

Experimental confirmations of the bioeffective effect of magnetic storms.

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The results of experiment for determination of influence of geomagnetic field disturbances on a human organism are considered. We used method of electropuncture diagnostics by R.Voll for this aim. The method is based on measurement of conductivity in acupuncture points and is convenient by that allows to estimate deviations from the norm in functioning of various organs in same units. Local A-index is used as an indicator of geomagnetic field disturbance. The daily measurements of group (27 persons) have shown presence of a synchronous mass response of inspected people on magnetic storm. At first it is exhibited as sharp (within 3-4 hours) increase of conductivity of the all acupuncture points from normal values, that corresponds to a maximum of adaptational capabilities of an organism. And then - long duration (about 4 day) falling of conductivity that describes depression of all organs and systems of an organism. The reaction of adaptation on three magnetic storms of identical intensity going with an interval per week was registered for a half inspected people. It was found out, that the duration of depression phase and disbalance of an organism, intrinsic to this phase, depends extremely on a wholeness of an organism (that is on a power of ties between organs and coordination of their activity), but not on a type of disease.

Introduction.

The people - part of a biosphere, as well as any alive organism. Therefore it is quite natural, that a person connected to external environment, dependent from it, adequately adapted for its changes during the existence on the Earth. For example, the response of our organism on changes of air temperature as regulation of body's temperature and illumination as expansion - narrow of a pupil is not subject to a doubt. But external environment is not only atmosphere and visible radiation, but also - electromagnetic, gravitational, acoustic, seismic fields, all part of a spectrum of solar and space radiation that inaccessible to our sense organs. That is our inability to feel some effect does not mean the absence of this effect. For example, there is widely known protective response of human skin on ultra-violet radiation, invisibilis by an eye, - as sunburn. Hence not so obvious response of an organism on, for example, changes of electromagnetic field (EMF) can exist also. The recent experiments speak for the benefit of this statement. They have shown, that the various organs of a person are sources of a weak magnetic field up to 10^{-8} - 10^{-9} Tl (Physical encyclopedia, 1990). Strength of this field is less than strength of constant magnetic field of the Earth and technogenic noise on a several orders. It seemed, what for we consider this problem in detail if so strong effects do not render visible influence on our organism? But a man - difficult non-linear system and " more " does not mean " more effective " for him (Breus, 1998). However, people meet weak fields much more often, than strong and it does not hinder to function normally to a man. Hence, the deal is not only in intensity. Except amplitude, frequency of EMF oscillations is played important role. Our organs actively radiate in frequency band from 0.01 up to 100 Hz (Physical encyclopedia, 1990). Receiving a hypothesis that the mechanism of the response of an organism on external weak fields is mainly based on a resonance, would be logical to assume, that EMF with similar frequencies of oscillations can render bioeffective effect.

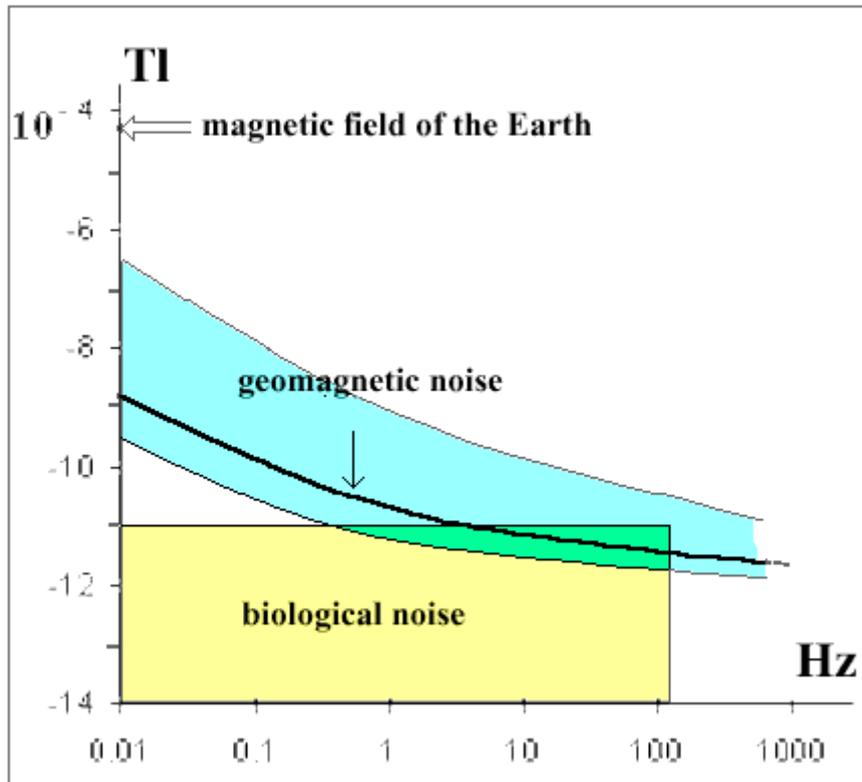


Figure 1 This picture illustrates interception of frequency bands of a magnetic storm and own EMF of various organs radiation of a person. The active response of an organism is necessary to expect in the field of interception of these ranges. Frequency and strength of magnetic field are postponed on the axes of abscissas and ordinates accordingly.

