in time to be similar, hence nearest neighbor histograms. Histograms were derived from the data in sequence and constructed from non overlapping sections of the time series. Thus, they do not share data from similar time series sections. We believe that the existence of some external universal cause determines a histogram shape. It is unlikely that this cause is due to some particular physical force, be it an electromagnetic or acoustic field, cosmic rays or tide gravitational effects. The universality of this effect alongside the histogram shape similarities that are independent of the type of process point to a universal cause.

Formerly, in the period of the 1980s–1990s, uncovering the near zone effect and the close to one day period of the recurrence of similar histograms took several years (see Fig. 5-10 in the first part of the book). After A.V. Pozharsky provided the GM program, we were able to demonstrate these effects within several hours. For the analysis of macroscopic fluctuations, these near zone phenomena as well as the effect of synchronism in absolute and local times proved to be very significant.

An important property of the near-zone effect and the manifestation of the local- or absolute-time synchronism is their variability. Sometimes the effect is very distinct, other times it is hardly noticeable. T.A. Zenchenko tried to identify a possible relation between this variability and other variable parameters of the environment. For this reason, in 2001, to my regret she stopped comparing randomized histogram series and focused solely on tracing the variations of manifestations of the similarity of nearest neighbor histograms. She made interesting observations in this area. For example, she found that the frequency spectra of variations in the near zone effect are very similar to the frequency spectra of some characteristics of magnet field changes [48, 48]. *Here, the main concern is not the temporary correlation between changes in magnetic fields and the occurrence of the near-zone effect.*

In light of the above-mentioned, in terms of the universality of this effect, I do not believe that a direct casual relationship, or a conditioning of the near zone effect with some magnetic, or electromagnetic effect should be our main source of concern, or focal area of investigation. However, this similarity of frequency spectra is interesting as a possible key for future discoveries.

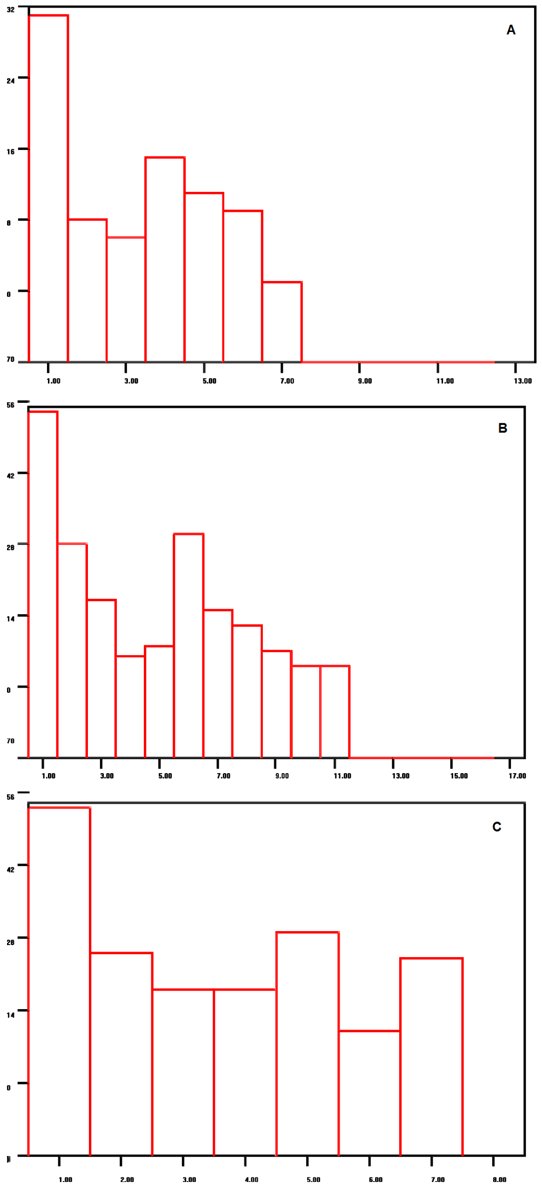

Figure 4-1: "Near-zone effect": (much higher probability of similarity of nearest neighbor histograms) this effect is universal and fractal, that is, it neither depends on the type of process nor on the absolute meaning of the time interval corresponding to one histogram. **A**: 6-hour intervals. Measurements of noises in "Ulitka" gravimetric-gradient antennae, Moscow, March 8, 2000. **B**: 1-minute intervals. Measurements of ^{239}Pu alpha-activity, Antarctic, March, 2003. **C**: 0,013-seconds intervals. 44 kHz generator, Pushino, March 6, 2006.

A straightforward explanation of the near-zone effect is that a shape idea stems from an external cause and is characterized by some specific "life-time". For some reason this life-time equals, as a rule, the time corresponding to two histograms, independent of the time interval taken up by one histogram.... Many times, for many years we tried to measure this "life-time of a shape idea". For this purpose we constructed histograms by time series sections of different lengths. One histogram (that is one interval) may equally well be derived from measurements of many hours, one hour, six minutes, one minute, or six seconds.... In a remarkable manner the near-zone effect does not change when the time interval is varied: the most similar histogram was always the closest in time, the adjacent one. This fractality leaves a somewhat mystical impression. We hope to clarify this mysticism through investigating even shorter time intervals – thousandths and millionths of a second.

The near zone effect is illustrated in Figure 4-1.

We have not yet determined a plausible explanation regarding the nature of the near-zone effect, that is the regularities that determine the occurrence of this effect. The fractal nature of an object is a sign of its complexity. Explaining this effect through an "external force" seems doubtful to me since V.V. Strelkov discovered this effect in the realization of a system of differential equations with dynamical chaos character [30]. In this case, the near zone effect is apparently due to algorithmic causes. How can I correlate this fact with the near zone effect? It is impossible to understand.

4.2 The dependence of the "near zone effect" on the spatial direction

Our measurements near the North Pole allowed us to observe the dependence of the near zone effect on the direction in space (see also Chapter 8). This effect almost disappeared at that location. The natural explanation of this could be the absence (decrease) of changes of a star sky pattern in the day, because the absence of the Earth rotation results in a relative constancy of the pattern relative to the earth's movements. However, in the experiments with the collimator directed at the Polar Star (Chapter 11), measurements in Pushino ($\mathbf{54^o\ NL}$) showed that this effect disappeared. This could not be explained in the same way as the measurement results from the North Pole. In the spring of 2009, we compared the near zone effects' relationship to the direction in space of collimators. I compared the results of different versions of simultaneous pair measurements of $\mathbf{^{239}Pu}$ alpha-activity made in 2005

1. with the collimator directed to the West,

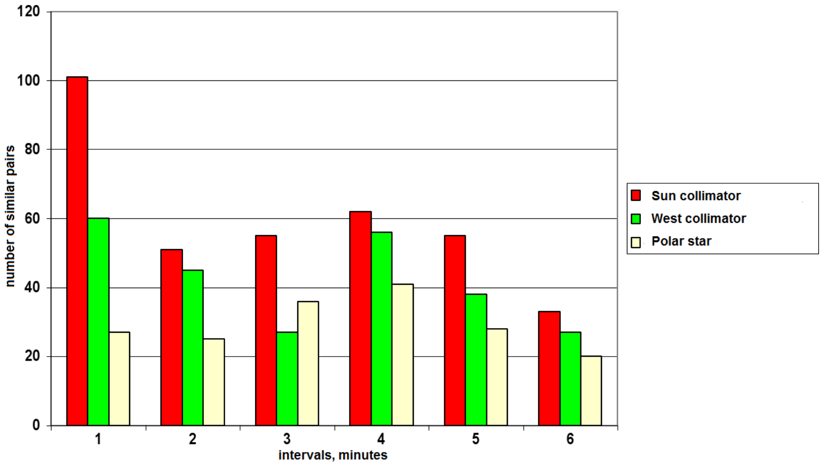

Figure 4-2: The near zone effect is twice as pronounced, as can be een by the height of the red bars, for measurements with the collimator directed at the Sun, as compared to measurements taken with a collimator that is directed to the West. For the Polar Star direction, the near zone effect is absent.

2. with the collimator directed towards the Sun,

and measurements made in 2003 of a

3. collimator directed to the West, and
4. collimator directed at the Polar Star.

The results were "impressive" (see Fig. 4-2): the most striking result was the occurrence of the near zone effect in the measurements from the collimator directed at the Sun; the effect was almost twice as pronounced as compared to measurements with the collimator directed to the West. On the contrary, the manifestation of the effect in measurements with the collimator directed at the Polar Star was almost less than twice as pronounced than for measurements with the collimator directed to the West.

Chapter 5.

Close to one-day periods

Our most significant results from the 1980s-1990s are the discovery of a 24 hour period in the recurrence of similar histogram shapes, as well as the discovery of a local-time synchronism of similar histograms, and of the near zone effect (Fig. 5-10 in Part 1).

The 24 hour period and the local-time synchronism imply a dependence of histogram shape changes on the Earth axial rotation [50]. The manifestation of a one day period varies across different experiments. One can find it in the results from histogram shape comparisons, where histograms were constructed from 60-minute measurements of the alpha-activity of a ^{239}Pu preparation from five experiments obtained at different days (Table 5-1 and Fig. 5-1).

Similar to the one day-period as such, these differences are not a consequence of or stand in relation with some anthropogenic daily activity, temperature changes, or electric circuit voltage, etc. We describe details of the histogram method for time series analysis. Any changes in the way measurements are retrieved can only have an effect on the average level of measured values. Various trends may appear, that is, relatively low-frequency changes of mean-arithmetic values that are correlated with changes in temperature, humidity, etc. No trends appear in measurements taken with devices constructed by I.A. Rubinstein.

However, even if low-frequency changes of average values (trends) are present, they cannot change the *shape* of a histogram.

Alpha-activity measurements provide some special advantages (as was mentioned in Chapter 1), because of their realization with 0,1 logic: only decay events are registered, independently of the features of a correspondent impulse. Furthermore, the discrimination threshold is so high that changes of the impulse amplitude, which typically occur , are discriminated. Thus, the repeated manifestations of day periods, the occurrence of the near zone effect, and the local-time synchronism across different experiments can only be a reflection of some fundamental underlying processes.

Table 5-1 represents the results obtained in the course of determining the number of similar 60-minute histogram pairs, according to the value of separating time-intervals. The relatively high probability for nearest neighbor histograms to be similar (the near zone effect) and the relatively high probability of identifying similar histograms when the time interval between them is 24 hours (one day period) are immediately apparent. Individual experiments show variations in results. The statistical confidence is increased

intervals	dates when measurements started							
hours	Feb. 17	Mar. 18	Apr. 15	Jun. 14	Jul. 11	sum	mean	root
1	118	79	86	66	76	425	85	20.6
2	65	36	44	35	64	244	49	15.6
3	76	30	39	36	50	231	46	15.2
4	60	38	53	34	27	212	42	14.6
5	45	40	28	31	40	184	37	13.6
6	27	32	20	21	42	142	28	11.9
7	34	48	29	17	46	174	35	13.2
8	45	30	29	22	24	150	30	12.2
9	37	32	27	20	31	147	29	12.1
10	41	36	29	35	33	174	35	13.2
11	51	44	57	30	49	231	46	15.2
12	37	34	42	27	45	185	37	13.6
13	34	36	39	23	40	172	34	13.1
14	52	22	38	20	50	182	36	13.5
15	33	32	33	23	38	159	32	12.6
16	52	39	35	13	53	192	38	13.9
17	62	39	45	22	44	212	42	14.6
18	38	45	43	25	34	185	37	13.6
19	45	39	38	17	39	178	36	13.3
20	34	39	46	26	45	190	38	13.8
21	39	33	45	27	34	178	36	13.3
22	44	42	36	32	35	189	38	13.7
23	71	37	57	55	54	274	55	16.6
24	91	111	77	64	106	449	90	21.2
25	53	49	52	55	60	269	54	16.4
26	39	35	57	35	43	209	42	14.5
27	37	33	23	28	42	163	33	12.8
sum	1360	1110	1147	839	1244	5700	1140	

Table 5-1: Number of similar histogram pairs related to the time interval between them.

when the distributions of all five experiments are evaluated together. It is worth to mention that the number of identified histogram pairs with similar shapes was only about 4% of all 140,000 comparisons for these five experiments.

The total distribution is presented in Fig. 5-1. From the table and the figure one can see that the recurrence of histograms with similar shapes is most likely for the nearest neighbor or adjacent interval, and for a period of 24 hours. These extremes differ from their average by 8-10 mean square deviations, the square roots of extreme values. From this can be seen that the probability of randomly obtaining such results is vanishingly small.

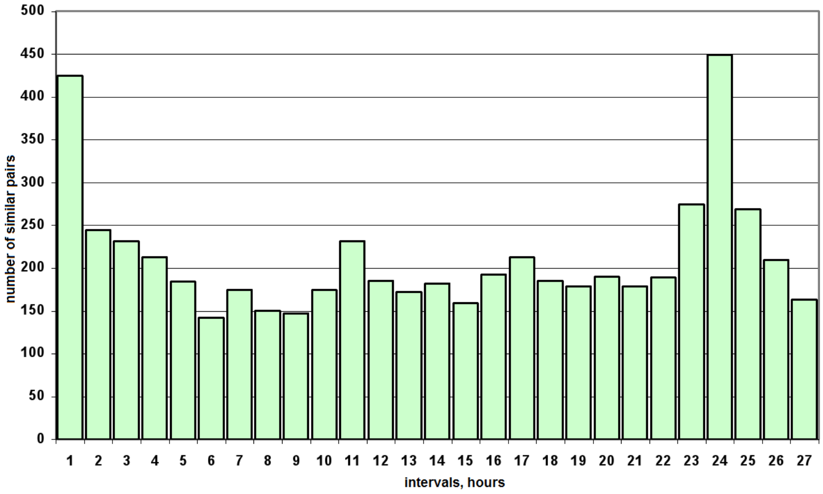

Figure 5-1: The probability of the realization of one-hour histograms with similar shapes.

It is relatively easy to reproduce the pattern presented in Fig. 5-1. Figure 5-2 demonstrates a similar distribution that was constructed from measurements in the Antarctic. This figure serves as another illustration hinting at the universality of this pattern.

I constructed distributions presented by Fig. 5-1 and Fig. 5-2, where histograms were compared without randomization. Through reasonably careful work, rather adequate results may be obtained even without randomization. Early applications of E.V. Pozharsky's program included control comparisons of the same material with and without randomization. T.A. Zenchenko conducted these control experiments for the case of day periods. Thus, Figs. 5-3 and 5-4 present her comparison results of randomized histogram series constructed from ^{239}Pu alpha-activity measurement results in May 1998 and July, 2000.

Fig. 5-5 presents an overlap of the same histogram sequence comparison results, after their randomization (T.A. Zenchenko) and without randomization (S.E. Shnoll).

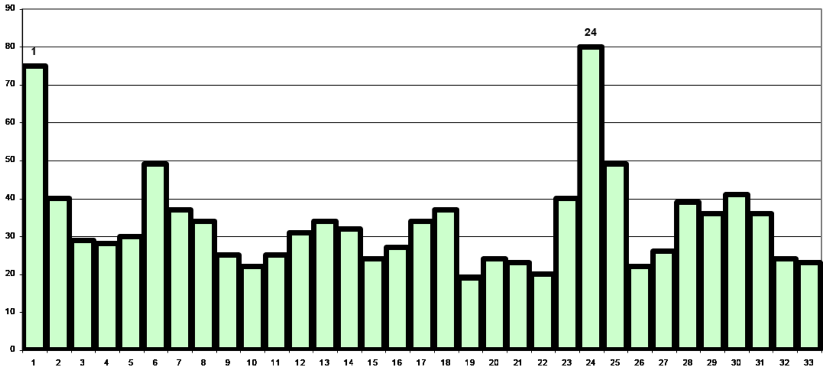

Figure 5-2: Effect of near-zone and a close to one day period of the recurrence of one-hour histograms with similar shapes from ^{239}Pu alpha-activity measurements on March, 1–2, 2003 at the Novolazarevskaya station in the Antarctic. Axes are the same as for Fig. 5-1.

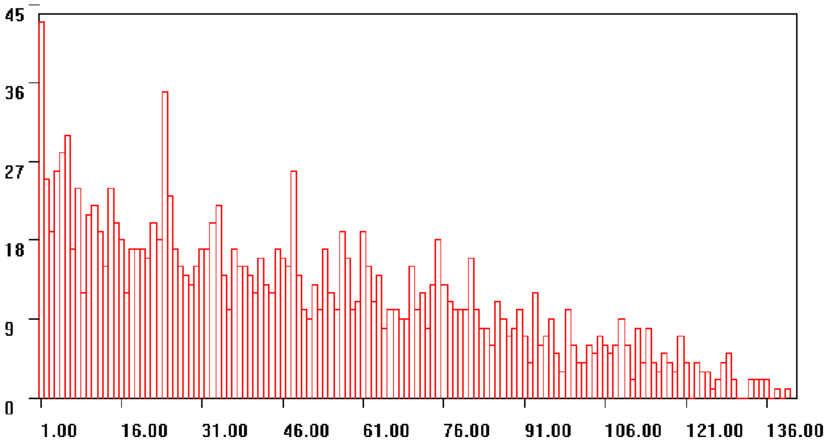

Figure 5-3: Results of the comparison of one-hour histograms constructed from results of ^{239}Pu alpha-activity measurements on July, 7–15, 2000 in Pushino. The series contained 143 one-hour histograms in total. T.A. Zenchenko compared the histogram sequence with complete mixing (randomization). 1,592 similar pairs were selected. X-axis shows intervals in hours. The near zone and peaks at 24 and 48 hours can easily be distinguished.

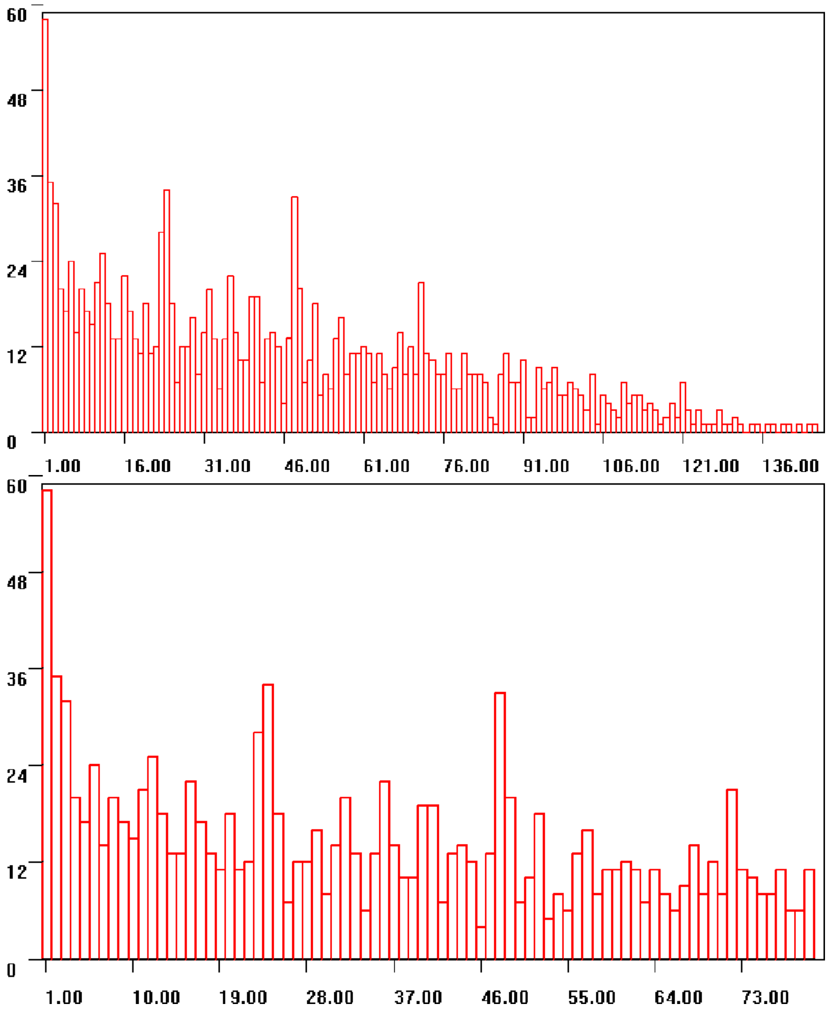

Figure 5-4: **Top:** Results of comparison of one-hour histograms constructed from the results of ^{239}Pu alpha-activity measurements on May, 18, 1998 in Pushino. 148 one-hour histograms; 1,408 similar pairs were selected. The series contained 143 one-hour histograms in total. The comparison with complete mixing (randomization) was conducted by T.A. Zenchenko. 1,592 similar pairs were selected. The X-axis shows time intervals (in hours). The near zone, and peaks at 24, 48, and 72 hours can again be perfectly distinguished. **Bottom:** Scaled fragment.

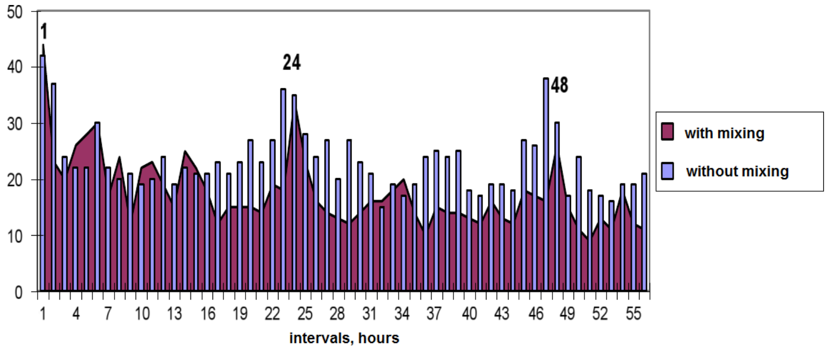

Figure 5-5: Results of an expert comparison of histograms from measurements of ^{239}Pu alpha-activity on July 8, 2000 with and without randomization.

The main result of these investigations is the occurence of a close to one day period, which shows in the graphs as a sharp peak. This corresponds to the increased probability of repeated realizations or recurrence of similarly shaped histograms and was reproduced many times during investigations of a variety of different types of processes.

Chapter 6.

Stellar day periods

On the 17^{th} of December, 1999 I was presenting (not for the first time) on my work on "macroscopic fluctuations" at the Institute for Cosmic Investigations (RAS) during the L.M. Zeleny workshop. This also involved many useful and kindly discussions with fellow participants, to name but a few: M.N. Nozdrachev, L.M. Zeleny, St.I. Klimov, G.N. Zastenker. Almost 20 years earlier I had a very useful (especially in its psychological aspects) dialogue with Yuri Ilyich Galperin while we were on our way from Zvenigorod on a suburban electric train. During the workshop Yuri Ilyich commented that I was able to show noticeable advances in my work since then, but also that a one day period with one-hour steps was poorly informative. He suggested that a close to one day period with at least one-minute resolution should really be explored. It is quite possible that a star day (of duration 1,436 minutes), rather than a Sun day (of 1,440 minutes) may rise to be more important.

His words made a great impression on me, and on 19 December I began my work in this area, which lasted for one month. In the early summer of 2000 the first result was obtained. During the investigation of one-minute histograms (constructed from 60 one-second measurements of $^{218}\mathbf{Po}$ alpha-activity, obtained by I.M. Zvereva at SINP MSU), 14,552 similar pairs were selected from about 200,000 comparisons. Fig 6-1 presents their distribution as a function of the separating one-minute intervals.

The figure shows that Yu.I. Galperin's prediction was confirmed. Since then I found periods equal to a star day many dozens of times. Investigations lasting for several months with measurement series over many hours that resulted in hundreds of histograms per series (as for the construction of Fig. 6-1) turned out to be unnecessary. Merely the comparison of a detailed distribution of the probability of similar histograms to occur within the interval between 1,434 and 1,444 minutes was sufficient to identify a more or less sharp extreme at the 1,436th minute exactly. This required one working day. Having confirmed the reliability of this phenomenon, I wished to inform Yu.I. Galperin about it. However, he has left on the 28^{th} of December, 2001. We repeated such investigations many times, because of the principal importance of the conclusion on the 1,436 minute duration of the close to a day period: in experiments with a flat open detector and in experiments with collimators. These experiments revealed new phenomena concerning the importance of the spatial orientation of detectors and sources. However, the main result was provided by the conclusion: a histogram shape depends on its exposure towards the sphere of fixed stars (or the "crystal canopy", as poets used to say). This moved a possible cause of the "macroscopic fluctuations" beyond the solar system. We got wind of inquisition fires when people inquired about these results.

The following detailed description serves as an example to illustrate the determination of the close to one day period by measurement results obtained with a West collimator that cuts a flow of alpha-particles streaming West during radioactive decay.

Histograms were constructed from results of 60 successive measurements that were derived from 1 minute time intervals each. Results of determining the interval spacing between similar histograms from this period are presented in Table 6-1 and in Figs. 6-2 and 6-3.

From Table 6-1 it is clear that during the July 3–4, 2003 experiment, only 19 histograms with a 1,434 minute interval were found; there were 31 with a 1,435 minute interval and 97 histograms with a 1,436 minute interval; we also identified 45 histograms with 1,437 minutes between them, etc. and we continued up to a 1,442 minute interval. The 1,436 minute interval stands out "clearly". The difference between the frequency of the recurrence of similar histograms corresponding to 1,435 and of those corresponding to 1,436 minutes is 66 histograms. There are 52 more histogram

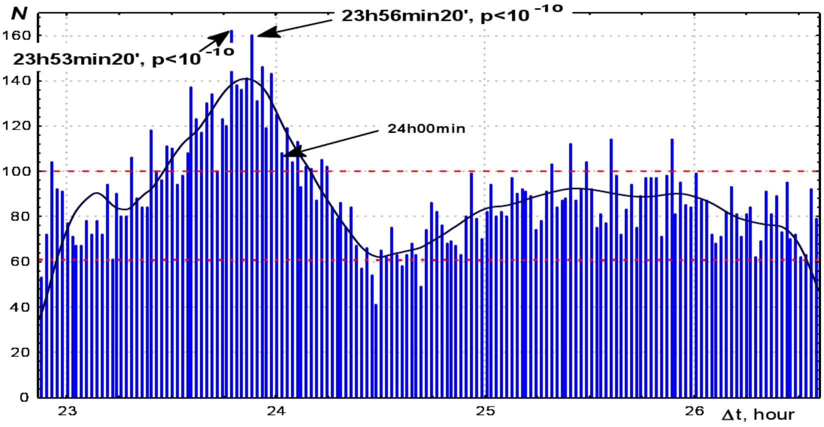

Figure 6-1: The probability of the recurrence of similarly shaped histograms increases with a period equal to a star day, i.e. 23 h 56 min. About 200,000 comparisons were made and 14,552 similar histogram pairs were selected. From these, this distribution was constructed [17]. P_i was evaluated by the hypergeometric distribution.

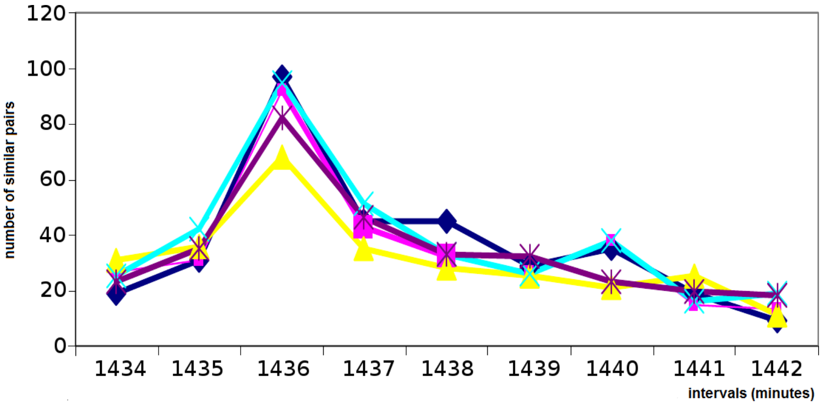

Figure 6-2: Number of similar histogram pairs relative to the value of the separating time interval in five experiments on ^{239}Pu preparation alpha-activity measurements with a collimator directed to the West (see Table 6-1). X-axis is intervals in minutes; Y axis is the number of similar histogram pairs corresponding to a given interval.

pairs that were obtained for the time interval of 1,436 minutes, as compared to 1,437 minutes. These differences amount to about 5 times the value of the standard deviation (square root from obtained values), that is, upon evaluating the results by the Poisson law, the probability of randomly obtaining such distinct values (P) is less than 10^{-4}. 6,282 comparisons were achieved in total during this experiment, resulting in 329 similar histogram pairs.

To verify the reliability of the resulting graph, we repeated this experiment five times, that is, we compared 31,400 pairs of histograms. We obtained identical patterns for all five experiments (see Fig. 6-2). The conclusion regarding the existence of a period of 1,436 minutes in the recurrence of some histogram shape can be drawn with more reliability because of the outcomes for the distribution of all five experiments showing similar histogram pairs as a function of time intervals between them: refer to the "sum" column of Table 6-1 and to Fig. 6-3. It can be seen that the 1,436 minute interval stands out from the total distribution. The peak at the 1,436th bin differs by about 10 standard deviations (about 10 square roots from the average peak height) if compared to the standard values. This corresponds to $P < 10^{15}$. At this point it is worth mentioning that the height of this extreme is only about 12% of the maximal possible value. (The maximum possible height of such a peak equals the number of histograms in a series: in this case 698 for the one experiment and 3,490 in total for all five experiments. The height of the largest peak corresponding to the 1,436 minute interval is 434, that is, 12% of the maximum height). The number of similar histogram pairs that were found only corresponds to a small share, about 5%, of the entire number of possible combinations. (In total, only 1,584 similar pairs from the 31,400 reviewed combinations).

Fig. 6-2 shows a relationship between the probability of the recurrence of similar histograms and the value of separating time intervals, which is the same across all five experiments. Fig. 6-3 confirms the reliability of the 1,436 minute period.

Apart from a detailed investigation of the degree to which a "star day" period occurs, we also conducted research on the corresponding time interval of a solar day. For this purpose, a solar day (24 hours) was divided into eight three-hour zones, with 180 one-minute histograms each: 1–3, 4–6, 7–9, etc., up to 22–24. Then we obtained continuous measurements over a period of 12 days during 4–16 March, 2001 and determined an increase in

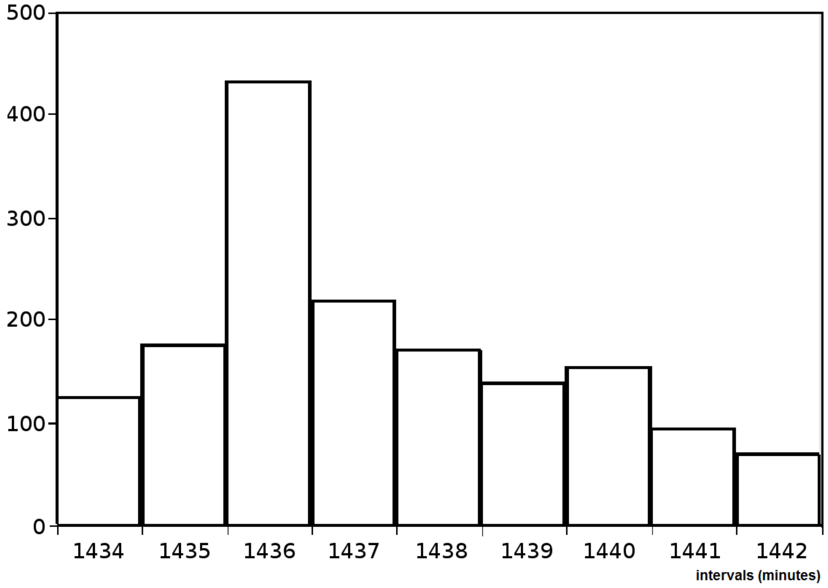

Figure 6-3: Similar histograms from measurements of ^{239}Pu alpha-activity are found with a period between them equal to 1,436 minutes, that is, one "star day". (Total values are taken from Table 6-2). X-axis is intervals in minutes; Y-axis is the number of similar histogram pairs corresponding to a given interval.

interval (min)	dates of measurements start, 2000							
	June 22	June 24	July 3	July 5	July 12	sum	mean	root
1,434	25	23	19	27	31	125	25	11.2
1,435	42	35	31	31	36	175	35	13.2
1,436	**95**	**82**	**97**	**92**	**68**	**434**	**87**	**20.8**
1,437	51	46	45	43	35	220	44	14.8
1,438	33	33	45	32	28	171	34	13.1
1,439	26	32	29	27	25	139	38	11.8
1,440	38	23	35	38	21	155	31	12.4
1,441	16	20	19	15	25	95	19	9.7
1,442	19	18	9	13	11	70	14	8.4

Table 6-1: Number of similar histogram pairs related to the value of a close to one day interval. Measurements of the alpha-activity of a ^{239}Pu preparation with a "western" collimator.

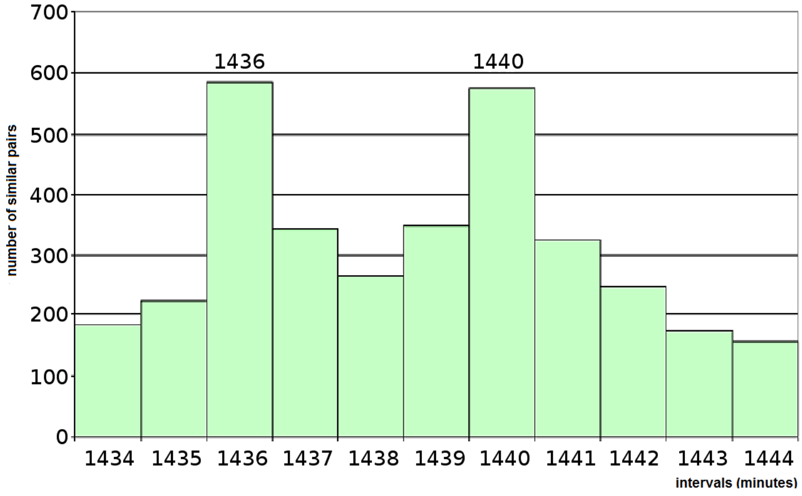

Figure 6-4: We observed two separate periods from measurements of ^{239}Pu alpha-activity with detectors located in the plane parallel to the plane of the Celestial equator: the first equals one star day (1,436 minutes) and the second equals one Sun day (1,440 minutes).

	time of day (hours)										
interval min	3–5 am	4–6 am	7–9 am	10–12 am	1–3 pm	4–6 pm	7–9 pm	10–12 pm	sum	mean	root
1,434	118	102	67	136	119	91	104	119	856	107	10.3
1,435	128	127	84	129	142	103	149	171	1033	129.1	11.4
1,436	**225**	**216**	**126**	**242**	**250**	**214**	**319**	**331**	**1923**	**240.4**	**15.5**
1,437	189	148	88	149	151	144	180	172	1221	152.6	12.4
1,438	151	151	107	150	156	146	163	134	1158	144.8	12.0
1,439	142	120	74	150	155	127	119	122	1009	126.1	11.2
1,440	152	140	102	170	137	147	146	136	1130	141.3	11.9
1,441	104	80	83	112	103	94	88	70	734	91.8	9.6
1,442	94	86	155	108	94	85	67	50	739	92.4	9.6

Table 6-2: Star period is 1,436 minutes at various times of a day. The number of similar histogram pairs corresponding to time intervals between them and to the time of day.

	dates, 2004								
interval min	Jul. 29	Oct. 12–13 (1)	Oct. 12–13 (2)	May 29	Oct. 04	Sept. 23	June 21	June 05	sum
1,434	52	30	23	11	20	18	11	19	184
1,435	52	35	29	16	23	25	19	26	225
1,436	**131**	**73**	**75**	**62**	**48**	**71**	**60**	**65**	**585**
1,437	71	56	37	35	25	49	32	27	342
1,438	69	37	33	20	18	41	19	29	266
1,439	75	51	43	34	32	61	29	23	348
1,440	**96**	**71**	**90**	**57**	**51**	**98**	**59**	**54**	**576**
1,441	71	48	35	29	34	52	30	26	325
1,442	47	44	23	19	36	39	20	18	246
1,443	37	23	18	14	23	25	15	21	176
1,444	35	22	22	7	16	20	12	23	157

Table 6-3: Results of determining the close to one day periods of repeated realizations of similar histograms. Histograms were constructed from measurements of ^{239}Pu alpha-activity with detectors, located on a plane parallel to that of the Celestial equator.

the frequency of occurrence of similarly shaped histograms for close to one day periods and for each three-hour zone of all twelve days. In each zone we compared histograms of March 4 with those of March 5; histograms of March 5 with those of March 6; histograms of March 6 with histograms of March 7, etc. We summarized results of the analysis of each zone and obtained "star day" periods for all zones. 19,400 histogram pairs were reviewed in each such time zone. The total number of all 8 zones' reviewed histogram pairs was 155,520. The results are presented in Table 6-2. The total pattern for all time zones is presented in Fig. 6-4.

Table 6-3 shows that an extreme corresponding to a star-day (1,436 minutes) is expressed most pronouncedly for the evening hours: between 7 pm and 12 pm. A lower expression of this period can be identified for morning hours: from 7 am to 9 am. Whether this difference is essential and to what degree will become clear someday in the future, after having repeated multiple tests. In total, as Table 6-2 presents, an average period equal to a star-day is expressed quite distinctly. The probability of a repeated occurrence of a similar histogram shape is about twice as high after 1,436 minutes, as compared to other time intervals. The probability of randomly obtaining such a result is smaller than 10^{-9}.

Thus, we postulate a close to one day period equal to 1,436 minutes (star-day).

This conclusion seemed quite strict. However, we did repeatedly identify two separate close to one day periods – one is 1,436 minutes (a star-day), the second is 1,440 minutes (a solar-day).

In 2004–2005 we noticed a dependence of our results not only on time or the direction of the outflow of alpha-particles during radioactive decay, but also on the slope of a plane on which the detectors were positioned. For years we placed measuring devices on a horizontal plane, that is, on a working bench. Having introduced collimators into our practice, we began to place them not on a horizontal plane, but on a plane parallel to an equinoctial line (considering the local latitude), or on an ecliptic plane. From this experimental setup, alongside the 1,436 minute period, another one equal to 1,440 minutes, that is a solar-day, began to manifest itself. A new avenue of research opened up. The main work of this new line of work still lies ahead. The mere existence of two independent close to one day periods, namely a star-day and a solar-day, may be considered proved. Table 6-3 and Figure 6-4, presenting results of the determination of the close to one day period from measurements with a collimator directed to the West that is also equipped with a counter placed in an equinoctial line plane, may serve to illustrate. Two extremes corresponding to a stellar and a solar day can be discerned.

The strict discrimination of a close to one day period into stellar and solar days imply that the orientation of a measured object is determined independently, towards both motionless stars, and the Sun. These two periods have been obtained with a resolution of one-minute accuracy, the same as for the local time synchronism. This serves as evidence for the effects of cosmic objects on the spectrum of fluctuation amplitudes of compared values, when their direction was distinctly controlled while obtaining the measurements. These narrow-band "rays", moving from cosmic bodies (gravity waves?) obviously interfere at each point of the Earth's surface. This creates a composite interference shape in the histograms that we study.

Chapter 7.

Local- and absolute-time synchronism at different geographical locations

A crosscheck by myself, which included repeated (non-randomized) histogram comparisons of all experiments where T.A. Zenchenko compared histograms after their randomization, in principal confirmed his results, them being close to identical. However, comparisons without mixing histograms were much quicker for obvious reasons. This method allowed us to demonstrate one-minute accurate local-time synchronism of histogram shape changes of ^{239}Pu alpha-activity measurements in:

- Pushino (Russia) and Valencia (Spain; measured by V.A. Kolombet);
- Pushino (Russia) and Athens (Greece; measured by V.A. Pancheluga);
- Pushino (Russia; ^{239}Pu alpha-activity measurements) and Tbilisi (Georgia; noises in an electron scheme; measured by V.A. Kaminsky).

7.1 Local- and absolute-time synchronism in measurements from Pushino, the Arctic, and Antarctic

A large portion of the work was completed while I was processing the results of synchronous measurements in Pushino and from the "Academic Fyodorov" ship during its Arctic (2000) and Antarctic (2001) expeditions. These expeditions were organized by the St. Petersburg Arctic and Antarctic Research Institute (AARI), and under stationary conditions during winter time at the Novolazarevskaya station in the Antarctic. These works were completed with the friendly participation of colleagues from Professor O.A. Troshichev's laboratory: E.S. Gorshkov, S.N. Shapovalov, A.V. Makarevich, and V.V. Sokolovsky [3].

These experiments confirmed the local-time synchronism of histogram shape changes at various latitudes with a close to one minute accuracy. In addition, we observed a rather reliable absolute-time synchronism more than once (like that of the 1987 experiment from measurements near the Galapagos Islands and in Pushino, refer to Fig. 5-19 in the first part of the book). The local-time synchronism implies a dependence of a histogram shape on the layout of the laboratory relative to some cosmic objects or to a change of orientation towards different directions in the surrounding space, namely changes in the Earth axial rotation. The absolute-time synchronism found in some experiments may imply that in this case a histogram shape is determined primarily by an external force affecting the Earth as a whole, while the Earth is not filtering this effect.

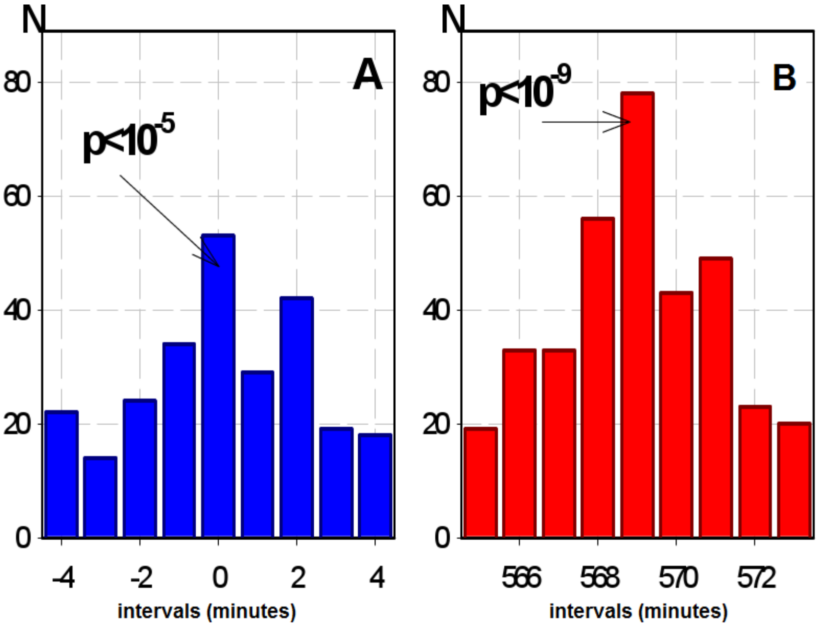

Figure 7-1: Absolute-time (A) and local-time (B) synchronism of similar histograms occurring from ^{239}Pu alpha-activity measurements in Pushino (K.I. Zenchenko) and in the Arctic (82^{o} NL; 179^{o} WL; S.N. Shapovalov) on August 31, 2000. The estimated local-time difference amounts to 572 minutes. X-axis is time intervals between similar one-minute histograms; 0 is the same absolute time in Pushino and in the Arctic; the Y-axis shows the number of similar histogram pairs corresponding to the interval between them. P_i is evaluated by the hypergeometric distribution.

It would be essential to find regularities in the appearance and disappearance of the absolute-time synchronism. We could not provide a complete study of these regularities, and thus now just have a series of examples. For example, we can compare histograms (Fig. 7-1) constructed from measurements made on August 31, 2000 in the Arctic ("a bit to the East from Bering Strait", near the North Pole, that is, 179 WL and 82 NL), and in Pushino. From these we see histogram changes synchronous both towards local and absolute time (while the latter is less pronounced); the accuracy is up to the minute scale.

On September 11, 2000, the synchronism was similarly distinct, both towards local and absolute times (Fig. 7-2).

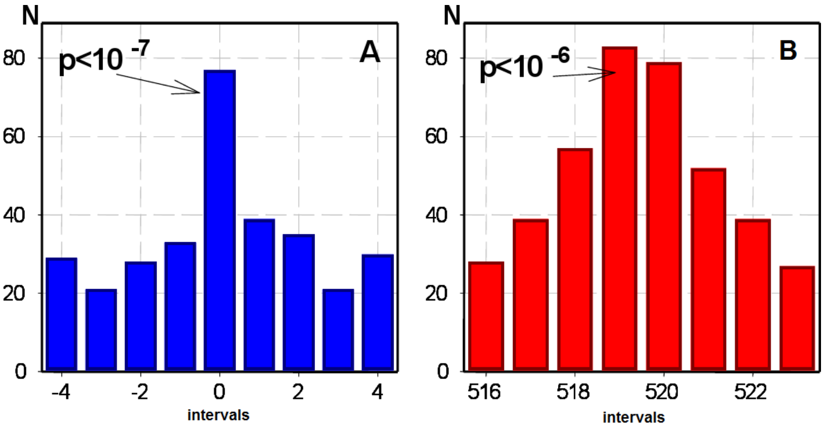

Figure 7-2: Absolute-time (A) and local-time (B) synchronism of similar histograms occurring from results of ^{239}Pu alpha-activity measurements in Pushino (K.I. Zenchenko) and in the Arctic (82^o NL; 167^{o}53' EL; S.N. Shapovalov) on September 11, 2000. The estimated local-time difference is 571 minutes. X-axis is time intervals between similar one-minute histograms; 0 is the same absolute time in Pushino and in the Arctic; Y-axis is the number of similar histogram pairs corresponding to the time interval between them [3]. P_i is evaluated by the hypergeometric distribution.

During the Antarctic expedition in 2001, the ship passed from the northern to the southern hemisphere, and the maximal difference between latitudes was 123. The expedition was of great interest to us, as it helped us to analyze the dependence of the local-time synchronism on the local latitude.

These expectations were based on the supposition that a histogram shape is determined by the pattern of the star sky over a point where measurements are taken. These expectations seemed to be legitimate [3]. When a ship was near the equator (27^{o}21' – 25^{o}06' NL; 16^{o}21' – 17^{o}07' WL), the local-time synchronism (with Pushino) was quite evident (Fig. 7-3) and the absolute-time synchronism was the same, but expressed a bit less pronounced. When the ship was in the southern hemisphere, and not far from the equator (38^{o}18' – 35^{o}53' SL), the local-time synchronism was much weaker, and the absolute-time synchronism became quite evident (Fig. 7-4).

A ship being located at high southern latitudes, near Molodyozhnaya and the Mirny Antarctic stations, lead to the local-time synchronism being practically indiscernible, while we found a rather distinct absolute-time synchronism (Fig. 7-5 and Fig. 7-6).

We explained these regularities by increasingly essential differences between the patterns of the star sky over Pushino and over the ship, following from an increase in latitude differences. But this explanation appeared false. The ^{239}Pu alpha-activity measured in 2003 by A.V. Shapovalov and A.V. Makarevich under steady-state conditions of the Novolazarevskaya station (in the course of the Antarctic expedition) was compared to the activity measured in Pushino; multiple experiments demonstrated their distinct local-time synchronism. For example, Fig. 7-7 shows reliable results on the high probability of histogram shape similarity at the same local time. The maximal similarity appears at 104 minutes, with one-minute accuracy on the estimated value of the local-time difference. There was no reliable local-time synchronism in measurements from March 1, 2003. Results of the local-time comparison thus can serve as a control mechanism for the reliability of the histogram comparison method.

At times, the absolute-time synchronism is very distinct; in other cases it is completely invisible. The local-time synchronism is almost always apparent: for close to the most extreme possible distances on Earth, and independent of the latitude difference.

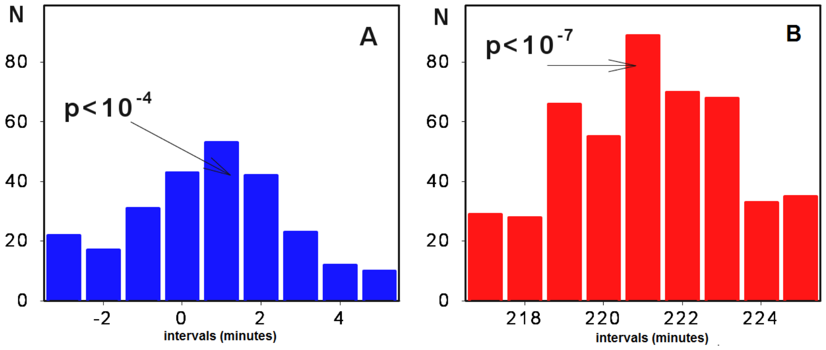

Figure 7-3: Absolute-time (A) and local-time (B) synchronism of similar histograms from ^{239}Pu alpha-activity measurements in Pushino and on the ship in the Arctic expedition (27^{o}21' – 25^{o}06' NL; 16^{o}21' – 17^{o}07' WL) on March 15, 2001. Distance is about 5,200 km. Estimated local-time difference is 216–219 minutes. X-axis is time intervals between similar one-minute histograms; 0 is the same absolute time in Pushino and on the ship; the Y-axis displays the number of similar histogram pairs for different separating time intervals [3]. P_i is evaluated by the hypergeometric distribution.

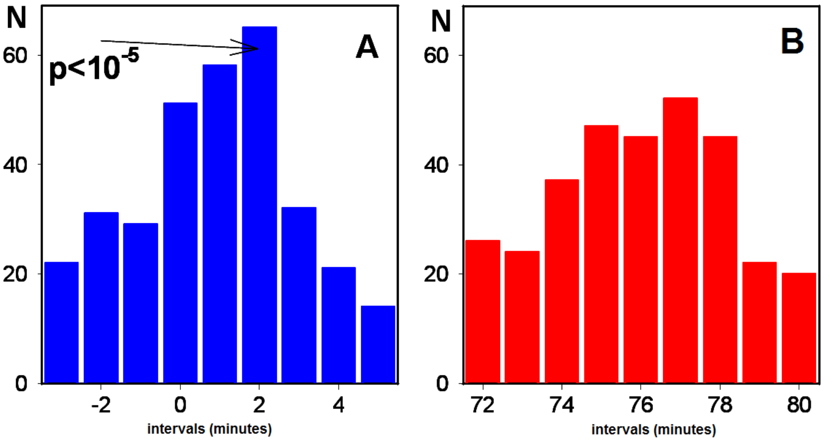

Figure 7-4: Absolute-time (A) and local-time (B) synchronism of similar histograms from ^{239}Pu alpha-activity measurements in Pushino and on the ship during the Arctic expedition (38^{o}18' – 35^{o}53' SL; 18^{o}27' – 18^{o}01' EL) on June 2, 2001. the distance between the two locations is approximately 10,700 km. The estimated local-time difference is 76–77 minutes. X-axis is time intervals between similar one-minute histograms; 0 is the same absolute time in Pushino and on the ship; the Y-axis shows the number of similar histogram pairs corresponding to separating time intervals [3]. P_i is evaluated by the hypergeometric distribution.

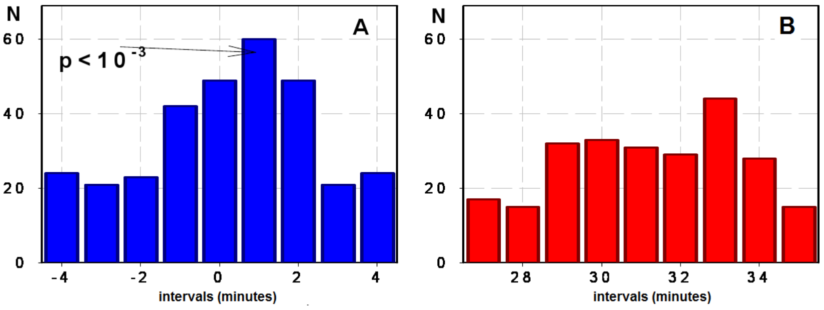

Figure 7-5: Absolute-time (A) and local-time (B) synchronism of the recurrence of similar histograms from ^{239}Pu alpha-activity measurements in Pushino and on the ship in the Arctic expedition (Molodyozhnaya station, 67^{o}39' SL; 45^{o}49' EL) on April 21, 2001. Their distance is about 14,200 km. The estimated local-time difference is between 32 and 33 minutes. X-axis is time intervals between similar one-minute histograms; 0 is the same absolute time in Pushino and on the ship; Y-axis is the number of similar histogram pairs corresponding to the time interval between them [3]. P_i is evaluated by the hypergeometric distribution.

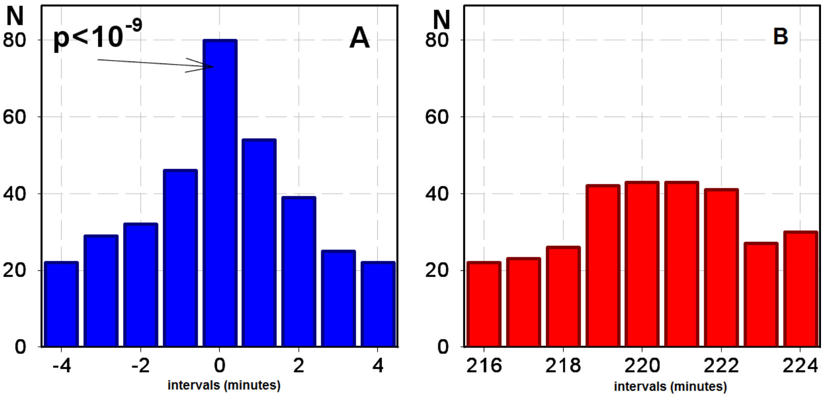

Figure 7-6: Absolute-time (A) and local-time (B) synchronism of similar histograms from ^{239}Pu alpha-activity measurements in Pushino and on the ship on its Arctic expedition (Mirnyy station, 66^{o}33' SL; 92^{o}58' EL) on May 13, 2001. Their distance is about 14,500 km. The estimated local-time difference is 220–221 minutes. X-axis is time intervals between similar one-minute histograms; 0 is the same absolute time in Pushino and on the ship; Y-axis is the number of similar histogram pairs corresponding to the time interval between them [3]. P_i is evaluated by the hypergeometric distribution.

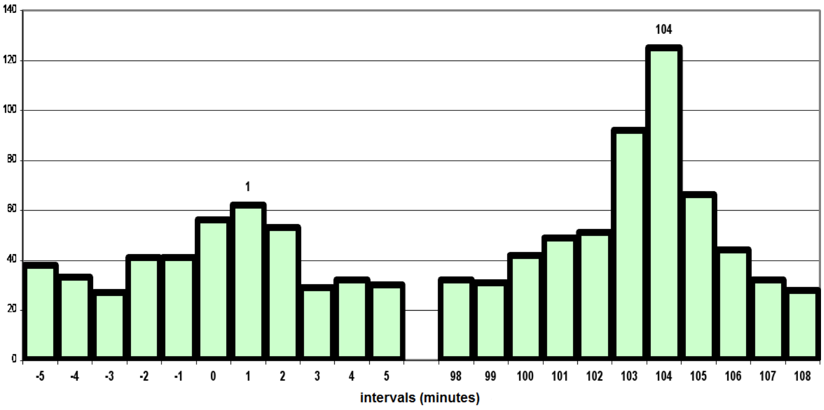

Figure 7-7: Comparisons of histogram shapes constructed from the results of ^{239}Pu alpha-decay measurements in Pushino and at the Novolazarevskaya station on March 1, 2003 demonstrate a high probability of histograms to be similar at the same local time. No absolute time synchronism was observed [53]. The linear distance between measurement locations is about 14,500 km.

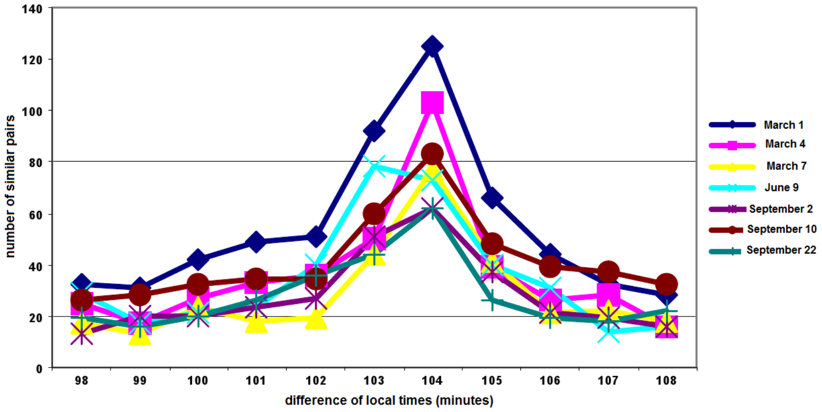

Figure 7-8: The effect of synchronous occurrences of similar histograms in the local time in Pushino and at the Novolazarevskaya station (Antarctic) on various dates from March 1, 2003 until September 22, 2003. The estimated difference between the local times is 104 minutes.

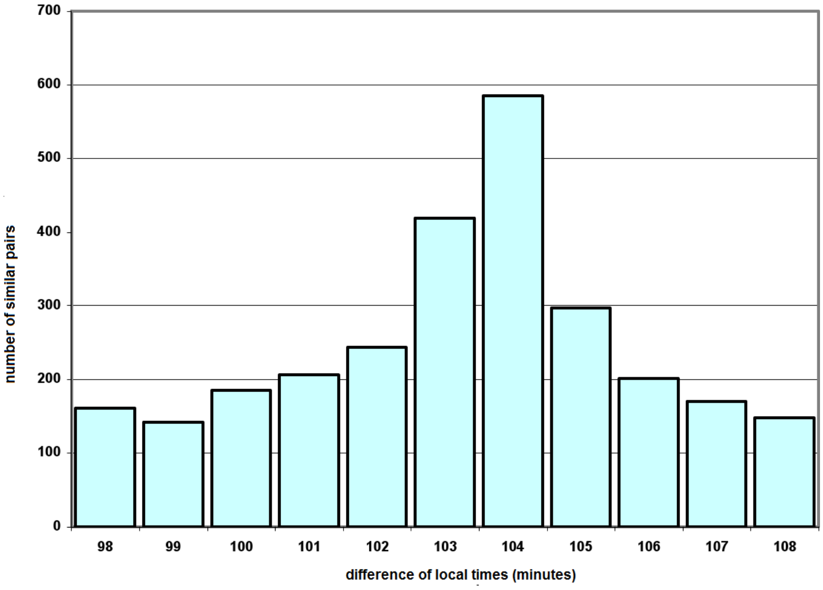

Figure 7-9: The effect of the synchronous apparance (according to the local time) of similar shape hystograms according to the observations produced in Puschino and Novo-Lazarevskaya (Antarctic). These are the average data of 7 observations, according to Fig. 26 of [53].

Considering the crucial importance of this result, the manifestation of the local-time synchronism from measurements in Pushino and in the Antarctic was investigated many times over. Fig. 7-8 presents the results of respective histogram comparisons constructed from measurements made on various dates from March 1, 2003 until September 22, 2003.

All seven experiments reveal a reliably high probability of similar histograms occurring at one and the same local time. Fig. 7-9 summarizes the results of these experiments.

The probability for such a result to occur randomly is vanishingly small. This result, the local-time synchronism with one-minute accuracy and distance between laboratories of 14,500 km, is wonderful in itself. However, the main conclusion I draw from it is: this synchronism implies that my previous conclusion on the dependence of histogram shapes on the pattern of the star sky over the measurement location is false. Star skies over the Novolazarevskaya station and over Pushino are very different.

Thus, the local-time synchronism is only determined by the difference of longitudes and does not depend on latitude differences.

Nevertheless, this conclusion does not explain the above-mentioned results of the Antarctic expedition of 2001. Nobody knows how to explain effects that were obtained then. They may be caused by the movement of the ship at the moment of measuring. This is a typical situation. New expeditions and comparison of results obtained during movement and in a steady-state are necessary.

7.2 Local and absolute times in the measurements of fluctuations in GPS noise generators

The phenomenon of macroscopic fluctuations from measurements of noise generators of the global consciousness project (GCP) system (see also Chapter 23) provided boundless opportunities for investigating the local- and absolute-time synchronism. The system was able to provide long series of continuous measurements in dozens of geographical points all over the world. All main effects that are of interest to us, such as the near-zone effects, stellar and solar days, local- and absolute-time synchronism, etc. could also be found there. We have only to realize new potentialities and to analyze regularities in the local- and absolute-time synchronism. The most interesting problem pertains to the regularities of the absolute-time synchronism, its appearance and disappearance and how these may correlate with some cosmophysical phenomena.

7.3 Manifestations of local- and absolute-time synchronism related to the collimator direction

The concepts of regularities in the local- and absolute-time synchronism of histogram changes occurring essentially changed when we employed collimators for alpha-activity measurements (see Chapters 11–14).

It turned out that when comparing results of simultaneous measurements of ^{239}Pu alpha-activity of S.N. Shapovalov at the Novolazarevskaya station (in the Antarctic) with those obtained in Pushino, the appearance of the local-time effect and of the local-time synchronism depended on the way measurements were obtained. It became evident that differing directions of collimators were affecting the results: towards the West, the Polar Star and at the Sun.

Local-time synchronism is distinctly evident for collimator-free measurements in the Antarctic and for Pushino measurements with a collimator directed to the West. *Furthermore, at the same time, practically no absolute-time synchronism could be revealed.*

For measurements in Pushino with collimators directed at the Polar Star or the Sun, the effect of synchronism with the Antarctic measurements is not discernible. However, the absolute-time synchronism is very distinct.

I revealed these wonderful regularities while analyzing the results of simultaneous measurements made in 2003 and 2005 in Pushino and at the Novolazarevskaya station. It was in the summer of 2008. In the spring of 2009, I completed a large number of histogram comparisons from measurements made in January and October of 2005. It was important to know whether the absolute- and local-time synchronism depended on a season. I suppose that such a dependence is absent. The absolute-time synchronism of histogram shape changes was revealed in the comparison of measurements in Pushino with collimators directed at the Polar Star or at the Sun to those made in the Antarctic with a collimator-free counter. Furthermore, no less important, there is no local-time synchronism between the measurements with these collimators and those made in the Antarctic. Also, when a collimator is directed to the West, the local-time synchronism is quite distinct, and the absolute-time synchronism is absent.

We believe we are dealing here with some fundamental property of our universe. It is a paradox: counters that are equipped with a collimator and counters that are collimator-free stand side-by-side in Pushino. However, no (or almost none) absolute synchronism of neighbors is found. At the same time, we see the absolute synchronism between changes of histograms constructed from measurements with counters directed at the Sun (or the Polar Star) with those made in the Antarctic without a colli-

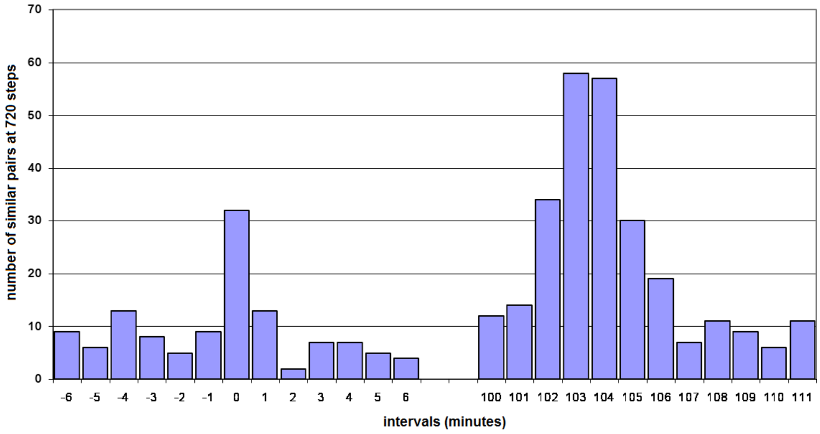

Figure 7-10: Construction of one-minute histograms from results of ^{239}Pu alpha-activity measurements with collimator-free counters in Pushino and in Novolazarevskaya. We find a local-time synchronism and the practical absence of absolute-time synchronism. Measurements were taken on January 24, 2008.

mator. The distance between Pushino and Novolazarevskaya is about 14 and a half thousand kilometers. Figures 7-10 to 7-15 illustrate these words.

7.4 Conclusion

The general conclusion of these results is: synchronisms of histogram shape changes at different geographical points at the same absolute time and at the same local time are phenomena with different causes. The local-time synchronism is obviously caused by the Earth axial rotation, and by the layout of the investigated process relative to the Sun or motionless stars. The absolute-time synchronism does not depend on the daily rotation of the Earth, and hence, it does not depend on the layout towards the Sun. It may be determined just by its layout relative to motionless stars, which changes as the Earth moves around its circumsolar orbit. Why is it that we can hardly see this absolute-time synchronism from the collimator-free measurements in Pushino? Why is it so distinct for measurements with a motionless collimator directed at the Polar Star and with a collimator that is constantly directed at the Sun? Why do collimator-free measurements upon registration of alpha-particles flying in different directions not cause the effect to appear when alpha-particles flying into one the same direction are registered: towards the Polar Star or the Sun?

One-minute histograms (results from ^{239}Pu alpha-activity measurements

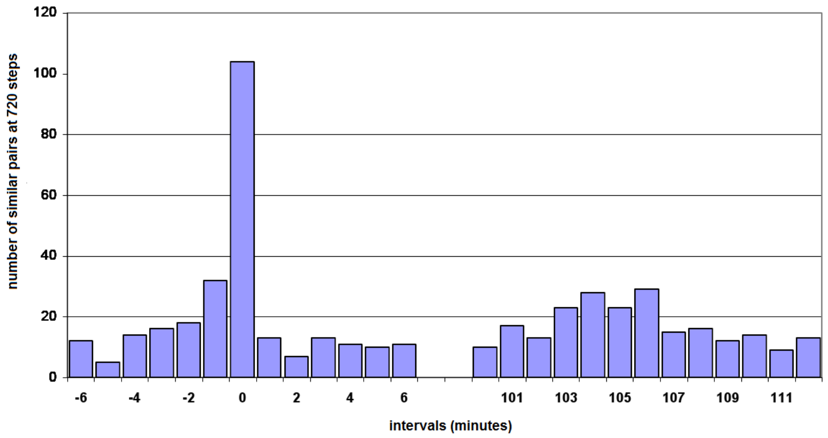

Figure 7-11: Construction of one-minute histograms from results of ^{239}Pu alpha-activity measurements with the collimator directed at the Sun. The counter in Pushino is once equipped with a collimator, and collimator-free counters are used in Novolazarevskaya. The local-time synchronism and the practical absence of the absolute-time synchronism become apparent. Measurements stem from January 24, 2008.

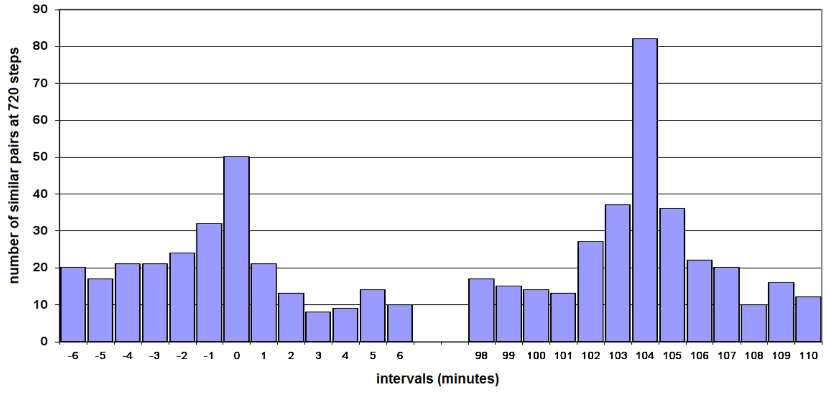

Figure 7-12: Construction of one-minute histograms from results of ^{239}Pu alpha-activity measurements with the collimator directed to the West. The counter in Pushino is equipped with a collimator, while the counters in Novolazarevskaya are collimator-free. A local-time synchronism and a weak absolute-time synchronism is shown. Measurements are of January 24, 2008.

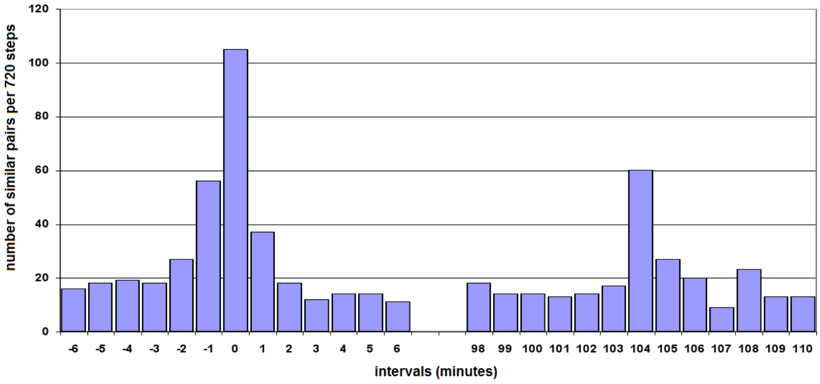

Figure 7-13: Construction of one-minute histograms from results of ^{239}Pu alpha-activity measurements with a counter equipped with a collimator directed at the Polar Star in Pushino, and with collimator-free counters in Novolazarevskaya. We find a strong absolute-time synchronism and a weak local-time synchronism. Measurements were taken on January 26, 2008.

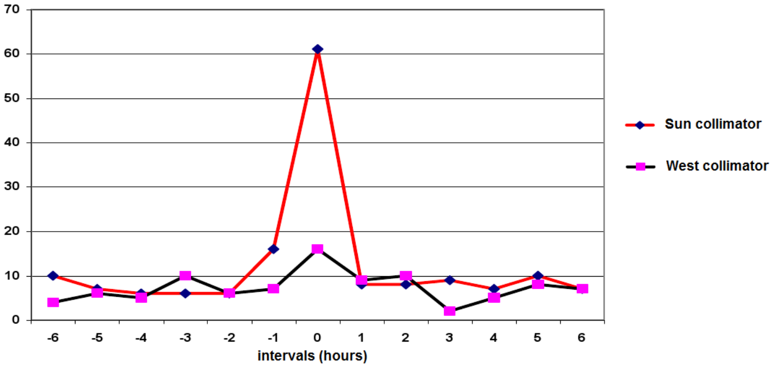

Figure 7-14: Construction of 60-minute histograms from the results of ^{239}Pu alpha-activity measurements with the counter equipped with a collimator directed at the Sun in Pushino and with collimator-free counters in Novolazarevskaya (the same as for the construction of one-minute histograms). A distinct absolute-time synchronism between Pushino and the Antarctic results. Measurements in Pushino with a collimator counter directed to the West reveal no absolute-time synchronism.

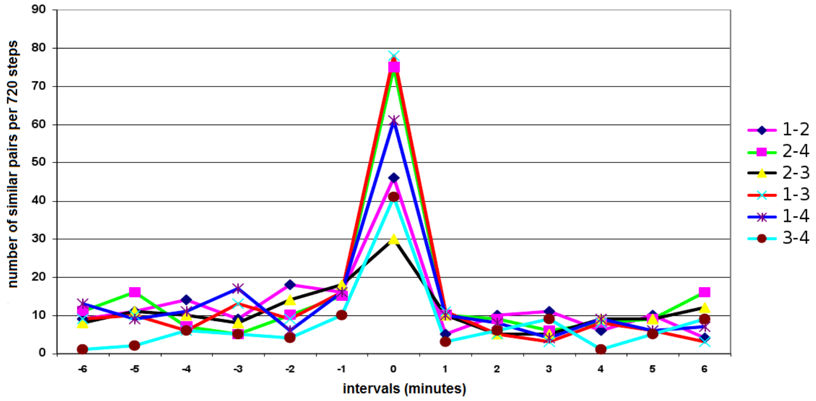

Figure 7-15: The ^{239}Pu alpha-activity measurements produced on October 15, 2005, in Puschino, with the collimater directed towards the Polar star, and, without a collimator, in Novo-Lazarevskaya. These are 1-minute histograms. It was registered, in the observations: the strong absolute synchroneity of the hystogram change, in Puschino, without the collimator (no. 1), and with the west-directed collimator (no. 3) at the same place; the strong synchroneity of the observations in Puschino, with the collimator directed toward the Sun (no. 2), and the observations in Novo-Lazarevskaya, without the collimator (no. 4); the average synchroneity of the observations without the collimator in Puschino (no.1) and in Novo-Lazarevskaya (no. 4); the weak synchroneity of the observations with the west-directed collimator in Puschino (no. 3), and the observations without the collimator in Novo-Lazarevskaya (no. 4); the weak synchroneity of the observations, in Puschino, with the sun-directed collimator (no. 2) and without the collimator (no. 1); the absence of the synchroneity in the obsevarions, in Puschino, with the sun-directed collimator (no. 2) and the west-directed collimator (no. 3).

in Pushino with a counter equipped with a collimator directed at the Polar Star and in Novolazarevskaya with a collimator-free counter) on October 15, 2005 showed:

1. the “strong” absolute-time synchronism of histogram changes from measurements in Pushino (N1) without a collimator and in Pushino with a collimator directed to the West (N3);
2. the “strong” absolute-time synchronism in Pushino with a collimator directed at the Sun (N2) and in Novolazarevskaya (without a collimator) (N4);
3. the “average” absolute-time synchronism for measurements in

Pushino (N1) and Novolazarevskaya (without a collimator) (N4);

4. the weak absolute-time synchronism from measurements in Pushino with a collimator directed to the West (N3) and in Novolazarevskaya without a collimator (N4);
5. the "weak" absolute-time synchronism in Pushino without a collimator (N1) and a counter with a collimator directed at the Sun (N2);
6. N 2-3 show no absolute-time synchronism for measurements in Pushino with neighboring Pushino "Sun" (N2) and "West" (N3) collimators.

The local- and absolute-time synchronism serves as evidence of an anisotropy in the space-time continuum. The extent of this anisotropy can be investigated from changes in time intervals and the spaces between objects. Progress in this line of work is related to the switching from measurements of radioactivity to measurements of relatively high-frequency fluctuations in semi-conductor noise generators. This switching was investigated from V.A. Pancheluga's experiments (see Chapter 24).

Chapter 8.

Measurements near the North Pole

The daily periods in the changes of histogram shapes naturally resulted in the proposition that geographical poles must lack these phenomena, similar to the distinct local-time synchronism. S.N. Shapovalov (from the laboratory of O.A. Troshichev) measured ^{239}Pu alpha-activity in the Arctic expedition under 82^o NL. Investigations of resulting histogram shapes revealed a complex pattern in the recurrence of histogram shapes. Histograms from 15-minute and 60-minute intervals did not show day periods or near zone effects. However, for the one-minute histograms, all three effects, namely the stellar- and solar-day periods, and the fairly distinct local-time synchronism were rather obvious.

Fig. 8-1 presents the vanishing of the near zone effect and close to a day period from histograms constructed from 15 minutes.

Comparison of 15-minute histograms: Figs. 8-1A and 8-1B present the time dependence of the probability of the recurrence of similar one-minute histograms. The histograms were constructed from results of measurements of the alpha-activity of ^{239}Pu-preparations in Pushino and in the Arctic: on the ship at 82^o NL and 172^o WL.

Each distribution shown in Figs. 8-1A and 8-1B is constructed from the results of the comparison of 52,200 pairwise combinations. In Pushino, the average share of similar pairs was 0.071 of the maximal possible number; in the Arctic, it was 0.061. Fig. 8-1A shows the high reliability of the near zone effect and the close to one day perioxd in the recurrence of 15-minute histograms that resulted from measurements obtained in Pushino (at 54^{o}50' NL and 37^{o}38' EL). The hypergeometric distribution based evaluation attached negligibly small values for the probabilities of a random occurrence of the main regularities: the "near zone effect" $(P < 10^{-13})$ and the close to one day period $(P < 10^{-10})$. When generalizing from these, a Poisson based estimation of these regularities seemed rather reliable: probabilities of $P = 10^{-4}$ and $P = 10^{-3}$ resulted, respectively. Fig. 8-1B presents the absence of reliable extremes, both for the near zone and for the close to one day period from Arctic measurements (at 82^{o}54' NL, 172^o WL). Though measurements with one-minute resolution under 82^o NL did not show the near zone effect, their solar-day period is rather distinct (see Fig. 8-3A and Fig. 8-3B).

