

International Council For Scientific Development  
INTERNATIONAL ACADEMY OF SCIENCE  
H&E



# SCIENCE WITHOUT BORDERS

Transactions  
of the International Academy of Science  
H&E

Volume 2  
2005/2006



Innsbruck

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In the book are published the transactions of Full members and Corresponding Members of the International Academy of Science/International Council For Scientific Development, and the articles, presented by Academicians of ICSD/IAS H&E.

The content of the book is interdisciplinary and covers the main spheres of modern natural science. During selecting the articles to the book, the special priority was given to scientific researches, which are at the joint of different sciences.

This book is of interest for wide circles of scientists and students in different spheres of science.

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# INTRODUCTION

The second volume of the book “Science without borders/Transactions of the International Academy of Science, H&E, 2005/2006”, has more than 60 scientific articles.

In the book are represented the articles of famous scientists of Austria, USA, Russia, Norway, Azerbaijan, Brazil, Germany, North Cyprus, Georgia, Italy, Taiwan, Kazakhstan, Indonesia, Japan, Turkey, Thailand.

This book solves one of the main problems of ICSD/IAS H&E the exchange of scientific information and uniting of efforts of different scientists of the world for solving of the most actual problems of humanity. The book consists of seven parts: Medicine and biology; Sciences about the Earth; Physics, mathematics and astrophysics; Chemistry and oil industry; Architecture and construction; Social and economical sciences; News of science.

Full members (Academicians) and Corresponding Members of IAS H&E from national sections of different countries have published their scientific articles in this book. Besides, there are the articles of scientists, presented by Academicians of IAS H&E.

Editing of the book “Transactions of International Academy of Science H&E” is planned once in two years.

The editorial board congratulates the representatives of all national sections ICSD/IAS H&E with publication of second volume of the book, and hopes that this effective beginning will have successful continuation.

## Editorial Board

## **THE NOBEL PRIZE LAUREATE Y.T.LEE - 70-YEARS ANNIVERSARY**

### **BIOGRAPHY**

**Yuan Tseh Lee** was born on November 19, 1936 in Hsinchu, Taiwan. His father is an accomplished artist and his mother a school teacher.

He started his early education while Taiwan was under Japanese occupation - a result of a war between China and Japan in 1894. His elementary education was disrupted soon after it started during World War II while the city populace was relocated to the mountains to avoid the daily bombing by the Allies. It was not until after the war when Taiwan was returned to China that he was able to attend school normally as a third year student in grade school.

His elementary and secondary education in Hsinchu was rather colorful and full of fun. In elementary school, he was the second baseman on the school's baseball team as well as a member of the ping-pong team which won the little league championship in Taiwan. In high school he played on the tennis team besides playing trombone in the marching band.

Besides his interest in sports during this time, he was also an avid and serious reader of a wide variety of books covering science, literature, and social science. The biography of Madame Curie made a strong impact on him at a young age. It was Madame Curie's beautiful life as a wonderful human being, her dedication toward science, her selflessness, idealism that made him decide to be a scientist.

In 1955, with his excellent academic performance in high school, Lee was admitted to the National Taiwan University without having to take the entrance examination, a practice the Universities took to admit the best students. By the end of his freshman year he had decided chemistry was to be his chosen field. Although the facilities in the Taiwan University were less than ideal, the free and exciting atmosphere, the dedication of some professors, and the camaraderie among fellow students in a way made up for it. He worked under Professor Hua-sheng Cheng on his B.S. thesis which was on the separation of Sr and Ba using the paper electrophoresis method.

After graduation in 1959, he went on to the National Tsinghua University to do his graduate work. He received his Master's degree on the studies of the natural radioisotopes contained in Hukutolite, a mineral of hot spring sediment under Professor H. Hamaguchi's guidance. After receiving his M.S. he stayed on at



Tsinghua University as a research assistant of Professor C.H. Wong and carried out the x-ray structure determination of tricyclopentadienyl samarium.

He entered the University of California at Berkeley as a graduate student in 1962. He worked under the late Professor Bruce Mahan for his thesis research on chemiionization processes of electronically excited alkali atoms. During his graduate student years, he developed an interest in ion-molecule reactions and the dynamics of molecular scattering, especially the crossed molecular beam studies of reaction dynamics.

Upon receiving his Ph.D. degree in 1965, he stayed on in Mahan's group and started to work on ion molecule reactive scattering experiments with Ron Gentry using ion beam techniques measuring energy and angular distributions. In a period of about a year he learned the art of designing and constructing a very powerful scattering apparatus and carried out successful experiments on  $N_2^+ + H_2 \rightarrow N_2H^+ + H$  and obtained a complete product distribution contour map, a remarkable accomplishment at that time.

In February 1967, he joined Professor Dudley Herschbach at Harvard University as a post-doctoral fellow. He spent half his time working with Robert Gordon on the reactions of hydrogen atoms and diatomic alkali molecules and the other half of his time on the construction of a universal crossed molecular beams apparatus with Doug McDonald and Pierre LeBreton. Time was certainly ripe to move the crossed molecular beams method beyond the alkali age. With tremendous effort and valuable assistance from the machine shop foreman, George Pisiello, the machine was completed in ten months and the first successful non alkali neutral beam experiment on  $Cl + Br_2 \rightarrow BrCl + Br$  was carried out in late 1967.

He accepted the position as an assistant professor in the Department of Chemistry and the James Franck Institute of the University of Chicago in October 1968. There he started an illustrious academic career. His further development as a creative scientist and his construction of a new generation state-of-the-art crossed molecular beams apparatus enabled him to carry out numerous exciting and pioneering experiments with his students. He was promoted to associate professor in October 1971 and professor in January 1973.

In 1974, he returned to Berkeley as professor of chemistry and principal investigator at the Lawrence Berkeley Laboratory of the University of California. He became an American citizen the same year.

In the ensuing years, his scientific efforts blossomed and the scope expanded. His world leading laboratory now contains seven very sophisticated molecular beams apparatus which were specially designed to pursue problems associated with reaction dynamics, photochemical processes, and molecular spectroscopy. His laboratory has always attracted bright scientists from all over the world and they always seem to enjoy working together. He takes great pride in the fact that more than fifteen of his former associates are serving as professors in

major universities, and many others are making great contributions at the national laboratories and in the private sector.

Lee and his wife, Bernice Wu, whom he first met in elementary school have two sons, Ted (born in 1963), Sidney (born in 1966) and a daughter, Charlotte (born in 1969).

*Among some of the awards and recognitions he has received over the years include:*

Alfred P. Sloan Fellow, 1969-1971

Camille and Henry Dreyfus Foundation Teacher Scholar Grant, Recipient 1971-1974.

Fellow, American Academy of Arts and Science, 1975.

Fellow, American Physical Society, 1976.

John Simon Guggenheim Fellow, 1976-1977.

Member, National Academy of Sciences, 1979.

Member, Academia Sinica, Taiwan, China, 1980.

Honorary Professor, Institute of Chemistry, Chinese Academy of Science, Beijing, China, 1980.

Honorary Professor, Fudan University, Shanghai, China, 1980.

Miller Professorship, University of California, Berkeley, California, 1981-1982.

Ernest O. Lawrence Award, U.S. Department of Energy, 1981.

Sherman Fairchild Distinguished Scholar, California Institute of Technology, 1983.

Harrison Howe Award, Rochester Section, American Chemical Society, 1983.

Peter Debye Award of Physical Chemistry, American Chemical Society, 1986.

National Medal of Science, 1986.

Honorary Professor, Chinese University of Science and Technology, Hefei, Anhui, China, 1986.

Honorary Doctor of Science Degree, University of Waterloo, 1986.

From Les Prix Nobel. *The Nobel Prizes 1986*, Editor Wilhelm Odelberg, [Nobel Foundation], Stockholm, 1987.

This autobiography/biography was written at the time of the award and later published in the book series Les Prix Nobel/Nobel Lectures.

**THE PRESIDUM**  
**of International Council for Scientific Development**  
**of International Academy of Science**

**CONGRATULATES**

The Nobel Prize Laureate, Prof., Dr. Yuan Tseh Lee – Honorary President of International Academy of Science / Health and Ecology with 70-years jubilee. Prof. Y.T.Lee is an outstanding scientist of the present.

After receiving the Nobel Prize in 1986, Yuan Tseh Lee continued his research in chemical dynamics. Aside from research on reactive scatterings, his research group has made major contributions in the elucidation of various photochemical processes as well as in the determination of the structure of various protonated molecular clusters by obtaining infrared spectra. Many new instruments were developed for these purposes. He also directed much of his attention to the advancement of international scientific developments and to the promotion of general public affairs. As a professor of chemistry at the University of California at Berkeley from 1986 to 1993, Lee on different occasions served as Co-Chair of the Chancellor's Asian-American Affairs Committee at UC Berkeley, Member of the California Council on Science and Technology, and Member of the California Institute of Technology Board of Trustees. At the national level, he served on the Secretary of Energy Advisory Board and the Welch Foundation Science Advisory Board.

In January 1994, after 32 years of research and teaching in the U.S., he took the important step of returning to his home country, Taiwan, to serve as President of Academia Sinica. Originally founded on the Chinese mainland in 1928, Academia Sinica has long been the most prominent research institution in Taiwan; at present, it has over 30 research institutes, covering the humanities, social sciences as well as the physical and biological sciences. During his tenure as President of Academia Sinica, Lee has worked hard to improve the quality of research in that institution. He believes the research conducted at Academia Sinica in several fields, including his own, now rivals the best works done in other parts of the world.

Lee has also taken an active role in promoting scientific and cultural developments in Taiwan. From 1994 to 1996, he was the chair of the national

committee for educational reform. From 1996 to 2000, he led a national organization for community empowerment in Taiwan. From 2000 to 2002, he chaired a nonpartisan group that gave advice on matters concerning cross-strait relations (i.e. relations between Taiwan and China) to President Chen Shui-bian, whose electoral victory in 2000 marked the first change in the ruling party since World War II. Since his return to Taiwan, Lee has established several new foundations and aided existing organizations that support educational and research activities. He has also traveled extensively around the world to attend scientific conferences and hold lectures.

The Presidium of International Academy of Science H&E wishes Nobel Prize Laureate Y.T.Lee a robust health, long creative life, further success in the development of his scientific researches, and happiness and prosperity to his family.

## **RESPONSIBILITIES OF SCIENTISTS FOR THE FUTURE 18 th SEPTEMBER 2005, INNSBRUCK**

**Yuan T. Lee Prof. Dr. Nobel Laureate**  
*President Academia Sinica, Taiwan, R.O.C.*  
Honorary President of the ICSD/IAS H&E  
*ytlee@gate.sinica.edu.tw*

*Mr. Kofler, Distinguished Guests, Ladies and Gentleman,*

First of all, I would also like to express my appreciation to Mr. Kofler for organizing this meeting and getting us here from all corners of the world. I would also like to congratulate his 60<sup>th</sup> birthday, and compliment what he has accomplished with his vision and dedicated efforts.

Several days ago, I attended 2nd Science, Technology and Society forum in Kyoto, Japan. In the Opening Ceremony, Mr. Omi, the conference chairman, reaffirmed the fundamental concept of the forum. Mr. Omi mentioned about positive and negative aspects of the rapid progress of science and technology, and also noted that the benefits of science and technology have not yet reached everyone equally. He said: "This is really what symbolizes the lights and shadows of science and technology." While the negative aspects must be properly controlled, the positive features of science and technology should be promoted.

I believe that most of us sitting in this room would support this idea whole heartedly. However, if we do not try to answer one of the very important questions: "How many people can planet of earth carry at the same time if we maintained the living standard of the people in the developed world?" then even if humankind learn to carry out "good sciences" and used them for good purposes, and scientists as a whole also take full responsibilities to make sure that science and technology really brings benefits to everyone equally, if we are not careful, one might expect that along with the excellent material comforts and improvement in medicare, the population explosion and excessive usage of natural resources might overload the planet of earth, and the sustainable development might not be possible.

Mr. Omi made another important point. He said "Today's problems are global and can not be solved by any single country or by scientists alone." He went on saying that "Boundaries between nations are merely lines on a map; nature makes

no such distinctions. We should think of ourselves as members of humankind, whose very existence will be at risk if we do not live in accordance with the principles of mother nature.” This is a great statement. What Mr. Omi was saying is “a global village” or “one community for the entire world” needs to be formed.

Let me make some observations along these two important points.

As we entered the 21<sup>st</sup> century, we found the human society on earth is undergoing two important phase transitions. Firstly, the earth which used to be “infinite” or “unlimited” for mankind for thousands and thousands of years has now become “finite” or “limited”, as the population on earth has increased dramatically during the 20<sup>th</sup> century and reached 6 billions, and human activities have been intensified with excess consumption of natural resources, yet we are still following the trajectories of the development of human society of the past when the earth was practically “infinite” or “unlimited” both in terms of natural resources available and the capacity of the earth to absorb or digest the waste produced by human activities. Especially, in the usage of energy and the impact on environment, we are heading toward a wrong direction all together.

Secondly, although we have witnessed the process of globalization of human society during the last two decades, the globalization is only half-way through, and because of it we are suffering from many consequences. Some of the human activities started to become globalized, and are carried out beyond national boundaries, especially in the areas of economy, science and arts, yet the nation-state based competitions are as strong as ever. In the half globalized world, only those people who use the entire world as their stage for their activities have benefited enormously, and it is not surprising that we will have to tackle such problems as the widening gap between the rich and the poor, both among countries and people in a country, and the threat to solve problems by military might. These problems could be easily avoided if the entire world were to be completely globalized, or if the entire world were to become “one community”, or we make it into a reality that “Boundaries between nations are merely lines on a map.”

11 years ago, after spending 32 years in the United States, I returned to Taiwan, and found that Taiwan had already become one of the newly industrialized countries with per capital income of about fourteen thousands dollars, and was trying very hard to catch up with Japan and the United States. The development of high tech industries was marveled by many neighboring countries in Asia. However, from the point of view of living environment, Taiwan was in fact “overdeveloped” and was not a model for not yet “overdeveloped countries” to emulate. It is just not sustainable. But, in a global market economy, we seem to keep on competing and drifting along with the big tidal wave, and not being able to find our own destiny. I am afraid that the same dilemma is bothering many developing countries at present.

The sustainable development for the entire humankind will not be

accomplished by merely having “overdeveloped countries” to help “not yet overdeveloped countries” to reach the same living standard with science and technology. We need to examine our way of life together, and to make necessary modification to the structure of our society based on local environment of different region.

Scientists can play key roles in finding the solutions to these problems. First of all, scientists should work together to make sure that science shall not be used by some to dominate others, and to cause damage to our living environment. In 1995, Sir Joseph Rotblat, a Nobel Laureate, urged in his acceptance speech that ‘the time has come to formulate guidelines for the ethical conduct of scientists, perhaps in the form of a voluntary Hippocratic Oath.’ He argues that scientists should not pursue scientific truth simply for truth’s sake without considering the ethical implications of their research. He emphasizes the social responsibility of scientists and believes that holding an “amoral” attitude towards science is actually “immoral”, as personal responsibility is tied to the likely consequences of one’s action. Although the idea of an ethic for science can be traced all way back to Francis Bacon in the seventeenth century, pledges founded on the values and responsibilities shared among scientists and engineers have become quite common in recent years. For example, the Peace Pledge Movement for scientists, launched in Japan in 1999, is committed to the Peace Pledge which reads: ‘I, undersigned below, pledge with honor and dignity: To the best of my knowledge, I will not participate in research, development, manufacture, acquisition and utilization of nuclear weapons as well as other weapons of mass destruction.’

It is certainly very important for the individual scientist to see to it that science brings benefits to mankind, but it should not to be used for evil purposes or to cause unexpected negative consequences. However, if we continue to engage in the fierce high-tech-based economic competition among nations, it might not be enough for the individual scientist not to participate in the research, development, manufacture, acquisition and utilization of nuclear, biological and chemical weapons or their means of delivery. At the current stage of human development on Earth, there is a difference between the responsibility of the individual scientist and of scientists as a whole. If we do not fully appreciate and understand the rules of the game and consequences of competitions in a globalized market driven economies, and other social differences, practicing so called “good sciences” for good purpose can still produce miserable losers among us when they are used as a means of economic competitions.

Perhaps, sometime in the middle of the 21<sup>st</sup> century, the globalization of the entire world is attained to a great extent, and international disputes are no longer settled by military confrontation. In the genuine global village, the tensions between advancement of science and sharing of technology, between economic rationality and political passions of nation-states are all resolved, and the advancement of science and technology will be used for the liberation of all rather

than a tool of domination by some. All humankind on earth will be civilized enough to learn to solve problems together, learn to share knowledge, new technological options and the limited resources available, learn to respect and understand different cultural heritages. Would that beautiful scenario ensure a sustainable development for mankind? It certainly looks wonderful and necessary, but might not be adequate. It is necessary for us to keep in mind the two “phase transitions” I mentioned earlier that the earth is not longer “unlimited”, it has become a “limited” spaceship, and the globalization process of human society needs to be completed as soon as possible. International collaboration on science and technology is only the first step. We need to work together to realize the vision that “Boundaries between nations are merely lines on a map.” The entire world should operate like “one community.”



## **THE RESPONSIBILITY OF THE POLITICIAN INDEPENDENTLY OF HIS/HER OWN POLITICAL UNDERSTANDING FOR THE FUTURE**

**GEORG KAHN-ACKERMANN**

*The Former General Secretary of the Council of Europe,  
Honorary President of ICSD/IAS,*

**Dear chairman, Ladies and Gentleman**

I will present some spotlights to politic responsibility today on the basis of my lifelong experience as politician, especially as former general secretary of the Council of Europe. I will present these ideas with regards to the positions of Walter Kofler, who was the winner of the European School Day many, many years ago. I will use the abstract of his paper, which was distributed to us.

Future and evolution seem to be closely connected. We define, is the way we use our possibilities, the future and tomorrow and therefore this situation of the evolutionary process in the future. In opposite to the past we know that there is such a not-determined permanent process we call evolution. For a politician and a scientist dealing with politic science it is clear that there are frames which are given what is possible in principle. But on the other hand we assume that the future is not only determined by the limits and it is not optional. Future is also not pre-determined, otherwise politics would not make any sense. Politics makes sense only if we assume that we can influence the future evolutionary Situation by decision of persons for themselves and in the name of social structures they are representing and that we can influences make predictable on them. This view seems to be not totally in agreement with the new evolution of many natural scientists. They describe evolution as a process which shows only the result of probability and inevitable consequences. If we assume this in general then it must be correct to attribute this to the future of our time too. But this position can not be accepted by a politician. For the political actors define and influence what will be effective in a given environment and in the connection of individual and consensus-oriented interests for the future. This is a result which is closely linked with the results of Kofler, who seems to be able to deduce this process, which is obviously correct for the running part of evolution on generalised principles.