The basic possibility of existence of similar responses is underlined, for example, in works Riznichenko and Plusina (1996), Kamenir and Kirillov (1998). The Figure 1 shows, that the range of a biological noise is intersected with range of magnetic field variations of the Earth. So the supposition about effect of magnetic storms on a man has the actual basis under itself, because the magnetic storm is not only jump of the components of geomagnetic field, but also - specific irregular geomagnetic variations with period 1-150 second (Saito T., 1974). Moreover, the rhythms of biological systems are described by *öwanderingö* of a phase and amplitude, they are similar to rhythms of gelio-geomagnetic parameters, that facilitates their *ötuningö* under a rhythm of the external synchronizer (Breus et al, 1995) .

Technique of experiment.

If we consider a person as an object of research, than a problem appears: which technique must we choose for registration of changes in an organism at effect of the external factors on this organism. If, for example, explorers take interest in people's reaction on magnetic storms, these types of investigations are carried out more often:

- The analysis of statistical data for long duration period of time (processing of illness histories, number of calls "of first aid " etc.). The technique, unfortunately, has strong social noise and its data are not always authentic.

- Biophysical experiments at a cell-like level and analyses of blood (outside of an organism). In this case it is necessary to take into account the difference between properties of cells and blood *in vitro* and their properties in an alive organism.
- Medical functional diagnostics (measurement of pulse, temperature and pressure, ECG, magnetograms , ultrasound, gastroscopy). These rather full and authentic methods too have the shortages: boundedness of enveloped systems, impossibility of a comparison of obtained results among themselves (we can not compare frequency of pulse with an acidity of a stomach); frequently a methods are shocking for inspected people.

We have used the method of electroacupuncture diagnostics by R.Voll (Ionescu-Tigroviste C., 1984). This method is nonshoking, objective in the description both whole organism and separate its systems. It is founded on the fact that change of acupuncture points properties depends on condition of an organism (Portnov F., 1987). Acupuncture points - local sites of skin with diameter and depth of the order of 2-3 mm, which have increased temperature, electrical conductivity and other special properties (Fig. 2). Thus, their characteristics vary synchronously with change of an internal condition of an organism. The electropuncture diagnostic method uses change of resistance in an electrical circuit passing through these skin sites as diagnosing parameter. The similar research allows to reveal rejection in functioning of various systems of an organism most precisely. Moreover, R.Voll's method registers change of resistance rather normal, as a rule, earlier, than first clinical indications of disease appear and sometimes earlier, than they can register deviation in functioning of an organ by standard methods of medical diagnostics (Portnov F., 1987).

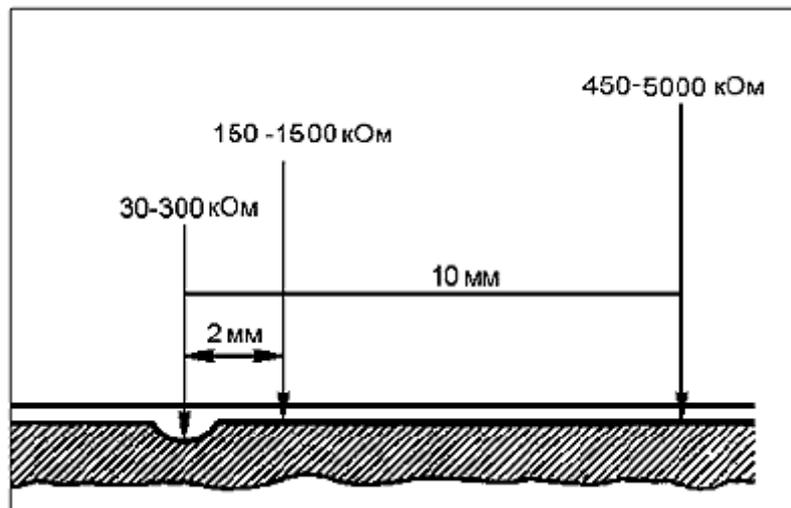


Figure 2 Change of electrical resistance of the skin depending on a distance up to the acupunctural points.