As one can see from Figs. 8-3A and 8-3B, the construction of one-minute histograms in Pushino and the Arctic reveals a distinct period for the recurrence of similar histograms, namely 1,436 minutes, that is, a star

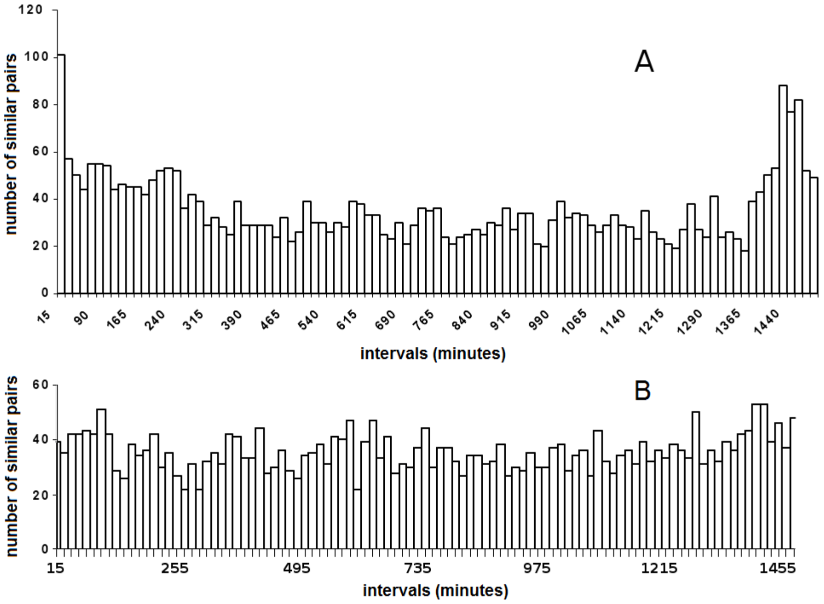

Figure 8-1: Comparison of distributions of similar histograms resulting from simultaneous measurements of the alpha-activity of ^{239}Pu preparations in Pushino (54^o NL, 37^o EL) (A) and on the ship in the Arctic (82^o NL and 172^o WL) (B). X-axis is time intervals between similar 15-minute histograms; Y-axis is the number of similar histogram pairs corresponding to an interval value.

day. In each case, 6,300 pairwise histogram combinations were compared. The portion of similar pairs was 0.062 and 0.076 of the maximal possible number of pairwise combinations in Pushino and the Arctic, respectively. The probability of a random occurrence of such a high extreme, corresponding to the 1,436 minute period and evaluated by the hypergeometric law is less than $P = 10^{-6}$ for Pushino, and $P = 10^{-5}$ for the Arctic.

Thus, simultaneous measurements in Pushino and on the ship during the Arctic expedition in 2000, confirmed the proposed scheme in principal: no close to one day periods are observed near the North Pole at moderately high resolution, and for 15-minute intervals. No "near zone effect" was observed at one-minute resolution either. Nevertheless, the one-minute accuracy allowed the finding of a star-day period and also of the local-time synchronism.

This may serve as another piece of evidence for the "fineness" of the histogram analysis, or the level of detail that can be picked up with this

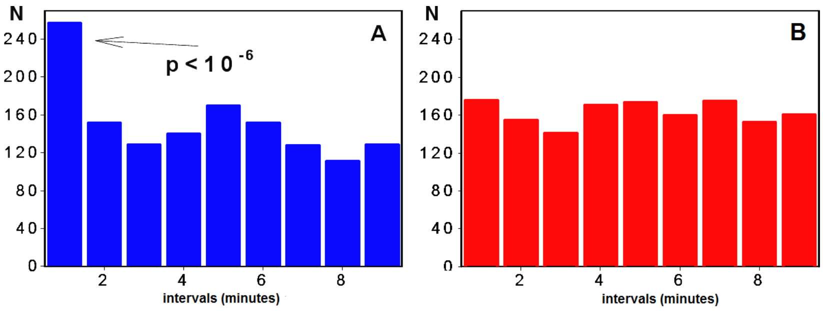

Figure 8-2: One-minute accurate measurements of ^{239}Pu alpha-activity in Pushino (54^o NL, 37^o EL) show the commonly observed "near zone effect" (A); the same measurements near the North Pole (B) do not show a "near zone effect". X-axis is time intervals between similar one-minute histograms; Y-axis is the number of similar histogram pairs corresponding to an interval value [3]. P_i is evaluated by the hypergeometric distribution.

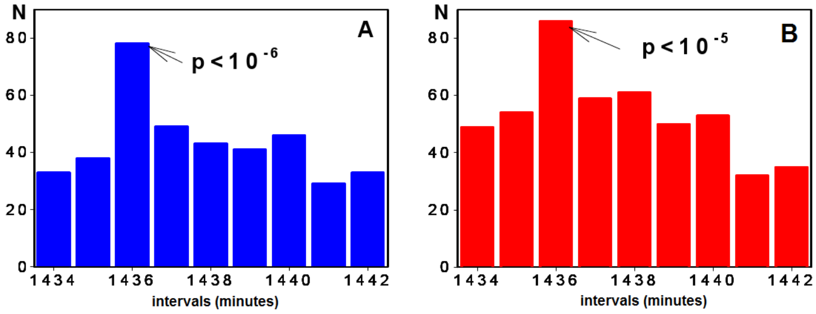

Figure 8-3: Period equal to a star day can be seen for measurements with one-minute resolution in Pushino (54^o NL, 37^o EL) (A) and in the Arctic (82,2^o NL, 179^{o}27' WL) (B) August 31 – September 1, 2000. P_i is evaluated by the hypergeometric distribution.

analysis method. Changes of the star sky for measurements under 82^o NL are still enough for the local-time synchronism and the stellar-day periods to appear. More reliable conclusions would require (multiple) measurements as close to the North and South Poles as possible.

Chapter 9.

Close to twenty seven-day periods in the recurrence of similar histograms

We naturally thought of investigating other possible cosmophysical correlations after having identified, step-by-step, the dependence of a histogram shape on the exposure or relative positioning of a measuring device to the sphere of motionless stars and to the Sun. **Boris Mikhaylovich Vladimirskiy** pointed to the commonly occurring close to 27-day periods in astrophysics (see [60], for example), which attracted my attention. Following his advice, I looked for such periods in the histogram series. A lot of extremes indeed fell into 26–27 day intervals. The corresponding distributions of the number of similar histogram pairs as a function of the time intervals separating them looked very unusual. This peculiar kinds of distributions raised doubts about their validity. Based on these doubts I was led to repeatedly look for periods in the 26–27 day range. Please also keep in mind: each such experiment requires the comparison of tens or even hundreds of thousands of histogram pairs!

9.1 Twenty seven-day periods from measurements of radioactivity

Our first experiment aimed at looking for "27-day periods" utilized the following time series: results of ^{239}Pu alpha-activity measurements made in 1994 and 1995 with 6-second intervals. Each histogram was constructed from 60 measurements obtained in a time interval of 6 minutes. Fig. 9-2 presents a lot of extremes in the results of more than 200,000 comparisons. 10,797 similar pairs were identified. In the figure we marked extremes that appeared and corresponded to periods expressed in sections of a day, including 26.95, 27.25, 27.35 and 28.025-day periods. Coarsening the intervals up to 60 minutes leveled out many small extremes. Only one rather reliable (about 10 mean square deviations) period, corresponding to 654 hours, that is 27.25 days, remained. This can be seen in Fig. 9-3.

Coarsening the intervals up to 60 minutes leveled out many small extremes. Only one rather reliable (about 10 mean square deviations) period, corresponding to 654 hours, that is 27.25 days, remained. This can be seen in Fig. 9-3.

The following Fig. 9-4 presents results of other searches for 27-day periods in the measurements from September 17 until October 14, 2001. These included the comparison of one-minute histograms. 2,060 histogram pairs were identified from approximately 70,000 comparisons. The intervals presented in the figure are increased to 12 minutes.

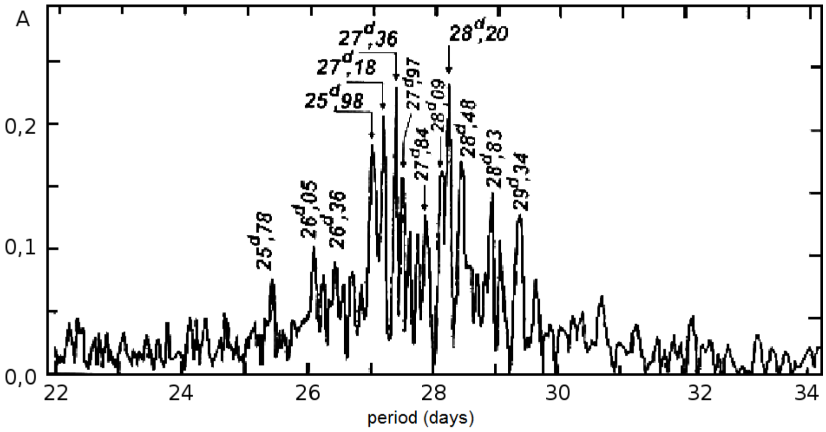

Figure 9-1: An example from astrophysics of a large number of extremes in the range close to the period of 27-days. The power distribution of changes in the sign of the interplanetary magnetic field (ground observations) shows the close to-27 day period. For observations from 1958–1980 by L.S. Levitskiy et al. (1985, Crimean astrophysical observatory, Ukraine. Courtesy of B.M. Vladimirsiy and P. Grigoryev), intervals were coarsened to 1 hour.

Again a large number of extremes can be seen. However, whether this large number presented by Fig. 9-5 can be considered real with a high statistical significance is not immediately obvious.

A large number of extremes remained even after roughening the time scales. The following periods equal to 632 hours (26.33 days), 639 hours (26.625 days), 647 hours (26.95 days), and 653 hours (27.21 days) seem to be important, as they were identified from different investigations.

Similar patterns were obtained repeatedly from the analysis of collimator-free and collimator-equipped measurements. A large number of extremes can always be seen at close to-27 day intervals. Fig. 9-6 presents one more such example: results of histogram comparisons from ^{239}Pu alpha-activity measurements with a collimator directed to the East; the results are analogous to the previous ones.

These results show a large number of extremes as well. Two of these are statistically significant: 647 hours (26.96 days) and 653 hours (27.21 days). These numbers perfectly coincide with results from the previous experiment.

I was very confused both by the great many extremes in the proximity of 27-days as well as by the inconsistency in the recurrence of similar his-

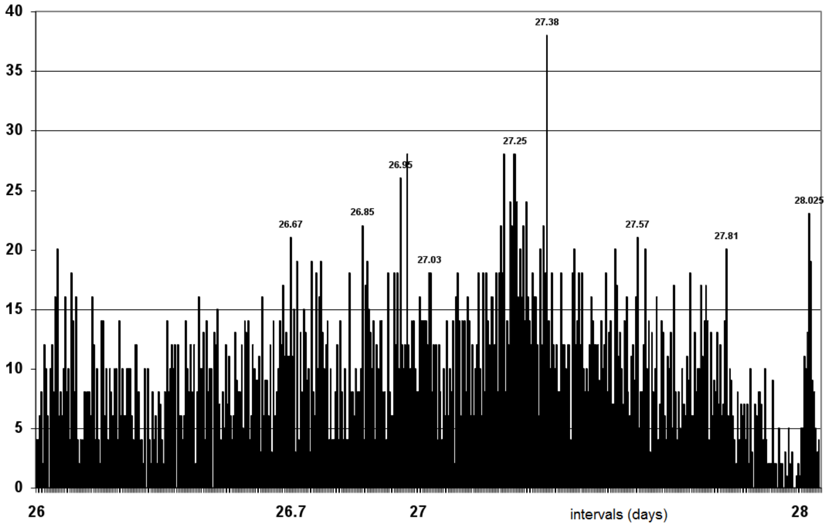

Figure 9-2: Dependence of the probability of recurrence of similar histograms on the separating time interval in the vicinity of the close to 27-day periods. Alpha-activity of ^{239}Pu was measured in 1994–95. X-axis units are 6 minutes.

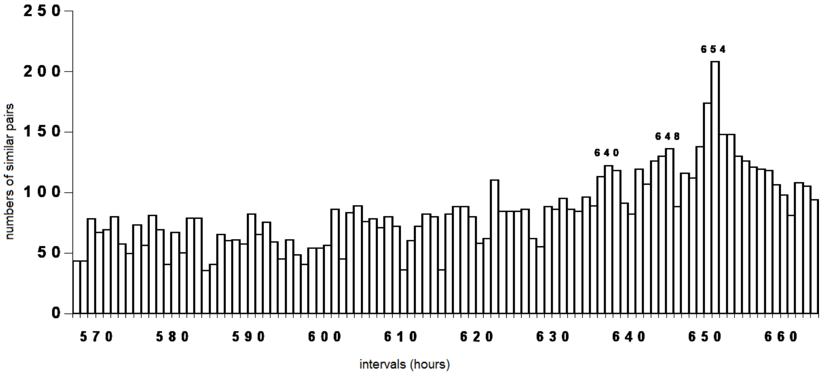

Figure 9-3: Distribution from Fig. 9-2 with coarsening up to the order of 60 minutes.

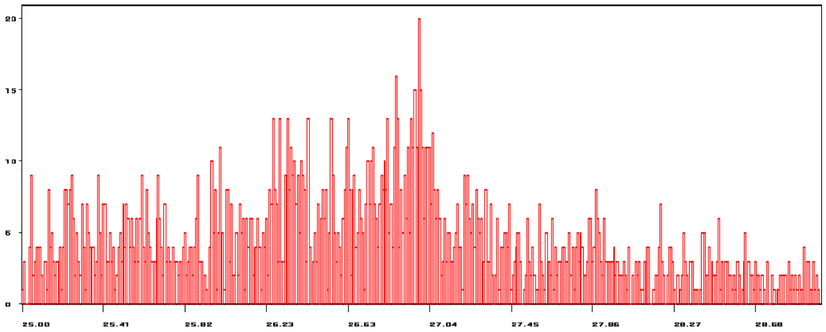

Figure 9-4: Dependence of the probability of repeated one-hour histograms of the same shape as a function of separating time intervals for close to 27-day periods. Alpha-activity of ^{239}Pu was measured between September 17 and October 14, 2000. One-minute histograms were compared; intervals are broadened to 12 minutes; X-axis is intervals in sections of a day.

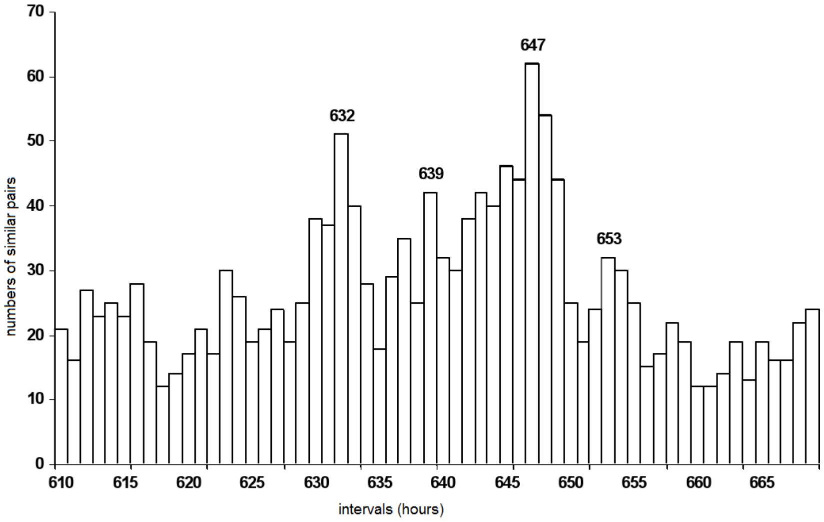

Figure 9-5: The same distribution as shown in Fig. 9-4, differing by the intervals on the X-axis, which amount to 1 hour here. Meaningful periods (and hours) are specified.

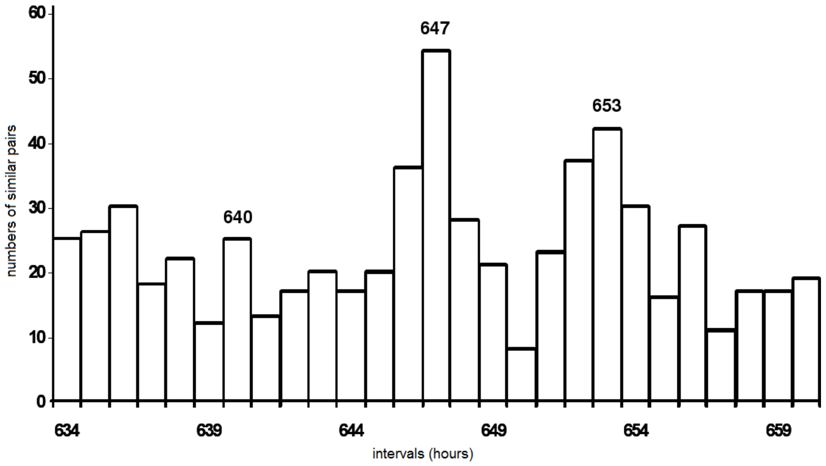

Figure 9-6: Dependence of the probability of recurring one-hour histograms of the same shape on the separating time interval for close to 27-day periods. Alpha-activity of ^{239}Pu was measured with the collimator directed to the East between June 22 and July 15, 2003. Axes are the same as for previous figures.

tograms and their corresponding values. Due to this confusion, I undertook multiple attempts to reproduce these regularities. In the end, my doubts were put to rest. Evidence was provided by literally the same pattern resulting from cosmo-geo-magnetic characteristics as determined in astrophysics [61]. Hence, it was essential to obtain analogous results from measurements of completely different types of processes. We obtained such results from different types of processes by analyzing gravity-gradient Ulitka antennae noises [62].

9.2 Twenty seven-day periods in measurements of noises in a gravity-gradient "Ulitka" antenna

"The twenty seven-day periodicity in the recurrence of similarly shaped histograms is not only real but universal". Results of investigations of gravity-gradient "Ulitka" antenna noises provided evidence for this periodicity. The antenna was constructed in Professor V.N. Rudneko's laboratory (SAI) many years ago [46], and is an analog of Weber gravitational wave registration devices. Similarly to other analogs of Weber antennae, it appeared not sensitive enough for the registration of gravity waves. Nevertheless, in my opinion the results of sufficiently long, continuous registrations of fluctuations (noises) in piezo-sensors, massive metal cylinders fastened

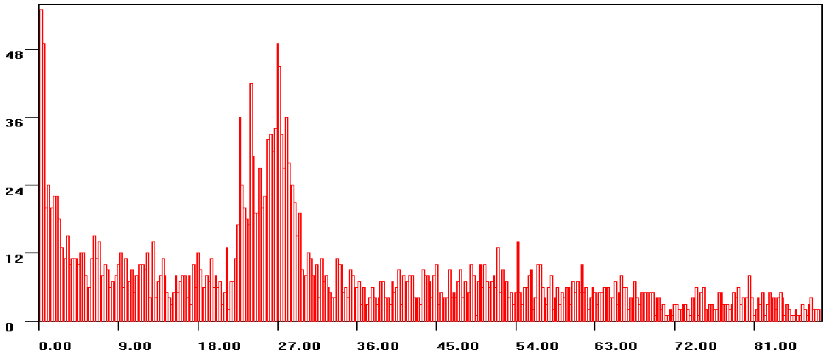

Figure 9-7: Distribution of the number of similar histogram pair results from measurements of "Ulitka" gravity-gradient antenna noises between July 18 and December 22, 1997 as a function of the time intervals separating them. An interval is 6 hours; X-axis is intervals (days).

onto the "antenna body", are of utmost importance.

Our cooperation began in 1997, when V.N. Rudenko passed a long time series to A.A. Konradov. The series contained values of mean square amplitudes of fluctuations calculated from 10-minute segments, that is, from 600 one-second measurements. We histogrammed these data (from 36- and 10-minute measurements; a histogram included 6 hours) and compared them with histograms constructed in a similar way from the results of our measurements (obtained at the same time) of ^{239}Pu alpha-activity. The probability of histograms resulting from different processes at one and the same time to be similar was very high. At that time we were not accus-

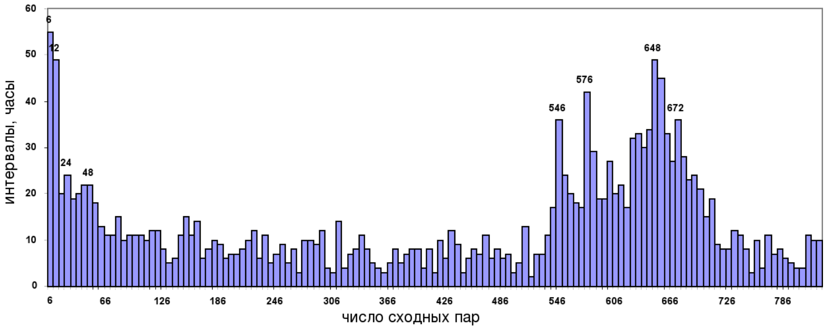

Figure 9-8: A more detailed version of Fig. 9-7.

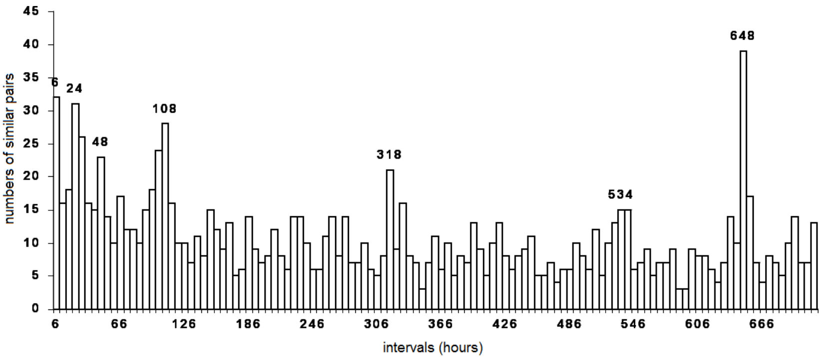

Figure 9-9: Distribution of the number of similar histogram pairs, resulting from measurements of "Ulitka" gravity-gradient antenna (provided by Professor V.N. Rudenko's laboratory) noises between March 8 and May 9, 2000 for separating time intervals.

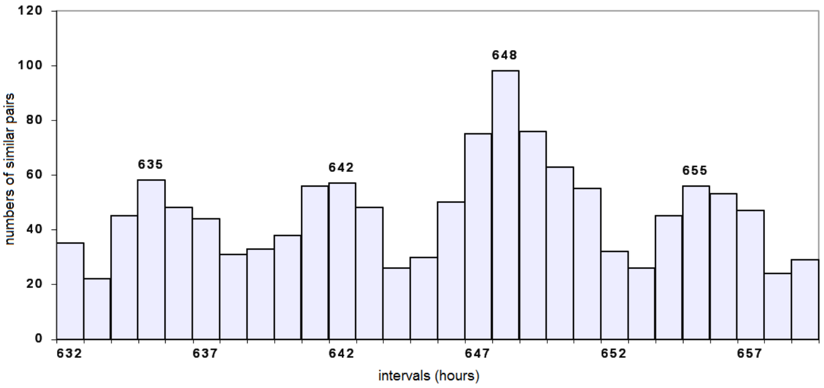

Figure 9-10: "Ulitka". Detailed distribution of intervals in the range of 27-day periods. Measurements were obtained between March 8 and May 10, 2000. The time interval from which a histogram was constructed is 1 hour. In total 1,300 similar pairs were found (6.5% of the 20,000 possible combinations).

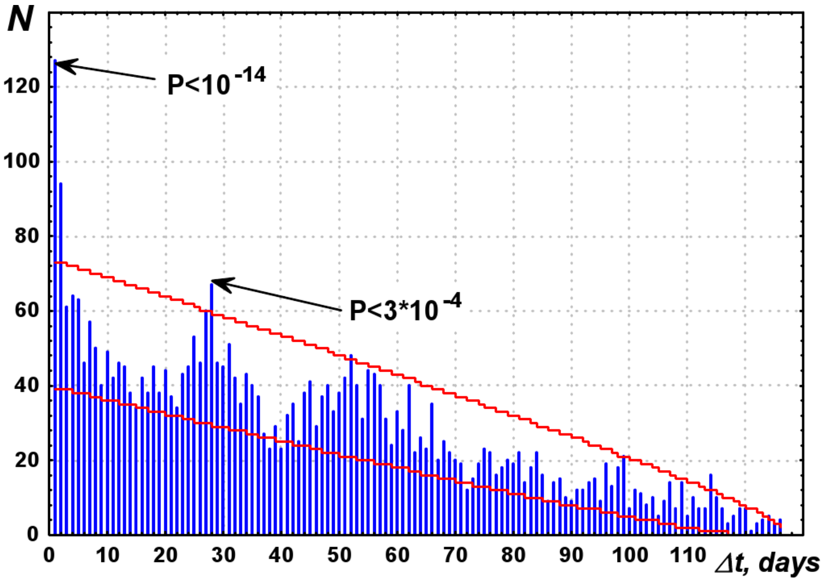

Figure 9-11: The occurrence of the near zone effect and the close to 27-day period in histogram shape changes when 6-hour histograms from measurement results of Ulitka gravity-gradient antenna noises are compared. Histograms were randomized and compared by T.A. Zenchenko. P_i was evaluated by the hypergeometric distribution.

tomed to the independence of histogram shapes from the type of process at any moment. I showed pictures with strikingly similar histograms resulting from measurements of "Ulitka" noise amplitudes and from measurements of ^{239}Pu alpha-activity in my report at SAI. However, the results could not "reach the listeners" and they displayed no interest (I suppose due to a lack of trust in the results obtained). Furthermore, the most interesting aspect to me of results of searching for the "close to 27-day periods" is presented in Fig. 9-7.

We took a series of measurements of mean square amplitudes of "Ulitka" noise fluctuations obtained between July 18 and December 22, 1997. A histogram was constructed from 36 numbers (in 6 hours). The histograms showed strong peaks, so to ease their visual comparison we smoothed them many (60) times. Then we determined the number of similar pairs from these measurements of this specific interval spacing and compared histograms from 1 to 508 (from 1 to 127 days). We completed more than 70,000 comparisons and identified 3,094 similar pairs. Fig. 9-7 presents the

Sidereal period of the Sun rotation at the equator	25.38 days	609.12 hours
The Sun synodical (relative to moving Earth) period: this time period separates passes of zero meridian through the center of the Sun disk	27.28 days	654.72 hours
The Moon sidereal month: the Moon returns to the same star	27.32 days	655.68 hours
The Moon synodical month: the Moon returns to the same position relative to the Sun	29.53 days	708.72 hours
The Moon Dragon month: period of the Moon returning to the same node of its orbit (point of ecliptic intersection; two nods in total)	27.21 days	653.04 hours

Table 9-1: Examples of close to 27-day periods, as provided by factors in the spheres of the Earth, the Moon, the Sun, and motionless stars [60].

distribution of the number of similar pairs as a function of the intervals. The distribution was constructed with the help of the GM program.

This result made a great impression on me. A "near zone effect" distinctly becomes apparent. The close to 27-day period is clear-cut. Within this zone a number of extremes can also be distinguished.

The next figure (Fig. 9-8) presents the same results in more detail. Day periods and longer periods can be identified rather reliably: 546 hours (22.75 days), 576 hours (24 days), 648 hours (27.0 days) and 672 hours (28 days).

We also continued our investigations of the occurrence of the 27-day periods, for which Professor V.N. Rudenko kindly provided measurement results from March to May 2000. The measurements were "Ulitka" piezosensor noise amplitudes with one-second intervals. T. A. Zenchenko added 4,000 to all values to make them positive; then she added up 60 measurements (per minute) and divided the result by 250. Alternatively, 360 measurements were summed and subsequently divided by 500.

Fig. 9-9 presents the result of the analysis of 6-hour histograms (sixty histograms each from 6 minutes of measurements). 1,260 similar pairs from about 20,000 comparisons were selected. The figure again shows the near zone effect, the day period and a narrow "27-day" peak. A period of 108 hours (4.5 days) is well expressed in the figure. The 6-hour intervals are too coarse a resolution for the close to 27-day periods to be able to appear. Therefore I completed an analysis of the same material with one-hour intervals. The results are presented in Fig. 9-10.

These multiples of nearly 27-day periods bear a close resemblance to, as was mentioned earlier, corresponding patterns in astrophysics. As this similarity is very important, T.A. Zenchenko conducted similar searches with full randomization of compared 6-hour histograms. The result of her comparisons is presented in Fig. 9-11. the near zone and 27-day periods are very clearly recognizable.

> **Thus, patterns found in measurements of alpha-activity and of gravity-gradient antenna noises are found to be equivalent. The range of close to 27-day periods is especially interesting for the phenomena we studied. Regularities appear independent of the type of process investigated: the range of energy changes during alpha-decay and the piezo-sensor noises differ by several orders of magnitude.**

What could these many numbers of extremes mean or imply? These changes in the probability of the recurrence of similar histograms are found in the range of close to 27-day intervals, as well as in measurements of completely different (maybe even any arbitrary type of?) processes? Close to one-day periods, the local-time synchronism, and year periods naturally lead to the implication of histogram shapes to be dependent on the orientation of the point of measurement in relation to celestial bodies. The existence of stellar days allows correlating histogram shapes with the orientation towards motionless stars. The solar day is evidence of the dependence on the relative solar orientation. The most distinct relation of the close to 27-day periods includes the collocation of three celestial bodies: the Earth, the Moon and the Sun (see Table 9-1).

Chapter 10.

Year periods

10.1 Similar histograms

Previously we (N.P. Ivanova, T.Ya. Britsina and I) hoped to find a relation between shapes of histograms and whatever cosmo-geo-physical regularities through our investigations in the 1970s and 1980s, when we conducted a standard experiment: every day at the same time we retrieved 250 measurements spaced in 30-second intervals of the DCPIP + AA reaction rate (the reader is asked to refer to Part I of the book). The rate was determined from the slope of the curve of optical density changes (decreases) in the reaction between dichlorophenolindophenol (DCPIP) blue dye and ascorbic acid (AA); a photoelectric colorimeter equipped with a recorder provided the slope. This work required high concentration and accuracy.

I must once more gratefully mention the arduous (more than 20 years of everyday experiments) work of N.P. Ivanova and T.Ya. Britsina. Since measurements of radioactivity and of semiconductor scheme noises are now automated through E. Pozharskiy's program, many hundreds and thousands of histograms can be retrieved daily. This improvement has made the collection of the material that forms the main content of this book possible. Previously the preparation of each successive experiment, the preparation of solutions, and the analysis of results required the whole working day. As a result, we could obtain only several histograms a day. As mentioned in the first chapter, the work of those "prehistoric" years was fairly essential because they allowed us to reveal the main phenomena. One of them is the repetition of histogram shapes strictly on one and the same day of every year.

Fig. 10-1 presents the wonderful results from those years: histograms, each constructed from 250 measurement results of different processes, namely from enzymatic (creatinkinase) reactions and from ascorbic acid (AA) + dichlorophenolindophenol (DCPIP) reaction rates on the same days (and hours) in February 1978 and February 1984, hence, separated by 6 years. It is essential that these histograms were similar in succession: it was a series of similar patterns. It is already rather unlikely to obtain synchronous similarity of one histogram pair. Furthermore, the random occurring similarity of 9 independent patterns in succession is highly unlikely, indeed incredible. This led to the conclusion on the non-random shapes of histograms and the regular recurrence of their shapes correlated with yearly movements of the Earth around its circumsolar orbit [9, 10].

When we commenced systematic measurements of radioactivity, we also

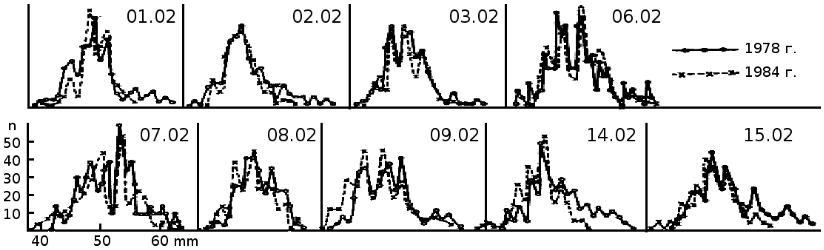

Figure 10-1: Series of similar histograms constructed from measurement results of the same dates and hours with a time interval of exactly 6 years apart: measurements were derived from creatinkinase enzymatic activity in 1978, and from AA + DCPIP reaction rates in 1984. Each histogram includes 250 measurements.

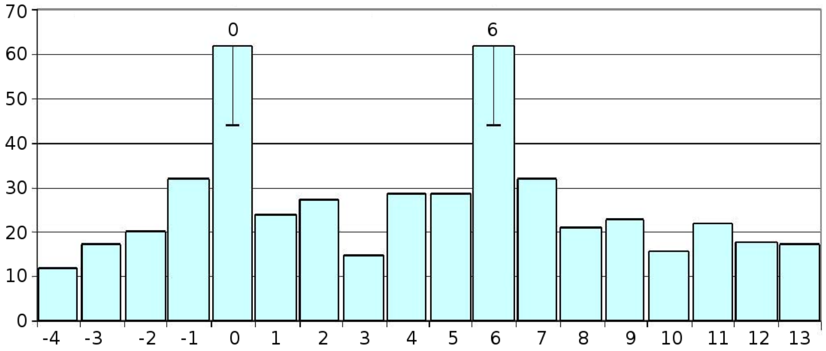

Figure 10-2: Distance between similar histograms after one year, corresponding to a subtracted 8,760 hours. Y-axis is the occurrences of similar one-hour histograms resulting from ^{239}Pu alpha-activity measurements. Histograms reoccur highly probably with an exact year period (calendar year) between them and after one year plus 6 hours (sidereal year) (please refer to the text for detailed explanations). X-axis is hours, and shows the number of similar pairs for separating time interval values [8, 63].

found similarity of histograms for the same days and in the same hours of every year. Nevertheless, it was only after starting to purposefully investigate, including the construction of the distribution of similar histogram pairs as a function of their separating time interval values, that it became possible to discern and interpret respective results of yearly periods of histogram recurrences with these shapes. These periods were identified with very high accuracy. A calendar year corresponds to 365 solar days, or 525,600 minutes. The corresponding period is determined with one-minute

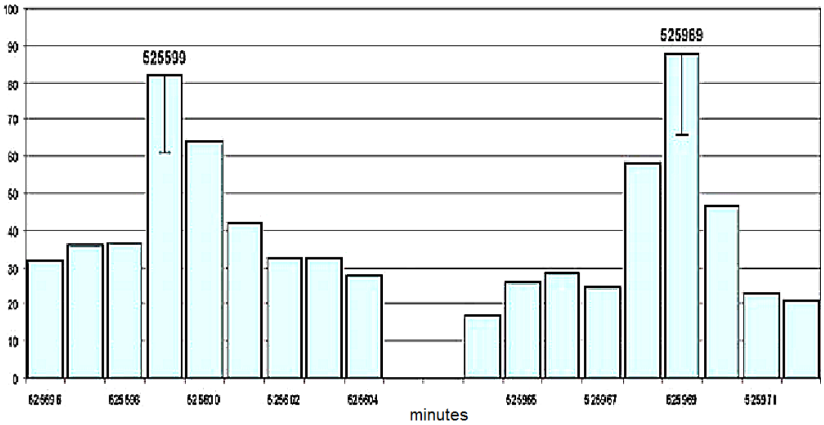

Figure 10-3: Histograms reoccur with a year period that includes two main periods, the calendar, equal to 525,599 and 525,600 minutes, and the sidereal, equal to 525,969 minutes, period; the accuracy of histograms is one minute. Measurements of ^{239}Pu alpha-activity on November 24, 2001 and November 24, 2002. X-axis is the time interval spacing between similar histograms in minutes. Y-axis is the number of similar histogram pairs corresponding to the separating time interval value [63].

accuracy when comparing histograms. We want to emphasize at this point that we are not concerned with the accuracy of the method (determination with accuracy of 1/525,600), but rather with the accuracy of the period, which is caused by cosmo-physical effects. We identified these periods not by comparing all 525,600 histograms to each other, but by comparing histogram sequences close to the periods in question. This level of accuracy in the determination of yearly periods allowed the identification of important regularities [63].

We postulated that:

1. the year period, similar to the day period, comprises two clearly distinct extremes: the first corresponds to a “calendar year”, i.e. 356 solar days; while the second one corresponds to a “star = sidereal year”, being 369 minutes longer than a “calendar year”;
2. similar histograms reoccur as follows: every other “calendar” year, one minute earlier than an estimated date; every second year two minutes earlier; and every third year three minutes earlier, etc.

These regularities, similar to the existence of “stellar” and “solar” days, imply that a histogram shape is determined by several non-correlating fac-

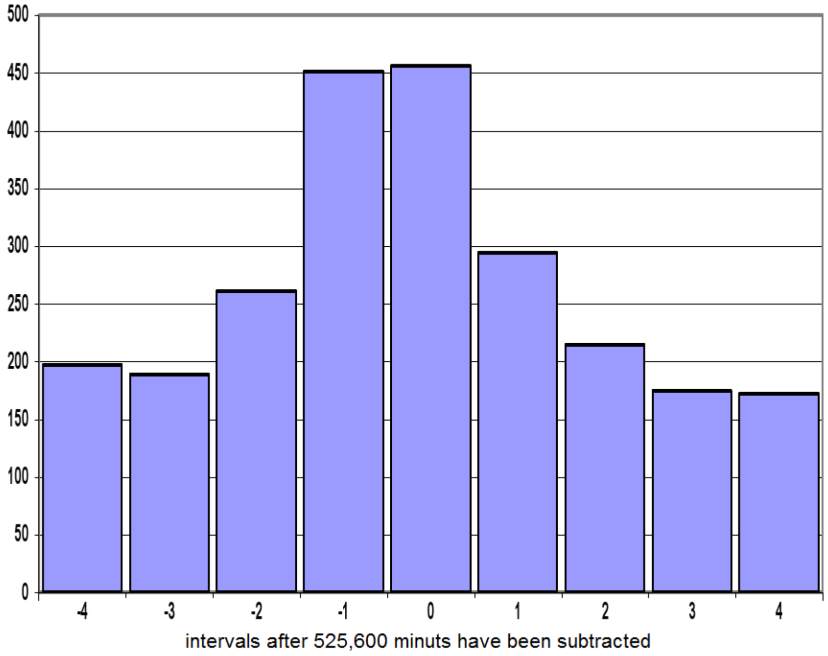

Figure 10-4: Similar histograms occur after a year (that is after 525,600 and 525,599 minutes). Measurements of ^{239}Pu alpha-activity on November 20–21, 2001 and November 20–21, 2002. X-axis is time-intervals between similar histograms after subtracting the number of minutes in a year (525,600 minutes). Y-axis is the number of similar histogram pairs corresponding to the separating time intervals.

tors.

A "calendar year" corresponds to the period necessary for the Earth to return to the same position relative to the Sun during its yearly circumsolar movement.

A "sidereal year" corresponds to the period needed by the Earth to return to the place of its circumsolar orbit relative to the motionless stars.

The existence of these periods, similar to the existence of "stellar" and "solar" days, corresponds to the dependence of histogram shapes on both the orientation of a laboratory relative to the sphere of motionless stars, and on its orientation relative to the Sun.

The second regularity, the yearly occurrence of similar histograms one minute earlier whenever the "moment of a New (calendar) year comes", may reflect the movement of the Solar system relative to some remote objects.

From these findings, we conclude that correlations exist between histogram shapes (and even more so, constructed from the results of alpha-decay measurements. . .) and the movement of the Earth around its circumsolar orbit. These results are parallel to the correlation found between histogram shapes and the axial rotation of the Earth. Moreover, one could seriously reason for formulating claims or conjectures on the hypothetical movement of the Earth as a whole. Grounds for such claims are provided by the large number (hundreds of thousands) of histogram shape comparisons from various experimental setups. One day a (prospective) computer program will compare these histogram shapes in several hours. However, for me it regularly required several hours of continuous work: doubting the results, reproducing the results, again doubting, and again reproducing, and again doubting. The materials presented in further parts of this chapter are based on multiple reproductions of the main results.

Fig. 10-2 presents the results of the determination of year periods for the recurrence of similar 60-minute (one-hour) histograms constructed from the results of ^{239}Pu alpha-decay measurements between October 23 and November 10, 2000 and 2001. X-axis is, as usual, the values of time intervals between similar histograms. The number of hours in a year is subtracted from the correspondent interval values. The Y-axis is the number of similar pairs corresponding to their separating time interval values.

The distribution of the number of similar pairs as a function of the time interval spaces between them was constructed after 4,000 comparisons had resulted in 478 similar pairs (12% of investigated combinations). The maximum possible heights of columns are equal to the number of histograms in a compared series: 427 in this case. Thus, the extremes corresponding to the intervals "0" and "6" (that are 62 similar pairs each) grew to about 14.5% of their maximum possible height. The probability of random extremes occurring with a difference in height from other columns of about 30, approximately amounts to $P = 10^{-7}$ [98].

Fig. 10-2 shows that the year period of changes in the probability of one-hour histogram recurrences of similar shape is split into two: the "calendar", equal to 365 solar days, and the sidereal year period, the latter being 6 hours longer than the former, calendar, year. I did not expect this result on the existence of a second "sidereal" period. However, we repeatedly identified these two periods. Later on it became obvious after discussions with colleagues, that this period is the "cause of leap-years". Every four years, this difference adds up to 24 hours and is compensated by an additional day, February 29, in the calendar. Nevertheless, the main

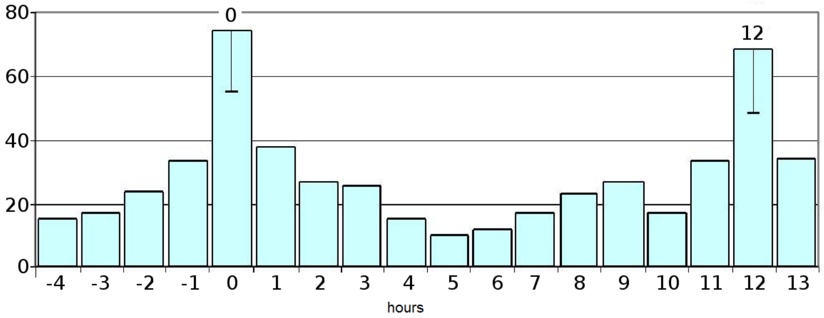

Figure 10-5: Similar histograms reoccur to the minute exactly after two years and after 2 years and 6 hours (accuracy is 1 hour). Measurements of ^{239}Pu alpha-activity in August-September, 2000–2002. X-axis is differences in time-intervals between similar histograms after subtracting the number of minutes in two years. Y-axis is the number of similar histogram pairs corresponding to their separating time intervals.

question, "why do histograms care about leap-years?", was never answered.

This result was corrected when 15-minute (total time) histograms were constructed and once even more detailed investigations of these periods, from a time interval of one minute in total (Fig. 10-3), were possible.

As one can see from Fig. 10-3, the first "calendar" period appears twofold: firstly, equal to 525,599 and 525,600 minutes; and the second, "sidereal" period is 525,969 minutes, that is 525,600 + 369 minutes.

Since these results are crucial, they were verified multiple times.

For an even more statistically reliable estimation, we compared about 80,000 pairs of one-minute histograms constructed from 6-day periods: between November 20 and November 25, 2001, and the same dates in the year 2002. We found 2,410 similar pairs. Their distribution as a function of their separating time intervals is presented in Fig. 10-4.

Fig. 10-4 depicts the very high probability of recurrence of similar in shape histograms in a year, with the period equal to the "calendar" year and the period of one minute less than a "calendar" year; the probability of randomly obtaining such pronounced extremes of a similar height as shown in Fig. 10-4, is vanishingly small.

Similar investigations were completed for two-year periods. Fig. 10-5 presents the results of one-hour histogram comparisons, which were constructed from measurements separated by two years: August–September of 2000 and of 2002.

The more detailed analysis, namely the comparison of one-minute his-

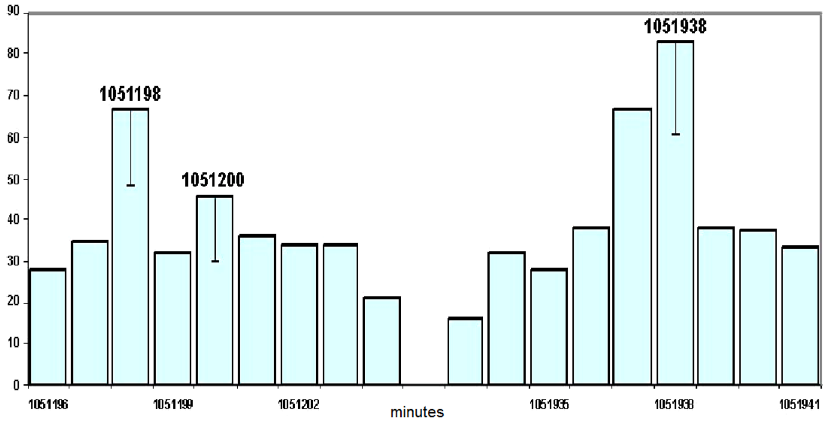

Figure 10-6: For one-minute resolution measurements of ^{239}Pu alpha-activity in two years, similar histograms reoccur with two main periods: according to the calendar and the sidereal year. The calendar period consists of two sub-periods: one equal to the estimated value (of 1,051,200 minutes), the second one amounts to two minutes less (1,051,198 minutes). Measurements of ^{239}Pu alpha-activity were obtained on April 20, 2001, 2002 and 2003. X-axis is the time intervals between similar histograms (in hours). Y-axis is the number of similar histogram pairs corresponding to the time interval between them.

tograms, demonstrated the first period being twofold: the first "sub-period was found to be 2 minutes less than two years (1,051,198 minutes), and the second one to be twice a "calendar year" (1,051,200 minutes); the second large peak in the year period distribution equals two "sidereal" years. This can be seen from Fig. 10-6. This result has also been reproduced multiple times.

In this case, again the higher statistical reliability of the determination of two-year calendar period values was provided by the comparison of more than 80,000 histogram pairs (13 pairs in a series of 698 histograms each). 81,900 comparisons were made, resulting in 3,789 similar pairs or 47% of all possible combinations.

As one can see from Fig. 10-7, over two years, similar histograms indeed occur two minutes earlier than the estimated time. The probability of this histogram recurrence is very high. The second sub-period only shows weakly. Still, the probability of such results randomly occuring is vanishingly small.

The principal point of the presented results is not only the demonstration

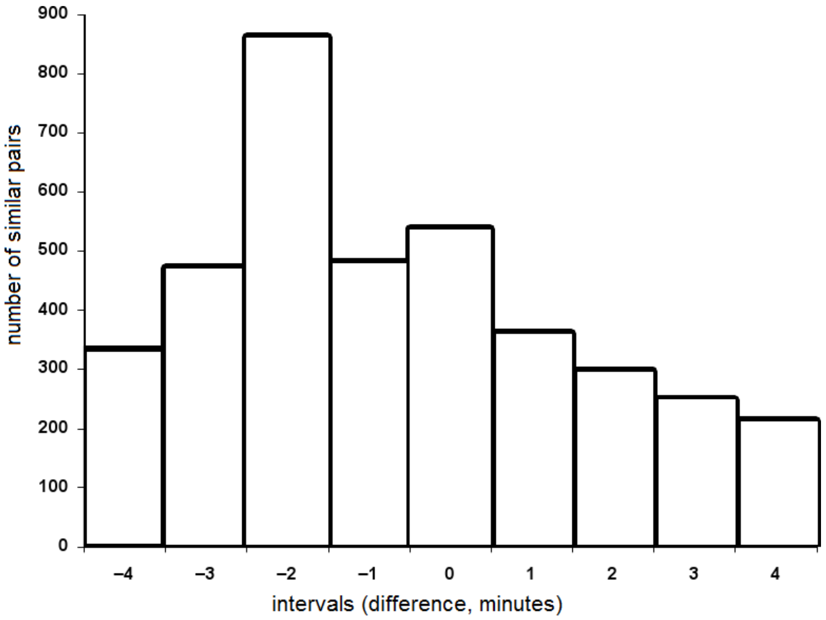

Figure 10-7: For measurements of ^{239}Pu alpha-activity over two years (1,051,200 minutes), the calendar period showing the maximum probable recurrence of similar histogram shapes is split into two sub-periods: one equals the estimated value (1,051,200 minutes), the second one is two minutes less (1,051,198 minutes). Measurements of ^{239}Pu alpha-activity from the same dates in April, October, and November of 2001 and 2003. X-axis is the time-interval spacing between similar histograms after subtracting the number of minutes in two calendar years (1,051,200 minutes). Y-axis is the number of similar histogram pairs corresponding to the time interval between them.

of two periods, Calendar and Sidereal, but also the splitting of a calendar period into two sub-periods. This splitting increases by one minute yearly. Hence, the difference for a two year period amounts to two minutes. The non-random character of this one-minute shift is confirmed by histogram comparisonss from the same date three years later.

From the construction of one-hour histograms three years later, we again obtained two periods: calendar, equal to the number of hours included in three years, and sidereal, 18 hours, that is three leap shifts different from the first one. This is presented in Fig. 10-8.

About 200,000 histograms were compared to obtain sufficient and statistically significant values for the three different yearly calendar periods

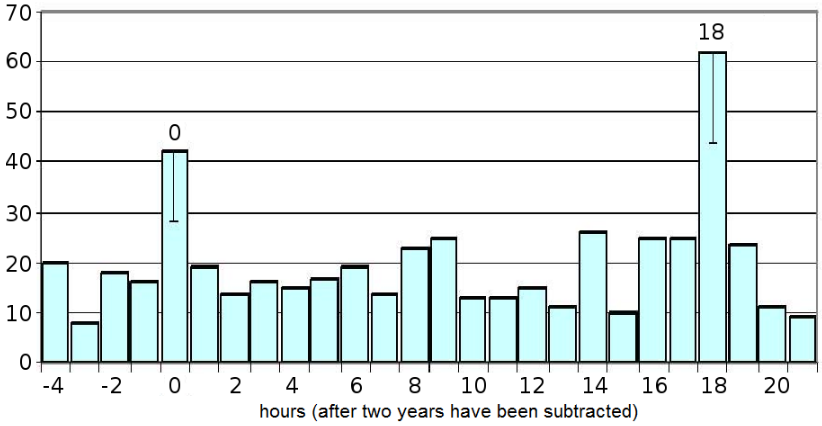

Figure 10-8: Similar histograms reoccur after 3 years and after 3 years and 18 hours (accuracy is one hour). Measurements of ^{239}Pu alpha-activity from April, October, and November 2001, 2002 and 2003. X-axis is time interval spacing between similar histograms after subtracting the number of hours in three years (hours). Y-axis is the number of similar histogram pairs corresponding to their separating time interval values.

that were identified with histograms of one-minute resolution. The results of these comparisons are presented in Fig. 10-9.

The second sidereal period corresponds exactly to the leap shift and equals $369 \times 3 = 1{,}107$ minutes, and can be considered as no less significant than the first period. That is: $1{,}576{,}800 + 1{,}107 = 1{,}577{,}907$ minutes. This can be seen from Fig. 10-10. Similar results were obtained repeatedly.

In the 4 years around the leap year 2004 and after adding February 29 to the calendar, the expected 4-minute shift of the calendar year was supplemented with a shift of 4 more minutes in the same direction caused by the 4-minute difference between the solar and stellar days. The total shift had to be minus 8 minutes. At the same time, the addition of February 29 compensated for the 24-hour leap difference. However, the difference between the sidereal and calendar years amounted to:

6 h $\times$ 4 = 24 h + 9 minutes $\times$ 4 = 24 hours + 36 minutes. Adding February 29 compensates for 24 hours only. The plus 36 minute difference then still remains.

This reasoning was formulated and conceptualized after a discussion with T.A. Zenchenko and D.P. Kharakoz. Even though it is quite astonishing, the results and their explanation appeared to be in agreement with

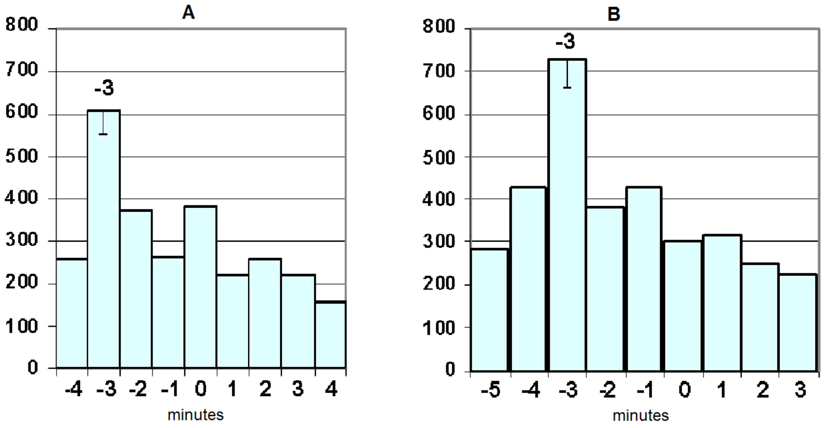

Figure 10-9: For measurements of ^{239}Pu alpha-activity over three years (or 1,576,800 minutes), the calendar period in the recurrence of similar histogram shapes is also split into two sub-periods: one equal to the estimated value, the second one three minutes less. Measurements of ^{239}Pu alpha-activity from the same dates: **A**: in October, **B**: in August and September of 2000–2003. X-axis is the time intervals between similar histograms after subtracting the number of minutes in three years (1,576,800). Y-axis is the number of similar histogram pairs corresponding to the time interval between them.

reality. This can be seen from Fig. 10-11. It shows a phenomenon that I named "odes of the calendar year". These are two equivalent periods: a calendar year and another period that is shifted from the first one by a minute per year. This increasing splitting seems to me a consequence of the movement of the Solar system within the Galaxy, so I suggest to name it a galactic period. The sidereal period of the previous 4 years caused an extreme at the 36th minute.

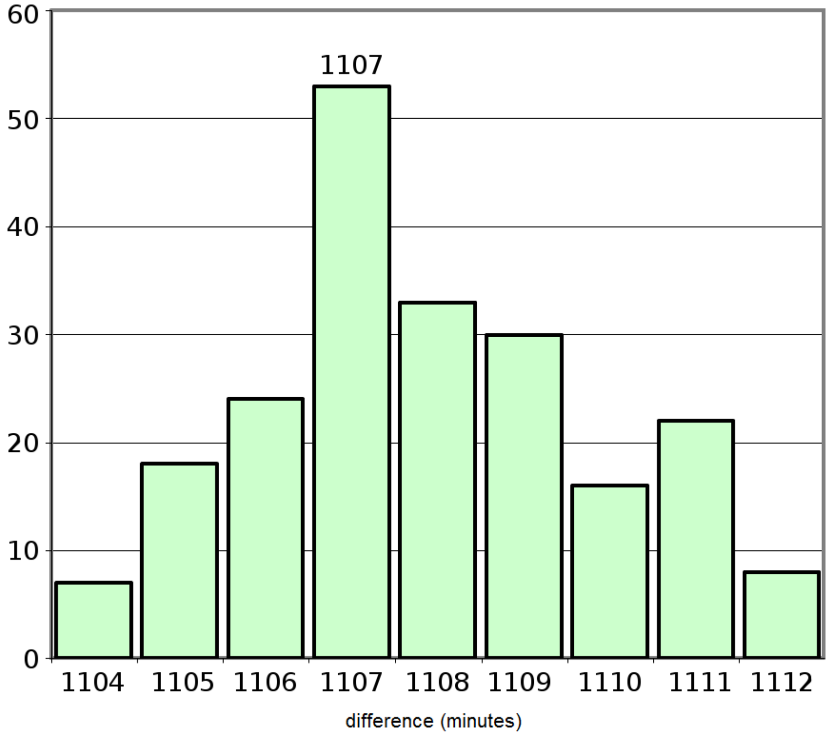

Figure 10-10: For measurements of ^{239}Pu alpha-activity over three years (1,576,800 minutes), the sidereal period of the recurrence of similar histogram shapes occurs with a treble leap shift, that is 369 $\times$ 3 = 1,107 minutes later than according to the estimated calendar time. X-axis is time intervals separating similar histograms after subtracting the number of minutes in three years (1,576,800 minutes). Y-axis is the number of similar histogram pairs corresponding to the time interval value between them.

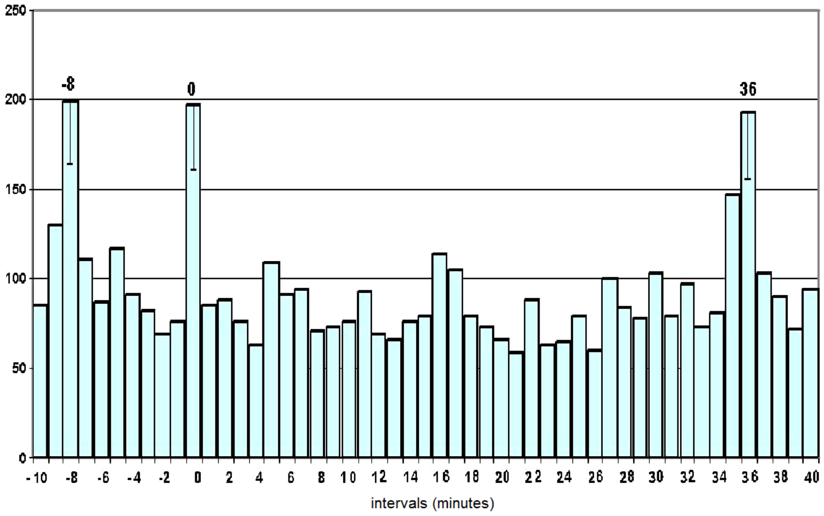

Figure 10-11: We discovered three extremes that denote an increased probability of similar one-minute histograms to occur from data obtained over four years (from measurements of ^{239}Pu alpha-activity on the same dates, and the same time of day: August, 2 and December 29, 2000–2004): the first, Calendar is equal to the estimated value. The number of minutes in four calendar years corresponds to 0 on the X-axis; the second, Galactical, is 8 minutes less than the estimated calendar period (4 minutes of a year shift + 4 minutes of the additional February 29), and the third, Sidereal, corresponding to the 36^{th} minute on the X-axis, is a not yet compensated remain of the leap shift after the addition of 24 hours on February 29. X axis is intervals after subtracting the number of minutes corresponding to four 365-day years. Y-axis is the number of similar pairs. Lower borders of 95% confidence intervals are marked at the peaks.

10.2 Confirmation of the one-minute shift from a calendar year and finding another year-period equal to a "tropical year" from the analysis of S.N. Shapovalov's and A.V. Makarevich's measurements in the Antarctic

Each of my investigation steps had a "natural" driver: doubts in the reliability of their results and in the validity of the conclusions. Doubts were caused by the uncommonness of the results and by the impossibility to find supporting work of other investigators (laboratories). The only way to overcome these doubts was to multiply reproduce the results through repeating the investigations in various versions. At this point it is important to mention the psychological shift that comes about when repeating investigations over a relatively large time period: the previous results lose their stand-alone individual significance and become a literature fact that needs testing. Our searching for year-periods started in 1970–1980, and it seemed completed to me in 2007. However, the doubts remained. In 2009 I decided to investigate year periods once more: using the results of radioactivity measurements made by our friends and colleagues from J.A. Troshichev's laboratory AARI over many years, S.N. Shapovalov and A.V. Makarevich, in the Antarctic expedition. Measurements of ^{239}Pu alpha-activity were obtained over several months with the I.A. Rubinstein device at the Novolazarevskaya station in the Antarctic; in 2003 they were collected by A.V. Makarevich, and between 2005 and 2008 by S.N. Shapovalov. Resulting copies of these extremely valuable measurements were kindly handed over to our laboratory; they are kept in our database archive, which was formed by T.A. Zenchenko over the years.

Fig. 10-12 shows a yearly one-minute shift for the galactic year period relative to the calendar period, from the comparison of one-minute histograms resulting from measurements of ^{239}Pu alpha-activity (the measurements were made by S.N. Shapovalov with a collimator-free I.A. Rubinstein counter at the Novolazarevskaya station in the Antarctic). Series of 720 histograms each, constructed from measurements obtained at the exact same time on April 2, 2003–2008, were compared. One can see that there is a shift of 1 minute in the histograms of the year 2008 relative to those of 2007; histograms from 2008 are shifted by 2 minutes relative to 2006, while the difference between 2008 histograms as compared to 2005 is 3 minutes, and 2008 relative to 2003 is 5 minutes. Similar results were obtained in the comparison of histograms constructed from measurements dated February 3 of the same years.

Fig. 10-12 shows that there is a weak indication of a calendar year period in these results, while a galactic period dominates. This may be related

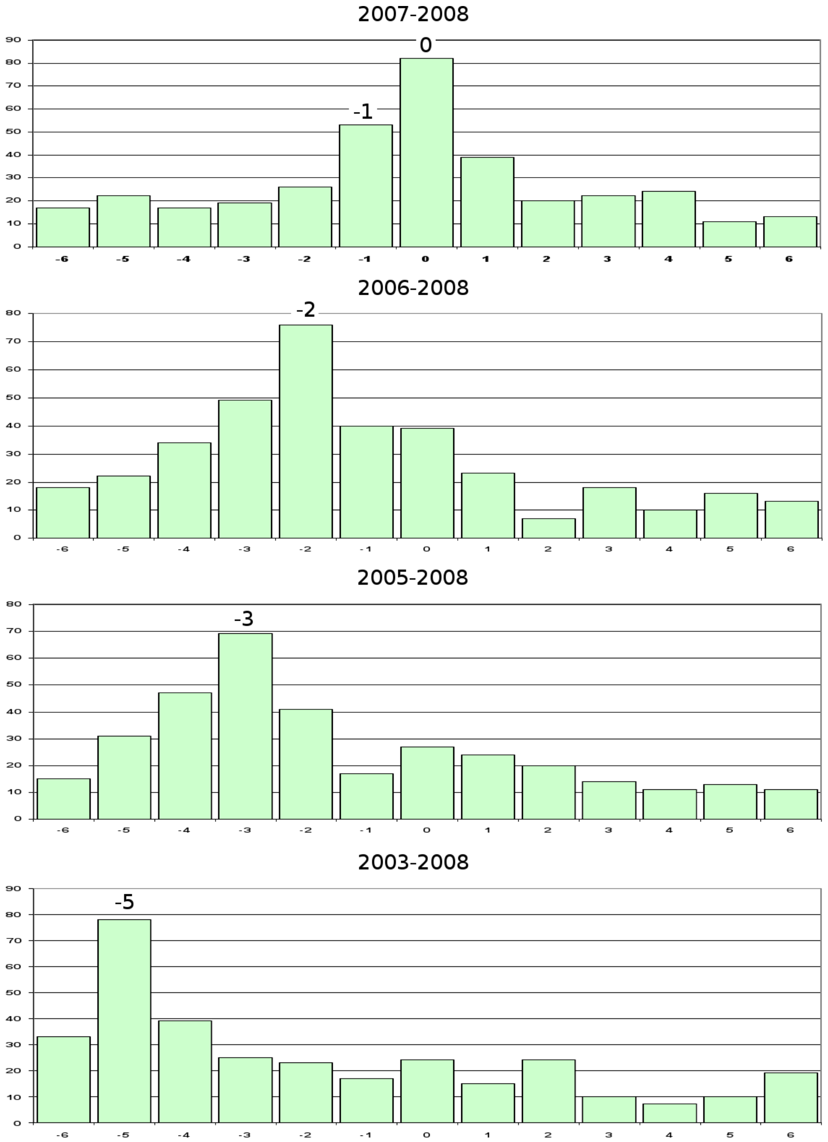

Figure 10-12: A yearly one-minute shift of the galactic year period compared with the calendar period from measurements of ^{239}Pu alpha-activity. Measurements were made by S.N. Shapovalov at the Novolazarevskaya station, in 2003–2008. One-minute intervals.

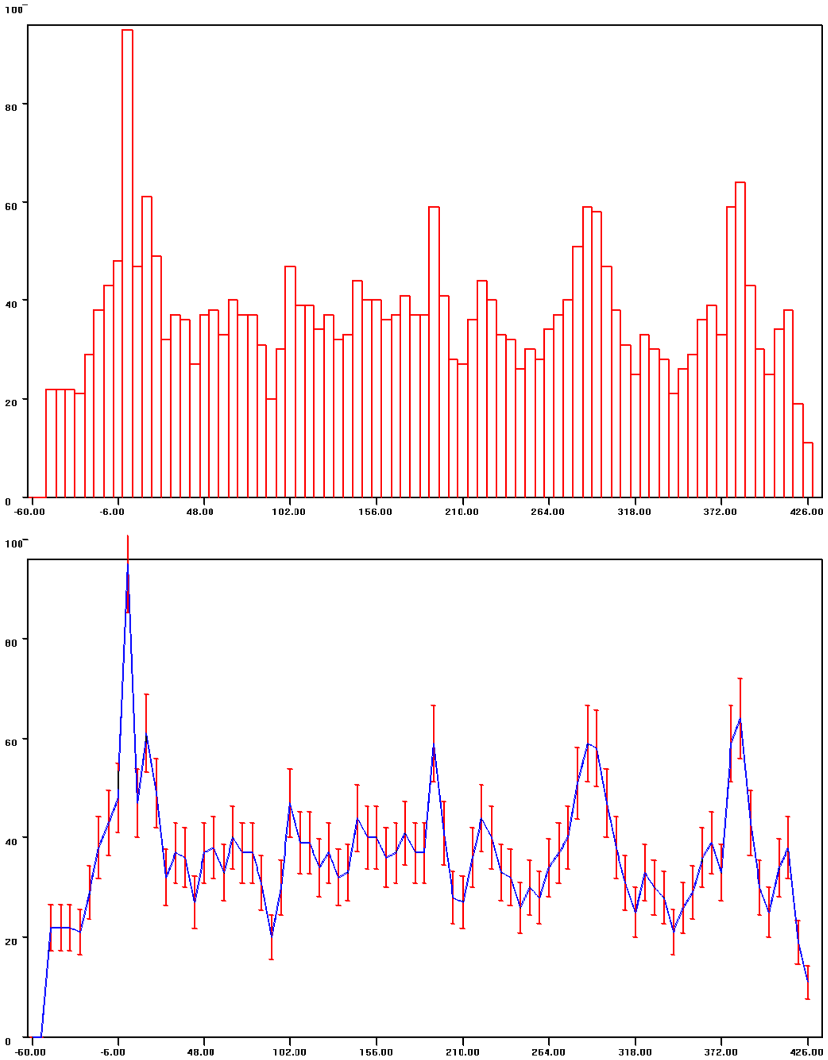

Figure 10-13: Distribution of the number of similar pairs of 6-minute histograms by the values of the separating time intervals. X-axis is intervals after subtracting the number of minutes in a calendar year. Y-axis is the number of similar pairs as a function of the time interval value.

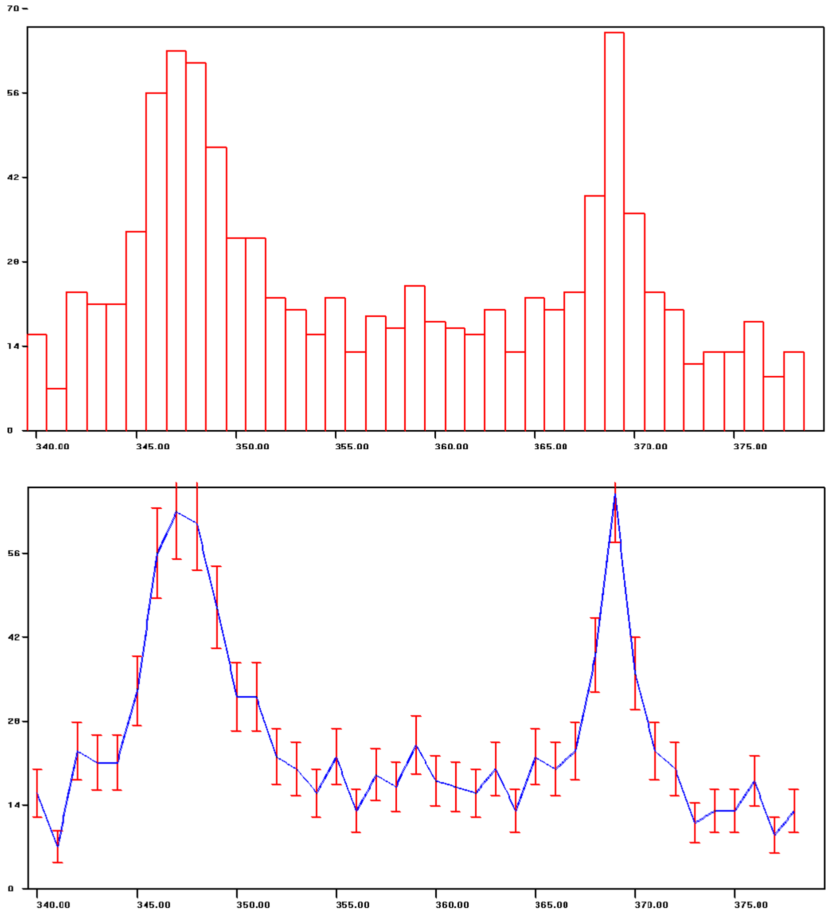

Figure 10-14: From the comparison of one-minute histogram series constructed from the results of S.N. Shapovalov's measurements at the Novolazarevskaya station, the tropical and sidereal year periods are clearly seen.

with the orientation of the flat alpha-particle detector towards the Ecliptic plane. However, this proposition requires more specific investigations.

From my background in astronomy I knew about the one year period, the tropical year equal to an average 365 solar days, 5 hours and 48 minutes. However, I did not find this period in the results of my measurements. This could be explained by my neither intentionally searching for the tropical year period nor for the sidereal period; it occurred unexpectedly in the

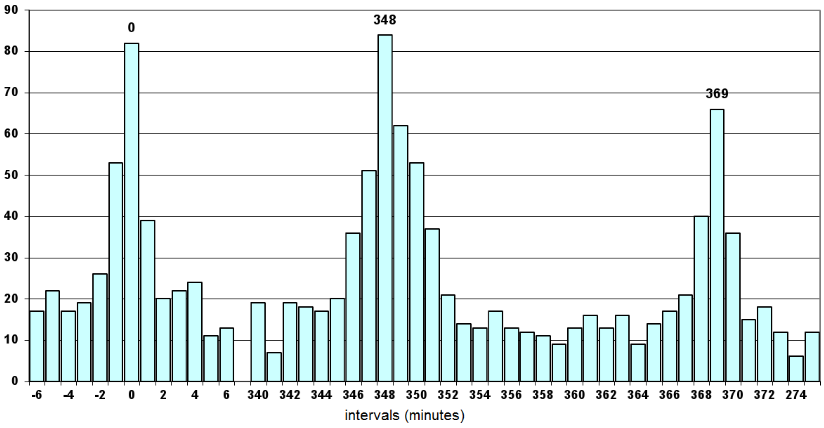

Figure 10-15: Calendar, tropical, and sidereal periods in the recurrence of similarly shaped histograms: obtained by comparing one-minute histogram series, constructed from the results of S.N. Shapovalov's Antarctic measurements in 2007 and 2008. Axes are the same as in Fig. 10-13.

comparison of one-hour histograms in the range of close to 356 days and 6 hours. When I decided to specify the duration of a sidereal period and began to compare one-minute histograms, I looked for this period (for methodological reasons) in the interval range around the periods 365 days and 369 days, adding and subtracting 13 minutes (365 days and 369 ± 13 minutes). If I now were to broaden this range, I could reveal the tropical period as well.

These searches were stimulated by a letter from geophysicists, the Vasilyevs (wife and husband) [T-10]. In the following we provide a fragment of the letter:

"Your experiments have revealed apparent peculiarities that occur during equinoxes. Though what distinguishes equinoxes from other days? Only the fact that at the moment of an equinox, the α angle between a Sun beam at the Earth and the axis of the Earth rotation is 90^o? From this arises a question: maybe the dependence between a histogram shape and an α angle is continuous and always present? I wrote to you earlier about rather complicated possibilities for testing this. And now at last I found the simplest way to check it. Fortunately, the Earth axis changes its spatial direction a bit (towards "motionless stars") in a year. Because of this, a spring equinox point is shifted along the ecliptic by a negligible value of 50.29 angular seconds in a year. However, the Sun moves 50.29 angular seconds of the ecliptic in a relatively longer period: approximately for 20.4 minutes. In your experiments of the close to one year periods, cycles are measured with at least one-minute accuracy. For this reason, your experiments are perfectly suitable for solving this problem. In brief, α angles do not repeat in a sidereal year (365 days 6 hours 9 minutes and 10 seconds), but 20.4 minutes earlier, that is, in a tropical year (365 days 5 hours 48 minutes and 45 seconds). The 365 days 6 hours 9 minutes and 10 seconds cycle does exist and may be explained by various effects. If shapes of histograms depended on the α angle, one more cycle of 365 days 5 hours 48 minutes and 45 seconds should exist. Was it tested, and could it be confirmed through testing? The presence or absence of a 365 days 5 hours 48 minutes and 45 seconds cycle will provide an answer to the question whether a histogram shape depends on the angle between the rotation axis and a beam conducting the effect. Athens, March 7, 2009"

As no "tropical year" can be seen from analyzing 60-minute histograms, I constructed a series of 6-minute histograms for a more detailed analysis. I used the results of S.N. Shapovalov's measurements from the Novolazarevskaya station made between February 3, 2006 and 2007. Fig. 10-13 presents the resulting distribution of a thorough histogram comparison in the interval between a calendar and a sidereal year.

Only the calendar period shows a clear expression in this figure (0 region of the X-axis). The sidereal and tropical year periods can be seen weakly. The similar distribution of 6-minute histogram analysis results was obtained from series of measurement results at the Novolazarevskaya station, with measurements starting at the same time on April 2, 2003 and 2008. Later on I constructed a series of one-minute histograms from the same measurement results and analyzed them in the interval range outlined in 6-minute series of "Tropical" and "Sidereal" year periods. The results of this analysis are presented in Fig. 10-14.

Correlations between calendar, tropical and sidereal year periods can be seen from the comparison of series of 2007 and 2008 histograms, presented in Fig. 10-15.

Reviewing preliminary results of investigations on year periods, I may state the following: They are fantastic. Furthermore, the narrowness of extremes makes the results ever more significant. The dependence of histogram shapes from the relative orientation (or the orientation towards separate directions) of the Earth, the Sun, Galactic and motionless stars is pronounced.

Chapter 11.

The Polar Star collimator

The histogram comparison results constructed from simultaneous measurements during an Arctic expedition in 2000 and in Pushino confirmed a correspondence between the histogram shapes and the daily Earth rotation. However, the result was only partly confirmed: from measurements obtained at 820, the day period in histogram shape changes and the near zone effect did disappear. The ship did not move any further towards the pole, and no measurements beyond that point are available. This result came out very clearly for one-hour and for 15-minute histograms only. For the one-minute histograms, that is, at a higher resolution, both Solar and stellar days also occurred quite distinctly at this latitude. I wanted an "unbiased experimental setup" by taking measurements maximally close to the North or South Pole. However, this was not possible at that time and is also not possible to date.

Following this, I decided to adapt these unrealizable plans and exchange the previously planned experimental setup with: obtaining the measurements with a collimator-equipped device canalizing the flow of alpha particles of radioactive decay directed at the Polar star. This decision was "not quite that rational". I could not base it on straightforward reasons. Ilya Alexandrovich Rubinstein promised to make such a collimator.

As usual, I called Lev Alexandrovich Blumenfeld, and he commented: "There should be some limits, don't go crazy. The experiment is pointless..." He was right, of course. Why should close to one day periods of histogram shapes constructed from measurements obtained in Pushino at 45^o NL show a change in their time patterns just because I put a collimator above the source of alpha particles? But I was not able to "yield to reason".

Meanwhile, Ilya Alexandrovich developed a wonderful device. When one narrow collimator tube followed by a semi-conductor detector was placed over an alpha particle source, few alpha particles will enter the hole and this will prevent that any further work can be achieved. Therefore I. Rubinstein designed the collimator in form of a paxolin (Plexiglas) plate, 11 mm thick, with a lot of (120) 0.9 mm holes. Hence, the number of alpha particles reaching the detector became large enough (up to hundreds in a second).

Now we had to mount the collimator (device in whole) in such a way as to direct the collimator towards the Polar Star. This was not simple. Was it perhaps another "ill-defined brainchild"? We had to mount a device in our laboratory on the third floor of a building. There were two stories of concrete floors above it. Directing the collimator towards the Polar Star meant that it would have to be directed towards the northern wall at the proper angle. As a matter of fact, speaking about directing the alpha particles towards the Polar Star was rather odd. Alpha particles fly for about 4 cm in space…

Nevertheless, I ignored these reasons at hand. I "was eager" to proceed with the experiment.