The assumption freedom of choice would be only relevant to understand human evolution could not solve this dilemma. The effects of the modern time is

related with outputs on the environment too and not only on the evolution on mankind. So the actual of parts of biological evolution must be seen in connection with the influence of freedom of choice. The actual given influence on the selection of species and their distribution is after the unintended output an inevitable, automatic result, but at the same time intended activities have an influence too. Such activities can be caused by human individuals and social structures. I remember the social programmes of European Community for Nature Conservation but by activities of the related living beings too. A very special example would be the learning effect of the pirots (small birds) in New Zealand. If I accept that they are autonomous restricted actors with freedom of choice, especially political factors, I do not deny that an evolutionary process would take place even in social context without automatic responses takes place, which must not be intended and must not be known. If a given resource to solve case A then the same case cannot be used to solve case B. This is an immanent consequence which can be done conscious but unconscious too. If a tree moves his leaves to the sun, behind the leaf shade is produced. With the shade the living conditions for other living being will be influenced automatically and not because of any wish of the plant. Such effects we have to expect in social structures too and it should be expected, that such automatically working linkages are taken into consideration by a special level of highly qualified politicians. With this description we link again with the position of Kofler. He distinguished between different faces in the evolutionary process with regard to conscious and unconscious integration of the same output of an activity. Any intended activity has unintended side effects too. They can be undetected and therefore underestimated in the face when the realisation of the intended effects is the focus of the doing. Afterwards the side effects can be recognised and maybe seen as a negative effect but have to be accepted because of the relevance of the intended main effect. At the next step a clever actor can see that the side effect allows in principle new possibilities for realisation, so the side effects can be integrated into decision-making procedure at the next higher level. To see, what everybody sees, to recognize, what never before has been recognised. This sentence is not only relevant for any type of science, it allows, according to Kofler, a better understanding of the steps in evolution. It is obvious, that the use of the former side effect for new main effects causes an emergent output. If the new possibility is taken over by other users due to any type of reason (genetically based reasons are only one of the possibilities for e.g. persons according to Kofler) and the new application allows to realise wished intentions, then we can expect, that the emergent will be used by many and can be therefore observed over longer period, maybe up to now. This principle can be used to characterize the interactions between the intentions of individual human persons and the environment with the output of an autocratic creation of simple social systems, but with the follow-up of these steps to higher

structures the integration of politics too. According to this assumption we have to expect, that simple social systems will build themselves automatically as a consequence of the side effect that persons act with the intention to survive personally and together with their relatives. The output will be a simple social structure. Social structures have norms and many restrictions to the individuals who join these agreements. Nevertheless the individuals will accept these negative outputs because of the positive main effects of the social structure and with the progress the valuation of the observed some persons will see, that there are immanent principles, which can be used not only as side effects but to realise higher and new type of goals too. Politics is formed.

What kind of politics and what kind of intention has to be expected?

According to the assumption of Kofler we have to expect, that the given social environmental structures, as well as other environmental conditions, will influence on what kind of level political activities can be expected, at what time of the evolutionary process of mankind. The political goals will be linked with the level of that, what is perceived by the powerful persons in the society and with the kind of values that are linked with the observed. These intentions can be very different as history shows and the same activity can have a total different content or complexity of the content. When Hamurabi created the first laws with the goal to make orders for his people and tell them about the pain they have to expect if the don't accept the regulations, then there is no need to attribute to Hamurabi an understanding of a very complex law as we have to do this now in our law systems. Louis XIV said: "I am the state", which means that the territory with all in it including the inhabitants was seen as instruments for the king. Later the idea was born, that the cultural unit should be the characteristic to define the area of states and nations. Then the networks between different national states increased in their relevance and in new forms of interactions between states where needed. There have been goals for many other social structures, different states and countries. Therefore structures like the Council of Europe or now, with much more competence, the European Community were created. But so we have to see, that political structures like the Council of Europe or European Community deal with a special geographical area, like countries to this but they are not a special version of a country. These political structures are from a different nature. These structures must be open in a way that they have space to include other countries with a different political self-understanding. The Council of Europe for example, included capitalistic and communistic countries. We have to see that there are joined interests and the need of consensus, which are independent from the different political views. It is a goal to make some of this consensus acceptable for all. If this consensus is reached, then this allows us to create new structures to optimise the cooperation between the integrated countries. We can expect that the countries will accept, that they built structures to cooperate between them e.g. like a control organ or a court.

Of course this can only occur for topics for which consent exists, maybe about human rights. If we think about such modern political structures we should not ask for the same capacities and potentials as we can ask for our home country. We have seen that the authorization is based on total different intentions. To stabilise freedom, to enforce tolerance, to improve economy can be such authorisations for institutions like the Council of Europe. In the actual given time we have to see some musts, which we can not influence, which are in principle the output of the running process. This would be e.g. globalisation.

Globalisation is an unintended output of the fact, that the whole world is linked through information, environment and economy. There is no alternative to globalisation but how to handle this and what kind of consensus about the allowed, the wished and the possible is the challenge for the politics of today and tomorrow. If we are speaking about nations, states, European Community etcetera we are speaking about entities Kofler would call para-autonomous actor. They are created by human persons, by agreements about the accepted behaviour of the humans in order to keep the consensus. If these para-autonomous actors will be changed in structure and intentions their influence on the living-conditions of persons and other structures will be changed, and with this change the intention of the politics will change too. Therefore we have to expect that such evolutionary changes in the linkage of environment and societies will cause and will need permanent changing's in the self-understanding of politics, what is acceptable, what should be intended and what not. Therefore all political statements must be seen in the context of the special evolutionary level in the political systems. Hence it is quite common that countries have no emotions just interests. With this sentence it was unspoken linked, that values, sensations, emotions have to be covered by the private sector only and are no matter of any political activity. Such a position must be seen in a more sophisticated way today. In principal the position is totally correct. Countries are not living being, therefore they cannot have emotions but the linkage between action and non-action in societies, the decision what should have priority and what not, and the interaction of them with quality of life and the change for the future for individuals and groups within the home country and abroad are much more complex and differentiated now than in the last centuries.

In the actual situation the representatives of countries and more complex social structures like European Community must take into consideration that action and non-action can have long lasting consequences even for the immaterial quality of life of individuals, families and other groups in a very complex way. But should such complexity be handled? Even politicians are only restricted autonomous actors and are limited in their capacity to deal with information. In principle politicians would need not a very high specialised knowledge but a very general one. They would need consultants which are able to demonstrate the relevance of the special topics in context to other aspects. But here we have a big

problem based on system-immanent principles within the modern times. Modern science focuses on higher and higher specification and specialisation. Therefore the politician needs an increasing number of experts just for one problem from which each of them has to be extremely competent in a small area. But the link between the statements of the different high specialised statements must be established by the empathy of the politician. Science lets the politician alone in a most relevant aspect of decision making procedure. The politician would need from the scientist much more of a “macro-scope” than of a microscope. To offer the needed help to the politician will influence the position of science in the society too. It would be very helpful if the proposed model of the extended view would bring an essential contribution to this problem.

## ACTIVITIES OF THE INTERNATIONAL ACADEMY OF SCIENCE H&E

**Kofler, Walter Prof. Dr. med**

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Two major needs have been the reason to establish the **International Academy of Science H&E** more than 25 years ago and these two basic ideas lead our work until today:

- *To encourage, work on and promote new inter- and transnational scientific achievements for a sustainable future for humanity.*
- *To establish personal bridges and networks between scientists all around the world to support this goal and their scientific work.*

After another year passing by since our last common publication, it is a great pleasure to observe the widespread, very successful and increasing activities set within this year in all our sections.

This second edition of “**Science without borders. Transactions of the International Academy of Science H&E**” provides a small view on the various activities of associates of IAS H&E all over the world from Brazil to Japan and from Russia to Italy - unifying four continents.

Science is in its last consequence communication and without the transport of information to an (international) audience, research remains enclosed within locked borders.

So it seems essential to offer a forum that grants us a possibility to get this view and to be stimulated by it – from my opinion the establishment of “Science without borders” is already and will be more and more a communication platform and the media to provide this view.

Lots of contributions in this volume have been presented during the **International Symposium in Innsbruck in September 2005** and reflect the basic ideas of IAS H&E as mentioned above: Linked interdisciplinary, transcultural activities for a more sustainable and health-oriented future. - And exactly this is the origin and background of the “**Convergence Project**”, a long-term project to test the applicability and to broaden the concept of an “**Extended View of our world**”.

The symposium and in consequence some of the articles published in this book are directly connected to this idea and the “Convergence Project”. Large efforts have been taken to support and advance this long-term project:

The International Symposium in Innsbruck was held on the occasion of the opening of the brand-new **Competence Centre of the International Academy of Science in Innsbruck**.

The centre offers a conference area for up to 30 people, two study-areas and two separated apartments including kitchen, bedrooms and sanitary units. It is equipped with the most up-to-date technical equipment (Samba-server, physical firewall, e-blackboard etc.) allowing to access data and high-speed-Internet in every room. The centre shall provide space (in every dimension) for excellent scientists/researchers to be able to apply their leadership in science in projects that empower and improve interdisciplinary theoretical and basic research within an international forum.

In addition of providing adequate room the “**Senior Fellowship Program Innsbruck**” has been established to encourage and support senior post-graduate scientists of all disciplines and faculties engaged on a full-time basis at recognized institutes of higher education all over the world who are interested in international and interdisciplinary scientific exchanges and collaborations inviting them to our centre in Innsbruck (Austria).

The Senior Fellowship Program is offered in cooperation with the **Medical University of Innsbruck** and the **Eurasia Pacific Uninet** to assure broad effectiveness and high scientific standards. Starting and crucial point of all scientific work to be done within the program is again the “Convergence Project Extended View”. Thus every Senior Fellow is provided with an opportunity to share resources and ideas and to establish stronger interactions and collaborations with other scientists who are willing to overcome traditional borders of scientific disciplines and faculties. Senior Fellows are supported by grants that allow full concentration on scientific research and exchange - free from all the administration and daily business tasks we all suffer from.

Our first Senior Fellowship was granted to Prof. Dr. Victoria Pogolian, head of department for modern languages for young learners at the Herzen State Pedagogical University of Russia (Saint Petersburg). During her stay in Innsbruck Prof. Pogolian focussed on communication, terms and language in an interdisciplinary context.

The Senior Fellowship Program Innsbruck as an institution and our awarded Senior Fellows as a growing community will be a valuable contribution to the further development of the scientific networks of IAS H&E and in general to international scientific cooperation and exchange.

As our honorary president Yuan T. Lee writes in his reflections about the responsibilities of scientists in this publication: “Boundaries between nations are merely lines on a map.”

- The International Academy of Science Health & Ecology and all the activities of its associates around the world have become a very valuable contribution to help to understand and live this conception in its true meaning.

A handwritten signature in black ink, appearing to read 'W. Thork'. The signature is fluid and cursive, with a large initial 'W' and a long, sweeping tail.

*President of IAS H&E*



## **MEDICINE AND BIOLOGY**

### **WHAT IS PAIN? AN ATTEMPT OF AN EXPLANATION BY AN „EXTENDED VIEW“**

**Walter Kofler, David Schnaiter**

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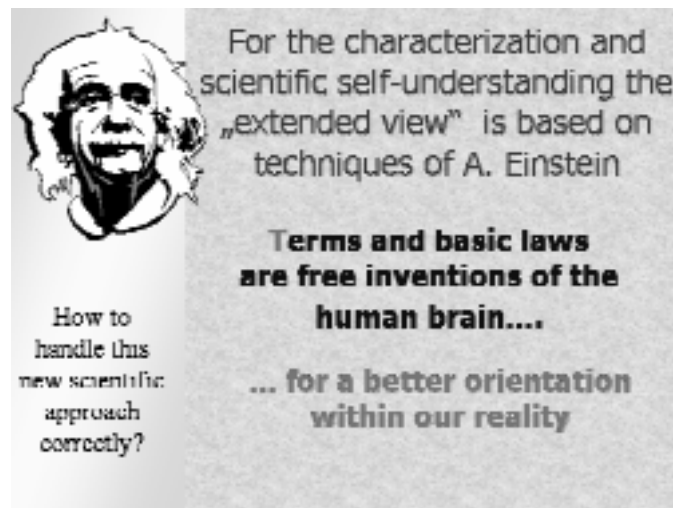
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“Compared to the pond of knowledge, our ignorance remains atlantic”, state R. Duncan and Miranda Weston-Smith, the editors of the encyclopaedia of ignorance /1/, in which P.D. Wall published his contribution: “Why do we not understand pain”/2/.

Up to now we have no generally accepted model for pain. There is an agreement that pain is a sensation caused by information a person can perceive. But who is sending what kind of message to whom?

If we as persons are ought to be the receivers who primarily should be informed and “pain” would be the message of actual danger to our health, we should expect that any type of illness should cause pain – expediently – in a dose-response-relationship to its relevance. Maybe you can not speak any longer because you are feeling pain after a long lecture, but you will not feel any pain caused by a death-causing lung cancer. Even similar types of injuries do not show a dose-response-rate: There are plausible reports of a lack of any instant pain in soldiers loosing an extremity e.g. a leg in battle, but that many soldiers feel pain when receiving an injection by a syringe. And why can an amputated leg cause phantom pain over years?

But we feel pain even without an illness: e.g. when our father dies or a vandal made a deep scratch over the whole bonnet of the beloved Ferrari Testarossa. – And not to forget there is still no explanation why placebos can enforce and suppress pain.



Duncan and Weston-Smith deduce in their encyclopaedia of ignorance that “our concepts are often our limiting factors. Perhaps some answers depend only on asking the correct questions”<sup>1/1</sup>. Therefore we should look at the adequateness of the used epistemological and ontological models. And we should not forget that Einstein determined that all scientific theories and scientific terms are “free inventions of the human mind just for better handling of reality”<sup>1/3</sup> and therefore from another nature than the research object of a natural scientist.

For him it is impossible to explain objectively “whatever holds the world together in its inmost folds” (J.W. Goethe, Faust part 1, Faust’s Study) and not relevant: Theories and scientific terms have just one authorisation for their creation: To deal better with the given problems in reality. Therefore we should focus on other questions: Are the used theoretical frames really the most appropriate for the questions we have to solve or not? If not we should be open to discuss other models, which are in a better agreement to as many different open phenomena as possible and allow better predictions.

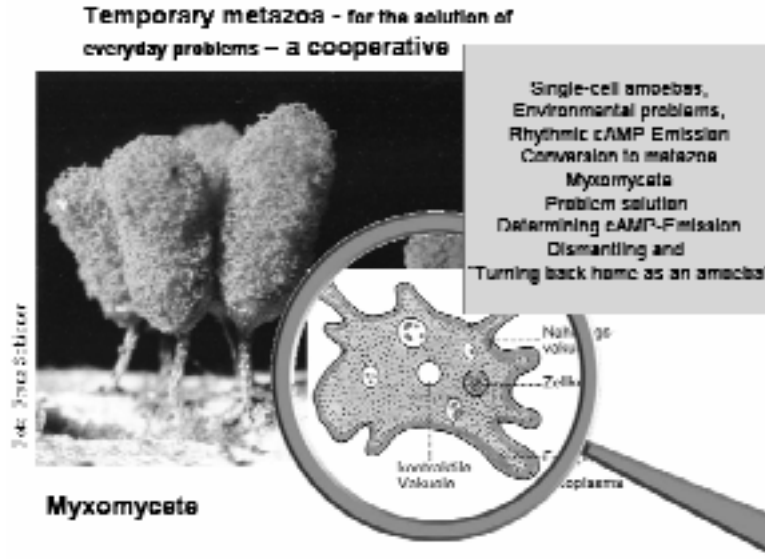
**The starting point: a mechanistic view of the body as a machine to optimise functions for the individual**

Indeed our models for the relationships between somatic cells, tissues and organs on one hand and the organism and the person itself on the other hand are really mechanistic. Often we explain the nature of somatic cells with their function to optimise their applicability for the individual or person.

Pain would then be comparable with an alarm lamp to inform a person of a defect within the corporal machine.

**ALTERNATIVE POSITION:**

**Somatic cells are – as single cellular – autopoietic, self-oriented and – within borders – autonomous actors. And Pain – as a pre-validated sensation a message to the organism.**



**Myxomycete – an example for cooperative trouble-**

What would happen, if we would accept somatic cells as autopoietic actors and not as machine-like units depending on the guidance of the nervous and humeral systems?

That this is a fact is easy to certify: Take a cell of an organ or a tissue and bring it in into an adequate culture medium far away from the organism. The cell will grow autonomously and it will show all other criteria of an autonomous actor.

If you accept the autonomous nature of the somatic cells then you would have to attribute to them – similar as to a single cellular – self oriented intentions and demands to deal with their environment in consensus. These needs would be obviously much more fundamental and less differentiated and therefore from another nature than many functions for which a child and later on an adult would use the same ancient function units: Under these assumptions the pain-causing message reaching the (ancient) brain would primarily not be focused on the person, but would be guided to the – also very old – part of the brain. Our further evolved brain would only intercept them and make conclusions related to the comprehensive new level.

**Pain-definition: At the same time a message and the expression of the evaluation of this message.**

Peripheral subunits/ members report to the helmsmen (brain) of the cooperative:

- that an expected contribution for joint activities will/can not be presented because of external influences on a partner
- that support is expected by the cooperative to solve this problem

With regards to the comprehensive value system of the affected individual/or person by e.g. feedback to the ancient brain:

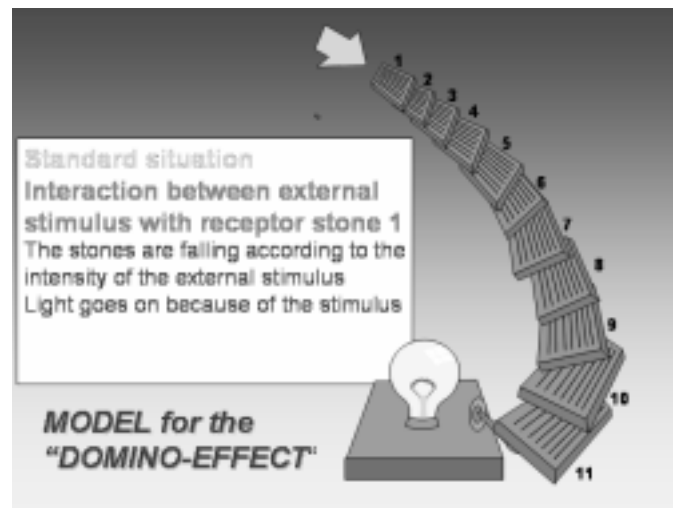
- an evaluation of the meaning of the message by the (ancient) brain takes place
- an alert-stimulus is sent out corresponding to the importance given to the “event“

Under these prerequisites not any information for the organism would be of interest e.g. for a social entity like a person, and not all what is of interest for the person would be of relevance for the organism. Therefore it would be convenient to be able to distinct between the relevant and the irrelevant and to enforce the relevant and minimise the irrelevant. Neurophysiology can confirm such mechanisms.