Technically examination is carried out so: the person appears live in a circuit of a continuous current. An inspected man holds the passive electrode in one hand, the active electrode densely nestles to chosen acupuncture point by pressing. Thus the point is irritated with current no more several μA . The healthy condition of an organ is characterized by its activation equals to force of an external irritation ($I \approx 8 \mu A$, $R \approx 100 kOhm$), thus the pointer of the device is established on 50 conditional units. The zero value of a dial corresponds to disconnected contacts, 100 units - short-circuit. The indications of the device in an interval 50-70 units are considered as the norm in medical practice, from 50-40 - as reduced function of an organ, lower then 35 - as destructive changes in an organ or system. If indications are

higher than 70 units - then there is hyperfunction, and values higher than 80-85 characterize an acute inflammation.

Thus, the offered technique allows to express changes in functioning of various organs in **same units** and this is cardinal difference between this methods and all above described.

Monitoring measurement with use of this technique are made for the first time. For example, the doctors actively using R.Vollø's method, inspect the patients not more often than time per one month, while we simultaneously inspect 27 persons of different age, sexes and with a various condition of health. The measurements are carried out daily by device "MicroVoll", certificated by Russian Ministry of Health. The examination of volunteers is made with an interval at 3-4 o'clock in days of storms. 10 checkpoints describing condition of nervous, endocrinology, lymphatic systems; blood, lungs, thick and thin intestine, heart and organs degeneration, allergy were chosen on both hands. The results of measurements for 4 months (during which 10 magnetic storms were registered) will be considered below.

Internal ties of an organisms - characteristic of our health.

If we want to know a precisely response on particular storm, we must to decide a double return problem: to find out, how the storms differ from each other and to define, how the distinguished from each other people will react to these storms. The technique of long duration measurements, used by us, allows to decide the second part of this problem. Treating the obtained information, we were aimed to find regularities presenting influence of magnetic storms on the people and circumscribing changes in an organism most simple and effective.

Let us to designate $F_{i,j}$ ($1 < i < 10, j = 1; 2$)- indication of the device "MicroVoll" at measurement in i -th acupunctural point on the left hand ($j = 1$) or right hand ($j = 2$). The diagrams of standard deviations of time series $F_{i,1}(t)$ and $F_{i,2}(t)$ were made for each examined person and all i , matrixes of conjugate correlations of these series also were calculated.

We shall consider a coefficient of correlation between series $F_{l,j}(t)$ and $F_{k,j}(t)$ as an element of such matrix $m_{l,k}$

The [diagrams of deviations \(a\)](#) and [matrix \(b\)](#) of two inspected people having code labels 16_fem and 81_fem, designed for case $j = 2$ on time frame April - May 1998 are shown on Figure 3. Number of points are given at once deciphered for convenience (for example $i = 1$ means *lymph* – lymphatic system), the values of elements of a matrix are shown by intensity of coloring.

The diagrams of deviations give representation about which organ is subjected of the greatest danger at unfavorable external effects. Large dispersion rather mean (large values of standard deviation) speaks about instability of an organ condition, and large difference between mean values - about instability of an organism in whole.

Matrix of conjugate correlations (\hat{I}_{bc}) describes synchronism of various organs response on external stimuluses and is an individual physiological portrait of an examined person. Strong tie between organs (mean value on nondiagonal elements of a matrix $R_{mean} \sim 0,7$) is

characteristic both for rather healthy organisms and for the people suffering by chronic diseases. Weak tie ($R_{mean} < 0,5$) speaks about a non-simultaneous response of organs on the stress-factors, the reasons of that can be, for example, advanced age, acute inflammations and other cases of disbalance of systems of an organism. Case of strong tie is demonstrated by matrix of examined 81_fem, and case of weak tie - 16_fem (Figure 3a).