To properly setup a collimator in a closed facility, where no stars can be seen, we consulted with Iozas Iozasovich Berulis, an astrophysicist working with the Pushino radioastronomic station of the Lebedev's Physical Institute. He became our collaborator. Yuri Mikhaylovich Popov was asked by I.I. Berulis to construct (and did so almost for free) a device from old telescope parts, permitting to direct a collimator where necessary. The gala day came. On the 19^{th} of November, 2001, three experts, namely I.I. Berulis, Yu.M. Popov, and Boris Valentinovich Komberg (theoretical astrophysicist), equipped with theodolite and other devices thoroughly determined a point under the ceiling close to the north wall and directed the I. Rubinstein collimator towards it. The collimator-free control device was an ordinary counter of the same construction with a flat source and flat detector (the same as for the collimator-equipped device). The measurements (by K.I. Zenchenko) started on the 31^{st} of January 2002.

These measurements (with one-second intervals) were obtained until June 14, 2002. Five series (over 20,000,000 measurements) were made:

1. from January, 2002 to February 17, 2002,
2. from February 17, 2002 to March 18, 2002,
3. from March 18, 2002 to April 15, 2002,
4. from April 15, 2002 to June 3, 2002,
5. from June 3, 2002 to July 11, 2002.

The results of one-second measurements were converted (by summing them up) into one-minute measurements, and hour-histograms were constructed from them. Already the first series showed: other factors being equal, the control (without collimator) device provided a distinct near zone and 24-hour period in histogram shape changes, while the collimator device does not provide either the near zone or the day-period. I conducted a thorough analysis of the results of the second series of measurements and called "Blum" (L.A. Blumenfeld) (he then occupied a special ward of the Cardiocenter…). L.A. Blumenfeld became anxious. He said: "You know, such experiments take place once in 72 years (I never understood to what event he actually referred as a starting point of his timing). Abandon all other things! Stop lecturing for a while! Make these measurements only!"

I sent him the results of the second series. He became even more interested and quite excited by the outcomes. Figures 11-1A and 11-1B present these results.

For this figure, about 60,000 histograms in total were compared to each other and 3,286 similar pairs were selected.

It is clear from the illustrations that changes of histogram shapes of one-hour histograms constructed from the measurement results with the collimator directed to the Polar Star include neither the near zone effect, nor the close to one day periodicity. A pattern similar to the pattern resulting from measurements near the North Pole is seen. Control measurements with the same counter but without a collimator show the distinct near zone effect and the close to a day periodicity.

The result was confirmed by another three measurement series.

Fig. 11-2 presents a summary of the results of this investigation: the sum of the interval distributions between similar histograms in all five series of measurements from 2002. To construct these distributions we compared the shapes of “control” (alpha particles flying from a West-oriented flat sample of ^{239}Pu measured with a flat detector) and of “experimental” (measurements of alpha particles flow reaching the detector through the narrow Polar Star-directed collimators) histograms. The average share of similar histogram pairs in the control group was 7.6 % of all possible combinations. For the experiments with collimators, this share amounted to 9.7%.

In the “experiment” the probability of similarly shaped histograms is almost the same for all measurements: neither the near zone, nor the close to a day period are found. The probability to randomly obtain such a difference in the results of the total interval distributions for the “control” and the “experiment” groups is vanishingly small.

In experiments with North-directed collimators, a measured object is situated at 54^o NL, and an observed pattern is similar to that resulting from measurements near the North Pole. This leads to the conclusion that a histogram shape depends not only on the star sky pattern over the measurement location but also and even more so on the direction of the alpha particle emission. This implies a sharp space anisotropy.

This result implies that it is **not the objects under investigation that shape the observed regularities or any arbitrary effects of those objects under investigation**: observed effects are similar for a ^{239}Pu preparation in Pushino, at 54^o NL and for measurements resulting from the Arctic expedition. We concluded that regularities of **histogram shape changes are determined by the direction of the alpha particle emission during radioactive decay**. However, we still doubted whether the observed effect

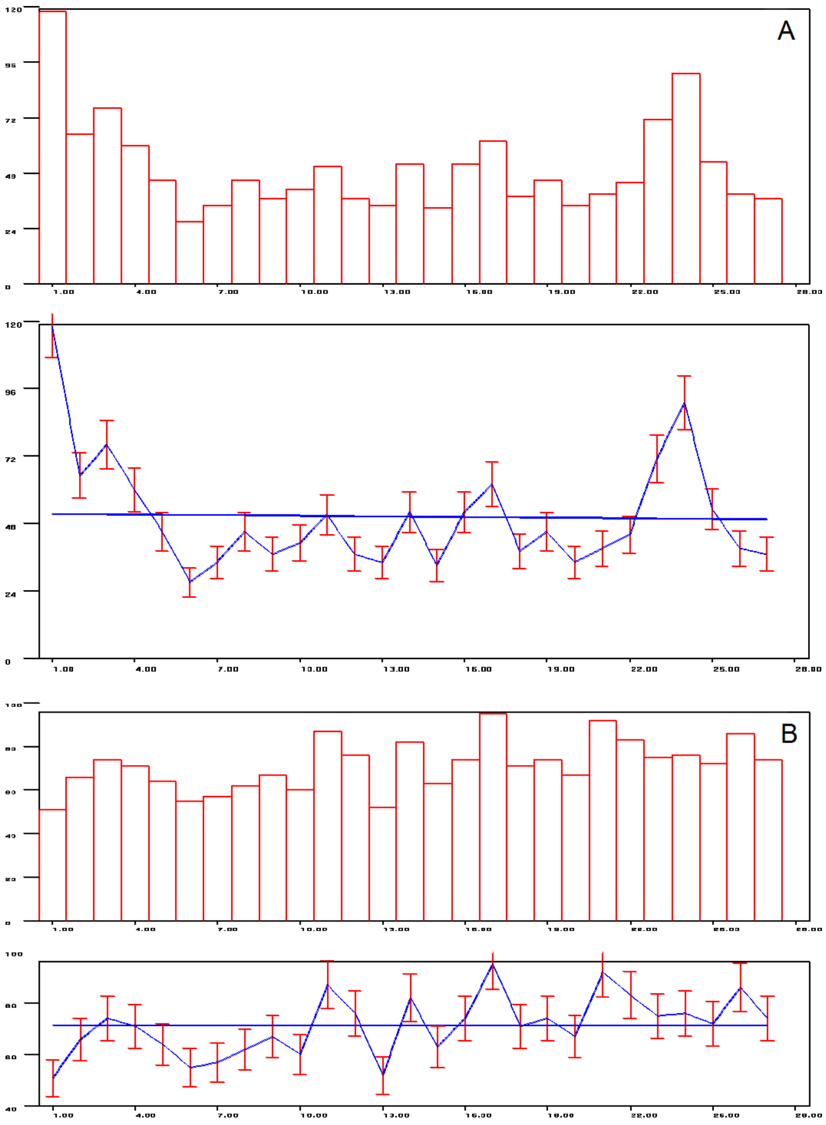

Figure 11-1: For measurements of ^{239}Pu preparations alpha-activity with a collimator-equipped device in Pushino (54^o NL), canalizing alpha particles flying during radioactive decay towards the Polar Star (90^o NL), the near zone effect and the close to a day-period of changes in 60-minute histogram shapes disappear. A: measurements with a control counter (collimator-free); B: collimator-equipped measurements. X-axis is intervals (in hours). Y-axis is the number of similar pairs.

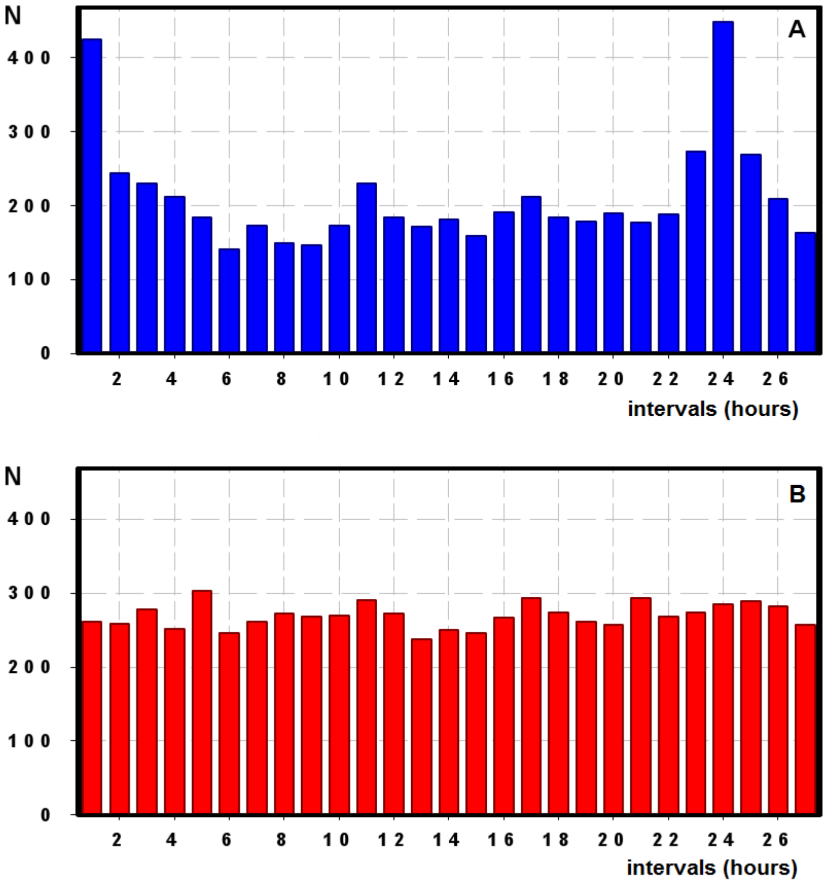

Figure 11-2: The distribution of intervals between similar histograms depends on the direction of emitted alpha particles from measurements of ^{239}Pu alpha decay. Measurements were obtained from January to June 2002. A: measurements of alpha particle flow from a West-oriented flat sample (measured with a flat detector); B: measurements of the flow of alpha particles reaching the detector through a narrow, Polar Star-directed collimator; Y axis is the number of histogram pairs, corresponding to the time interval between them. As usual, and also shown for the control device, the distinct "near zone effect" and close to a day period appear.

could be determined by some influence of the collimator itself on histogram shapes. To eliminate this possibility we undertook a similar investigation with two collimators: directed towards the North (the Polar Star) and towards the West (Fig. 11-3).

Collimator is directed towards West		Collimator is directed towards North	
1	**332**	**1**	**181**
2	**161**	**2**	**116**
3	121	3	124
4	119	4	99
5	168	5	142
6	115	6	136
7	128	7	121
8	130	8	122
9	114	9	116
10	134	10	122
11	132	11	95
12	136	12	128
13	125	13	140
14	168	14	159
15	138	15	119
16	137	16	130
17	143	17	103
18	137	18	122
19	88	19	144
20	95	20	145
21	132	21	156
22	**201**	**22**	**159**
23	**236**	**23**	**179**
24	**352**	**24**	**162**
25	**172**	**25**	**155**
26	98	26	143
27	94	27	145

Table 11-1: When a flow of alpha particles emitted during radioactive decay is directed westward, the "near zone effect" and the close to a day period in the recurrence of similar histogram shapes are observed. In the Northern (towards the Polar Star) direction, the near zone effect is almost absent, and the close to a day period is completely absent. The distribution of the number of similar histogram pairs as a function of the separating time intervals (in hours) is shown in tabular form here. The total time interval from which measurements were obtained was February 18 to May 11, 2003.

Fig. 11-3 shows that the near zone effect and the close to a day period occur in measurements obtained with a collimator directed to the West, the same as for measurements without collimators. When the collimator is directed northwards, these effects are not present. Thus, regularities of histogram shape changes indeed only depend on the direction of alpha

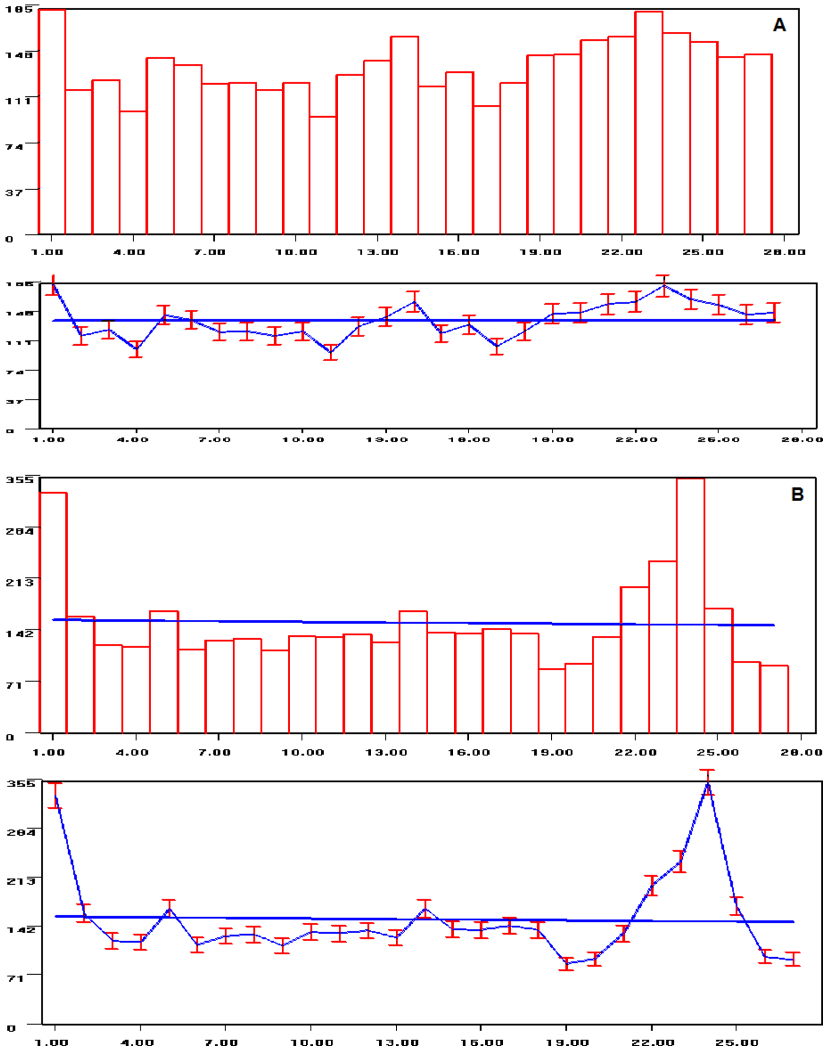

Figure 11-3: Distribution of intervals between similar 60-minute histograms from measurements of ^{239}Pu alpha activity in Pushino (54^o NL) with North- (Polar Star) directed collimator (A) and with West-directed collimator (B). Experiments were carried out between February and May 2003.

particle emission during radioactive decay. Measurements of two versions of the experiment differ only by the collimators' spatial direction. Hence,

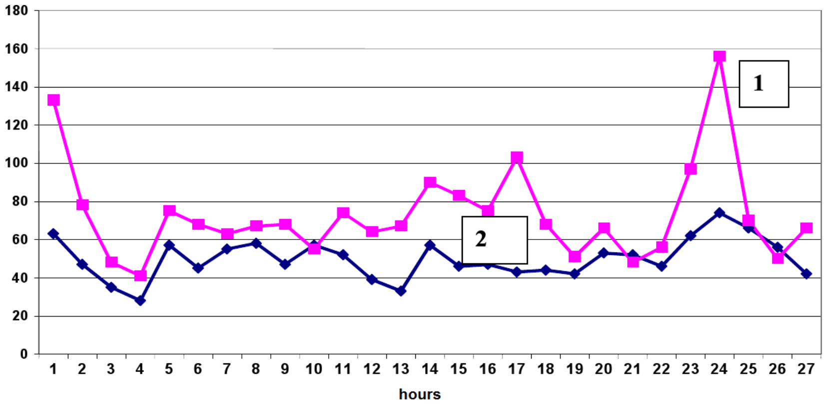

Figure 11-4: Distributions of the number of similar histogram as a function of the time interval separating them from measurements of ^{239}Pu decay with two collimators: one is West-directed (1), and the second is Polar Star-directed (2). Measurements obtained between December 2003 and January 2004. Axes are the same as in Fig. 11-1.

the observed regularities, the vanishing of the "near zone" effect and of the close to a day period, are not due to differences in the measurement conditions: be it with a flat detector or with a collimator-equipped detector. Observed differences between the "control" and the "experiment" group are provided by differences in the spatial directions of the alpha particle flow during radioactive decay. Hence, the results of the 2000 Arctic expedition measurements are not the only evidence any more for the effect on the shapes of histograms under conditions close to the North Pole.

In light of the principal importance of this conclusion, appropriate experiments were reiterated. For example, Fig. 11-4 presents the results of another series, obtained with two collimators: one directed at the Polar Star and one directed to the West (measurements from December 2003 to January 2004).

Thus, we may postulate that in these experiments, a histogram shape is determined by the direction in anisotropic space of alpha particles emitted during radioactive decay.

Chapter 12.

Experiments with collimators directed to the West and East

The conclusion on the dependence of histogram shape changes on the direction of the alpha particles emission was confirmed by experiments, where histograms that resulted from measurements with westward and eastward directed collimators were compared. The results of these experiments are presented in Tables 12-1 and 12-2, and in Figures 12-1 to 12-3.

From Table 12-1 and Fig. 12-1 one can see that the probability of a synchronous occurrence of similar histograms (the interval between them equals "0") in the measurements obtained with "Western" and "Eastern" collimators is not above the random level. Instead, extremes corresponding to a 12 hour difference in measurement times are clearly expressed. (+) Sign denotes "Western" histograms, which were observed later than the "Eastern" histograms. (–) Sign means that "Eastern" ones were obtained later than their "Western" counterparts. Hence, at one and the same time when the flow of alpha particles moves into different directions, we observed various histogram shapes. Alpha particles were emitted through the

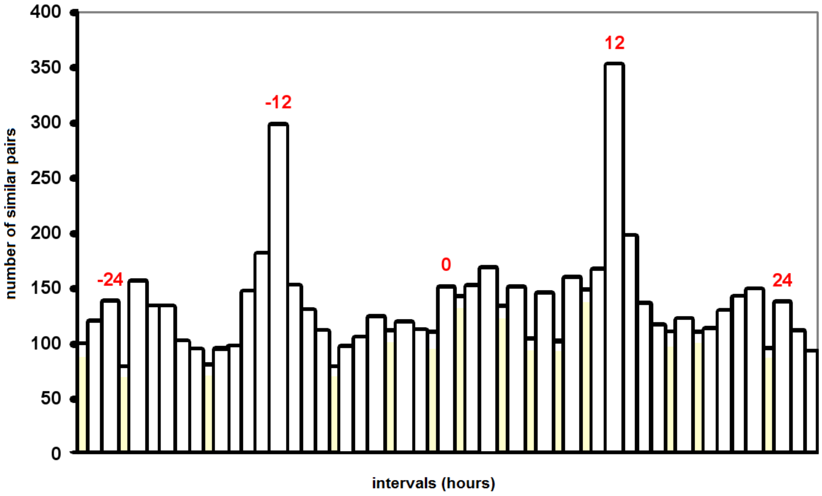

Figure 12-1: For measurements with collimators directed in opposite orientations, the probability of simultaneous occurrence of similar histograms decreases sharply. Similar one-hour histograms occur "in the West" half a day later as compared to their appearance in the "East". Measurements were obtained from ^{239}Pu alpha activity in Pushino between June 22 and October 13, 2003.

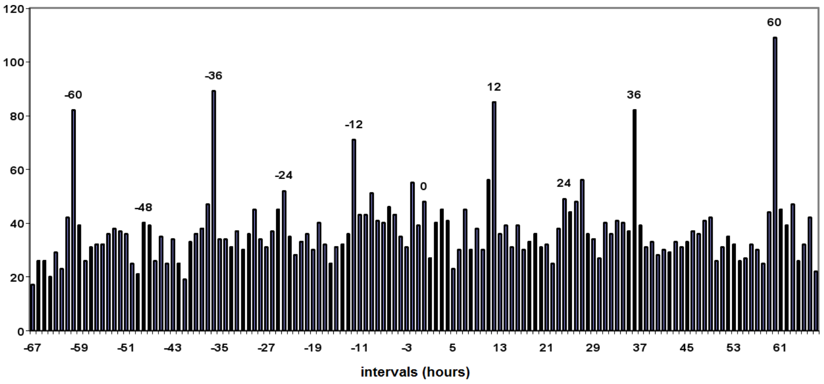

Figure 12-2: Comparison of 60-minute "Western" and "Eastern" histograms, resulting in the distribution of the number of similar histogram pairs as a function of their separating time intervals. Measurements from ^{239}Pu alpha activity in Pushino between June 15 and August 16, 2003.

Western collimator in the same direction that alpha particles were emitted through the Eastern collimator 12 hours prior.

This half day, or 12-hour periodicity persists for many periods. This can be seen from Fig. 12-2.

Results of these experiments evidence the stability of the revealed anisotropy in the environment.

Table 12-2 presents results of the comparison of "Western" and "Eastern" one-minute histograms. The histograms were constructed from 60 results of one-second measurements of ^{239}Pu alpha activity.

Nine of the one-minute histograms separated from others in time by 715–723 minutes were compared with all 698 histograms of the same time series. Eleven experiments of this sort were completed in total. The total number of comparisons is 69,102. 3,145 similar pairs were identified. This corresponds to about 4.5 % of those analyzed. One can see the similarity of distributions in all eleven experiments. The total result is presented for representational purposes in Fig. 12-3.

As one can see from Table 12-2 and Fig. 12-3, there is a sharp extreme at 718 minutes, implying that histograms tend to be similar with a higher frequency at this particular time distance.

Does this imply that a histogram shape is determined by the star sky pattern towards which alpha particles are emitted during radioactive decay?

intervals (hours)	Sept. 13 – Oct. 14	Jun. 22 – Jul. 14	Jul. 15 – Aug. 16	Aug. 17 – Sept. 13	sum	intervals (hours)	Sept. 13 – Oct. 14	Jun. 22 – Jul. 14	Jul. 15 – Aug. 16	Aug. 17 – Sept. 13	sum
-26	27	26	24	22	99	0	34	50	35	32	151
-25	32	26	35	27	120	1	31	38	54	19	142
-24	38	31	38	31	138	2	31	35	54	32	152
-23	17	34	27	0	78	3	19	45	69	35	168
-22	29	52	41	34	156	4	28	34	57	14	133
-21	26	37	39	31	133	5	16	48	58	29	151
-20	28	40	38	27	133	6	25	31	24	24	104
-19	20	37	43	22	122	7	28	41	29	47	145
-18	16	28	21	29	94	8	28	15	29	30	102
-17	8	21	28	23	80	9	21	49	49	40	159
-16	13	22	37	23	95	10	33	39	52	24	148
-15	19	30	30	18	97	11	34	39	62	32	167
-14	28	40	50	29	147	12	87	97	92	76	352
-13	24	45	73	39	181	13	50	56	53	38	197
-12	66	75	80	77	298	14	36	45	33	22	136
-11	34	34	49	35	152	15	21	32	41	22	116
-10	23	32	45	30	130	16	26	22	25	37	110
-9	14	27	41	29	111	17	16	28	35	43	122
-8	17	23	20	18	78	18	16	37	33	24	110
-7	19	25	28	25	97	19	18	40	30	25	110
-6	19	29	34	23	105	20	22	43	41	23	129
-5	33	33	38	20	124	21	22	43	41	23	129
-4	26	27	39	19	111	22	38	39	43	29	149
-3	31	25	40	23	119	23	27	34	34	29	95
-2	26	25	32	29	112	24	26	30	38	43	137
-1	21	26	48	15	110	25	25	29	31	26	111
0	34	50	35	32	151	26	15	21	26	30	92

Table 12-1: Comparison of 60-minute “Western” and “Eastern” histograms. The number of similar histogram pairs as a function of the separating time interval between them from four experiments (June through October 2003) from Pushino.

Dates/intervals (minutes)	715	716	717	718	719	720	721	722	723
June 17, 2003	9	25	33	**82**	43	30	29	15	11
June 18, 2003	12	16	24	57	34	32	20	9	8
June 19, 2003	21	30	37	78	42	43	36	23	23
June 22, 2003	22	24	50	75	50	33	34	39	20
June 23, 2003	29	30	55	89	76	43	40	33	28
June 24, 2003	6	8	28	70	42	33	15	11	4
June 25, 2003	25	26	34	47	58	36	47	32	19
July 1, 2003	9	16	29	78	36	15	21	3	5
July 7, 2003	24	30	41	88	60	27	39	18	15
July 10, 2003	8	12	25	59	28	22	16	7	5
July 12, 2003	23	19	37	58	43	26	25	25	20
Sum	188	236	393	781	512	340	322	215	158

Table 12-2: Comparison of one-minute "Western" and "Eastern" histograms. The numbers of similar histogram pairs as a function of their separating time intervals for eleven experiments conducted in Pushino (June – July, 2003).

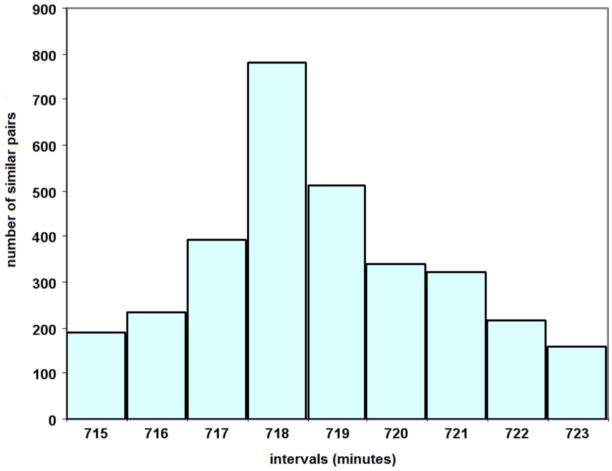

Figure 12-3: Similarly shaped histograms occur in the measurements that were obtained with a collimator directed westward 718 minutes (that is half a star day) later than with the collimator directed eastward. Comparison of one-minute "Western" and "Eastern" histograms in eleven experiments from Pushino (June–July 2003). X-axis shows the time interval between similar histograms in minutes. Y-axis is the number of similar histogram pairs for different corresponding interval values.

The dependence of histogram shapes not from a star sky pattern, but from an "isolated" spatial direction provides an alternative explanation of the phenomenon. Both explanations are equally probable. The lack of the synchronous appearance of similar histograms from simultaneous measurements with the "Western" and "Eastern" collimators may be explained by the same above mentioned alternatives. Without collimators, similar histograms occur at the same geographical point (at the same local time) synchronously even when measuring different types of processes. However, for measurements with "Western" and "Eastern" collimators at the same geographical location and at the same laboratory, no synchronism is observed. This was demonstrated from the comparison of 60-minute "Western" and "Eastern" histograms in experiments over several months, between June and October 2003 (Table 12-1 and Fig. 12-1, 12-2).

Hence, a histogram shape is primarily determined by the direction in which alpha particles are emitted during radioactive decay.

Chapter 13.

Experiments with rotating collimators

All our experiments taken together as well as specifically the experiments with collimators directed towards the Polar Star, the West, or the East, resulted in the confirmation of the idea that there exists a dependence of a histogram shape on the inhomogeneity of the environment. During the Earth axial rotation and its movement around the circumsolar orbit, examined objects pass various points in this inhomogeneous environment.

This structure in the environment is stable enough be able to reproduce with high probability definite histogram shapes at the same points in day or year periods of the motion of the Earth.

As one can see from the accumulated results, this inhomogeneity of the environment is conditioned by at least three independent factors: the orientation towards the sphere of motionless stars (a star day); its orientation relative to the Sun (a Sun day), and maybe also relative to the Earth, the Moon, and the Sun collocation (period of close to 27 days). As we are fixed on the Earth, which is moving in this heterogeneous, anisotropic environment, we "scan the sky" permanently.

We followed further along the lines of this pattern ans investigated following this idea of "active scanning", that is conducting experiments with rotating collimators. (A.V. Kaminski independently arrived at the same idea, when we were already preparing our experiments). Rotating the collimators, we directed an alpha particle beam in various directions, thus imitating the daily rotation of the Earth. We expected that the probability of the recurrence of similar histogram shapes would change with the periods determined by the state of the collimator rotation. For counterclockwise rotation, that is the same as the Earth axial rotation, one rotation (that of the Earth around itself) should be added to the number of collimator rotations. During clockwise rotation, one Earth rotation should be subtracted from the rotation angle. It means that for one clockwise rotation of a collimator, the daily rotation of the Earth will be compensated and all (?) periods should vanish.

This was our conception. Very well, but the above mentioned expectations were confirmed. This became possible through fruitful collaboration with I.A. Rubinstein and V.A. Shlektaryov.

Vladimir Alexeyevich Shlektaryov designed from "a selection of materials and instructions" an implement in which an I.A. Rubinstein collimator equipped device could be rotated clockwise or counterclockwise. The collimator direction and tilting angle of the rotation plane could also be

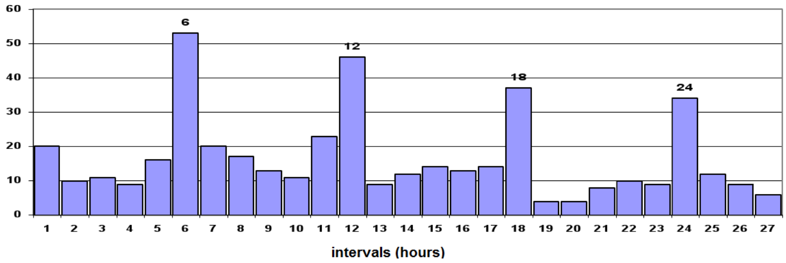

Figure 13-1: Comparison of 60-minute histograms. For four counterclockwise rotations per day of the collimator section, a narrow beam of alpha particles is emitted during ^{239}Pu radioactive decay. The figure shows the probability of recurrence of similar one-hour histograms, which increases with a period of 6 hours. Measurements were obtained between May 27 and June 9, 2004. X-axis is time intervals (in hours); Y-axis is the number of similar pairs.

properly adjusted.

The transfer of measurement results from the rotating device to a stationary motionless computer seemed to be very hard. Connecting wires would twist. Several preventive measures were proposed: metering of rotating collector; optical communication; placing a microcomputer together with a counter onto the rotating platform. All this was quite a challenge for us at that moment. **Fuat Enmarovich Ilyasov** unexpectedly found a simple solution. He said that no complex facilities were necessary, since at this not very fast rotational frequency, twisted wires that connect the detector and the computer would not be a problem. The device was made. All expenses, including those for one more computer were paid by **Vladimir Petrovich Tikhonov**. The first experiment started on the 27^{th} of May, 2004.

13.1 Counterclockwise rotation of collimators

In my more than 50 years of research work I conducted a number of successful experiments. I am accustomed to experiments with a long duration, sometimes working over several years. Usually, when questions are posed, they are rarely answered immediately, if at all. Furthermore, as a rule, the answer is ambiguous. Experiments with rotating collimators were of completely different type. We obtained the expected results immediately, starting with the first experiment, and their contents were not doubted or open to interpretation.

Fig. 13-1 presents the results of the first experiment.

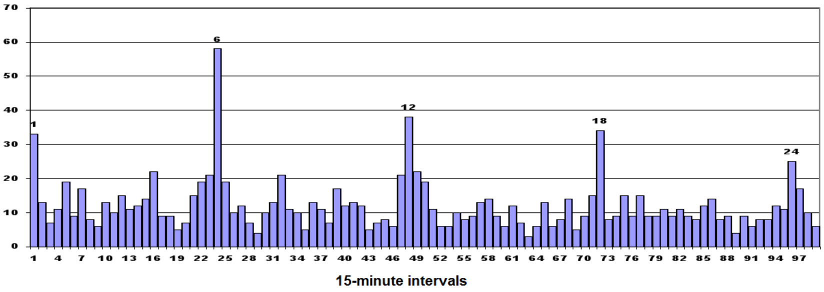

Figure 13-2: Comparison of 15-minute histograms. For four counterclockwise rotations per day of the collimator section, a narrow beam of alpha particles is emitted during ^{239}Pu radioactive decay. The probability of recurrence of similar 15-minute histograms regularly increases with a 6 hour period. Measurements obtained between May 27 and June 9, 2004. X-axis is 15-minute intervals; Y-axis is the number of similar pairs.

The collimator intersected an alpha particle beam in the plane parallel to the equinoctial (that is, considering the Pushino latitude, the rectangular to the South-North axis, which is tilted 54 degrees towards the horizon) and made 3 counterclockwise rotations a day in V.A. Shlektaryov's device. One more rotation per day was completed by the Earth itself. In this way we "scanned the sky" with the 6 hour period $(24/4=6)$. As one can see from Fig. 13-1, the comparison of one-hour histograms shows that there is a period in the probability of recurrence of similar histogram shapes, which increases each 6 hours.

The following Figure 13-2 shows that this 6-hour periodicity becomes even more pronounced when histograms are constructed more frequently, that is from smaller time series sections of 15 minutes each.

It is fortunate and fantastic that the observed period can also be identified with an accuracy of up to one interval. The corresponding "peaks" are very narrow.

The result presented in Fig. 13-3 summarizes these experiments. Constructing one-minute histograms (that is from 60 results of one-second measurements) not only confirmed the existence of a 6-hour period, but also showed that the period was clearly split into two, "stellar" and "solar", periods. This splitting implied the dependence of histogram shapes on the relative orientation to both, "motionless stars" and the Sun, which I was already familiar with. Nevertheless, the result was unexpected. This equivalent representation of stellar and solar periods was obviously the result of the location of the collimator not in the horizontal plane (where usually

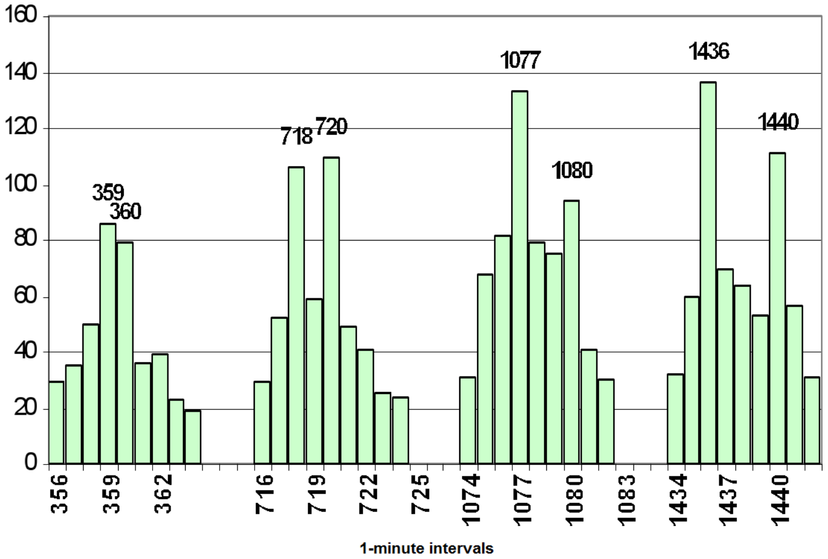

Figure 13-3: Comparison of one-minute histograms. For four counterclockwise rotations of the collimator section per day, a narrow beam of alpha particles is emitted during ^{239}Pu radioactive decay. Similar histograms recur with periods corresponding to fractions of star and solar days. One rotation takes 60 minutes. The probability of similar one-minute histogram recurrence increases with periods equal to 359 and 360 minutes. For two rotations, the probability of similar histogram recurrence increases after 359 × 2 = 718 minutes and for 360 × 2 = 720 minutes. For three rotations, these values amount to 359 × 3 = 1,077 minutes and 360 × 3 = 1,080 minutes and for four rotations they are 359 × 4 = 1,436 and 1,440 minutes, respectively. Measurements between May 27 and June 9, 2004. X-axis is one-minute intervals; Y-axis is the number of similar pairs.

our sources would be located), but in the "latitudinal" plane, closer to the ecliptic plane.

Results of these experiments are similar to other experiments with collimators, because they seem paradoxical. Indeed, "why do emitted alpha particles care about remote stars or the Sun?" And, above all: how is it that periods split with up to one minute accuracy upon application of a collimator with 5 degrees aperture, corresponding to 20 minutes time ("**the Kharakoz paradox**"). In such situations it is first of all necessary to prove that this is true: the artificial "day" period, with its duration determined by the number of collimator rotations, does split into two, star and

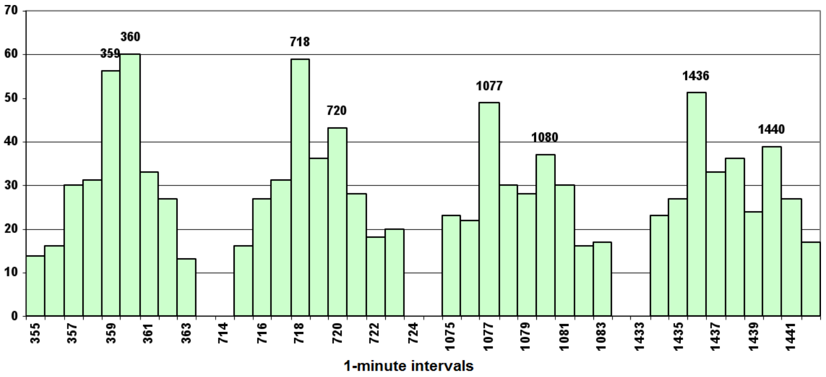

Figure 13-4: Experiment similar to that illustrated by Fig. 13-3. Indeed, for four counterclockwise rotations of a collimator section per day, a narrow beam of alpha particles is emitted during ^{239}Pu radioactive decay. Similar histograms recur with periods corresponding to fractions of stellar and solar days. Measurements obtained between June 9 and June 15, 2004.

solar, periods. The validity of the conclusion was confirmed by a number of experiments. The results of one of them are presented in Fig. 13-4.

Hence, a histogram shape is determined by the direction of alpha particles emitted into space. It is clear that we are not referring to an influence of an environmental inhomogeneity on alpha particles that were already emitted from a nucleus. The distance they cover across space is less than 7 cm. And the length of their pathway in a collimator only amounts to 1 cm. We furthermore do not measure their energy, but rather merely the fluctuations of their numbers per unit of time. Hence, a histogram shape is determined before an alpha particle is emitted from a nucleus. The size of a nucleus is about 10^{-13} cm... Does it mean that space inhomogeneities are of such dimensions as they could be detected at that scale? All this is quite peculiar. The narrowness of extremes contradicts the explanation of a histogram shape by the presence of a set (spectrum) of probabilistic constants of radioactive decay. However, let's allow theoreticians to deal with these problems. We shall just state the following fact: a histogram shape does depend on the orientation of particles emitted from a decaying nucleus relative to both, the sphere of motionless stars and (independently) the Sun (27-days periods), and the collocation of the Moon, Sun and Earth...

Almost through the whole summer of 2004 K.I. Zenchenko and I experimented with rotating collimators. We measured the number of rotations per day. I analyzed the probabilities of similar histograms recurring for 1,

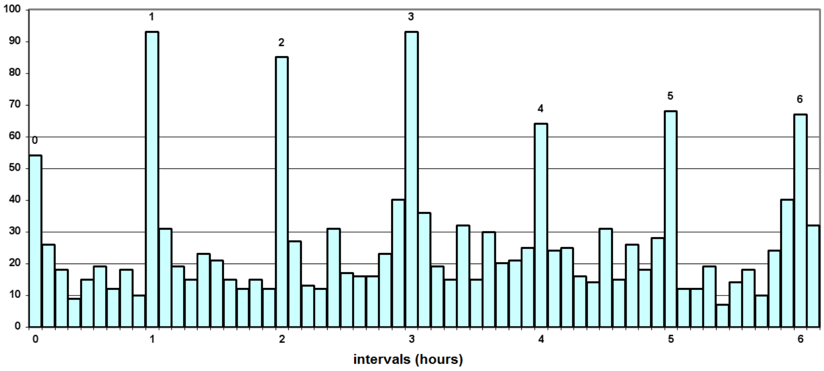

Figure 13-5: 6-minute histograms. 24 counterclockwise rotations per day. The probability of similar histogram recurrence changes correspondingly with a one-hour period.

2, 3, 4, 5, 6, 7, 8, 9, 12 and 24 rotations per day (these numbers include the (1) rotation of the Earth itself). We obtained many and comprehensive results. The main result is that everything was confirmed. The period for which an increase in the probability of the recurrence of similarly shaped histograms is found, is determined by the number of collimator rotations. Stellar and solar day periods are manifested separately.

Because of the significance of these confirming results, we provide additional illustrations. Fig. 13-5 demonstrates the change of probability of similar histograms' recurrence for 24 collimator rotations a day: one-hour periods appear. 6-minute histograms were compared. Therefore the splitting into stellar and solar periods is not observed.

13.2 Clockwise rotation of collimators

Results of experiments with clockwise collimator rotation were crucial. The daily Earth rotation is compensated by this rotation: alpha particles are permanently emitted into the same direction towards the Sun. Results of one of the experiments with "offsetting" the Earth rotation are presented in Fig. 13-6.

One more (the last?) version of the experiment is to be implemented. For better understanding, the following question was posed, and based on an idea of D.P. Kharakoz: what if a flat detector without a collimator were rotated? The results can be seen from Fig. 13-7.

It would seem that these experimental results (displayed in Fig. 13-7) are rather good because the experiment confirms that the rotation permits

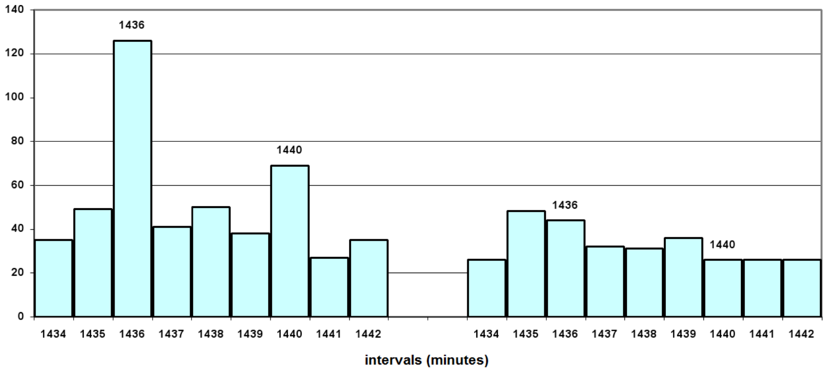

Figure 13-6: One-minute histograms. One clockwise collimator rotation compensates the Earth rotation and leads to the disappearance of day (stellar and solar) periods. (The left chart serves as a control: these results were obtained with a motionless western collimator; the right chart shows results from the rotating collimator). Experiment from June 8-10, 2004.

to "scan the sky" just by using a collimator. However, "really" (as L.A. Blumenfeld used to say) it is absolutely not clear why a period (even if maybe less pronounced) is absent in the rotation of a flat detector. I conducted a whole series of similar experiments from September to October

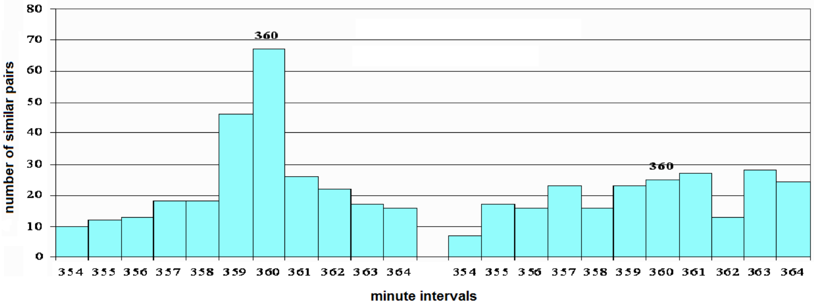

Figure 13-7: Experiment with rotating alpha particle detector with a collimator (left) and the rotation of a flat source and a flat collimator-free detector (right). (3 rotations plus one rotation of the Earth around itself = 4 rotations per a day = 6 hour period). During rotation with a collimator, a period appears that is a multiple of the number of rotations per day. For the rotation of a flat collimator-free detector no "scanning of the sky" takes place.

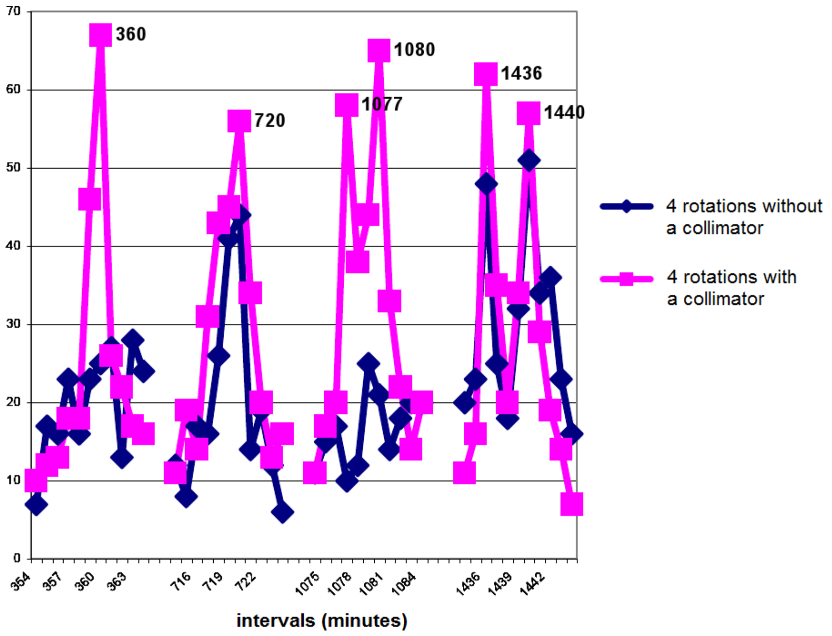

Figure 13-8: Comparison of results from rotation of collimator-equipped and collimator-free counters. Four rotations per day. Experiments were made between October 1 and October 4 2004. X-axis is intervals (in minutes); Y-axis is the number of similar pairs. Between October 11 and October 18 2004, a similar experiment but with 5 rotations a day was conducted. The result is presented in Fig. 13-9.

2004. No clarity could be attained. New phenomena were revealed. More as well as new experiments are necessary... So, I will now present some results of these experiments with these series, without comprehensive comments (relying searching readers...).

Between October 1 and October 4, 2004, an experiment with two rotating counters (one was equipped with a collimator, the second one was collimator-free) was implemented. The result is presented by Fig. 13-8. In the figure, the distributions of similar histogram pairs are presented by lines instead of columns. One can see when looking at the "with a collimator" line that the first extreme is very pronounced for the first period of 360 minutes. For the second period, that is 12 hours later, this period is quite distinct both for the "experiment" and for the "control". In other words, a half a day-period showed equally during the rotation of two counters, with

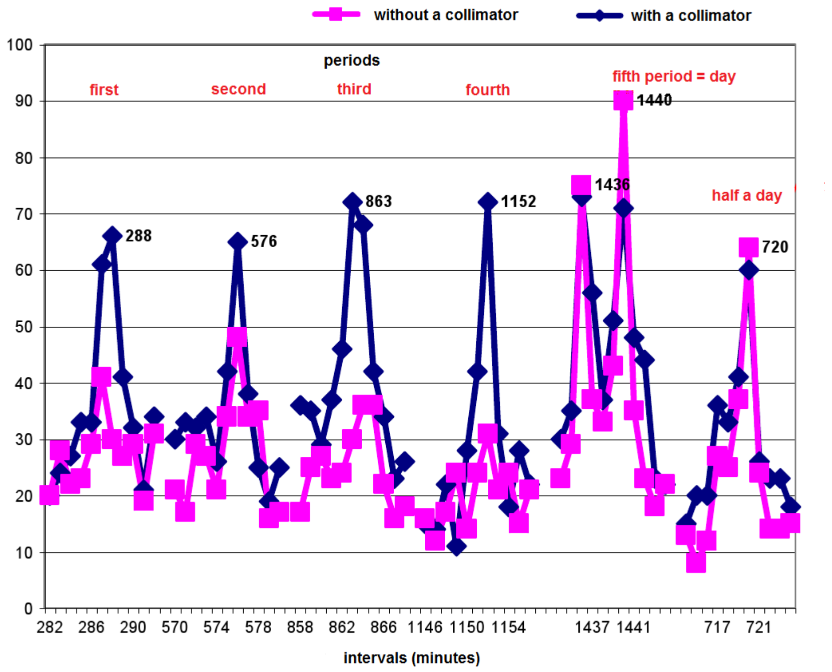

Figure 13-9: Comparison of results from rotation of collimator-equipped and collimator-free counters (5 rotations a day). Experiment from October 12 to October 18, 2004.

as well as without a collimator. For the third period the extremes again only occur for the rotation with a collimator. In this case the star (718 minutes) and Sun (720 minutes) periods are well expressed. For the fourth period of around a day, the control and the experiment show the same results: clearly distinct stellar (1,436 min) and Solar (1,440 minutes) day periods can be seen.

The clear manifestation of the half a day-period only for collimator-free measurements is most surprising. One would assume that if the first period is absent, the second one should be absent as well... Furthermore, the absence of the third period is "clear": if the first is absent, the third would be absent as well. However, why is the fourth period equivalent in both versions of the experiment. Maybe the half a day- and day-periods are not related with the rotation of the detectors? What is the difference between collimator-free measurements with a counter on a rotating platform and multiple collimator-free measurements that were obtained before? No half a day-period showed earlier. Is the rotation the significant factor? Or is this due to counters that were now placed in the plane parallel to the celestial equator? Earlier counters were placed on a horizontal plane. Each of these questions can only be answered by experiments spanning long time periods.

As expected, for 5 rotations a day, similar histograms recur in the collimator-equipped measurements with a 288-minute period (1440/55 = 288). Without a collimator this period is just slightly "indicated". The same patterns are observed for the second period (of 576 minutes), the third period (of 863 minutes) and also the fourth period (of 1,152 minutes). However, the 720-minute period of half a day is not related with the number of rotations per day. It is similarly expressed in both the "control" and the "experiment" (this period is presented at the right end of the figure). Stellar and solar day-periods are also clearly expressed in the two versions of the experiment.

13.3 Conclusions

All experiments with rotating collimators permit the following, rather paradoxical, conclusions:

1. During the rotation of collimators, the scanning of the sky does occur; the probability of repeated recurrence of the same histogram shapes increases with a period equal to the number of rotations per day.
2. The rotation of a flat collimator-free source shows no scanning effect. Hence, in this beam of alpha-particles, we are really dealing with discrete spatial inhomogeneities. These inhomogeneities become "blurred" if a collimator is absent.
3. The pulsations of the alpha particle emission intensities depend on their spatial direction.
4. The inhomogeneity of the space is obviously not screened by the concrete floors.
5. The discontinuity in space that was revealed with the use of collimators obviously does not depend on the collocation of the Earth and the Sun. A solar day period of 1,440 minutes is observed independent of the schedule of the experiment: with motionless and rotating collimators and without a collimator.
6. Surprisingly, there is a distinct half a day-period as well; it stays the same independent of the rotation, the motionlessness, or of the collimators' orientation. Such a period may imply a dependence between the angle under which a subject (apparatus, measuring device or

sample) is “seen” from the West or from the East. Results from either these directions seem to be equivalent.

7. A star day period (of 1,436 minutes) also does not depend on the rotation either: this period shows during the rotation with a collimator and without a collimator (and also without rotation and without collimator).
8. The occurrence of these “independent” Solar and stellar periods obviously depends on the slope of the plane in which measurements are obtained: the star period is expressed more pronouncedly when detectors are placed in the plane parallel to the celestial equator, considering our latitude; the Sun period is in the plane corresponding to an Ecliptic angle. (All those years we worked on a horizontal plane. . .).
9. What is it then that the rotating collimators scan? Not the stars? What does this paradox, mentioned by D.P. Kharakoz imply: identifying and not identifying the one day and half a day periods with a motionless flat detector at one-minute resolution with a collimator angle of 5-10 degrees, and without a collimator?

Answering these questions requires a lot of experimental work. This work would require many years and incorporate new equipment, young researchers, and appropriate financial support. It is extremely unlikely that all of this will be possible for me. . . .

Chapter 14.

Experiments with collimators that are continuously directed towards the Sun

I decided to improve the experimental techniques by having collimators complete one clockwise rotation in a day. For such a type of rotation, the collimator is directed in the same angle towards the stars and the Sun at all times. However, the Earth's circumsolar rotation, and also the pattern of the section of the star sky towards which it is directed, shift by 4 minutes in a day. This shift is hard to be noticed immediately: it is equal to 4/1,440 = 1/360 of a single interval. (How could this possibly help with determining the 1,436 minute period?) However, for "testing purposes", hoping to somehow isolate shapes of histograms from the relative movement to the Sun and to motionless stars, we directed such a rotating collimator towards the Sun. Now the collimator was directed towards the Sun "around the clock", following all its movements day and night. It seemed that during the first weeks of this experiment a rather trivial problem was being solved: for such measurements, as was expected, all day-periods and, respectively, the local-time synchronism with "normal" counters disappeared. Even after having obtained there results I decided not to stop this "Solar telescope": these measurements were obtained continuously, whenever possible, for several years now. Since the spring of 2005 we have a very large database of every-second measurements, "freed" from a possible dependence of histogram shapes from changes in the orientation of the alpha particle flow towards the Sun and from the Earth axial rotation. Changes of histogram shapes that persisted under these conditions could be attributable only to the movement around the Earth's circumsolar orbit. It is clear that the analysis of such dependencies involves series of multiple days of measurement results.

14.1 Identifying a strange period (1,444 minutes) in the measurements obtained with the "solar" collimator

As stated above, patterns in the changes of histogram shapes constructed from these measurement results, did not contain either "Sun" (1,440 minutes), or "star" (1,336 minutes) day periods. However, while looking for these periods in the second half of July 2005, we identified a strange period equal to 1,444 minutes. I considered it "an artifact". However, it did not disappear when we repeatedly tried to determine it. Its occurrence increased step by step, reached its maximum approximately in the period of July 24–29, and then decreased rapidly until it completely disappeared

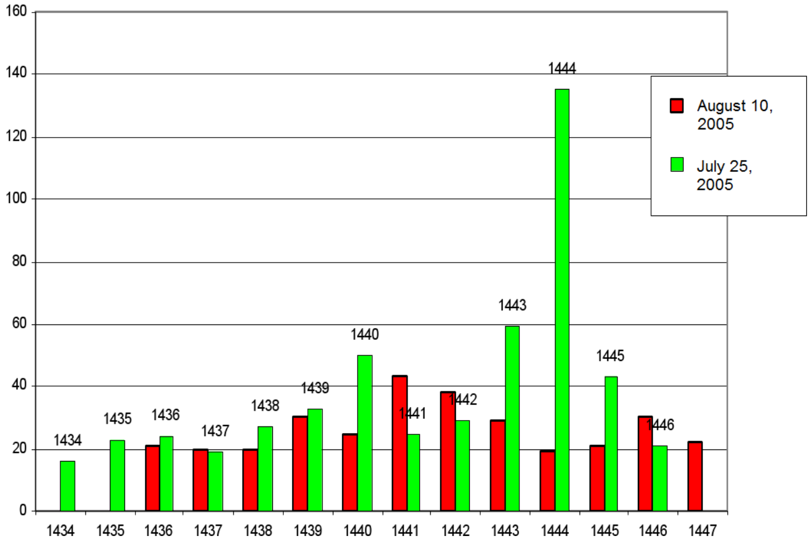

Figure 14-1: Illustration of an "anomalous" period, equal to 1,444 minutes, in the recurrence of similar in shape histograms on July 25, 2005. Usually measurements with the Sun collimator do not provide noticeable day periods, as one can see from results obtained on August 10, 2005. X-axis is periods of recurrence of similarly shaped histograms (in minutes); Y-axis is the number of similar pairs as a function of the time period between them.

in the first days of August. This phenomenon is illustrated by Figures 14-1 to 14-3.

Fig. 14-1 shows the distribution of a number of similar histogram pairs from measurements with a Sun collimator on July 25 and August 10, 2005. The close to one day periods cannot really be seen even with a low significance on August 10. (The periods are the same, but not expressed in similar measurements with the "Sun" collimator on other days). However, on July 25, a high probability of a repeated occurrence of similar histograms with a period equal to 1,444 minutes appeared. This period does not correlate with cosmophysical processes familiar to us, and its appearance seems very strange.

It was important to know, whether this period does manifest in measurements with a Sun-collimator only. From comparisons with measurement results with a "West" collimator obtained at the same time with the standard procedure. An example of such comparisons is presented in Figure 14-2. It shows the distributions of the numbers of similar histogram pairs, con-

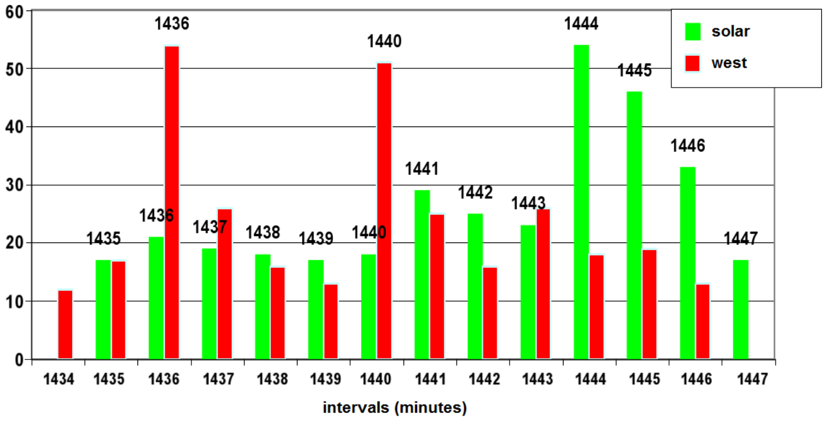

Figure 14-2: 1,444 minute period appears in the measurements with the "Sun" collimator and this period is absent "ceteris paribus" in measurements with a "West" collimator. From measurements with a "Sun" collimator, 1,436 and 1,440 minute-periods are seen but are absent from measurements with a "West" collimator. Measurements were obtained on July 24, 2005.

structed from the results of simultaneous measurements with "Sun" and "West" collimators on July 24, 2005. One can see that for measurements with a "West" collimator, the 1,436 minute and 1,440 minute periods occur distinctly, while the 1,444 minute period is absent. Furthermore, from measurements with the "Sun" collimator there are no star and Sun day periods, but there is a distinct 1,444 minute period. Therefore, this period is related with the flow of alpha particles towards the Sun only.

Searching for this period on other days of the year was unsuccessful at first. However, this strange period appeared again at the same dates in July, 2006 (despite incomplete data), in July, 2007 and in July, 2008. The essential step was that we revealed this period strictly after half a year, on the same days of January, 2007 and January, 2008, which is situated "on the other side" of the circumsolar obit. From Fig. 14-3 one can see that the degree to which the 1,444 minute period occurs changes in a similar way on respective days in July, 2005, 2007 and 2008 and at the "symmetrical" dates of January, 2007 and 2008.

14.2 Conclusions

These results imply that at least twice a year during the movement around its circumsolar orbit, the Earth for several days enters into a spatial section

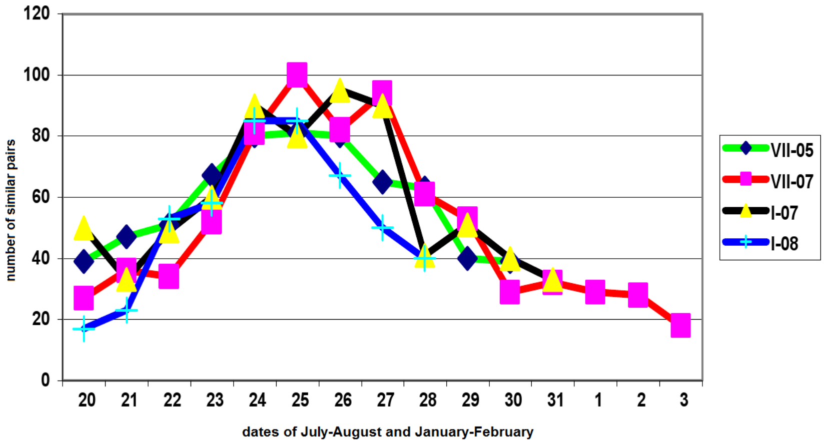

Figure 14-3: From measurements with a Sun-directed collimator, the "1,444 period" appeared at the same dates of July and January, 2005, 2006, 2007 and 2008.

with "anomalous properties" changing with a 1,444 minute-period. This section of space is an "anomalous strip" directed through the orbit center (through the Sun) in the "July-January" direction. It is wonderful that "properties" of this anomaly are not impacted by the Sun. Hence, they are expressed on both sides of the orbit in the same way. No analogy with the Doppler effect could be noticed, either: the 1,444 minute-period appears "suddenly", and does not change (as the Earth moves) and disappears "suddenly". It is worth mentioning that for "parallel" measurements without collimators, or with collimators that are not directed to the Sun, this phenomenon is not observed. The "anomalous direction" that the Earth crosses in its movement around the circumsolar orbit corresponds roughly to the direction of the circumsolar orbit from the Cancer (between July 21 and August 11) to the Capricorn (between January 19 and February 16) zodiac constellations. This phenomenon is mysterious in nature. The 1,444 minute-period is 4 minutes longer than the day period, and hence it cannot be (?) explained by any factors from within the Solar system.

Chapter 15.

Dependence of histogram shapes on the relative position of the Sun and the Moon on the horizon

15.1 Shapes of histograms during Sun- and Moon- rises and sets

The first part of the book tells that in August 1986, while working at the MSU White Sea Biological station, I noticed a similarity of histograms resulting from measurements of ^{239}Pu alpha activity in of the time that the Moon was rising on various days. These histograms appeared similar to those that resulted from the same measurements from moments of the moonrise and sets in Pushino. This was very strange, but seemed to be in line with an extravagant idea I had on the dependence of histogram shapes on direct effects of gravity. The idea was based on the very high and low tides in the White Sea, when huge water masses move towards the laboratory that is located almost at the beach and then away from it. The madness of this idea was evident. But I was able to calm myself by reasoning that the idea is not concerning an effect on alpha decay but only a dependence of histogram shapes, that is, of the spectrum of the fluctuation amplitudes. And there were no prohibitions on crazy hypotheses: "an effect" means a change in the averages of measured values... we focus on the fine structure of amplitude spectra with our investigations... "Everything can happen here". Together with N.V. Udal'tsova we evaluated histogram similarity and established the reliability of the similarity of compared histograms [47]. However, the idea of direct gravity effects was not confirmed. The relation between histograms and the location of the Moon on the horizon seemed to exist, but no high-low tidal rhythms were revealed in our multiple attempts.

Nevertheless, the revealed similarity between histogram shapes and the location of the Moon on the horizon initiated many years of investigations: doubts, confirmations, and specifications. More than 20 years passed since the time period between 1981 and 1986. I began regular comparisons of histogram shapes at moments of Sun- and Moon- rises and sets after I.A. Rubinstein made reliable devices for alpha activity measurements in 2000.

These investigations are not completed yet. Hundreds of valid examples of the relation (correlation) between histogram shapes and the Moon and Sun location on the horizon were identified.

Time and again we observed an evidently non-random similarity of histogram shapes during moments of Moon and Sun rises and sets at different geographical points at the same dates in different years, when these moments correspond (for the Moon) to various local times, and, hence, are not conditioned by the similarity of the pattern in the star sky.

Histogram shapes typical for moments of new moon and solar eclipses were identified for these years. However, no histogram shapes typical for Moon and Sun rises and sets could be found.

Thus, the dependence of histogram shapes from the location on the horizon of the Moon and the Sun established through the large quantities of material accumulated gives no more reasons for doubts. However, this shape depends on other factors as well.

The similarity between patterns, often very complex in shape, cannot be random. The similarity at definite (but not random) moments is even more nonrandom.

Furthermore, it is astonishing that histograms following moonrises and sets are often more similar to those following the same dates of other years and not to those of the next (nearest) days. Furthermore, moonrises and sets of the same dates but in different years occur at different times of the day. The conclusion that a histogram shape is determined by a number of factors, including the horizon location of the Moon or the Sun as a dominant, but not the single factor, is quite natural. At times other factors appear to be dominant.

Due to space limitations I only present several figures from hundreds, illustrating the non randomness of definite histogram shapes occurring for similar locations of the Moon and the Sun on the horizon. Thus, the series of Figures 15-1-(A-E) illustrate the similarity of histograms at the moments of moonrise and moonset at the same dates of 2000 and 2001.

These figures present fragments of a computer database, sequences of smoothed histograms including 10 numbers before and 10 numbers after the calendar moments of the moonrise and moonset in 2000 and 2001. The figures illustrate the procedure of selecting similar histograms.

In Fig. 15-1-A one can see that at the moments of moonrise on October 23, 2000 and 2001 a rather rare histogram shape occurs. In the figure there are no more than 2 such shapes out of the 42 that were constructed from the data. From this follows the probability of its occurrence (not strictly) to be about 1/20. The probability of the occurrence of this shape at a "proper place" (one of possible 21 places) a year later is, from a rough evaluation, about 1/400.

The moonset on October 23, 2000 and 2001 (Fig. 15-1-B) is characterized by histograms of different shape. However, these histograms are again similar to each other. The same rough evaluation concludes the probability of random histogram similarity to be equal to 1/100.

On the next days, October 24, 2000 and 2001, histograms from the moments of moonsets have different but "clearly" similar shapes (Fig. 15-1-C).

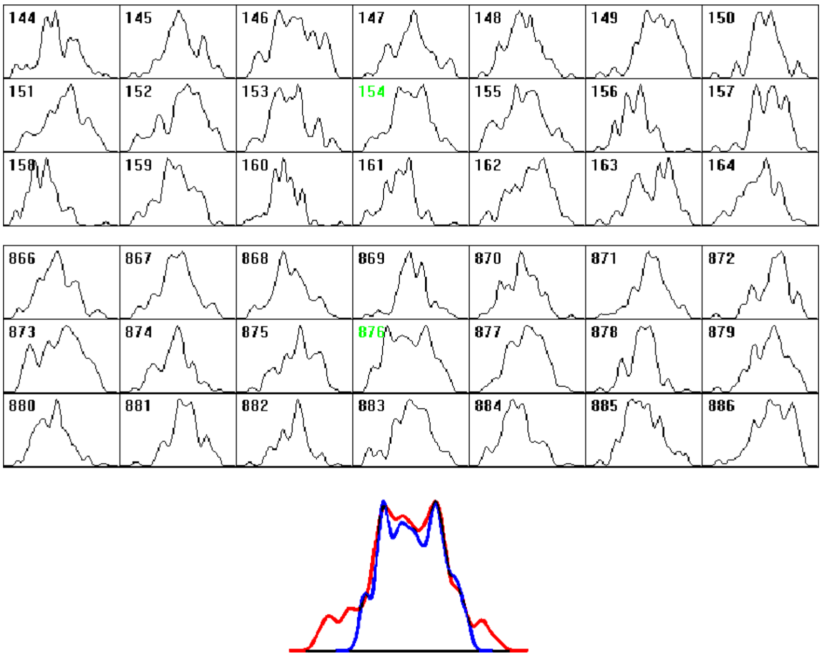

Figure 15-1-A: Illustration of the histogram shape similarity during moonrise on October 23, 2000 and October 23, 2001. Fragments of a computer log are presented. On top, measurements were made on October 23, 2000. The moon rose at 1.34 am. The histogram N 154 corresponds to the calendar moment of the rise. The bottom fragment of the log is measurements made on October 23, 2001. The Moon rose at 2.36 pm. The histogram N 876 corresponds to the calendar moment of the moonrise. Bottom: histogram N 154 is overlapped with histogram N 876.

From an evaluation of the randomness of this similarity, we find it to be of the same order as the previous one.

A similar situation was identified for other figures of this series. As it is clear from Fig. 15-1-(A-E), no histogram shape typical only to the moonrise or set is can be found. However, the repeated occurrence of similarly shaped histograms one year later, at the same location on the horizon of the Moon, independently of the time of day seems nonrandom.

The next series of figures, number 15-2, shows one of a number of available similar illustrations of histogram shape similarity at the moments of the Sun and the moonrise and set at the same dates within a 4 year interval.

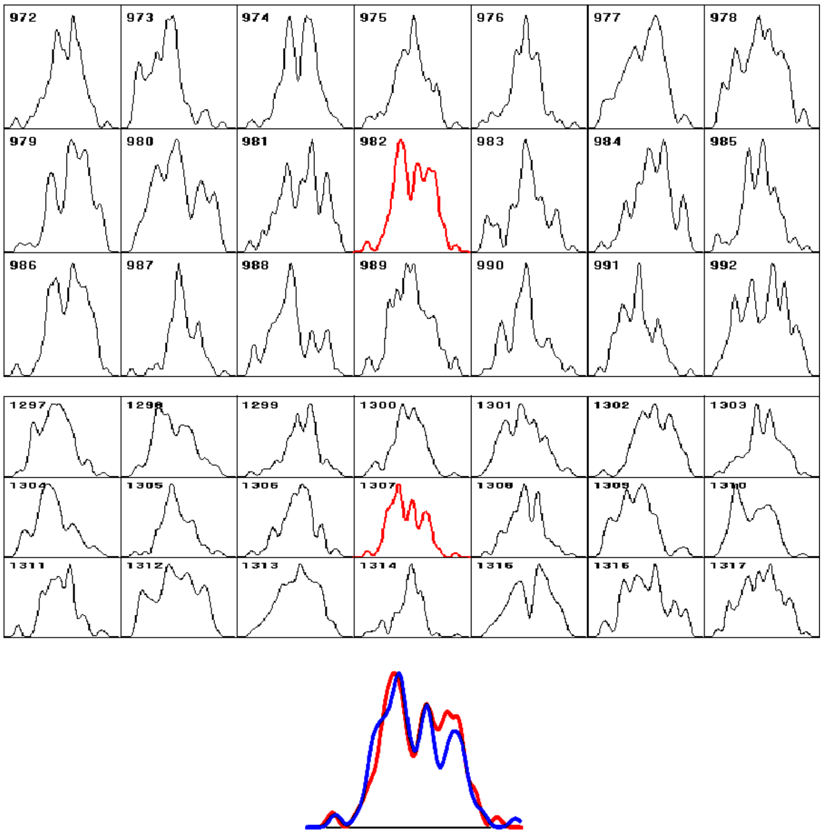

Figure 15-1-B: Illustration of histogram shape similarity at the moments of moonset on October 23, 2000 and 2001. Fragments of the computer log are presented. The top log fragment presents measurements made on October 23, 2000. The moon set at 4.23 pm. The histogram N 982 corresponds to 4.22 pm, that is, one minute earlier than the time set by the calendar. The bottom log fragment is measurements made on October 23, 2001. The moon set at 9.47 pm. The histogram N 1307 corresponds to the moment set by the calendar. Bottom: an overlap of histograms N 982 and histogram N 1307 after it was mirrored.

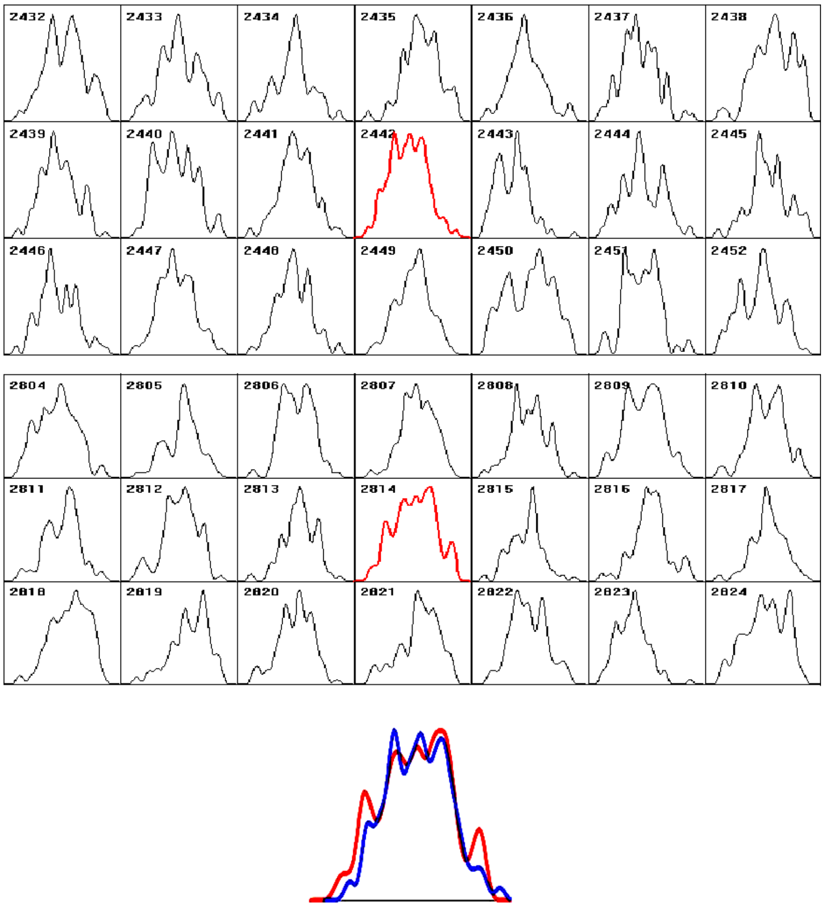

Figure 15-1-C: One minute earlier than the rise time given by the calendar. The bottom log fragment is measurements made on October 24, 2001. Moonset was at 10.53 pm. The histogram N 2814 is one minute later than the time set by the calendar. Bottom: histogram N 2442 and histogram N 2814 illustrate the histogram shape similarity during moonsets on October 24, 2000 and October 24, 2001. Fragments of the computer log are presented. The top log fragment is measurements from October 24, 2000. The moonset was at 4.43 pm. The histogram N 2442 corresponds to 4.42 pm. The two were overlapped.

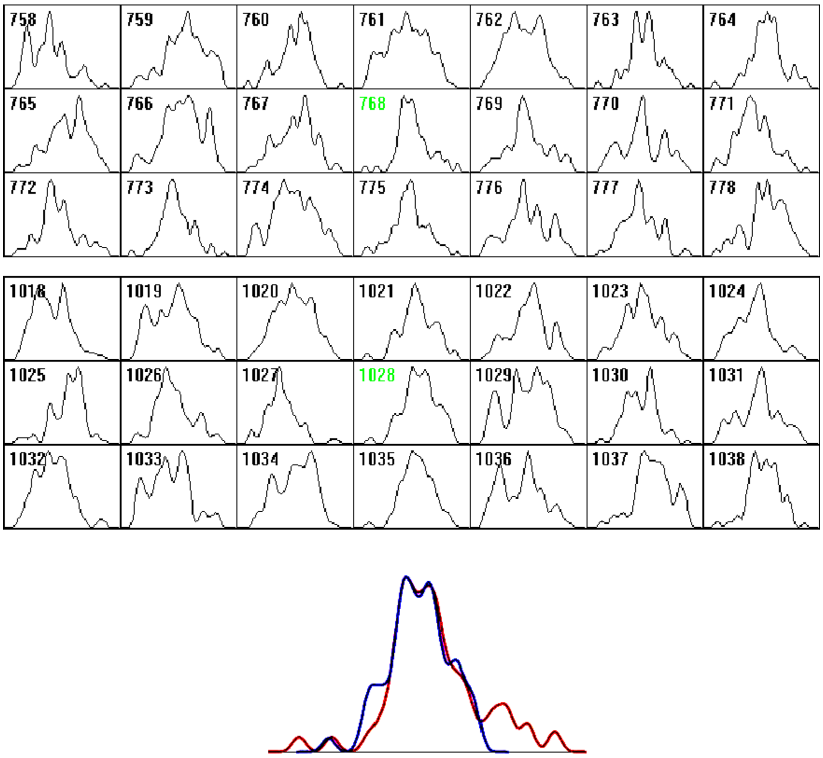

Figure 15-1-D: Illustration of histogram shape similarity at moonrise on October 31, 2000 and 2001. Fragments of a computer log are presented. The top log fragment is from measurements of October 31, 2000. The moon rose at 11.46 am. The histogram N 768 corresponds to 11.48, that is 2 minutes later than the calendar rise moment. The bottom log fragment is from measurements of October 31, 2001. The moon rose at 5.07 pm. The histogram N 1028 corresponds to 5.28 pm, that is 1 minute later than the calendar moment of rise. Bottom: histogram N 768 is overlapped with histogram N 1028.