The principle of active inhibition (Sechenov, Pavlov) and the principle of motivation (Anochin) are generally accepted in neurophysiology since decades. The example of the soldier loosing his leg without any actual pain is such an extreme example for temporary suppression. But this phenomenon can be observed in animals too: In 1998 I could observe a gazelle hunted down by hyenas in Africa. The hyenas were devouring the gazelle’s rumps when the gazelle was still alive. It observed the process like an outside observer with interest but without any screaming. The gazelle didn’t seem to feel pain.

Maybe we will explain this with “shock”: But this is just a term to make a long and finally not understood story short and doesn’t give any explanation.

We all know that from the permanent flow of many million stimuli of our sensory cells etc., that only one single stimulus in a time unit reaches the cortex consciously: All others are selected out. It is a fact that the brain can enforce given stimuli and can minimise them.



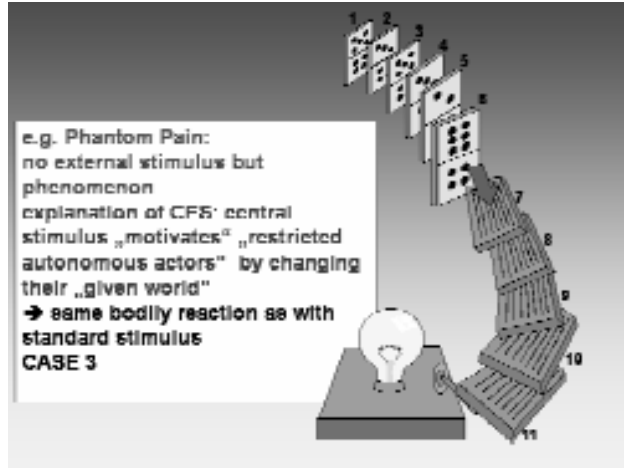
So we can symbolize the situation with an extended view of a domino-effect: a peripheral stimulus can start a cascade of falling stones up to the initiation of the common realised phenomenon. But the stones must be seen like within a “protective cover”, which can inhibit or enforce the incoming stimulus according to the afferent and efferent flow of impulses with the brain – always with regards to the values and expectations of the decision making person (valid also on other levels).

This explains the former paradox of the lack of pain in lung cancer but the existence of pain after a long speech: From the position of a social entity the information about a threatening loss of the ability to communicate is more relevant than the – from the social point of view – irrelevant change in the pathophysiological status of a lung cancer.

We know from reflex theory of Sechenov, Pavlov etc., that a neuron can use the permanent running flow of information between e.g. a sensory cell in the eye and a neuron to initiate a central stimulation of the sensory cell (e.g. of the eye). This has the same biochemical and electrical effects as the related environmental stimulus, even without a stimulus from the environment: So you continue e.g. to see a red pullover as red, even in periods, when the red component of light was selected out and you should see it black. You can confirm this by considering the “afterimage”: Due to the consumption of the chemical causing the impression/information “red”, the afterimage is green (complementary colour) and not white as it should be expected.

So we have to extend our “domino model” for situations, in which the process is started by a central stimulation without any stimulus from the outside or – maybe – without any stimulus from the somatic system: Doing so, we are able to deal much better with phantom pain.

On one hand the organism can initiate with its brain bodily stimuli and in consequence the cascade depending on them and on the other hand it can inhibit given ones – and the following cascade which would be expected. So can the individual or person, if it is able to initiate the “old brain” to do so. If we integrate this into the “view of the matrix-world” created by the individual according to its valuation of the given stimuli from the outside according to the expectations of the valuating individual or person, then we can deal much better with placebo /4, 5/, with the white coat phenomenon and with toxicopy(6) too. So placebo is only a special case of a standard situation:



The patient creates a different matrix-world for his “bodily co-operative” than the doctor does. – But both create “matrix-worlds”.

Back to the principle problem how to answer the same, in our case painful, information on different levels of the brain: One question is, in which way the obviously given different levels of brain could have been evolved:



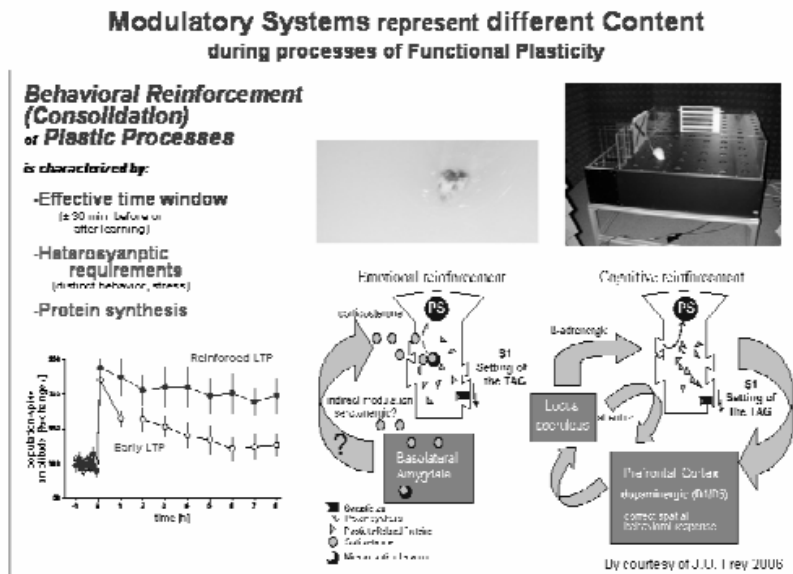
Paul McLean, a world famous neurophysiologist proposed the idea of the triune brain in animals /7, 8/: He concluded from the fact that an evolution of the brain was only possible with a fully acting brain, that the younger brain segments must have been developed additionally to the given use of the existing brain segments: Therefore any stimulus e.g. causing pain – coming from outside or inside – has to pass first the brain stem (typical for reptiles) and then all younger segments.

If the decision is taken that the stimulus information due to its relevance does not need a quick answer, the time window (see Julietta Frey stated below) allows to pass this stimulus to the next level, the level of the old mammalian brain (e.g. shrew mouse) which is dominated by the limbic system. And if the time window allows not to act on this level either, then the decision is forwarded to the level of the younger mammalian brain (and therefore cognitive answers can be expected, e.g. monkey).

We think that there is an additional level we have to take in consideration if we have to deal with humans as social beings. This “Four-united Brain” is not based on a new hardware of the mammalian, but on the use of the acquired “software”: To deal with final-oriented relations – as adult humans can do.

The other question is how we can explain in which way neurons, as autonomous actors with the ability to make decisions according to the given experiences and expectations, can act in a way that the step from one evolutionary level to the next can be observed in reality.

Of vital importance is the principle of inhibition discovered and integrated into neurophysiology in the 19<sup>th</sup> century by Sechenov /9/.

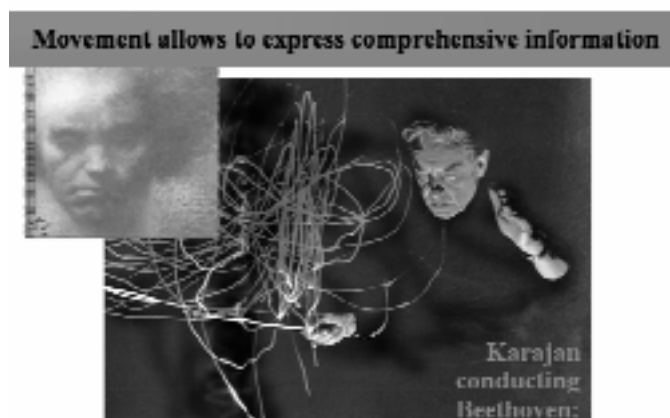


Actual research demonstrates the physiological principle on the level of single cells: the key point to understand the progress in the answer to the same stimulus by younger brain sections is linked with the ability of the same neuronal cell to defer the answer to the stimulus on the level of the older (e.g. emotion based) brain section for such a long time that the same neuron decides to answer the stimulus on the younger (cognitive) level (compare J. U. Frey et al. /10-13/. This depends on the former experiences etc. of the individual.

**Information related to the relevance of a very young brain must be answered by ancient functions – by translation into an ancient messenger**

Information makes only sense if the informed can deal with it adequately. A person can feel pain even because of the threatening loss of meaning and other immaterial values. To deal with such types of risks requires the ability to start spontaneously, in consequence of a subjective valuation, a cascade of information and activation from the related level of brain up to the level of the somatic cells to initiate their “ancient” types of realisation even by immaterial stimuli (compare /14, 15/). And pain is such an immaterial stimulus – it is information.

If we combine the different principles we discussed above, we will be able to deal much better with the phenomenon of placebo (see also /15, 16/).



By courtesy of J.U. Frey 2006

This principle helps us to explain phantom pain if we start such a cascade on the level of an old mammalian brain (McLean) and placebo in e.g. dogs, if we start on the young mammalian brain. But to deal adequately with the placebo-effect in humans we have to start with (unconscious) processes on the young mammalian brain with the specific human applications. This approach allows us to consider much more complex phenomena. E.g. why Karajan was able to inform his musicians just by movements – by the ancient functions of his hands – using



the baton, to initiate their ancient function units in such a way, that the 9<sup>th</sup> symphony of Beethoven was interpreted in a totally new way.

**Why ancient cell systems can be used for brand new functions: A Matrix-world – created by the “lazy brain cells” for the uninformed members of a cooperative – “over-formed” by younger brain segments for emergent intentions and demands.**

Now we analysed the chain of information flow from the somatic cells and the sensory cells to the ancient brain up to the highest evolved functions of the neocortical brain including the feedbacks within the brain. But there is another question open: How to turn the way back: From the highest level of the value systems, wishes and fears of a modern human person, which can cause pain, up to the possible bodily reactions. All these explanations require that there must be a sufficient reason why autonomous cells can be stimulated for functions which lie outside of the range of their own possible intentions and demands. One of the epistemological prerequisites of the “Extended view” is not to accept assumptions, attributed to the autonomous actors, which would cause them.

These activities are conclusive, if we assume that the cells act as para-autonomous actors with totally different information about the given causes to act. They are not informed for what their action is used in reality. They get the information by ancient messengers for a demand of ancient basic problems and they agree to solve them like in a cooperative. The somatic cells are covered by skin and mucosa: Both are impermeable for information about reality. So the only available information they have is offered by the brain. And the brain is able to modify the information given by the sensory cells and by thinking. Our brain can create spontaneously sensory stimuli and ideas. Therefore every individual and even more a human person can initiate the ancient function for brand new combinations and therefore totally other purposes than those the somatic cells have organised themselves to within an (ancient) organism.

So emergent intentions and functions can be created just on the basis of the old ones. These “over-formed” functions cause emergent structures in the brain when using the old structures of the brain too. And this is in a very good agreement to the ideas of McLean (triune brain). But there is no biological equivalent for the further progress in sensations and therefore we have to use the old sensations even for the more differentiated, but basically similar, situations: Up to the point that a scratch in the Testarossa can cause pain and the movement of the baton of Karajan can cause Elysian sounds.

**THIS EXPLANATION IS IDENTICAL TO THE DEDUCTIONS WE HAVE TO EXPECT USING THE “EXTENDED VIEW”**

Maybe you believe this is just a nice story including many up to now unexplained phenomena. But you would come to the same conclusions if you would use the model of the “extended view of reality and Wirklichkeit” and its application for a model of a human person as a social being and its interaction with and expectations on his environment./17/

The “extended view” is a so called “real theory” according to A. Einstein. He developed this epistemological technique as a special application of a meta-theory to link indispensable but – by epistemological reasons – each other excluding theories to link the theories of movement on the basis of Newton, Galilee and Kepler on one hand and Maxwell, Faraday etc. on the other hand. A real theory allows additional answers without the loss of power of the given, now linked theories.

We all know the answer: The theories of relativity – the basis of a totally new worldview in physics. The situation of modern medicine is similar to the situation of physics at the beginning of the 20th century and our analysis of “pain” confirms this impression: As they could not relinquish neither the power of the classical physics nor the power of electromagnetism, medicine can not do it neither without natural science-based medicine nor without psychosomatics and other health related sciences. Therefore the use of a “real theory” for medicine would be an adequate and correct solution. That’s why the “extended view” was developed.

This approach bases on the assumption that the given incompatibility between the materialistic-based natural scientific view of human health and the idealistic-based models resting upon non-natural sciences (like psychology, sociology, economy, arts, law etc) are not based on the nature of the human person itself: Each person is one entity with physical, chemical, psychic, economic etc. abilities. The gap between the scientific disciplines is caused by the used epistemological simplifications. Therefore the gap can be closed by a view which deals adequately with all health relevant aspects independently from the scientific discipline which is commonly dealing with only one special aspect. The basis for such a real theory could be an aspect which is accepted by all disciplines. In the extended view the “evolutionary nature” of the human person and all health-related aspects is used as such a jointly common ground. If we would have a conclusive model which would allow, in agreement with the indispensable positions of the different sectoral health relevant sciences, to reproduce the evolutionary process for all health relevant factors (therefore including light) up to humans and our social structures in the 21<sup>st</sup> century, we should expect that the gap between natural and non-natural sciences would disappear.

The key problem for such a linkage would be a model to deal adequately with placebo. It seems that this is possible.

Other basic assumptions are that the process we call “evolution” is a process in which the different stages are not predetermined but within researchable frames. This is theoretically possible, if we accept that the process is based on activities of actors, which are restricted but have some options within their restrictions. If these options have to be selected not only with regards to optimise self-oriented possibilities but also with regards to a consensus, then we can expect subsets of actors which follow the principles of consensus – and cause phenomena which can be predicted. This use of a consensus with some freedom for individual decisions can not be predicted in every single case, but for majorities. – And this individual use can be offered as the matter of a new consensus. If other actors accept it, a subset of actors will emergently occur.

Thus we had to postulate the basic abilities of the most basic actors in a monistic way. The evolutionary process seems to be conclusive as a process caused by a unique type of basis restricted actors. The most basic observable actors are named and characterised by physicists as quanta – which create more and more complex actors due to their abilities, in consensus and with regards to the given settings. This approach allows deducing in which way even non-living actors could organise themselves to basic living entities and that single cellular could create simple purpose-oriented multi-cellular structures. For the step from the purpose-oriented multi-cellular structures to the sense-oriented organisms it seems to be an indispensable prerequisite to attribute to the “helmsmen” the ability to create a “matrix-world” to motivate the members of the “cooperative” to act without any real information about their reality.



From Homo sapiens to Homo sapiens finalis

The oldest figure of the immortal soul

Lascaux, Dordogne, ca. 15.000 B.C.

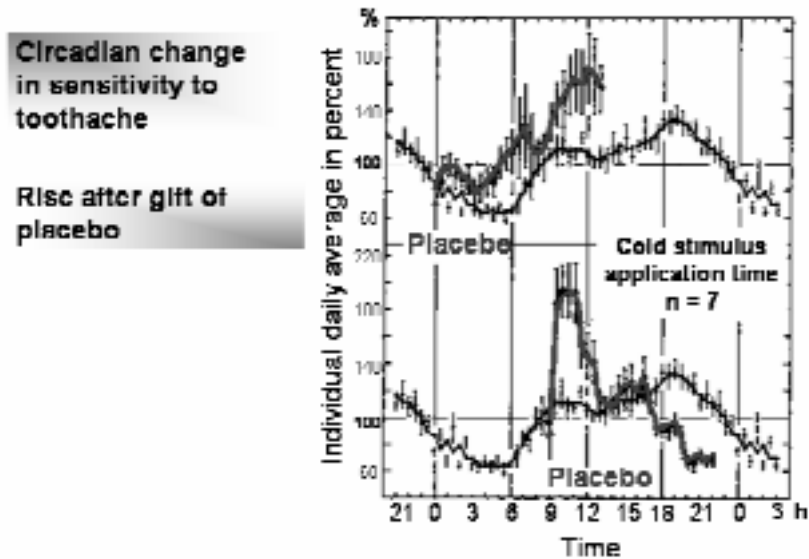
(Pinger A. Das Bild der Seele im Spiegel der Jahrtausende)

The progress in the use of these principles allows the actors to create an additional quality: “sense”. Scientific research processes based on sense have to

attribute to the observed actors the intention to be in relationship to another autonomous existing actor. From this position it is only one, but a fundamental step to the final-oriented homo sapiens of our time: – To extend the relationship from biological and materialistic characterisable realisations to relationships expressed in values and meanings, and finally to relationships of abstract assumptions or assumed entities (like god, honour...) – to goals outside of matter, time and space (finality). Even this can be examined by an observer: Without attributing such types of reasons to the research objects the reproducible observable phenomena can not be explained conclusive on the basis of logic.

The applicability of a theory to deal with placebo is valid as a self-critical criterion for a comprehensive theory dealing with natural and non-natural scientific approaches to health: According to the predictions of the “extended view” we should expect a special type of medical drugs with an indirect healing effect: direct effects influencing the brain to stimulate a “changing in the matrix-world” so that this new stimulation of the brain is causing the healing effect. Such an effect should be blockable with a chemical which is not blocking the effect of the drug but the chemical caused by the brain.

There are results confirming this. For example Petrovic et al. /18/ as well as Benedetti et al.(14) point out that placebo analgesia can be blocked by opioid antagonist naloxone. A review paper in “Science” about the placebo phenomenon, pursuing these thoughts, asks the provocative question: “Can placebo be the cure?”/19/



Source: G. Filigheddu, G. & L. Palloni, 1997

According to the proposed theory we should expect the same circadian effects in placebo as we can observe in the verum. This has been confirmed by Hildebrandt and Pöllmann demonstrating the effectiveness of a placebo inhibiting the effect of artificial tooth pain caused by electricity and by cold: They show significant differences according to the circadian rhythmic. And also the placebo effects does /20/.

“Pain” can deal with purpose, sense and – only in humans – finality. So “pain” is a good example to demonstrate the power of the “extended view” to deal more appropriate with up to now unexplainable phenomena.

The “extended view” permits us to expect additional conclusions within many fields of natural and non-natural sciences. Therefore this model is the actual focus point of the activities of IAS H&E. We support this initiative also with a special Senior Fellowship Program in Innsbruck. The new centre of IAS H&E allows us to host scientists in our own rooms – so they can work without interferences by the usual daily work tasks. In this initiative we had e.g. in the last 12 months scientists from Russia (Prof. Pogosian V., Dept. of Linguistics, Herzen State Pedagogical University of Russia, St. Petersburg), Germany (Prof. Frey J., Leibniz Institut, Dept. of Neurophysiology, Magdeburg), Spain (Astrobiology) and Thailand (Microbiology) as guests in Innsbruck.