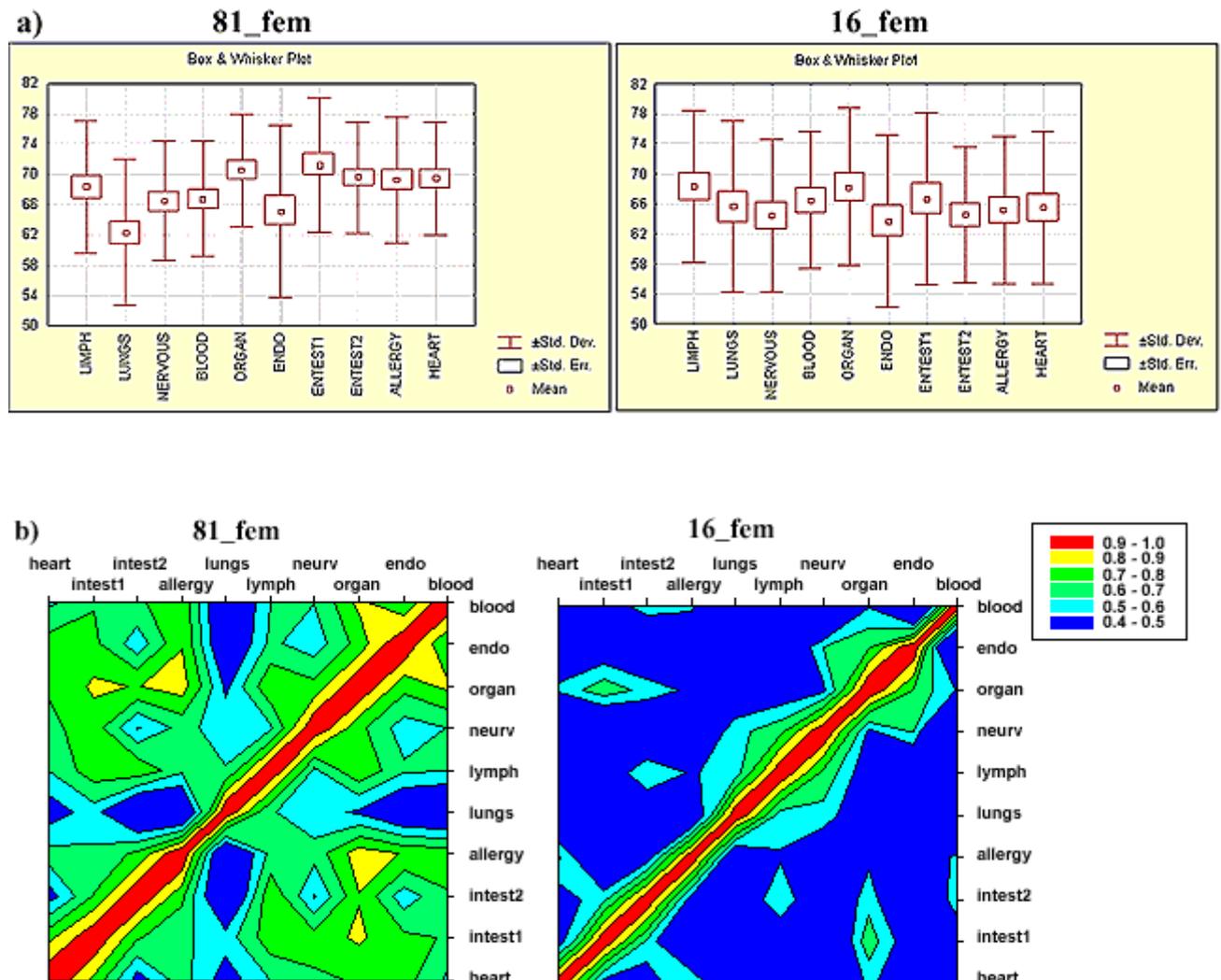


Figure 3 The diagram of standard deviations from mean **a)** and matrix of mutual correlations **b)** can be used as an individual portrait of the person. For **18_fem** the high correlation of systems of an organism with each other is visible; the mean values of for different i have small dispersion. It is characteristic for the healthy people and people with the settled mechanism of a course of chronic diseases. **16_fem** demonstrates strong dispersion of mean and weak correlation between systems. It is the case characteristic for the people of senile age or having acute inflammations.

A matrix of conjugate correlations and diagram of deviations of each person characterize the common condition of an organism and have a smooth seasonal and diurnal course. Thus parameters can striking differ in different days.

Comparison of data rows with local A-index.

Correlation coefficient (R_A) between local A-index of geomagnetic field and time series $F_{i,j}$ for each person for all period of measurements was calculated. It was founded, that as a rule R_A is not higher 0.55, that corresponds to already known results ([Lapko A.V., 1994](#), [Thcijevisky A.L., 1930](#), [Smirnova N.A., 1998](#)). However, as a matter of fact, the speech here is about the correlation with an undisturbed field. And it is impossible to judge about response of the person's organism on a storm using these values, as storms are rarity and the period of quiet geomagnetic situation lasts much longer. Besides, results of our experiments have shown the shift of a response peak is various in different seasons. For example, imagine that inspected N had reaction on magnetic storm in the day of a storm in April, in May - June - before day, in July-August - in two days after beginning of a storm. Such changes inevitably should result in a drop of correlation coefficient obtained on whole file.