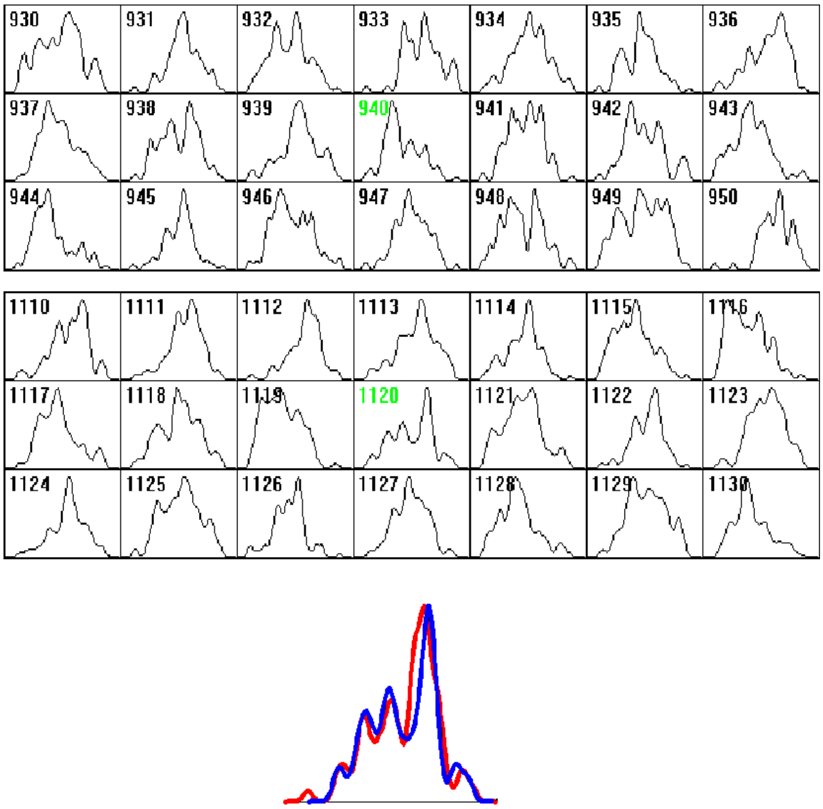

Figure 15-1-E: Illustration of histogram shape similarity during the moonrise on November 4, 2000 and 2001. Fragments of the computer log are presented. The top fragment is measurements from November 4, 2000. The moon rose at 2.39 pm. The histogram N 939 corresponds to 2.40 pm, that is 1 minute later than the moment of moonrise according to the calendar. The bottom log fragment is measurements obtained on November 4, 2001. The Moon rose at 6.39 pm. The histogram N 1120 corresponds to 6.40 pm, that is the same but one minute later than the calendar moment of rising. Bottom: histogram N 940 overlapped with histogram N 1120 after it has been mirrored.

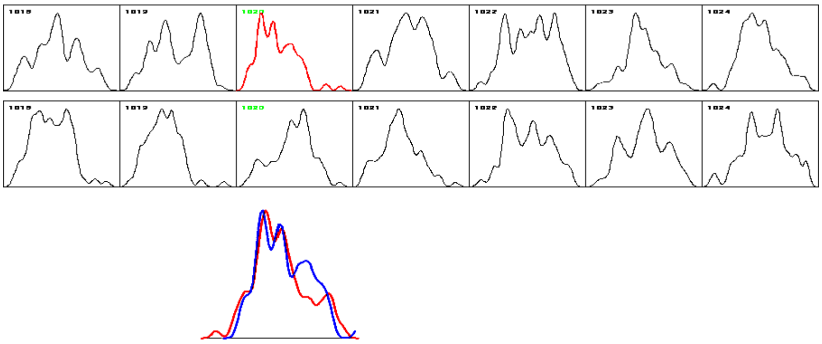

Figure 15-2-A: One minute before the sunset on October 28, 2000 and 2004, similar histograms (each numbered 1020) were realized. Measurements of ^{239}Pu alpha activity with a flat semiconductor detector without a collimator in 2000; measurements with a motionless collimator directed to the West in 2004). Bottom: the histograms were overlapped after mirroring.

The series of figures number 15-2: examples of histogram similarity from ^{239}Pu alpha activity measurements at the moments of Sun and moonrise and set on the same dates within a 4 year interval. The table presents the moments of rising and setting and numbers of the corresponding histograms for the moon and the Sun on October 28, 2000 and 2004 (from the "Astrolab calendar").
Calendar:

	Sunrise	Sunset	Moonrise	Moonset
28 X 2004	725 No. 445	1701 No. 1021	1659 No. 1019	737 No. 457
28 X 2000	725 No. 445	1701 No. 1021	814 No. 494	1756 No. 1076

Similar shapes of histograms are observed at the moments of moon and dunrises and sets, at different geographical points, in different years and from investigations of different types of processes. This similarity is not determined by the time of day or by the similarity of the star sky pattern at the moments when measurements are obtained.

Over many years, we accumulated a lot of examples for the obviously nonrandom histogram similarity at the moments of Sun and moonrises and sets. Similar histograms always had very complex patterns, making the probability of their random similarity very small. However, I failed to find any single shape of a histogram that is typical just for the Sun (the same

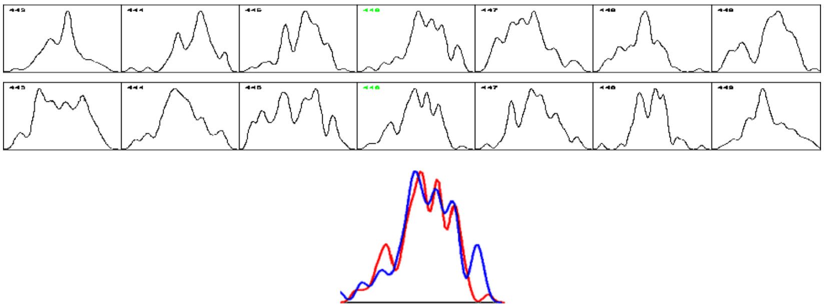

Figure 15-2-B: Similar histograms (both numbered 446) were observed one minute later than the calendar moment of sunrise on October 28, 2000 and 2004. Measurements of ^{239}Pu alpha activity with a flat semiconductor detector without a collimator in 2000; measurements were obtained with a motionless collimator directed to the West in 2004.

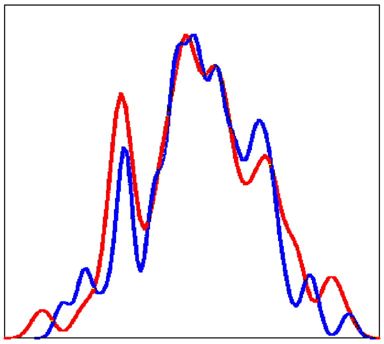

Figure 15-2-C: Similar histograms (both with number 447) were observed 2 minutes after the calendar sunrise moment on October 28, 2000 and 2004.

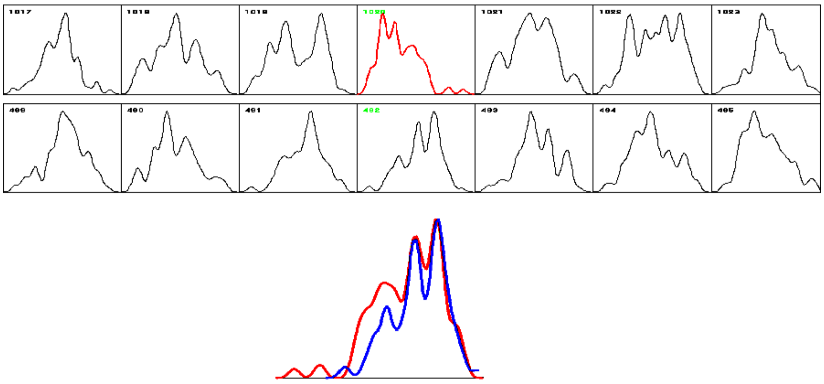

Figure 15-2-D: Similar histograms were observed on October 28, 2000 and 2004 at the moments of moonrise (histogram N 492) and sunset (histogram N 1020). Bottom: overlapping of N 492 and N 1020 after mirroring.

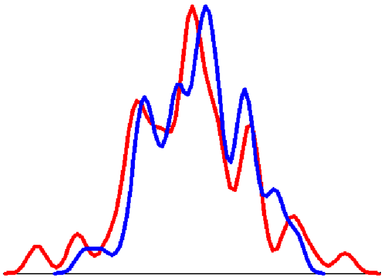

Figure 15-2-E: Similar histograms were observed on October 28, 2000 and 2004 one minute later than the moonset (histogram N 1077 at 5.57 pm, 2000) and (histogram N 458 at 7.37 am, 2004).

as for the moon) rise and set. To find regularities in these situations, more than a few separate examples should be analyzed, that is many hundreds and thousands of histogram pairs should compared. I did it.

Changes of histogram shapes depending on the time after sunrise

Sunrises and sunsets were chosen because these moments are easily fixed. Actually, the problem is more general: does a histogram shape depend on the location on the horizon of the Moon or the Sun?

Answering the question about the relation between a histogram shape and the location on the horizon of the Sun required to exclude the rather probable correlation between the histogram shape and the time of day. For this purpose, histograms constructed from the same time interval after sunrise from various months were compared. Results of measurements from the following dates were used: December 10, 2001 and January 10, February 10, March 10, April 10, June 10, July 10, August 10, September 10, October 10 and November 10, 2002. It was 12 series in total and the time of the day when the sunrise occurred was essentially different for successive dates. Histograms were constructed from measurement results, each histogram was calculated from 60 2-second measurements, that is for a total time equal to 2 minutes. The series were overlapped ("leveled") at the moments of sunrise. Then the similarity of histograms of all series with each other was analyzed with a frame of ±4 histograms around them. We set the moment of synchronism to the same time interval after sunrise, was defined as zero. Results of histogram comparisons are presented in Fig. 15-3. This figure shows the dependence of the probability of similar histograms that occur in the time interval after sunrise.

Curve 1 in Fig. 15-3 is the result of the comparison of the first 30 histograms of each series in the first hour after sunrise at different months. 494 Pairs of similar histograms were identified, that is 22 % of the 2,250 analyzed combinations for the curve. The central peak is 159 pairs or 44% of the maximal possible value. The probability of randomness of such an extreme is less than 10^{-4}.

Curve 2 in Fig. 15-3 is the result of the comparison of 30 histograms from each series, corresponding to the time interval after sunrise from 9 hours 52 minutes to 10 hours 50 minutes. The number of identified pairs of similar histograms is 327 (14.5 %); the central peak = 82 pairs (25 %, that is the proportion of the central peak relative to the entire set of 327 similar histgrams).

Curve 3 shows the comparison of histograms from N 501 to N 530. The time interval after sunrise is from 16 hours 42 minutes to 17 hours 40 minutes. 364 (16 %) Pairs of similar histograms are identified. The central peak is 97 pairs (27 %).

Curve 4 is the comparison of histograms from N 601 to N 630. The time interval after sunrise is from 20 hours 02 minutes to 21 hours 00 minutes. 362 (16 %) Pairs of similar histograms are found. The central peak is 89 pairs (24.7 %).

From Fig. 15-3 one can see that the probability for the occurrence of similar histograms from measurements of ^{239}Pu alpha activity is maximal when times of measurements from a sunrise are the same.

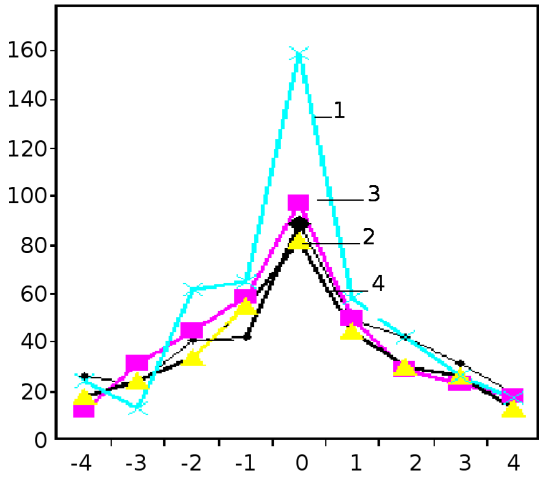

Figure 15-3: In the same moment after sunrise, one can see the similarity of histogram shapes resulting from ^{239}Pu alpha activity measurements at various months between January and December. Curve 1: measurements of the first hour; curve 2: 10 hours; curve 3: 16 hours and curve 4: 20 hours after sunrise. X-axis is deviations from synchronism in the occurrence of similar histograms for various measurements relative to the "sunrise time". "0" is complete synchronism. One interval is 2 minutes. Y-axis is the number of similar histograms pairs, which correspond to the extent of the decline in the synchronism.

From the analysis of Fig. 15-3 it follows that at the initial moment (at the first hour after sunrise) independently from the time of day or the exact moment, the probability of histograms to be similar is maximal: "the Sun" is most dominant amongst all other values of the distance to the "sunrise time". The sunrise time synchronism also shows in another way, when the Sun rises and sets, though its "level of dominance" becomes less.

This result seems rather peculiar: at different months the Sun rises at different heights over the horizon for the same time after sunrise; it occurs at different times of day; the patterns of the star sky are different then; the angles of the ecliptic planes are different. It is absolutely unclear why histograms are similar. Particularly astounding is that this "sunrise time"-synchronism occurs after the sunset (curve 2) and "deep in the night" (curve 4).

This seemingly paradoxical situation is analogous to revealing the distinct day (solar and star) periods from measurements of the Arctic and the Antarctic both under the conditions of a polar night, when the Sun does not appear over the horizon at all and under polar day conditions, when the Sun does not set at any time and when it is dark throughout the day.

15.2 Dependence between histogram shapes and the time of day

To clarify the observed effects, we aimed to explain their dependence on the time of day by completing another equivalent investigation of the same measurements results with the only alteration in that the times of day were shifted. Time series were not shifted by the moments of sunrise, but instead by the time in the day.

The result of this investigation is presented in Fig. 15-4.

The first curve of Fig. 15-4 is a result of the comparison of 2-minute histograms constructed from the results of measurements made during nighttime from 0 until 1 am (N 1 – N 30), in different months. The synchronism occurs only quite unreliably.

Curve 2: Manifestation of the synchronism at noon, between 12 pm and 1 pm. The synchronism is noticeable.

Curve 3: Synchronism during the morning hours, between 10 am and

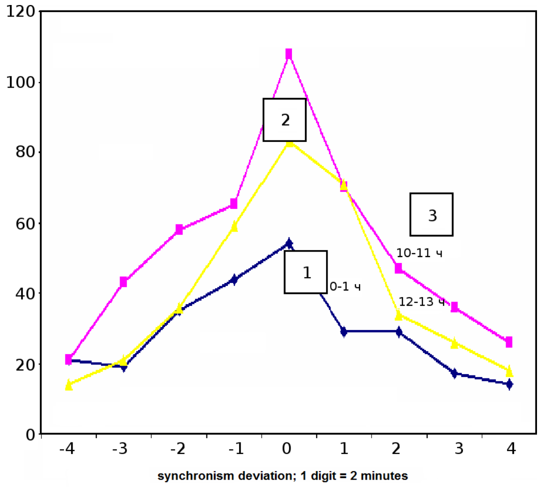

Figure 15-4: Synchronously, at one the same daytime, similar histograms are likely to occur in different seasons, and for different locations on the horizon of the Sun. X-axis is deviations from synchronism of similarly shaped histograms occurring at the same daytime. “0” is the exact synchronism. One interval equals 2 minutes. Y-axis is the number of similar histogram pairs corresponding to the value of the deviation from synchronism.

11 am; the synchronism of similar histograms occurring is most pronounced in this time of day for different months.

Thus, the realization of similar histograms also depends on the daytime. However, this dependence is less expressed than the dependence from the Sun location in the first hours after sunrise.

In the morning hours, the "sunrise" synchronism and the "daytime" synchronism show similarly pronounced. This may be explained by a reciprocal interference: the Sun effect is hardly removable during these hours. The relatively weak "daytime" synchronism in various months may be explained by various different patterns of the star sky in this case.

Separate factors determining a histogram shape may be revealed, as one can see from our experiments, by the "epochs overlapping" techniques. This technique, widespread in geophysics and heliobiology, is analogous to the technique of the "leveling" of genetic texts during searches for homologous nucleotide sequences in them. Basically, it is just the leveling that I use to reveal regularities of histogram shape changes in the "sunrise or moonrise time", by daytime, or by star time.

Revealing separate factors with the aid of such a technique becomes possible once the factors change with different periods. We saw it for the example of a "star" (1,436 minutes) and a "solar" (1,440 minutes) day.

Fig. 15-5 presents the result of the comparison of one-minute histogram shapes from a two day interval and from three experiments (based on measurements of ^{239}Pu alpha activity): April 23, 2004 and April 25, 2004; April 25, 2004 and April 27, 2004; April 27, 2004 and April 29, 2004.

The total distribution for all three experiments of the number of similarly shaped histogram as a function of the time intervals between them is presented.

Similar histograms occur after two star days (1,436 × 2 = 2,872 minutes) 8 minutes earlier than after two solar days (1,440 × 2 = 2,880 minutes). On these days, the Sun rose every day about 2 minutes earlier than the day before; the two days are thus 4 minutes ahead. Three correspondent extremes are seen in the figure. The first one on the left is maximal with a high probability of histograms similarity at the same star time (2,872 minutes); the second occurs at the same time after sunrise (2,876) and the third corresponds to the same time of the day (2,880).

One more extreme, relative to the moon time, after leveling of the time series by the time counted after moonrise. However, the everyday shift of the moonrise is relatively large (April 23, 2004 at 6.22 am; April 25, 2004 at 7.37 am; April 27, 2004 at 9.49 am and April 29, 2004 at 12.30 pm), so it is impossible to present it on the same figure as the Sun or the stellar periods.

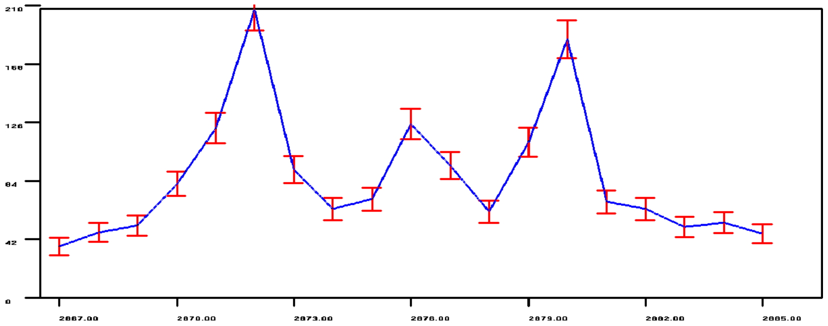

Figure 15-5: From the comparison of histograms constructed from ^{239}Pu alpha activity measurements with an interval equal to two average solar days (2,880 minutes), three close periods, “star”, “sunrise” and “average-day”, are revealed. Please refer to the text for details.

I prepared Figure 15-6 especially to illustrate this aspect. One can see a clear extreme at the “moonrise time”.

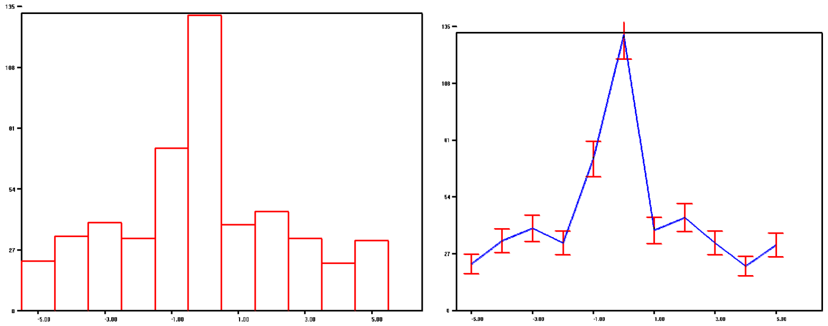

Figure 15-6: After the time series has been leveled according to the “moonrise time” (time of Moon rise), the correlation between histogram shapes and the location of the Moon on the horizon is revealed.

I began this chapter with a description of the “almost random” observation of histogram similarity during moonrise at the MSU White Sea Biological Station in 1986. At the bank of the “Great Salma” it was natural to suppose the observed effects to be related with tidal changes of gravity. 20 years passed. This natural supposition was not confirmed: no changes of histogram shapes correlated with the periodic changes of tidal forces.

At the same though, in 1986, N.V. Udal’tsova found a 29.5 day period in the changes of the mean-square amplitude of "macroscopic fluctuations" in measurements of the AA+DCFIF reaction rate [9, 10]. Fluctuations amplitudes and shapes of histograms change independently. The comparison of histograms from different time series that were synchronized (or leveled) by the new moon moments became the first step on the way to reveal a connection not for amplitude scattering results, but merely for histogram shapes. A new moon is observed on the whole Earth at the same time. Hence, the horizon location of the moon is not the same at different geographical points. Thereby, the time counting relative to the new moon moment, the "new moon time" synchronism, may allow to make inferences about a correlation of histogram shapes with other moon phases.

Chapter 16.

Dependence of a histogram shape on the position of the Sun on the horizon during equinoxes and solstices

It is clear from the aforementioned that a histogram shape is influenced by a number of factors. It depends both on the position of the Sun and the Moon on the horizon, and on the collocation of the Earth, the Moon and the Sun, as well as on the orientation of a measuring device towards "motionless stars". The "solar" and a "stellar" day period do not depend on changes in the correlation of dark and light times of day, they can be observed permanently in different seasons and at different latitudes. "Star" days are similarly expressed both during equinoxes and during solstices, when day-times and night-times are strikingly different (see Fig. 16-1 and 16-2). In the Arctic and Antarctic, "solar" and "stellar" days can be observed during a Polar night, when the Sun does not appear on the horizon at all. All this implies that equinoxes and solstices are especially favorable for revealing the dependence between a histogram shape and the position of the Sun on the horizon location.

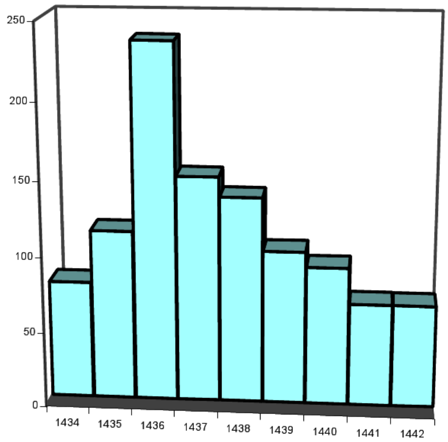

Figure 16-1: Equinoxes that took place between 2000 and 2003. Similar to other days of the period, these times showed a distinct period of the recurrence of similar histograms, equal to 1,436 minutes, that is a "star day". (As usual, the X-axis is the intervals between similar histograms in minutes; the Y-axis shows the number of similar histogram pairs, corresponding to a separating time interval.)

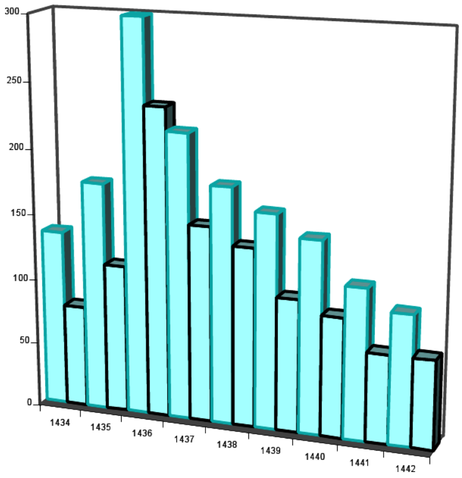

Figure 16-2: Solstices that took place between 2000 and 2003 (similar to other days in that period) also showed a distinct period in the recurrence of similar histograms, equal to 1,436 minutes, that is a "star day". (The axes are the same as in Fig. 16-1.)

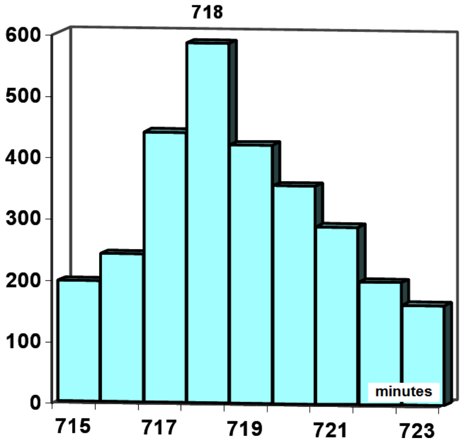

Figure 16-3: Similar histograms occurred highly probably during equinoxes between 2000 and 2003 with a half a "star day" period.

We needed to conduct a large collection of experiments during equinoxes and solstices to clarify the effects of the position of the Sun on the horizon. In these experiments, an approximately half a day period was revealed first. The period was often equal to 718 minutes (the same as in Fig. 16-3). Multiple experiments that followed showed that the duration of this half a day period depended on the accuracy of the relation between dark and light times of various days close to an equinox moment.

It can be expected that a period of about half a day, which occurs during equinoxes, becomes more pronounced when the ratio of day and night time approaches 1. The period then becomes more and more expressed every day when moving towards an equinox, and less and less expressed while moving away from it. This is demonstrated in the series of Figures 16-4 to 16-8.

This change in the expression of the 718-minute period depending on the proximity to an equinox can also be seen in Fig. 16-8. This figure shows the height of an extreme at the 718^{th} minute on various days close to the spring equinox of 2003.

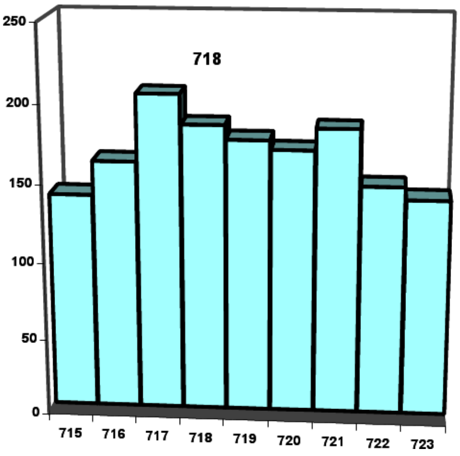

Figure 16-4: Solstices that took place in June and December, 2000–2003, showed neither half "solar day" nor half "star day" periods in the recurrence of similar histograms.

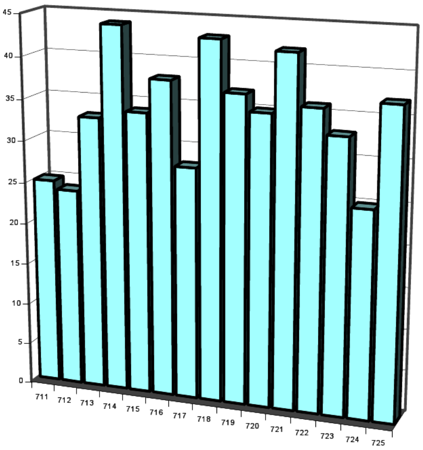

Figure 16-5: September 21, 2005. Periods at 718–720 minutes can already be seen. The mean height is about 40 similar pairs. (Measurements were obtained with a Western collimator).

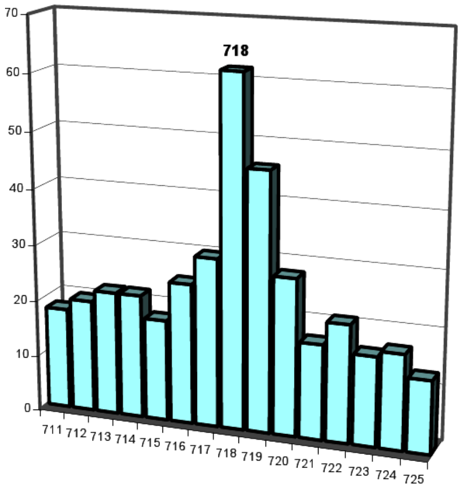

Figure 16-6: September 22, 2005. A 718-minute period showed quite pronouncedly (its height is 62 similar pairs). (Measurements obtained with a Western collimator).

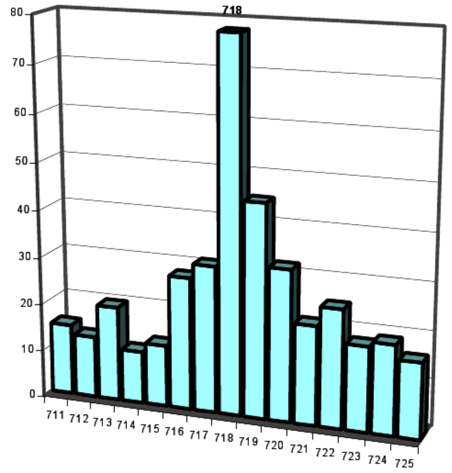

Figure 16-7: September 23, 2005. A 718-minute period is expressed very distinctly (Measurements obtained with a Western collimator).

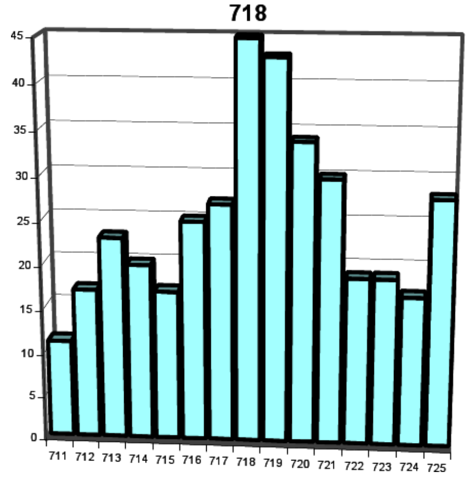

Figure 16-8: September 24, 2005. We find merely a weakly expressed 718-minute period (44 similar pairs only). (Measurements obtained with a Western collimator).

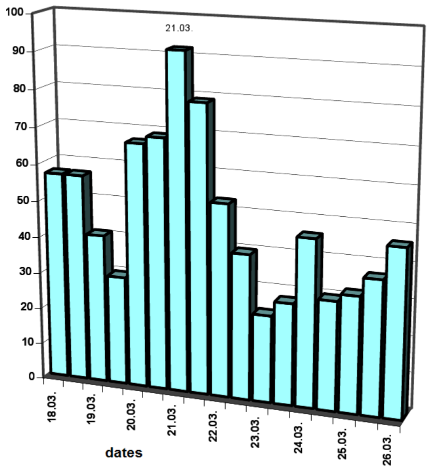

Figure 16-9: During the spring equinox of 2005, a 718-minute period is expressed quite pronouncedly on March 21. (Measurements obtained with a Western collimator). The X-axis shows the days near the spring equinox of 2003; The Y-axis represents the heights of the peaks at 718 minutes.

As was expected, no half a day period can be observed during solstices (Fig. 16-9).

At the same time, if a solstice takes place during a day with only very slight changes between light and dark periods, the dependence of a histogram shape on the position of the Sun on the horizon is especially distinct (it can be seen in Table 16-1 and in Figs. 16-10 and 16-11, which present an analemma).

Dates (2006)	20	21	22	23	24
June	1,040	1,040	1,040	1,040	1,040
December	432	433	432	431	432

Table 16-1: Duration of the daylight time during solstices (in minutes).

I could not resist the temptation to place this wonderful picture at this point, which was composed (and presented to me) by a scientist from the Crimea Astrophysical Laboratory of the Ukrainian Academy of Sciences, Vasiliy Rumyantsev. I wish to express my sincere thanks to him.

Figure 16-10: Analemma, or the illustration of changes in the position of the Sun at the same average solar time during the course of a year.

The meaning of the picture is illustrated in a less aesthetic way in Fig. 16-11, (see also `http://www.astronet.ru/db/msg/1177716/analemma_vr_big.jpg.html`).

On the 22^{nd} of December, a winter solstice day, the daylight time at the Pushino latitude is 432 minutes, and the dark portion of the day is, correspondingly, 1,008 minutes. If a histogram shape is determined by the position of the Sun on the horizon, similar histograms should appear on these days with precisely these periods. If in addition the exposure to the sphere of motionless stars is accounted for in the occurrence of similar histograms at a given Sun height over (or under) the horizon, the periods of light and dark times should be corrected by accounting for the relative difference between the solar and the star days. This amounts to a value of 1,440/1,436 = 1.002785. After this correction, a light period should be 430.8 minutes and a dark period should be 1,005 minutes. During a light period, when the Sun is over the horizon, the difference between the star-time and the solar-time periods is hardly distinguishable (430,8 minutes

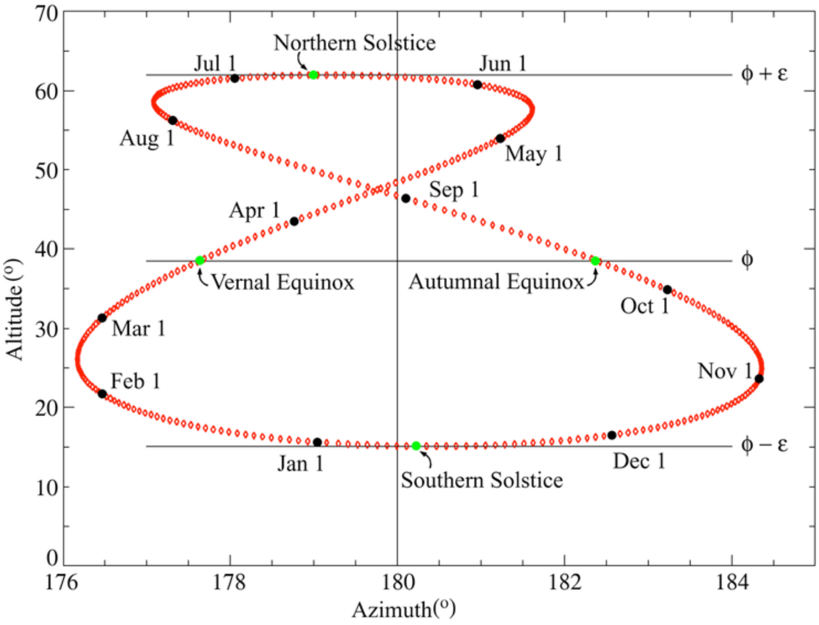

Figure 16-11: The Sun analemma. One can see that during solstices (dates close to June 22 and December 22), there are only slow and slight changes in the ratio between the daylight time and dark times, while during equinoxes there are fast changes.

as compared to 432 minutes...). In the dark period of December, the difference in this period is more pronounced (1,008 versus 1,005 minutes).

One can definitely see from Figures 16-12 and 16-13 that the probability for similarly shaped histograms to multiply reoccur during a winter solstice on December 22, 2000 changes with a period equal to 431 or 432 minutes in the light time of the day and with 1,005 or 1,006 minutes in the dark time of day. This is in precise alignment with the periods corresponding to the correction for the correlation between the stellar and the solar day periods.

On the 22^{nd} of December, a winter solstice day, the daylight time at the Pushino latitude is 432 minutes, and the dark portion of the day is, correspondingly, 1,008 minutes. If a histogram shape is determined by the position of the Sun on the horizon, similar histograms should appear on these days with precisely these periods. If in addition the exposure to the sphere of motionless stars is accounted for in the occurrence of similar

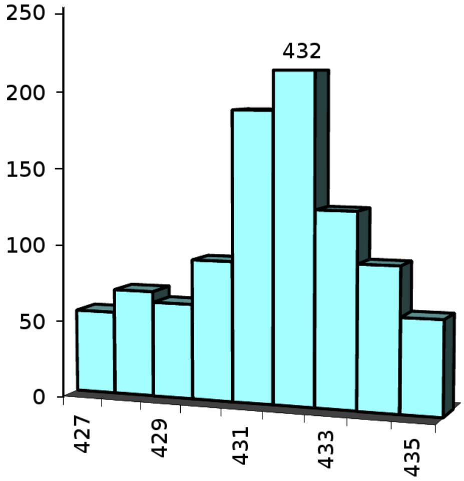

Figure 16-12: On a winter solstice day, December 22, 2000, similar histograms appeared with a period equal to the duration of a "light"-day, without any dependence on the solar or a star time. The X-axis is intervals between similar histograms.

histograms at a given Sun height over (or under) the horizon, the periods of light and dark times should be corrected by accounting for the relative difference between the solar and the star days. This amounts to a value of 1,440/1,436 = 1.002785. After this correction, a light period should be 430.8 minutes and a dark period should be 1,005 minutes. During a light period, when the Sun is over the horizon, the difference between the star-time and the solar-time periods is hardly distinguishable (430,8 minutes as compared to 432 minutes. . .). In the dark period of December, the difference in this period is more pronounced (1,008 versus 1,005 minutes). One can definitely see from Figures 16-12 and 16-13 that the probability for similarly shaped histograms to multiply reoccur during a winter solstice on December 22, 2000 changes with a period equal to 431 or 432 minutes in the light time of the day and with 1,005 or 1,006 minutes in the dark time of day. This is in precise alignment with the periods corresponding to the correction for the correlation between the stellar and the solar day periods.

Similar results were obtained for the summer solstice on June 21–22, 2004. The light part of the day at the Pushino latitude is 1,040 minutes long. If similar histograms appear in correlation with a repeating pattern

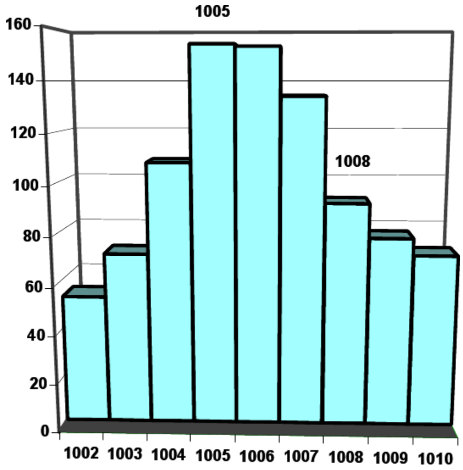

Figure 16-13: On the day of a winter solstice, December 22 in 2000, similar histograms appeared with a period equal to the duration of the dark time of day, when corrected by the time difference between stellar- and solar-days (day duration is 1,005 and 1,006 minutes, instead of 1,008 minutes).

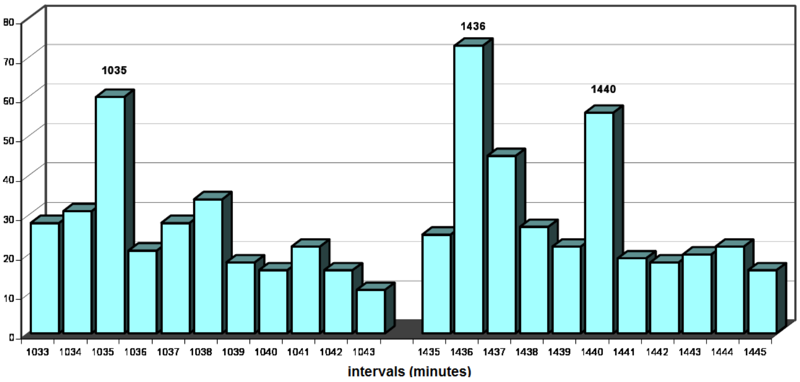

Figure 16-14: On the day of the summer solstice on June 22, 2004, three extremes can be seen with periods equal to: (from left to right) the duration of the light time of the day (N.B.: but 1,035 minutes instead of 1,037), a stellar day (1,436) and a solar day (1,440).

of the star sky, the period should be equal to 1,037 minutes. However, no 1,037 minute period had been found.

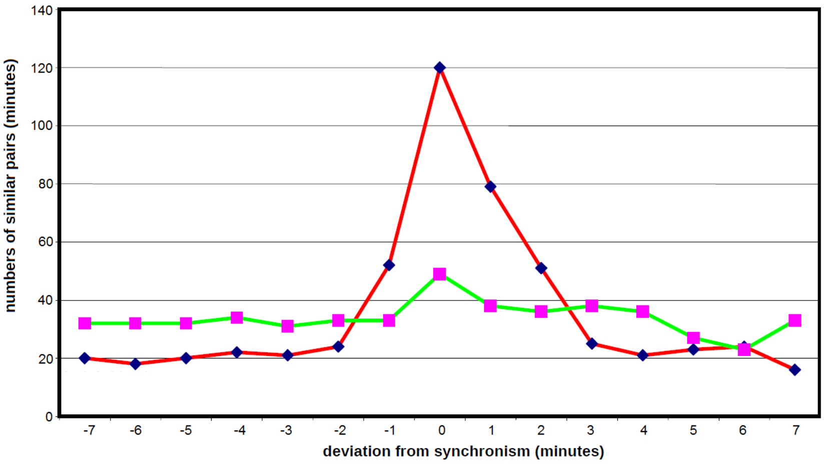

Figure 16-15: Curve No. 1 – The probability for the sequence of histograms of the 1st half of the day (between 12 am and 12 pm) on March 21, 2005 being similar to the sequence of histograms of the second half of the day of September 23, 2005 is very high; Curve No. 2 – The sequence of histograms of the first half of the day (00:00 to 12 pm) on March 21, 2005 is not similar to the histogram sequence of the first half of the day of September 23, 2005.

However, instead we identified a distinct period equal to 1,035 minutes, which appeared for collimator-free measurements. As one can see from Fig. 16-14, for the days of the summer solstice of 2004, an extremely high probability of periods equal to both solar (1,440 minutes) and stellar (1,436 minutes) days can be seen along with the 1,035 minute period.

Thus, a histogram shape is really determined by a combination of at least three factors: the position of the Sun on the horizon, the position of the Earth on its circumsolar orbit, and the exposure of the "laboratory" to a particular pattern in the sphere of motionless stars.

On the other hand, on *equinox days* we were able to identify a considerable decrease in the dependence of a histogram shape on the position of the Sun on the horizon, and also to determine the role of the exposure of the laboratory to the sphere of motionless stars more distinctly.

In February 2006, taking all these results into account, I decided to start some experiments comparing histograms of spring and autumn equinoxes with each other.

To achieve this, I worked from the assumption that the night time "star sky" on days of spring equinoxes is similar to the day time "star sky" for days of autumn equinoxes. Series of histograms obtained on days of spring and autumn equinoxes and summer and winter solstices of various years were compared several times.

As one can see from Fig. 16-13 and 16-14, the sequence of histograms constructed from the results of radioactivity measurements in the first half of the day (between 12 am and 12 pm) on March 21, 2005 is quite likely to be similar to the sequence of histograms of the second half of the day (from 12 pm to 00:00) of September 23, 2005. Sequences of histograms corresponding to the analogous half-days during spring and autumn equinoxes were not similar. It took about 2 years to analyze these differences between the two day sections (halves) (see also Chapter 22 on "Palindromes").

Note:

When the "palindromes" phenomenon (see Chapter 22) was discovered, I realized that the division of a day into a first and a second half as was done in the experiments of this chapter is incorrect. A day should be divided into its "day-time", between 6 am and 6 pm of the local time, and its respective "night-time", from 6 pm to 6 am. However, even though I did not change the material of this chapter, this remark may still be valuable to keep in mind as an indication for the research outcomes presented in Chapter 22.

Chapter 17.

Histogram shape changes due to the celestial equator crossing the Sun, Moon, Venus and Mercury

The previous chapter used measurements obtained during equinoxes and solstices for the sole purpose of identifying separate characteristics of the dependence of histogram shapes on the relative location of the Sun on the horizon and its relative orientation to motionless stars. However, at a later stage of these experimentations, it became clear that amongst other factors that determine a histogram shape **the collocation of the Earth and the Sun precisely at the moments of equinoxes plays a special role**.

We came to this conclusion after the discovery of a fairly distinct period equal to a tropical year (see Chapter 10). The duration of a tropical year is 365 average solar days plus 5 hours and 48 minutes. This period stems from vernal equinox moments when the Sun crosses the celestial equator.

It is very important to note that these points in time go along with different patterns in the star sky and different times of day that are caused by a yearly shift of a vernal equinox point. **Hence, the similarity of histograms at these moments can be attributed neither to the orientation towards motionless stars nor the dependence on the height of the Sun above the horizon.**

Keeping the above-mentioned in mind, we compared the shapes of histograms constructed from the results of long series of measurements of ^{239}Pu alpha-activity during vernal and autumnal equinoxes in Pushino (54^{o}50' NL and 37^{o}38' EL) and at the Novolazarevskaya station (70^{o}46' NL and 11^{o}50' EL, SN Shapovalov's measurements).

It is essential that the moments of equinoxes were fixed in these experiments at one-minute accuracy.

We revealed a fairly distinct dependence of a histogram shape on the time passed after the precise moment of an equinox. These experiments were conducted as a control together with similar investigations for the moments when the Moon crosses the celestial equator ("lunar equinoxes") and (rather unexpectedly) we obtained the very same results for the case of "solar equinoxes". The similarity of gravity effects between the Moon and the Sun could serve as an explanation (though this contradicts the fact that no dependence of histogram shapes from tidal rhythms was revealed in multiple attempts over a number of years). In order to obtain a more reliable "control", we conducted similar investigations of Venus' crossings of the celestial equator. Remarkably, we obtained the same outcomes on the dependency as a result. We also obtained the same results for moments of crossings of the celestial equator by Mars and Mercury. Multiple tests of these effects demonstrated their reliability.

The results of these investigations are described below.

17.1 "Solar Equinoxes"

In comparing series of histograms during vernal and autumnal equinoxes in different years, we noticed an increased similarity of histogram shapes for autumnal and vernal equinoxes obtained from the same time of year across different years. Herewith, the following conjecture appeared: a histogram shape depends not only on its proximity to the point in time when the Sun crosses the celestial equator plane, but also on the direction of their movement towards that plane: whether the plane is approached "from above" or "from below".

Fig. 17-1 presents the result of the comparison of histogram shapes constructed from measurements obtained during autumnal equinoxes in 2005 and 2006. One can see that similar histograms occur synchronously with an equal distance to the moment of the same type of equinox and the reliability of this similarity is high. The precise equinox moments occur at

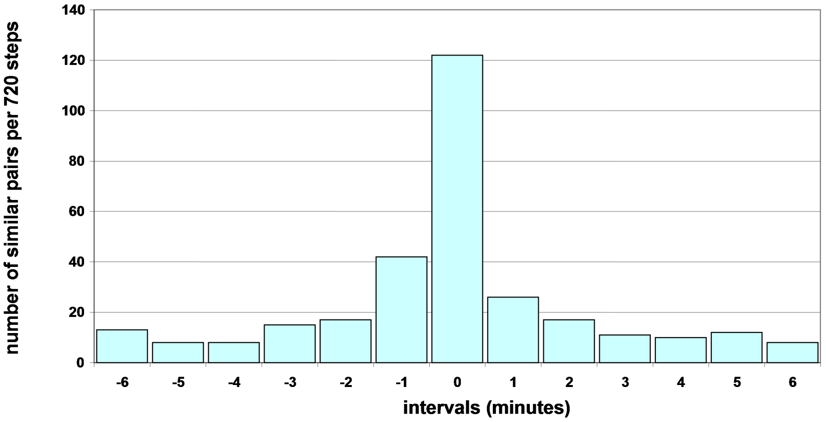

Figure 17-1: High reliability of histogram similarity for equal distances to the Sun from moments of autumnal equinoxes in 2005 and 2006. The equinox moments were: 2005 September, 22, 10:21 pm; 2006 September, 23, 4:04 am (GMT). Measurements of ^{239}Pu alpha-activity were made by SN Shapovalov at the Novolazarevskaya station (Antarctica). The X-axis represents time intervals separating similar histograms; the Y-axis displays the number of similar pairs corresponding to the time distance interval value.

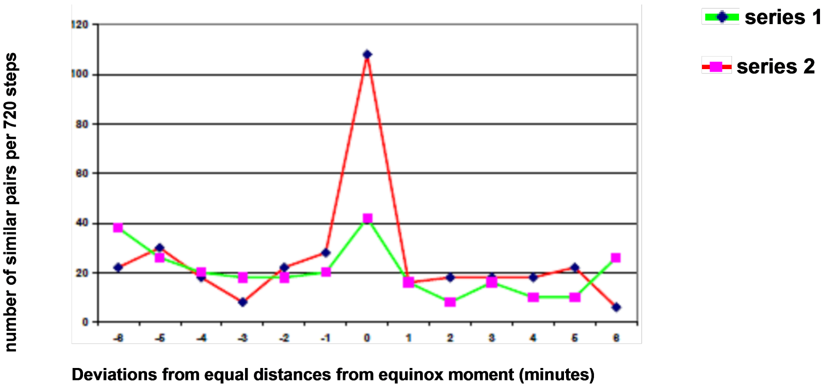

Figure 17-2: Comparing series of autumnal and vernal equinoxes in 2005, the synchronous similarity of one series compared with the inverse (series 2) of the other was observed with a high reliability. Almost no synchronism appeared without inversion (series 1). Each series contained 720 one-minute histograms constructed in such a way that equinox moments fell into the center of a series (histograms N360, N361). Measurements were made at the Novolazarevskaya station (S.N. Shapovalov). Axes are the same as in Fig. 17-1.

different times of day in different years. Therefore this synchronism cannot be explained both by the relative position of the Sun on the horizon and its orientation towards "motionless stars". The result does not depend on the measurement location (in Pushino or at the Novolazarevskaya station) and is similarly pronounced for autumnal and vernal equinoxes alike.

It is clear that during autumnal and vernal equinoxes the Sun crosses the plane of the celestial equator in different ways, "from above and from below", respectively. To explore this, we compared series of "autumn" and "spring" histograms. As we had expected, we discovered that the series of the autumnal equinox were highly reliably similar to the inverse series (the same series in reverse sequence or ordering) of the vernal equinox and, vice versa, the series of vernal histograms were more similar with the inverse series of autumnal histograms. This can be seen from Fig. 17-2.

From the results of Fig. 17-2 it follows that changes of histogram shapes depend on the direction of the Sun movement relative to the plane of the celestial equator. However, the results as such do not mean that changes of histograms are related only to the moments of equinoxes.

At that stage of our investigations it was important to explore whether it can be proved by comparison of histogram shape changes before and after such equinox moments. Such proof was obtained use a modification

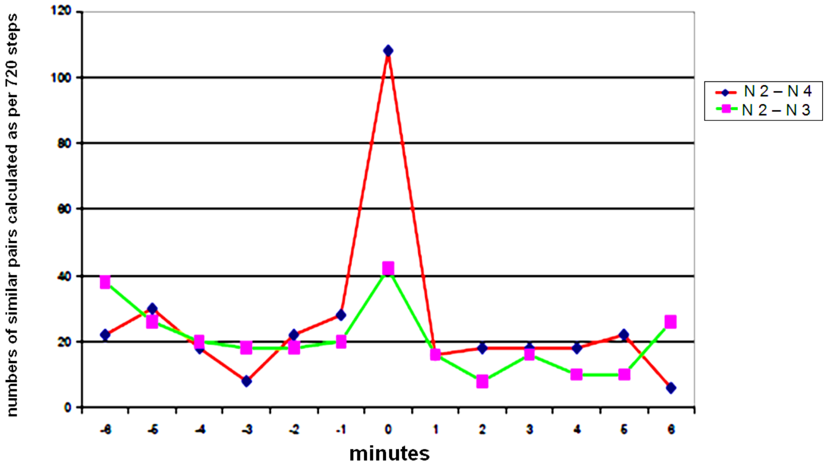

Figure 17-3: Comparison of two halves of a histogram series of the same vernal equinox in 2005. The high reliability of histogram similarity can only be seen when comparing a forward series of one half with an inverse series of the other one (N2–N4). Almost no similarity is seen without inversion (N2–N3). Axes are the same as in Fig. 17-1.

of our "palindrome" method (see Chapter 22). In this method we compare changes of forward and inverse series before and after a "key moment". Identifying similarities between histogram series after inverting a series at a defined target moment is an indicator for the accuracy of the positioning of the moment in the time series.

Fig. 17-3 presents the results of such kinds of comparisons of two halves of histogram series obtained for the same vernal equinox of 2005. To achieve this, we took a series of 720 histograms with the center between N360 and N361 and partitioned it into two halves: the first half from N1 to N360 and the second half was counted from N361 to N720. As seen in Fig. 17-3, the high reliability of the histogram similarity only becomes apparent when comparing histogram series of the first half with the inverse series of the second half. Synchronous similarity is hardly noticeable without inversion. The sharpness of an extreme for synchronous histograms, corresponding to a zero time interval between them, means that the similarity of histograms is only determined by the moment of an equinox. It is the moment from which the time before and the time elapsed after is determined.

Thus, changes of histogram shapes are in fact determined by the Earth moving around its circumsolar rotation to or away from the position when it crosses the equator, namely the point of an equinox. The sharpness of an identified extreme determined with up to one minute accuracy, permits to eliminate the idea of any dependency of the effect on the relative orientation to some other objects present in a "sphere of motionless stars" (recall that the starting point of an equinox shifts approximately 348 minutes each year. Hence, it takes place in a given other "pattern of the star sky" that differs each time around).

17.2 "Moon Equinoxes"

The Moon crosses the plane of the celestial equator twice a month. We have discovered that these crossings that are the "lunar equinox" moments are followed by regular changes of histogram shapes, similar to those described for the Sun.

The regularity displayed in Fig. 17-4 was reproduced multiple times. This regularity can be seen in measurements with both collimator-free counters and with counters equipped with collimators directed westwards and towards the Sun. This is shown in Fig. 17-5.

In Fig. 17-5 the series of 720 one-minute histograms each (360 before and 360 after the equinox moment) constructed from measurements of July 25, 2005 and August 9, 2005, were compared with series of August 9, 2005 with and without inversion. One can see that, independent

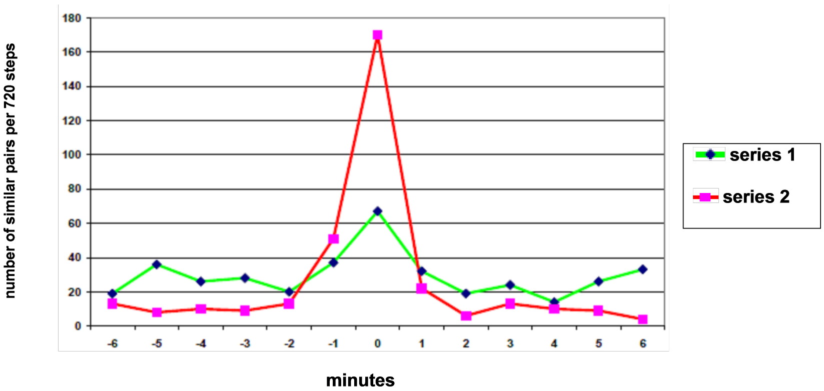

Figure 17-4: Comparing histogram series during a previous "Moon equinox" (January 15, 2005) with histograms of the inverse series (2) of the following one (January 30, 2005), one can see a highly reliable similarity of histograms that are equidistant to an equinox moment. Almost no similarity of such sort can be seen when comparing series without inversion (1). Axes are the same as in Fig. 17-1.

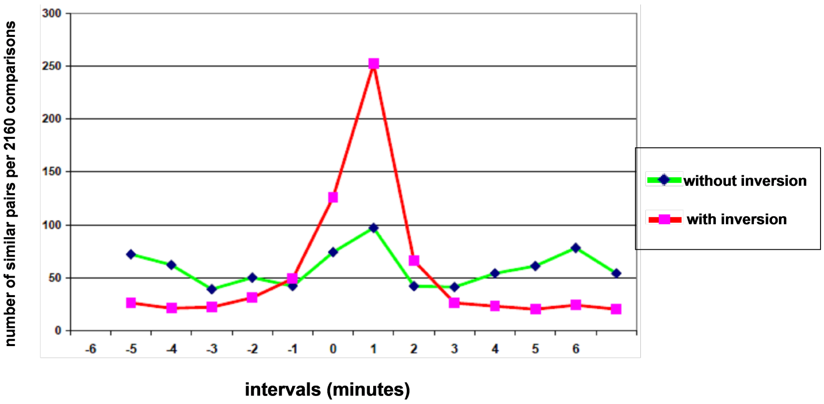

Figure 17-5: Summary of results of histogram series comparison with and without inversion, from collimator-free measurements and those with collimators that are continuously directed towards the Sun or westwards at the moments of the following "lunar equinoxes" on July 25, 2005 and August 09, 2005.

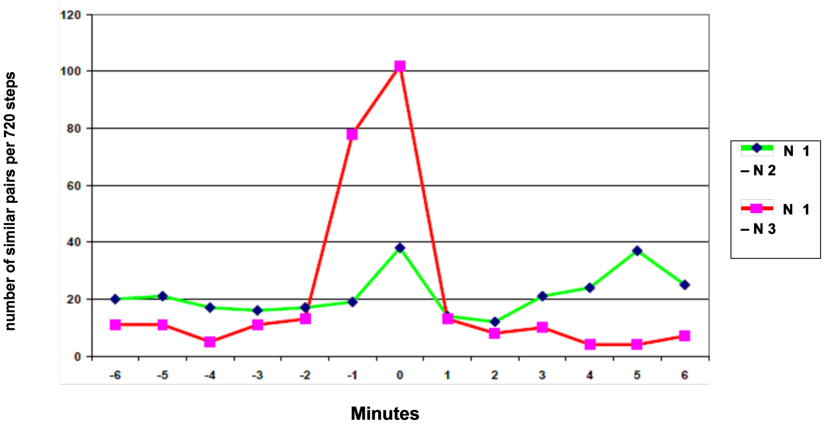

Figure 17-6: Moon "equinoxes". When separating a series of one-minute histograms into two halves of 360 histograms (each derived from a one minute time interval) each, the first half positioned before and the second one after an equinox moment, a high probability of histograms being similar is observed when inverting one of the halves (N1–N3). Practically no similarity can be seen without inversion (N1–N2). Summary result for equinoxes on July 25, 2005 and August 9, 2005. Axes are the same as in Fig. 17-1.

of the measuring methods, the series of histograms are similar only after the inversion of a following "equinox", when the Moon crosses the celestial equator, approaching it from the other side. Therefore, a histogram shape in fact changes depending on the direction of the Moon movement; therefore, a histogram shape is related to the position of the Moon relative to the equator plane, and when it reaches the same points in space, similar histograms appear. Particulars of collimators used for the measurements do not affect the result.

Thus, similar to "solar equinoxes" or "lunar equinoxes", changes of histograms depend on the movement direction of a celestial body when it crosses the celestial equator. These directions are opposite for subsequent equinoxes. Thus, oppositely directed series of histograms appear similar.

Just as for solar equinoxes, the key role of the precise moments when an equator plane is crossed by the Moon can be proved by the palindrome phenomenon of two halves of one and the same series. This can be seen from Fig. 17-6.

17.3 "Venus Equinoxes"

As can be seen from Fig. 17-7, when histograms constructed from the results of measurements in times following equinoxes of Venus are compared,

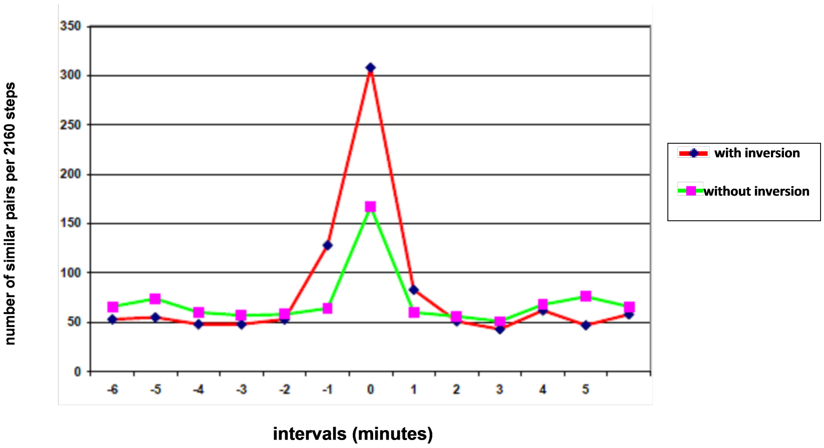

Figure 17-7: Summary of the results of comparing three histogram pairs that have been constructed from measurements during successive Venus "equinoxes" where one series was inverted. The equinoxes took place on October 18, 2002, March 10, 2002, and August 06, 2002.

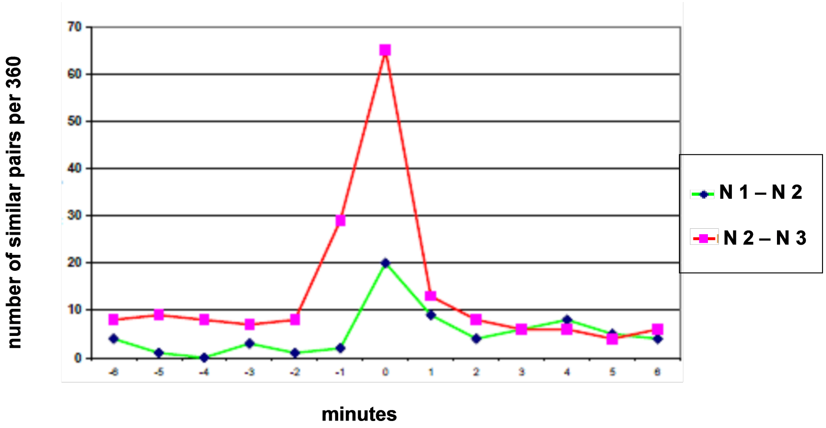

Figure 17-8: Comparison of two halves (360 minutes each) of a histogram series during a Venus "equinox" on July 11, 2002. High probability of similarity can be observed only after inverting one of the series halves. Axes are the same as in Fig. 17-1.

the probability of histogram similarity depends on the direction of the motion of Venus while crossing the celestial equator plane. The similarity appears to be much more significant when comparing opposite (or inverse) series of histograms.

Similarly as for the Sun and the Moon, precisely the moments when the equator plane is crossed plays a key role and this is supported by the palindrome phenomenon that can be found between two halves of one and the same series. This is displayed in Fig. 17-8.

The narrowness of the extreme in Fig. 17-8, similar to other analogous cases, means that with about one minute accuracy, a histogram shape is indeed determined by its closeness to a moment when the Venus crosses the celestial equator.

17.4 "Mars Equinoxes"

Fig. 17-9 presents the results of comparison of histogram series obtained during "equinoxes" of Mars on January 20, 2002 and October 19, 2002. From this figure one can see that changes of histograms depend on the direction of the movement of Mars when it crosses the celestial equator plane: in successive equinoxes the similarity is more likely when one series is inverted.

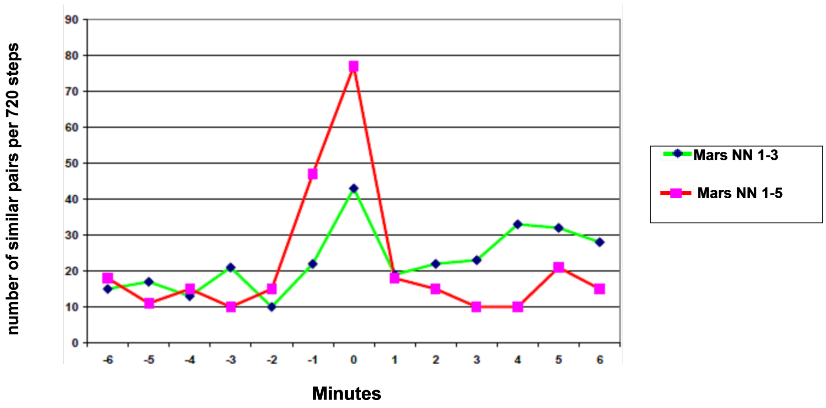

Figure 17-9: Series of histograms during successive equinoxes of Mars are more likely to be similar with inversion, than without inversion. Equinoxes on January 20, 2002 and October 19, 2002. Axes are the same as in Fig. 17-1.

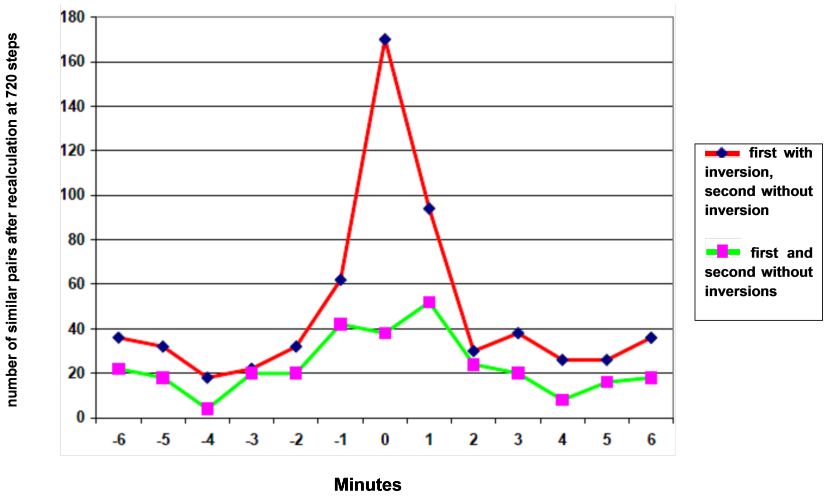

Figure 17-10: Comparison of two halves of the series of Mars equinoxes on January 20, 2002 with and without inversion of one half of the series.

The statement that changes of histograms are indeed related to the moments when Mars crosses the celestial equator, as in previous cases, follows from a palindrome observed when comparing two halves of one and the same series; the similarity is maximal when a subseries of one half of the series is inverted (see Fig. 17-10).

17.5 “Mercury Equinoxes”

We investigated “equinox” effects continued for about 7 years. The results left us more and more startled with bewilderment. It was clear that the observed regularities were not related to some properties of the planets. Practically each week we discussed it during our workshops. We reached our psychological limits in May 2010, when V.A. Kolombet picked the precise dates of Mercury “equinoxes”. And we repeatedly obtained the same regularities of changes of histogram shapes close to the moments when Mercury crossed the plane of the celestial equator. Just like in all other cases for the celestial bodies that we had previously investigated. (Fig. 17-11 and Fig. 17-12).

One can see from the figure that histograms of two halves of the time series are essentially more similar when one of the halves is inverted (similarly to all other such cases).

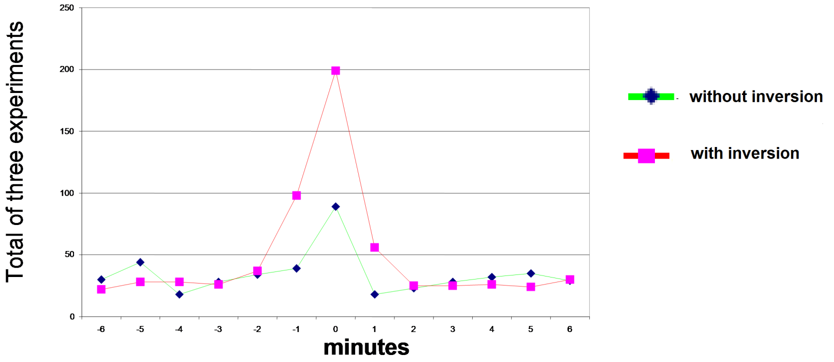

Figure 17-11: Comparison of series of histograms constructed from time series halves, 360 minutes (histograms) each: the first series occurred before the precise moment of an “equinox”, the second series was measured 360 minutes after that moment.

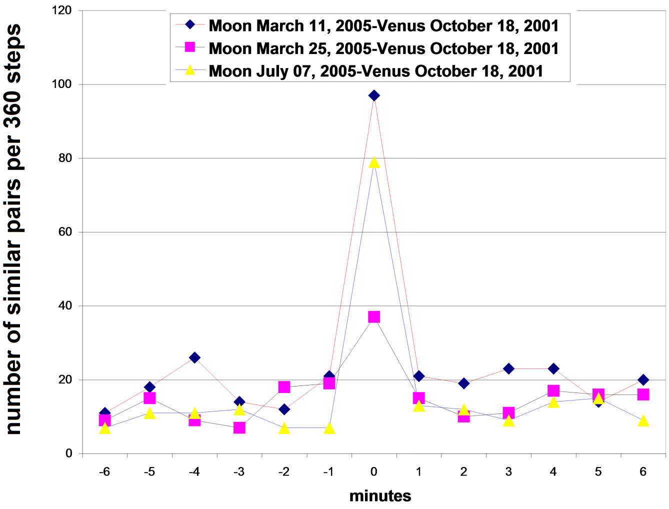

Figure 17-12: Series of histograms from the "equinox" of Venus on October 18, 2001 are highly probably similar to the series of histograms obtained during "equinoxes" of the Moon on March 11, 2005 and April 07, 2005. They are not similar when compared with the series of histograms during the Moon equinox that occurred on March 25, 2005.

17.6 Summary diagrams

Examining the effects of equinoxes, I repeatedly compared time series of histograms that belonged to moments of "equinoxes" of various celestial bodies. It appeared that such "crosswise" comparison provided essentially the same results as those from comparing series of some celestial body alone. However, it is essential for such comparisons to consider the direction of the ecliptic movement of the celestial bodies being compared. This is illustrated in Figure 17-12).

From Fig. 17-12 one can see that:

1. The shapes of the curves characterising changes of probabilities of histogram similarity depending on the time elapsed since the moment when a body had crossed the celestial equator are highly probably similar in different years at the moments of "equinoxes" of different celestial bodies: Moon and Venus (the differences amount to about 4 years).
2. This similarity depends on the directionality with which an equator plane is crossed. The following "equinoxes" of the Moon on March

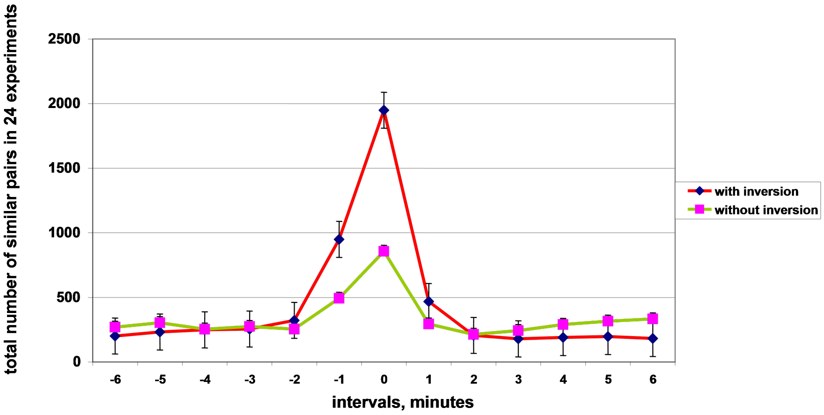

Figure 17-13: Total result of 24 experiments from the comparison of the following (successive) equinoxes of different celestial bodies: "from Sun to Mercury". Successive series of histograms are essentially more similar when one pair of one series is inverted. A shape of a histogram at the moment of a celestial body "equinox" depends not on its nature but only on the direction of the ecliptic movement of a body: the celestial body either approaches the equator "from above" or "from below".

> 11 and 25 are oppositely-directed ("autumn–spring"). Therefore, the series "March 11, 2005" of the Moon is similar to the series "October 18, 2001" of the Venus, and the Moon series of "March 25, 2005" is not similar. The series of "April 07, 2005" of the Moon has the same direction as "March 11, 2005". Therefore it is similar to the histogram series from "October 18, 2001" of Venus.

The results on the lessons learned on the high similarity of regularities of any type of "equinox" series are summed up for different experiments' diagrams and can be seen in Fig. 17-13 and 17-14.

Fig. 17-14 sums the results of the comparison of forward and inverse half-series during 17 different equinoxes.

From Fig. 17-14 one can see that the similarity between one half of a histogram series and the other one is essentially (3 times) higher when one half is inverted. Hence, the narrowness of an extreme implies a highly accurate correspondence of an inverted moment to the moment when the Ecliptics crosses an equator plane. It means that the similarity of histograms at opposite sides of the equator (from "above" and from "below") depends only on the distance to a moment when the equator plane is crossed. This result may seem to contradict the dependence of a histogram shape from the

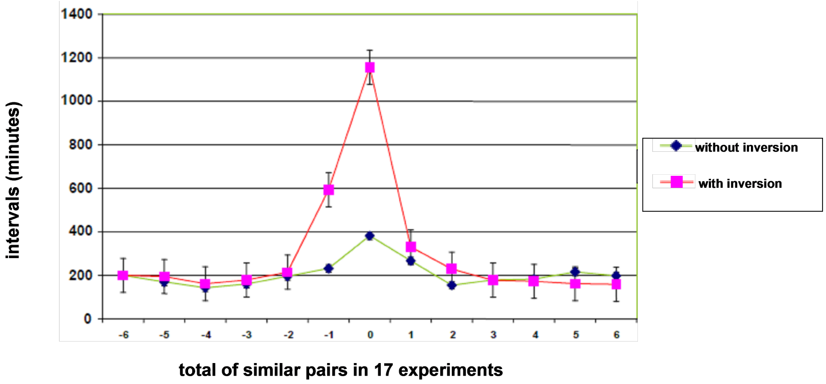

Figure 17-14: "Palindrome similarity" of two halves of histogram series at moments of equinoxes of various celestial bodies implies a high accuracy of the localisation of an equinox moment: the place (or moment) of the crossing between the ecliptics and the celestial equator plane. The palindrome effect is expressed as a significantly (by 3-fold) higher similarity of two halves of histogram series after one of them has been inverted.

direction of the ecliptic movement. Further specific analysis demonstrated this contradiction was not valid. The similarity of the integral inverse series and the similarity of the inverse halves of one series are apparent from different combinations of histograms.

17.7 Measurements with collimators with different orientations

The results corresponding to Fig. 17-13 and 17-14 were obtained from ^{239}Pu alpha-activity measurements with semiconductor detectors that were collimator-free or with detectors with collimators directed West or East or with collimators that were continuously directed towards the Sun. No sharp dependence of observed regularities on the type of detector used was registered. However, **when a collimator was directed towards the Polar Star, the effects of equinoxes changed significantly:** at the following equinoxes, the series of histograms appeared more similar without inversion than with it. This is shown in Fig. 17-15, which sums up the results of 8 experiments from measurements with a collimator directed towards the Polar Star during "equinoxes" of the Moon, Sun and of Mars.

The results presented in Fig. 17-15 may mean that when a collimator is directed towards the Polar Star, no differences between the directionality (of approaching) of the equator plane are registered.

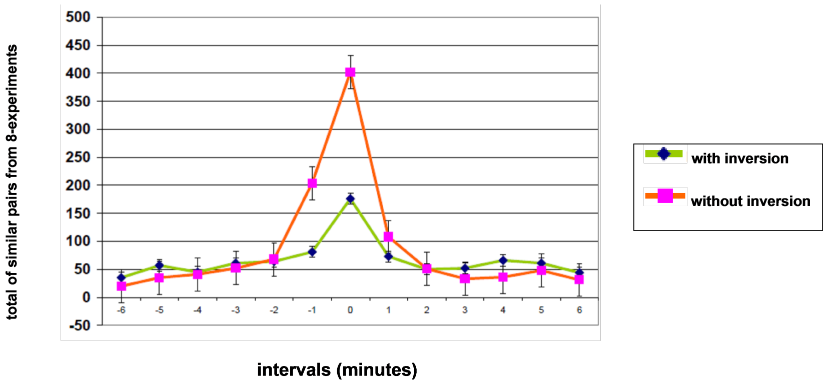

Figure 17-15: Summary results of 8 experiments with the collimator directed towards the Polar Star at moments of Moon, Sun and Mars "equinoxes". One can see that the series without inversion are significantly (3-times) more similar than those with inversions.

17.8 Discussion

Different celestial bodies cross the celestial equator at sharply different velocities. Histogram series from the same time and of different celestial bodies have not only similar shapes but also similar scale. From here it follows that the same dependence of the probability of histogram similarity from the time interval between histograms observed in Fig. 17-13, is provided by the movement of the Earth and the speed of its axial and ecliptic rotations. The speed at which the Earth passes a point of a celestial equator crossing with the ecliptics does not depend on whether any celestial body is present at this point, how long it is present there and what the speed is with which the body crosses an equator plane. Moments of equinoxes of various planets are merely a way, and maybe not the best one, to reveal the daily (nota bene) passing, namely the exposure of a laboratory towards an equinox point. Therefore, all laws of "equinoxes" must be observed every day, at different times of a solar day or at the exact same time of a tropical day.

Summary of results

It is astounding that despite differences in the velocities of the ecliptic movement of different celestial bodies, the speed at which changes of histogram shapes occur during their "equinoxes" are the same. Correspondingly, the curves for different celestial bodies are practically not distinguishable from one another: histogram shapes centred by equinox moments, for example those of Moon and Venus, are highly probably similar. We were able to summarise similar types of experimental results with equinoxes in different years and with different planets.