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## **FUNCTIONAL SYSTEMS THEORY DEVELOPMENT IN ANOKHIN'S SCIENTIFIC SCHOOL: APPLIED ASPECTS FOR HEALTH DIAGNOSTICS AND HEALTH RECREATION**

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In recent years, it has become clear that an essential feature of living matter is its systematicity, i.e. the ability to form systems. In the 1960's, L. von Bertalanfy, a Canadian biologist, formulated a theory of biological systems, describing them as an «arrayed multitude of inter-linked elements». On the basis of L.Bertalanfy's theoretical ideas a new biological approach called «system approach» was formulated /1/.

The system approach has become widely used not only in biology and in other fields of science but as well in mathematics, philosophy, sociology, psychology, economics etc. At the same time, the very notion of «system» introduced by L.Bertalanfy and his followers, as well as a general theory of systems developed by them, could not give the answer to the question: What caused individual elements to form system entities? Thus, the very concept of “system” needed a more profound specification of its properties, operational architectonics, and, primarily, its system-forming factors that would transfer an arrayed multitude of actively functioning elements on the level of a functioning system.

The materials of the latest International Congresses of Physiological Sciences (IUPS) clearly testify to that fact. Therein the statement of Prof. E.R.Weible, former president of IUPS could sound remarkable: «What changes should be done to turn physiology back to the thick of things? We have arrived to the conclusion that a key notion that can fulfill this task may be an «integrative physiology» /2/.

Not belittling the highest scientific importance of analytical molecular-genetic mechanisms of life it is quite natural to raise the question: How are molecular-genetic mechanisms functioning in the whole organism?

In this respect a system approach to the organization of an organism as a whole is quite essential. The concept of «functional system» formulated by P.K.Anokhin in 1935 perfectly complies with these requirements.

P.K.Anokhin was the first to demonstrate that living matter possesses a dynamic ability to converge and form discrete auto regulating functional systems, whose activity provides adaptive results, useful to the entire organism /3/.

**Functional systems** are dynamic, self-organizing and auto regulating organizations whose activity is aimed to achieve adaptive results useful to the system and the organism as a whole. The results of metabolic reactions in tissues, various parameters of internal environment and results of behavior, satisfying human metabolic and social needs act as useful for the organism results that constitute functional systems.

According to the functional systems theory separate molecules, cells, organs and tissues - nervous ones included - selectively consolidate into self-organizing, self-regulating system organizations for the achievement of adaptive results, useful to the organism. The association of nervous elements into various functional systems always takes place selectively according to the adaptive task performed by the functional system.

From the functional systems theory point of view any activity of a living being is defined as a multiple of well-coordinated functional systems of molecular, homeostatic, behavioral and psychic levels /4/. Some of these functional systems by their dynamic self-regulating activity determine various parameters of internal milieu and homeostasis as a whole. Others define a behavioral activity of humans and animals directed to the achievement of useful adaptive results that provide the satisfaction of various metabolic, zoo-social, and in humans – social needs.

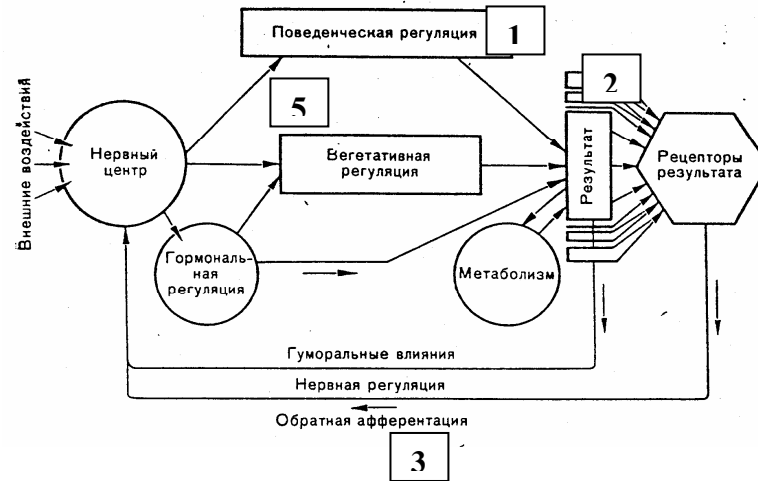
Functional systems of any organizational level have a similar structural design and include the following common and shared by different systems peripheral and central principal mechanisms (Fig. 1):

1. Useful adaptive result as a main functional system component;
2. Receptors of result;
3. Reverse afferentation coming from the receptors of result into the central units of the functional system (feedback mechanism);
4. Center representing nervous elements of different levels selectively associated by the functional system into special system mechanisms;
5. Executive somatic, autonomic, immune and endocrine components including goal-directed behavior.

Since in principle different functional systems of the body are uniformly designed, they are rightly considered to be isomorphic.



In any functional system, every shift of result as well as its optimum for the metabolic level is continuously perceived by corresponding receptors. Signals («reverse afferentation» according to P.K.Anokhin) born in receptors come to the corresponding centers to rise the executive activity and thus to restore the adaptive result needed for the metabolism.



**Fig. 1. General scheme of a functional system by P.K.Anokhin (comments see in the text).**

Reverse afferentation is the background of auto regulating processes in any functional system. The concept «reverse afferentation» was introduced to physiology by P.K.Anokhin 12 years before N.Winner, who, as is well known, formulated the notion about «feedback».

Central architectonics of functional systems include the following principal stages consecutively replacing each other: afferent synthesis, decision-making, acceptor of action's result, efferent synthesis, and, finally, assessment of the achieved result.

The initial stage of a functional system is **afferent synthesis**. At this stage, the center of functional system executes the synthesis of excitations caused by inner metabolic need, by environmental and trigger (conditioned) afferentation, with constant utilization of genetic and individually acquired memory mechanisms. The afferent synthesis stage terminates with a **decision-making stage**, which physiologically restricts the functional system activity freedom rate and selects the only effector action able to satisfy the leading organism's requirement formed at the afferent synthesis stage.

The next stage in the dynamics of consecutive central architectonics development is taking place simultaneously with effector action formation is the

stage of predicting the required result of the functional system activity, i.e. the acceptor of action's result. At this stage of the functional system central organization, the programming based on the previous experience of the principal parameters of the result, satisfying the initial need, and their constant assessment based on reverse afferentation of the achieved result parameters takes place. When a significant result satisfying the initial organism's need is achieved the activity of the functional system decreases. And vice versa, if the achieved result parameters do not correspond to the parameters of the acceptor of action's result, there occurs disagreement, i.e. searching reaction; afferent synthesis is restructured, a new decision is made, and the functional system follows in a new direction required for the initial need satisfaction.

Effector action is preceded by the efferent synthesis stage, when an executive act is center-formed as a certain central excitation complex and is not accomplished peripherally as particular actions.

All stages of achievement of organism-beneficial results and their various states are continuously assessed through reverse afferentation. Reverse afferentation arises when respective receptors are stimulated by result parameters and via respective afferent nerves and humoral factors arrive in structures forming the acceptor of action's result. If reverse afferentation bears no valuable information concerning the optimal result level, the nervous cells of the acceptor of action's result are excited, a new afferent synthesis takes place and a new action occurs.

Thus, reverse afferentation concerning the result of performed acts in system organization of a goal directed behavior plays both evaluative and sanctioning role.

Functional systems of behavioral level have active external auto regulating links determining goal-directed behavior of subjects in the environment, often including active reorganization of the environment and active influence on it. Goal-directed behavioral activity is determined by formation of the respective biological motivations of these functional systems. The central architectonics of these functional systems, invariably includes different brain structures and the brain cortex. Examples of such functional systems are the functional systems whose activity maintains the optimal level of nutrients in the organism, osmotic pressure, metabolic production rate, body temperature etc.

Sometimes the result of a functional system activity is localized in the brain, for example in cases of human intellectual activity. Functional systems of psychic level determining human cognitive ability are supplied with an auto regulating unit of inner speech constantly interacting with an external behavioral unit affecting reproduction of oral or written speech or development of the corresponding behavior. However, in this case, the structural design of functional systems of cognitive activity is also isomorphic in its mechanisms.

The whole organism can be represented as a harmonic integration of

functional systems by different levels: molecular, homeostatic, behavioral, mental etc. Cooperation of functional systems on brain level is always built on the principle of dominance, discovered by A. Ukhtomsky (1925): in every given point of time the brain activity is governed by a functional system, a leading one for maintenance of life and adaptation of an organism in the environment /5/. All other functional systems at that time either contribute to the activity of a dominant system or are inhibited. After the satisfaction of the organism's need, which formed a dominant functional system, another system, leading in social and biological value, starts its dominating role and so on.

Another principle of functional systems integration is the principle of multiparametric coordination. This means that any change of parameters of the result in one system immediately reorganizes the state of the results in the other functional systems inevitably connected with that one.

One more principle in integration of functional systems in the organism as a whole is the principle of their successive cooperation when the achievement of the result of action in one functional system stimulates the activity of the other functional system.

As a further development of the functional systems theory a new concept about «systemquanta» of behavior and psychic activity of living beings was formulated in the P.K.Anokhin scientific school /6,7/.

According to that concept all continuum of behavioral and psychic activity in humans and animals is split into separate resulting «systemquanta», which provide the satisfaction of leading requirements of living beings. Every «systemquantum» of behavior presents a self-regulating organization including the initial need, motivation, system architectonics as described above, intermediate and final results, and continuous evaluation of the achieved results by dynamic reconstruction of acceptor of action's result. In dynamics of development of central architectonics of «systemquanta» of behavior and psychic activity under the influence of reverse afferentation from parameters of the achieved results and signals from the acceptor of action's result to afferent synthesis, a dynamic reconstruction of system architectonics of a behavioral act takes place, which in the long run provides the achievement of the adaptive result – satisfaction of the initial need.

#### **Dominant motivation as a basis for system organization of brain functions**

The experiments /8/ testify to the fact that biological motivations in animals, caused by various metabolic needs such as hunger, thirst, fear, aggression, sex and so on are formed on the principle of ascending activating influences of hypothalamic centers on other brain structures, in particular limbic ones, thalamus, brain stem reticular formation including brain cortex and its frontal structures. Those influences are distinctly seen on animals' electroencephalograms under urethane anesthesia.

Social motivations in humans are built by pacemakers localized not in hypothalamus but in other brain structures including frontal parts of brain cortex /9/. It was found that in the process of forming dominating biological motivations cortical neurons in their turn influence pacemaker center of hypothalamus (specific descending activating and inhibitory influences). As a result ascending and descending influences under dominating motivations develop into dynamic cortico-subcortical reverberating interaction that define the energy of dominating motivations. On that ground a retrieval of memory traces by dominating motivation occurs. In mechanisms of ascending activating influences of hypothalamic structures on other brain regions different neurotransmitters and neuropeptides participate in various integrative correlations. Dynamic integration of chemical mechanisms of various brain structures on different stages of animals' resultant activity was revealed as well /10/.

Reorganization of neuron chemical integration in limbic-reticular brain structures was found in dynamics of emotional stress and in formation of alcohol motivation /11/.

Oligopeptides stimulating and inhibiting biological motivations were also discovered. It was shown that oxytocin microinjection into lateral hypothalamus in fed rabbits stimulated an additional food intake.  $\beta$ -lipotropin injection into lateral ventricles in fed animals caused activation of instrumental food-searching behavior and additional food intake. The same effect was observed under ACTH<sub>10-14</sub> and MSH<sub>4-7</sub> intracerebroventricular injections.

Pentagastrin intra-abdominal injection activated feeding behavior in fed rabbits while microiontophoretic application to neurons of lateral hypothalamus in fed rabbits caused a pattern of pulse-to-pulse activity typical for hunger state; peripheral ACTH<sub>5-8</sub> application activated self-stimulation in rabbits. Bradykinin injection into cerebral lateral ventricles facilitated defense reactions in rabbits under electrical stimulation of ventro-medial hypothalamus.

It was shown that under cerebral lateral ventricular injection of anti-serum to  $\beta$ -endorphin, angiotensin II and delta-sleep-inducing peptide double-stage effects were observed: for the first hours – a suppression of biological motivations and their facilitation on the next day. It may be supposed that the first reaction on anti-serum application to oligopeptides could be an increased production of endogenic oligopeptides by the animals, which by mechanism of negative feedback effect inhibit the realization of motivation into behavior. And only later and under the effect of anti-serum optimal and even lighter conditions for transformation of motivation into a proper behavior are formed /12-13/.

Special experiments showed that dominating motivation significantly changed the convergent and discriminating properties of brain neurons, increased their sensibility to neurotransmitters, neuropeptides and other biologically active substances. Neuron sensitivity as reinforcing factor satisfying the initial needs

significantly widens.

It is significant that neurons involved into dominating biological motivation despite their generalized localization in brain structures make up only a certain number of common neuron populations of brain structures. The part of neurons involved in dominating biological motivation is significantly higher in brain stem and gradually decreases in direction to the cerebral cortex. This phenomenon shows the very important role of brain functions. Cortex neurons in their adaptive behavior fulfill other not less significant functions: they react on conditioned stimuli, location and migration of reinforcing agents and so on /13/. Unlike the structures involved in architecture of genetically determined biological motivation the most of the brains cortical neurons fulfill plastic adaptive functions of learning and estimation of the factors of the environment by subjects.

The factor that synchronizes the activity of different brain neurons in functional systems is the result of functional systems activity. The state of the result is reflected in the character of allocation of inter-spike intervals of neurons in different brain structures included into different functional systems. As soon as the parameters of the action result are changed the character of the impulse activity of brain neurons immediately changes. Under the influence of dominating motivations the activation of *c-fos* and *c-jun* early gene expression in brain structures was revealed /12/.

The experiments mentioned above testify to the fact that dominating motivations change the properties of brain structures and respective peripheral receptors making them selectively perceive and interact with factors that satisfy the needs underlying those motivations. As a result, under the effect of a dominating motivation a peculiar informational constellation of neurons of different brain structures is formed - able to perceive reinforcing influences.

### **System mechanisms of reinforcement.**

#### **Interaction of motivation and reinforcement on brain structures**

From functional system theory position the processes of reinforcement include: the impact of different parameters of behavioral results on the receptors of the organism which experiences a definite need, and their comparison by reverse afferentation with the acceptor of action's result.

Acceptor of action's result of every functional system represents a mosaic architectonics, widely spread along different cortical and subcortical brain structures.

Due to cyclic interactions between interneurons associated into acceptor of action's result, excitations in these neurons by reverberation are able to remain for a long time and to continuously evaluate the reverse afferentation coming to them from different parameters of the results achieved by the subjects. The confirmation of the spread of pyramidal tract stimuli on interneurons was found in special experiments where reactions of interneurons of different brain structures in response to antidromic stimulation of the central end of pyramidal tract cut in the

olive of medulla were investigated.

Under antidromic stimulation of the pyramidal tract responses of neurons were registered in somatosensory, visual cortex and dorsal hippocampus. The same neurons vividly reacted on stimuli of different sensory and biological modality and on stimulation of motivationogenic centers of hypothalamus. All that shows that on the brain interneurons which constitute the acceptor of action's result activated by a dominant motivation, sensory information coming from various organism's receptors excited by relevant parameters of reinforcing influences, can be «imprinted».

In the processes of successive change of «systemquanta» a dynamic architectonics of acceptor of action's result is formed, reflecting on informational grounds the chain of actions and results leading to the satisfaction of the relevant need.

Every parameter of the reinforcing effect leaves its own specific information trace in the corresponding visual, taste, auditory, tactile etc. projection brain zones, determining in this way a generalized in various brain structures architectonics of acceptor of action's result. So if genetic components of acceptors of action's result of different functional systems are conservative, the architectonics of the acceptors of action's results in dynamically changes during individual's life span according to the changes in the parameters of the reinforcing influences. Every reinforcement as a part of a many-sided activity leaves its own information imprint on the acceptor of action's result structures of a corresponding functional system.

As the central units of many functional systems of homeostatic and behavioral level converge on the brain structures, a generalized acceptor of action's result is formed on which every given moment anticipatory reactions of a dominating functional system are revealed.

Reinforcing stimuli are addressed just to the brain neurons which initially are involved into dominating motivation and in their discharge activity reflect a specific for the given motivation character of inter-spike intervals distribution.

A series of experiments shows that the animals' behavior conditioned by early gene expression under electrical stimulation of hypothalamus motivationogenic centers is not blocked by protein synthesis inhibitors such as cycloheximide, puromycin, actinomycin D and others. However, under training when behavior initiated by motivation ends with the achievement of the needed results that is the formation of functional systems, the mentioned protein synthesis inhibitors block this behavior.

Inhibitors of DNA synthesis – azidothymidine and amidothymidine also suppress a trained behavior blocking selectively behavioral molecular engrams and anticipation of useful adaptive results by animals.

So under reinforcement on the structures of acceptors of action's results of functional systems behavioral molecular engrams are formed.

### **Imprinting mechanism of acceptor of action's result**

As known, K.Lorenz was the first to discover imprinting phenomenon in newborn birds /14/. He showed that subjects which newborns saw first, in particular, the parents, were imprinted in their memory and defined their reaction to follow these subjects. But K.Lorenz and his followers in particular N.Tinbergen did not answer the question: «What are the intimate mechanisms of imprinting and how long does this imprinting mechanism last in ontogenesis of living beings?»

Imprinting phenomenon has got a new understanding from the theory of functional systems point of view. In 1978 we proposed an imprinting hypothesis of forming acceptor of action's result. According to the imprinting hypothesis of forming acceptor of action's result under the influence of the results of behavior their different parameters by reverse afferentation are imprinted as molecular engrams on the respective structures of acceptor of action's result. In that way acceptor of action's result in every functional system is formed and becomes enriched during the whole individual's life by previous reinforcements and imprints of properties of parameters of the reinforcing effects on the structure of a dominating motivation.

As shown above the interaction of reverse afferentation from the parameters of the achieved behavioral results with the initial dominating motivation takes place.

All that allowed formulating a holographic principle of interaction of dominating motivations with reinforcement on brain structures.

### **Holographic principle in organization of a functional system**

In optics, a holographic principle was discovered by Dennis Gabor. Creating a hologram, a light wave is normally split by a special prism into two waves. One is a supporting wave, and the other, a subject wave, reflected from the object to be photographed. To reconstruct a hologram, a supporting beam is sufficient.

By analogy with physical holography, reverse afferentation arriving in the central organs of a functional system from a shifted level of result providing the optimal metabolism (i.e. from the need) can be regarded as a «supporting wave». On the other hand, signals of various parameters of the result satisfying one or another need, can be considered a «subject» wave. Thus, only the «supporting wave» is able to restore the properties of the needed result.

That is why when a need arises, individual elements begin to merge into functional systems and to reflect forthcomingly the qualities of the needed result in their activity.