Sometimes maximum of crosscorrelation function appears shifted concerning a row of data A-index forward or back. It corresponds to an outstrip or delay of an organism's response concerning geomagnetic field variations. And if the delay can be explained certain resistivity of an organism just to geomagnetic field variations, the outstrip, obviously, characterizes the response to any other kind of effect.

In spite of the fact that binder of a time course of parameters $F_{i,j}$ with undisturbed geomagnetic field is not traced for majority inspected people (R_A is small), there are separate inspected people having a rather high correlation coefficient ($R_A \approx 0.8$). There is a little them - only 10 % and all of them have a strongly connected correlation matrix of organs with each other. It is possible to assume, that geomagnetic field - constant external synchronizer for them.

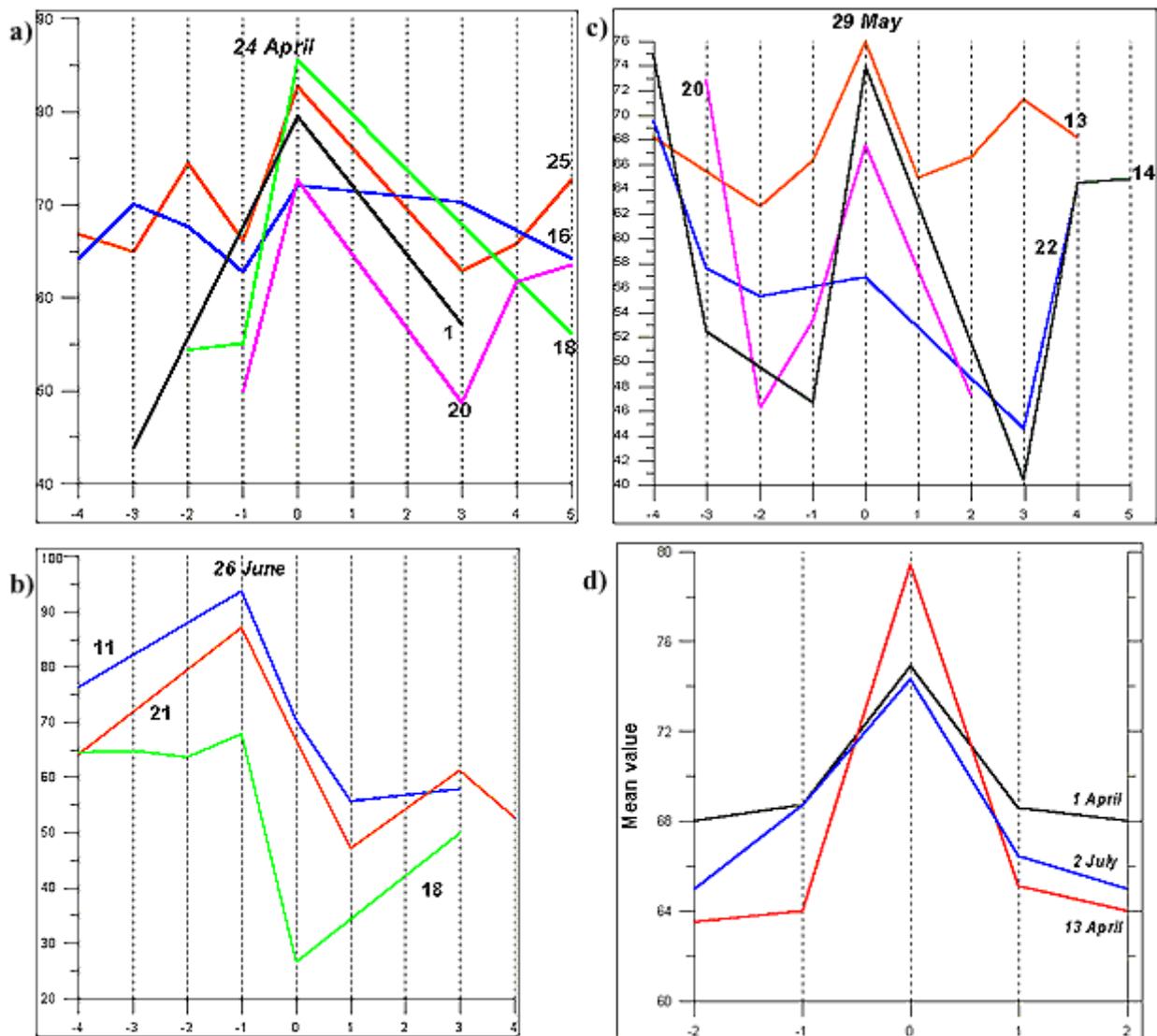


Figure 4 A response of different inspected on magnetic storm **a)**, **b)**; on the sharp doubled increase of A-index during 1 hour **c)**; **d)** a response of the inspected person on sharp (within 1 hour) jump of pressure $\Delta P \geq 1$ mbar. **4a)** the phase of hyperfunction (jump of mean values of $F_{i,j}$ calculated for all i above than 65 units) with a consequent falling of values (phase of depression) within 3-4 days is well traced. **4b)** the phase of hyperfunction is not registered, but phase of depression is visible well. **4c)** 50 % inspected have reacted on the sharp jump of geomagnetic field as on a storm. **4d)** response on jumps of atmospheric pressure is characterized by absence of the phase of depression.

So, coefficient of correlation with changes of A-index calculated on full file for long duration period - not enough effective index of response of an organism on magnetic storms. Much informative the graphics plotted on the method of imposed epoch by A.L Tchijevsky ([Tchijevsky A.L., 1976](#)). Such graphics describe a condition of an organism in the time frame ± 4 days in relation to day of a storm beginning. Similar mass (up to 80 % from common number inspected people) response on magnetic storms is well visible on them. It express by sharp change of all values $F_{i,j}$ in the day of magnetic storm ([Figure 4a](#)).