The only common feature of "equinoxes" of different celestial bodies is the fact that they correspond to the moments when a body crosses the plane of the celestial equator. The moments occur at different times of day in different months and seasons. They are therefore neither related to the orientation towards the Sun, nor to its orientation towards motionless stars. They are determined only by a place ("hole", or point of intersection) in an equator plane crossed by a trajectory of a planet movement. Small deviations of planetary movements from an ecliptic plane may be roughly neglected, and one may consider all celestial bodies moving with a different periodicity and at different times along a similar trajectory in this plane, passing through the same point of intersection (or cross section if seen in two dimensions) in the plane of the celestial equator.

In such a case we observe only typical series of histograms when the Earth approaches (or distances from) towards (or away from) this intersection. Hence, the particulars of a celestial body are not of relevance to us: they are only indicators of the time of a day corresponding to a calculated moment of "transection" of a celestial equator plane by its ecliptics. Without references to lunar, Martian and other "equinoxes" we could calculate these moments for each date, considering the movement of a vernal equinox point in a year because of mutations and changes of a laboratory's orientation relative to the point because of the daily rotation of the Earth.

In such a way we must emphasise once more that there is no dependence of those "effects" on the type of measurement or on the type of process under investigation. The wording or metaphor of a ≪hole≫ that we used earlier possibly is not perfectly accurate or even suitable; it may be rather the intersecting line of planes that cross: the ecliptic plane and the equator plane. It follows, for example, from the comparison of solar and lunar equinoxes. "Holes" of the following, vernal and autumnal (solar) equinoxes at an equator plane are at opposite ends of a circumsolar orbit. "Holes" of the following lunar equinoxes are at the same plane at a distance of about 1/10 of the diameter. Their only common factor is the direction of a line connecting the following "holes". Thus, it refers to a line that results from the crossing of these two planes.

It is extraordinary to have quantitatively identified the scale similarity of the regularities. This is distinct for comparisons of similar diagrams that were constructed during "equinoxes" of different celestial bodies: a practically full similarity of curves for the Sun, Moon, Venus, Mars, and Mercury was found.

Different celestial bodies pass a celestial equator plane with different speeds and different periods. Similarity of scales of histogram time series constructed for different equinoxes as well as the congruence of the speed of histogram shape changes are in all cases determined only by the velocity of the Earth's axial and circumsolar movements.

As described in this chapter, we discovered two "palindrome effects".

The first was discovered from measurements of neighbouring or successive equinoxes of various celestial bodies. Time series following one another, for example, from vernal and autumnal equinoxes appear similar after one series was *inverted*.

Secondly, when comparing the two halves of the same time series of histograms, where one half occurred before a calculated moment of equinoxes and the second one afterwards, sequences of histograms of one half series are similar to the *inverse* sequence of the second one.

The first palindrome effect means that a histogram shape changes its dependence from the direction of the ecliptic movement: occurring "from above" or "from below".

Furthermore, a similar asymmetry was demonstrated, though in this case with the inversion point set at the moment of the crossing of an equator plane, that is, at the moments of "equinoxes".

The seeming contradiction of these two effects can be resolved by considering that in these two cases different histogram pairs are similar: in the first case, a part of them is responsible for the similarity of the completely inverse series; and the other part for the inverse similarity of the halves of these series. It is essential to mention here that the second palindrome effect permits the setting of an inversion point, which is the moment when an equator plane is crossed, with maximum accuracy of one minute in our experiments.

Our conclusion on the anisotropy, meaning the dissimilarity of movements from "above and from below" equator plane spaces naturally corresponds to the results of experiments with collimators directed towards the West or East, the Sun and the Polar Star. In experiments with a collimator directed towards the Polar Star, "the first palindrome effect" disappears: series of histograms of the next equinoxes become reliably similar without inversions. This could be explained by the fact that the direction towards the Polar Star, that is, the North Pole of the Earth is perpendicular to an equator plane. Hence, the asymmetry given by the approaching from "above" or from "below" disappears.

17.9 Summary

In experiments with motionless and rotating collimators during measurements of radioactivity… in experiments with a pair of noise generators oriented towards different azimuths… in similar experiments with a pair of Brownian motion sources… neither of those led us to conclude about a sharp anisotropy of our space. We have observed sharp dependencies of histogram shapes from the collocation of the Earth, the Moon, and the Sun. The list is supplemented with a sharp dependence of histogram shapes on the orientation of objects under investigation towards the "equinoxes line", that is, the line where the equator and the ecliptics planes cross. A physical sense of spatial individualisation of this direction should become an object of specific investigations. The proximity to and directions of equinoxes lines and the "axis of evil", the spatial direction of minimal relict emission temperature, shown by Boris Valentinovich Komberg, may develop into a landmark in this context.

To conclude the discussion of our longstanding investigations of equinoxes and solstices presented here we end this chapter with a poetical image from a famous poem by V.V. Mayakovsky:

And beyond that village
yawned a hole,
into that hole – and not just maybe –
the sun for certain always rolled,
slowly, surely, daily.
At morn
to flood the world
again
the sun rose up –
and ruddied it.
Day after day
it happened this way,
till I got
fed up with it.

Vladimir Vladimirovich Mayakovsky

Chapter 18.

Times of "new Moon". Correspondence between a typical histogram shape and new moon moments

We repeatedly attempted to compare histogram shapes during a rising or setting sun and moon, but were unable to reveal any definite shapes because those moments are not coordinated: the collocation of the sphere of the moon, the Sun and motionless stars changes through time. At times one can discern a more strict coordination. These moments include: new moon, full moon, and times of solar and lunar eclipses. At these moments the moon and Sun collocations are similar. There only remains a "lack of coordination" with the location of the sphere of relatively motionless stars. For these reasons, I began comparing histogram shapes at "new moon times". The results of these comparisons are presented in Fig. 18-1.

Fig. 18-1 illustrates the high probability of similar histograms from synchronous measurements at the "new moon time". These were taken from different months and years and at various times of day. The figure is based on the comparison of histogram shapes constructed from measurements of six time series from ^{239}Pu alpha activity during new moon phases: January 1, 1995 (10 hours 55 minutes); January 30, 1995 (22 hours 48 minutes); March 1, 1995 (11 hours 49 minutes); December 10, 1996 (16 hours 58 minutes); February 7, 1997 (15 hours 8 minutes); March 9, 1997 (1 hour 16 minutes). (new moon times are in parentheses). The histograms were constructed from 60- and 6-second measurements with a total time of 6 minutes each. Each series included 60 histograms. The series were "leveled" by the "new moon" time. The first 31 readings of each series correspond to new moon moments. 11,970 pair-wise histogram combinations in total were compared. 935 (7.8 %) similar pairs were identified. "0" on the X-axis, that is, a "new moon time" synchronism corresponds to the peak with a height of 145 (16 % of the theoretically possible quantity). The probability for obtaining such an extreme randomly is vanishingly small.

In Fig. 18-1 one can discern a very clear dependence between histogram shapes and the time of new moon: at the same "new moon time", histograms are similar with high probability. Analogous results were obtained from several other time series.

Therefore, along with the dependence on the "sunrise time", the "moonrise time" and the "star time", the histogram shape also depends on the "new moon time".

This result does not imply anything novel in principle: a histogram shape is indeed correlated with the collocation of the moon and the Sun.

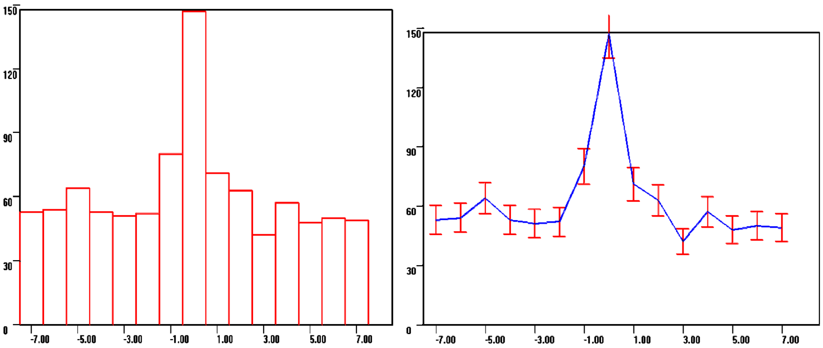

Figure 18-1: Illustration of the high probability of similar histogram recurrence at the same "new moon time". Explanations are provided in the text.

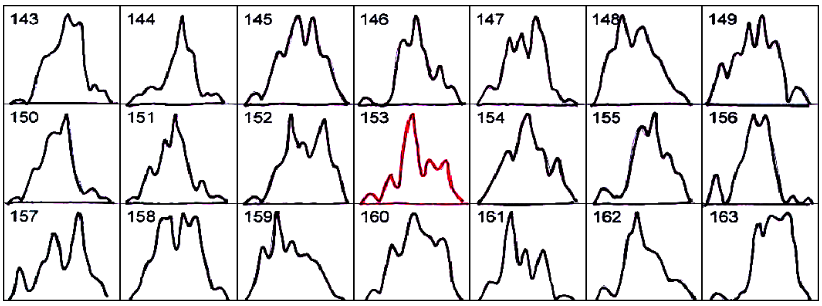

Figure 18-2-1: Measurements made in Pushino (54^o NL, 37^o 50' EL) on July 31, 2000. The new moon time was 3.39 am (Greenwich time). It corresponds to the histogram numbered N 150. The histogram N 153 occurred six minutes later than the new moon moment. This histogram is the only one with such a shape from all other 21 histograms of this series.

However, we came across some unexpected luck in this context. It appeared that typical shapes of histograms follow moments of new moon.

Here my dream about shapes of histograms that are typical for specific cosmophysical situation seemed to begin to come true. (This dream had not realized from histogram comparisons during rises and sets of the moon and the Sun). Analyzing the dependence of histogram shapes on "new moon time" I noticed that a typical histogram shape immediately succeeds the moment of new moon. This typical shape was registered more clearly for histograms of one or two minutes total time than for 5, 10 or 15 minute histograms. We did not identify a typical shape from the construction of histograms from one hour total time.

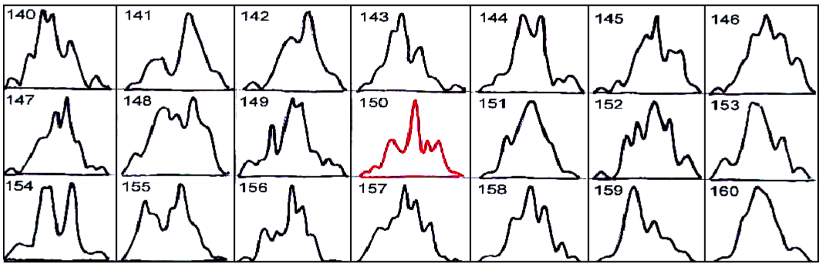

Figure 18-2-2: Measurements made on August 29, 2000 in Pushino. The time of new moon was 11.21 am; it corresponds to histogram N 150 with the typical shape.

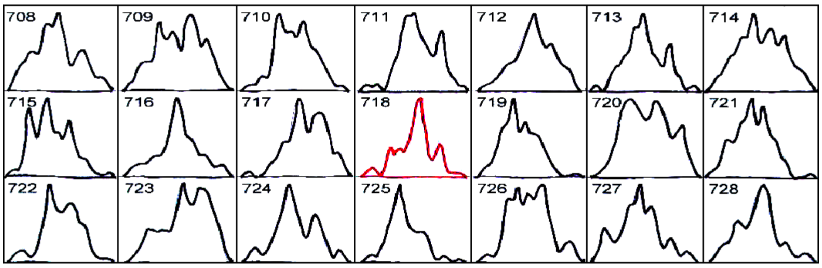

Figure 18-2-3: Measurements made (by S.N. Shapovalov) on September 27, 2000 on the "Academic Fyodorov" ship in the course of the AARI Arctic expedition in the Arctic Ocean at 82^o NL and 50^o EL. The new moon time was at 8.54 pm. This moment is followed by histogram N 717. The typically shaped histogram N 718 occurs with a distance of 2 minutes from this moment. No other comparable histograms of that same shape are displayed in the figure.

Figures 18-2-1 to 18-2-8 present the series of successive histograms constructed from 60 two-second measurement results of ^{239}Pu alpha activity (of 2 minutes total time each) in the periods of new moon phases at different dates and at different geographical points.

These figures (similar to Fig. 15-2-A–E) present fragments of computer logs: 10 histograms before and 10 histograms after the histogram with typical "new moon" shapes. They illustrate the distinct typical shape as compared to other histograms of the same series.

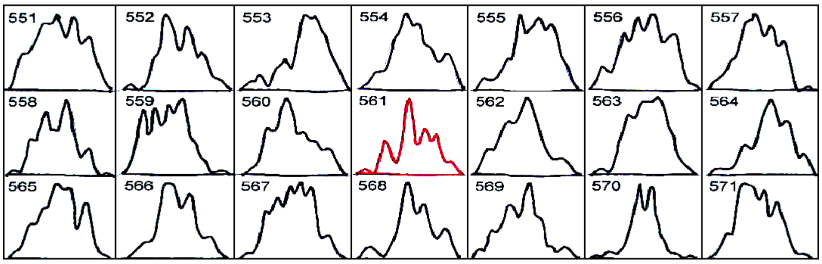

Figure 18-2-4: Measurements (S.N. Shapovalov) May 23, 2001 at the "Academic Fyodorov" ship during the AARI Antarctic expedition near the Antarctic coast (63^o SL, 88^o EL). The new moon time was 2.48 am. This moment is followed by the histogram N 555.5 (that is, one minute in between the numbers 555 and 556). The histogram of typical shape N 561 occurs 5.5 minutes after this moment.

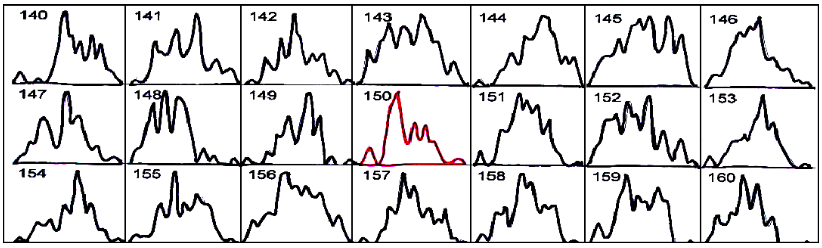

Figure 18-2-5: Measurements from February 23, 2001 in Pushino. The new moon time was at 8.23 am. The histogram of typical shape N 150 corresponds to this moment.

At the present time we have identified histograms of such typical shape during more than 70 new moon phases at different geographical points, and for measurements of different types of processes, as well as in different years and for different seasons. These observations witness the reliability of "new moon" histogram recurrence all over the Earth at practically the same time.

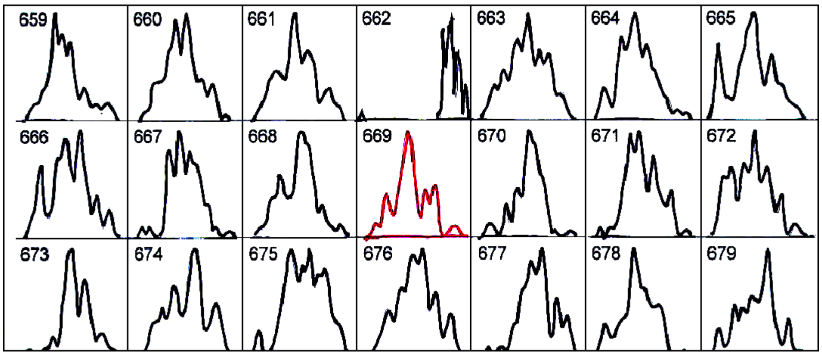

Figure 18-2-6: Measurements from June 21, 2001 in Pushino. The new moon time was 11.59 am. This moment is followed by histogram N 670.5. The histogram of typical shape N 669 occurs 1.5 minutes later.

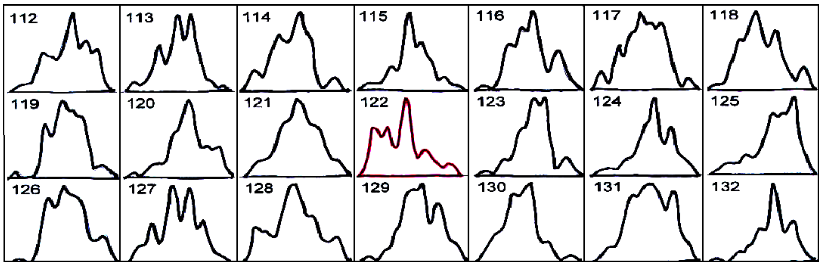

Figure 18-2-7: Measurements from June 21, 2001 on the "Academic Fyodorov" ship during its AARI Antarctic expedition in the Atlantic Ocean at 33^o NL, 13^o WL. The new moon time was 11.59 am. Following this moment, the histogram N 118.5 occurs. The histogram of typical shape is N 122, that is, 7 minutes after this moment.

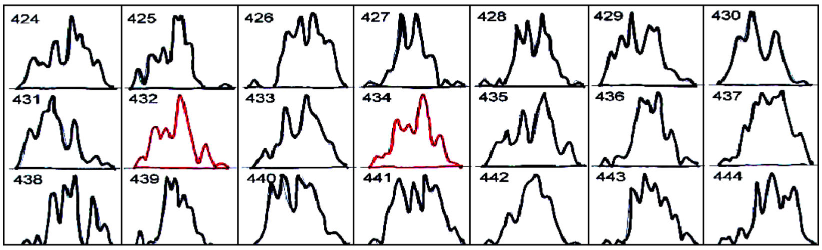

Figure 18-2-8: Measurements from September 17, 2001 in Pushino. The new moon time was 10.28 am. This time is followed by the histogram of typical shape N 434. The histogram N 432 occurs 4 minutes before the new moon histogram. Those two histograms have a similar shape. During new moon, histograms of typical shape occur at different geographical points at the same time with an accuracy of up to several minutes.

The similarity of "new moon" histogram shapes from measurements obtained at different dates and at different geographical points is illustrated in more detail in Fig. 18-3.

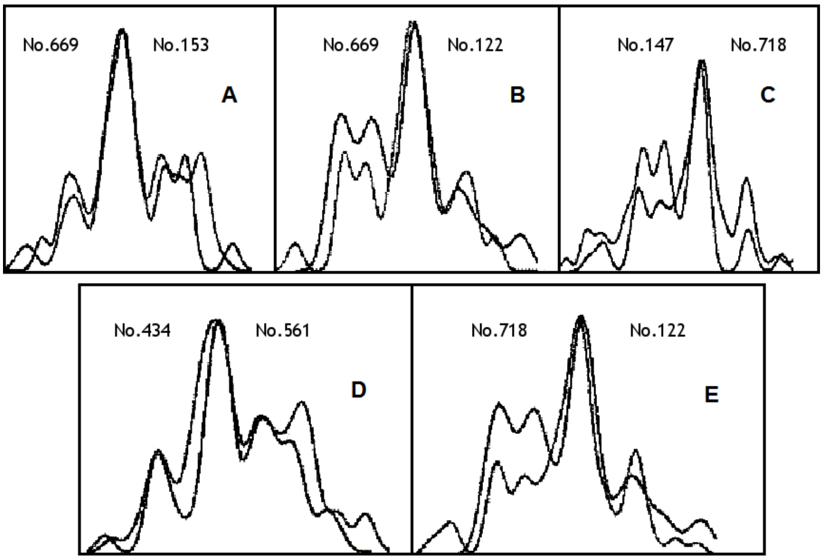

Figure 18-3: Histograms constructed from measurements of ^{239}Pu preparations alpha activity during new moon at different geographical points at different dates.

(A) Histogram **N 153**: measurements during new moon on September 17, 2001 in Pushino; **N 669**: measurements during the new moon on June 21, 2001, also in Pushino. These illustrate that **at the same geographical point at different dates**, histogram shapes during a new moon are rather similar.

(B) **N 669**: the same histogram, Pushino June 21, 2001 and histogram **N 122**, of the measurements in the Antarctic expedition on the "Academic Fyodorov" ship at 33^o SL and 13^o EL at the same time. This illustrates the similarity of "new moon histogram" shapes **at the same time at different geographical points**: they are separated by many thousand kilometers and significant local time differences are also present.

(C) Analogous illustration of the similarity of "new moon histograms" constructed from measurements **during the same new moon at different geographical points**. New moon on September 27, 2000. The histogram **N 147** was derived from measurements in Pushino, histogram **N 718** is from measurements in the course of the Arctic expedition on the "Academic Fyodorov" ship 80^o NL and 50^o EL.

(D) Illustration of similarity of new moon histograms **at different geographical points during different new moon phases**. **N 434** is from measurements in Pushino on September 17, 2001; **N 561** from measurements on May 23, 2001 in the Antarctic at 63^o SL and 88^o EL.

(E) Analogous illustration of **histogram similarity at different dates and different geographical points**. **N 718** is constructed from measurements obtained on September 27, 2000 in the Arctic, **N 122** is from measurements in the Antarctic.

From Figure 18-4 one can see that, similar to other cases, a typical histogram shape does not depend on the type of process. The upper part shows one-minute histograms, constructed from measurements of noises in "Ulitka" gravity antenna. Histogram N 265 follows the new moon moment. The lower part shows histograms constructed from the results of ^{239}Pu alpha activity measurements in Pushino. The new moon moment is followed by the histogram N 264.

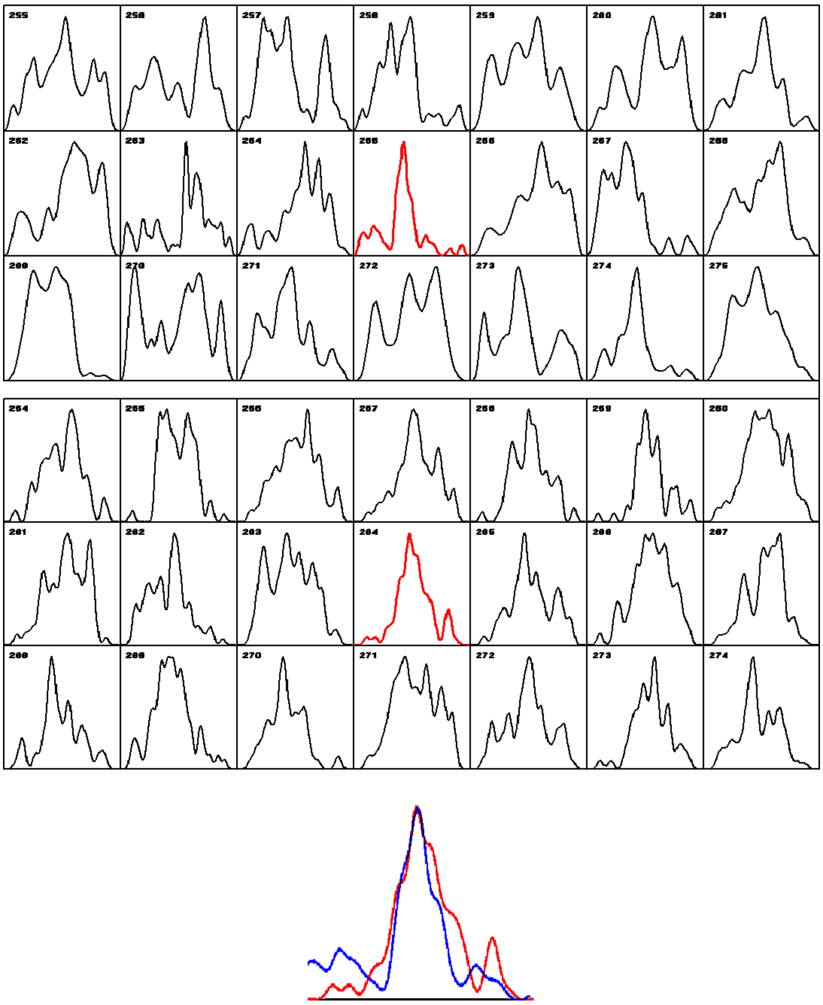

Figure 18-4: The typical histogram shape for a new moon occurs at the same time (with 1 minute accuracy) at different geographical points (here: in Pushino and in Moscow) for different types of processes (here: ^{239}Pu alpha activity and noises in “Ulitka” gravity antenna). Measurements were obtained at the same time on March 25, 2001.

Thus, under the conditions during new moon moments, in our investigations of different types of processes, we identified a recurrence of histograms of typical shape at different geographical points at the same time.

Identifying these wonderful phenomena, where specific correlations could be found between new moon moments and histogram shapes, brought me back to my old dream: the search for possible relations between "macroscopic fluctuations" and solar eclipses. Solar eclipses and new moon phases are very similar in nature. Solar eclipses occur when the moon shadow falls on the surface of the Earth.

Chapter 19.

Full moon phases

After the unexpected success of identifying typical histogram shapes during new moon and during solar eclipses, I naturally attempted to find the same phenomenon for full moon moments as well. First attempts failed: I did not see any special or typical shapes of histograms during full moon phases or moments. However, later on during the systematic comparison of histograms (from routine ^{239}Pu alpha activity measurements) from successive full moon periods of 2002, it became clear that at these moments, histograms of nonrandom and specific shapes occur with high probability.

I shall take this occasion to illustrate once more specific problems with these investigations. Similar to the new moon investigations, the series of Figures 19-1 presents fragments of our computer database with histograms constructed from measurements of new moon periods of 2002, similarly to the series of figures in 18-2 from the new moon investigations. These fragments that display 21 successive one-minute histograms each, are tables made up of three lines, with 7 histograms each. The center of the middle line of each figure shows histograms that correspond to a maximum moment of a full moon (marked in red).

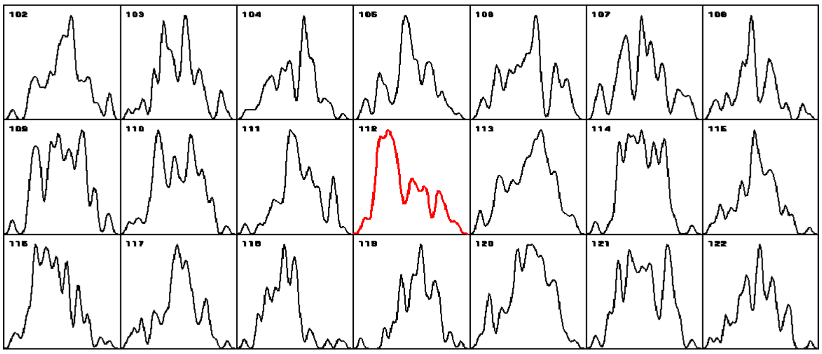

Figure 19-1-1: Full moon on January 29, 2002. The maximum is N 112.

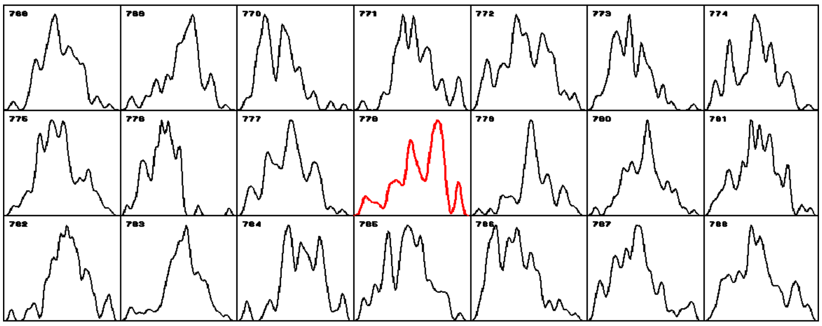

Figure 19-1-2: Full moon on February 27, 2002. The maximum is N 778.

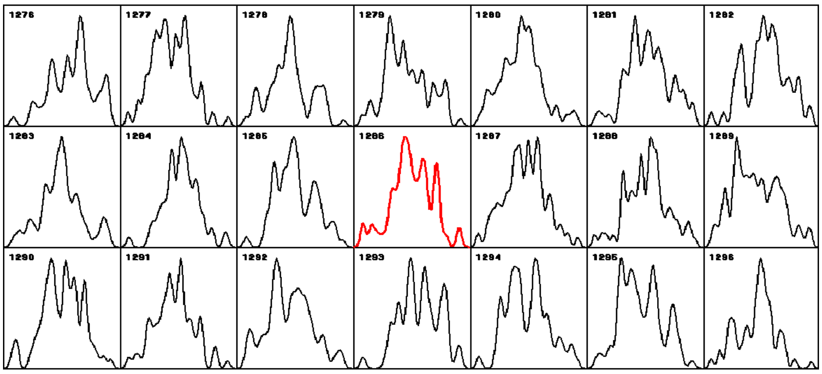

Figure 19-1-3: Full moon on March 28, 2002. The maximum is N 1286.

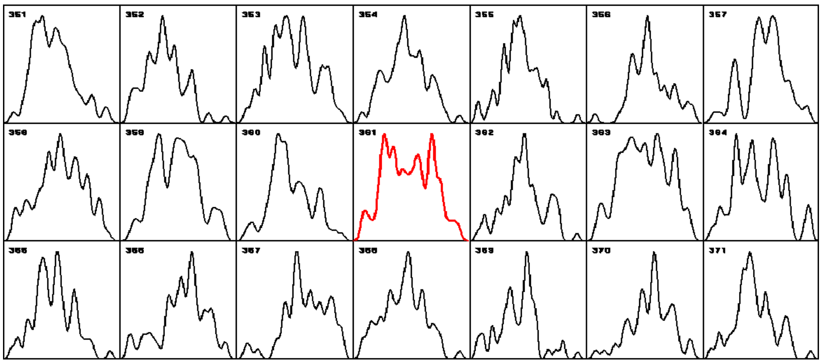

Figure 19-1-4: Full moon on April 27, 2002. The maximum is N 361.

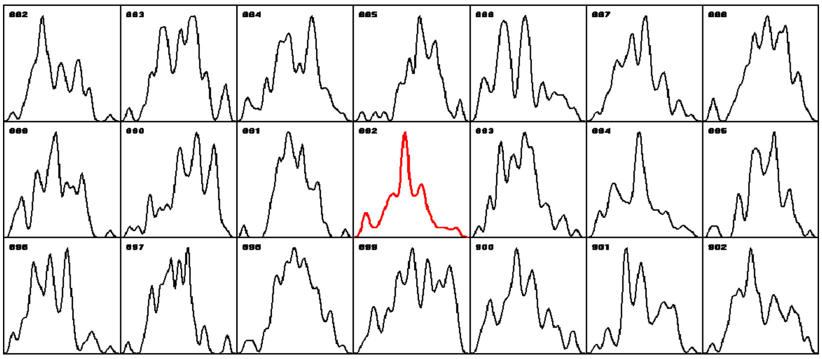

Figure 19-1-5: Full moon on May 26, 2002. The maximum is N 892.

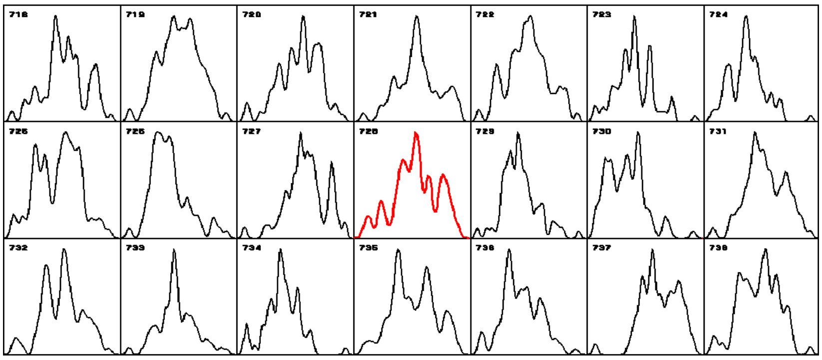

Figure 19-1-6: Full moon on July 24, 2002. The maximum is N 720.

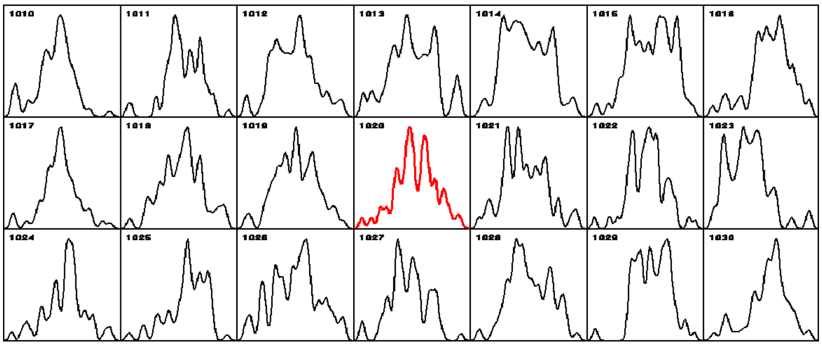

Figure 19-1-7: Full moon on September 21, 2002. The maximum is N 1020.

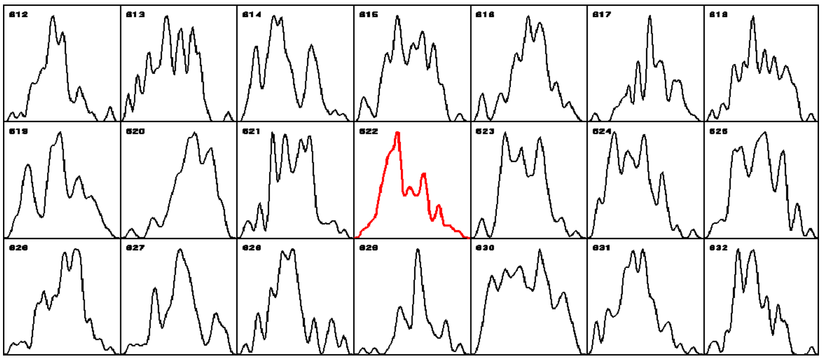

Figure 19-1-8: Full moon on October 21, 2002. The maximum is N 622.

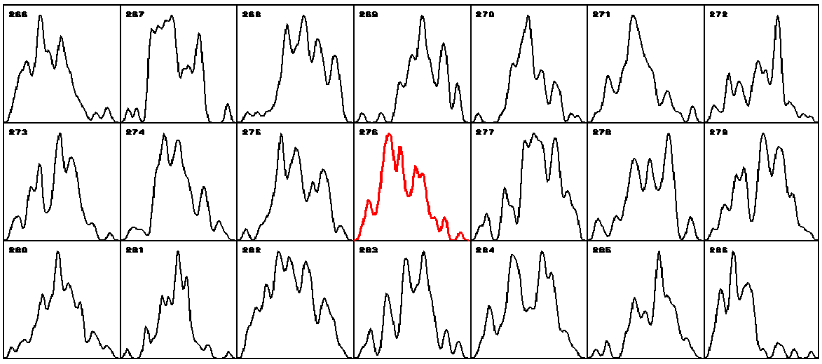

Figure 19-1-9: Full moon on November 20, 2002. The maximum is N 276.

"At first glance" there is nothing here... However, when comparing all central red histograms and their neighbors to each other, a nonrandom correlation between special histogram shapes and the full moon phases becomes apparent. Let us review the results of these comparisons.

Fig. 19-2 is the fragment of the computer log, the results of comparing histograms close to all full moon moments of 2002.

While reviewing the series in Figures 19-2, the existence of a general "shape idea" close to the full moon moments becomes evident. This impression required a more detailed investigation. Such an investigation was completed for the following series of 25 figures in Fig. 19-3.

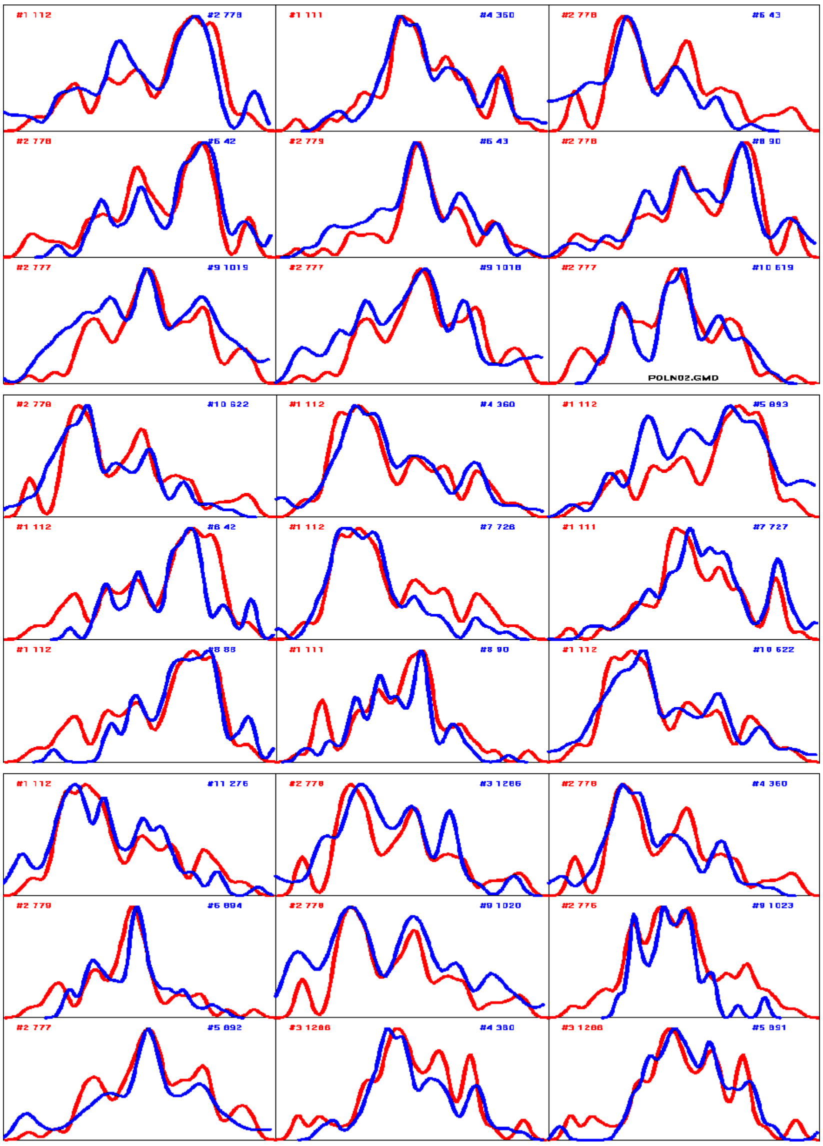

Figure 19-2: Manifestation of similar shapes of histograms at full moon.

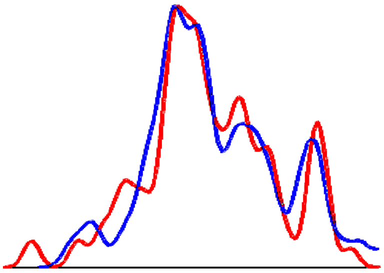

Figure 19-3-1: Full moon on January 29 and April 27, 2002, one minute before maximum. “Anyone can see” here that these histograms share a similar “shape ideas”.

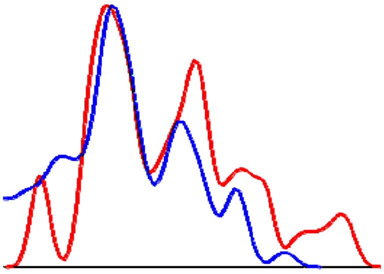

Figure 19-3-2: Full moon on February 27 and June 25, 2002 at its maximum moments. The general shape idea can also be seen here.

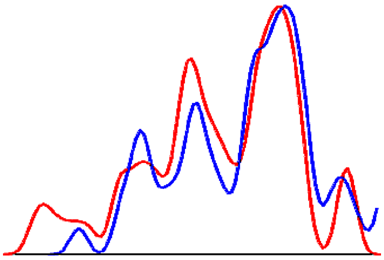

Figure 19-3-3: Full moon on February 27 at the moment of maximum and on June 25, 2002, one minute before the maximum. The shape idea is the same as for the previous figure, but with the mirroring after having identified the obvious similarity of the pair.

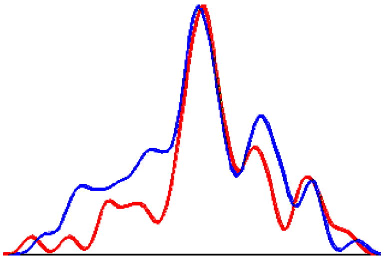

Figure 19-3-4: Full moon on February 27 one minute after the maximum and on June 25, 2002, at the moment of maximum. The shape idea for this pair is different from the idea of the previous one: it was mirrored as well. Please not that in the previous figure it was one minute before the maximum, while here it is one minute after the maximum.

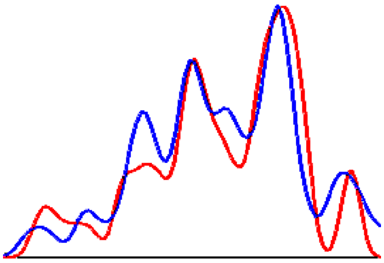

Figure 19-3-5: Full moon on February 27 and August 23, 2002, at the moments of maximum. "Clearly visible" similarity, again with mirroring. . .

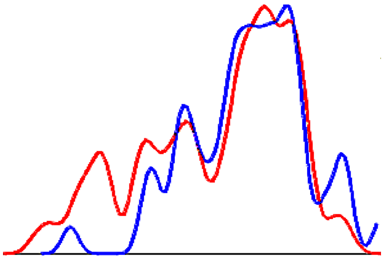

Figure 19-3-6: Full moon on January 29 at the moment of maximum and on August 23, 2002, two minutes before maximum.

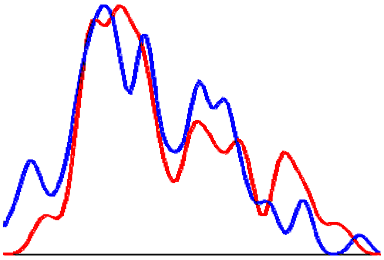

Figure 19-3-7: Full moon on January 29 and October 21 at the moments of maximum.

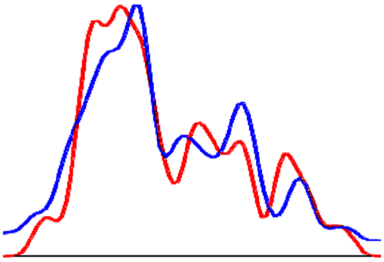

Figure 19-3-8: Full moon on January 29 and November 20, 2002, at the moments of maximum. It is clear that shape ideas of January, October and November full moon shapes are similar.

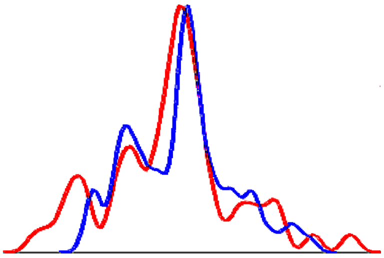

Figure 19-3-9: Full moon phases on February 27 one minute after the maximum and on May 26, two minutes after the maximum.

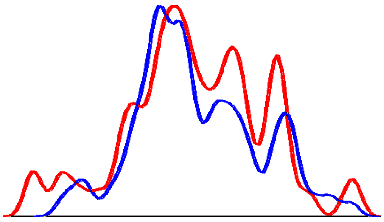

Figure 19-3-10: Full moon phases on March 28 and April 27, 2002, at the moments of maximum. The common shape is quite evident. . .

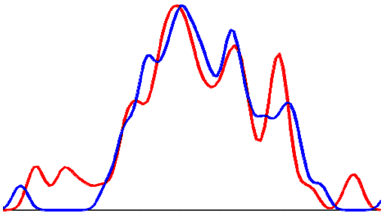

Figure 19-3-11: Full moon phases on March 28 at the moment of maximum and on May 26, 2002, one minute after the moment of maximum.

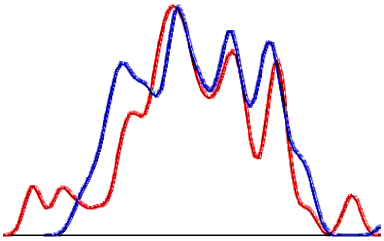

Figure 19-3-12: Full moon phases on March 28 at the moment of maximum and on June 25, 2002, one minute after the moment of maximum.

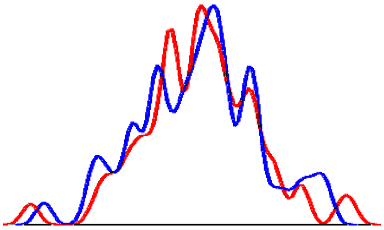

Figure 19-3-13: Full moon phases on March 28 and July 24, 2002, at the moments of maximum.

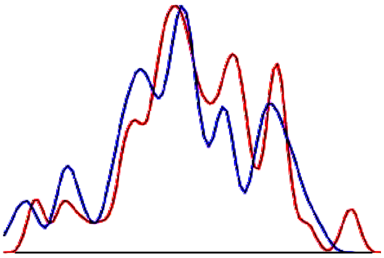

Figure 19-3-14: Full moon phases on March 28 and August 23, 2002, at the moments of maximum.

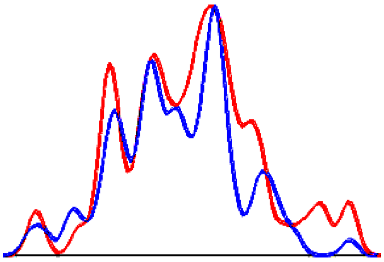

Figure 19-3-15: Full moon phases on March 28 and September 21, 2002, two minutes before the moments of maximum.

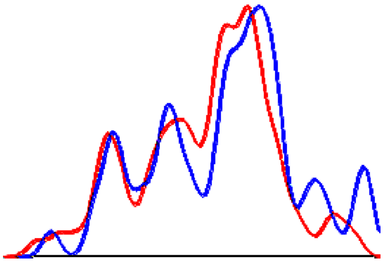

Figure 19-3-16: Full moon phases on April 27 and June 25, 2002, one minute before the moments of maximum.

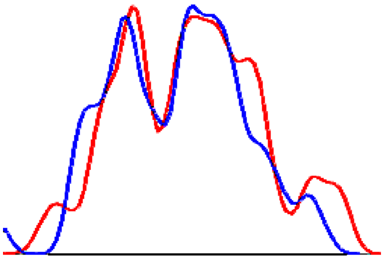

Figure 19-3-17: Full moon on April 27 and June 25, 2002, two minutes before the moments of maximum.

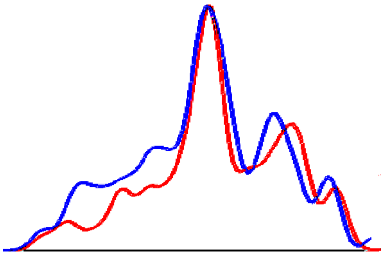

Figure 19-3-18: Full moon on May 26, two minutes later, and on June 25, 2002, one minute prior to the moments of maximum.

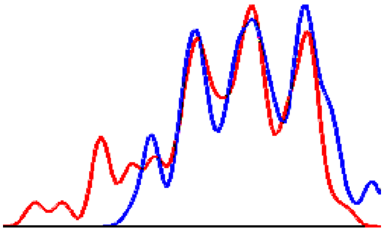

Figure 19-3-19: Full moon on May 26 and August 23, 2002, two and three minutes before the moments of maximum.

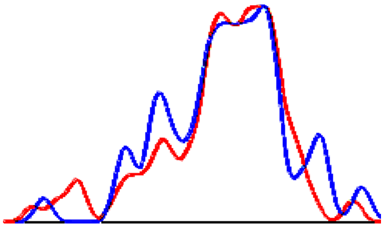

Figure 19-3-20: Full moon on July 24 at the moment of maximum and on August 23, 2002, two minutes before the moment of maximum.

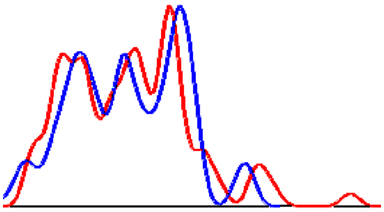

Figure 19-3-21: Full moon on July 24 and November 20, 2002, two minutes after the moments of maximum.

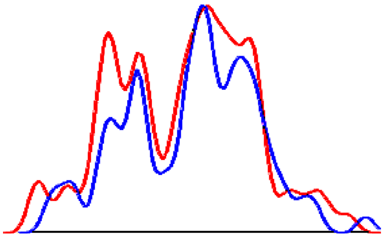

Figure 19-3-22: Full moon on July 24, three minutes after and on November 20, 2002, three minutes before the moments of maximum.

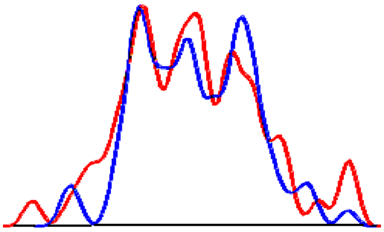

Figure 19-3-23: Full moon on August 23 and October 21, 2002, one minute after the moments of maximum.

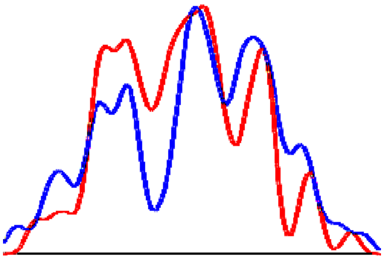

Figure 19-3-24: Full moon on September 21, 2 minutes after, and November 20, 2002, one minute after the moments of maximum.

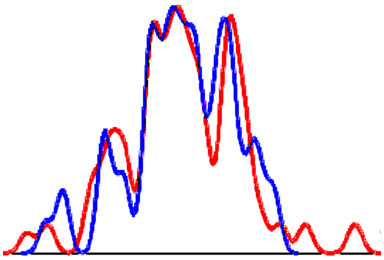

Figure 19-3-25: Full moon on October 21 and November 20, 2002, three minutes after the moments of maximum.

All 25 figures of this series display the similarity of the idea of a histogram shape when these are constructed from measurement results obtained at the moments of various full moon periods between January and November 2002. However, no single (and individually identifiable) shape typical for a full moon could be separated (in contrast to the results of the new moon). The shape similarity is quite “evidently” and “clearly” non-random. One can see that the changes in these shapes are similarly non-random. Similar shapes recur regularly in narrow time intervals “around” the full moon moment. Randomness of these patterns seems improbable. The probability of a random histogram similarity could be quantified by comparing histograms from the “full moon time”, similarly to the corresponding comparisons during “new moon-”, “rise-”, or “eclipse-” times. However, I had no desire to pursue this: the regular histogram similarity obtained from new moon periods found earlier and the “new moon time” seemed sufficient.

At the present time we find ourselves in a similar state concerning our investigations of histogram shapes during moon eclipses. We have gained some “impressions”, but there are no detailed comparisons yet. I shall leave this problem “to the offspring”.

Chapter 20.

Solar eclipses

The first part of the book recollected our measurements during the solar eclipse on July 31, 1981. More than 20 years have passed, and the techniques changed significantly. Automatic, continuous every-second measurements now enable us to obtain increasingly more definite results from our investigations of day-periods, and of dependencies from the Sun and the moon horizon locations, as well as of eclipses and other phenomena.

The first attempt to obtain measurements under these new conditions during a solar eclipse after 1981 was taken in 1989. That year a total eclipse band crossed the South: countries it passed through included the Crimea, Bulgaria and Turkey. Our Crimea and Bulgaria "expeditions" failed. In the Crimea, just at the hours of the eclipse. . . , the register appeared not to be switched on. In Bulgaria the device, a portable radiometer "Sosna", was out of order. The next full solar eclipse was expected in the territory of our country in about 200 years. . . (We had to wait for the new total solar eclipse to take place in the territory of our country for about 200 years. . .).

We did not have to wait, as it appeared! Instead, a new stimulus to look for similar effects during solar eclipses was to investigate the simultaneous recurrence of typical histograms during new moon around the entire globe.

new moon and solar eclipses are similar phenomena. The moon shields the Sun. This is new moon. When the resulting shadow reaches the Earth, it is an eclipse. We could expect an absolute identity of the effects during these times on the similarity of corresponding histogram shapes. Eclipses are rarer than times of new moon. The new moon happens every month. Solar eclipses happen, as a rule, only twice a year. Our computer archive contained records of ^{239}Pu alpha activity measurement results from the times of 9 solar eclipses only. It was the letter of my American postal colleagues, G. Vezzoli and Fr. Lukkatelli [66], that became an immediate stimulus for the analysis of how histograms would be impacted during the time of an ordinary solar eclipse.

On April 9, 2005 at 0:43 am Moscow summer time, such a solar eclipse occurred. It could be seen in the Southern hemisphere only. Now that we had gained experiences through the new moon investigations, this did not confuse me.

Table 20-1 and Fig. 20-1 present the time series sections of measurement results obtained during the solar eclipse on April 9, 2005. The measurement frequency is 1 second.

No.	Imp/s	No.	Imp/s	No.	Imp/s	No.	Imp/s	No.	Imp/s	No.	Imp/s	No.	Imp/s	No.	Imp/s	No.	Imp/s
1	304	21	252	41	**283**	61	**286**	81	**283**	101	299	121	260	141	271	161	265
2	281	22	296	42	**259**	62	**303**	82	**280**	102	271	122	268	142	291	162	267
3	271	23	291	43	**275**	63	**245**	83	**305**	103	295	123	275	143	302	163	278
4	257	24	265	44	**276**	64	**276**	84	**287**	104	267	124	267	144	281	164	260
5	265	25	241	45	**309**	65	**304**	85	**290**	105	285	125	307	145	270	165	271
6	288	26	291	46	**297**	66	**275**	86	**288**	106	270	126	254	146	242	166	280
7	276	27	259	47	**279**	67	**285**	87	**255**	107	278	127	260	147	286	167	264
8	293	28	288	48	**306**	68	**287**	88	**269**	108	298	128	278	148	287	168	258
9	274	29	269	49	**262**	69	**299**	89	298	109	311	129	297	149	273	169	263
10	286	30	275	50	**270**	70	**248**	90	294	110	268	130	289	150	252	170	270
11	279	31	313	51	**265**	71	**281**	91	269	111	290	131	275	151	297	171	264
12	270	32	336	52	**286**	72	**276**	92	284	112	290	132	294	152	258	172	316
13	274	33	**250**	53	**257**	73	**292**	93	257	113	294	133	266	153	282	173	276
14	288	34	**264**	54	**291**	74	**284**	94	300	114	297	134	280	154	261	174	298
15	269	35	**311**	55	**269**	75	**287**	95	313	115	278	135	284	155	277	175	287
16	287	36	**288**	56	**270**	76	**265**	96	270	116	290	136	244	156	254	176	274
17	296	37	**295**	57	**292**	77	**266**	97	280	117	266	137	289	157	256	177	279
18	298	38	**282**	58	**271**	78	**279**	98	300	118	259	138	264	158	268	178	280
19	264	39	**271**	59	**304**	79	**273**	99	312	119	324	139	316	159	276	179	271
20	289	40	**301**	60	**263**	80	**269**	100	299	120	304	140	266	160	288	180	276

Table 20-1: The results of measurements obtained during the solar eclipse on April 9, 2005. Number of seconds are specified; time intervals (in minutes), corresponding to the maximal eclipse moment, are in bold.

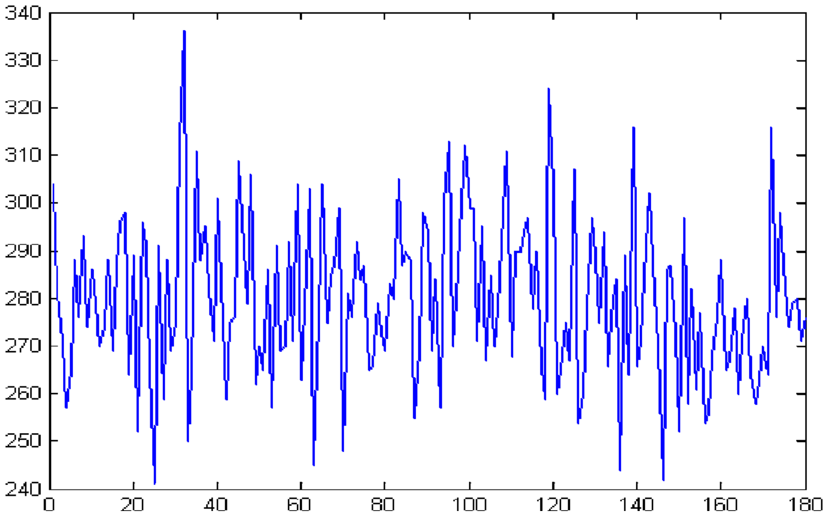

Figure 20-1: Section of the time series: the results of ^{239}Pu preparation alpha activity measurements during the solar eclipse on April 8, 2005 (0.43 am on April 9, 2005 in Moscow summer time = 11.43 pm on April 8, 2005 in Moscow winter time = 8.43 pm Greenwich time). X-axis is seconds. Y-axis is the number of impulses per second. The eclipse maximum corresponds to the interval between 31 and 90 seconds (see the above table).

We habitually look for the standard effects in the measurement results of corresponding time series immediately. Indeed, some regular changes in the radioactive decay rate related to a solar eclipse maximum can be identified. Nevertheless, it is obvious that it is hard to do with the data presented in Table 20-1 and Fig. 20-1. At the same time, as was expected, a histogram has a specific shape at an eclipse maximum. For example, Fig. 20-2 presents a part of the histograms constructed from these measurements. Each histogram is constructed from the results of 60 one-second measurements, that is, from one minute total time. The histograms are smoothed eleven times with moving averages. A histogram index corresponds to the number of minutes since the start of measurements. Histograms N 42, N 43 and N 44 correspond to the section of time series presented in Figure 20-1. The time of the eclipse maximum is followed by the histogram N 43.

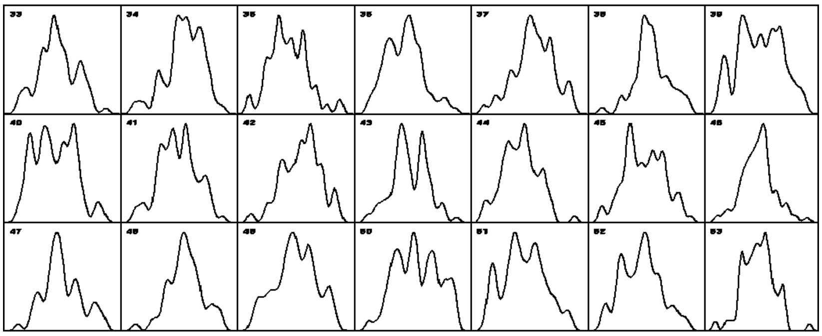

Figure 20-2: Fragment of the computer log: sequence of histograms constructed from 60 one-second measurements of a ^{239}Pu sample's alpha activity; the sample is fastened onto a semiconductor detector. Specified are the numbers of histograms in the series. The numbers correspond to the quantity of minutes since 00:00 in Moscow winter time on April 9, 2005. The shape of the one-minute histogram N 43 (at the center of the second line), constructed from results of measurements at the moment of the eclipse maximum, differs from the shapes of other histograms. X-axes are the results of measurements. Y-axes are the numbers of measurements corresponding to the resulting value range. The histograms are smoothed 11 times with moving averages.

One can see that the histogram N 43 differs strikingly from the others presented by the figure. Actually, such shapes can appear independently from an eclipse. However, here only one such shape presents itself, and it differs strikingly from the other 20 displayed in the same figure. However this is not yet a basis for considering the shape typical of an eclipse maximum.

However, and this is the most important, the "shape idea" of histogram N 43 in Fig. 20-2, occurs synchronously during the investigation of solar eclipses, for measurements of different types of processes, in different years, at different geographical points, and independently of the rate with which the eclipse at respective places takes place.

The series presented in the further figures, similar to Fig. 20-2, shows histogram series corresponding to the moments of solar eclipse maximums from investigations of different types of processes, in different years, and at different geographical points.

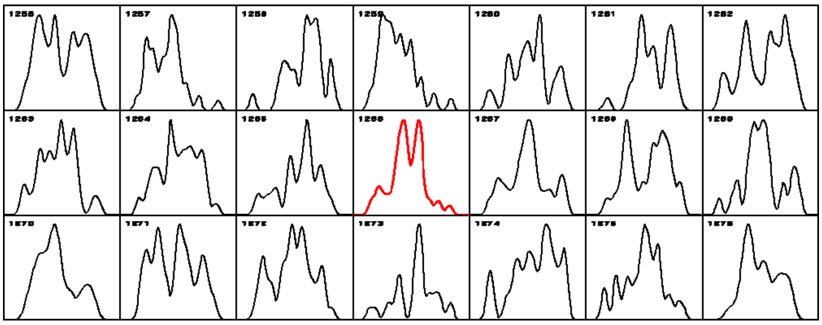

Figure 20-3: 0.5-minute histograms are constructed from ^{239}Pu alpha activity measurement results obtained with a flat detector during the solar eclipse on December 4, 2005 in Athens (38^o NL, 23.66^o EL) (V.A. Pancheluga's measurements). Eclipse on December 4, 2002. Histogram N 1266 in the center of the second line corresponds to the moment of the eclipse maximum with 0.5-minute accuracy.

The histograms in these figures are constructed from the results of ^{239}Pu samples' alpha activity measurements (Fig. 20-3 to 20-5) or from the noises of generators of the GCP (global consciousness project) system (Fig. 20-6 to 20-11) (the GCP system is described in [54] and in Chapter 23).

The central histograms occupying the second lines of each figure correspond to the moments of a solar eclipse maximum.

From these figures one can see that at moments of solar eclipses, histograms of typical shapes are observed at exactly the same time, with 0.5 to 1 minute accuracy, at different geographical points, from measurements of different types of processes.

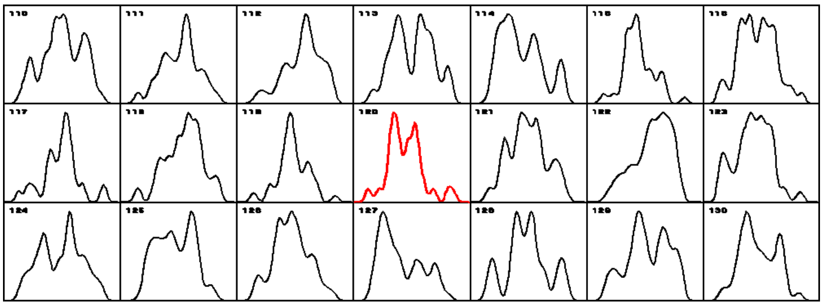

Figure 20-4: One-minute histograms are constructed from the results of ^{239}Pu alpha activity measurements with a detector with a collimator directed to the Polar Star during the solar eclipse on December 4, 2002 in Pushino (54.8^o NL, 37.6^o EL). The eclipse occurred on December 4, 2002. Histogram N 120 in the center of the second line corresponds to the moment of eclipse maximum with one minute accuracy.

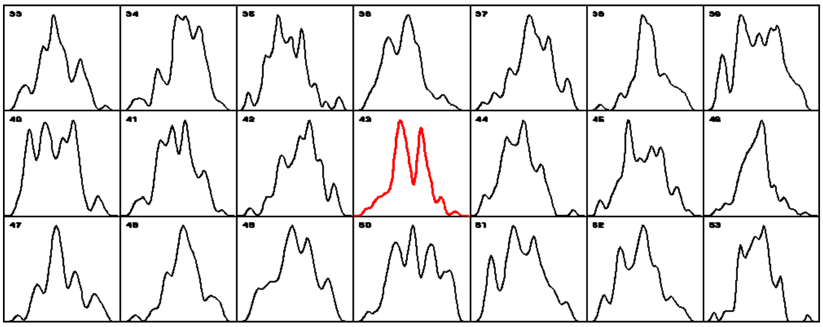

Figure 20-5: One-minute histograms constructed from results of ^{239}Pu alpha activity measurements with a detector with a Sun-directed collimator that was rotated clockwise with a rate of one rotation a day during the solar eclipse on April 9, 2005 in Pushino (54.8^o NL, 37.6^o EL). Histogram N 43 in the center of the second line corresponds to the moment of the eclipse maximum with one minute accuracy.

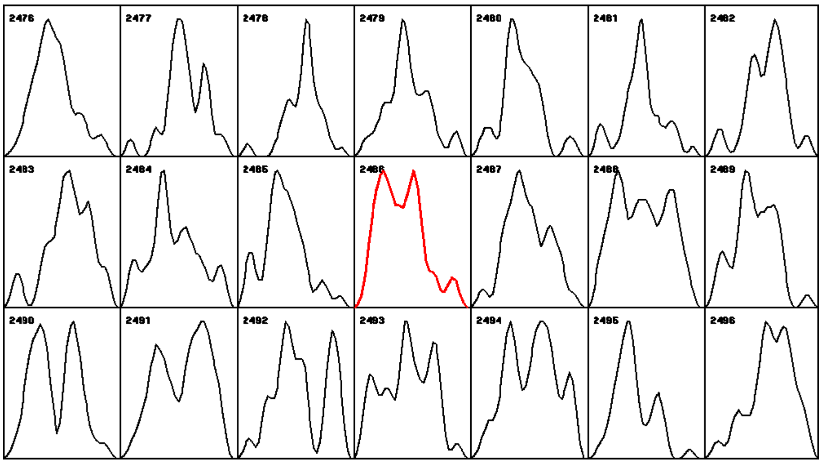

Figure 20-6: 0.5-minute histograms are constructed from measurement results of noises in the GCP generator No. 28, Princeton, NJ, USA (40.35^o NL, 74.66^o WL) during the solar eclipse on April 8, 2005. Histogram N 2486 in the center of the second line corresponds to the moment of the eclipse maximum with 0.5-minute accuracy.

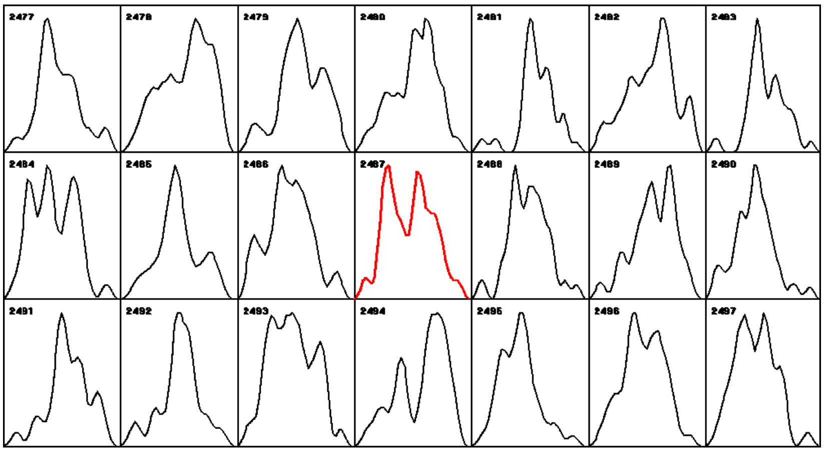

Figure 20-7: 0.5-minute histograms are constructed from the results of measurements of noises of the GCP generator No. 37 Neuchâtel, Switzerland (47.08^o NL, 7.06^o EL) during the solar eclipse on April 8, 2005. Histogram N 2487 in the center of the second line occurs 0.5 min later than the maximal eclipse moment.

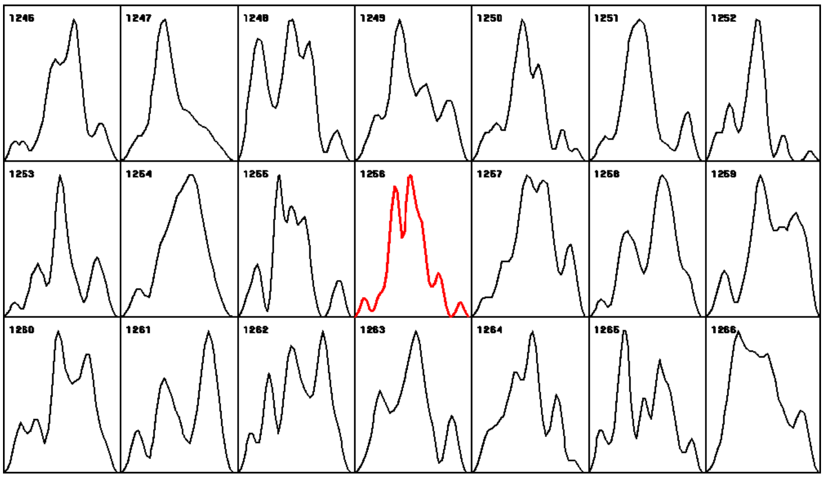

Figure 20-8: 0.5-minute histograms are constructed from the results of measurements of noises from the GCP generator No. 100, Suva, Fiji (17.75^o SL, 177.45^o EL) during the solar eclipse on October 3, 2005. Histogram N 1256 in the center of the second line corresponds to the maximal eclipse moment with 0.5-minute accuracy.

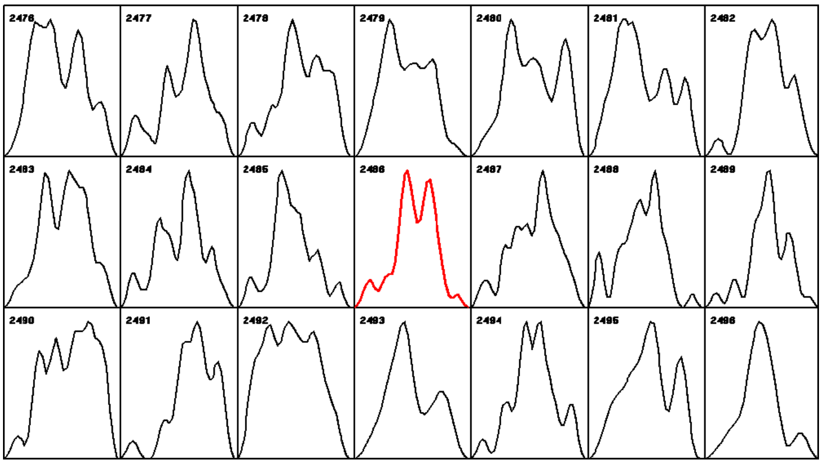

Figure 20-9: 0.5-minute histograms are constructed from results of measurements of noises of the GCP generator No. 103, San Antonio, TX, USA (29.49^o NL, 98.62^o EL) during the solar eclipse on April 8, 2005. Histogram N 2486 in the center of the second line corresponds to the moment of the eclipse maximum with 0.5-minute accuracy.

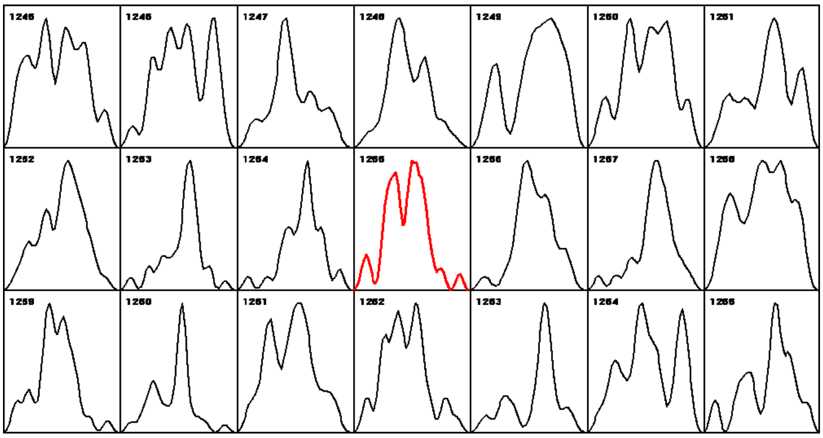

Figure 20-10: 0.5-minute histograms are constructed from the results of measurements of noises from the GCP generator No. 103, Princeton, NJ, USA (40.35^o NL, 74.66^o WL) during the solar eclipse on October 3, 2005. Histogram N 1255 in the center of the second line occurs 0.5 min earlier than the moment of the solar eclipse maximum.

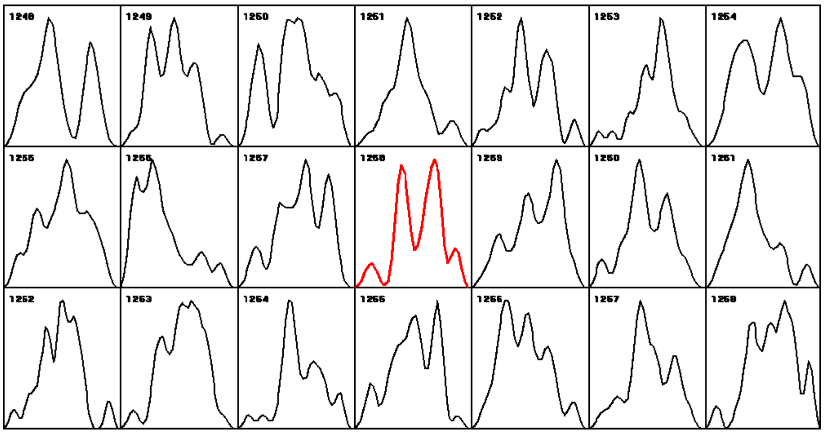

Figure 20-11: 0.5-minute histograms are constructed from measurement results of noises from the GCP generator No. 37, Neuchâtel, Switzerland (47.08^o NL, 7.06^o EL) during the solar eclipse on October 3, 2005. Histogram N 1258 in the center of the second line occurs one minute later than the moment of the eclipse maximum.

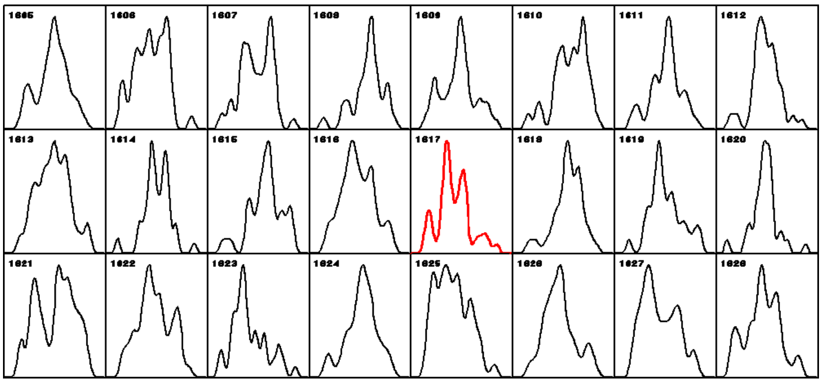

Figure 20-12: 0.5-minute histograms are constructed from results of ^{239}Pu alpha activity measurements with a flat detector during the solar eclipse on October 3, 2005 in Pushino (54.8^o NL, 37.6^o EL). Histogram N 1617 in the center of the second line corresponds to the moment of the eclipse maximum with 0.5 min accuracy.

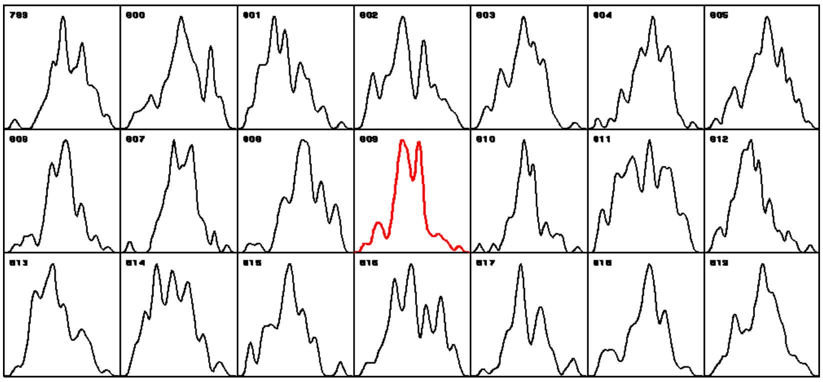

Figure 20-13: One-minute histograms are constructed from results of ^{239}Pu alpha activity measurements with a flat detector during the solar eclipse on October 3, 2005 in Pushino (54.8^o NL, 37.6^o EL). Histogram N 809 in the center of the second line occurs one minute later than the moment of the eclipse maximum.