Interaction between the signals of need and its satisfaction takes place on an interference basis and on the acceptors of action's result. In conformity with the holographic theory each element (cells and organs) included into the corresponding functional system by its rhythmic activity reflects the state of its activity result: the initial need forming it, and various degrees of the need's satisfaction.

Dominating motivation is a basic factor for brain hologram retrieval /11/. Dominating motivation retrieves memory traces (engrams) from acceptor of action's result containing the properties of the needed result and specific conditional stimuli and pathways previously contributing or inhibiting the achievement of adaptive results useful for the organism and satisfying the organism's vital needs.

At present the scientific contribution of P.K.Anokhin, the value of his scientific ideas and intentions which he could not realize are becoming more and more visible and ponderable. Just in that scientific heritage Anokhin's disciples and followers of the great master find inspiration for their creative work and strivings. The theory of functional systems has allowed to elevate the level of analytical research to a new grade and opened new perspectives in system analysis of human and animal's behavior, integrative mechanisms of homeostasis in different environmental conditions and also in applied aspects of medical studies and clinical research.

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Further development of functional systems theory has opened prospects for the evolution of new approaches in diagnostics of human functional state and human health recreation and rehabilitation under the influence of different environmental stressors.

In such aspect the theory of functional systems interpenetrates closely the theory of "extended view", developed by W.Kofler /15/. This theory proposes a model to understand the human person from an evolutionary point of view (evolution of the energetical/material qualities and evolution of informational qualities – „abilities to organize“). Abilities to organize physiological functions emerged in human evolution millions years ago and developed on genetic level (extremely slow).

On the other hand, within the last decades the environmental habits of the Earth are changing so tremendously that the necessary adaptation (in limited time frames) to the consequences of the already occurring and future environmental or psychosocial changes may become an impossible burden for humanity. The person of today has to handle new problems of the 21st century (environmental, psycho-social) with bodily inborn instruments and/or mechanisms of "plasticity" which were selected by evolution for solving **in principle** other problems, without a chance for genetic or epigenetic selection concerning new demands. In such conditions "...we can expect additional to the specific effects „causally unspecific



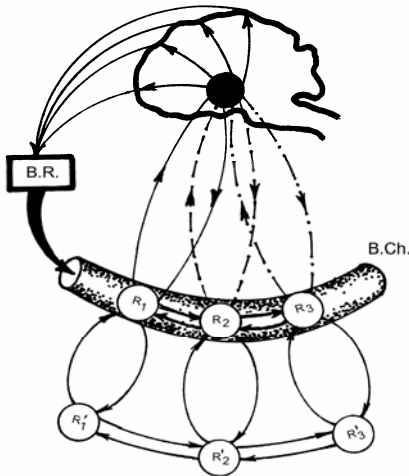
effects“ e.g. in consequence of environmental disasters the risk for civilization-caused illnesses could increase” /15/.

If we discuss the same situation in terms of the functional systems theory in connection with the theory of “extended view” we can conclude that in conditions of stress situations and maladaptation a deficit in the “abilities to organize” may cause **lower quality in organization** of:

- 1) separate functional systems of relatively simple level and
- 2) cooperation between homeostatic functional systems.

In that case the matter of principal importance for preventive medicine is providing new diagnostic methods to inform us about an unbalanced „homoestasis” of a patient and the elaboration of techniques for balancing homeostatic functions in their integration and recreation on the basis of human health.

In view of the theory of functional systems the most relevant theoretical point on which proposed new measuring and recreating approaches are based is the principle of multiparametric regulation /6/. The principle means that the activity of one functional system inevitably influences the ultimate adaptive results in other connected functional systems as well as redistributes activity between executive autonomic and humoral mechanisms in cooperative functional systems. This principle reflects the informational level in the organization of physiological functions /16/. Our previous data demonstrate that in environmental hazards earliest stress manifestations are associated with disbalanced interaction of different homeostatic functional systems /17/. Thus the multiparametric principle gives an important background for the elaboration of a new integral criterion of human functional state under long-term stressors describing multiple quantitative relationships between different functional systems.



**Fig.2. The principle of multiparametric regulation (see in the text): B.R. – behavioral result, R<sub>1</sub>,R<sub>2</sub>,R<sub>3</sub> – useful results of homeostatic functional systems (homeostatic parameters) influenced by behavioral activity, B.Ch. – blood channel, R'<sub>1</sub>, R'<sub>2</sub>, R'<sub>3</sub> – corresponding functional systems.**

Proceeding from that principle the "Health Certificate" method and computer system were developed for the multiple evaluation of individual functional state and personal physiological peculiarities. The hardware of the computer diagnostic system "Health Certificate" is concentrated in the Examination Panel which contains a set of cardio- and pneumosensors for screening the physiological health and carrying out psycho physiological tests. It also provides digital analog conversion of the sensor signals. The Examination Panel is to be connected to any computer.

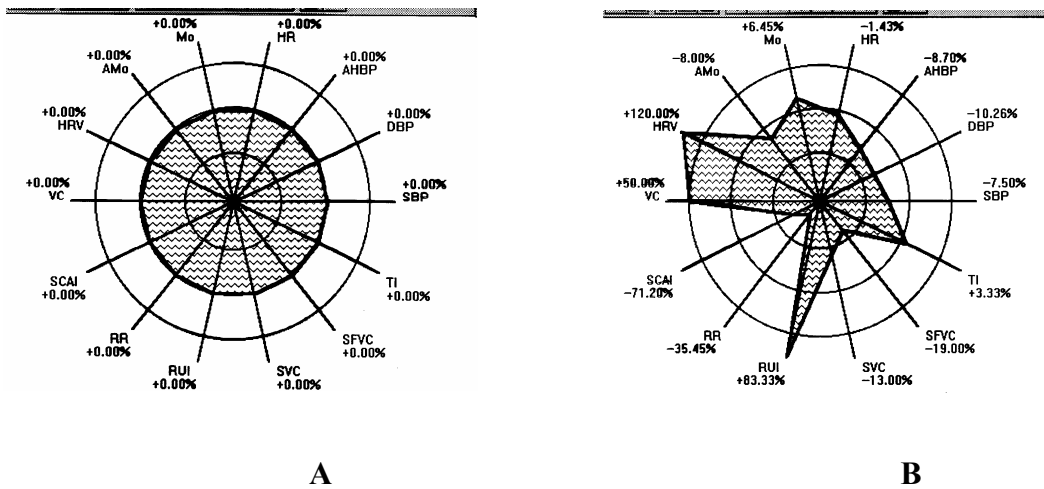
The physiometric characteristics allow to deposit into the PC data base the following parameters: height, weight, chest circumference, dynamometry of the right and left hand, locomotor activity; systolic (SBP) and diastolic (DBP) blood pressure, vital lung capacity (VC), forced vital capacity (FVC), Shtange's test (breath holding time when inhaling).

The analysis of cardiac rhythm and pneumometry allows, in parallel, to put in the cardiogram and pneumogram data record by external sensors. The input process is displayed. The test results are used in the building of the cardiointervalogram and pneumorhythmogram. The heart rate (HR), respiratory rate (RR), their variability and parameters characterizing the activity of the autonomic nervous system are calculated: - stress-index of and - index of respiration unevenness /16/.

The complex integral analysis of human functional state was based on procedures of graphic descriptive modeling and constructing the operational rules. Based on values of the most informative cardiovascular and respiratory parameters we constructed an "image" of the condition of the person under examination as compared to an "ideal" age- and sex-related norm "chosen" from data bases of the computer program on entering the passport and anthropometric data for a given person; the "norm" was reflected on figures as a central circle (Fig. 3) and estimated quantitatively the degree of deviation of each index from the "ideal" standard.

From the set of deviation values of all parameters we calculated the disbalance coefficient of physiological functions (DC), a quantitative multiple criterion of the human's adaptation to ambient conditions.

States of adaptation were classified by DC values (according to H.Selye's concept of stress-syndrome) as follows: class 1 - satisfactory adaptation ( $DC < 1.5$ ); class 2 - functional strain ( $1.5 < DC < 3.0$ ); class 3 - unsatisfactory adaptation or functional overstrain ( $3.0 < DC < 4.5$ ); and class 4 - failure of adaptation or stress ( $DC > 4.5$ ).



**Fig.3. The principle of graphical modeling of multiparametric physiological data:**

**Sample A.** The parameters are presented as vectors according to individual «ideal» characteristics, which are “extracted” from computer data base and presented as central circumference. Graph A: Image of an optimal (“ideal”) functional state.

**Sample B:** Under stress disorders of the parameters relationships, their deviations from the individual’s norm are observed and graphical image acquires an irregular star.

The developed program allows to reveal on a real temporal scale the functional condition of person and to plot an autonomic "passport of health". In this process one not only can determine the class of condition and individual prognosis of functional state under stress-influences but also can produce a typization, separation of persons with similar autonomic functional shifts which suggest development of similar disorders under the influence of stress-provoking environmental factors (psycho neurological shifts; autonomic disregulations; disorders of vascular tone; bronchial obstructive disorders; etc.).

In development and verification of the polyparametric method “Health Certificate” and it’s hardware with computer program special comparative pilot dynamic examinations of about 400 students were carried out.

In the first set of comparative studies 266 schoolchildren underwent comprehensive medical ambulatory examination. In addition, each young patient underwent a polyparametric check-up and received a Health Certificate chart, then the polyparametric results were compared with clinical examination conclusions. It was revealed that in each age group of schoolchildren about one half were

relatively healthy, but experienced various functional deviations. However the question arises how healthy are the persons of Health Groups I and II, how resistant are they to environmental stress factors?

Figure 4 shows different adaptational levels in relatively healthy persons. Less than 50% of the children were found with satisfactory adaptational level. The others exhibited insufficient adaptational abilities, i.e., they were in need of different rehabilitation procedures.

Thus the application of the polyparametric method “Health Certificate” allows to reveal children and adolescents without chronic diseases but with impaired relationships between different homeostatic functional systems, i.e. in different stages of stress.

Our data based on polyparametric approach show that practically up to 80% of the children are in dire need of health-recreational manipulations and rehabilitation courses.

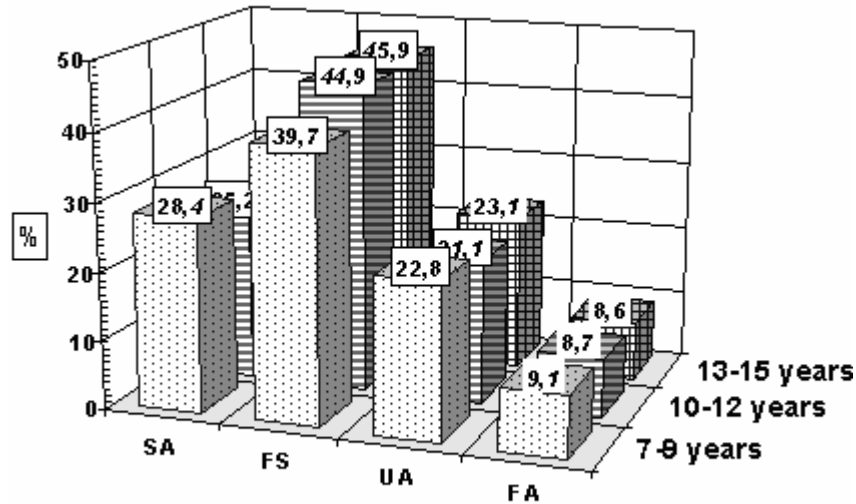


Fig. 4. Distribution of relatively healthy schoolchildren from radio ecologically unfavorable regions on classes of adaptation (in %), carried out on the basis of DC values.

Designations: SA - satisfactory adaptation, FS - functional strain, UA - unsatisfactory adaptation or overstrain, FA - failure of adaptation.

Taking into account the fact of permanent residence under ecologically unfavorable conditions in the future and non-specificity of the revealed abnormalities, the development of non-drug means of enhancement of the adaptive potential and resistance of the child's organism is one of the urgent problems.

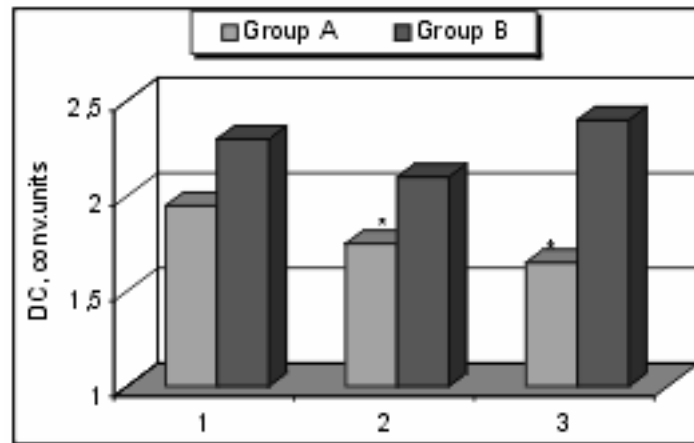
The procedure of normobaric intermittent hypoxic training (IHT) may be one of such techniques. IHT means breathing with hypoxic gaseous mixture (11-14% vol. oxygen) under normobaric conditions in interval regimen: 3-5 min. for hypoxic inhalation with 5 min. normoxic intervals, several repetitions in one session. The method of IHT is based on the adaptation medicine principle of non-specific protective cross-effects of preconditioning to different natural stimuli (physical load, emotional stress, cold, high altitude etc). Therefore, training the body for short-term normobaric hypoxia not only protects it from this factor but also enhances its resistance and adaptation capacities to physical loads, chemical pollutants, emotional stressors /18,19/.

In such conditions IHT works as an additional (manmade) external executive mechanism to majority of homeostatic functional systems. Hence hypoxia training after some repeated procedures helps the functional systems to sustain adaptive results - physiological parameters in normal range and to make harmony in cooperative activities of homeostatic functional systems despite of unfavorable environmental stressors.

In the other set of our studies with more than 108 adolescents the polyparametric method was testified to evaluate the dynamics of functional state during the program of IHT for schoolchildren who are living in ecologically and socially unfavorable regions.

Figure 4 shows the mean values of disbalance coefficient in children with triple polyparametric examination – before, after and a month following IHT program. The children underwent IHT program consisted of 18-20 sessions to each pupil comprised Group A, 56 pupils), the control group included 52 pupils /17/.

Analysing the average group DC dynamics it was shown that, in the group of children exposed to the IHT course, DC continuously and significantly declined from the initial value of  $1.97 \pm 0.19$  to  $1.75 \pm 0.15$  and  $1.61 \pm 0.11$  immediately after and a month after the health-building course respectively. This indicates a better balance of autonomic functions and mechanisms of neurohumoral regulation. In the control group, the DC dynamics was insignificant and the DC values were considerably higher than in the A group.



**Fig. 5. The dynamics of the disbalance coefficient (DC) of physiological functions in children of experimental (A) and control (B) groups before (1), after (2) and in one month following (3) the course of IHT. (\*-  $p < 0,05$ ).**

It was shown, that in the IHT group, the decrease in average DC value occurred at the expense of redistributing the schoolchildren by classes of adaptation to the environment. Whereas before the health-building procedures all classes of adaptation contained an approximately similar number of children from either group (with predominating conditions of strain and overstrain), after the IHT course in the dispensary more than 50% children of group A were assigned to the "satisfactory adaptation" class. Within a month even more pronounced changes were observed: 59% of schoolchildren possessed sufficient adaptive capacities and the other children were in a marginal state of "functional strain". In the control group, the dynamics of conditions was different: after the health-building course a part of schoolchildren were transferred from classes "unsatisfactory adaptation" and "failure of adaptation" to the condition of functional strain of functional systems. However, representatives of unsatisfactory adaptation classes reappeared in this group within a month while schoolchildren with a satisfactory state of the adaptive "potential" comprised as little as 18.1%.

The positive dynamics of the integral index of adaptive capacity of children group A occurred at the expense of decreasing practically all risk factors and indicators of stress. For instance, initial examination has revealed tachycardia in 28 children; signs of disturbed bronchial patency - in 36 children; predomination of sympathicotonic autonomic control - in 47 children; and hypertensive reactions - in 33 children. After the IHT course, tachycardia was observed in 13 children; obstructive disorders remained only in 11 children; sympathetic predomination - in 13 children; hypertensive reactions were not

founded. Such considerable dynamics were not observed in the control group.

Therefore, performed investigations with the use of elaborated polyparametric method revealed systemic multiple optimizing effects of intermittent hypoxia training program on homeostatic cardiovascular and respiratory mechanisms in their integration. Feasible mechanisms of IHT can be considered as follows: regular hypoxic “impulses” intermitted by normoxic ones train neuronal centers, balance central-peripheral autonomic intercommunications and, therefore, result in cross-adaptation effects and increase the capacity of homeostatic and behavioral functional systems to resist environmental and social impacts.

Thus multiple evaluations of relationships between vital system parameters (BP, RR, HR, VC, FVC, coefficients of autonomic regulation etc.) which manifest themselves as new, informative diagnostic characteristics of a human’s functional state, are a more relevant, sensitive and exact method in revealing earliest signs of environmental stress and stress-induced disturbances. The initial stress manifestations are associated with disbalanced interaction of functional systems and autonomic regulatory effects. On the other side, by this method we are able to control the efficiency of any psychological or physical (pharmacological) intervention proposed as health recreating treatment.

The presented data of our investigations once again demonstrate the evident proofs of advantages and perspectives of the application of the main statements and principles of the functional systems theory in the evolution of new approaches to preventive medicine and new methods of health and life style improvements to humanity.