In more details it looks so: in the beginning a jump of $F_{i,j}$ to overstated values (> 60 units) is observed, this condition of hyperfunction lasts 3-4 hours and corresponds to the maximum of adaptation capabilities of an organism; then - the depression (sharp falling of values,

sometimes even up to 20 units) is registered during two - three day. Therefore, even if we have not registered a jump of $F_{i,j}$ at the people, which are inspected of time per day, the phase of depressed condition of an organism is visible (Figure 4a). So expressed response is not observed for 20 % inspected, or the parameters $F_{i,j}$ sharply vary before or after day of magnetic storm beginning (\pm days).

It is necessary to especially allocate a case, when the mass response was observed 1 day prior to the storm on June 26 (Figure 4b). Also case on May 29 (Figure 4c) attracts attention, when a storm was not, but the sharp jump of a magnetic field within several hours was registered, thus A-index has not left for value 20. The response of a circumscribed above type was given by 50 % inspected in this day, for remaining presence of reaction was disputable.

Thus, the effect looks like a type of a stress-response and is accompanied by increase of conductivity in a circuit passing through acupunctural points. Results of other investigators analyzing a responses of blood circulation and nervous system at people and animals confirm it (Chibisov, Breus et al, 1995, Oraevsky, Baevsky et al, 1997). It is necessary to note, that the response on other stress-factors essentially differs from a response on a magnetic storm both amplitude of peak and the absence of a long duration depression phase (Figure 4d shows, for example, response on sharp jumps of atmospheric pressure).

The fact looks interesting, that curve of mean on all points $F_{\langle i \rangle, \langle j \rangle}(t)$ for different inspected people demonstrate similar conduct 1-2 days prior to a magnetic storm, in spite of the fact that the clear likeness between them was not observed up to it. It is possible to assume, that, though majorities of the people do not have expressed tie between behavior of parameters and undisturbed field, change of a geomagnetic field become the external synchronizer and for them for a pair days up to a storm. Or it happens due to any information signal of other kind preceding to approach of a magnetic storm.