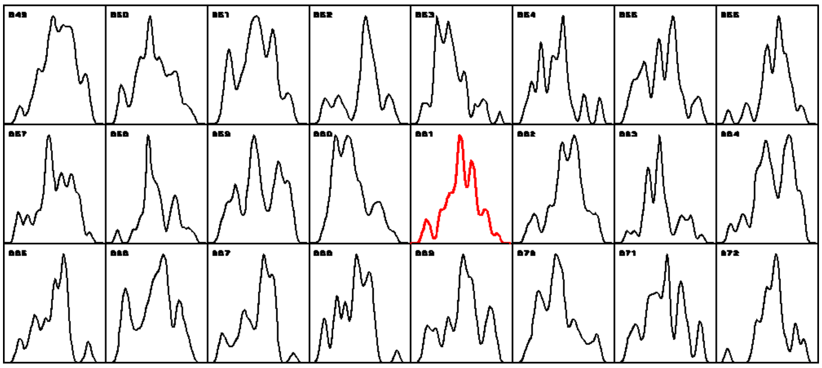

Figure 20-14: One-minute histograms are constructed from the results of ^{239}Pu alpha activity measurements with a flat detector during the solar eclipse on May 31, 2003 in the Antarctic (Novolazarevskaya st., 70^{o}02' SL, 11^{o}35' EL). Histograms N 860 and N 862, and N 861 and N 863 in the center of the second line correspond to the moment of the maximal eclipse within a ± 0.5-minute interval.

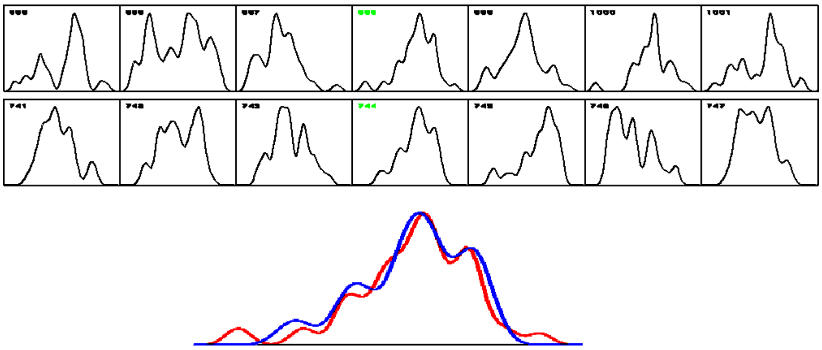

Figure 20-15: A typical "transit" shape of 0.5-minute and one-minute histograms can be observed one minute before the moment of the eclipse maximum. The top line is histograms constructed from ^{239}Pu alpha activity measurements in Pushino in the time of the solar eclipse on April 19, 2004. The second line is the same for measurements obtained during the solar eclipse on July 31, 2000. Histograms one minute before the eclipse maximum were placed into the center of the upper and second lines. Bottom: these histograms are drawn and overlapped.

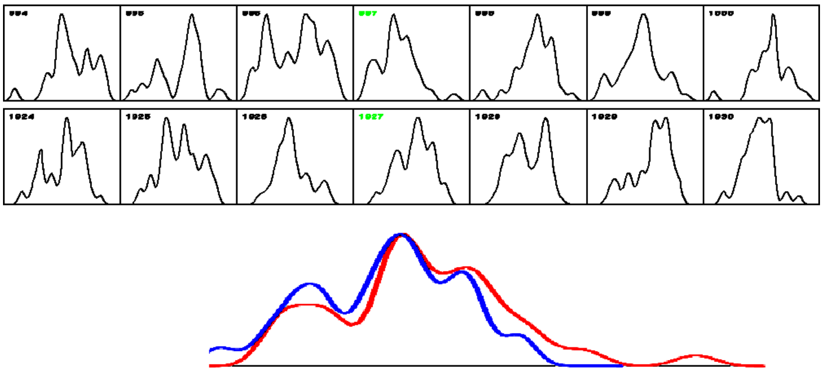

Figure 20-16: A typical “transit” shape of 0.5-minute and one-minute histograms can be observed 0.5 to 2 minutes before eclipses maximums. Measurements of ^{239}Pu alpha activity in Pushino on June 21, 2001 and on April 19, 2004. Legend is the same as in Fig. 20-15.

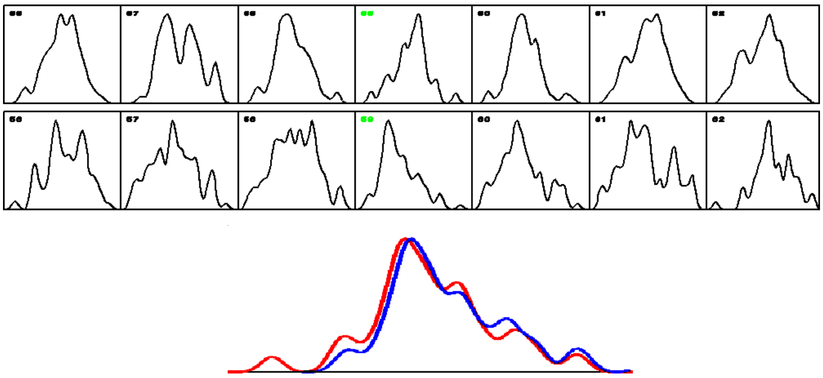

Figure 20-17: Typical “transit” shape of one-minute histograms can be observed one minute before the time of an eclipse maximum both on December 4, 2002, and on November 24, 2003. Measurements of ^{239}Pu alpha activity in Pushino with a counter with the collimator directed to the Polar Star.

Besides the histograms with a "main eclipse shape", other less probable but typical shapes are observed close to an eclipse maximum. Some examples of such shapes are presented in Figures 20-15 to 20-17. Identifying such "transit" shapes is harder than registering a "main eclipse shape".

First of all, it is essential that a certain histogram shape is related with a certain physical phenomenon. This as such is a peculiar observation...

Gravity changes during periods of new moon and eclipses are relatively slow: they occur with about ten minute periods. Typical histograms can be observed at the scale of about the order of minutes to tens of a second. This is more similar to the crossing of the moon and some anisotropic flows coming from the Sun.

In 1992 R.A. Gulyayev and N.L. Gulyayeva published an article: "A possible non-gravity mechanism of effects of the moon on biological processes" [68]. The authors state that during each new moon, "the moon, like a non-transparent damper, closes a flow of solar wind, creating a sort of 'corpuscular shadow' ". "...when such a shadow falls onto a surface of the magnetosphere, that is turned to the Sun, the pressure of the solar wind at the appropriate place (under the shadow) vanishes, naturally...a magnetic perturbance, moving together with a corpuscular shadow movement by the surface of the magnetosphere should occur.... The corpuscular shadow creeps onto the surface of the magnetosphere from the West about a day before the new moon moment; a day after new moon, a shadow changes over from the magnetosphere surface on the East side.... Effects of a corpuscular eclipse on the Earth may be only secondary, and they may be related with the eclipse effects in the magnetosphere.... Furthermore, effects on the Earth can be expected not only in the place located at an extension (or projection) of a corpuscular shadow, but also at all other locations...it is not at all straightforward that the corpuscular shadow projection lies on the Earth surface...for a magnetosphere, the transversal dimensions of which are 10 times higher than the dimensions of the globe, each new moon is followed both by an optical and a corpuscular eclipse...such effects must be observed not only during times of eclipses, but for each new moon phase.

This idea is very interesting. However, as mentioned earlier, the times of the effects are disproportional. We can see that all over the Earth typical histograms occur simultaneously with about one minute accuracy. How is the flow changed by a "damper"? From all the available and numerous data it follows that a sharp spatial anisotropy is the central point. In what way this anisotropy is related with the shape of histograms constructed from measurements of any type of process: from noises obtained with physical noise generators to alpha decay?

Chapter 21.

Evection

It seems to me that someday my attempts to find regularities in changes of histogram shapes related with changes of the collocation of the Earth, the moon and the Sun will seem naïve. And actually, they really are. An image persists in the back of my mind, of a blind man making his way down a lively street of a modern town. I imagine being this man. Slightly knocking the surrounding things with my white stick and listening attentively, I try to find a pedestrian subway on my way to the park.... But then I run into a newspaper kiosk, and into people waiting for a trolley-bus and I also stumble across a paled spot where the asphalt is in the process of being repaired. And there is nobody who can help me. I am in an unknown country with unknown customs. Is there anybody to guide me...?

To me, the shapes of histograms seemed to be related with the position of the Sun and the moon on the horizon. For many years (I use this time scale, measuring time in units of decades...) I have tried to find some typical shapes. I succeeded in finding many reliably similar pairs. However, I failed to find an ultimate relation between these shapes and the positions of the Sun and the moon. The idea that such a relation may stem from gravitational causes is absurd "from the viewpoint held by modern science". Gravity effects are extremely weak, and in our experiments we deal with alpha decay or with chemical reactions.... Propositions about electromagnetic fields are a bit easier to formulate: they are "bordering with pseudo-science" as well, but are not quite as strange. Furthermore, a lot of dissidents to science look for the occurrence of correlations between changes in the electromagnetic field characteristics and changes in the properties of biological and chemical processes. Long live the pioneering dissidents! However, gravity is a bit too heavy, the supposition goes a bit too far.

Sincerely speaking: I failed to find tidal rhythms (maybe I was just not doing my best?). So where are the explanations for the multiple and evidently nonrandom coincidences of peculiarities of histogram shapes, which display complex patterns in different years at the moments of similar positions on the horizon of the Sun and the moon? Also, by no means could typical shapes of histograms in the short moments of a new moon and during solar eclipses be explained by gravity effects. I did not yet investigate lunar eclipses. I conjecture that the main reason for this gap in the possible explanations is due to the primitiveness of my concepts on the nature of gravity effects. What if the issue is the second derivative of gravity changes? Is there anybody to take me by the hand and lead me to the park, to where the silence is only broken by rustling leaves and noises from waterfalls?

Our symposia on cosmophophysical effects in biological and physicochemical processes (Pushino, 1983, 1990, 1993, 1996 and 2004) were very fruitful, One of the most essential results for me was meeting researchers from Leningrad (Saint Petersburg) from the Arctic and Antarctic Research Institute (AARI). There was a concentration of outstanding persons at the laboratory of Oleg Alexandrovich Troshin: Eduard Stepanovich Gorshkov, Victor Vladimirovich Sokolovsky, Sergey Nikolayevich Shapovalov, Makarevich, Ivanov. We are much obliged to them for the resulting cooperation, which was mentioned in the book many times. They are heroes that participated repeatedly in Polar expeditions and in several winterings in the Arctic and Antarctic. S.N. Shapovalov measured the alpha activity along with solving his own problems with the aid of I.A. Rubinstein counters during the Arctic expedition in 2000, and during long winterings in the Antarctic. These measurements provided us with invaluable material. However, at this point I want to specially refer to the following absolutely original investigations of these authors [69-75].

Each of us knows that the regularities of the collocation of the moon, the Sun and the Earth are extremely complex. We know that the moon equations of motion include about 900 terms. We do not make attempts to investigate this because it is known. Therefore, looking for any kind of correlations with the moon position, we limit ourselves to the following "evidence": rises, sets, new moon, full moon, eclipses. I did the same, as one can see from the aforementioned. Furthermore, I managed to find some regularities. For example, changes of histogram shapes in correlation with the time of the "new moon".

Some moon-related terms that I did not know earlier appeared in reports of our symposia and in articles of the Arctic-Antarctic authors: "evection, variation, year disparity". First I thought that all of them were created by a professional astrophysicist, S.N. Shapovalov. It appeared that evection was discovered by Ptolemy, and variations and year disparities by Tiho Brage and Newton.... Formerly, it was called the moon's second anomaly. Shapovalov's thesis presents a brief and clear description of these phenomena [76]. I borrow (with the author's permission) the description of these phenomena with minor adaptations to the original text:

All three of these terms relate to the initial conditions of the terms in the moon equation. They reflect regularities in changes of the moon movement, which is mainly caused by the gravity effect of the Sun. The terms in the equation characterizing the moon deviations from the uniform movement with a constant angle rate are referred to as *disparities*. From the first five disparities, the terms with 6.289^o and 0.214^o coefficients comprise an eccentricity of an unperturbed (Keplerian) orbit, and those with 1.274^o (evection), 0.658^o (variation) and 0.186^o (year disparity) coefficients – with solar perturbations...

Evection is the most essential deviation from the laws of Johann Kepler of the apparent motion of the moon caused by the Sun effect. In other words, from evection follows a periodic change of the shape of the moon orbit, that is, an increase and decrease of the moon orbit eccentricity. An evection period equals 31.81194 days... The effect is provided by the Sun's gravity effect on the moon...

Variation was discovered by Tiho Brage, and explained by Isaac Newton in his "Principia". A variation period equals half a synodical month: 14.8 days. In the theory of moon motion, the *"variation"* term relates to the term $0.658^o \sin(2D)$ in equation 1.1, where D is the (mean) elongation, or the mean angular distance of the Moon from the Sun. This term, similar to evection, is caused by the Sun gravity effect on the moon...

Year disparity (discovered by Tiho Brage) is a periodical change of the average moon motion with a period equal to one year. The year disparity implies that the real moon is slower than average in the period between January 2 and July 2, and faster than average between July 2 and January 2. In equation 1.1, the year disparity corresponds to the term $0.186^o \sin(L)$, where L is the moon's mean anomaly, that is the mean angular distance of the moon from its perigee.

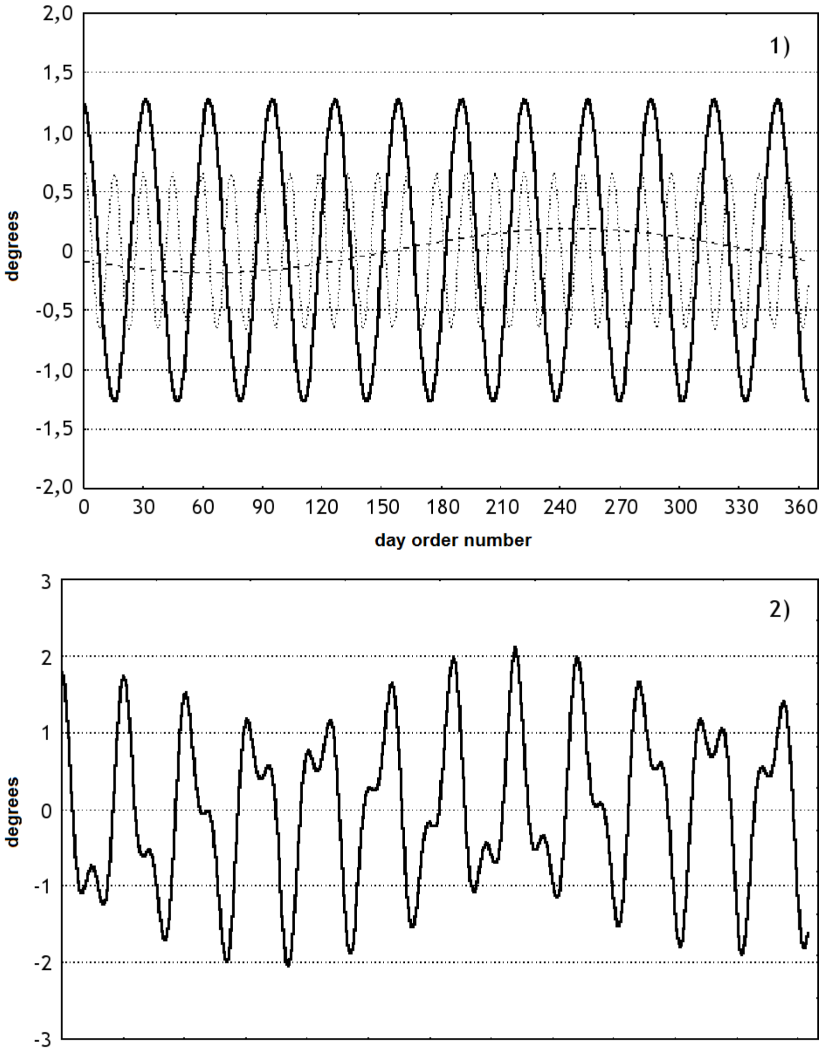

Figure 21-1: The main solar perturbances in the true geocentric ecliptic moon longitude for the period July 17, 1996 to May 31, 1996 (by [76]); 1) the line is evection, dots are variation, dotted line is year disparity; 2) the sum of angles of evection, variation and of the year disparity.

Figure 21-1 presents

1. the temporary angle change during evection, the variation and year disparities in the period between January 1, 2001 and December 31, 2002;
2. λ, the angle increase of that same period, calculated by the program for processing the perturbed disparities of the moon's true geocentric ecliptic longitude.

All this would not especially attract my attention, even though it was new to me. There were surprising results of investigations obtained by this group. They revealed a close correlation between a series of physical, physico-chemical and biological processes and these characteristics of the moon motion. Here is only one example of such a type of correlation [72].

From Fig. 21-2 one can discern a correlation between changes in the blood hemoglobin content and deviations of the moon motion and the Keplerian orbit. Similar patterns were obtained for the unithiol oxidation rate (V.V. Sokolovsky's techniques), the rate of erythrocyte sedimentation, "computer time" fluctuations, and some other indices (see [72]). Naturally, the customary exclamation can be heard: "But, why do erythrocytes care about small (of the order of 1^o) deviations of the moon motion from the orbit expected by Kepler?"

It is especially remarkable that correlations of the evection and variation are absolutely unrelated with the new and full moon times. This can be seen from Fig. 21-3, where new moon moments are plotted in the λ graph with black circles.

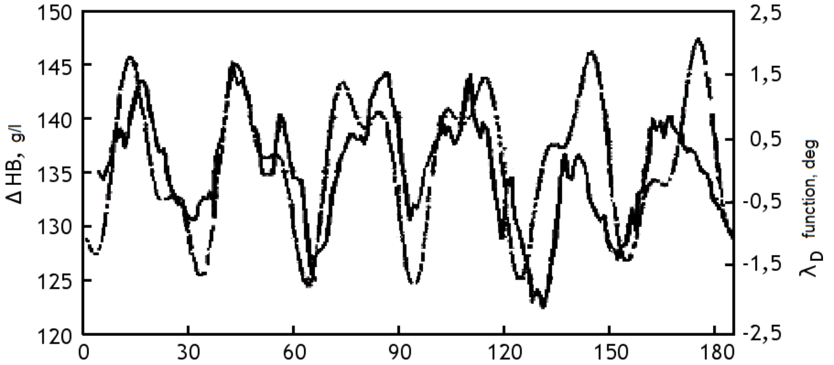

Figure 21-2: Changes of blood hemoglobin content (in the blood of the investigator) from daily measurements between June 1 and October 31, 2002 under conditions of the Antarctic expedition compared to changes in λ [71].

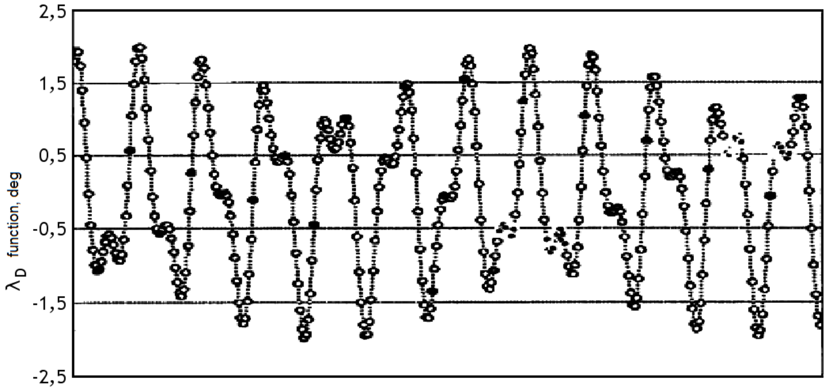

Figure 21-3: New and full moon moments do not coincide with λ minimums and maximums, which are provided by evection and variation (Sokolovski et al., January 01, 2002 to January 01, 2003 [77]).

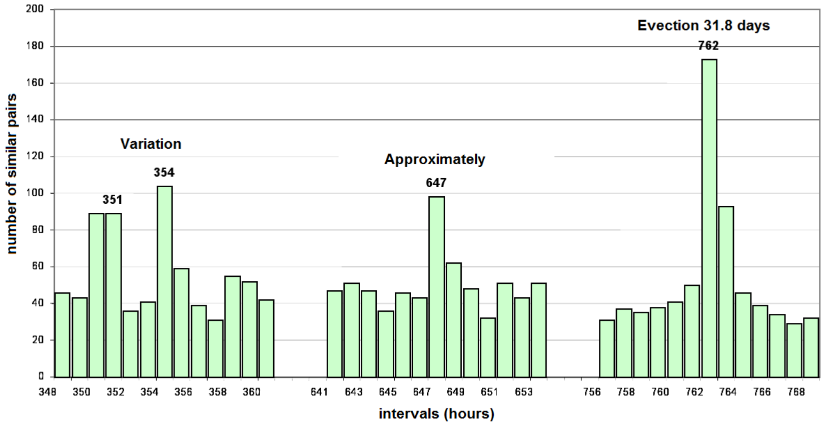

Figure 21-4: Similar histograms occur with periods corresponding to those of 1) variation, 2) 27 days, and 3) evection.

The “influence” of S.N. Shapovalov led me to conduct searches of periods in histogram changes in the ranges of evection and variation periods. The result of the search is displayed in Fig. 21-4.

The search for the periods utilized a number of results of continuous every-second measurements of ^{239}Pu alpha activity, made from May 26, 2005 to the end of the year with an I.A. Rubinstein counter. Series of one-minute (from 60 one-second results) and one-hour (from 60 one-minute results) histograms were constructed from these results. I looked for the periods in the ranges of the anticipated periods, namely for ranges of expected periods of evection (762 ± 6 hours, or about 31 days); 648 ± 6 hours (27 days), and of variation: 355 ± 6 hours (about 15 days). Resulting from two large experiments, we constructed the distribution of the numbers of (one-hour) similar histogram pairs by the time-intervals (periods) separating them. This is presented at Fig. 21-4.

All expected periods are shown in the figure. However, the period corresponding to evection is much more pronounced. Formerly (see Chapter 9), I looked for close to 27 day periods and found them many times. It was very important because the presence of the period assisted in determining regularities of the collocation and state of the Sun, the moon and the Earth. A close to 14 day period also occurred many times in our investigations. For this experiment the periods were reliably "split". All three groups of periods were constructed in the same way, from histogram comparisons and by the same "expert" (myself). Hence they may serve as mutual controls of their reliability. Such a pronounced occurrence of the evection period

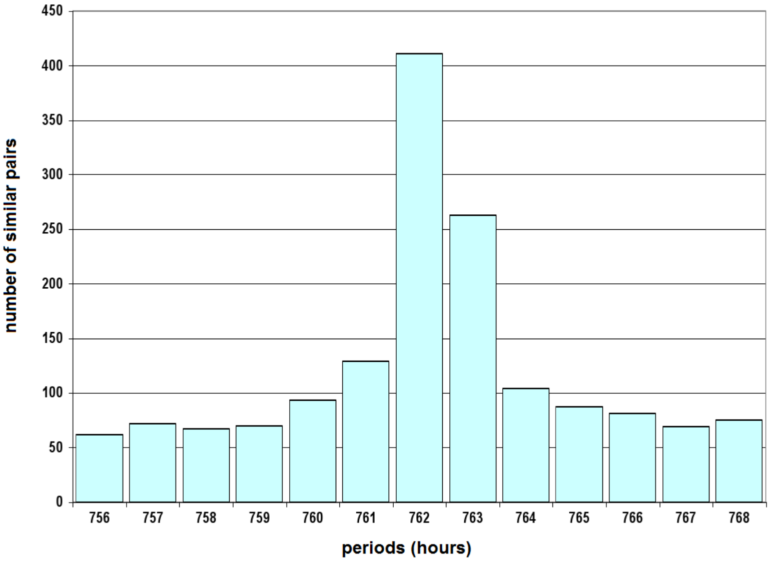

Figure 21-5: Total result of the determination of the evection period from the comparison of one-hour histograms.

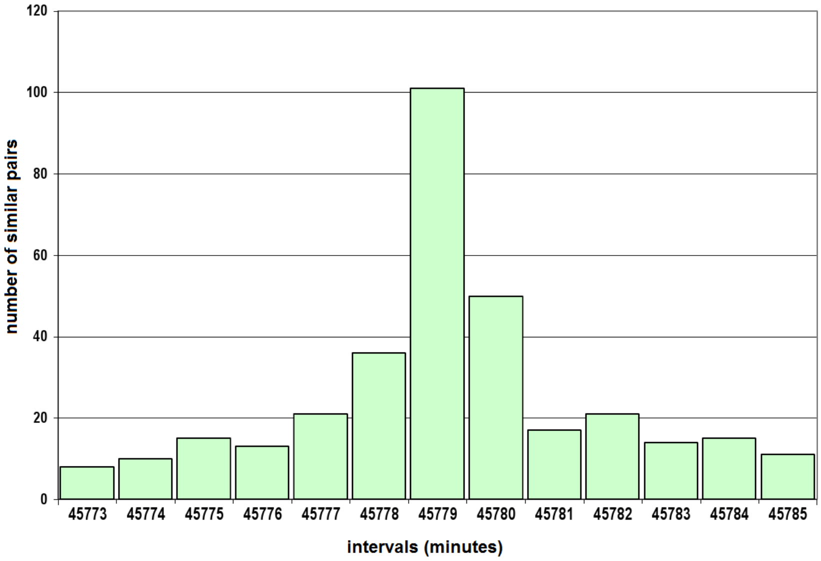

Figure 21-6: Determination of an evection period with one-minute accuracy.

impressed me quite a lot. "Had I made the correct steps earlier,. . . I would have found an evection period long ago. . . ." With multiple repetitions an evection period was now determined for periods of up to one minute.

Even though the occurrence of the evection period was quite convincing, I again made a series of similar searches for this period. Fig. 21-5 presents the final result of five corresponding experiments from thorough comparisons of one-hour histograms.

In Fig. 21-6 an evection period was determined with at a resolution of one minute (45,779 minutes = 31.79 days).

In this figure, similar to previous observations, the extreme narrowness is especially impressive. Evection is a relatively slow process with a 31.8 day period. Naturally, almost no manifestations of evection, or a distortion of the regular Keplerian orbit, can take place in one (of 45,779) minute. However, how can such a sharp extreme be explained? Maybe there is no way that it can? Similar to the occurrence of a typical histogram shape within the 0.5-minute interval of a solar eclipse maximum or in the 5-minute interval of a new moon, or the splitting of a close to one day-period into a stellar (1,436 minutes) and a solar (1,440 minutes) period, as well as the "Kharakoz paradox", all cannot be explained at present (see Chapter 13). The paradoxes do confuse me, and because of this I checked once again:

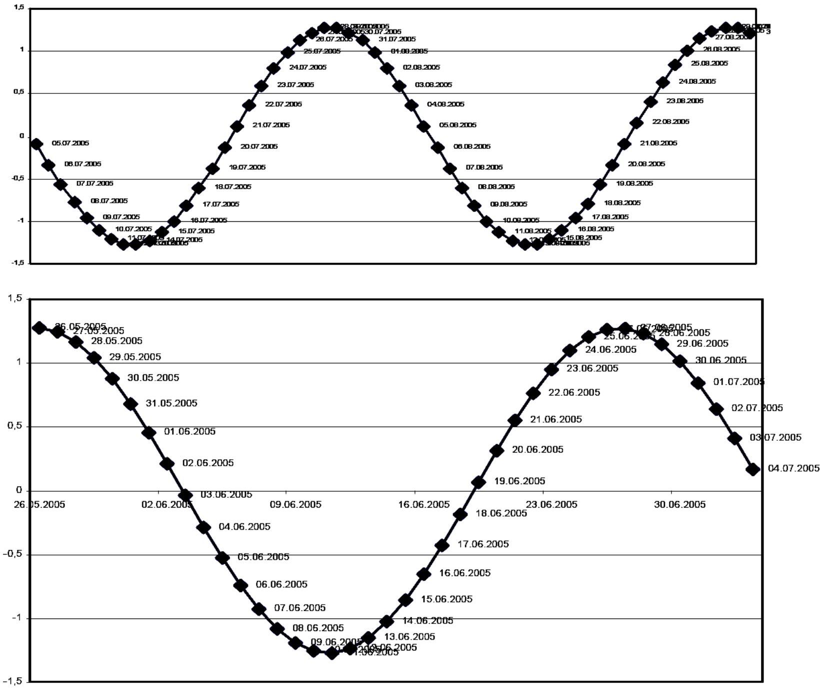

Figure 21-7: Evection phenomenon: periodical change of the distortion rate of the moon Keplerian orbit between July and August 2005. Evection maximums: May 26, June 26, July 27, August 28-29, September 29-30, November 1, December 2, minimums: June 10, July 11–12, August 12–13, September 13–14, October 15–16, November 16, 2005.

whether these paradoxical phenomena are not the results of a bias from the expert comparison. Each time I become more certain that the bias is neither present, nor should it be the main source of concern.

It is not an easy problem: to explain the presence of an evection period in the changes of histogram shapes by changes of gravity forces. This is hard, as the most real gravity effects should be caused by high tides. However, high and low tide periods do not show in the changes of histogram shapes (or let me state more accurately: "we failed to reveal them"?).

When the palindrome phenomena were discovered in 2008 (see Chapter 22), it seemed interesting to me to see whether the "forward" and "backward" halves of the cycle form a palindrome? S.N. Shapovalov provided me with the numerical characteristics of evection cycles corresponding to the dates of ^{239}Pu alpha activity measurements in 2005 (see Fig. 21-7).

According to these charts, I constructed a series of histograms from alpha activity measurements. The series were separated into odd corresponding to the first halves of evection (that is, 381.6 hours or, more accurately, 22,896 minutes). Furthermore, they all corresponded to periods from the second halves. Then I compared one-hour histograms in a pairwise manner: odd halves with even halves. Here, the odd series included two types: those straight and those inverted. The order of histograms of the inverted series was inverted. The result was quite clear: when comparing a straight odd series with an inverted even one, we found that histograms with the same numbers in a successive series were much more likely to be similar. From comparing an odd histogram series with histograms of an even series without inversion, we found that a similarity was less likely. The similarity of straight and inverted series and the palindrome effect are reviewed in detail in Chapter 22. The illustration of a palindrome effect for evection is presented in Fig. 21-8. The figure summarizes the results of four experiments (four periods of evection) from measurements obtained between May 26 and October 1, 2005. Curve N 1 is the result of four pairs of the comparison of histogram series: straight odd semi-periods with inverted pairwise even semi-periods; the distinct palindrome, the high peak corresponding to the coincidence of straight and opposite histogram numbers can be seen. Curve N 2 is the same series of histograms but without inversions: obtaining a similarity of histograms with the same number is improbable. In the chapter titled "Palindromes", I emphasize especially an essential advantage in the method of such kinds of experiments. I compare the same histograms. The result only depends on the order of their positions. That is, one curve is a methodical control of the other.

What does this result mean? A palindrome effect means that in the second half of a period, histogram shapes repeat in a similar order as those that had passed earlier in the opposite order. Similar to the well known example that is described by the sentence "So many dynamos!", the sequence of letters (and the histogram sequence) can equally be read from left to right as well as in the opposite direction of the letters. In our case a palindrome effect means that the shapes of histograms passed in the first half of a period are essentially unchanged when we look at them moving in the opposite direction across the sequence. It is not clear how "sharp" the returning point is that we determined here. I have no accurate (hours, minutes...) data on a period or a moment of the evection maximum. What do forward and backward sequences for evection mean? The same goes for the distortion of the moon Keplerian orbit: what does this imply for us? Furthermore, what does the stability of histogram shapes corresponding to

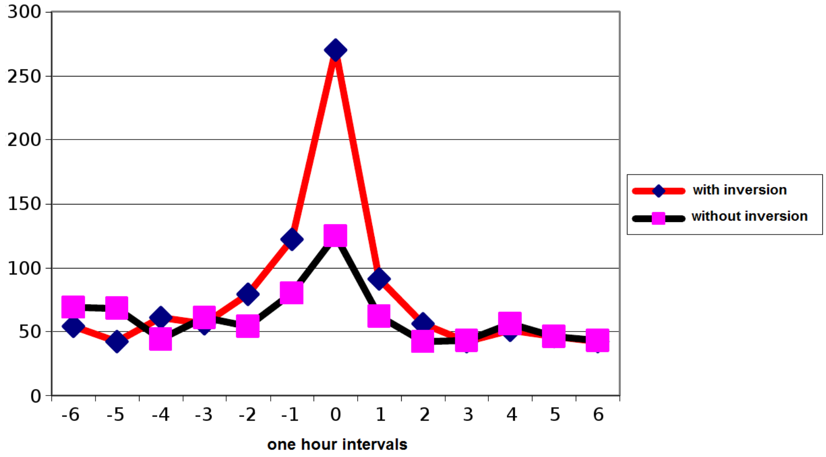

Figure 21-8: Palindrome effect during evection. (Explanations are provided in the text).

a cycle phase (with different signs) that lasts for several months mean? Assuming that histogram shapes are determined by an apparently quite large number of factors, the palindrome during evection seems extremely mysterious. (However, not much more than other phenomena...). Testaments of Socrates and of Nikolay Kuzansky especially, are very appropriate to such a situation...approaching a situation with "genuine ignorance".

Chapter 22.

The palindrome effect. – "So many dynamos!"

In April, 2004 Stanislav Valeryevich Polozov, a rather young man, proposed the following to me: "to look whether some regularity in the half-a-year similarity of histogram shapes existed". He based this claim on the idea, that if a unidirectional "ethereal wind", or similarly, a motion in separate directions, for example, compared to the movement of the Solar system towards "the Hercules" exists, the spring and autumn circumsolar motions of the Earth will move in the opposite direction. Thus, for example, in autumn, the rate of the autumn circumsolar movement would be added to the rate of the "ethereal wind", and in spring time, it would be subtracted. Is it possible that this circumstance is reflected in the shapes of my histogram series?

The idea seemed interesting to me. Even without S.V. Polozov's suggestion, I myself had tried to find some regularities with half a year periods during my detailed investigations of year periods. And I found a plethora of regularities.... However, S.V. Polozov provided a new stimulus, and I conducted a large (difficult as usual) series of experiments from March and September 2002, comparing histograms (of ^{239}Pu alpha activity). I compared one-hour histograms by overlapping the histogram series with a time distance of half a year, starting out from midnight on the respective dates. There was an indication, or "hint" of similarity between histograms shifted by 12 hours, and even more accurately: from the comparison of one-minute histograms of "symmetrical" dates (in opposite positions in the year) in March and September, namely a time distance between similar histograms of 718 to 720 minutes.... It meant quite a lot of work. The results were inconclusive. S.V. Polozov, being a qualified programmer, was going to create a program for the computer to compare histograms: naturally, he did not want to compare them visually, "by eye".... His program failed. He had lost interest in the idea, I suppose, and he "disappeared from the scene".

Then I continued my thoughts about the correlation between histogram similarity and the date from where the measurements for the histogram sequences were retrieved. My reasoning was as follows (April 19, 2004):

1. There is a constant rate of ethereal wind or, equivalently, a constant rate in the movement of the Solar system towards Hercules or Leo, to pick an example for possible points of reference for this relative direction. This is $\mathbf{V_{eff}}$.

2. We also find a unidirectional rate in the movement of the Earth around its circumsolar orbit $= \mathbf{V_s}$.
3. We have the Earth axial rotation rate $= \mathbf{V_z}$. In one half of the year, at opposite parts of the circumsolar orbit, for simplicity:
   (a) the total rate **in March during daytime** is
   $\sum = \mathbf{V_{eff}} + \mathbf{V_s} - \mathbf{V_{zi}}$
   (b) the total rate **during the nighttime** is
   $\sum = \mathbf{V_{eff}} + \mathbf{V_s} + \mathbf{V_{zi}}$
   (c) **in September during daytime**, the total rate is
   $\sum = \mathbf{V_{eff}} - \mathbf{V_s} + \mathbf{V_{zi}}$
   (d) **for the nighttime**, the total rate is
   $\sum = \mathbf{V_{eff}} - \mathbf{V_s} - \mathbf{V_{zi}}$

   One can see that the differences between the rates become maximal when the March nighttime is compared to the September nighttime.

Several years passed. I can recall a lot of reasons that hampered the further elaboration of this thinking and these experiments. One of them was tragic, the sudden death of A.A. Konradov (on May 18, 2004) and the simultaneous starting of measurement series with rotating collimators. This series (obtained between May 29 and October, 2004) produced remarkable results. From this followed euphoric emotions that were stirred in consequence to my report at V.L. Ginzburg's workshop (on October 24, 2004), which was organized especially at my request. All of this put all other lines of investigations aside for a long time.

The "psychology of science" is quite interesting. "Actually", the mere statement of the problem proposed by S.V. Polozov contained nothing new for me. The influence of spatial directions on our results had been of interest to me already long ago. I studied a paper of Dayton Miller, who had continued the Michelson–Morley experiments on the determination of the speed of light in experiments with an interferometer. I knew that the papers of this author contained a number of important contributions and this work convinced me. It proves the imperfections of Makelson's measurements, basing their conclusion on the constancy of the speed of light. Never did I presume myself to be competent enough to join opponents of the Relativity Theory [77-84]. However, I do believe that the detailed investigations of fluctuations within their appropriate scope, together with considerations of the real presence of separate spatial directions, could be largely significant scientifically. The belief was supported by a series of works of K.A. Trukhanov [85-87], Yu.A. Baurov [88-95], R.T. Cahill [80-82]

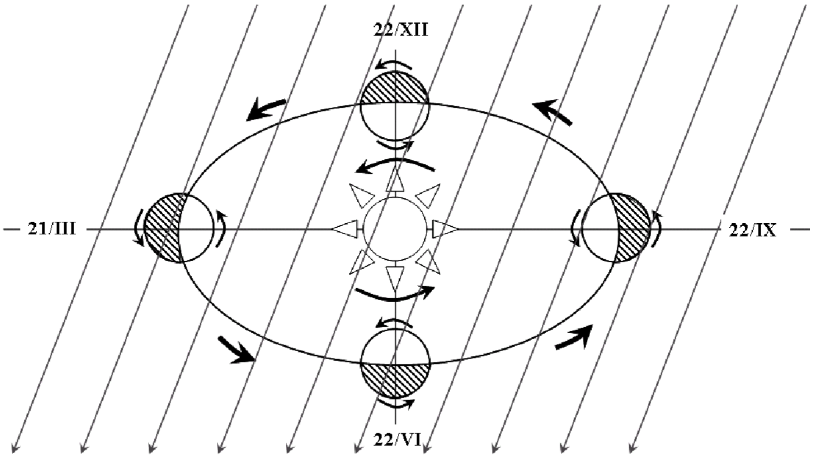

Figure 22-1: Movements of the Earth, the Sun and the solar system in the galaxy.

and De Witte [83], which provided experimental and theoretical justifications of the idea of spatial anisotropy. Nevertheless, the fleeting visit of S.V. Polozov delivered a new stimulus to our laboratory.

I returned to these problems "predominantly"in the autumn of 2007. Daily discussions with M.N. Kondrashova and weekly discussions with colleagues at our laboratory workshops were especially valuable during this return. The main result of the discussions is the determination of "daytime" and of "nighttime".

The sketch displayed in Fig. 22-1 presents co-movements in various directions of the "Sun – Earth" system in separate directions relative to the movement of the whole solar system (for example, towards Virgo or Leo).

The center of the sketch displays the Sun rotating counterclockwise with a close to 27-day period. The yearly path of the Earth around its circumsolar orbit is also in a counterclockwise direction. Daytime on one side of the Earth means that the Earth faces the Sun. The opposite side corresponds to nighttime. The Earth rotates around its axis, counterclockwise. The equinoctial line crosses the sketch. Arrows from top to bottom indicate the conventional direction of the Solar system in the Galaxy.

From the figure we can see:

1. During "daytime" ("light-time"), the Earth axial rotation has one direction, and its circumsolar rotation is opposed to the rotation of the Sun. During "nighttime" ("dark-time"), the directions of the

Earth axial rotation and the circumsolar rotation are the same as that of the Sun rotation.

2. Circumsolar rotations of the Earth have the following half-a year correlation: its "light-time" direction at the one end of the circumsolar orbit is opposite to the "light-time" direction, and the same as the "dark-time" direction at the other one. That is: the rotation during the "light-time" on March 21 is opposite to the "light-time" on September 21, and the same as the "night-time" rotation on September 21 (the same applies to the June 22 and December 22 pair).
3. From this follows that the "daytime" in any season should be the time between 6 am and 6 pm of the accurate local time. "Nighttime" is the time between 6 pm and 6 am of the next day.
4. If we take the direction of the Solar system in the Galaxy, presented in the figure, on March 21 (spring equinoxes) during nighttime, the Earth axial and circumsolar rotations are "co-directed" with the movement of the Solar system. On September 22 during nighttime, the Earth axial and circumsolar rotations are "counter-directed" with the movement of the Solar system. Actual correlations amongst these directions depend on the experimental determination of the direction of the movement of the Solar system relative to the "equinoctial lines". Yu. A. Baurov's work may be especially important in this context [88–95].
5. Correlations between the directions of the Earth rotation and of the rotation of the Sun need some special analysis. These obviously manifest as the close to 27-day periodicity.
6. The sketch does not consider the moon's rotation around the Earth. Incorporating this might make the correlations too complex.

All this reasoning was built from the assumption that the **rates of motion** of an investigated object determine histogram shapes. There were no real grounds for this assumption. The rate of the Earth axial rotation is almost 100 times less than the rate of its circumsolar orbital rotation. Therefore, the effect of a one percent change in the total rate of change of histogram shapes may not be worth highlighting. However, the **correlation of the direction** changes of the movement at 6 am and at 6 pm sharply may well be; note that it is the sign of this correlation that changes. For these directional changes, the regions of space covered before a change in the sign are covered again by a "backward" motion. The "real" backward motion is caused by a switch from daytime to nighttime, and does not cover the same regions in space: the Earth moves around its circumsolar orbit. Only through experimenting can we clarify whether this is essential.

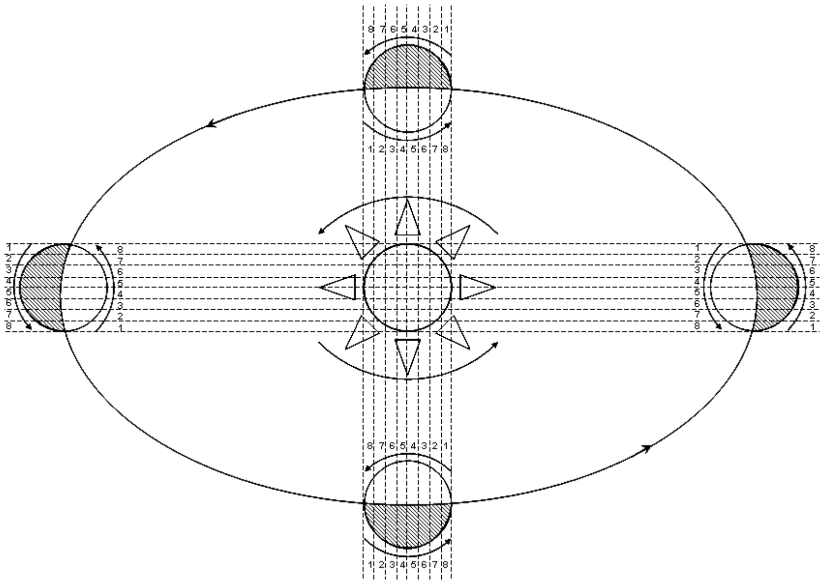

Figure 22-2: Scheme of the "palindrome effects". Four Earth positions around its circumsolar orbit are displayed. The Sun is in the center. Both Earth and Sun rotate counterclockwise. The Earth also moves counterclockwise around the circumsolar orbit. So, during the "nighttime", between 6 pm and 6 am local time, the Earth's motion is co-directed with both, its circumsolar motion and the Sun motion. During "daytime", between 6 am and 6 pm local time, the directions of these movements are opposed to each other. During the "backward" movement, a measured object covers the regions of space in daytime that were covered "forward" during nighttime.

I thought: and what if during the "backward" motion of the laboratory, in the "daytime" Earth rotation, the laboratory is approximately exposed to the same regions of the sky sphere as was the case for its "straightforward" motion during "nighttime" (though in the opposite direction). We were able to identify a "palindrome effect", that is, the series of successive nighttime histograms is similar to the series of "backward successive" daytime histograms. The scheme (further specified in the "half-a-day palindrome effect" is presented in Fig. 22-2.

This provided the basis for the experimental scheme: series of successive histograms resulting from measurements in the precise local time (that is, longitudinal) between 6 am and precisely 6 pm were compared with the "inverted" histogram series, which was organized in the opposite order and

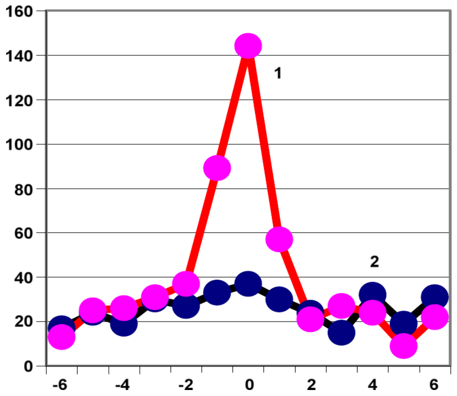

Figure 22-3: The first experiment displaying the "palindrome effect". The sequence of one-minute "daytime" histograms is highly probably similar to the backward (inverse) sequence of "nighttime" histograms of the experiment yielding ^{239}Pu alpha activity measurements with a collimator-free counter on April 23, 2004 (curve 1). Without inversions, that is, from the comparison of forward daytime and nighttime series (curve 2), no synchronous similarity was identified. X-axis is intervals that show the difference in time (in minutes) of histograms; Y-axis displays the number of similar pairs corresponding to the separating interval.

resulted from the measurements between 6 pm and 6 am of the next day.

Together with V.A. Pancheluga, we realized the plan. We took a series of one-minute histograms constructed from ^{239}Pu alpha activity measurements with a collimator-free counter on April 23, 2004 and divided it into two parts: firstly, measurements from between 6 am and 6 pm and secondly, from 6 pm to 6 am on April 24, 2004, precisely (up to the scale of seconds) in line with the local longitudinal time. After that we "inverted" the series of nighttime histograms and compared the forward series of daytime histograms with the inverted series of nighttime ones. The comparison of two series without inversions served as a control. The result was "striking" indeed. It is presented in Fig. 22-3.

I obtained this result on December 31, 2007 and sent it to V.A. and M.S. Pancheluga (who were in Rostov for the Christmas vacation).

This result additionally provides the following methodical merit: the same histograms are compared, "other things being equal", by the same expert, and the results depend only on the order of the histograms in the series. The similarity of the forward series of daytime histograms with the inverted series of nighttime histograms was so strong, so pronounced, and so convincing, that we had to postulate the following: the Earth's circumsolar movement affects the similarity of histograms scarcely (if at all). The palindrome effect meant that histogram shapes were determined by the exposure of a measured object to the rather stable regions of space.

The euphoria that this result caused in me changed again soon enough, interrupted by the usual doubts. I verified the effect with results of many different measurements from many different versions of the experiment. I have been involved in this work since 2008 and I am still now. After repeated checking, the "palindrome effect" not only "failed to vanish", but also became undoubtedly reliable and we found a lot of typical circumstances. The discovery of the "palindrome effect" at last allowed the construction of a rather harmonious or united pattern of relations between a histogram shape and cosmophysical factors. This chapter aims at revealing these "new circumstances" and constructing this new pattern.

22.1 The palindrome effect can be observed in any season and does not depend on the geographical coordinates. Experiments can be conducted during equinoxes and solstices. Palindromes were identified in measurements from the Antarctic and Arctic. The absence of palindromes in measurements with a motionless collimator directed towards the Polar Star and for a collimator permanently rotating and directed towards the Sun

The first question that arose after having revealed the palindrome effect was: how much does this effect depend on a season or on the inclination of the Earth? We were able to show the absence of such dependence very soon: palindromes resulted similarly immediately in measurements that were obtained during various seasons. Most clearly it can be seen in the extreme moments of the Earth year around its circumsolar movement: during equinoxes and solstices. As has been described in Chapter 16, I have already worked with these a lot, trying to correlate changes of histogram shapes with changes of light and dark times, and with the direction relative to the points of spring and autumn equinoxes of the circumsolar Earth movement. These attempts were based on the belief in the primary importance of the Sun as a factor that determines a histogram shape. The independence of the palindrome effect on the seasons and from the position of the Earth on its circumsolar orbit implies that the position of the Sun on the horizon plays only a minor role. Hence, the Sun was supposedly not as important a factor as previously assumed.

The manifestation of the palindrome effect on days of spring and autumn equinoxes and summer and winter solstices is illustrated in Figures 21-4 to 21-7. Taking this experiment (Fig. 22-4) as an example, I

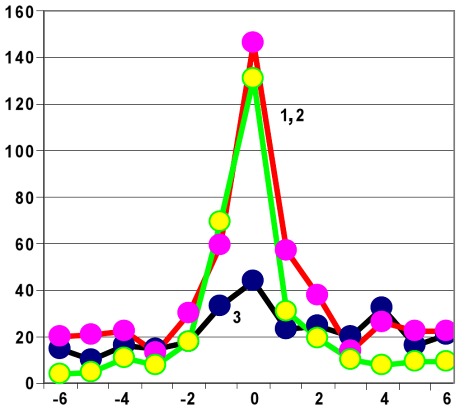

Figure 22-4: Palindrome effect during the autumn equinox on September 23, 2005. Measurements of ^{239}Pu alpha activity without a collimator. Comparison of histogram series: 1) "daytime" (6 am to 6 pm) versus inverted "nighttime" (6 pm, September 22 to 6 am, September 23, 2005); 2) "nighttime" versus inverted "daytime"; 3) "daytime" versus "nighttime", both series are not inverted (see January 5, 2008).

provide the detailed description of the necessary calculations to reproduce a palindrome effect.

We utilized a massive data set, ciphered as r050908.dat, from our computer database: it contained the results of ^{239}Pu alpha activity one-second measurements obtained without a collimator. Start of the measurements was September 8, 2005 at 12 hours 49 minutes and 33 seconds pm in Moscow winter time. If we start out from the 40,227th second, the starting date becomes September 9, 2005: 00 hours 00 minutes 00 seconds. 12 days (or 86,400 × 12 =) 1,036,800 seconds later we arrive at September 22, 2005 00 hours 00 minutes 00 seconds. Considering the Pushino geographical coordinates (54^{o}50' NL, 37^{o}38' EL) by the Astrolab calendar on September 22, 2005, the Sun rose at 6:15 am and set at 6:29 pm. The duration of the day was 12 hours 14 minutes. The precise afternoon commenced at 6:15 am + 6 hours 07 minutes, at 12:22 in the Moscow winter time. The "true 6 am" local time corresponded to 6:22 am in Moscow time. The "true 6 pm" was 6:22 pm. Recalculating these periods in seconds, we understand that 6 am in the local (longitudinal) time corresponds to the 1,079,187th second from the beginning of the data set. 6 pm is then 43,200 seconds later. I "cut" 43,200 second sections from the 1,079,187th second from the beginning of the data set. Then I obtained a set of 43,200 second data successively: the "daytime" of September 22, 2005; the "nighttime" between September 22 and September 23, 2005, etc. Then, with the help of Excel I created an additional set of inverted series from the straight ones. I constructed and compared histograms of different series, in the routine manner, using Edwin Pozharsky's program. In this comparison, each top and bottom row contain 7 histograms. Here we provide an example of two versions of the comparison:

1. September 06, 2003 "daytime" histograms with the inverted series of "nighttime" histograms from June 23–24, 2003 and
2. the same series without inversion.

In the first case, from the analysis of a series of 720 histograms, 363 similar histogram pairs were found; in the second: 261 pairs were identified. The resulting interval distributions are presented in the table below and in Fig. 22-4.

Number of similar pairs at comparison:

intervals (minutes)	nighttime Sept 22, 2005/ daytime Sept 23, 2005, with inversion	daytime Sept 23, 2005/ nighttime Sept 22, 2005, with inversion	daytime Sept 23, 2005/ nighttime Sept 22, 2005, both series without inversions
-6	4	20	15
-5	5	21	10
-4	11	22	16
-3	8	13	15
-2	18	30	18
-1	69	59	33
0	**131**	**146**	**44**
1	31	57	23
2	19	38	25
3	10	14	20
4	8	26	32
5	9	22	16
6	9	22	21

Table 22-1: Number of similar histogram pairs after comparing them.

Fig. 22-4 and Table 22-1 show a distinct manifestation of the palindrome effect during an autumn equinox. A similar pattern was repeatedly obtained for the spring equinox also.

The palindrome effect was identified equally distinct for equinoxes (Fig. 22-4) and solstices (Fig. 22-5). This implies its independence from the inclination of the Earth.

Now I needed to know: whether the palindrome effect depended on the geographical coordinates and on the procedure of taking measurements; or on the direction of alpha particles during radioactive decay.

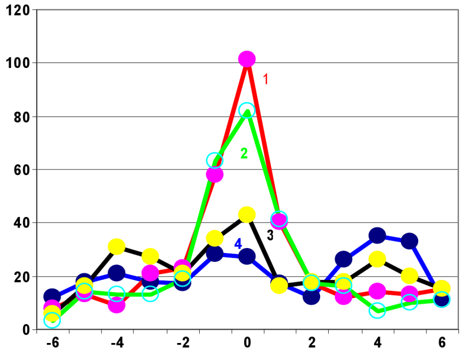

Figure 22-5: Occurrence of the palindrome effect for winter and summer solstice days in 2004: 1) "daytime" June 22 versus "nighttime" December 22, both without inversion; 2) "daytime" June 22 versus "nighttime" June 22-23; 3) "daytime" June 22 versus inverted "nighttime" December 22; 4) "daytime" June 22 versus "daytime" December 22, both series of histograms are not inverted (see January 7 and 9, 2008).

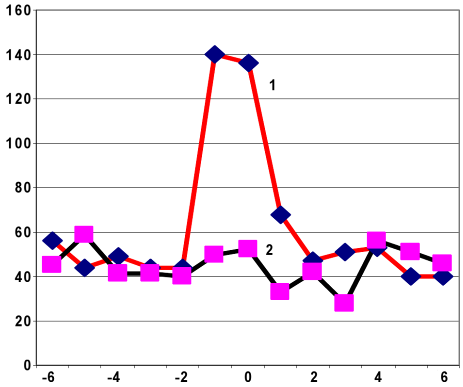

Figure 22-6: Palindrome effect from S. N. Shapovalov's measurements of ^{239}Pu alpha activity on March 21, 2005 at the Novolazarevskaya station in the Antarctic (70^{o}47' SL; 11^{o}49' EL): 1) comparison of histograms of "daytime" series with histograms of inverse "nighttime" series; 2) the same without inversion (see July 7, 2008).

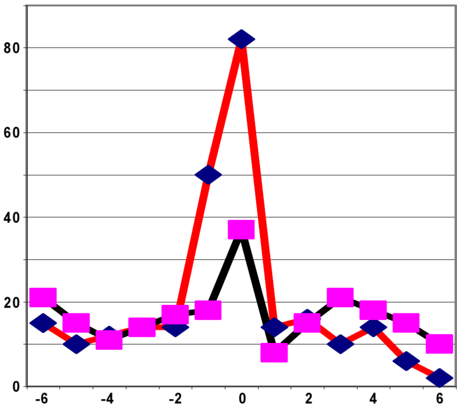

Figure 22-7: Palindrome effect of S. N. Shapovalov's measurements of ^{239}Pu alpha activity in the Arctic near 82^o NL and 174^o EL on September 21, 2009: 1) comparison of series of "daytime" histograms with histograms of inverted series of the next "nighttime"; 2) the same without inversion (see November 25, 2008).

For this purpose, I used, first of all, the results obtained by S. N. Shapovalov during his work in the Arctic (the expedition on the "Academician Fyodorov" ship) and in the Antarctic at the Novolazarevskaya station. His series of ^{239}Pu alpha activity measurement results displayed a rather distinct palindrome effect. This can be seen from Figs. 22-6 and 22-7.

Thus, a palindrome effect occurs at completely different geographical coordinates.

The discovery of the palindrome effect was based on patterns of Earth axial and circumsolar rotations. In this context, knowing whether the effect manifested in the measurements of alpha activity with collimators directed towards the Polar Star and the Sun was quite obvious and natural. In particular, when a motionless collimator is directed towards the Polar Star, and when a rotating collimator is continuously directed towards the Sun, the Earth axial rotation is offset. Under these circumstances there is no "scanning" of the sky. No palindrome effect was observed in the measurements for such an experimental design.

Fig. 22-8 displays a distinct palindrome effect in measurements obtained with a motionless collimator directed to the West, and the effect was completely absent in simultaneous measurements of ^{239}Pu alpha activity obtained with a collimator that was constantly directed towards the Sun.

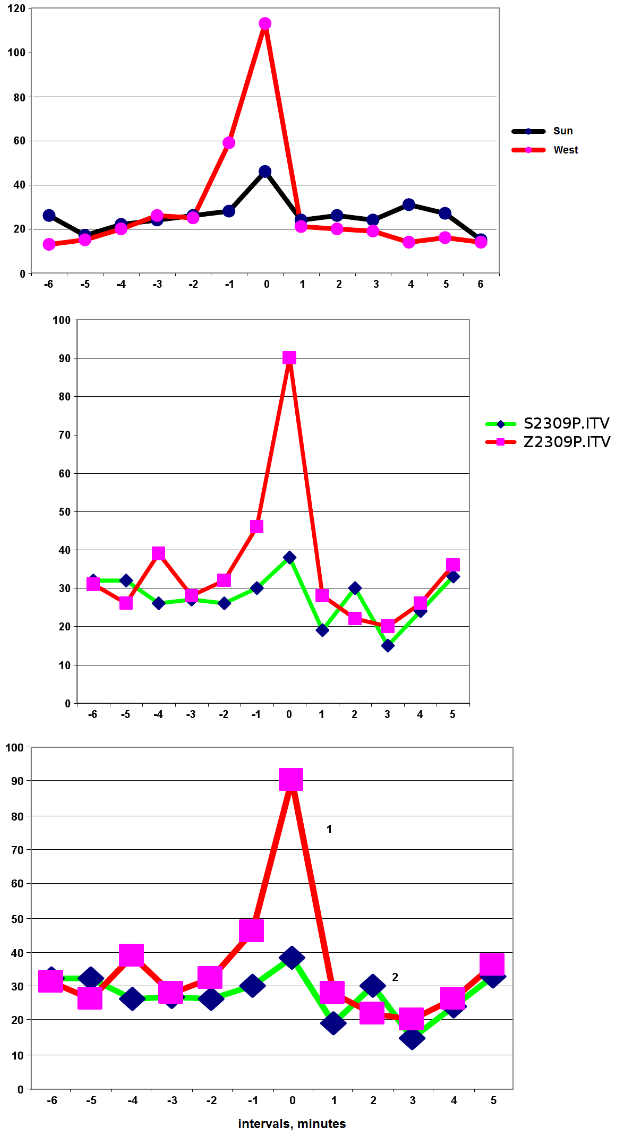

Figure 22-8: A distinct palindrome effect occurs for ^{239}Pu alpha activity measurements with a counter with a motionless collimator directed to the West ("daytime" versus inverted "nighttime") and it is completely absent in measurements with a collimator permanently directed towards the Sun, which completes one clockwise rotation in a day (July 3, 2005): (1) the same "daytime" versus inverse "nighttime"; (2) axes are the same as in previous figures (see January 19; May 8, 2008 and May 9, 2008).

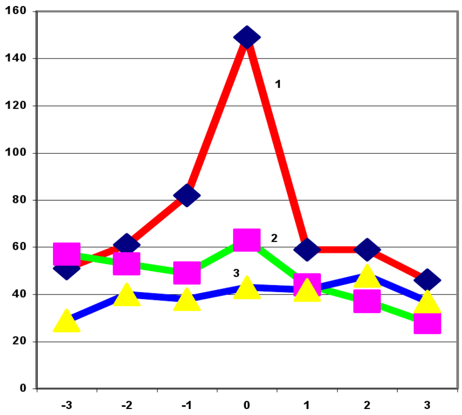

Figure 22-9: There is a distinct palindrome effect for measurements without a collimator, and it is absent if measurements were obtained with a collimator directed at the Polar Star. Measurements of ^{239}Pu alpha activity on June 17, 2006 (see June 22, 2008): 1) without a collimator, "daytime" versus inverse "nighttime"; 2) the same without inversion; 3) collimator directed towards the Polar Star, "daytime" versus inverse "nighttime".

Fig. 22-9 presents the result of the search for the palindrome effect in measurements obtained with a collimator directed at the Polar Star.

22.2 The "half-day" palindrome effect can be observed in experiments of ^{239}Pu alpha activity with collimators rotating counterclockwise

From all the above mentioned it follows that the palindrome effect refers to the similarity between series of "daytime" histograms and inverted series of "nighttime" histograms. It was natural to wait for the results of experiments with rotating collimators that complete several counterclockwise rotations in a day, thus obtaining artificial "daytime" and "nighttime" series of histograms and determining whether a palindrome effect would occur. I completed this analysis in experiments of 2004 with 4 counterclockwise rotations (three rotations of the collimator plus the (one) rotation of the Earth itself). It is obvious that the "artificial days" of this experiment was 6 hours long: 3 hours was the length of such a "daytime", and 3 hours corresponded to the respective "nighttime". First of all, I determined the beginning of measurements at strictly 6 am local time. Then I "cut" the time series of one-minute histograms into 3-hour sections (of 180 histograms each). All odd sections were referred to as artificial "daytimes"; all even ones were the

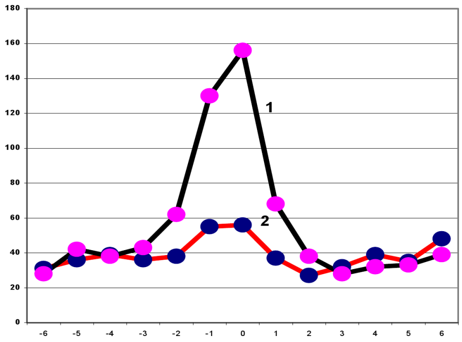

Figure 22-10: The collimator and the Earth taken together make 4 counterclockwise rotations a day; "an artificial day" then is 6 hours long. A very distinct half-day palindrome effect can be observed from the comparison of the series of "daytime" 3-hour histograms with the inverted series (1) and cannot be observed from the comparison of the non-inverted series (2) 3-hour "nighttime" histograms. Results were obtained from two experiments in total on May 29–30 and May 30–31, 2004.

"nighttimes". Then I created the inverted night sections and compared all daytime series of histograms with the inverted and forward nighttime sections. The total results for 8 "artificial days" (for 48 hours) are presented in Fig. 22-10.

22.3 Half-year palindromes

At opposite ends of the circumsolar orbit (after strictly half a year) the daytime series of histograms from the one side is similar to the inversion-free nighttime series of the other one.

The idea to specially examine half-year palindromes was originated by M.N. Kondrashova. The probable manifestation of half-year palindromes follows from Figures 22-1 and 22-2. Their manifestation can also be seen in Figures 22-4 and 22-5. The figures show not only the palindrome effect at equinoxes and solstices, but also the effects of half-year palindromes: the similarity of histograms at the opposite ends of the circumsolar orbit. For example, in Fig. 22-5, similar histograms are observed in the comparison of successive series of June 22 and December 22: (1) the "daytime" histograms of June 22 with "nighttime" histograms from December 22 (both are not inverted); this correlates with the results of (3) the "daytime" of June 22 is not similar to the inverse "nighttime" of December 22; and (2) the "daytime" of June 22 is similar to the "nighttime" of June 22 with inversion: this is a "normal" palindrome, it is quite well expressed during a solstice. And from the result (1) one can know that the (4) inversion-free "daytime" of June 22 is not similar to the "daytime" of December 22. These regularities have been reproduced several times.

Let me refer to Chapter 16, where I had already observed the regularity in the similarity between histograms of autumn and spring equinoxes, and vice versa. However, at that time I termed these findings differently: I referred to the "first and second halves of a day" or the light and dark period of a day, as "daytime" and "nighttime". This could be the reason why the regularities revealed then were not sufficiently definite.

22.4 For measurements with collimators directed to the West or East half-day palindromes depend on the direction of the flow of alpha particles during radioactive decay

I decided that the series of experiments presented above characterize the palindrome effect rather completely. The idea that a histogram shape is determined **primarily** by the continuously changing (over a year) orientation towards typical regions (or directions) of space could be considered proved. The dependence of a histogram shape from the collocation of the Earth, the Moon and the Sun; or from the horizon location of the Moon and the Sun, described in previous chapters, may be of secondary importance.

One more aspect seemed to remain unanswered though: to make sure that the effect is the same when using both West- and East-directed collimators. However, as it usually happens in experimental investigations, the situation appeared to be more complex. There was a poor "reproducibility" of the palindrome effect in measurements with these collimators. Sometimes very distinct palindromes were observed; other times they were under-expressed. I noticed that this non-repeatability, or challenge to be reproducible, was in some way related with the priority or order of the time series sections; to be exact: that it could be important whether a "daytime" precedes an inverse "nighttime" or an inverse "nighttime" precedes the corresponding "daytime". Besides, the palindromes of West- and East-collimators seemed "antisymmetric" to me: The East-collimator provided palindromes when a "daytime" preceded an "inverse nighttime" and the West-collimator did the same only vice versa: it resulted in palindromes when an inverse "nighttime" preceded a "daytime". The validity of these propositions should be tested.

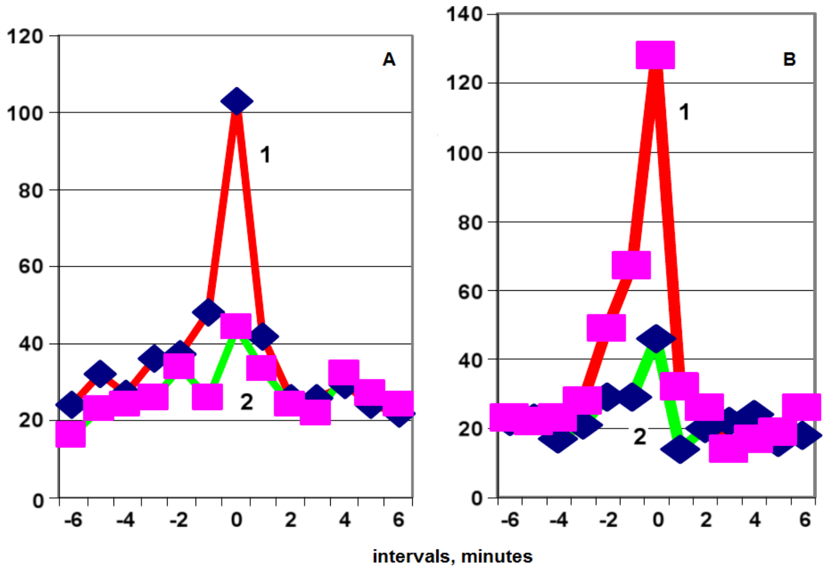

Figure 22-11: Palindrome effects in simultaneous measurements of ^{239}Pu alpha activity with East-directed (A) and West-directed (B) collimators. Measurements on September 22 to 23, 2003: A: "East" 1) "daytime" versus preceding inverse "nighttime" (AE1a.gmd); 2) "daytime" versus preceding inverse "nighttime" (AE2a.gmd); B: "West" 1) "daytime" versus preceding inverse "nighttime" (W3b.gmd); 2) "daytime" versus succeeding inverse "nighttime" (AW1a.gmd), (see June 22, 2008).

Fig. 22-11 shows a distinct palindrome effect in the measurements with an East-collimator from the comparison of the forward series of histograms that resulted from measurements between 6 am and 6 pm on September 22, 2003 ("daytime") with inverted series of histograms resulting from measurements from 6 pm September 22, 2003 to 6 am September 23, 2003 ("nighttime"). The comparison of the forward series of "nighttime histograms" (measurements from 6 pm on September 22, 2003) with the inverted series of succeeding "daytime histograms" (measurements from 6 am to 6 pm on September 23, 2003) resulted in no palindrome effect.

The opposite situation occurred in the following setup: a clear palindrome effect resulted from measurements with a West-collimator from the comparison of the forward or straight series of histograms resulting from the measurements from 6 pm September 22, 2003 to 6 am September 23, 2003 ("nighttime") with an inverted series of histograms resulting from measurements between 6 am and 6 pm on September 22, 2003 ("daytime"); no palindrome resulted from the comparison of the forward series of histograms, which were obtained from measurements between 6 am to 6 pm on September 22, 2003 ("daytime") with the inverted series of histograms resulting from measurements between 6 pm on September 22, 2003 to 6 am September 23, 2003 ("nighttime"). Or, to be brief:

> The East-collimator provides palindromes comparing the daytime histograms with inverted histograms of a SUCCEEDING NIGHTTIME and the West-collimator when daytime histograms are compared with inverted histograms of the PRECEDING NIGHTTIME.

These multiple experiments included very complex variants of possible combinations of the compared series, including: inverted and straight nighttime series, inverted and straight daytime series, preceding and succeeding straight and inverted series for all possible pairwise combinations. It resulted in a wonderful pattern in the dependence of the palindrome effect on the direction of the flow of alpha particles, which corresponds to the collimator direction.... It was necessary to prove that these were not mistakes or due to bias. From our repeated experiments we conclude that the effects are reproducible and reliable.

intervals (minutes)	E09-1-2.ITV "East": "daytime" versus preceding "nighttime"	E09-1-3.ITV "East": "daytime" versus succeeding "nighttime"	W09-1-2.ITV "West": "daytime" versus preceding "nighttime"	W09-1-3.ITV "West": "daytime" versus succeeding "nighttime"
-6	33	23	16	23
-5	22	19	14	25
-4	22	16	23	22
-3	17	20	38	21
-2	19	35	22	22
-1	39	40	41	19
0	**40**	**142**	**109**	**57**
1	19	32	26	21
2	24	15	16	23
3	21	18	11	18
4	25	15	13	25
5	23	18	16	23
6	20	20	12	16

Table 22-2: Measurements obtained on September 22, 23 and 24, 2003.

intervals (minutes)	E06-1-2.ITV "East": "daytime" versus preceding "nighttime"	E06-1-3.ITV "East": "daytime" versus succeeding "nighttime"	W06-1-2.ITV "West": "daytime" versus preceding "nighttime"	W06-1-3.ITV "West": "daytime" versus succeeding "nighttime"
-6	36	20	26	8
-5	30	26	14	32
-4	22	6	20	18
-3	10	24	24	28
-2	18	14	32	22
-1	24	58	68	38
0	**72**	**158**	**162**	**72**
1	26	22	40	30
2	22	18	14	24
3	28	18	10	32
4	14	26	34	18
5	14	22	26	30
6	20	16	12	24

Table 22-3: Measurements obtained on June 22, 23 and 24, 2003.

intervals (minutes)	E1607.GMD "East": "daytime" versus preceding "nighttime"	E1607.GMD "East": "daytime" versus succeeding "nighttime"	W1607.GMD "West": "daytime" versus preceding "nighttime"	W1607.GMD "West": "daytime" versus succeeding "nighttime"
-6	38	18	40	20
-5	24	20	42	22
-4	34	28	40	22
-3	32	22	30	24
-2	24	32	42	24
-1	44	52	34	26
0	**60**	**142**	**148**	**60**
1	22	30	34	26
2	34	18	14	16
3	36	16	20	12
4	48	16	18	26
5	32	6	10	22
6	24	14	26	26

Table 22-4: Measurements obtained on July 15 – 17, 2003.

intervals (minutes)	E2509.GMD "East": "daytime" versus preceding "nighttime"	E2509.GMD "East": "daytime" versus succeeding "nighttime"	W2509.GMD "West": "daytime" versus preceding "nighttime"	W2509.GMD "West": "daytime" versus succeeding "nighttime"
-6	16	26	14	30
-5	14	18	40	20
-4	6	22	22	22
-3	16	20	30	26
-2	16	22	38	20
-1	14	54	48	14
0	**40**	**160**	**160**	**38**
1	12	28	40	28
2	14	16	22	24
3	6	10	20	22
4	14	20	22	20
5	24	18	16	18
6	16	14	16	10

Table 22-5: Measurements obtained on September 24 – 26, 2003.

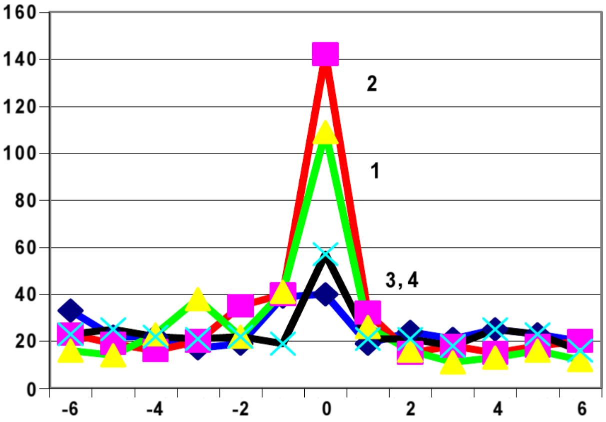

Figure 22-12: Palindrome effect in measurements of ^{239}Pu alpha activity with collimators directed to the West and East. Measurements were made on September 22, 23 and 24, 2003. 1) West: "daytime" versus preceding inverse "nighttime"; 2) East: "daytime" versus succeeding inverse "nighttime"; 3) West: "daytime" versus succeeding inverse "nighttime"; 4) East: "daytime" versus preceding inverse "nighttime".

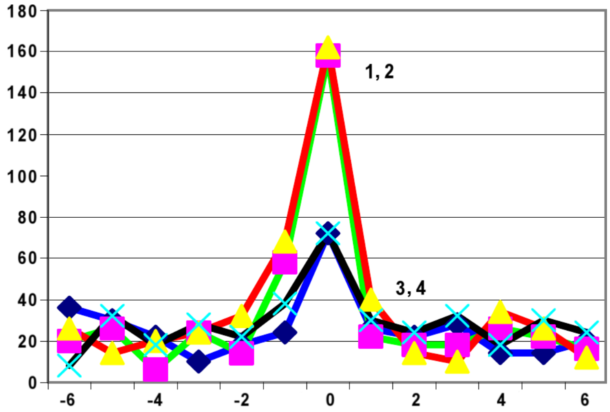

Figure 22-13: Palindrome effects as measurements of ^{239}Pu alpha activity with collimators directed to the West- and East. Measurements were made on June 22, 23 and 24, 2003. 1) West: “daytime” versus preceding inverse “nighttime”; 2) East: “daytime” versus succeeding inverse “nighttime”; 3) West: “daytime” versus succeeding inverse “nighttime”; 4) East: “daytime” versus preceding inverse “nighttime”.

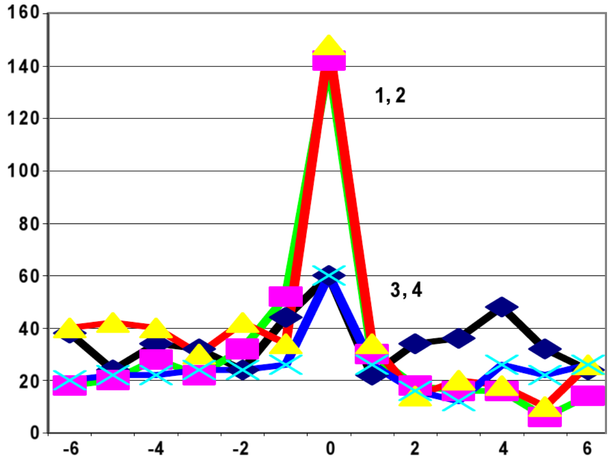

Figure 22-14: Palindrome effect in measurements of ^{239}Pu alpha activity with collimators directed to the West and East. Measurements were made on July 16, 17 and 18, 2003. 1) West: “daytime” versus preceding inverse “nighttime”; 2) East: “daytime” versus succeeding inverse “nighttime”; 3) West: “daytime” versus succeeding inverse “nighttime”; 4) East: “daytime” versus preceding inverse “nighttime”.

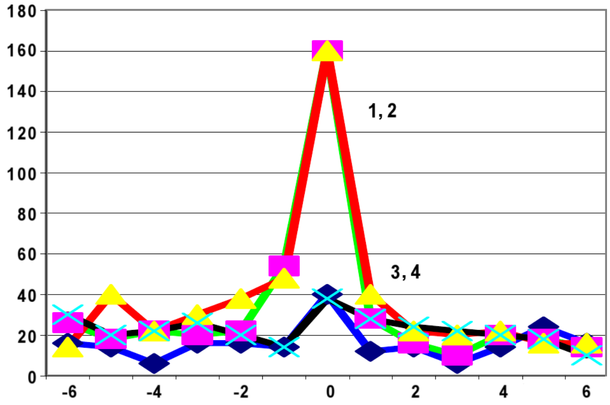

Figure 22-15: Palindrome effect in measurements of ^{239}Pu alpha activity with collimators directed to the West and East. Measurements were made on September 24, 25 and 26, 2003. 1) West: "daytime" versus preceding inverse "nighttime"; 2) East: "daytime" versus succeeding inverse "nighttime"; 3) West: "daytime" versus succeeding inverse "nighttime"; 4) East: "daytime" versus preceding inverse "nighttime".