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# THE IMPACT OF IMPLANTABLE BIOMEDICAL DEVICES ON NOSOCOMIAL INFECTIONS AND ITS PREVENTION BY THE OLIGODYNAMIC ACTIVITY OF SILVER IMPREGNATION OF BIOMATERIALS WITH SILVER NANOPARTICLES

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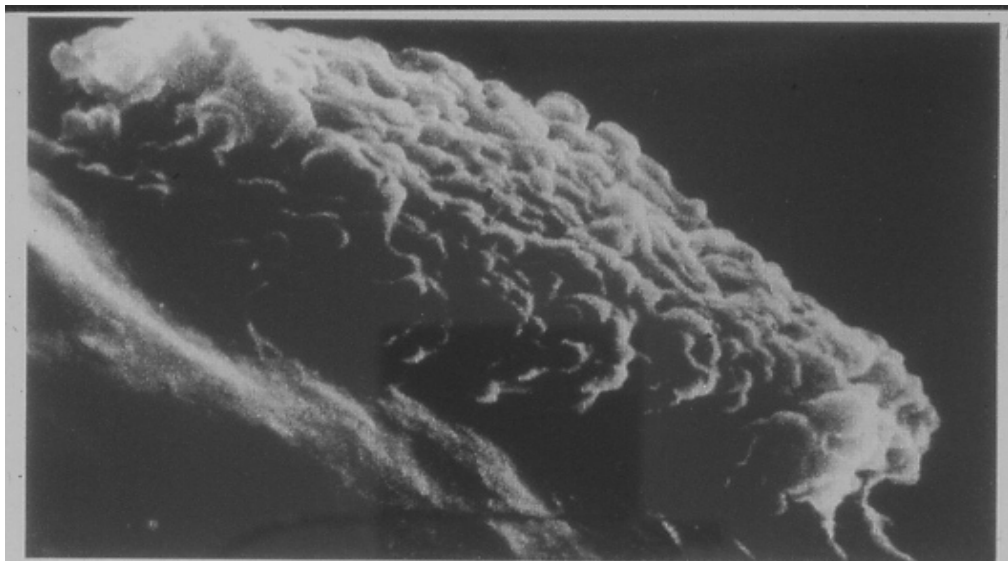
## **Description of the problem**

Health care associated infections, the fourth leading cause of disease in industrialised countries, are a major health issue. Such nosocomial (hospital-acquired) infections are today by far the most common complications affecting hospitalized patients. Based on a conservative estimate, 10% of the European population is hospitalised each year. Thereof, it is assumed that 5% (3.8 % on a general ward, 15.3 % in intensive care units) acquire at least one nosocomial infection. Based on these figures, it can be estimated that some 1.75 million hospitalised patients are affected annually by a nosocomial infection in Europe. Assuming a conservative 10% attributable mortality rate, this equals a minimum of 175,000 deaths every year. /1/ The results of the EPIC study suggest even higher numbers of affected patients /2/. Reports from the US indicate that nosocomial infections account for 2 million infections and 90,000 preventable deaths per year. /3/ In 2000, the US Centers for Disease Control and Prevention estimated the total costs of nosocomial infections to be in excess of 5 billion US \$. An excess length of stay (mean, 10 d; median, 5 d;  $p = 0.007$ ) and increased direct costs (mean difference, \$34,508;  $p = 0.008$ ) has been described. /4/ These figures don't include the disabilities they cause, the decrease of healthy life expectancy, the impact on the loss of productivity due to early death or chronic illness. /5/ In Germany, it is estimated that approximately 2.4 billion € are spent annually for treatment of these infections. /6/

The consequences of hospital acquired infections have become more severe than a decade ago because of an increasing number of highly vulnerable patients together with emerging of antibiotic-resistant microbes, especially *Staphylococcus aureus* (MRSA), *Enterococcus species* (VRE) and Gram-negative microorganisms

producing extended spectrum beta-lactamases (ESBL). /7, 8, 9/ In addition, the demographic trend towards an ageing population enhances the risk of increasing infection as elderly people are prone to invasive medical procedures and are, in general, more susceptible to infectious diseases. The situation is aggravated by the fact that in the future there will be very few new antibiotics under development /10/.

Modern medical and surgical practices have increasingly utilized implantable medical devices of various kinds. Such devices may be utilized only short-time or intermittently, for months, years or permanently. They improve the therapeutic outcome, save human lives and greatly enhance the quality of life of these patients. However, plastic devices are easily colonized with bacteria and fungi. /11, 12/ Multi-resistant nosocomial pathogens are the most common organisms colonizing the outer and inner surface of catheters and proliferate on the surface at a rate of 0.5 cm per hour. A thick biofilm is formed within 24 hours on the entire surface of these plastic devices once inoculated with a small number of bacteria. /13, 14, 15/



The review of the literature and multivariate analyses revealed implantable medical devices as a major independent risk factor present on more than half of patients with positive blood cultures. /16, 17, 18, 19/ It became clear since Elek and Conen demonstrated 1957 that the presence of a foreign body significantly reduces the number of bacteria required to produce infection. /20/ Microorganisms gain access to the body by multiple pathogenetic pathways: the disruption of the integrity of the surface of the body and direct and indirect access of microorganisms into the respiratory tract, the urogenital tract, bloodstream and cerebrospinal space are major routes. /18/ Despite the sometimes low virulence of

invading microorganisms involved, the bodies own defence mechanisms are unable to eradicate the organisms effectively even when the host is fully immunocompetent. However, underlying disorders like malignancies, diabetes and agents impairing host defence mechanisms e.g. administration of corticosteroids, antineoplastic agents and parenteral nutrition are well recognized risk factors. Risk for nosocomial infections is, among others, associated with duration of hospital stay, type of ward and intensity of care. /21, 22, 23, 24, 25/ The presence of indwelling devices, bypassing the normal host defence mechanisms are identified as major independent risk factors.

### **Prevention**

Eradication of microorganisms from infected biomaterials proved to be difficult as sessile microorganisms require substantially higher concentrations of antimicrobial substances for eradication than planktonic organisms. /26/ The ultimate goal must therefore be the prevention of device related infections. By drawing upon existent knowledge of epidemiology and pathogenesis rational guidelines for prevention can be formulated and appropriate material modifications instituted. Strict adherence to hygienic rules, vigorous barrier precautions during insertion or implantation of the device as well a continuing care are aspects of particular importance and require the need for the consistent application of guidelines. Handwashing, ideally with an antiseptic containing preparation is “the single most important intervention in infection control” Included are also sterile gloves, a sterile long sleeved surgical gown, mask, cap and a large sterile drape including aseptic care and appropriate supportive measures. /27, 28, 29, 30/

The implementation of an infection control program utilizing education of personnel skilled in the placement of intravascular devices, process control, and performance feedback has been shown to be associated with significant reductions in rates of IVD-associated bloodstream infections (BSI) and mortality. /31, 32/

### **Development of an infection resistant material**

Favourable in vitro activity has been reported by the impregnation of polymers with antibiotics, chemotherapeutics and disinfectants after coating with antibiotics, impregnation with antibiotics and combinations thereof. Such measures have allowed a high antimicrobial activity to be achieved locally for a short period of time.

There are a number of adverse events with this technology: First, there is a restricted spectrum of activity of various antibiotics limited in addition by the increasing number of multiresistant microorganisms. Second the eradication of sessile microorganisms from plastic surface requires 100-250 fold higher concentrations

compared to the eradication of planctonic microorganisms. Last not least subinhibitory concentrations of antibiotics favour the development of resistant microorganisms by induction and selection. /25/ The impregnation of Hickman catheters with vancomycin has resulted in the selection of vancomycin resistant enterococci for which no effective antibiotic was available. Rifampicin, an antibiotic with good activity against staphylococci, is also a potent inducer of resistance. /33, 34/

There is also unanimous agreement to strictly prohibit the use of antibiotics for prophylaxis which could eventually be used as therapeutics. If prophylaxis fails, no effective antimicrobial substance is available for treatment. All these factors make incorporation of prophylactic antibiotics in polymers highly unattractive and limit it to second or third choice substances with a limited spectrum and lack of reliable efficacy.

The duration of the antimicrobial activity has to last for the entire use of the catheter which is generally > 30 days.

The antimicrobial activity of silver as well as copper and other metal ions, has been well known for centuries as oligodynamic activity of metals. Silver is the element with the highest antimicrobial activity and the lowest toxicity for animal cells. /35/

- Silver ions form insoluble compounds in the cell wall of bacteria and fungi with sulfhydryl groups which are essential components of enzymes responsible for the transmembranous energy metabolism and electrolyte transport. The result is a loss of fluid and electrolytes from the microorganisms, which dry out and shrink.
- Silver ions block the respiratory chain of bacteria in the cytochrome oxidase and NADH-succinate-dehydrogenase region.
- Silver ions enter the cell and bind to bacterial DNA. Intercalation of silver leads to an increased stability of the double helix and prevention of splicing. Therefore no further proliferation occurs. This also explains the prevention of proliferation of adherent bacteria and the prevention of biofilm formation.

### **Antimicrobial activity of silver**

The antimicrobial activity of silver ions includes the majority of gram-positive and gram-negative cocci as well as gram-positive and gramnegative rods, fungi and many viruses. Clinically relevant organisms e.g. methicillin resistant *S. aureus*, multiresistant enterococci and corynebacterium jeicum, gram-negative bacteria e.g. multiresistant *P. aeruginosa*, *Stenotrophomonas maltophilia* are included in the spectrum of activity. /36/ Microorganisms with resistance to the antimicrobial activity of silver are exceedingly rare. It has been reported that those microorganisms with a defective ion pump – responsible for resistance – also exhibit reduced virulence. There is no cross resistance with antibiotic and no induction of resistance has been observed so far.

### **Toxic effects of silver**

Silver has a remarkably low acute and chronic toxicity. Argyrosis, an irreversible local and systemic deposition of silver in various tissues that give rise to a grayish skin colour, is the only known toxic effect of the systemic administration of silver. /37/

For its development a total amount of absorbed silver in excess of 2 g is required. While this silver deposition in the skin has only cosmetic consequences, deposition in the eye (e.g. the Descemet's membrane, i.e. the lamina limitans posterior corneae) can result in disturbance of dark adaptation. This occurs at a total concentration of 0.9 g. In extremely high local concentrations (1000 µg/ml) a reduction in nerve conduction velocity can occur.

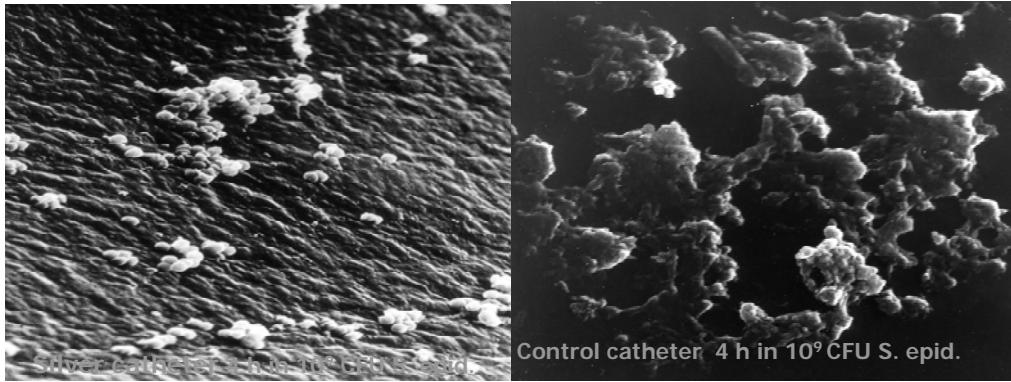
Silver is taken up with food in a concentration of 10 – 80 µg/day. The accepted limits of silver in drinking water are 100 µg/l of which a maximum of 1% is absorbed. /38/ Serum concentrations of up to 60 µg/dl and urine concentrations of 1100 µg/24 h have been observed in burn patients treated with silver containing ointments without adverse effects. /39/ With the technology of the nano-silver catheter used in our institution maximal amounts of 250 ng of silver are released from the catheter over a period of 24 hours. These concentrations are 1000 fold below toxic concentrations for humans even if implanted for years.

### **The technology is important**

Coating either by vapour deposition or ion implantation does not result in a sufficient liberation of silver ions and hence in inadequate antimicrobial activity. Investigations over the last decade eventually thought us to create an large surface of metallic silver in the polymer by impregnation of the entire matrix with finely distribution of billions of silver nanoparticles (<10 nm diameter, > 1000 cm<sup>2</sup>/g polyurethane) in the polymer matrix. /40/

In addition the polyurethane must be hygroscopic and attract free water and electrolytes. By these means an electrolyte solutions may interact with the finely dispersed metallic silver nanoparticles and free silver ions in bactericidal concentrations are released to the surface. In addition the surfaces become hydrophilic and a thin water film forms at the surface of the polymer. The electronegative surface of bacterial microorganisms attracts the positively charged silver ions for antimicrobial activity. This thin leads to a

- Reduction of the adherence of bacterial microorganisms on the surface
- The water film also provides an environment not favouring thrombus formation
- Prevention of attachment of platelets, fibrinogen and fibronectin.
- Prevention of biofilm formation



**A substantial increase of the activity of silver has been achieved by activation with silver alloys or addition of water insoluble silver salts resulting in a galvanic element.**

Investigation of antimicrobial activity in vitro of activated nanosilver impregnated catheters

Dow shaker method:

Preelution of 1 cm<sup>2</sup> surface

Addition of 10<sup>9</sup> CFU, investigation

every

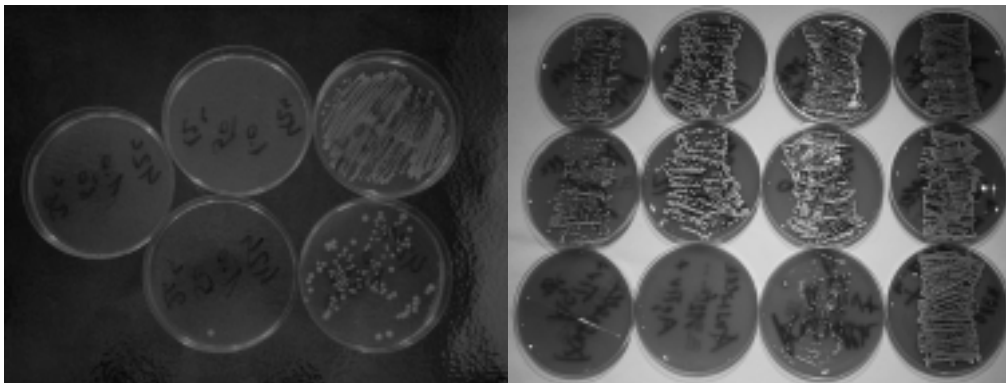
of CFUs in 6 hourly intervals

Roll on culture method:

Immersion of catheter in 10<sup>9</sup> CFU S.

aureus for 4 hours, roll on cultures

6 hours



**Cytotoxicity, biocompatibility and thrombogenicity was investigated and favourable results have been obtained. Catheter received CE certification in EU in 2003 Investigation of clinical activity /41, 42/**

	Short term- CVC			Long term CVC
	Study 1	Study 2	Study 3	
Ag-surface	450 cm <sup>2</sup>	250 cm <sup>2</sup>	2000cm <sup>2</sup>	450 cm <sup>2</sup>
Number of patients	165	425	204	42
Mean duration of placement	9,4 d	12,2 d	9,5 d	8,4Mo(Ag) 9,8 Mo (Con)
Contamination control catheter [%]	22,8 %	27,0 %	---	---
Contamination silver catheter [%]	14,0 %	20,1 %	< 10 %	---
Reduction [%]	38 %	26 %	---	---
Sepsis control catheter [%]	18,3 %	14,6 %	---	3/5071 Cath. Days.
Sepsis silver catheter [%]	5,1 %	5,9 %	0,51 %	0/5980 Cath. days.
Reduction [%]	72,0 %	60 %	est. 90 %	---

### **Summary:**

Nosocomial infections are a great threat to hospitalised patients. Implantable biomaterials are responsible for at least 60 % of all hospital acquired infections. Crude mortality rates associated with nosocomial infections due to device-related infections vary from 12 – 80 %, dependent on the population studies and the definitions used.

Health care providers, clinical epidemiologists, clinicians and hospital administrators become increasingly concerned with the problem of preventable health care associated infections as infected medical devices are a common source of nosocomial infections and contribute to substantial morbidity and mortality. Moreover, with the introduction of the diagnostic-related Groups system (DRGs) hospital acquired infections are generally not remunerable.

Material modifications with impregnation of the catheter matrix with billions of activated nanoparticles of silver<sup>0</sup> has the greatest potential for prevention of biomaterial related infections. Experimental and clinical studies with short term central venous catheters, urologic catheters and external ventricular drainage systems show a favourable effect and are able to reduce these infections substantially. As a consequence all implantable biomaterials should be endowed with antimicrobial properties in the future.

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# **ETHICS AND THE NEED FOR A COMPREHENSIVE EPISTEMOLOGICAL BASIS FOR HEALTH RELATED SCIENCES - OBSERVED UNDER THE CURRENT CONDITIONS IN THAILAND**

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## **Introduction**

Sciences and natural aspects of health basis are involves by various multifactors of the principles of ethics and epistemology for the proper application.

Sciences composes of the quality, application, presentation and excellence of center.<sup>(1)</sup>

Nature is environment, and human living that are birth, aging and death. They are the basic fundamental of arts, culture, economic, custom, belief, regulation and governmental systems. We must accept these unavoidable factors of the nature.

Therefore, for better understanding it will be easy to give an example for discussion about the applications of ethics and epistemology with the nature of health.

The scope of health is focused on prevention, promotion, treatment and rehabilitation for human body and mind. They are not similar in quality and quantity in any where which is due to financial support. In addition, competition in excellency is an ultimate goal of each medical institute. They are materialism and the real basic problems of health, even it is the developmental process of sciences.

## **Causes of the problems**

An example of the social-doctor problem is the mal distribution of doctors in rural areas. It was reported by the ministry of public health that the ratio of doctor to population to be 1:800 in Bangkok and 1:5,700 in some rural areas in the north

eastern part of Thailand.<sup>(2)</sup> The doctors, themselves, are at a high grade of worker and intelligent quotient. They know all the problem, and at the same time, create problems, both, faster than the general population can do. It affects good and bad in the society. In the past, present and the foreseeable future the medical students have been studying in the western style medical school. Their schools are situated in big cities. These schools are old and famous. They learn their medical procedure in a big hospital setting of more than 400 beds in the in department wards.<sup>(3)</sup>

Their instructors and professor are highly qualified, are middle class people and well accepted in the society. Their family are lovely and warm. Their children study in the first class schools in town. The medical students feel very happy and appreciate seeing their professors in television routinely at primetime. In conclusion, their professors are an example of role model for them to follow. Everyone looks for security in her/his profession. Facts need no proof and reference. People with justice in mind should believe and understand the above mentioned. This lead to the problem of mal distribution of doctors in rural areas, why do doctors live in big cities or wish to be in the private sector?

In fact, not many a number of doctors serve in the rural areas. About 4-5 of them, their name will be announced yearly as the best rural doctor award.<sup>(4)</sup> After the big ceremony, lasted not longer than a month, it is hard to remember their name. They are proud to be praised, it pushes them into stress intentionally with all the best of their intelligence and the total of their body strength to work harder in rural. Unfortunately their earning, the security of their profession, the increased chance of being sue, to get caught in the medical litigation, the expenses of their family social status and the study of their children cannot be compared to of those doctors in big city and/or in the private sector.<sup>(5,6)</sup>

### **Ethics and the comprehensive application of epistemology in the mal distribution of doctors in rural areas.<sup>(6)</sup>**

Ethics in general may be supposed to deal with the idea of just and respectful coordination of actions. Reciprocity, balance or a kind of symmetry and fairness seem to be of importance. This is in some respect the special task for ethics in distinction from religious rules, government system and more general cultural aspects in the formation of human actions.

In this sense professional ethics generally has to do with an equilibrium between what is demanded of the professionalist and the reward he has a right to.

This might be applied to medical professionalists directly.

Although doctors should be directed towards their patients, prepared to understand their problems, it must be clear that a doctor is not a god at all. She or he cannot perform miracles, and cannot live on air dirt, grass and good. Will.