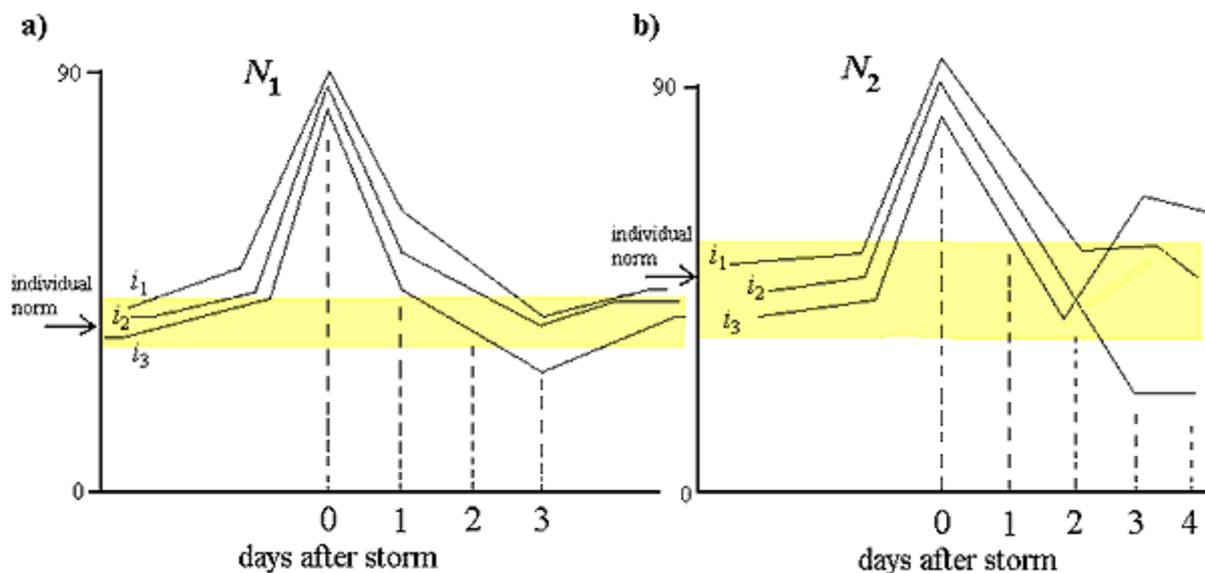


Figure 5 Difference in the phase of depression.

The group N_1 on Fig.5a) is characterized by a rather short phase of depression (2-3 days), curve for various parameters fast aim at area of the individual norm. A more long duration phase of depression and curve's disbalance in this phase are characteristic for group N_2 on Fig.5b).

It is necessary to note, that the complaints to bad state of health not always coincide the hyperfunction phase, they are more often were characteristic for the phase of depression. Thus the people with a poorly connected matrix M_{bc} have a more long duration depression phase on a comparison with group of the people M_{bc} of which is strongly connected. The difference between the depression phase of these one is visible in Figure 5a and 5b. Curve of values $F_{i,j}$ for different i fast came to mean in this phase for group of inspected N_1 , while for group N_2 strong disbalance in curves behavior for various i was observed. Thus, our experiments not confirmed widespread judgment, as if the response of people on magnetic storm depends on a type of disease (see, for example, Lapko, 1994.). The response depends on synchronism of organs activity, internal coordination, instead from the particular diagnosis.

One more interesting effect was remarked: about 50 % inspected have shown a response of adaptation on three storms approximately identical intensity going with an interval per 6-7 days: the heavily response on the first storm was observed and there was no response on consequent storms (Figure 6a). Values $F_{i,j}$ fast came to normal after a jump. Other half of inspected people had standard or increasing reaction on the storms (Figure 6b). For this group of people the values of acupunctural points conductivity were increased with each consequent storm, not returning in area of the individual norm in period between the storms.

This implies, that would be not bad to make the test for adaptation for the people that out work with frequent spectrum of fields close to the spectrum of magnetic storm (for example, for astronauts, personnel of submarines and drivers of electrotrains). Besides it is obvious, that the offered us technique of monitoring measurements of acupunctural points conductivity allows to estimate people's adaptational capability under action of others stress-factors.