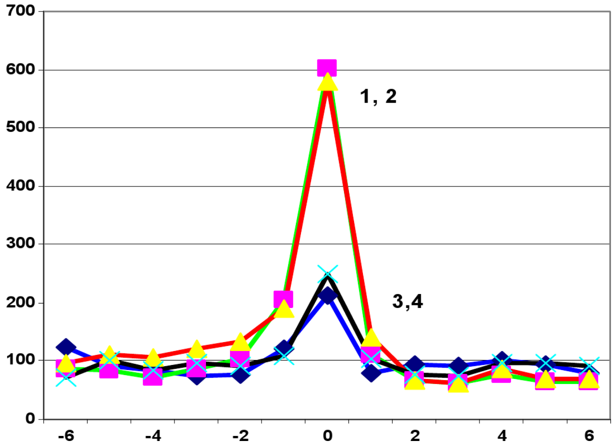

Figure 22-16: Palindrome effect in measurements of ^{239}Pu alpha activity with collimators directed to the West and East. Four experiments in total. 1) West: "daytime" versus preceding inverse "nighttime"; 2) East: "daytime" versus succeeding inverse "nighttime"; 3) West: "daytime" versus succeeding inverse "nighttime"; 4) East: "daytime" versus preceding inverse "nighttime".

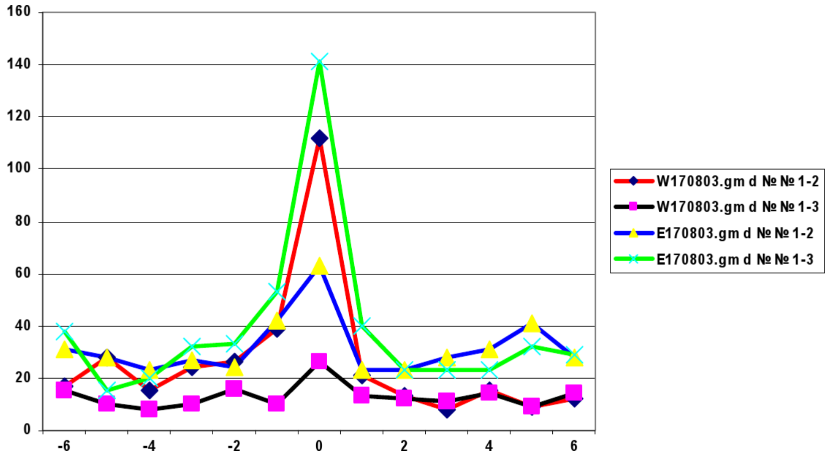

Figure 22-17: The palindrome effects from measurements of ^{239}Pu alpha activity with collimators directed to the West and East. Measurements were made on August 16, 17 and 18, 2003. Legend: W170803 No. 1 West: "daytime" between 6 am and 6 pm on August 17, 2003; W170803 No. 2 West: the preceding "nighttime": from 6 pm on August 16, 2003 to 6 am on August 17, 2003. Inversion; W170803 No. 3 West: succeeding "nighttime": from 6 pm, August 17, 2003 to 6 am, August 18, 2003. Inversion; E170803 No. 1 East: "daytime" from 6 am to 6 pm, August 17, 2003; E170803 No. 2 East: preceding "nighttime": from 6 pm, August 16, 2003 to 6 am, August 17, 2003. Inversion; E170803 No. 3 East: succeeding "nighttime": from 6 pm, August 17, 2003 to 6 am August 18, 2003. Inversion.

For that purpose I completed one more big schematized series of experiments in the time from November to December 2008: I compared the daytime series of "western" and "eastern" histograms with the inverted preceding and succeeding nighttime series. The results are presented in Tables 22-2 through 22-5, with appropriate documentation, and also in Figures 22-12 through 22-15. Tables 22-2 to 22-5 show palindrome effects: the interval distribution of the numbers of similar histogram pairs from the comparison of straight or forward "daytime" series with the inverse series of the preceding and succeeding nighttime series, resulting from measurements with West and East collimators.

The results of these experiments were so successful that I wish to present these almost identical figures. Their beauty derives just from their identity. The reliability of the "asymmetry" between the measurement results with West- and East-collimators is even more distinct in Fig. 22-16, which

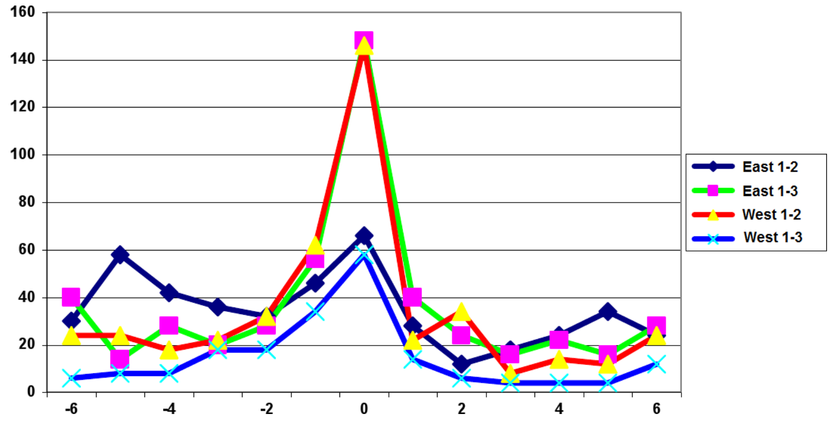

Figure 22-18: Palindrome effects from measurements of ^{239}Pu alpha activity with collimators directed to the West and East. Measurements were obtained on August 17, 18 and 19 2003. Legend: West 1–2: "daytime": between 6 am and 6 pm on August 18, 2003 versus the "inverted nighttime" series obtained between 6 pm on August 17, 2003 and 6 am on August 18, 2003; West 1–3: "daytime": 6 am to 6 pm on August 18, 2003 versus "inverted nighttime" from 6 pm on August 18, 2003 to 6 am on August 19, 2003; East 1–2: "daytime": from 6 am to 6 pm on August 18, 2003 versus "inverted nighttime" from 6 pm August 17, 2003 to 6 am August 18, 2003; East 1–3: "daytime": from 6 am to 6 pm August 18, 2003 versus "inverted nighttime" from 6 pm August 18, 2003 to 6 am August 19, 2003.

summarizes the distributions of the four previous experiments.

However, even though the presented results were very illustrative, my doubts did not disappear. I made one more series of similar experiments: analyzing the results of measurements with West and East collimators obtained in August 2003. Figures 22-17 and 22-18 present the results of this analysis.

In Figures 22-14 and 22-15 one can see distinct palindromes from the comparison of "western daytimes" of August 17, 2003 and August 18, 2003 with the preceding inverse nighttimes of August 16, 2003 and August 17, 2003. Furthermore, the same distinctive palindromes occur from the comparison of "eastern daytimes" of August 17, 2003 and August 18, 2003 with the preceding inverse nighttimes of August 17, 2003 and August 18. No palindromes are identified from the comparison of the "western daytime" of August 17, 2003 with the succeeding inverse nighttime of August 17, 2003 and the "eastern daytime" of August 17, 2003 with the preceding inverse nighttime of August 16, 2003.

These series of experiments confirmed the dependence of the palindrome effect on the direction of the flow of alpha particles during radioactive decay. The conclusion of such dependence is based on the totality of experiments with the Polar Star collimator direction; with a counterclockwise and clockwise collimator rotation; and with the compensation of the daytime Earth rotation during experiments with collimators that are constantly directed towards the Sun.

We do not need to emphasize how sensational this phenomenon is. Similar to previous results obtained, the main question is their reliability. The probability that this conclusion is incorrect seems very low. Indeed, as previously mentioned, to have a palindrome effect, one compares the same histograms. The result depends only on the order of histograms in the series. The effects themselves are expressed very well: the distribution of peak heights of palindromes surpass the level of "controls" significantly: (for example, 160 versus an expected on average 40 in Fig. 22-18, or even sharper in absolute terms, 600 versus 200 in Fig. 22-16). The effects are very reproducible: this can be seen from the uniformity of the shape displayed in the multiple figures of the last series, purposely illustrating this circumstance. Once more: in each figure, the principle "control" is provided by the "experiment" observed. One curve, without a palindrome effect, is constructed with "all other things being equal" to the other that displays the effect.

However, as is common for experimental investigations, the situation "really" appeared to be more complex. I made about 20 such experiments in total. 3 of them provided results that were inexpressive. One distinctly provided the opposite result: In the "East" direction, a daytime was similar to the preceding inverse nighttime and for the "West", with the succeeding.... These "failures" nevertheless do not decrease the reliability of the preceding results at all. Special insight or understanding is required.... I leave this understanding for future systematic investigations of this wonderful phenomenon. These investigations may be concluded by the following generation, if I myself should fail to do so.

So, what does the phenomenon mean? I do not want to refer to a "mechanism", or the underlying physics of the effect, but I do want to make comments on the phenomenological aspects only. The "physics" of the phenomenon is a matter of the future. However, the phenomenon implies that for measurements with collimators directed to the West, each new daytime series of histograms is similar to the *inverse* series of a *preceding nighttime*, and in the East-direction, the time series of daytime histograms is similar to the *inverse* time series of histograms of the *succeeding nighttime*.

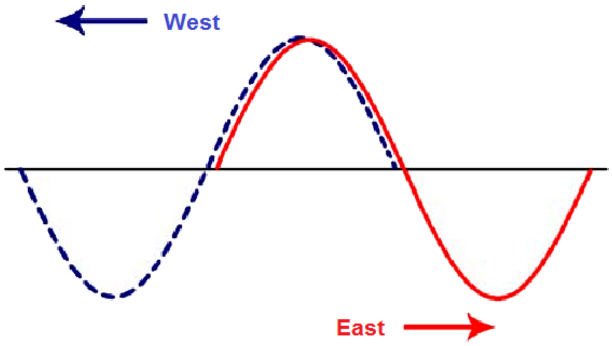

Figure 22-19: Schematic presentation of the dependence of the palindrome effect on the direction of the flow of alpha particles for experiments with West- and East-directed collimators. Series of histograms resulting from the measurements with a West-collimator are similar to inverse series of preceding nighttime histograms. Series of histograms resulting from measurements with an East-collimator are similar to the corresponding inverse series of succeeding nighttime histograms. The blue arrow above points West, the red (below) one points to the East.

In poetic terms: the "West looks to the past, and the East looks to the future".

What could these words mean? That our scheme needs completing? In a "West collimator" during daytime, alpha particles fly into the same direction as the daytime Earth rotation and conversely to its motion around the circumsolar orbit, while at nighttime, they fly conversely to the Earth axial rotation and conversely to the movement around the circumsolar orbit. For an "East collimator" at daytime, alpha particles fly conversely to the Earth rotation, and at nighttime alpha particles fly co-directionally both with the around-the-clock Earth rotation and its movement around the circumsolar orbit.

I tried to present the opposite-directionality of West- and East-collimators in Fig. 22-19.

The scheme certainly needs completing. However... we did not study the rates of these movements at all. We observe how many particles fly in various directions or, even more accurately, not how many particles do fly, but how does the fine structure of the spectrum of fluctuation amplitudes change depending on the direction of the flow of particles.

Furthermore, without a collimator, do alpha particles uniformly fly **in all** directions? Is there anybody who saw it? It has been my dream for a long time now: to make such an experiment with the simultaneous registration of alpha particles flying from a sample placed at the center of a spherical detector.... In one way or another, an East-collimator is a flow of alpha particles flying "towards the time flow". And a West-collimator is a flow of alpha particles directed "after leaving time".... Yet:

during daytime time and at nighttime they change over the direction of their movements around the circumsolar orbit... In what way should this be expressed as a palindrome?

And as usual, the question arises: "why should one be concerned with this".... For how are histogram shapes concerned with their environment? And also keep in mind in this context that we are talking about any type of process. Hence, we need not be limited to constructs related to the physics of alpha decay or the physics of noises from gravity antennae...

The phenomenon means that changes of histogram shapes are not just related with the Earth axial rotation, but also with the change of the orientation of our objects towards the Sun and motionless stars. Is the last statement indeed true? Daytime periods disappear from experiments where collimators are constantly directed towards the Sun and the Polar Star. However, changes of histogram shapes remain. No typical changes can be noticed upon a "Sun stop" or upon "interrupting" the Earth rotation (direction towards the Polar Star) without special analysis. Hence, the shapes of histograms change "by themselves", "due to thermodynamic reasons", and their shapes are just "modulated" by external factors?

It is very strange: why can no star days be discerned in experiments with half-day palindromes? Why do palindromes not have four-minute shifts? Is it because the orientations towards motionless stars are not important for us in the palindrome effect? Or is only the orientation towards the Sun significant? It would be strange: how could half-year palindromes then be explained? The Sun, with a rotation period of 25–27 days.... In half-a-year the Sun is a "wrong number" yet. Also, a lot more questions arise when thinking about these results. However, since I have "some experience" I can tell: each such question needs time, many years.... This may change if a computer program that is yet to be designed were to replace an expert in analyzing patterns in histogram series....

Related to all of this, I should remind the reader of experiments with West- and East-collimators from 2003 (described in Chapter 12). I then had obtained a very important result: series of histograms registered from measurements with an East-collimator repeated in measurements with a West-collimator with a period equal to half-a-day, moreover: also for 718 minutes, or a half of a star day. Similar histograms appear while the same regions of the sky sphere gets into the "field of vision" from the East-collimator to the West-collimator along the Earth day rotation. Thus, a half-day shift is no news really. I then came to the following conclusion: a histogram shape is determined by the region of the sky sphere (I then termed this "patterns of the star sky"), towards which the flow of alpha particles is directed. Let us leave the question "why do alpha particles flying during radioactive decay care about their direction towards the sky sphere?" without discussion once again. Let us merely mention that this half-day shift has some similarity with the palindrome effect under discussion here.

So, it was necessary to in some way align the two manifestations of this time asymmetry: the fact that similar histograms appear

(1) "in the West" half-a-day later than their appearance "in the East", and that

(2) "daytime" histograms "in the West" are similar to the inverted histograms of the preceding "western" nighttime,

(3) and "daytime" histograms "in the East" are similar to the inverse histograms of the succeeding "eastern" nighttime.

I tried to present it in another schematic form:

In these schematic figures are numbers of regions (or directions) of space towards which a laboratory is exposed during a day rotation of the Earth. The vertical position of a figure points to its spatial orientation. The vertical shift of lines symbolizes the motion of the Earth along the circumsolar orbit. Arrows and sequences of figures point to changes of the Earth rotation and the relative direction of movement along the circumsolar orbit. "Really", these figures do not reflect real changes of regions (directions) of space, caused by a movement around the circumsolar orbit. Therefore, this scheme is more or less suitable for the nearest day only.

Even this primitive scheme shows that:

(1) series of **histograms** in "eastern daytime" are similar to the succeeding straightforward series of histograms in "western nighttime";

(2) series of **histograms** in "eastern daytime" are similar to the succeeding, inverse series of histograms in "eastern nighttime";

(3) series of **histograms** in "western daytime" are similar to the preceding, straight or forward series of histograms in "western nighttime";

(4) series of **histograms** in "western daytime" are similar to the preceding, inverse series of histograms in "eastern nighttime".

22.5 The discovery of “half-day and half-year palindromes” clarifies the “phenomenon of macroscopic fluctuations”

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The general conclusions on the palindrome effect are as follows:

1. Factors determining a histogram shape are related with stable constant characteristics of the environment. In experiments with half-day palindromes it follows with a high probability that shapes of histograms of a straightforward series of half-day histograms and histograms of inverse series of the other half of the day are similar. In experiments with half-year palindromes it can be seen that this stability persists over years: shapes of histograms “at opposite ends of the circumsolar orbit” are similar with a high probability. The similarity of correspondent time series of histograms is determined by the direction of the motion towards the “sphere of motionless stars”. At opposite ends of the diameter these directions are opposite. Daytime series of one end (in half-a-year) are similar with inverse daytime series and with straightforward (non-inverse) nighttime series at the other end of the diameter.
2. From the half-day palindrome phenomenon, the existence of critical points follows: at precisely 6 am and 6 pm in local time, at which a sign of correlation of motion direction at the Earth day rotation and its motion by the circumsolar orbit changes.
3. From the experiments with West- and East-directed collimators, the dependence of histogram shapes on the direction of the flow of alpha particles follows.

Chapter 23.

The GCP system. A new methodical basis for the study of "macroscopic fluctuations"

"Long, long ago", in the 1980s, when it became clear that firstly, the spectra of fluctuation amplitudes (the shapes of corresponding histograms) reflect rather general properties of the environment, and secondly that cosmophysical and maybe even cosmogonic regularities are manifested in them, I became eager to organize synchronous uniform measurements of radioactive decay at different geographical points, and to establish a "global net" of identical devices with a center for the collection of all results here in our laboratory in Pushino. In the early 1980s we retrieved simultaneous measurements of AA+DCFIF reaction rates at various geographical points: in Pushino and Simpheropol; in Pushino and Alma-Ata; in Pushino and at the MSU White Sea Biological station, and at the moment of a Solar eclipse on July 31, 1981 at 10 points altogether (see the first part of the book). However, these experiments only spanned a short time. We needed a permanent global network.

We proposed to base this network on counters, analogous to those of ours that were measuring the alpha decay intensity. Our laboratory could become the center for collecting results from various geographical points. We proposed to found such a net to the "international community". In 1989 in Wageningen (near Amsterdam), the First International Congress on Geo-cosmic Relations was held. After this, in 1990, the International Congress on Biometeorology, was held in Vienna, Austria.

At that time, the "perestroika" bloomed in our country. Shops were empty. We were gardening to feed our families. But an aura of freedom was with us. We were given the possibility to attend the congresses, which would have been unthinkable previously. N.V. Udal'tsova and V.A. Kolombet went to Amsterdam. N.B. Bodrova went to Vienna. We presented reports on the main results of the "macroscopic fluctuations" investigations [97–101]. Now, many years later, I see that those reports were essential: they contained the main facts and ideas of investigations that were obtained over long periods of time. As a result of this "debut", we established contacts with the international scientific community. We were not the only ones who supposed that there was a reflection of cosmophysical effects not only in biological processes but also in physicochemical processes. V.A. Kolombet and N.V. Udal'tsova found like-minded people there. Especially valuable was the contact with Carmen Capel-Bout, a colleague of Giorgio Piccardi, who continued his works (see the first part of the book). Giorgio Piccardi and C. Capel-Bout were initiators of the CIFA International Organization. In 1993, C. Capel-Bout together with about 20 CIFA-members from various countries (including the USA, China, the Netherlands, etc.) came to Pushino to attend our 3^{rd} International Symposium "On the Investigation of Cosmophysical Correlations in Biological and Cosmophysical Processes". All this was of great importance for us but no possibilities for the establishment of a global net were yet available. As usual, we had no money. Despite the fact that a global net was not yet established, we nevertheless conducted experiments comparing histogram shapes from measurements in various geographical points, over all these years. We made measurements in Pushino, on ships in the Pacific, the Atlantic and the Ice Oceans, in Pushino and at various places and in different countries. They are presented in previous chapters of the book. However, we dreamed about a global net.

This dream suddenly became a reality.

In 2000 we found that such a global net did already exist. Under Professor Roger Nelson from Princeton University, standard (physical) generators of noise processes had been, since 1989, established at various geographical points. Every second, results of registrations of fluctuation amplitudes enter the Internet through the Princeton computer center. In 2000, these generators were established at more than 30 geographical points (today, in 2006, the number of these points is more than 60). This global net was established by investigators who believed that the psychic conditions of humans affect physical processes. For this reason, the Project was named Global Consciousness Project (GCP). Members of the Project investigated global effects in the Noosphere: a possible correlation between changes of noise amplitudes in the devices and of changes in the psychic condition of a large number of people (masses) following important global events. In order to avoid trivial, that is, pure physical effects on the work of noise generators, XOR electronic "masks" destroying trends in resulting time series were mounted on the exits of the generators.

The registration of psychic changes with the aid of noise generators is not our area of interest. However, the network itself seemed like a dream come true. We could hope to find the main manifestations of macroscopic fluctuations by means of our histogram method. And this hope became a reality at once! T.A. Zenchenko compared completely mixed histograms and I compared the series of non-mixed histograms: these revealed quite reliable local-time synchronous histogram shape changes for the GCP-measurements at different geographical points: in Princeton and in Switzerland; at Fiji and in Amsterdam.

What a strange thing psychic investigations are! However, we obtained reliable results. Comparisons of histograms from mixed (randomly indexed or ciphered histograms) series cannot possibly allow for subjective preferences. The effect of this randomization does not leave room for doubts. Nevertheless, we "suddenly realized" that the exits of the generators are XOR masked, and therefore no physical "effects" on the results of GCP-generators are possible. It was K.I. Zenchenko who discovered it. Besides, as A.A. Konradov demonstrated, masks distort shapes of histograms. However, we have been able to obtain reliable results.... However...we do realize that this is impossible.... My colleagues emphasized this insistently. Hence, I stopped those investigations because there was an immense number of other problems for me to attend to.

After the shock caused by the "Benford-scandal" (see Chapter 25) and experiments with the GCP, T.A. Zenchenko discontinued our collaborative efforts and work. Where mixed histogram comparisons formerly provided a sort of psychological assurance in the reliability of observed regularities to me, this was now no more the case, I stopped relying on this mixing alone. It seemed that I was the only expert comparing histograms and bearing the responsibility for ensuring the reliability of all observed regularities. Therefore I had to readjust the comparisons again and again.

Almost five years had passed, spent on such work. I permanently maintained "in my subconsciousness" that the comparisons of the GCP generators had provided reliable results. However, I could not refer back to them: a psychological barrier prevented me from it. Hence, it was only in October, 2005 that I felt the same "sudden" impulse that could not be postponed any longer. The GCP network had expanded over those years. Its main members were not eager to contact me. Very intensively I compared the shapes of large series of histograms resulting from measurements of various points of the GCP network. While doing this, I re-detected all main features and regularities of the "macroscopic fluctuations": the near zone, the stellar and solar days, the local-time synchronism and solar eclipse effects. The GCP system retained the universal physical manifestations, in spite of its mask.

Collaboration with V.A. Pancheluga was very essential for these efforts. He, being a qualified radio-physicist, analyzed the XOR mask effects and concluded: the mask does not distort a histogram shape very significantly. We wrote an article together. Excerpts of it are presented in the following [54].

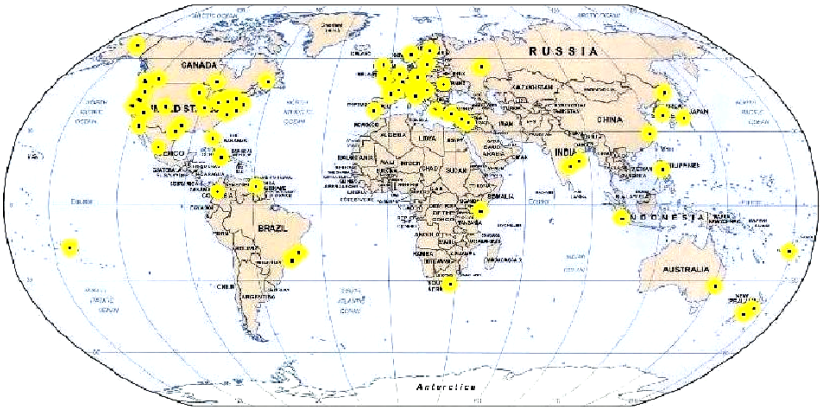

Figure 23-1: Map locating the GCP network random number generators (RNGs).

23.1 Brief description of the GCP-network (this section is written in collaboration with V.A. Pancheluga)

At the present time, the GCP-project includes more than 60 computers that record random numbers through physical random number generators. These are located at various points on the Globe [96]. Each of them permanently monitors some noise process that is dependent on a type of physical process used as a random number generator (RNG). The generators are connected to the Princeton server over the Internet. The server in Princeton collects data and processes them and also maintains a database that has been continuously updated since August 1988 [96]. All RNGs are synchronized over the Internet, and in every second all data of the network are registered at the same time and forwarded to the Princeton server, where they are fed into a public database.

The GCP-project uses three types of RNG of approximately the same construction but differing in the type of white noise source used. In the following we list these different white noise sources: 1) heat noises of resistors; 2) field noises from transistors; 3) Zener-diodes noises.

The algorithm of a typical GCP-net generator is as follows. An analog signal from a noise generator with a uniform spectrum in a frequency-band from 1,100 Hz to 30 kHz goes through a low frequency filter with cut-section frequency of 1,000 Hz; the cut or filter removes frequencies below a discretization frequency. After appropriate processing, a low-frequency signal is transformed into a meander, allowing further processing of this digital signal image.

Digital processing is achieved by applying an XOR-mask to a signal; the mask realizes "exclusive OR" with the resulting meander and impulses of a tact generator of 1,000 Hz frequency. After the XOR-mask, the number of exit sequence bits is estimated; it corresponds to 200 periods of a tact generator. Exit signal values of the random number generator result. These are forwarded to the Princeton database, classified and saved as a time series.

23.2 XOR-mask does not impact the regular time-dependent change of a histogram shape

The central point investigated is the independence of histogram shapes on the ordering of measurement results in a sequence within a time series section used for the construction of histograms. For example, our routine histogram, constructed from 60 points of a time series. There are about 10^{82} different histograms in a typical time series when histograms are consistently constructed from the same number of measurements. A histogram shape reflects the spectrum of amplitudes of fluctuations in a measured value within the time series section. Hence, it is not surprising that when applying our analytic methods, all main manifestations of the "macroscopic fluctuations" phenomenon also occur in the time series of the GCP-net in spite of the XOR-mask. The occurrence of cosmophysical regularities in a system of GCP-generators is not surprising, because this system also shares the properties of any random physical process: they all take place in a connected space-time continuum.

The aim of the following figures is to demonstrate the overlap between the main regularities found in the investigations of time series of fluctuations in measurement results of various physical processes and regularities in time series obtained with the help of the GCP-net random number generators.

23.3 A "near zone effect" is the first evidence of a cosmophysical dependence in GCP-system time series

Fig. 23-2-A presents a time series: the direct result from the registration of generator N 28 noises (Roger Nelson, Princeton, NJ, USA, 40^{o}35' NL and 74^{o}65' WL) on April 8, 2005. Fig. 23-2-B presents a distribution function of these fluctuations constructed on the basis of this signal. The complete absence of any trends and the obvious correspondence to "white noise" can be noticed.

The first and most easily found witness of "macroscopic fluctuations" is the "near zone effect". As was explained earlier (Chapter 4), this effect implies that quite reliably, the probability for histogram similarity is highest

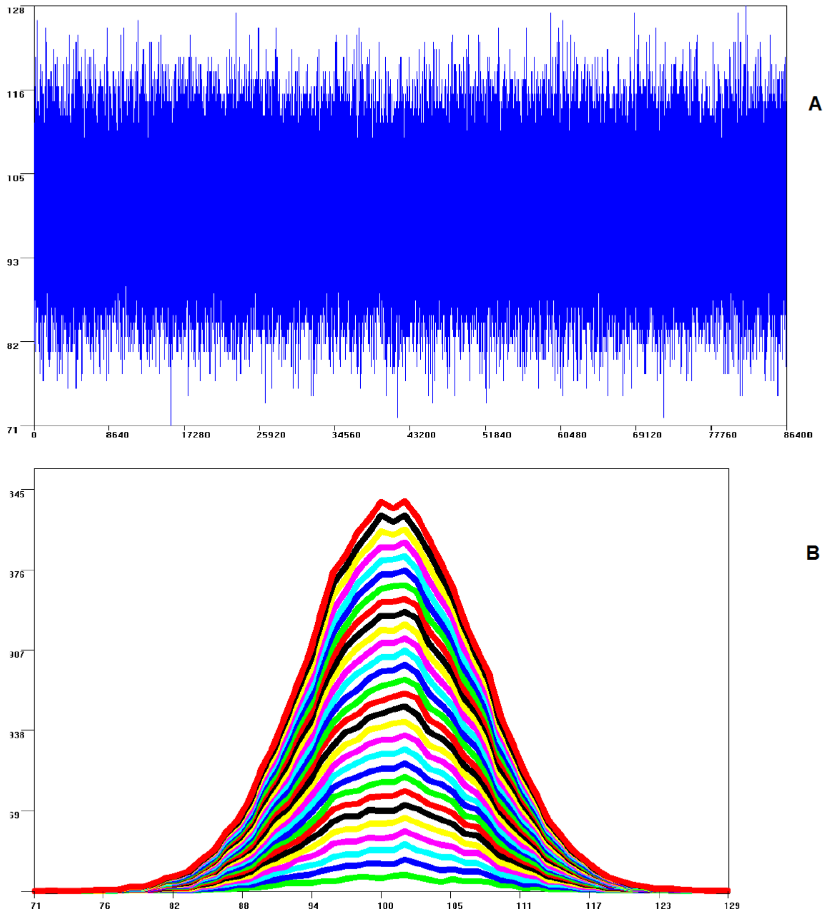

Figure 23-2: Time series section from the GCP generator N 28, August 8, 2005 (A), and its distribution function (not smoothed) (B).

for nearest or neighboring histograms. In the time series obtained by the GCP-generators, the effect manifests very distinctly. Fig. 23-3 may serve as an example for the near neighbor effect, as the most similar (adjacent) histograms occur with a time distance of one. The figure presents a change in the number of similar pairs of 0.5-minute histograms constructed from the data of Fig. 23-2 with increasing separating time intervals between similar histogram pairs. From Fig. 23-3 one can see that for the time series section analyzed, in a histogram series of 700 in total, 80 similar pairs were

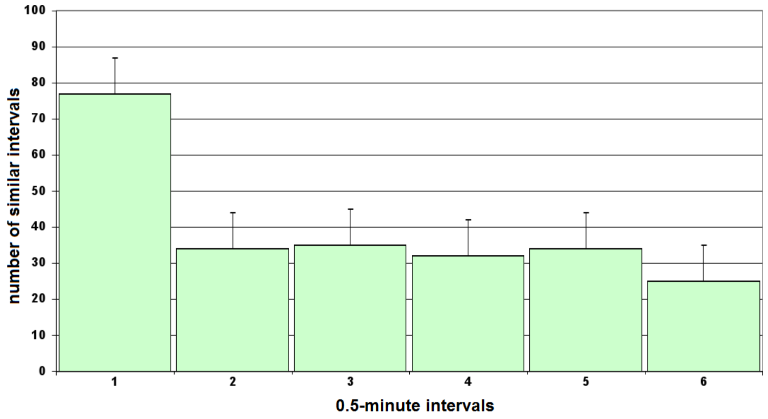

Figure 23-3: Distribution of intervals characterizing a "near zone effect".

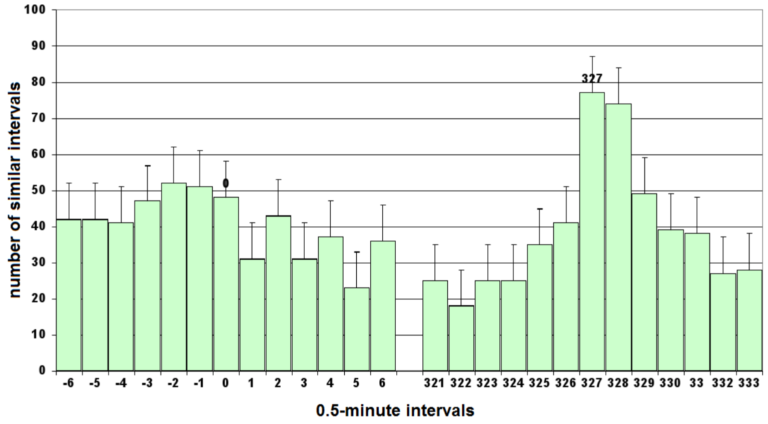

Figure 23-4: Local- and absolute-time synchronism. Dependence of the probability of recurrence of similar histogram shapes on the values of time intervals between them from the comparison of measurement results with generators N 28 (Roger Nelson, Princeton, NJ, USA, 40.350 NL and 74.659 WL) and N 37 (John Walker, Switzerland, 47.079 NL and 7.062 EL) on June 7-8, 2000. Left: intervals in the range of the differences in local times. Right: the same in the absolute time differences range. Each histogram is constructed on the basis of the initial time series section equal to one minute. The estimated difference between local times is 327 minutes.

identified for the nearest neighbors (that is, the nearest by 0.5 min) while no more than 32 pairs were selected for any following time interval.

23.4 Local-time and absolute-time synchronous occurrence of similar histograms at different geographical points as the second evidence of a cosmophysical dependence of histogram shapes from the time series of the GCP-system

The second evidence of a cosmophysical dependence of histogram shapes following the "near-zone effect", is the dependence of histogram shapes on the Earth axial rotation. Chapter 7 presented illustrations of the high probability of local-time synchronous occurrences of similar histogram shapes at different geographical points. The synchronism can be seen in the measurements of ^{239}Pu α-activity, of gravity antenna noises, of dark current fluctuations in photomultipliers and of chemical reactions rates. From measurements in Pushino and on ships during expeditions in the Indian Ocean, the Arctic and Antarctic; at laboratories in Russia (St.-Petersburg,

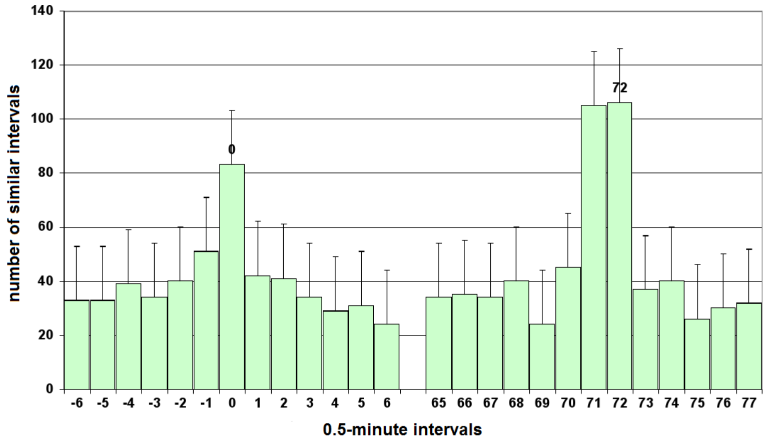

Figure 23-5: Local- and absolute-time synchronism. Dependence of the probability for the recurrence of similar histogram shapes on values of time intervals separating them from the comparison of measurement results with generators N 37 (John Walker, Switzerland, 47.079 NL and 7.062 EL) and N 102 (Peter Vulac, Wien, Austria, 48.217 NL and 16.367 EL) on April 8, 2005. Left: intervals in the range of local time differences. Right: the same in the absolute time differences range. Each histogram is constructed from a section of the initial time series equal to one minute. The estimated difference between local times is 36 minutes (72 intervals).

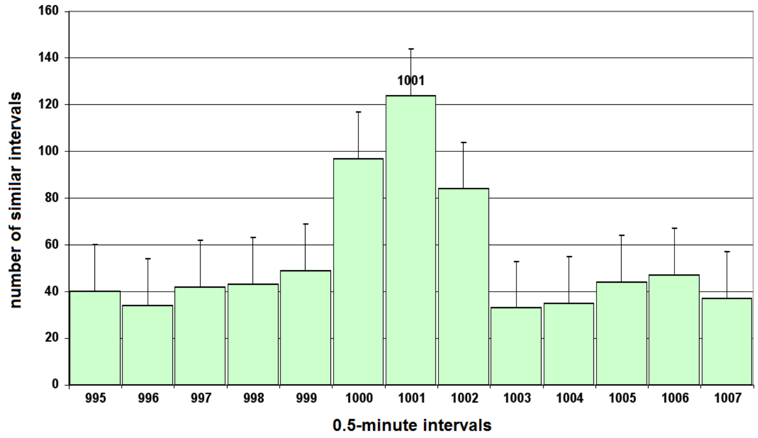

Figure 23-6: Local-time synchronism. Dependence of the probability of similarly shaped histograms to reoccur from the comparison of measurement results obtained with generators N 28 (Roger Nelson, Princeton, NJ, USA, $40^o35'$ NL and $74^o65'$ WL) and N 100 (Robin Taylor and Simon Greaves, Suva, Fiji Islands, -17.75^o SL and -177.45^o EL) on April 8, 2005 on the time interval values between similar histograms. The estimated difference between local-times is 1,006 minutes.

Moscow) and Georgia (Tbilisi); in Germany (Neisse and Lindau); in Greece (Athens), in Spain (Valencia), and in the USA (Columbus). The local time-synchronism was found to be independent of the latitude and the type of process investigated. It was shown with high accuracy at one-minute resolution and for any distances (up to 14,000 km) between laboratories.

It became apparent that the time series from GCP-system generators are no exception. With high probability, similar histograms with local-time synchronism could be identified in the analysis results of GCP-measurements from different geographical points.

We also investigated the absolute time-synchronism in physical processes. Similar histograms were found with a high probability at the same Greenwich Time. However, this global absolute synchronism can also be identified in a different manner depending on the experimental setup, and we failed to reveal a distinct regularity of the phenomena. Results from GCP measurements may behave similarly in this regard. This is illustrated by Figures 23-4 through 23-10.

Fig. 23-4 presents the relationship between the probability of the occurrence of similarly shaped histograms when comparing results of measure-

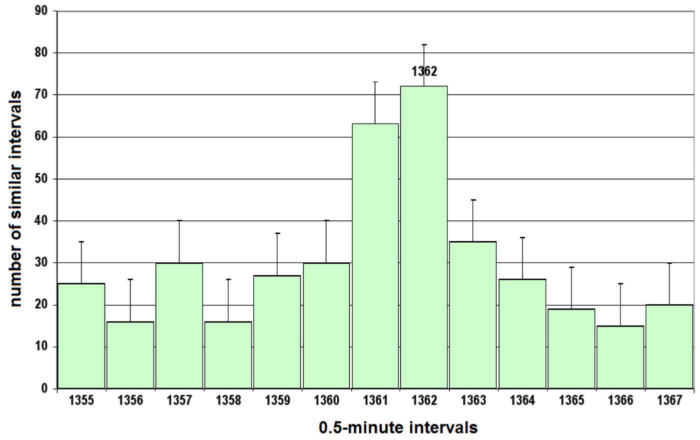

Figure 23-7: Local-time synchronism. Dependence of the probability of the recurrence of similarly shaped histograms on the value of the separating time intervals from comparing measurement results from generators N 37 (John Walker, Switzerland, 47.079^o NL and -7.062^o EL) and N 100 (Robin Taylor, Simon Greaves, Suva, Fiji, -17.75^o SL and -177.45^o EL) on April 8, 2005. The estimated difference between local times is 681.8 minutes.

ments with the help of generators N 28 (Roger Nelson, Princeton, NJ, USA, 40.350 NL and 74.659 WL) and N 37 (John Walker, Switzerland, 47.079 NL and 7.062 EL) on June 7–8, 2000. The local time difference is 327 minutes. As Fig. 23-4 shows, exactly this time difference interval corresponds to an extreme: the maximum probable realized number of the recurrence of similar histograms in the time series from the two generators. From the same figure (right) the absence of a reliable absolute-time synchronism can be discerned.

Fig. 23-5 presents the similar histogram patterns resulting from measurements on April 8, 2005 with generators N 37 (John Walker, Switzerland, 47.079^o NL and 7.062^o EL) and 102 (Peter Wulac, Vienna, Austria, 48.217^o NL and 16.367^o EL). The two peaks denoting a high probability of histograms that are synchronous locally and the evident absolute-time synchronism are striking. Figures 23-5 through 23-8 provide additional illustrations of the high probability of similar histograms constructed from time series obtained with GCP-generators at different geographical points at the same local time.

The presented results are similar to the previously identified regularities of various physical processes and time series obtained from GCP-generators.

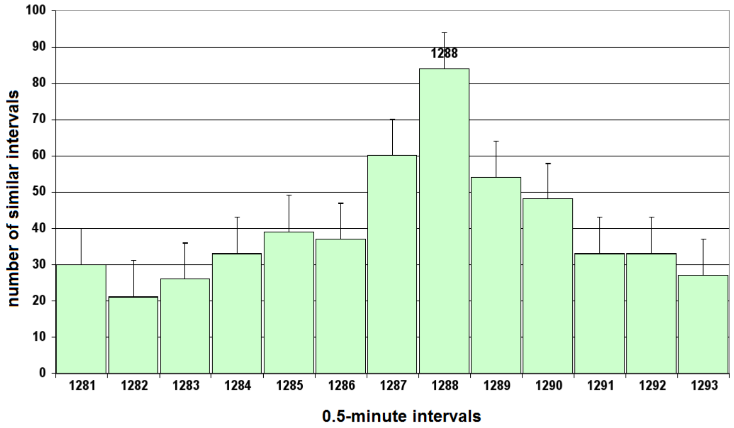

Figure 23-8: Local-time synchronism. Dependence of the probability of similarly shaped histograms recurring on the time interval value separating them from the comparison results of measurements with the generators N 102 (Peter Vulacz, Vienna, Austria, 48.217^o NL and -16.367^o EL) and N 100 (Robin Taylor, Simon Greaves, Suva, Fiji, -17.75^o SL and -177.45^o EL) on April 8, 2005. The estimated difference between local times is 644 minutes. Histograms were constructed from 0.5-minute intervals.

Nevertheless, it was essential from a psychological perspective to obtain further evidence from the direct comparison of histograms from our standard results of ^{239}Pu α-activity measurements with an I.A. Rubinstein device with a collimator on the one hand, and from the GCP-measurements on the other hand. The results of this comparison are presented in Figures 23-9 and 23-10.

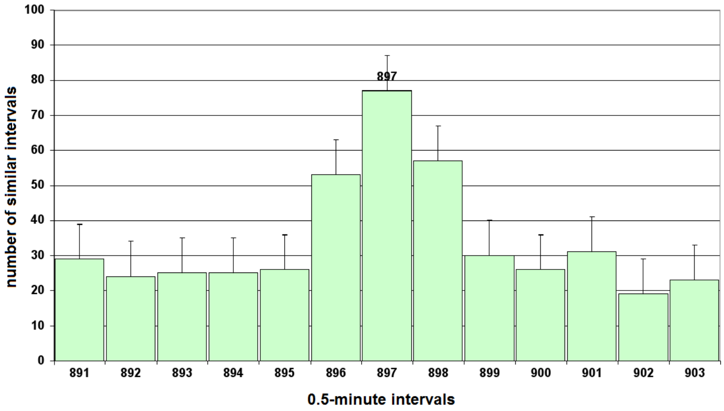

Figure 23-9: Dependence of the probability of the recurrence of similar histogram shapes on the time interval value separating them from the comparison of measurement results obtained with the generator N 28 (Roger Nelson, Princeton, NJ, USA, $40^o35'$ NL and $74^o65'$ WL) and results of ^{239}Pu α-activity measurements in Pushino (Simon Shnoll, Puschino, Russia 54.7^o NL and -37.6^o EL) on April 8, 2005. Right: mean square errors. 0.5-minute intervals. Estimated difference between local times: 449 minutes.

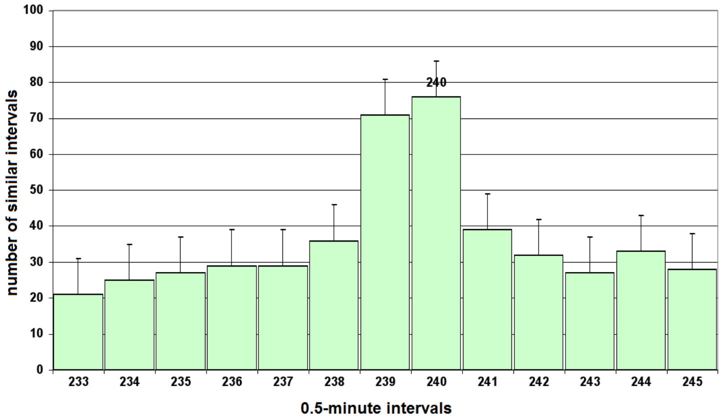

Figure 23-10: Dependence of the probability of the recurrence of similarly shaped histograms on the time interval value separating them from the comparison of measurement results with the generator N 37 (John Walker, Switzerland, 47.079^o NL and -7.062^o EL) and from results of ^{239}Pu alpha activity measurements in Pushino (Simon Shnoll, Puschino, Russia 54.7^o NL and -37.6^o EL) on April 8, 2005. Mean square errors are indicated. Estimated difference between local times: 122 minutes. X-axis is 0.5-minute intervals.

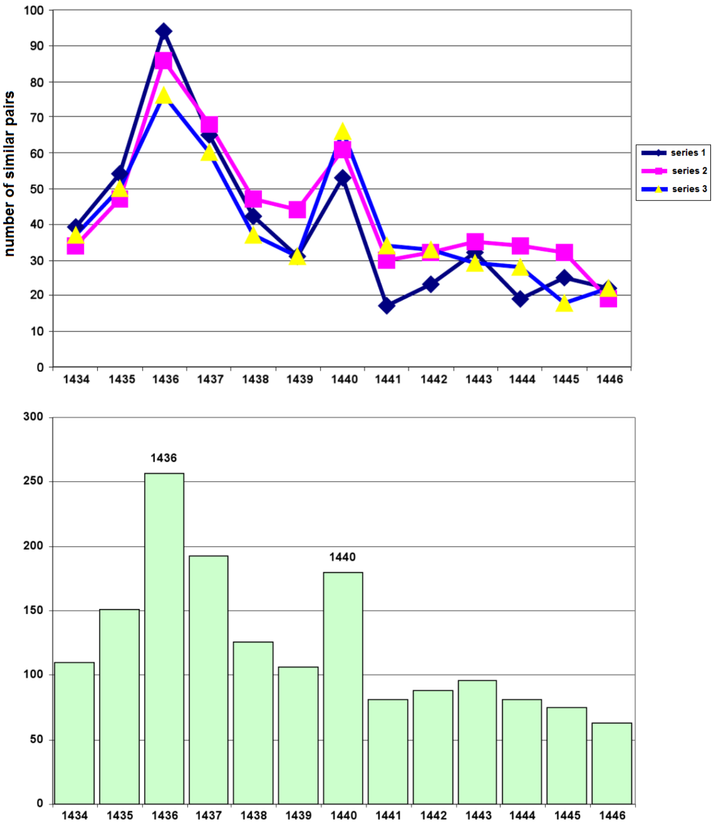

Figure 23-11: Distribution of the number of similar one-minute histogram pairs as a function of the time interval values between them (in minutes). The probability of the recurrence of similar histogram shapes varies according to two different day periods: one equal to "the Sun day" (1,440 minutes) and the other equal to "the star day" (1,436 minutes). Generators: N 28 and N 37; The total distribution is displayed to the right. The results of three separate comparisons are shown below. X-axis is the time intervals between similar histograms (in minutes). Y-axis is the number of similar pairs for different time interval values.

23.5 "Star" and "Sun" day periods in the changes of probabilities of recurrence of similar histogram shapes as evidence number three for the cosmophysical dependence of histogram shapes in the time series of the GCP-system

As the previous chapters demonstrated, there are two distinctly different day periods in the changes of the probability of similarly shaped histograms to reoccur: one is equal to the "solar" day (of 1,440 minutes), the other equals the "star" day (of 1,436 minutes). As one can see from Fig. 23-11, precisely these periods are also typical for the histograms constructed from time series established by GCP-generators.

23.6 Synchronous occurrence of similarly shaped histograms at moments of maximal solar eclipses as a fourth evidence for the cosmophysical dependence of histogram shapes in time series of the GCP-system

Previous materials result from our traditional method: the pair-wise comparison of histograms with each other followed by the calculation of time interval spacings between similar histograms. This is followed by the construction of distributions of the number of similar histograms as a function of the time intervals between them. This work is laborious. To construct each chart such as those presented in the figures, we had to assess the histogram similarity of about 7,000 histogram pairs.

However, as the previous chapters demonstrated, at the moments of New Moon and of solar eclipses, histograms of typical shapes occur frequently and highly probably at completely different geographical points all over the Earth, from the Artic to the Antarctic, on Western and Eastern hemispheres, practically at the same time. Identifying typical histogram shapes for New Moon or solar eclipses does not require the sorting of similar pairs. First, we check whether a typical histogram shape is present at the appropriate estimated moment. Applying the analysis method (for example typical histograms for maximal solar eclipses) to explore the behavior of the series obtained from the GCP random number generator network confirmed the conclusion about the dependence on cosmophysical factors of the corresponding histogram shapes.

We already saw in Chapter 20 that the occurrence of typical histogram shapes peaks at the moments of solar eclipses. For completeness sake, we illustrate this idea once more using some of the figures obtained from GCP-system data. Fig. 23-12 presents a fragment of the computer archive:

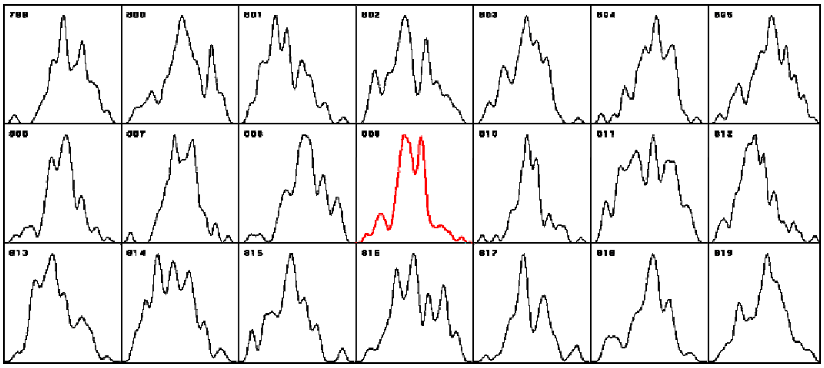

Figure 23-12: Fragment of the computer archive: series of one-minute histograms, constructed from results of ^{239}Pu α-activity measurements in our Pushino laboratory at the moment of the solar eclipse on October 3, 2005. (Victor Panchelyuga, Puschino, Russia 54.7^o NL, -37.6^o EL). A histogram of a typical shape, N 809 (red) occurs one minute later than the one of the estimated time N 808.

series of one-minute histograms, constructed from measurement results of ^{239}Pu α-activity in Pushino on October 3, 2005. The histogram N 809 (red) follows after the eclipse maximum.

Fig. 23-13 presents a similar fragment of the computer archive: a series of one-minute histograms constructed from measurement results obtained with the GCP-generator N 28 (Roger Nelson, Princeton, NJ, USA, 40^{o}35' NL and 74^{o}65' WL) during the solar eclipse on April 8, 2005. The estimated moment of maximal eclipse and occurrence of a typical shape coincide with 0.5 minute accuracy with the histogram N 2486. Fig. 23-14 presents the series of 0.5-minute histograms constructed from results of measurements of the GCP-generator N 37 (John Walker, Switzerland, 47.079^o NL and -7.062^o EL) on April 8, 2005.

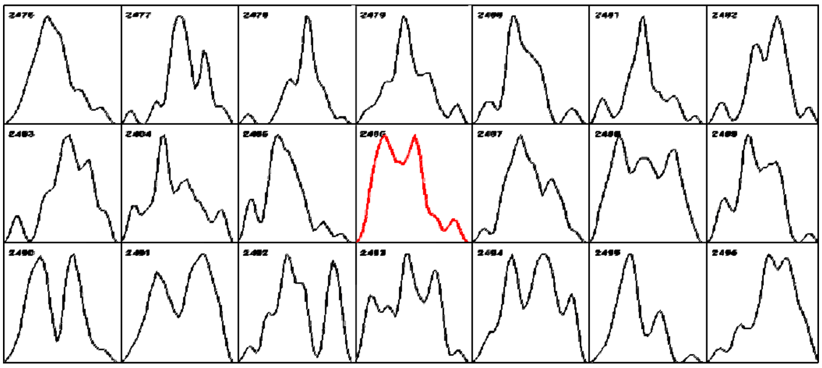

Figure 23-13: A fragment of the computer archive: the series of one-minute histograms constructed from the results of measurements with the GCP-generator N 28 (Roger Nelson, Princeton, NJ, USA, 40^{o}35' NL and 74^{o}65' WL) during the solar eclipse on April 8, 2005. The estimated moment of maximal eclipse and the occurrence of a typical histogram shape coincide with 0.5 minute accuracy with histogram N 2486.

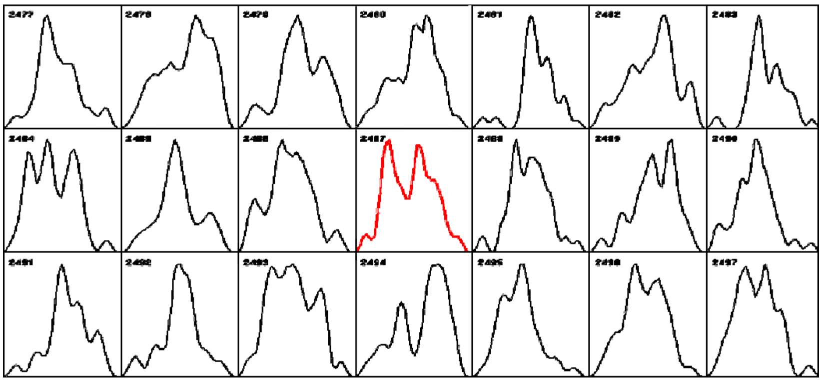

Figure 23-14: The series of 0.5-minute histograms constructed from the results of measurements taken with the GCP-generator N 37 (John Walker, Switzerland, 47.079^o NL and -7.062^o EL) on April 8, 2005. The estimated maximal eclipse moment is the histogram N 2486; the time difference between histograms with a typical shape (N 2486 to N 2487) is 0.5 of a minute.

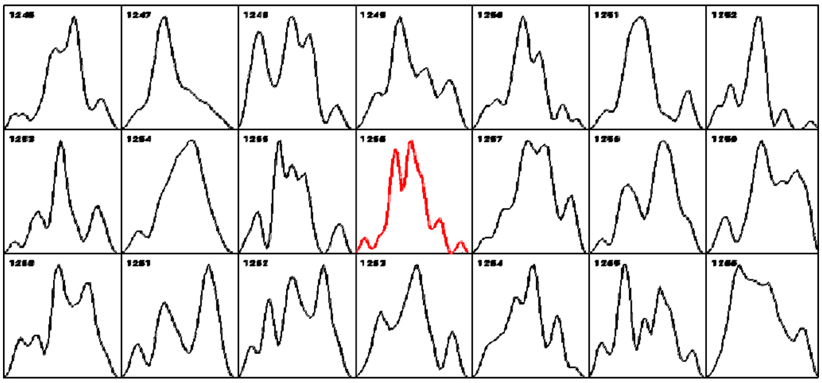

Figure 23-15: The series of 0.5-minute histograms constructed from the results of measurements obtained from the GCP-generator N 100 on October 3, 2005 (Robin Taylor, Simon Greaves, Suva, Fiji, -17.75^o SL and -177.45^o EL). The estimated maximum eclipse moment is the histogram N 1256; a histogram of a typical shape occurs strictly at this moment.

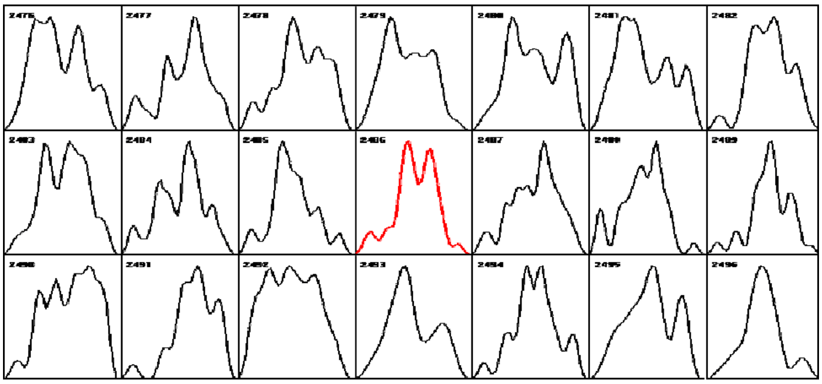

Figure 23-16: The series of 0.5-minute histograms constructed from the results of measurements with the GCP-generator N 103 (Rick Berger, San Antonio, TX, USA, 29.493^o NL and 98.6127^o EL) on April 8, 2005. The estimated moment of maximal eclipse is N 2486; the histogram of typical shape strictly occurs at that same moment.

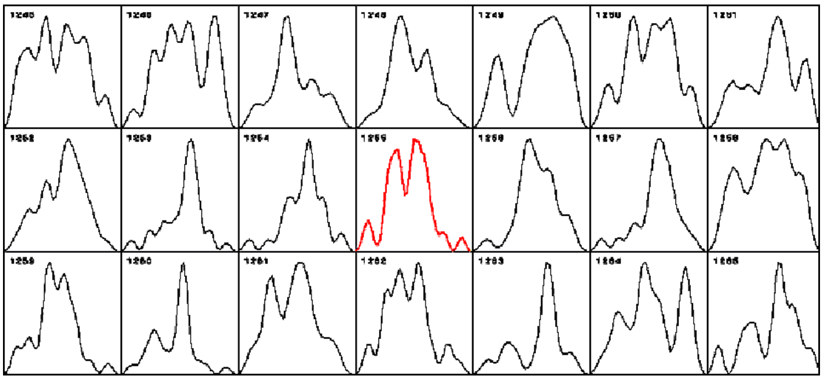

Figure 23-17: The series of 0.5-minute histograms constructed from the results of measurements obtained with the GCP-generator 28 (Roger Nelson, Princeton, NJ, USA, 40^{o}35' NL and 74^{o}65' WL) on October 3, 2005. The estimated moment of the eclipse maximum is N 1256; the histogram of similar shape occurs 0.5 min later (N 1255).

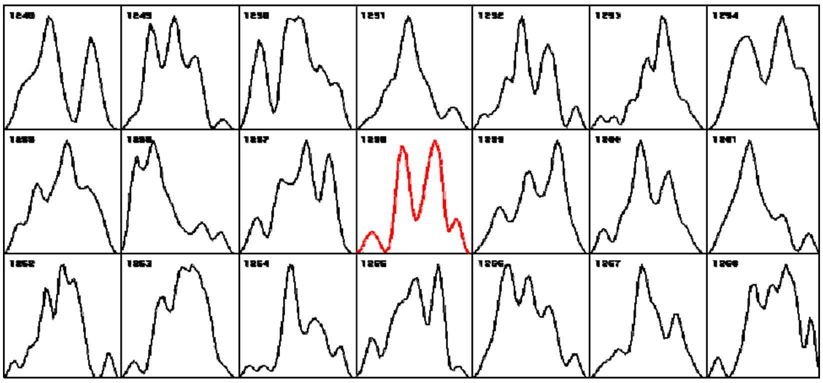

Figure 23-18: The series of 0.5-minute histograms constructed from the measurement results obtained with the GCP-generator N 37 (John Walker, Switzerland, 47.079^o NL and 7.062^o EL) on October 3, 2005. The estimated moment of maximal eclipse is N 1256; the histogram with the typical shape occurs 1 minute later (N 1258).

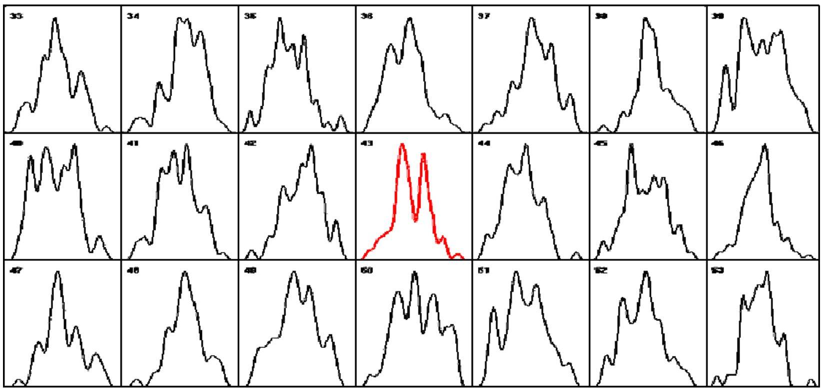

Figure 23-19: Fragment of the computer archive: the series of one-minute histograms constructed from the results of ^{239}Pu α-activity measurements at our Pushino laboratory at the moment of the solar eclipse on April on 9 (8), 2005. (Simon Shnoll, Puschino, Russia 54.7^o NL, -37.6^o EL). The histogram N 43 (red) with the typical shape strictly occurs at the estimated moment.

The estimated maximal moment is the histogram N 2486; the histogram of typical shape, N 2487, is shifted in time by 0.5 min from it. Fig. 23-15 is the series of 0.5-minute histograms constructed from the results of measurements with the GCP-generator N 100 on October 3, 2005 (Robin Taylor, Simon Greaves, Suva, Fiji, -17.75^o SL and -177.45^o EL). The estimated moment of maximal eclipse is the histogram N 1256; the histogram of typical shape strictly occurs at this moment.

The presented series of figures shows that typically shaped histograms for solar eclipse maxima occur precisely at the estimated time both in measurements of radioactivity and for measurements in the GCP-net generators. Hence, the cosmophysical factors that determine a fine structure, that is, a histogram shape become apparent in this experimental result as well.

The series presented in the figures demonstrate that histograms with shapes that are typical for solar eclipses occur strictly at the estimated time, both for radioactivity measurements and for measurements with GCP-net generators. Hence, factors determining a fine structure or a histogram shape are influenced by cosmophysical factors, and thus the histogram shapes also incorporate this feature.

Chapter 24.

Electronic noise generators as an object for investigating "macroscopic fluctuations"

We chose measurements of radioactive decay as the main subject for our investigations for the following methodological reasons: the process is not sensitive to "Earth" effects and it is possible to contain measurements in a stable manner and to work continuously. An essential advantage of this particular investigation is the possibility to research the spatial anisotropy in experiments with collimators. However, this also carries a central defect: investigations of short (smaller than a second) time intervals are practically impossible. This requires preparations with very high alpha decay intensity, which is connected with limitations given by the idle time of detectors and radiation hazard.

I hoped to use measurements of fluctuations of artificial phospholipid membrane conductivity (refer to Ivanov's experiments, 1988 in [24]) as an attempt to increase the time resolution. Noises of membrane conductivity contain "all" frequencies and their registration depends on the availability of amplifiers with the necessary frequency band. However, in the course of that work we also encountered a lot of other problems. We needed special experiments with noise generators with a frequency band of approximately tens (or even hundreds) of kHz.

The investigations commenced with an experiment that was completed in collaboration with A.V. Kaminsky, a highly qualified physicist from Tbilisi. In December 2002 he sent me a letter:

> *"I knew about your investigations of macroscopic fluctuations from a Gordon's program. I got very interested in the results of the experiments that show correlations between physical values. Thereupon I got acquainted with your works. The effects that you found in your experiments are interesting to me as I suppose them to have a lot deeper causes than cosmophysical factors. You may have faced a manifestation of the finiteness of our world. A model of a finite universe may quite naturally explain the revealed effects, and besides also establish an explanatory position for possible causes of flicker noise and the occurrence of the Benford distribution".*

What the correlation between a histogram shape and the finiteness of our world was, remained unclear to me. The possibility to explain flicker noises also remained similarly unclear: we attempted such explanations and failed. The collaboration that had started with the above letter appeared very useful. A.V. Kaminsky quickly made a device with noise generators and our conjoined investigation demonstrated the main manifestations of the "macroscopic fluctuations" phenomenon: a near zone effect and the synchronism of histogram shape changes for thousands of kilometers distance between objects (Tbilisi – Pushino). Here we had the possibility to construct histograms for time periods of about 0.01 sec [102, 103]. Amongst others, the letter meant that we had not wasted our time: he knew about our work from an Alexander Gordon television program; to participate in this program I had supposed to be a "waste of time". Our collaboration with A.V. Kaminsky lasted for about two years and was very interesting for me. Along with the investigation of amplitude spectra of noise generator fluctuations, we started to conduct long and interesting investigations of the degree of non-randomness of histogram shapes for Brownian motion together. We started... and never finished. Reasons for this include the interruption of normal interrelations between Russia and Georgia, the lack of financial support, the remoteness.... It was quite a pity. I think that the investigation of Brownian motion with the "histogram method" may reveal wonderful phenomena in it....

Victor Anatolyevich Pancheluga started the use of electronic noise generators on a regular basis. Our collaboration began in 2002, when he worked in Athens, Greece. He started measurements of alpha activity and we proved the local-time synchronism between Athens and Pushino. We found a typical shape at the maximal moments of solar eclipses also in his measurements. Our collaboration intensified after his return to Russia and his becoming a part of the Pushino laboratory staff in 2005.

The works that have already been completed and that will be made with the participation of V.A. Pancheluga open up new perspectives for the investigations of the "macroscopic fluctuations" effects. One day they will become the material for a new book. Now I shall limit myself just to a brief "summary", and list the work that was completed up to the autumn of 2008.

24.1 Changes of histograms shapes in a centrifugal field [104, 105]

More than 10 years ago, Victor Konstantinovich Lapidevsky (who died in December 2007), advised empathically to make a centrifuge experiment during a discussion on the hypothetic "mechanisms" determining the regular changes of histogram shapes at our workshops. This centrifugal experiment should place an alpha particle source into the centrifuge, and observe whether a histogram shape depended on the value of the centrifugal acceleration. This experiment was very difficult: it required a device for the registration of decay acts in a sample rotating with very high speed. No handy removable disks, like modern flashes, were available then, just like a lot of other devices and details: it was during the period of the USSR dissolution and this went along with an absolute impoverishment of science.

V.A. Pancheluga radically changed the design of the experiment. He rejected the idea to place the alpha particle source into a centrifuge. Instead, he took two I.A. Rubinstein devices with collimators, placed one of them in such a way that the alpha particles resulting from the radioactive decay flew along a plane of a couple centrifuge loads rotation, and the other in a way providing an orthogonal flight. The most wonderful aspect here was that alpha sources were 1.5 meters away from the K-70 centrifuge, from its 1 cm thick steel corpus.

The experiment was conducted as follows: gradually start the "acceleration" (increase the centrifugal rotation to a number of up to 3,000 rotations per minute), keep a steady-state rotation, and then switch off and gradually break the rotation. The duration of the entire cycle was 10 minutes: 5 minutes for the acceleration and 5 minutes for the breakage. The task of histogram comparison was assigned to me. The results of the experiments were fantastic. Shapes of histograms resulting from the registration with a collimator cutting the alpha particles beams in a direction orthogonal to the rotation plane changed with a distinct 5 minute period. When alpha particles flew in the direction of a centrifuge rotation, this period was not observed, but a new one appeared: the not very distinctly manifested 2–3 minute period. . . .

"For what reason" does a histogram shape change when close to a rotation centrifuge; why does the effect depend on the direction of the emission of alpha particles? I cannot find a more "intriguing" question. Answers to the question could facilitate the general understanding of properties of the histogram fine structure. . . .

They could. However, based on my intuition I considered these experimental results to be insufficient. The experiments should be repeated multiply in different versions. The experiments are extremely important and mean an increased load that I am responsible for. The results are based on my visual, expert comparison of histograms. Certainly, as usual, I did my best to be more accurate and to be "objective". . . . However,. . . I would prefer (if I were V.A. Pancheluga) not to proceed with new investigations until having obtained multiple repetitions. . . (Here I am, 55 years have passed and I am still short of an appropriate clarification. . .). In one way or another, I consider these experiments no less (maybe even more) crucial than those that include the rotating collimators.

Psychological reasons can explain the fact that we limited ourselves just to these experiments with a centrifuge and did not allocate more time to them. The introduction of noise generators into our investigations and our practices by V.A. Pancheluga, promised attractive possibilities for new discoveries. These (justified) anticipations primarily involved a sharp increase of time and spatial resolution of observed regularities. In the following we present a short summary.

24.2 The paradox of "solar and stellar" splitting of periods. "Local-time effects" at about 1 meter distance between objects [106–108]

After I.A. Rubinstein had made stable devices for long and continuous measurements of alpha radioactivity, experiments with synchronous local and absolute time manifestations of histogram shape changes became one of the most interesting areas of study. The detection of the synchronism at maximal distances between objects seemed to be the most essential. As Chapter 7 showed, the problem had been solved: we discovered the local-time synchronism (and sometimes an absolute-time synchronism as well) for maximal possible distances on the Earth (about 15,000 km). The use of electronic noise generators allowed the construction of histograms for time periods of about 10^{-3} seconds and provided us with the possibility to investigate the local-time synchronism at relatively small distances.

One of Serpukhov's suburbs, "Bol'shevik", is 15 km away from Pushino. The local-time difference (corresponding to the longitude difference) between the points is 62.7 seconds. V.A. Pancheluga and V.A. Kolombet made 10-minute series of simultaneous measurements of fluctuations of two generators with 44 kHz frequency band amplitudes in Pushino and in Bolshevik. From these results, histograms from a total of 1 second and 0.2 sec time-periods were constructed. I compared the histograms and got quite distinct extremes, the maximal similarity of histograms was found for a time difference of about 63 seconds, which adequately corresponds to the local-time difference. The construction of 0.2 second histograms with a 5-fold and higher resolution resulted in the same position of the extreme: the 63 second interval was found to be the most probable for the occurrence of similar histograms. When V.A. Pancheluga constructed histograms from a time interval of 0.02 sec each, the extremes split into two peaks: one at the 62.98 second interval (that is, at the time difference between similar histograms); the second, at the 63.16 second interval. The splitting was very distinct: the extremes were spaced 8 intervals apart from each other (eight 0.02 second histograms). It is fantastic, but the split, as V.A. Pancheluga demonstrated, corresponded to the splitting of a day period into "stellar" and "solar" periods (see also Chapter 6). Indeed, "a star day" = 1,436 minutes is 4 minutes, or 240 seconds, different from "a solar day" = 1,440 minutes. This solar day related difference is k = 240/86,400 $= 2.78 \times 10^{-3}$. Almost the same relation was identified for the split peaks of the "Bol'shevik – Pushino" experiment. The similar split resulted in the determination of the local time-synchronism at measurements in Pushino and in Rostov. There, with a 568.56 second local time difference, the peak split at a 1.58 second interval between "sub-peaks".

The phenomenon of the peak split according to the local time difference is paradoxally the same for many of our findings. Indeed, even the split of a day period into "stellar" and "solar" ones can hardly be attributed to different laboratory expositions towards motionless stars and the Sun. The difference is only 1^o. The value in itself is confusing: the experimental split into stellar and solar periods occurs in measurements that seem to be independent of spatial factors: they are flat sources of radioactivity, and flat semiconductor detectors. The collimators that we use have about 5^o apertures and do not seem to be able to explain findings from a more accurate spatial resolution. Furthermore, the explanation of a split at an even higher resolution by precisely orientating the device towards the stars or the Sun seems absolutely impossible....

Again, this requires a lot of hard work. In this I carry a great psychological load: whether I was quite "objective" in determining the extremes? "I rather do believe that I was", I think, but, but, but....

These paradoxes did not lower our efforts in trying to reveal "a local-time effect" at extremely small inter object distances.

When the local-time synchronism was detected at 15 km distance, V.A. Pancheluga and I made experiments with distances of 8, 4 and 0.5 km. The analysis of histogram series constructed by V.A. Pancheluga confirmed the presence of the phenomenon at these distances as well.

Then the series of measurements within our Institute building was obtained. The building, as if it was specially designed for the purpose of our experiment, is perfectly oriented: one corridor is situated from North to South, strictly along a meridian; the second: from West to East along a parallel. This, along with the appropriately high time resolution at histograming measurements of rather high-frequency electronic noises, allowed us to get a "local-time effect" at 15 meters distance between two generators at first, and then we decreased the distance down to up to 1.3 meters and further down to 0.75 cm. It is very important that the effect did depend on the spatial direction: it corresponded to a calculation of the arrangement of the generators along a parallel (West to East). Arranging them along a meridian, we could see a high probability for the absolute-time synchronism of the occurrence of similar histograms.

Thus, to illustrate, at the Eastern end of my desk (arranged along a parallel), similar histograms appear 3.5×10^{-3} seconds earlier, than at the Western end. . . .

To align the experiments, V.A. Pancheluga made a very useful ruler: he fastened two generators to two ends of a board and got a hand-held device similar to a compass needle: turning it towards various directions, we could thoroughly investigate the dependence of a histogram shape on the orientation of the ruler relative to the Earth axial rotation.

We made 3 very large experiments on measuring high-frequency noises of the changes of the azimuth orientation of the ruler with a 11.5^o spacing. The comparison of corresponding histograms took almost 4 months and was quite a big challenge for my eyes. We got a confirmation of the local-time synchronism, which distinctly manifested at 1.36 m distance between generators arranged along a parallel. We also obtained the same distinct absence of differences, in the absolute-time synchronism, when the experiment was arranged along the meridian. Furthermore, for intermediate directions, the interval distributions of the number of similar histograms were "bad". Sometimes several extremes were detected or the patterns had no distinct extremes at all. These findings were described in article publications [106–108]. I don't like the patterns. They are too sophisticated.

Meanwhile, V.A. Pancheluga continued new extravagant experiments.

The first of them was conducted on a plane flying from Cairo to Moscow. The journey went strictly along the meridian: from South to North. For experiments on the earth, the arrangement of a ruler with two noise generators along the meridian corresponding to a local-time effect, similar shapes of histograms appear in both series at the same time: a chart has one peak, which corresponds with the synchronous occurrence of similar histograms in both generators. On the plane that was moving with a speed of 850 km/hour, the peak split: another peak that was 8 intervals (0.5 msec each) away appeared.

On July 18, 2007 we went to a small aerodrome near Pushino. There, V.A. Pancheluga made measurements with two generators fastened to a ruler with 75 cm distance on a Yak–18 airplane. The plain (with V.A. Pancheluga in it) was flying with 200 km/hour in various directions (azimuths). We got a lot of material for constructing histogram series. Then (on August 27, 2007), measurements were made in a car that was moving down a road from West to East and back at 50, 75, 100 and 120 km/hour speed with a ruler arranged along and across the direction of the motion. A lot of material was collected. Preliminary results of the experiments are published in [109]. The results are extremely interesting. Once confirmed and developed, they may essentially change our concepts of the universe.

Chapter 25.

Mathematical and physical factors determining a histogram shape

In some way, the previous chapters omitted the first and maybe the main question: **How to explain the "fine structure of a histogram"?** Up to now this question seems naive to many people: they know that "a fine structure" is random.... However, the main conclusion of our investigations supposes that changes of a histogram fine structure depend on cosmophysical processes and are regular. Furthermore, the changes are caused by the motion of the studied objects in the inhomogeneous space-time continuum. Does this imply that if we excluded motions of any type, we would then obtain truly smooth distributions at last? I wish I had an answer....

However, not only physical causes may be able to explain fine structures of sample distributions; these explanations can also be provided by arithmetic causes. Many years ago I had started a dilettantish (because of my poor education) study of this possibility.

25.1 Fibonacci numbers

Due to my poor education, I discovered the Fibonacci numbers on my own. In the summer of 1957 I took my accumulated vacation of three months from the Chair of Medicinal radiology: in April, Alyosha had been born. The three of us went "to the country" together. And all of June, July and August I carried Alyosha's baby buggy for hours alongside flowering meadows and glades of the Moscow Region. My thoughts were busy with the same problem as now: the explanation of a histogram fine structure. I wanted to get an unbiased normal (Gaussian) distribution from raw data of some natural process and to use the normal distribution as a control. The fields were full of flowering chamomiles (Leucanthenum vulgare). Their flowers were composed of various numbers of petals. I collected bouquets and (while Alyosha was sleeping) plumed them and counted the number of petals. Someone watching me may have got a somewhat strange impression from my activities. Chamomiles are often plumed to find out about: "love me and love me not". In my case, this knowledge was not my goal.... It was simply because the fields and forests were deserted and wonderful and no foreign witness of my exercises was around. However, the result I gained was unexpected. I found that flowers could have 5 (the most "sapless") or 8 petals in number; 13 petals were more frequent, and 21 petals yet more frequent; chamomiles with 34 petals grew on luxurious meadows, and in rare cases I found flowers with 55 petals. The intermediate numbers would practically never occur. No normal distribution!