Charity is necessary, but not enough. A doctor has to take care of herself or himself and her or his family as everybody else.

Medical ethics has to do with both of this, and this leads to kind of symmetric behavior. Patients are ethically constrained to respect the doctor as a human person as it is the obligatory in the reverse case, too.

In practice, cultural or even religious, for instance Buddhist principles suggest to evaluate situations and behaviour according to the following five principles:

Truth-Benefit-Right manner-Right time-Right person.

With this formal approach the ethical principles have to be applied. These principles, again in the example of a Buddhist culture, are:

Rights (the have to be respected and protected.)

Justice

Truthfulness

Honesty

Effective action

Avoidance of doing bad

At a closer look these formal and ethical principles are, even if they are taken from a special cultural background, of a transcultural character.

The ethical and epistemological principles have to be applied and selected according to the formal principles that are general criteria for right actions.

**Keywords:** Ethics, Medical practice, Epistemology

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## POSSIBLE DEPENDENCE OF COMPLICATIONS OF VARIOUS TYPES OF ARRHYTHMIA FROM CHANGE OF SECTORAL STRUCTURE OF INTERPLANETARY MAGNETIC FIELD

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**keywords: arrhythmia, IMF, Holter's ECG monitoring, Solar activity.**

**Abstract.** The reports of the 905 patients in the age from 30 to 75, who underwent the Holter- monitoring in 1983-1984 and 1989-1990 years, were investigated with the purpose of determination of a possible correlation between the divert type of arrhythmia and the interplanetary magnetic field sector structure's polarity changes (IMFSPC) in the dependence of the 11-years solar cycle's phases. The data collected were compared with the IMFSPC in the days of the sign's shift form negative to positive and vice versa. In the maximum of the cycle, as well as on the descending part of the solar activity, the significant influence of the IMFSPC on the incidence of the different type of the arrhythmia has been determined.

### 1.INTRODUCTION

Recently actively is investigating the influence of the solar activity on the biosphere, particularly on an individual health and various diseases. The so-called carrier of the solar activity onto the earth is the interplanetary magnetic field (IMF) which effects the geomagnetic field (GF) and forms its rhythms, similar to those of solar activity, and possibly rhythms in biosphere binding cosmos with an individual through the timing-informational interchange. IMF has the complex sector

structure. During its movement the earth is exposed to the different sectors of IMF with opposite orientation of a magnetic field. When the power of the magnetic tension of IMF is directed oppositely regarding to GF, on the border of IMF and GF arise areas of fields' intersection through which the streams of the solar plasma in the form of high energy protons penetrate and cause a magnetic storms on the earth /6/. In the maximum of 11-year solar cycle the 2-sector structure of IMF with 14<sup>d</sup> harmonics is observed, in the phase of a decline – 4 sectors with 7<sup>d</sup> harmonics. In the minimum of a cycle the sector structure either disappears or becomes 2-sector and remains the same right up to the next maximum /2/.

On the base of the foregoing it is possible to assume that the variations of the IMF's sector orientations in the different phases of the solar cycle perhaps reflect in different ways on the clinical course and complications of cardiologic diseases. Some authors indicate on the aggravation of the clinical course of Coronary Heart Disease (CHD) and Essential Hypertension (EH) in correlation with the polarity of IMF but independently of the solar cycle's phases /1,4/.

The investigation aimed to determine the possible coherence of different types of arrhythmia with the dynamic of IMF sector structure variability in diverse phases of the solar activity.

## **2.THE MATERIALS AND METHODS**

The 905 patients from 30 to 75 year-old had been investigated with Holter's monitor. The 638 patients were with CHD, 267 – with EH. The characteristics of IMF polarity changes are taken from the Internet site "National Space Science Data Center, Mail code 633, NASA, November 1999, NEP". The medical and heliogeophysical data have been processed by the method of superposed epochs /3/ and by the test of  $\chi^2$  /5/. In case of processing with data by use of former method As a zero (critical) days we have selected 10 days from each investigating year when well-defined changes of IMF's sector polarity from negative to positive and conversely happened. For each type of arrhythmia the appropriate tables are constructed by the investigating years. By means of the tables the average values of the arrhythmia's intensity within 9 days have been received. For the confidentiality of the results the material was processed with test  $\chi^2$ . The total amount of the days in 1983-84 composed 731, in 1989-90 – 730. From these days we have excluded the days (W) when there were no observations of IMF. For the period of 1983-84 W=259, and for the 1989-90 – W=264. The total number of all so-called critical days when the changes of the polarity from negative to positive and vice-versa were clear enough in 1983-84 was 78, and in 1989-90 – 79.

### 3.RESULTS AND DISCUSSION

The period from 1983 to 1984 corresponded to the declining phase of the cycle, 1989-1990 – to the maximum. In the Table 1 are shown the distribution of the arrhythmia in critical days by the method of superposed epoch.

#### Quantity and ratio in percents of arrhythmia in days of IMF sectors' polarity changes.

Symbols: S – supraventricular extrasystoles, P<sub>s</sub> – supraventricular paroxysmal tachycardia, V<sub>1</sub> – ventricular single extrasystoles, V<sub>m</sub> – ventricular multiple extrasystoles.

Table 1.

Arrhythmia	1983-1984			1989-1990		
	Total quantity	In the critical days	%	Total quantity	In the critical days	%
S	111	72	65	80	43	54
P <sub>s</sub>	85	41	48	83	37	44.4
V <sub>1</sub>	169	47	28	182	77	44.3
V <sub>m</sub>	90	52	58	48	33	69

In the Figures 1, 2 are shown the distribution of different types of arrhythmias received by the method of superposed epochs.

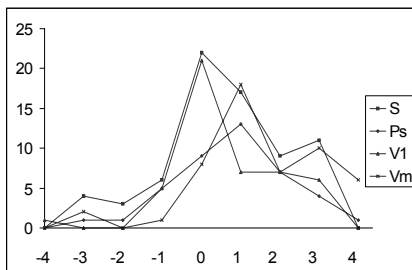


Figure 1.

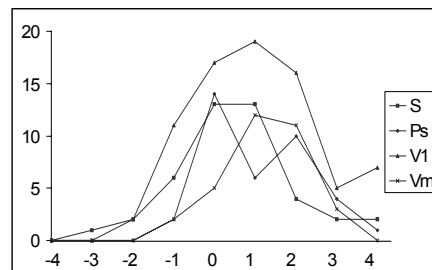


Figure 2

Distribution of different types of arrhythmias during 1983-84.	Distribution of different types of arrhythmias during 1989-90.
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From the Table 1 and Figures 1 and 2 follows that during the changes of the IMF sectors polarity in 1983-84 the arrhythmia arose in ~ 50-60 % of cases (except  $V_1$ ); the maximal cases are shown to be in the zero day or just on the next day ( $P_s, V_m$ , according to our observations in the most cases  $V_m$  was preceded by  $P_s$ ). In 1989-90, in the period of the cycle's maximum, the maximum cases of the arrhythmia are revealed, from which most were  $V_m \sim 69\%$  (Table 2). For all types of arrhythmia the maximums have been registered in the zero day ( $P_s, S$ ) or on the next day ( $V_1, V_m$ ).

The probability of accidental arrhythmia independently of solar cycle is  $P_1=78/(731-259)=0.165$  for 1983-84, and  $P_2=79/(730-264)=0.169$  for 1989-90.

In the table 2 are shown all cases of arrhythmia in the critical and ordinal days.

**The quantity of arrhythmia in the critical and ordinal days.**

Table 2.

Arrhythmia	1983-1984		1989-1990	
	Total quantity	In the critical days	Total quantity	In the critical days
S	16	48	20	45
$P_s$	18	34	18	24
$V_1$	28	62	23	59
$V_m$	12	38	19	35

In the Table 3 are shown the results of processing of the material by the method of  $\chi^2$  :

$$\chi_1^2 = (v_1 - nP_1)^2 / nP_1 + (v_2 - nP_2)^2 / nP_2 = (v_1 - nP_1)^2 / nP_1(1 - P_1),$$

where  $v_2=n - v_1, P_2=1 - P_1$ .

**The meaning of  $\chi^2$  for the each type of arrhythmia. Symbols:  $v_1$  – number of arrhythmia in critical days,  $n$  – total number of arrhythmia,  $P_1$  – probability of arrhythmia accidentence.**

Table 3.

Arrhythmia	1983-1984				1989-1990			
	$v_1$	$n$	$np_1$	$\chi^2$	$v_1$	$n$	$np_1$	$\chi^2$
S	16	64	10.24	3.86	20	65	11.05	8.73
$P_s$	18	52	8.32	13.46	18	42	7.14	19.9
$V_1$	28	90	14.4	15.28	23	82	13.24	7.09
$V_m$	12	50	8	2.38	19	54	9.18	12.65

With the use of the test  $\chi^2$  it is possible to assert with the high confidentiality that the coincidence of the arrhythmia with the days of the polarity changes is not accidental. As follows from the Table 3 the confidential index of  $V_m$  arrhythmia in the declining phase corresponds to 90%, and in the phase of maximum it is close to 100%, as for the  $P_s$ .

From these follows that in the phase of the solar cycle's maximum the change of IMF sector's polarity influences indeed the frequency of the complex arrhythmia. On the descending branch of the solar activity the influence of a polarity changes on arrhythmia also is significant. At that, in percentage the most are S and  $V_m$  arrhythmia, but in comparison with the maximum phase for  $V_m$  these indices are rather low.

The data determined could be explained by the fact that on condition of 2 sectors structure of magnetosphere there is cumulated more energy than in case of 4 sectors. But this hypothesis needs further more thorough investigations. As our opinion, a sick organism for the reason of diminished adaptation potentialities is more inert in comparison of a healthy one. Perhaps, this is why it reacts stronger on the alteration of the polarity after prolonged ( $14^d$ ) exposition to the field of the one sign (2-sector structure) than in the condition of a polarity's frequent ( $7^d$ ) alterations (4-sector structure).

### **Conclusions:**

1. The alterations of the IMF's sector structure's polarity can cause the various arrhythmias in CHD and EH that is revealed in the phase of the solar maximal activity (to a greater extend) as well as on the descending branch immediately in the day of the polarity alteration and on the next day.
2. The most frequency of the fatal multiple ventricular extrasystoles are determined in the phase of the solar activity maximum.

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**RESEARCH PROGRAM FOR DEVELOPING A METHOD OF  
HOLISTIC EVALUATIONS JCSD  
JAPAN COMMITTEE OF SCIENCE DEVELOPMENT  
2003~2005**

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**THE AIM**

Recently requirements for evaluation have increased in many fields of our society. But traditional methods of evaluation - in principle qualitative and quantitative analysis - focus only on certain physical elements and show the connections between them. However, we need various methods of evaluation which are different from these traditional ones. In fact it is quite easy to find such methods in many scientific fields, e.g. in social sciences, medical sciences and engineering.

We can call them 'holistic approaches' in contraposition to 'reductionistic approaches'. 'Reductionistic approaches' are characterized by evaluating objects as a whole. In case of evaluating a person, holistic approaches do not only understand the person as a whole, but they do weigh his/her mental aspects, senses and mind too.

However, the holistic approach has not been established systematically until now. It is used and developed separately in many different fields. Thus it will be necessary that we build a scientific system of holistic approaches.

One of the main purposes of JCSD scientific work is to establish methods that permit to evaluate the positive effects on the health of a person by certain products and to evaluate phenomena that cannot be evaluated with traditional approaches. For this purpose, we will analyze holistic approaches in many different fields of science.

**Importance of the research**

JCSD (Japan Committee of Science Development) is an assembly of Japanese natural and social scientists. One of our purposes is to provide our societies with the fruits of studying social problems that scientific developments bring about. Since the research of holistic evaluations responds those demands of our societies, it is also very helpful to our purposes.

**Activities 2003 – 02/2005**

First meeting: January 17, 2003

Professor Nakai Yoshihide (University of Kansai Medical Science):

**‘Healing mechanisms and water’**

Second meeting: June 7, 2003

Professor emeritus Imai Yoshihiko (Kochi University):

**‘Problems of good water’**

Third meeting: September 18, 2003

Assistant Professor Kawasaki Masashi (Graduate School of Kyoto University):

**‘What is a view of town and landscape worthy of the name Kyoto?’**

Fourth meeting: January 17, 2004

Doctor of internal medicine Takebayasi Naoki:

‘New approaches of clinical research: From reductionism to a system theory  
of health’

Fifth meeting: July 16, 2004

Doctor of internal medicine Takebayasi Naoki:

**‘The actual situation of integrated medical treatments in the USA’**

Sixth meeting: November 24, 2004

Professor Miyazawa Masaaki (Kinki University):

**‘What is immunity?’**

Seventh meeting: February 5, 2005

**Summarizing Symposium**

## **NATURE-CULTURE-HEALTH AS A HOLISTIC MODEL**

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### **Summary**

There is both a strong political and economic rationale for governments to invest more in community based public health research and practice. Urbanisation seems to lead to greater inequalities among population groups both within the urban areas as well as due to rural-urban differences. The shaping of health promoting settings at work, in hospitals, in schools and in local communities, therefore has been significantly supported by the World Health Organisation. Health promotion requires partnerships for health and social development between the different sectors at all levels of the community. New health challenges mean that new and diverse networks need to be created to achieve intersectoral collaboration. Such networks should provide mutual assistance within and between countries and facilitate exchange of information on which strategies are effective in which settings. Health promoting community building and participation through Nature-Culture-Health activities to increase peoples functional ability should be studied in future research.

Illness, disease and sickness have a major impact on the economic situation and well-being of an individual in any society. This is particularly true in the lower income regions of countries and big cities. Improvements in health may boost productivity and the individual's level of income, capacity to acquire an education, and psychological wellbeing. There is therefore a strong both political and economic rationale for governments to invest more in public health research and practice /1/. The Commission on Macroeconomics and Health, chaired by Professor Jeffrey Sachs of Harvard University, showed that disease is a drain on societies, and that investments in health can be a concrete input to economic development /2/.

## **Urbanisation, inequalities and public health**

Nowadays, people in Europe live longer and lead healthier lifestyles than ever before. However this does not give grounds for complacency. One in five citizens still dies at early age, often due to preventable disease, and there are disturbing inequalities in health status between social classes and across geographical areas.

Urbanisation is an on-going process, having a profound impact on people's livelihood and health status. The globalisation of markets, increased use of communication and new information technologies are the driving forces behind this process. The urbanisation process has marked effects on the natural and cultural environment, on housing arrangements and social networks, as well as on work and employment patterns, not only in cities, but also in rural areas. Urbanisation seems to lead to greater inequalities among population groups in regard to distribution of risk factors to health, both within the urban areas as well as due to rural-urban differences. Access to health care, social services and cultural activities are generally often better in the cities, but usually access is not evenly distributed among the population.

## **Salutogenesis as a supplement to pathogenesis**

These rapid processes of change represent a challenge to public health policy. Public health research and practice should focus not only on factors causing disease and injuries (pathogenesis), but also factors promoting health (salutogenesis) in the perspective of health promotion and prevention in different settings. Tomorrow's society will most probably focus more on that which strengthens health, namely the salutogenic (health causing) factors as described by Antonovsky /3/. The shaping of health promoting settings at work, in hospitals, in schools and in local communities, therefore has been significantly supported by the World Health Organisation (WHO).

## **Partnerships for public health**

Health promotion requires partnerships for health and social development between the different sectors at all levels of the community /4/. Existing partnerships need to be strengthened and the potential for new partnerships must be explored and evaluated. Partnerships are now used as a public health tool in some European countries. Two cases from United Kingdom and Norway are examples of this kind of community approach to public health.

The first example is the introduction of partnership in East Anglia, England /5/. The Joint Plan for Colchester, June 2004, will improve the health and

wellbeing of local people, particularly those who are experiencing poor health linked to social and economic deprivation or other forms of disadvantage.

Underlying the plan are three main principles:

1. Reducing health inequalities
2. Social, cultural, economic and environmental factors have not only direct impact on health, but may also limit or strongly influence the choices people make about their lifestyles and behaviours.
3. Significant improvements in public health will only occur if organisations work together towards shared objectives.

There are already many local groups, involving a wide range of agencies working together, that focus on public health issues. What has been missing is an overarching cohesive, coordinating group to ensure that there is progress in all relevant areas with clear links across groups. The overarching group will also ensure that duplication of effort is minimised. It is planned that the Colchester Partnership for Public Health Group will take on this role /5/.

### **Increased community capacity and empowerment to the individuals**

Health promotion is carried out *by* and *with* people, not *on* or *to* people /4/. It improves both the ability of individuals to take action, and the capacity of groups, organisations or communities to influence the determinants of health.

“Settings for health” represent the organisational base of the infrastructure required for health promotion (4). New health challenges mean that new and diverse networks need to be created to achieve intersectoral collaboration. Such networks should provide mutual assistance within and between countries and facilitate exchange of information on which strategies are effective in which settings.

### **Experience with a new community based approach to health promotion in Norway**

The second example is from a municipality west of Oslo. Partnerships for health promotion and new and diverse networks have been created to achieve intersectoral collaboration in a local community /6/. The aim was to create a common arena and forum for wholeness thinking and creativity, in order to improve environment, quality of life and health among people in the local community /7/. The challenge was to get various interest groups, i.e. public agencies, private businesses, voluntary organisations and pioneers to co-operate in order to develop the idea to be realised in health promoting settings /8/. The center described below is now one of the official partners of public health in the county of Akershus as well as the municipality of Asker.

At the Centre for Nature-Culture-Health (NaCuHeal) in Asker there have since 1994 been several experiments where individuals from the local population



have been helped to find their own talents and capacity for work to maintain function and pleasure in work (6-8). At the Nature-Culture-Health centre it is desirable with participation and positive interactions between persons of all ages, health status, philosophies and social positions. The idea is that such a meeting place between practitioners and theorists, between the presently well and the presently not so well, will be stimulating and enlightening to most people. Through participation in Nature-Culture-Health groups the individual will find the opportunity to bring to life his or her own ideas by emphasizing positive and creative activities outside one self. At the same time, NaCuHeal-activities may nourish other sides of one's personality that may also need development, attention and strengthening, to prepare for community and new social networks.

Persons with different health problems may forget their health related and social problems for a while. Among others, some participants were long-term certified sick, in rehabilitation or other social security clients.

The NaCuHeal concept

The concept of Nature-Culture-Health is based on the idea of stimulating to wholeness thinking and by emphasizing:

- Nature, out-door life, and environmental activities
- Culture, art, physical activity and diet
- Health promotion, prevention and rehabilitation

The intention was to:

- Increase participants' own empowerment and participation in activities in relation to strengthening their own health, quality of life and function
- Create growth in social networks that are encouraging and stimulating
- Motivate to work ability and to explore ways of coping in day-to-day activities.