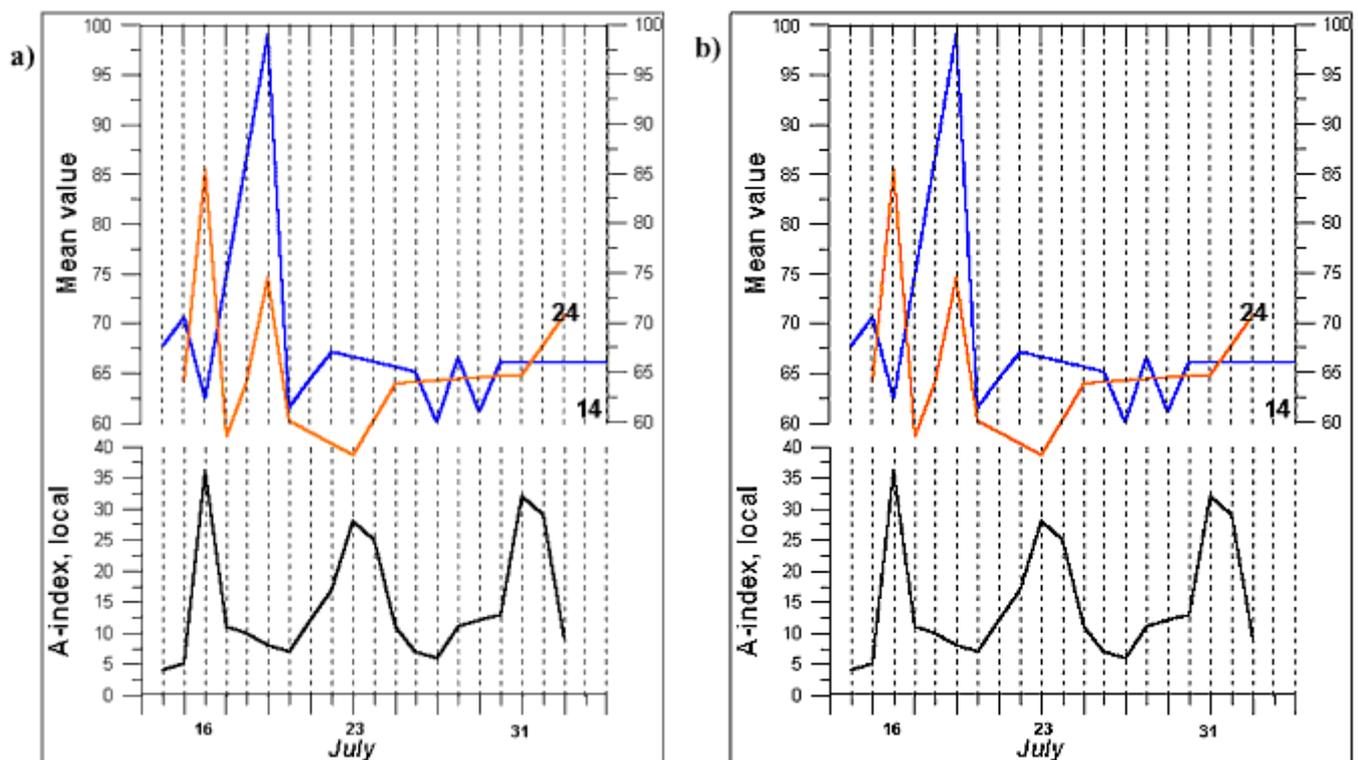


Figure 6 A response of inspected people on 3 successive storm of identical intensity.

6a) Reaction of adaptation: the heavily splash of mean values of $F_{i,j}$ associated with the first storm and absence of a response on remaining ones is observed. The values $F_{i,j}$ return in area of the individual norm after jump. **6b)**

Absence of adaptation: the stress-reaction on all storms is observed. Curve of mean of $F_{i,j}$ do not returns to normal values even in case of a smoothed response .

Conclusions and arguing.

Surveying obtained results it is possible to tell, that monitoring measurements with the help of electroacupuncture diagnostics method confirm the fact of effect of magnetic storms on people and enable to look deeply in essence of changes, happening in an organism. The offered us technique of experiment realization and data processing allows to estimate changes of various organs in same units operatively, that is very convenient for the description of an organism's response on external effects. Thus it was possible to reveal, that:

- The response of an organism on a magnetic storm is identical to an overwhelming majority of people, despite of difference) in the age, diseases and subjective sensations.
- The effect of magnetic storms - the cause of stress-response of organism, that is excitation of all systems of an organism is primary, but not braking is.
- Response on the magnetic storms is divided into two phases: hyperfunction with a maximum of adaptational capabilities of an organism (several hours) and depression (several days). Such response is characteristic only for magnetic storm, for the remaining stress-factors (such as change of atmospheric pressure, weather conditions, family disorders) the phase of depression is sharply reduced (no more day).
- The intensity of a response on geomagnetic disturbance depends not on a type of disease, but on coordination of systems of an organism activity . The people with poorly connected matrixes of internal correlations endure magnetic storms most heavily, as their organism is strongly trimmed out during the phase of depression.
- the effect of adaptation at frequently recurring magnetic storms of identical intensity for 50 % of inspected people is observed.

The fact that curve of $F_{i,j}(t)$ circumscribing the condition of an organism for various persons have similar course for 2-3 days prior to the storm beginning speaks about a response on forerunners of magnetic storm. If to take into account, that for some people the jump of values $F_{i,j}(t)$ happens for a pair of days up to the magnetic storm, it is necessary to assume, as if the people react to change of ionospheric-atmospheric parameters and parameters of interplanetary environment that precede to development of magnetic storm. The concrete mechanism of similar effects yet is not quite obvious. However it is clear, that if the type of reaction on geomagnetic disturbance depends on the person, time of appearance of this response and its presence are determined both thin structure of magnetic storm and previous history of its development. The further expansion of methods of measurement of people's organism health and methods of fine structure of geomagnetic field oscillations and other parameters analysis during disturbances of a geomagnetic field are necessary. Also, it is necessary to carry out in-depth study of events accompanying origin and development of magnetic storms on possible earlier stage.

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