Since the early 1900s we have known about *quantization*: it implies the existence of *allowable* and *prohibited* energy levels. I was astonished once I knew that *quantization* could also occur for purely mathematical reasons. Later on I learned that such mathematical causes are exemplified in the Fibonacci numbers and had already been discovered 500 years before me, in an old if not ancient section of mathematics. The series of numbers is derived as follows: in the sequence, the succeeding number is made up of the sum of the two preceding ones. I did not know then that the ratio of neighboring numbers converges to the Golden Section mean Phi !!!!! (21/34 = 0,6176...; 34/55 = 0,6181...; 34/21 = 1,6190...; 55/34 = 1,6176...); I did not know that a lot of investigations had already dealt with them from early on [110]. However, the quantization, or the discreteness made a great impression on me.

A remarkable property of the Fibonacci numbers is the uniformity of the Golden Section ratios. It is a manifestation of a by now widely investigated so-called "self-similarity" property. The uniformity of the Golden Section ratios in various positions of the number series may lead to coincide with histogram shapes: the probability of the realization of a given series member, where the X-axis represents relative units. It implies that histograms that were constructed from various absolute meanings of measurement results are similar, if the examined values belong to the Fibonacci series. And this is a typical property of the "macroscopic fluctuations" effect: the similarity of histogram shapes for various processes, independent of the absolute values of the resulting numbers. Just this property allows the comparison of different types of processes with each other.... All this was very fascinating. However, the Fibonacci numbers are an algorithmic exoticism, the consequence of an imaginary algorithm. "For what reason" should natural processes follow this algorithm? Why should they not? However, why then are there so many manifestations of the Golden Section present in nature? And why would so many thinkers have spent their time on them?

In one way or another, from these (vague) thoughts followed that the discreteness and the macroscopic quantization can result from certain algorithms.

I began to look for algorithmic reasons for the discreteness.

25.2 Discreteness as a result of multiplying and exponentiation

Let us imagine a measurement v_c, of a (chemical) reaction rate, where the interaction of A and B reagents, produces C:

$$A + B \longrightarrow C$$

In accordance with the law of active masses

$$\mathbf{v_c} = \textbf{k [A] [B], where k is constant.}$$

[A] and **[B]** are instantaneous readings of the reagent concentration (their *activity*). The values are continuously fluctuating (for *thermodynamic reasons*). During fluctuations, random (!?) combinations of **[A] and [B]** readings occur. Corresponding to these combinations, various values of $\mathbf{v_c}$ occur. It is clear that the probabilities of separate $\mathbf{v_c}$ values are different. Some particular $\mathbf{v_c}$ **values will occur frequently, some will be more rare, while other values (the prime numbers) will be absent. The frequency (or rather the occurrence = the probability) of a value** $\mathbf{v_c}$ **is determined by the number of ways in which their occurrence can manifest through the multiplication of [A] and [B], or, equivalently, by the number of multipliers (or rather: the number of divisors!) for a specific** $\mathbf{v_c}$ **value.**

For example, 10 can be the result of the multiplication of [A] and [B] in two ways only: 10 × 1 and 5 × 2; The result 11 can only be attained in one way: 11 × 1, and 60: in six ways (1 × 60; 2 × 30; 3 × 20; 4 × 15; 5 × 12; 6 × 10).

The numbers of multipliers in the series of successive numbers are distinctly different for each number. Hence, the results of our measurements will be discrete inevitably.

A histogram shape resulting from such measurements is determined by the number of multipliers in the correspondent sections of the natural number series.

It is wonderful that a distribution that occurs in our model (a histogram) is the more definitive, the more discrete and the fuller the random sorting of all possible combinations of A and B values is. A histogram shape does not become smoother when the number of measurements increases, but it grows more distinct. (The same really takes place for the fine structure of the distribution of measurement results, for example of radioactivity – see Fig. 25-1.)

Fig. 25-1 presents the distribution of the numbers of multipliers of the natural number series. This is the "natural series of multiplier numbers". One can see the distinct discreteness, the nonuniformity of multiplier numbers in the sequences of a natural number series. The highest peaks of the figure correspond to the numbers divisible by 12. The deepest minima naturally correspond to the prime numbers.

Though seemingly complicated in Fig. 25-1, the pattern in the distribution of multiplier numbers in the natural number series is "really" not complicated. It may be presented as a periodical repetition of identical

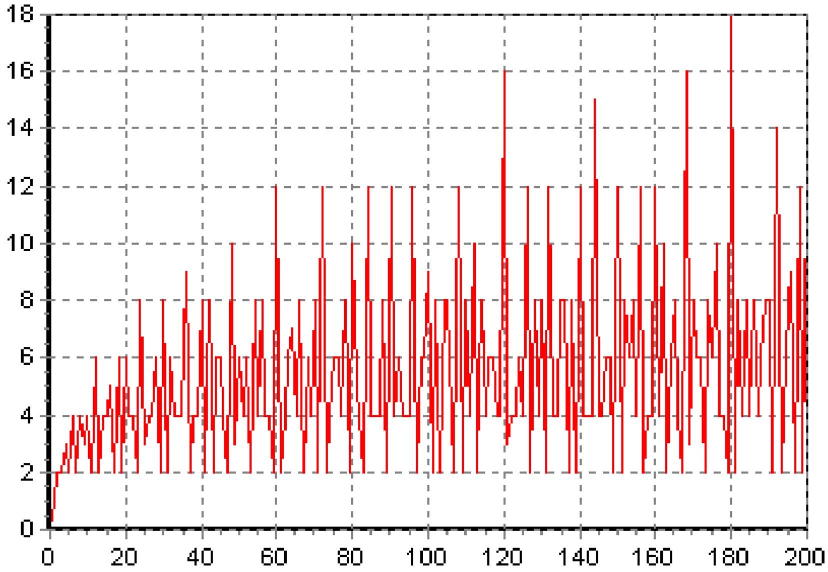

Figure 25-1: The "natural series of multiplier numbers" = numbers of multipliers in the natural number series.

histograms. Shapes of these histograms are determined by the length of a natural number series section. The number of these shapes is not very large. We made such an experiment (A.S. Botin and K.I. Zenchenko assisted me): we distributed a natural series of multipliers into various sections of the same length: that is, into sections of 10, 11, 12, etc. numbers each. Then we summed up a number of multipliers of numbers taking the same order positions in different sections (for example, a number of multipliers corresponding to the first position for all 12-member sections; a number of multipliers corresponding to the second position, etc., up to the 12^{th} position of the section). We made such a summing for sections with a length of 10 to 100. We obtained extremely beautiful patterns (my gratitude belongs to T.A. Zenchenko who created the patterns on the computer).

It would be a pity to deprive the reader of scrutinizing the pictures, hence please refer to the series of figures in Fig. 25-2. The most wonderful is that upon summing up a very large number of sections (we took the natural number series up to many millions). A histogram shape or the distribution of multiplier numbers along a section length remains almost unchanged! (I shall remind once again: an increase in the number of extremes in the measurements does not imply that our distributions become smoothed!

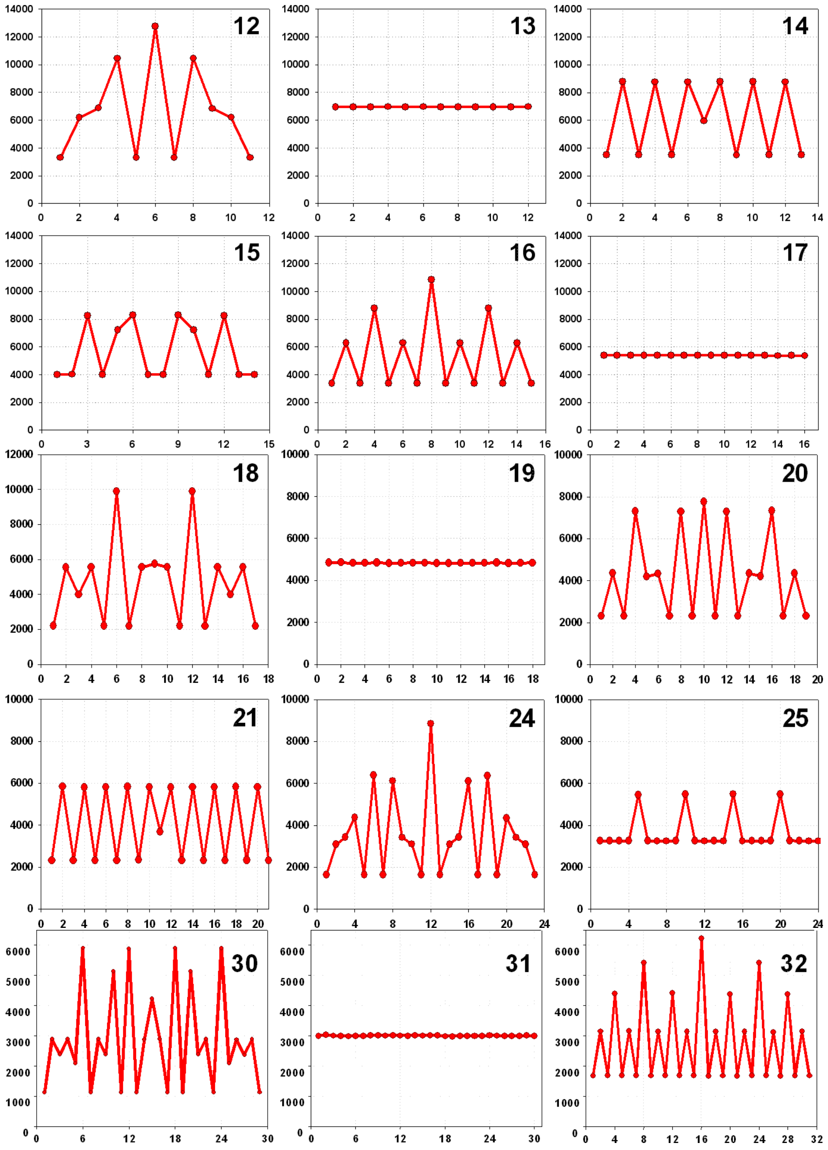

Figure 25-2-1: Distribution of multiplier numbers within orders corresponding to various number systems. Numbers in upper corners of figures are values of sections of multipliers in the natural sequence.

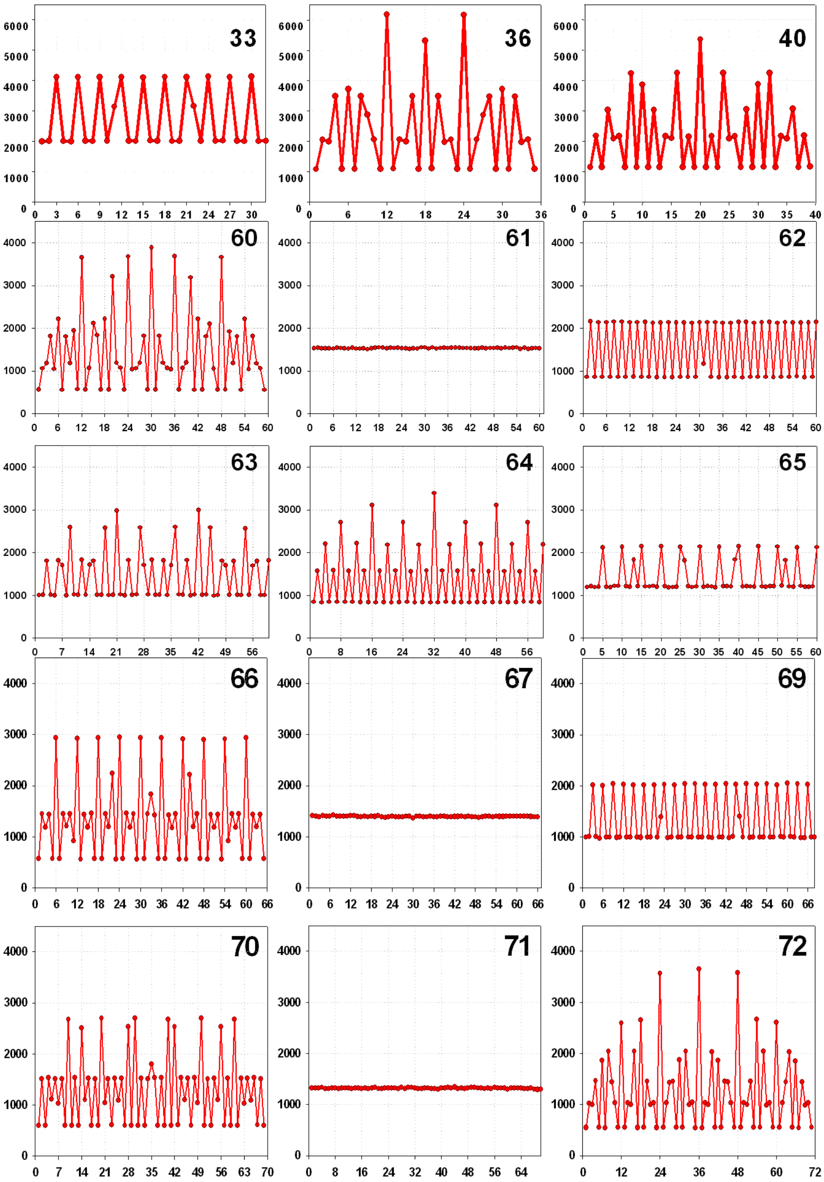

Figure 25-2-2: Distribution of multiplier numbers within orders corresponding to various number systems. Numbers in upper corners of figures are values of sections of multipliers in the natural sequence.

Please refer to Fig. 25-2.

A section of a definite length is followed by a typical histogram shape. A histogram shape allows judging a section of the length of the natural series. All sections with a length equal to one of the prime numbers (11, 13, 17, 19, etc.) are followed by straight lines. "The most beautiful" (intricately patterned symmetry) histograms correspond to section lengths that are divisible by 12 (12, 24, 36, 48, 60, etc.). **The reflection symmetry of all histograms is wonderful (see Fig. 25-2).**

25.3 Narrowness of extremes in histograms – fractality and interference

Viewing these pictures and "deciphering" their origin is very fascinating. One can see, for example, a histogram in the form of a straight line for prime numbers resulting after multiplying two prime numbers in a two-state prime histogram (for example, 11 × 3 = 33, or 5 × 5 = 25, or 23 × 3 = 69). Any pattern can be "deciphered" in such a way. However, my main concern was for the patterns in and the extreme "narrowness" of the lines in the histograms, their fractality. Since the very beginning of our investigations I kept in mind that the narrowness of peaks in histograms resulting from physical measurements means that a histogram shape, its peaks and valleys is not related to the probability of the value. When regarding radioactivity measurements, this implied that the existence of distinctively discrete peaks is not a result of the presence of several radioactive atoms' "fractions" with different probabilistic decay constants in the preparations. At that moment, I could find only one explanation for the lines' narrowness in histograms that resulted from the measurements. I explained them by interference. Interference? The question is on the correlation of periodical processes? Here, the narrowness of lines in histograms resulting from multipliers of the natural number sequence has an additional, purely arithmetic, explanation. And a cloudy idea to unify them both, interference and the properties of numbers, occurred to me. This was just a thought or an idea, meanwhile....

25.4 The histogram shape and number systems. The natural number system is duodecimal

Representing the sequence of natural numbers in various number systems can result in different distributions of a natural multiplier sequence into periods with values corresponding to various section lengths. Practically speaking, Fig. 25-2 presents histograms characterizing various number systems. In the "11-base" system, all numbers of a period are equally probable. In the duodecimal, the most probable (for our multiplication model) are numbers occupying the 4^{th}, 6^{th} and 8^{th} position of an order. In the 60-based number system, the most probable would be the numbers occupying the 12^{th}, 18^{th}, 24^{th}, 30^{th}, 36^{th}, 42^{nd} and 48^{th} position of an order. In this way a histogram shape is determined by. . . the number system.

I wish I could say what system the Lord uses? Furthermore, could a histogram shape change over time imply a number system change? Moreover, on what does the choice of a "natural" number system depend on, should any such choice exist? Furthermore, do physical factors that change a number system exist?

Around 1984, N.V. Udal'tsova, following my request, constructed an autocorrelation function of multipliers in a natural number sequence. The striking result included: the numbers of multipliers changed with a "natural" period equal to 12. A shape of the distribution of multiplier numbers was repeated every 12 steps. The autocorrelation function contained no other patterns (see Fig. 25-3). The 12-period of multipliers in the natural number sequence was determined without any bias or prior preference. Astonishingly, the duodecimal system is a natural system, which had been known since the antique Babylon. . . .

(I considered revealing the regular periodicity in a natural sequence a great event. I could not anticipate how new it was for experts in number theory. I tried to "deliver" the subject to professionals many times over. No dice. Some of them told me: "these are hard times now, and this job will never be paid. . . ").

Hence, the natural number system is a duodecimal one. Are shapes of histograms resulting from experiments just modifications of this natural histogram?

I came back to this proposition in our work with V.A. Kolombet in the 1980s. At that point in time beyond reasoning on multiplier numbers and the naturalness of the duodecimal system, shapes of histograms resulting from experiments with biochemical and chemical reactions seemed to be modifications of a "canonic shape" [111]. We could not obtain firm evidence of the hypothesis. Could it be true for histograms with abscissas that are divisible by 12, that is for an abscissa of (x1, x2, . . . x12) type N?

The attempt failed because real physical processes have more complicated algorithms: combinations maybe of repeated multiplications (or divisions), summation, exponentiation, etc. Should I place my hope in finding a correlation between the shape of a histogram resulting from an experiment and the distribution of multipliers in a natural sequence, even after this failure? Nevertheless, it would be a pity to abandon the hope completely. . . .

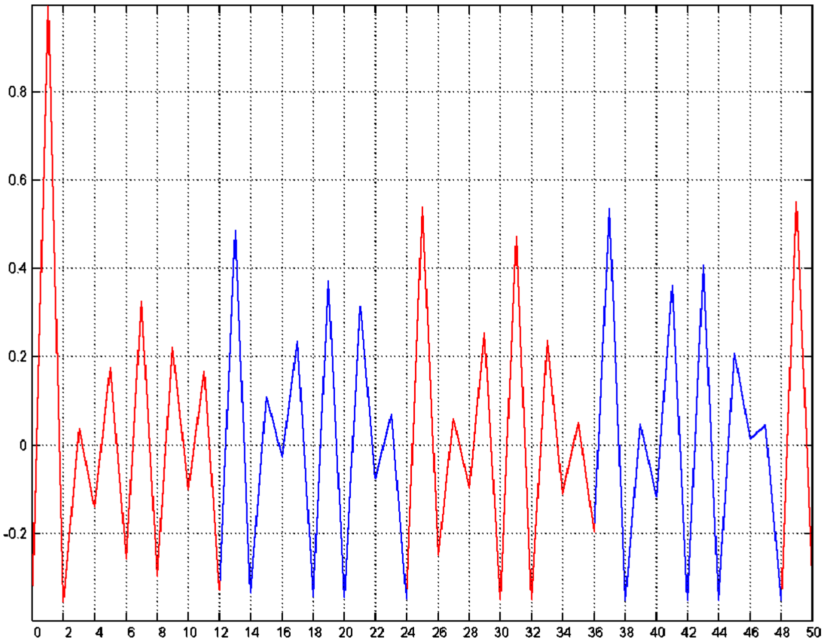

Figure 25-3: Autocorrelation function of the dependence of multiplier numbers in a natural number sequence. One can see that the same "histogram" with a spacing equal to 12, the distribution of multiplier numbers in a successive number sequence, is repeated periodically throughout the sequence.

Yet the main conclusion stands: a natural sequence of multipliers has a periodic structure. It is "self-similar"! This is just the explanation for why histograms corresponding to different sections of the natural sequence of numbers are similar! A histogram shape does not depend on the absolute meanings of compared values. For this reason the similarity of histograms of different types of processes is possible ("And we used to be surprised...").

25.5 The "computer catastrophe"

The last quarter of the twentieth century brought computers into our daily use, and it became natural to prove a hypothesis with numerical modeling. The similarity of histograms resulting from computer modeling with those resulting from measurements of physical processes seemed to provide doubtless evidence of the randomness of the processes. Shocks awaited us here.

The first one came in 1980, after V.A. Kolombet had modeled a process of radioactive decay with a computer (Poisson statistics): a histogram constructed from the modeled sequence did not differ from histograms resulting from measurements of radioactivity.... This created yet another shock. I caught Kolombet laying out sheets with computer-drawn histograms and observing them in a state of great confusion. What do we really do? What is the value of our reasoning about the physics of the investigated processes, if the same histograms can be constructed by a random number generator of a computer.... Science can be rather fuzzy!

Everything got rushed? By no means!

Extremely similar shapes can be found in series of "computer" and of "physical" histograms. However... a computer issues the same sequence of histograms ad libitum. When physical processes are measured, the shapes of successive histograms display a regular time dependence. A lot has been said about it in previous chapters. However, after these words followed many years of work. Finally, in 1980-82 ... V.A. Kolombet understood. T.A. Perevertun indignantly refused to continue our collaboration on the "investigation of a normal distribution", which was quite understandable as well. The similarity of arithmetical and physical histograms is not surprising in itself. Computer programs that generate random numbers use multiplication algorithms and, hence, the discreteness of resulting distributions is inevitable. Early versions of programs of random number generators employ some techniques to weaken the discreteness, but it cannot be avoided completely.

We must take a break here. It is important to note that we mean different things! When "mankind" refers to the concept of randomness, what is meant is the randomness of successive values (here it does not matter whether we deal with the results of measurements in time or a series of the successive realization of a time series generated by computer programs). This could be referred to as the "randomness of abscissas". What we are concerned with in our research is the randomness of shapes of histograms, that is, the randomness of fluctuation amplitude distributions. That is, the "non-randomness of ordinates"! Mathematicians expended great efforts characterizing and diagnosing the degree of randomness of successive sequences; search techniques to recover attractors of higher and higher degrees would be developed or elaborated on. Just these methods are used to evaluate the quality of computational random number generators. However, a sequence of random numbers made by an advanced random number generator may be completely non-random "by the Y-axis". Software developers designing programs consider the "fine structure of a histogram" as "invariably random". They justify the resulting distributions by fitting criteria based on central limit theorems, which in turn are based on neglecting the "fine structure". Fitting criteria are in principle not suitable to characterize a fine structure. They just do not notice it; they are insensitive at this level of detail. "And they are right": an overwhelming majority of problems does not require information about the fine structure of a distribution (or the detailed shape of a histogram) at all. These problems majorly need the maximally accurate determination of mean values. The "scattering of results" is just interference for them. I emphasized this point repeatedly in other chapters.

For this purpose, computers may be wonderful instruments for investigating the regularities that determine a histogram shape: regularities in the distributions of fluctuation amplitudes.

Thus, the "computer catastrophe" actually provided us with an important conclusion on a possible common algorithm shared by the physical nature displayed in histograms constructed from measurements, and by computer generated histograms. A fine structure of a histogram resulting from measurements of physical processes is the result of algorithms that shape the "reagents" interactions. A regular time change of a "physical" histogram may in such a case mean the regular time change of the algorithms. Quite an appealing hope may follow from this: to investigate the algorithms of interactions that lead to certain shapes of physical histograms by means of computer programs.

These decisions appeared extremely urgent 20 years later and seemed to maybe have been a part of my strongest personal crisis.

25.6 The "Benford-scandal"

At the beginning of 2001 I got into contact (through V.L. Voyeykov) with Susanna Benford from Columbus (USA). She was investigating whether paranormal effects on radioactive decay are real. Somebody told her that I had some special methods for characterizing radioactive decay. Maybe, she suggested, I would be able to notice the effect with my methods? Naturally, I considered the effect impossible. However, I decided to take this opportunity. At that point in time, we investigated the "local-time effect": synchronous changes of histogram shapes at the same local time at different geographical points. The difference between local times in Pushino and in Columbus is 8 hours. We agreed to create a series of simultaneous measurements: S. Benford together with J. Talnagi at the Center for Nuclear Investigations in Columbus would measure beta (gamma) decay of ^{137}Cs; we in Pushino: alpha decay of ^{239}Pu. Long-lasting continuous measurements of radioactivity can rarely be made at a conventional laboratory.

Therefore, J. Talnagi had to improve their measuring methods slightly, to get rid of low-frequency trends and technical failures. Thereupon, in January and February 2001, we obtained three large series of measurements.

I did not notice any paranormal effects, but comparing shapes of histograms, we revealed a very clear local-time effect. The results are presented in the book in Chapter 3, Figures 3-13 and 3-14.

It is very important that T.A. Zenchenko compared histograms in the regime of full mixing, when the real sequence of histograms in the compared series was completely ciphered. I compared the histograms of the experiments as well but without randomization of the series. The effect was absolutely reliable; the probability of the randomness of the results was "vanishingly small". Naturally, we informed our American colleagues about our results.

They did not trust the information we provided. And they. . . sent us the next series of measurements, not informing us that these were not measurements of radioactivity but a computer series created by MatLab with the help of a "random number generator" program. We knew nothing about it. T.A. Zenchenko compared histograms (in the same way, after complete randomization) and again found a very high synchronism of histogram shape changes in the two series. I found the "local-time synchronism" as well. . . .

A long (two weeks of) silence followed after we had informed the Americans about the result. On March 8, 2001 their dry official letter provided us with information about the series, in which we had found the synchronism. . . . At first I did not believe them: perhaps, they made a mistake and send us two series, radioactive and model? Perhaps, they had mixed up the numbers of the series? No. They had not made a mistake. They told us exactly which MatLab program they had implemented to create the series. And they assured us that the series was from a computer model.

Our entire team was in shock. The news about "the catastrophe" spread immediately among friends and enemies. T.A. Zenchenko said: "I feel as though I am in a coma". . . . Somebody tried "to cheer me up". . . . It was really one of the sharpest crises imaginable in science.

Over the long years of our investigations I was challenged to overcome my own doubts as well as oftentimes meet the doubts of others. Without the psychological support of S.E. Severin, L.A. Blumenfeld, G.M. Frank and, always and most of all, of M.N. Kondrashova, I would definitely have gone mad. However, "a unique experiment" was conducted with me. . . . We found something "unlike anything we had encountered before".

. . . Since childhood I have modeled myself after Robinson Crusoe. Like him, I began analyzing the condition of the wreck.

1. The possibility of a voluntary or instinctive influence on a result is completely excluded.
2. The result of histogram comparisons cannot be random.
3. Hence, the shapes of histograms occupying the same positions relative to the beginning of the series are indeed similar with high probability.
4. Hence, in this experiment, physical and algorithmic factors determining a histogram shape are congruent, and they show similar results.

With the help of my colleagues, I took another 9 sections of the computer modeled series of histograms, and none of them showed a similarity with the same radioactive series.

Certainly, this was miraculous. However this miracle also incorporated quite a bit of luck. It means that a detailed analysis of factors determining shapes of modeled histograms may facilitate to reveal factors that determine the shapes of physical histograms. Hence, it appeared that the physical processes, to which the changes of histogram shapes are due, in turn can be attributed to the motion of the earth through cosmic space. This can be compared to the computer being responsible for changes of modeled histogram shapes that appear in the behavior of the algorithms at that moment.

Is this a mad hypothesis? Following the reasoning of N. Bohr, "Is it mad enough?". Answer: maybe not too mad. It is quite possible that there are not too many variants of the sequence of histogram shapes, because the sequences are not random! We could see it, just a moment ago, with the example of histograms in a natural sequence of multipliers. And the number of variants of histogram shapes is not too large (being an expert, I can distinguish about 20 of them). A very interesting problem comes to mind here: the investigation of algorithms from changes of space-time physics. Also, the patterns of the dependence of histogram shapes in a sequence of multipliers may not only be useful in a psychological sense. Shapes of histograms may change regularly with a change of the natural number system. The changes can, in turn, occur for changes of a space-time metric from a change of the "gravity situation". Hence, the revealed periodicity of the natural sequence of numbers (natural sequence of multipliers) will change and the sequence of histograms will change as a natural result. Is there anybody who believes that this is false? Let him "cast the first stone at me"....

The shock had passed. What stayed was a belief in the necessity of multiple repetitions of the peculiar though wondrous results: the wonder of physical and model series correspondence. It is precisely such investigations that give hope for clarifying "mechanisms" that determine a histogram shape.

Negotiating the Benford-scandal was very important. If I recall that time, it was 2001. The experiments with collimators directed towards the Polar Star and the Sun, the West and the East, as well as with clockwise and counterclockwise rotations still lay ahead of us; the investigations of the close to a year periods were not completed yet; the suitability of GCP-generators for the investigations of our problems was not stated yet; electronic noise generators were not in daily use; palindromes were not discovered yet. . . .

So much took place in the following 9 years. . . (but it could never happen. . .) Some "crystallization" took place, and I feel I can attempt to draw a sketch of a "world view" considering the main results of our work that had started incredibly long ago.

25.7 "Randomness" by an abscissa and regularity by an ordinate

It is time to conclude. Regular changes of the fine structure of a histogram, the "macroscopic fluctuations", may be the result of physical and mathematical effects. There is no dependence between a histogram shape and the properties of a time series of measurement results. Processes that are classified as "rather random" by physical criteria, can and do produce "quite regular" shapes of histograms. We should introduce the concept of "processes with random abscissas and regular ordinates". No natural process can occur with "random ordinates". Modeled algorithmic processes can be "ordinate regular" in a similar way. Ordinate regularity can be similar in a natural (physical) and algorithmic process. Physical factors may determine histogram shapes, changing either the algorithms of the interaction of "reagents" or the "number systems". What are the ways in which they achieve this?

Chapter 26.

Conclusions. Conjectures on properties of histogram "fine structures"

The previous chapters contain a comprehensive survey of regularities in the manifestation of the "macroscopic fluctuations" phenomenon of measurements from different types of processes. The texts are full of paradoxes and ambiguities awaiting further investigations. Nevertheless, the general pattern becomes increasingly clear. The change of a histogram shape is determined by the motion of compared objects in the inhomogeneous, anisotropic space-time continuum. A histogram shape represents a characteristic of a space-time region. The region properties are stable and reproducible over longer time periods. The most probable cause of a space-time continuum anisotropy and inhomogeneity might be the presence of discrete mass "condensates", celestial bodies. Gravity interactions interfere at each point of the space. A histogram fine structure is a reflection of the interference pattern of a space region crossed by a moving "object". A histogram, with its relatively narrow zones, corresponding to discrete meanings of compared values and to their peaks and valleys, is probably merely the interference pattern. This is an approximate *phenomenological* pattern.

A *physical* interpretation of the pattern is much more ambiguous. Indeed, it is not clear: what kind of gravity inhomogeneities could explain the observed fluctuations in values? This refers to a variety of different types of processes: from electronic schemes noises to alpha-decay. The only feature common to all these processes is their presence in the same space-time continuum. Is it sufficient to explain the fluctuations of properties of the space-time continuum during the motion of objects in the inhomogeneous and anisotropic gravity field alongside the meanings of characteristics of fluctuations of different types of processes? How could the different meaning of relative fluctuation amplitudes in different processes be explained? Why does a piezo-quartz have a variation of 10^{-6} around its average of measured values (frequency in this case); for the amplitude of fluctuations of chemical reactions rates, we find an average of 10^{-2}, and for radioactive decay the fluctuation amplitude is proportional to $\mathsf{N}^{-1/2}$. What could explain the striking hirality (mirrowness) or the existence of histograms that are shaped with a bias towards the right or the left? What could explain the "Kharakoz paradox"? For this we use flat or oriented sources of radioactivity with or without collimators at low spatial resolution to register changes of histogram shapes realized during very small time intervals. Strikingly, during these small time periods the orientation of the sources changes by angles much less than the devices apertures. Why is that so?

Our main contribution resulting from our work is the formulation of questions that could not be posed earlier. That is because the phenomena on which they are based had not been discovered yet. First it was necessary to reveal the "near-zone effect". The question on the nature of the effect arose subsequently. The question on why realizations of similar histograms appear consistently more frequently in neighboring time intervals, even though they are not related, but rather stem from intervals of random time series? Furthermore, why does the phenomenon disappear from time to time? The reason for its fractality is also worthy of consideration: why do we fail to find a time interval that is small enough for a histogram shape "to not have enough time" to change, to entirely "stop for a moment" and to halt the changes of histogram shapes?

It was possible to reveal a close-to-a-day periodicity of similar histograms, and to become more confident (in spite of a natural suspicion) that this was not an anthropogenic effect, that it was not related to rhythms stemming from human activity. After this was clarified, it became appropriate to pose the question on the nature of the periodicity. Since we split the daily periods into two, it was possible to reveal solar and stellar days. From this the question of the nature of the periodicity, a splitting resulted. We named this question, or new way of inquiry, at our laboratory "the Kharakoz paradox": using devices with a fine spatial resolution, we reproducibly distinguished the orientation of the Sun and the "motionless stars" with just one degree angular difference. What should I do, and what can I say, if such a splitting of a "local-time effect" can be observed with a difference of up to 10^{-3} of a second? How could I pursue further investigations to explain these effects? To reject those observations as they are "impossible"? Sincerely speaking, what shall I do listening to words that seem perfectly reasonable to me: "well, you cannot determine year periods with one-minute accuracy at 525,600 minutes per year!". I want to state: "I can". Moreover, I set a yearly one-minute shift of a solar year period, and I can comprehensibly describe the procedure that I follow.

Paradoxical effects continuously accompany the work, which could at times cause anguish in the course of revealing the effects presented in this book. They include the first experiments with collimators, which revealed the disappearance of the day-period, when the collimator was directed at the Polar Star. Where does this stem from? Why are Plutonium-239 atoms concerned with the direction of the paths of alpha particles? "This really seems to belong to the world of imagination". This was the reaction of one refined well-bred theoretic. After having obtained these results, the year 2004 proved to be very productive in delivering clarifications through the work in the experiments with rotating collimators. Many follow-up questions arose that were previously impossible to state. In some way, those questions did not just arise, but were brought to life and inspired new versions of and ideas for experiments. A major problem that we struggled with was the reliability of the phenomena. Entertaining such doubts can be exhausting. Their negation (or confirmation) requires exhaustive experiments. Hence, I now comprehend "where 55 years have been lost": any such question or doubt alike, even less important ones required, as a rule of thumb, approximately one year of my life. In particular when the problem is a phenomenon such as the following: "a series of daytime histograms of a West-collimator forming a palindrome with a series of *previous* nighttime histograms, whereas a series of an Eastern-collimator daytime histograms forms a palindrome with a successive nighttime; implying that a West-collimator looks into the past, and the Eastern counterpart into the future". It would be better to keep quiet, and to continue the experiments for several years. Alternatively, following the usual customs of the 17th to 18th centuries, to cipher a message in the form of an "anagram". This way of doing things kills two birds with one stone: priority is sustained and criticism is escaped. This is appropriate for those who are concerned about their reputation.

Hypotheses of theoreticians and experimentalists' doubts

I am afraid a reader may think that all this work is "purely empirical" and merely raw material for true scientific research of future theoreticians. One may disagree with this supposition. At each step, continuous experimental work was followed by work of the mind and also the formulation of novel, sometimes increasingly extravagant, questions. I possessed an advantage in the formulation of reasonable questions because I had thought about the problems day and night, for many years. Discussions with colleagues proved to be very helpful, but I cannot remember a point in time where someone would have proposed a question or made a proposal that was actually new to me (see "the Vezzolli effect" [68]). Years passed and our research efforts brought about a variety of theoretical interpretations of the phenomena [113]. These contained some interesting hypotheses, but a really crucial experiment was never proposed. Apart from that, there are several publications that doubt the reliability of our findings [114]. This book is not the place to pursue detailed discussions on work of the aforementioned authors or disproof of the latter ones. Concerning the first group, I put forth my insufficient education as the reason for refraining from the discussion; concerning the second discussion, which will not be dealt with at this point: I claim an insufficient experimental foundation of their objections.

Chapter 27.

Supplementary chapter. "Science and life" [115]

Parallel spaces.... Admittedly a strange concept. I started working on this a very long time ago. From today's perspective the early 50s may seem like the *last* century. State officials from the security service would carry containers with radioactive preparations for me.

Other important events that have persisted in my memory include:

The Chair of Medicinal radiology. Arrests of "saboteur doctors". 30-year old L.A. Blumenfeld with his specific appearance resembling a contrabandist from the opera "Carmen" and a thick profound bass voice.

S.E. Severin listening to my confused stories about a strange scattering of results of experiments with actomyosin. Stalin's death on March 5, 1953. Beria's arrest. V.A. Engelgardt informing his colleagues (after my report on March 27, 1957): "what kind of a student is he? ... he has gone mad ... don't conduct any experiments with him...". Lectures and trainings on the application of radioactive isotopes for postgraduate medical students at the Center. B.P. Belousov oscillating chemical reaction. Physical faculty of MSU, Chair of Biophysics, 1960. Lectured the course "Biochemistry" for students of the Physical Faculty from 1958 until now. In the spring of the year 1963: G.M. Frank's order on the establishment of the Laboratory of Physical Chemistry in Pushino. June of 1964: transfer to Pushino. Students of the Pushino Chair. The Laboratory.

And a lot of other parallel "central" spaces: we, Alyosha-Olya, mother, mother-in-law, brothers, nephews, grand-children....

The work had started in Stalins lifetime; Malenkov succeeded Stalin, then Khrushov, then Brezhnev, Chernenko, Andropov, Gorbachov; then the USSR dissociated, the Gang of Eight, Yeltsin, Putin....

Over the entire course of my life I have surrounded myself with the "scattering of results", oscillations, histograms, "statistical spectra of realized states". Days, months, years, decades.... Changing "views of the world" that could assist to explain the results. Passions and psychological challenges.

How was it possible? Who gave permission? In what kind of country can such (a mess) be possible? I could find various explanations for that. . . .

I always was free in my endeavors. I was free, as I paid for my freedom.

10 years of work with the Chair of Medicinal Radiology. I paid through the establishment of a graduate course and lecturing it; developing the of tutorials on the application of radioactive isotopes and conducting them; the organization of all (hazardous) work with radioactivity, ranging from storage and the use of isotopes over the utilization of isotopes to the washing of labwares and the establishment of dosimetric controls. Furthermore, I authored on new methods for the investigation of labeled radioactive compounds conversion.

50 years of work with the Chair of Biophysics of the Faculty of Physics. All those years meant lecturing, preparing curricula and syllabi, working with students, et cetera.

During the same time I worked for 45 years with the Laboratory of Physical Biochemistry at the Institute for Biophysics. High productivity of program investigations and the establishment of a creative environment were signs of that time: the laboratory staff was involved throughout their lives, 22 doctors of natural sciences. . . .

A lot of work was published. The main publications on macroscopic fluctuations were not highlighted at all. . . .

As a result, I enjoyed a favorable relationship with persons, in high positions such as Professor Vasiliy Kornilovich Modestov, Head of the Chair of Medical Radiology; also through all these years, a friendship and collaboration with L.A. Blumenfeld at the Chair of Biophysics and beyond. The support of the director of the Institute for Biophysics, G.M. Frank, with his slogan "Don't kill the flame!", and later on: the positive attitude of G.R. Ivanitsky, E.E. Fesenko, L.M. Chaylakhyan, and again G.R. Ivanitsky. While students lapsed, V.A. Tverdislov at the Chair and D.P. Kharakoz at the laboratory developed and matured and became my chiefs. Hence, the environment stayed friendly and productive. "Sitting pretty" as our friends used to say.

It was a peculiar situation. In our investigations of "macroscopic fluctuations" we are concerned with fundamental concepts of our world. And we were granted no positive recognition from the Academy of Science. Maybe it is good.... "Beware of the Masters, they will cause you trouble any day...." What is the matter here? We await the answer. And what if everything is a "mock-science"? And if everything is true: let's fix the negative connotation of the "made-in-Russia" image and be proud....

"The perestroika" arrived. Financing, though scarce, but convenient for the Soviet time, stopped. How fortunate that I have managed to stack up some low-active preparations of Plutonium-239. Its half-life period is long enough. The devices are self-made.... I was completely content. However,... no grant for the investigations through all these years. They did not even answer me with their "Failed" stamp. It is normal: it means that the work is completely new, and there is nobody to judge it. But we need computers and other equipments. We got support through this time from a completely unknown and not too rich American: the physicist Thomas Peterson, also an elderly engineer. He had heard of our work from M.N. Kondrashova during a Symposium and... came to Pushino.... For several years we received money from him, enough to equip us with computers. And then, again thanks to M.N. Kondrashova, a wonderful person, Vladimir Petrovich Tikhonov, the same engineer and physicist, a Bauman Moscow Technical University graduate and owner of the "DIODE" plant appeared. He said that he could not allow the investigations to discontinue just like that. For several years our laboratory received 700 dollars per month from him and we were able to update our equipment. It is great in a sense: the uninterested companionship that is typical for Russian science did not disappear. In this way, without any official funding, and without grants we managed to collaborate with investigators on the Arctic and Antarctic from O.A. Troshichev's laboratory of the Arctic and Antarctic Institute (AARI), with Ilya Alexandrovich Rubinstein from the MSU Nuclear Institute; under those circumstances Vladimir Alexeyevich Shlektaryov made wonderful devices almost for free.

The work continued. The number of actual tasks was increasing. Among these tasks was the preparation of measurements at ICS. Five years had passed in attempts of getting permission for an experiment under the conditions of a cosmic flight. We finally obtained the permission. The experiment may take place in 2011. We should be ready instantly. Will we be able to obtain a period of recurrence of similar histogram shapes that is equal to the period with which the measuring station rotates around the Earth? Will the dependence on the direction of the particle flow remain? Will we be able to see effects due to the station moving at high speed?

We strove to obtain this permission for a long time. I appeared in auditoria to those responsible. I told them: “soon I will be 80 (!), it’s impossible to delay”. The reply I got was: “But, live longer!” Priceless advice! Let me follow it. . . .

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We also share a renowned teacher, Professor Sergey Evgen'evich Severin. We are obliged to him for "directing our lives" ever since we joined the Chair of Biochemistry in 1948. He had left long ago but both of us still hear his voice, and remember his intonations, his questions, his advice. M.N. Kondrashova and I come from different scientific disciplines: she originates from biochemical physiology; I am much more involved with the "mysteries of the universe". We both enjoyed his priceless support not only in science but also in real life, which did not always come easy. I have described this in my book "Heroes, villains and conformists of Russian science" [114].

For more than 50 years, ever since the first days of investigating "ATP-ase activity of muscle proteins solutions" in 1951, I was fortunate to be able to discuss my strange results not only with S.E. Severin but also with Lev Alexandrovich Blumenfeld. His interest, his intuition in physics, his kindness and psychological support are unforgettable. I have told this tale in another book of mine: "Lev Alexandrovich Blumenfeld. Biophysics and poetry" [115].

Over a long time period I enjoyed the possibility to investigate a problem that was not grant supported; I had this opportunity not only because of my teaching salary from the Chair of Medical Radiology of the Central Institute for Doctors Advanced Training and at the Chair of Biophysics of the university and fruitful work in other laboratory tasks at the Institute of Biophysics, but also thanks to the kindness and support of these institutions' leaders: the Head of the Chair of Medical Radiology, Professor V.K. Modestov, Directors of the Institute of Biophysics of the USSR Academy of

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References of Part II

1. Shnoll, S.E., Kolombet, V.A., Zenchenko, T.A., Pozharski, E.V., Zvereva, I.M. and Konradov, A.A., The Cosmophysical Origin of “Macroscopic Fluctuations” – *Biofizika*, 1998, v. 43, iss. 5, pp. 909–915 (in Russian).
2. van der Ziel, A., Fluctuations in radiotechnics and physics, Moscow-Leningrad, Gosenergoizdat, 1958.
3. Shnoll, S.E., Rubinshtein I.A., Zenchenko, K.I., Zenchenko, T.A., Udal’tsova, N.V., Kondradov, A.A., Shapovalov, S.N., Makarevich, A.V., Gorshkov, E.S., Troshichev, O.A., Dependence of “macroscopic fluctuations” on geographic coordinates (from materials of the expeditions in the Arctic (2000) and the Antarctic (2001).) *Biofizika*, 2003, 48(6), pp. 1123–31 (in Russian).
4. Shnoll, S.E., Zenchenko, K.I., Berulis, I.I., Udal’tsova, N.V., Zhirkov, S.S., Rubinshtein, I.A., Dependence of “macroscopic fluctuations” on cosmophysical factors. Spatial anisotropy. *Biofizika*, 2004 Jan-Feb; 49(1), pp. 132–9 (in Russian).
5. Shnoll S.E., Zenchenko, K.I., Berulis, I.I., Udaltsova, N.V., Rubinstein, I.A., The fine structure of histograms of alpha activity measurements depends on the direction of the alpha particles flow and the Earth rotation: experiments with collimators, arXiv: physics/0412007.
6. Shnoll, S.E., Rubinshtein, I.A., Zenchenko, K.I., Shlekhtarev, V. A., Kaminsky, A.V., Konradov, A.A., Udaltsova, N.V. Experiments with rotating collimators cutting out pencil of alpha particles during radioactive decay of Pu-239, evidence of a sharp anisotropy of space, arXiv: physics/0501004.
7. Shnoll, S.E., Rubinshtein, I.A., Zenchenko, K.I., Shlekhtarev, V. A., Kaminsky, A.V., Konradov, A. A, Udaltsova, N.V., Experiments with rotating collimators cutting out pencil of alpha-particles during radioactive decay of Pu-239. Evidence of a sharp anisotropy of space, *Progress in Physics*, 2005, v. 1, pp. 81–84.
8. Shnoll, S.E. and Rubinstein, I.A. Regular changes in the fine structure of histograms revealed in the experiments with collimators which isolate beams of alpha-particles flying at certain directions, *Progress in Physics*, 2009, v. 2, pp. 83–95.
9. Shnoll, S.E., Macroscopic fluctuations with discrete distributions in different types of processes, in: Scientific and technical summary,

Molecular biology, Skulachev VP, ed. 1985, v. 5, VINITI, Moscow, pp. 130–200 (in Russian).

10. Udaltzova, N.V., Kolombet, V.A., Shnoll, S.E., The probable cosmophysical nature of macroscopic fluctuations in different types of processes. - ONTI NCBI AN SSSR, Pushchino, 1987, p. 96 (in Russian).
11. Shnoll, S.E., Udaltsova, N.V., Kolombet, V.A., Namiot, V.A. and Bodrova, N.B., On regularities in discrete distributions of measurement results (cosmophysical aspects). *Biofizika*, 1992, v.37, iss. 3, pp. 467–488 (in Russian).
12. Shnoll, S.E., Kolombet, V.A., On the realization of discrete states during fluctuations in macroscopic processes (the phenomenon of "macroscopic quantification", and the phenomenon of "macroscopic fluctuations "), *Physical Thought of Russia*, 1995, No. 1, pp. 87–93 (in Russian).
13. Shnoll, S.E., Kolombet, V.A., Pozharski, E.V., Zenchenko, T.A., Zvereva, I.M. and Konradov, A.A., Realization of discrete states during fluctuations in macroscopic processes. *Progress in Physical Sciences*, *Russian Academy of Sciences*, 1998, v. 41, iss. 10, pp. 1025–1035 (in Russian).
14. Shnoll, S.E., Pozharsky, E.V., Kolombet, V.A., Zvereva, I.M., Konradov A.A. and Zenchenko, T.A., On the discreteness of measurement results due to cosmophysical reasons. (The phenomenon of "macroscopic quantification", and the phenomenon of "macroscopic fluctuations"). *Russian Chemical Magazine*, 1997, 41 (3), pp. 30–36 (in Russian).
15. Zenchenko, T.A., Pozharsky, E.V., Zvereva, I.M., Kolombet, V.A., Konradov A.A. and Shnoll, S.E., The fine structure of distributions of measurement results in all different types of processes as a result of cosmophysical influences. *Russian Chemical Magazine*, 1999, 43 (2), pp. 3–6 (in Russian).
16. Shnoll, S.E., Kolombet, V.A., Pozharski, E.V., Zenchenko, T.A., Zenchenko, K.I., and Konradov, A.A., Evidence for the influence of cosmophysical factors on the fine structure of experimental distributions – *Progress in Physical Sciences*, 2000, v. 43, iss. 2, pp. 214–218 (in Russian).
17. Shnoll S.E., Macroscopic fluctuations of discrete distribution forms as a consequence of arithmetic and cosmophysical causes (factors determining fine structures of histograms may be beyond the Solar

system), *Biofizika*, 2001, 46(5), pp. 775–82 (in Russian).

18. Shnoll S.E., Changes in the fine structure of stochastic distributions as a consequence of space-time fluctuations. *Progress in Physics*, 2006, v. 2, pp. 39–45.
19. Khmaladze E.V., Martingale limit theorems for divisible statistics, *Theory of probabilities and its application*, 1983, v. 28, iss. 3, p. 504 (in Russian).
20. Udaltzova, N.V., Urinov I.K., Evaluation of observed extremes probabilities in histograms constructed from small samples, dep. VINITI, iss. 850-B89, 08.02.1989 (in Russian).
21. Udaltzova, N.V., Bodrova, N.B., Shnoll, S.E., Ivanov, P.S., Evaluation of the similarity of shapes of histograms constructed from small samples, in: *111th All-Union Scientific Conference "Prospective planning and analysis methods"*, Grodno, 1988, pp. 155–156 (in Russian).
22. Bodrova N.B., Udaltzova, N.V., Ivanov, P.S., Shnoll, S.E., On the non-randomness of inconsistent histograms shapes, NCBI preprint, Pushino, 1989 (in Russian).
23. Udaltzova, N.V., Probable cosmophysical conditionality of changes of biochemical and physicochemical process parameters, PhD thesis, Pushino, IBPh USSR AS, 1990 (in Russian).
24. Ivanov P.S., Macroscopic fluctuations of background conductivity of bilayer lipid membranes, in: Engineering and physical problems of new techniques, Moscow, MSU-Press, 1990, pp. 144-145; Ivanov P.S., Stability of gramicidine channels state, PhD thesis, MSU Physical Faculty, 1992 (in Russian).
25. Pozharsky E.V., Elastic characteristics of protein crystals and lipid vesicles, PhD thesis, Pushino, ITEB RAS, 1998 (in Russian).
26. Strelkov, V.V., A new measure for histogram comparison and its application in time series analysis. *Pattern Recognition Letters*, 2008, v. 29, pp. 1768–1774.
27. Lyamin, E.A., Manuscript (author's archive) (in Russian).
28. Novitsky, P.V., Zograf, I.A., Error estimation of measuring results, Leningrad, Energoatomizdat, 1985 (in Russian).
29. Fyodorov, M.V., Application of modified methods of wavelet approximation and classification topography of the shapes of sampling distributions for the analysis of measurement results of biological and physical processes, PhD thesis, Pushino, ITEB RAS, 2002 (in Russian).

30. Strelkov, V.V., Near-zone effect in dynamic chaos, *Biofizika*, 2001, v. 46, iss. 5, pp. 807–810.
31. Zenchenko, T.A, Deformation effect on catalytic activity of crystallized enzymes, carboxipeptidase A, PhD thesis, Pushino, ITEB RAS, 1995 (in Russian).
32. Bodrova, N.B., Discrete macroscopic fluctuations in processes of different nature, PhD thesis, Physical Faculty of MSU, 1989 (in Russian).
33. Kolombet, V.A., Phenomenological investigation of "macroscopic" fluctuations in physical and biological systems, – PhD thesis. Pushchino, Institute of Theoretical and Experimental Biophysics, 1993, p. 24 (in Russian).
34. Zvereva, I.M., Study of histogram fine structure time changes in measurements of alpha-activity PhD thesis, Physical Faculty of MSU, 2000 (in Russian).
35. Shnoll, S.E., Pozharsky, E.V., Kolombet, V.A., Zvereva, I.M., Konradov, A.A. and Zenchenko, T.A., On the discreteness in measurement results due to cosmophysical reasons. (the phenomenon of "macroscopic quantification", and the phenomenon of "macroscopic fluctuations"). - *Rossiiskii Chimicheskii Zhurnal*, 1997, 41 (3), pp. 30–36 (in Russian).
36. Zvereva, I.M., Zenchenko, T.A., Pozharski, E.V., Kolombet, V.A., Konradov, A.A., Shnoll, S.E., Radioactive decay of Radium family isotopes as an illustration of synchronous changes in the fine structure of the distributons of measurement results. *Biophysics*, 1998, v. 43, N4, pp. 693–695.
37. Shnoll, S.E., Kolombet, V.A., Pozharsky, E.V., Zenchenko, T.A., Zvereva, I.M., and Konradov A.A., The shape of state spectra realized in the course of macroscopic fluctuations varies simultaneously in independent processes in the range of measurement periods from 0.06 seconds to 1 minute, *Biofizika*, 1998, v. 43, iss. 4, pp. 716–719 (in Russian).
38. Shnoll, S.E., Kolombet, V.A., Pozharsky, E.V., Zenchenko, T.A., Zvereva, I.M., and Konradov A.A., Illustration of synchronous variations in the fine structure of distributions of measurement results exemplified by radioactive decay of the Uranium-Radium family. *Biofizika*, 1998, v. 43, iss. 4, pp. 732–735 (in Russian).
39. Shnoll, S.E., Pozharski, E.V., Zenchenko, T.A., Kolombet, V.A., Zvereva, I.M., Konradov, A.A.,The fine structure of distributions in

measurements of different processes as affected by geophysical and cosmophysical factors. *Phys. Chem. Earth A*, 1999, v. 24, N8, pp. 711-714.

40. Zenchenko, T.A., Pozharsky, E.V., Zvereva, I.M., Kolombet, V.A., Konradov, A.A. and Shnoll, S.E., Fine structure of distributions of measurement results in every different type of process as a result of cosmophysical influences. *Russian Chemical Magazine*, 1999, 43 (2), pp. 3–6 (in Russian).

41. Shnoll, S.E., Kolombet, V.A., Zenchenko, T.A., Pozharski, E.V., Zvereva, I.M., Konradov, A.A., On the discreteness of different processes time series measurements which results from cosmophysical sources, Annales Geophysicae, 1998, Supplement 1 to v. 16, Part 1 Society Symposia, *Solid Earth Geophysics & Geodesy*, p. C312, EGS, XXIII General Assembly, Nice, France, April 20–24, 1998.

42. Zvereva, I.M., Zenchenko, T.A., Pozharski, E.V., Shnoll, S.E. On the synchronized changes of histogram fine structures for time series of Radium family isotopes activity. Annales Geophysicae, 1998, Supplement 1 to v. 16, Part 1 Society Symposia, *Solid Earth Geophysics & Geodesy*, p. C312, EGS, XXIII General Assembly, Nice, France, April 20–24, 1998.

43. Shnoll, S.E., Zenchenko, T.A., Pozharski, E.V., Zenchenko, K.I., Kolombet, V.A., Konradov, A.A., Zaikin, A.N., Kuzhevsky, B.M., Rudenko, V.N., Baurov, Yu.A., Sobolev, Yu.G., Kushniruk, V.F., Macroscopic fluctuations of space-time as a possible source of nonrandomness of similarity of distributions of synchronous measurement results for processes of different nature. In: Biophotonics and Coherent Systems, *Proc. of the* 2^{nd} *Alexandr Gurvitsch Conference and Additional Contributions*, Eds. Belousov, L., Popp, F.-A., Voeikov, V., van Wijk, R., 2000, pp. 44–52.

44. Zenchenko, K.I., Zenchenko, T.A., Kuzhevskii, B.M., Vilken, B., Axford, Y., Shnoll, S.E., Forms of histograms constructed from measurements of alpha-decay of 228Ra in Lindau (Germany) and neutron fluxes in Moscow change synchronously according to the local time. *Biofizika*, 2001 46(5): 783–5 (in Russian).

45. Fedorov M.V., Belousov L.V., Voeikov, Vi., Zenchenko, T.A., Zenchenko, K., Pozharski, E.V., Konradov, A.A., Shnoll, S.E., Synchronous changes in dark current fluctuations in two separate photomultipliers in elation to Earth rotation. *Astrophysics & Space Science*, 2003, N1, pp. 105–112.

46. Gusev, A.V., Kulagin, V.V., Oreshkin, S.I., Rakhmanov, A.N., Rudenko, V.N., Serdobol'sky, A.V., Tsepkov, A.N., Tsyganov, A.V., Motylev, A.N., *Astronomy magazine*, 1997, v. 74, iss. 2, pp. 287–296 (in Russian).
47. Shnoll, S.E., Correlation between the shapes of spectra of macroscopic fluctuations amplitudes and the position of the moon on the horizon, *Biofizika*, 1989, v. 34, iss. 5, pp. 911–912 (in Russian).
48. Zenchenko, T.A., Konradov, A.A., Zenchenko, K.I., Correlation of the amplitude of the near zone effect dynamics with parameters of interplanetary magnetic field, *Geophysical processes and biosphere*, 2005, v. 4, iss. 1/2, pp. 125–132 (in Russian).
49. Zenchenko, T.A., Konradov, A.A., Zenchenko, K.I., Macroscopic fluctuations: periodicity of the manifestation of the "near-zone" effect. *Biofizika*, 2003, 48(6): 1132-6. http://www.ncbi.nlm.nih.gov/pubmed/14714530, (in Russian).
50. Shnoll, S.E., Shapes of spectra of realized states due to macroscopic fluctuations depend on the Earth axial rotation, *Biofizika*, 1995, v.40, iss. 4, p. 865–875 (in Russian).
51. Shnoll, S. E., Zenchenko, K.I., Udaltsova, N.V., Cosmophysical effects in the structure of daily and yearly periods of changes in the shape of histograms constructed from the measurements of 239-Pu alpha-activity. *Biophysics*, 2004, v. 49, Suppl. 1, pp. 155–164.
52. Shnoll, S.E., Zenchenko, K.I., Udaltsova, N.V., Cosmo-physical effects in the structure of the daily and yearly periods of changes in the shape of the histograms constructed from results of measurements of alpha-activity Pu-239. arXiv: physics/ 0504092.
53. Shapovalov, S.N., Personal information.
54. Shnoll, S.E., Pancheluga, V.A., Cosmo-physical effects in the time series of the GCP network, arXiv: physics/0605064.
55. Panchelyuga, V.A., Kolombet, V.A., Kaminsky, A.V., Panchelyuga, M.S., Shnoll, S.E., Local time effect in noise processes – *Proc. of Kaluga University*, 2006, iss. 2, pp. 3–8 (in Russian).
56. Kolombet, V.A., Kaminsky A.V., Shnoll, S.E., Investigations of the local-time effect on small space-time scale – *Hypercomplex numbers in geometry and physics*, 2006, vol. 3, iss. 1(5), pp. 116–121 (in Russian).
57. Panchelyuga, V.A., Kolombet, V.A., Pancheluga, M.S., Shnoll, S.E., Local-time effect on small space-time scale. In: *Space-Time Structure*, collected papers, Tetru, MocKBa, 2006, pp. 344–350.

58. Panchelyuga, V.A., Kolombet, V.A., Pancheluga, M.S., Shnoll, S.E., Experimental investigation of the existence of a local-time effect on the laboratory scale and the heterogeneity of space-time, *Progress in Physics*, 2007, v. 1, pp. 64–69.
59. Panchelyuga, V.A., Shnoll, S.E. On the second-order splitting of the local-time peak, *Progress in Physics*, 2008, v. 2, pp. 154–157.
60. See, for example: Vladimirsky, B.M., Temuryants, N.A., Martynyuk, V.S., Cosmic weather and our life, 20th Century Press, 2004 (in Russian).
61. Kotov, V.A., The Sun as a star: look from KrAO, *KrAO Proc.*, 2007, v. 103, iss. 2, pp. 245-254, Kotov, V.A., Levitsky, L.S., Discreteness of interplanetary magnet field rotation periods, *KrAO Proc.*, 1983, v. 68, pp. 56–68 (in Russian).
62. Shnoll, S.E., Regular changes of fine structure of random processes statistical distributions as a result of arithmetic and cosmophysical causes, (Report at MSU Rector academician V.A. Sadovnichy's workshop on October 16, 2002) *Proceedings of "Chaos and mathematical problems"*, iss. 3, Knizny dom University, Moscow, 2004, pp. 121–154 (in Russian).
63. Shnoll, S.E., Paradoxes and problems of the interpretation of the macroscopic fluctuations phenomenon, *Russ. Chem. Journal*, 2002, v. 46, iss. 3, pp. 3–8 (in Russian).
64. Shnoll S.E., Zenchenko K.I., Shapovalov S.N., Gorshkov E.S., Makarevich A.V., Troshichev, O.A., The specific form of histograms presenting the distribution of data of alpha-decay measurements appears simultaneously in the moment of New Moon in different points from Arctic to Antarctic, arXiv: physics/0412152.
65. Shnoll, S.E., Panchelyuga, V.A., On the characteristic form of histograms appearing at the culmination of Solar eclipse, arXiv: physics/0603029.
66. Vezzoli, G.C., On the explanation of the physical cause of the Shnoll characteristic histograms and observed fluctuations, *Progress in Physics*, 2008, v. 2, pp. 158–161.
67. Shnoll, S.E., Reply to the letter by Gary C. Vezzoli, *Progress in Physics*, 2008, v. 2, pp. 162–163.
68. Gulyayev, R.A., Gulyayeva, T.L., A probable non-gravitational mechanism of Moon effects on biological processes. *Biofizika*, 1992, v. 37, iss. 3, pp. 541–546 (in Russian).

69. Gorshkov, E.S., Shapovalov, S.N., Sokolovskii, V.V., Troshichev, O.A., Gravitational cause of fluctuations of the rate of oxidation of unithiol by nitrite ion. http://www.ncbi.nlm.nih.gov/pubmed/11040968, *Biofizika*, 2000, 45(4), pp. 631–5 (in Russian).

70. Shapovalov, S.N., Gorshkov, E.S., Borisova, T.D., Sokolovskii, V.V., Troshichev, O.A., Random fluctuations in readings of measurement devices: cosmophysical effects? *Biofizika*, 2001, 46(5), pp. 819–22 (in Russian).

71. Sokolovsky, V. V., Gorshkov, E. S., Ivanov, V. V., Shapovalov, S. N., Troshichev, O. A., Relation of the regular gravitational field variations to biochemical processes observed in vitro and in vivo. *Biophysics*, 2004, v. 49, Suppl. 1, pp. S85–S91.

72. Troshichev, O.A., Gorshkov, E.S., Shapovalov, S.N., Sokolovskii, V.V., Ivanov, V.V., Vorobeitchikov, V.M., Variation of the gravitational field as a motive power for rhythmics of biochemical processes. *Advances in Space Research*, 2004, v. 34, pp. 1619–1624.

73. Shapovalov, S.N., Gorshkov, E.S., Troshichev, O.A., Borisova, T.D., Frank-Kamenetsky, A.V., Effects of non-electromagnetic disturbances from the Sun in computer time instability. *Biophysics*, 2004, v. 49, Suppl. 1, pp. S79–S84.

74. Shapovalov, S.N., Gorshkov, E,S., Troshichev, O.A., Cosmophysical effects observed in impulses of the microphotocolorimeter current. *Biophysics*, 2004, v. 49, Suppl. 1, pp. S119–S122.

75. Gorshkov, E.S., Shapovalov, S.N., Sokolovskii, V.V., Troshichev, O.A., Detection of pulsed cosmic radiation. *Biofizika*, 2000, 45(5), pp. 947–9 (in Russian).

76. Shapovalov, S.N., Priniciples of a physical indication of cosmogeophysical non-electromagnetic ecological factors, PhD thesis, Saint-Petersburg, AARI and RSHU, 2003 (in Russian).

77. Atsukovsky, V.A., Critical analysis of the theory of relativity, Petit Press, 1996 (in Russian).

78. Allais, M., L'Anisotropie de l'Espace. Paris, Editions Clement Juglar, 1997.

79. Miller, D.C., The ether-drift experiment and the determination of the absolute motion of the Earth, *Review of Modern Physics*, 1933, v. 5, pp. 204–241.

80. Cahill, R.T., Gravitation, the "Dark Matter" effect and the fine structure constant, arXiv: physics/0401047.

81. Cahill, R.T., Novel Gravity Probe B gravitational wave detection, http://arxiv.org/abs/physics/0408097.
82. Cahill, R.T., Absolute motion and gravitational effects. *Apeiron*, 2004, v. 11, N 1, pp. 53–111.
83. Cahill, R.T., The Roland De Witte 1991 experiment (in memory of Roland De Witte). *Progress in Physics*, 2006, v. 3, pp. 60–65.
84. DeMeo, J., Critical review of the Shankland et al. analysis of Dayton Miller's ether-drift experiments presented at the meetings of the Natural Philosophy Alliance Berkeley, California and Storrs, Connecticut, May-June 2000.
85. Trukhanov, K.A., Probable role of the Aharonov-Bohm effect in the biological action of a magnetic field, http://www.ncbi.nlm.nih.gov/pubmed/661216, in: *Physico-mathematical and biological mechanisms of EMF effects and air ionization*, Nauka, Moscow, 1975, v. 1, pp. 151–152 (in Russian).
86. Trukhanov, K.A., Probable role of the Aharonov-Bohm effect in the biological action of a magnetic field, http://www.ncbi.nlm.nih.gov/pubmed/661216, *Kosm Biol Aviakosm Med.*, 1978, 12(3), pp. 82–3 (in Russian).
87. Baurov, Iu.A., Trukhanov, K.A., The probable role of cosmological vector potential as a factor of cosmo- and geliophysical relations, *Biofizika*, 1998, v. 43, iss. 5, pp. 928–934 (in Russian).
88. Baurov, Yu.A., Konradov, A.A., Kuznetsov, E.A., Kushniruk, V.F., Ryabov, Y.B., Senkevich, A.P., Sobolev, Yu.G., Zadorozsny, S., Experimental investigations of changes in /3-decay rate of 60-Co and 137-Cs, *Mod. Phys. Lett. A*, 2001, v. 16, N32, p. 2089.
89. Baurov, Yu.A., Shutov, V.L., On the effects of Earth and Sun vector magnetic potential on beta-decay rate, *Applied physics*, 1995, iss. 1, p. 40 (in Russian).
90. Baurov, Yu.A., Klimenko, E.Yu., Novikov, S.I., Experimental observation of space magnet anisotropy, *Proceedings of USSR Academy of Sciences*, 1990, v. 315, iss. 5, p. 1116 (in Russian).
91. Baurov, Yu.A., Space magnetic anisotropy and a new interaction in nature. *Phys. Lett. A*, 1993, v. 181, p. 283.
92. Baurov, Yu.A., Timofeyev, I.B., Chernikov, V.A., Chalkin, S.I., Experimental investigations of the spatial anisotropy of impulse plazmotron emission, *Applied physics*, 2002, iss. 4, pp. 48–57 (in Russian).

93. Baurov, Iu.A., The structure of physical space and a new energy production process, Krechet-Press, Moscow, 1998 (in Russian).
94. Baurov, Iu.A., Iakovenko, V.A., Komissarov, A.V., Verzhikovskii, V.G., Konradov, A.A., Study with a quartz resonator of a new natural informational channel associated with quantum properties of the physical space (vacuum). *Biofizika*, 2001, 46(5), pp. 823–8 (in Russian).
95. Baurov, Yu.A., Yakovenko, V.A., Komissarov, A.V., Verzhikovski, V.G., Baurov, A.Yu., Konradov, A. A., Zenchenko, T.A., Preliminary results of an experimental investigation of a new information channel in nature with the aid of quartz resonators' system. *International Journal of Scientific Research*, 2006, v. 16, pp. 469–473.
96. On the global consciousness CP system, http://noosphere.princeton.edu/.
97. Udaltzova, N.V., Kolombet, V.A., Shnoll, S.E., The possible gravitational nature of factor influencing discrete macroscopic fluctuations, In: *Proc. First Intern. Congress on Geo-cosmic Relations*, Wageningen, Netherlands, 1989, pp. 174–180.
98. Shnoll, S.E., Udaltzova, N.V., Bodrova, N.B., Macroscopic fluctuations with discrete structure distributions as a result of universal causes including cosmophysical factors, In: *Proc. First Intern. Congress on Geo-cosmic Relations*, Wageningen, Netherlands, 1989, pp. 181–188.
99. Bodrova, N.B., Udaltsova, N.V., Kolombet, V.A., Shnoll, S.E. Macroscopic quantum effect: discrete distributions of physico-chemical parameters, *International Congress on Biometeorology*, Austria, Vienna, August 26-September 03, 1990.
100. Shnoll, S.E., Kolombet, V.A., Global network of automatic devices for monitoring fluctuative biometeorological processes, *International Congress on Biometeorology*, Austria, Vienna, August 26-September 03, 1990.
101. Kaminsky, A.V., Shnoll, S.E., The study of synchronous (by local time) changes of the statistical properties of thermal noise and alpha-activity fluctuations of a 239-Pu sample, arXiv: physics/0605056.
102. Panchelyuga, V.A., Kolombet, V.A., Kaminsky, A.V., Panchelyuga, M.C., Shnoll, S.E., Local time effect in noise processes, Proc. of Kaluga University, 2006, iss. 2, pp. 3–8 (in Russian).
103. Panchelyuga, V.A., Shnoll, S.E., Experimental investigation of rapidly rotating massive body effects on the shape of distribution functions

of amplitudes of α-decay rate fluctuations, *Hypercomplex numbers in geometry and physics*, 2006, v. 3, iss. 1(5), pp. 102–115 (in Russian).

104. Panchelyuga, V.A., Shnoll, S.E., Experimental investigation of spinning massive body influence on the fine structure of distribution functions of alpha-decay rate fluctuations, arXiv: physics/0606173.
105. Panchelyuga, V.A., Kolombet, V.A., Pancheluga, M.S., Shnoll, S.E., Local-time effect on small space-time scale, In: *Space-Time Structure*, collected papers, Tetru, Moscow, 2006, pp. 344–350.
106. Panchelyuga, V.A., Kolombet, V.A., Pancheluga, M.S., Shnoll, S.E., Experimental investigation of the existence of a local-time effect on the laboratory scale and the heterogeneity of space-time, *Progress in Physics*, 2007, v. i, pp. 64–69.
107. Panchelyuga, V.A., Shnoll, S.E., On the second-order splitting of the local-time peak, *Progress in Physics*, 2008, v. 2, pp. 154–157.
108. Pancheluga, V.A., On regularities of shape similarity of fluctuations amplitudes spectra in various types of processes, PhD thesis, Moscow, Physical Faculty of MSU, 2008 (in Russian).
109. van der Waerden, B.L., Statistical Theory, Inostrannaya Literatura, Moscow.
110. Shnoll, S.E., Kolombet, V.A., Ivanova, N.P. and Britsina, T.Ya., Macroscopic fluctuations as common property of aqueous solutions of different enzymes and other substances. Statistical analysis of macroscopic fluctuations, *Biofizika*, 1980, v. 25, iss. 3, pp. 409–416.
111. Shnoll, S.E., The "scattering of the results of measurements" of processes of diverse nature is determined by the Earth's motion in the inhomogeneous space-time continuum. The effect of "half-a-year palindromes". *Progress in Physics*, 2009, v. 1, pp. 3–7.
112. **Theoretical constructions and hypotheses**
    I only mention here the references to works of some authors, which somehow relate to the theoretical interpretation of the macroscopic fluctuations phenomenon; the analysis of proposed concepts is beyond the scope of the book.

    T-1 Namiot, V.A., On the theory of the effect of macroscopic fluctuations, Biophysics, 2001, v. 46, N5, pp. 856–858.

    T-2 Blumenfeld, L.A., Zenchenko T.A., Quantum transitions between states and cosmophysical fluctuations, Biophysics, 2001, v. 46, N5, pp. 859–861.

T-3 Lyapidevskii, V.K., Diurnal variations in the flux of alpha-particles as possible evidence for changes in the vector of velocity of movement of an experimental set-up relative to a relic system, Biophysics, 2001, v. 46, N5, pp. 850–851.

T-4 Dmitrievskii, I.M., A possible explanation of the phenomenon of cosmophysical fluctuations, Biophysics, 2001, v. 46, N5, pp. 852–855,

T-5 Kirillov, A.A., Zenchenko, K.I. On the probability of disturbance of the Poisson statistics in processes of radioactive decay type, Biophysics, 2001, v. 46, N 5, pp. 841–849.

T-6 Goleminov, N.G., Possible nuclear activity of Dark Matter, Gravitation & Cosmology, 2002, v. 8, Supplement, p. 219.

T-7 Rodionov, B.U., On the way to new physics, Gravitation & Cosmology, 2002, v. 8, Supplement, pp. 214–215.

T-8 Blumenfeld, L.A., Solvable and unsolvable problems of biological physics, URSS, Moscow, 2002.

T-9 Müller, H., Global Scaling – Die Basis ganzheitlicher Naturwissenschaft, Raum und Zeit, Special 1, 2004.

T-10 Vasiliev, S.A., Problems of non-material physics construction and its importance for all of us, Moscow, 2004.

T-11 Vasiliev, S.A., On the physical model of the phenomena registered in the experiments by Shnoll's group and Smirnov's group, *Progress in Physics*, 2009, v. 2, pp. 29–43.

T-12 Rabounski, D., A theory of gravity like electrodynamics. *Progress in Physics*, 2005, v. 2, pp. 15–29.

T-13 Borissova, L., Gravitational waves and gravitational inertial waves in the General Theory of Relativity: a theory and experiments, *Progress in Physics*, 2005, v. 2, pp. 59–91.

T-14 Namiot, V.A., Shnoll, S.E., On the possible mechanism of periodicity in fine structure of histograms during nuclear decay processes. *Physics Letters A*, 2006, v. 359, pp. 249–251.

113. **Criticism of experimental results**

I further list all issued papers that I know, which doubt my experimental results. I have answered them to the best of my knowledge in the texts of this book.

K-1 Preobrazhenskaya, T.A., On spontaneous changes of actomyosin properties, *Biofizika*, 1971, v. 16, iss. 1, pp. 152–153 (in Russian).

K-2 Vekshin, N,L., Macroscopic fluctuations: phenomenon or artifact? *Biofizika*, 1989, v. 34, iss. 4, pp. 723–731 (in Russian).

K-3 Ivanchenko, Yu.G., On macroscopic fluctuations in measurements of radioactivity, *Biofizika*, 1989, v. 34, iss. 4, pp. 732–735 (in Russian).

K-4 Shnoll, S.E., On papers of N.L. Vekshin and Yu.G. Ivanchenko, *Biofizika*, 1990, v. 35, iss. 1, pp. 162–166 (in Russian).

K-5 Gusev, A.V., Rudenko, V.N., Serdobol'sky, A.V., Analysis of background noise of "Ulitka" gravitational antennae, *Astronomy magazine*, 2003, v. 80, iss. 8, pp. 728–737 (in Russian).

K-6 Derbin, A.V., Bakhlanov, S.V., Egorov, A.I., Muratova, V.N., Remarks on the "Realization of discrete states in macroscopic processes fluctuations", *Progress in Physical Sciences*, 2000, v. 170, iss. 2, pp. 209–212 (in Russian).

K-7 Kushnerenko, E.A., Pogozhev, I.B., Comment on the paper by S.E. Shnoll et al., *Progress in Physical Sciences*, 2000, v. 170, iss. 2, pp. 213–214 (in Russian).

114. Shnoll, S.E., Heroes, villains and conformists of native science, 3rd edition, URSS, Moscow, 2010.

115. Shnoll, S.E., Lev Alexandrovich Blumenfeld, Biophysics and poetry, MSU Press, Moscow, 2009.

Cosmophysical Factors in Stochastic Processes

by Simon E. Shnoll

This book is the result of long-term observations that were recorded and analysed over many years. Through these we were able to identify a new, previously unknown, phenomenon, which remains as yet unexplained. Attempts to explain it through some methodical cause, the "scattering" of measurement results obtained from absolutely different types of processes — chemical and biological reactions, noises in electronic systems, thermal noise in a gravitational wave antenna, and also many different kinds of radioactive decay. This phenomenon is due to space-time fluctuations, which appear in the object being studied during its travel through an inhomogeneous anisotropic space-time region. The fine structure of the fluctuations' amplitude spectrum of the measured quantities, i.e. the form of the respective histograms, changes periodically with time and only depends on the geographical location and the local time of observation. Part 1 of this book provides a description of the main stages of this research produced during the period of 1951–1997. Those led to conjoint and consistent conclusions. Part 2 of this book presents the results obtained in the study of the aforementioned effect in systematical measurements of ^{239}Pu alpha-decay.

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