The activities seem to strengthen the ability to cope, improve quality of life and enable us to meet everyday life in a positive manner. To encourage Nature-Culture-Health activities among other things means emphasizing the positive factors leading to health (salutogenesis). *Health* may in this context be defined as having as little illness as possible while having the energy to cope with the tasks and challenges of everyday life.

Many individuals have through different Nature-Culture-Health activities experienced that e.g. dance, music, art, physical activity, nature walks, hiking, gardening or contact with pets give an indirect effect with feelings of zest for life, inspiration and desire for rehabilitation. For many persons certified sick, this has been a method for return-to-work. The direct route through vocational rehabilitation may be of help to some people. For others, however, it may be necessary to take a more indirect and creative route to succeed in their rehabilitation, i.e. to practice and participate in NaCuHeal-activities for later to

achieve a more useful and active existence. The way through such creative activities may give each individual a feeling of meaning and desire to act.

There is reason to believe that there is an untapped potential for improving public health by employing health-promoting nature and cultural activities. This is also a great challenge to our new multicultural and urban society. The goal is increased ability to cope, productivity and prosperity to *all* people, i.e. not only the affluent members of society, but also the ones who are in danger of becoming permanently incapable of working.

The challenge is to get various interest groups, i.e. public agencies, private businesses, voluntary organisations and pioneers to co-operate in order to develop this idea to be realised in health promoting settings.

### **New challenges for public health evaluation and information**

Since new health challenges mean that new and diverse networks - *community building* - need to be created to achieve intersectoral collaboration, new methods of public health research have to be developed. Synthetic research methods, probably have to be applied in order to evaluate the community approach to public health used at the NaCuHeal-center in Asker.

The increase of information and publications of science, medicine, public health and health promotion force us to develop new information systems in order to apply an evidence based community approach to public health in the years to come. *Information design* and *Polyscopic Modeling* offers a way to construct reliable or scientific high-level information /9/. Health promoting community building and participation through Nature-Culture-Health activities to increase peoples functional ability should be studied in future research.

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## THESAURUS APPROACH IN HUMANITIES

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The humanities are being subjectivated and straying from the ideal of science as the objective knowledge increasingly. At first, positivistic paradigm and then paradigms of structural functionalism, structuralism, historical materialism and other microsocial theories suffered considerable losses under the impact of the criticism of the representatives of the subjectively-directed concepts of the humanitarian knowledge. This criticism cannot be denied and ignored by the scientific community. Indeed, in conditions of the “information explosion”, which characterizes the culture of the moderne, there is a stubborn problem a researcher has to solve: is he/she able to master a huge corpus of information to draw certain scientific conclusions? The objectivity of a research turns out to be doubtful not only in one or another specific case, but on the whole. Subjectivity of the modern science is not just tribute to fashion, but a natural consequence of the cultural development. How should one work with this subjective component and satisfy the requirements of the scientifically-directed knowledge at the same time?

The answer to this question and this scientific need, especially in the sphere of the humanities, absorb the minds of the outstanding scientists. Far from accidentally the philosophy of the 20<sup>th</sup> century had such a powerful influence of the studies of L. Wittgenstein who put the linguistic barrier as the stop of the completeness of knowledge: a human being is able to know only what the resources of language he/she uses let formulate (Wittgenstein 1953). The criticism of this position (including from the direction of linguists, e.g., A. V. Wierzhbitsckaja — Wierzbicka 1990) does not cancel it at all: activity of understanding of the reality by a subject. Culture cannot be realized and involved in the human activities in full measure as we

talk about an individual or a society. It cannot passively reproduce the objective correlations but it inevitably reconstructs them.

The study of these processes and subsequent consequences is advisably to be conducted with the use of the thesaurus approach, which has been developed during the last years (Lukov Val., Lukov Vl. 2004). It has showed its heuristicness in cultural studies, sociology, philology and other fields of the humanitarian knowledge.

The focal concept of this approach - thesaurus. In Ancient Greece they used "thésaurós" meaning treasure, treasure-house, supply. In the scientific terminology of nowadays - in linguistics, semiotics, informatics, theory of artificial intelligence and other fields of knowledge - thesaurus means a specially formed *accumulation*. In informatics and theory of artificial intelligence attention is paid to the systemization of data, which form thesaurus, and to their *orienting* nature. In particular this characteristic of thesaurus underlied the content of this concept in the general humanitarian thesaurus approach: thesaurus is the term to indicate a structured notion and universal image of the part of world culture, which can be learned by a subject.

**Thesauruses can be described by the following features:**

1. *The structure of thesaurus is contradictory.* Completeness characterizes it by definition, but this feature is subjective, it unites and puts together what is separated in the reality by space and time in the same plane, it covers not only reality, but also supposition about reality (not only the *past*, the *present*, but also the *future*). At the same time incompleteness (selectivity) is peculiar to a thesaurus in comparison with the diversity of the real world, which is presented in a thesaurus fragmentarily and in a specific configuration (for instance, like the pictures by the surrealists and Salvador Dali).

2. Thesaurus is not a chaotic conglomeration of a great number of data and preparednesses, but a hierarchical (in some cases) or network (in the others) *system*, which is intended to the orientation in the environment. It means that various people have different thesauruses, since both their personal features and milieu of their vital activity are not the same. A thesaurus reflects the hierarchy of the subjective notion about the world, in this meaning it can be considered to be the part of the reality, which is mastered by a subject (an individual, a group).

3. The consequences of the orientation on the basis of a thesaurus are: firstly, *the lack of coincidence of the subjective worlds* (their co-ordination is observed only in a confined circle of parameters and within certain limits; secondly, *predominantly the value regulation of social behavior* (which transforms all the factors and determinants of such a behavior); thirdly, *the activity of behavior of a social subject in the social environment*. The uniqueness of the vital worlds forms the basis for their tie-up, which varies in the different

levels of the social organization and also has the specific forms and ways of realization on the level of the every day life.

Thesauruses provide the basis for the social construction of the reality, if the latter is understood as not only a concept in the field of the sociology of knowledge, which was elaborated by Peter L. Berger and Thomas Luckmann (Berger, Luckmann 1966), but also as the activity of a perceptive, cognizing, understanding subject who interacts with the world in the regime of a dialogue and “interchange of blows”, or in other words - by impulses of an active influence.

Thereby it is productive to use the thesaurus approach for the comprehension and organization of the social projection, where thesaurus is a full-systematized structure of information (knowledge) and aims in this or that sphere of life, which helps to orientate oneself in it. In the thesaurus concept of the social projection a more general sociological principle was reflected, which is being used effectively in the developing of the theories concerning different aspects and manifestations of socialization. The core of the principle is in the declaration of the activity of a subject of the social conduct (or in other words - of the social subjectivity) as the deciding factor, which determines the content and forms of the social life. This principle is well-known, covered within various scientific paradigms and defined differently by great names (among them - K. Marx, M. Weber), but not very rarely can be found in a too abstract form, which does not let transfer it from the field of social philosophy to the sociological interpretations.

In particular the concept of thesaurus can be effectively applied in the last respect: it marks empirically generated mental structures, which display sense of the ordinary actions of people and their communities, but besides predetermine different deviations of the commonness and have (maybe decisive) influence upon the whole complex of social structures, institutions and processes. The thesaurus approach has demonstrated this efficiency in the analysis of the youth problematic having shown that it can be used as one of the system constitutive methods of developing of the theories within the sociology of youth.

Continuing this line we have made an attempt to show that the thesaurus approach gives new methods for describing and understanding of the processes of socialization, including in the dynamically changing social systems, when a reliable social-practices-from-generation-to-generation transfer system by means of socialization sometime experiences an abject failure.

Such a failure in socialization was at first the establishment of the Soviet model of socialization and then its collapse. It took only 15 years for the first and the second processes to be fulfilled, although it is evident that the process of socialization is basically extremely conservative and only because of that it ensures the reproduction of the whole system of social relations. If conservatism of the socializative processes is the rule then how do the socializative practices change at a time and on a mass scale? The problem is also the separation of

identities from quasi-identities - it is hard to accomplish in the conditions of transitional societies. On the whole world the established opinion about socialization as the process of acquiring of models of behavior, psychological mechanisms, social norms and values - which are indispensable for successful functioning of an individual in a society - is becoming doubtful. Firstly, it is not clear enough how the process of acquiring can lose repeatability. Secondly, in the situation of the social anomie the problems of interpretation of models of behavior, norms and values shared in the society are appearing. Thirdly, the conception of the successfulness of a person is also doubtful: various socio-cultural areas presume different interpretations of human successfulness depending on a decision about the philosophical (and religious) meaning of life.

Our hypothesis is that /1/ individual thesauruses are being formed within the socializative process from elements of thesaurus constructions; /2/ there are several thesaurus constructions with different degrees of topicality (i.e. degree of diffusion, normativeness, formalization); correspondingly, on the individual level the co-existence of several thesauruses and straightening of a thesaurus with a mobile hierarchy of elements are possible; /3/ topicality, actualization and loss of urgency of one or another thesaurus constructions are determined by objective social processes and subjective definition of situation (on different levels of social organization); /4/ socializative practices provide transfers of both relevant and non-relevant thesaurus constructions, which form thesaurus.

From the standpoint of the information mentioned above it is important to underline that we understand thesaurus as such an organization of information of an individual, which is closely connected with his/her place in a society and in the macro- and micro-social areas. The appearing within the socializative process combination of elements (data, models of behavior, aims, values, etc.) is constructed from the fragments of thesauruses of *significant others*. This fragments bear evidence of earlier thesaurus formations, also assimilated from the significant others of the other generations. We call the general part of thesaurus fragments, which, as a matter of fact, form individual thesauruses, - thesaurus constructions. They can be compared with roots of words, which take the precise meaning in the combination with other construction blocks (prefixes, affixes, etc.)

The analogy with *idioms* - steady phraseological turns - gives a more faithful representation of thesaurus constructions. The distinctive features of idioms lie in the fact that their meaning does not arise from the meaning of the word, which make up phraseologism. It is also typical for phraseological fusions, where a motivation of a set of elements is not clear (e.g., Russian “bit’ baklushi” - to twiddle away one's thumbs - literally “to beat forms, which are made for manufacturing of wooden spoons”). The same is for phraseological unities, which have a clear motivation (“plyt’ po techeniju” - to go with the stream; “sidet’ na igle - to fix (slang) - literally “to sit on the needle”) and for the other types of phraseologisms.

Cohesion between thesaurus constructions into thesauruses is caused by the aim of orientation in the socio-cultural space and time. The axis of hierarchical organization of thesaurus lies in the other plane than in the systematical code of human knowledge, which is being kept, modified and enlarged in the forms of science. The axes of thesaurus lies in the “one’s-other’s” coordinate system, which provides orientation of a human being in the environment. But this statement can be expanded taking differences in /1/ social distances and /2/ levels of sociality into account.

If we talk about social distances (spatial and temporal) then here the coordinates “one’s-other’s” let separate the closest, remote and distant social milieus in horizontal plane. The closest milieu is the most important; it is transparent, predictable, feeds different normative-value characteristics and corresponding activities (evaluation of behavior, gossips, sympathy, practices of exclusion, etc.). The remote milieu is less considerable; there is less information about it, it is not transparent and presented in a thesaurus fragmentarily, it does not arouse deep feelings and emotions. The distant milieu is situated in the opaque zone of the “other’s”, which is perceived as strange, sometimes hostile.

At least three conditions break this harmonious picture of social distances. The first - the phenomenon of *the referent groups or personalities* in the cases when they are located outside the closest milieu (in space and time), but in the line of them an orientation complex of an individual or a group has formed. In such situations the real closest milieu can pass on to the periphery of a thesaurus. In the temporal aspect the removal towards the referent groups or individuals can be measured in millenniums. Such is, for instance, the thesaurus of the outstanding French thinker of the Renaissance Michele Montaigne, which we have investigated. The core of it is the orientation to system of ideas and values of a Roman philosopher Seneca (the time gap is about 1500 years).

The second - the *research interest*, which is quite often connected with an occupation and also with amateurishness. Research as a process of perception diminishes the opacity of the “other’s” and makes it “one’s”. Essentially, the example of Montaigne demonstrates this research interest, which determines another distance in time and inserts thesaurus constructions of any remoteness in an actual thesaurus.

The third - the *situational resentments* in the social area (historical events, developments in a private life - move, death of close people, marriage, etc.), in the result of which the core and periphery of a thesaurus get mixed up.

The complications for harmony and stability of a thesaurus are also created in the vertical shearing of the reality, i.e. in such an examination of it when different levels of sociality are taken in consideration. In this regard it is important to underline that thesauruses to some extent include information of different levels of sociality, although predominantly they appear in a transformed and adapted



condition: the adaptor is the individual level, and more exactly it is what is being consolidated as an experience.

But again it is a general principle. In the periods when on that or another level extraordinary changes, high risks, catastrophes occur there is a removal also in thesauruses, and a significant event with a high degree of consequence for people breaks a thesaurus hierarchy and subdues the personal to the public. Such is particularly the mechanism of sudden changes in the state of public opinion during August 19-21, 1991 in Russia or the terrorist attack on New York and Washington on September 11, 2001. A shift in thesauruses in such situations can shape a well-fixed form of commonality of emotional reactions, appearing of new unions (including with the former “strangers”), changes of informational preferences, etc.

Specificity of construction of a thesaurus hierarchy lies in the fact that the orienting tools are identification models (models oriented on the standards of life “as people have”; model with orientation toward originality, combination of their parts depending on a situation). In this case the completeness of information on a thesaurus means only the adequacy, which is defined by an orientation purpose. All the rest information goes to the periphery; it is subdued according to the hierarchy of a thesaurus and is distorted under the impact of the main ideas and aims or it is not noticed at all.

By means of that, by the way, the problem of entirety of socializational impact in the diversity and quite often the opposition of socializational practices can be solved. Why does the same situation of socializational impact give different results? The consequence of every factor taken separately does not offer an answer. Thus in the families with parents-alcoholics there are observed both aspiration for overcoming such a life style and continuing the practices of parents. Or another example: the investigations of the specific of the value attitude to violence among the young people who are aligned (according to self-appraisal) with images of such movie heroes as Rambo, Terminator, the characters of Jean Claude Van Damme, etc., did not find a significant difference with an average figures of the youth environment, although, it might seem, in this subgroup the limits of permissibility must be reduced.

The Goffman’s idea of “public indifference” (Goffman 1971), which was formed within the sociology of town and expresses the peculiarities of interaction with a high degree of their facelessness, from the standpoint of these discourses can get slightly another perspective of examination: neglecting this or that piece of information serves as a protective mechanism of an identity and as an aspect of orientation in the social milieu. It is being formed in the socializational practices. At the same time it must be noted that the neglected information can remain in the reserve and in a suitable moment become relevant. Such are usual for everyday life situations of delivery of a child or death of a relative, when the traditional

practices of ritual activities of not current importance are “remembered” and assimilated for a time and then again go to the “store-rooms” of consciousness.

On the whole one can affirm that a more detailed study of thesauruses lets achieve a better understanding of the essence and dynamic of the transitional epochs as the clots of complicated socio-cultural processes, which mix more or less stable layers of thesauruses. The effect of *glimmer of meanings* exists. It means that meanings, which reflect, express and organize human life, are indestructible; they just stray from a relevant situation in the peculiar “store-rooms” of the historical memory and in a hypothetically suiting case become active, legitimate and quite often “solely correct” again.

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## **EVERYTHING IN LIFE REPRESENTS FLUCTUATION PROCESSES**

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Nothing is static in life, everything is in constant movement and dynamic, for example: human cells are renewed every seven years; the seventh year of life is the 1<sup>st</sup> level of spiritual development, readiness to school, second teeth grow; the process of sexual maturity finishes at fourteen; development of height of human being stops at twenty one.

This dynamics in time is accomplished in the same manner as in fluctuation movements: in cosmic sphere, biosphere and geo-sphere.

Chrono-biology is a science about processes occurring in time (in connection with external environment) in human body, availability of which may be proven as rhythms. They are also called as a science about internal watches of living organisms.

The most important rhythm for human being is a circadian one i.e. a rhythm, which is equal to 24 hours. It is a center of internal biological watches of human being. Discovery of this rhythm proved, that biological rhythms of all living creatures are derivative from geophysical and cosmic rhythms.

Researches were conducted by Jurgen Ashoff in Andex, near Munich in conditions of complete absence of time orientation. The functions of physical body and protocol recordings in the condition of the bunker pointed to 25 hours rhythm. Simultaneously, the same tested persons before bunker had 24 hours rhythm.

It is explained by the point, that 350 million years ago, when life formed in the Earth, one year was equal to four hundred present days, 1 day was equal to 25 hours of present time.

All functions of our body were adapted to modern Earth rotation, due to time sensors accomplishing permanently new adjustment of rhythms of 24 hours, which gives a privilege to all living beings, due to which flexibility for adaptation is guaranteed.

Change of the location discovers variance of rhythms of physiological functions between former local time and new time. This phenomenon is called as

jet-leg syndrome. This function must be tuned to new local time. Firm rule is: change of local time per one hour requires one day for adaptation. Change of local time implies violation of the state of health, for example: disturbance of dream; headache, tiredness, decrease of intellectual working capacity.

Frequent or continuous shift of internal hours leads to complication of negative conditions (for example: shift work, trans-meridian flights, irregularity in style of life, work and management). Irregular style of management can cause chaos and enormous economical losses /Mor-Ede, 1993/.

Culmination of frequency of heart infarct and values of blood pressure falls on early morning hours: 7-10<sup>00</sup>. At the same time the shortest time of blood coagulation during a day and also the highest sensitivity to stress, nicotine, alcohol and caffeine arrives.

Depending on daytime different sensitivity is discovered in relation to: chemical, pharmacological, therapeutic, physiotherapeutic, physical, meteorological, social and ecological impacts on our body, which reacts in the morning in quite another way, than in the evening.

Presently physiology of dream is described almost exclusively by rhythms. The most significant point is a REM-dream cycle (80-120 minutes), REM-rapid Eye Movement. Dream runs functionally in two phases, which could be measured by means of EEG, EMG, EOG. They distinguish REM-dream and Non-REM-dream. Phase of Non-REM-dream runs in four phases: 1) falling asleep; 2) surface dream; 3) dream of middle depth; 4) deep dream. Then phase of REM-dream follows etc. The quality of dream is defined by rhythmical equilibrium between REM-dream and deep dream (stage 4). Deep dream is, predominantly, responsible for physical relaxation of the body; REM-dream is responsible for psychical relaxation of body, for remembering of information in long-term memory and for development of individual program of behavior. Phases of REM-dream and deep dream in their specific presentations are characterized by other multiple parameters, for example EMG (electro-myogram), hormonal and exchange processes, frequency of heartbeat, blood pressure.

These processes activate in the phase of REM-dream (level increases), and deactivate in the phase of deep dream (level decreases). Human being sees dreams in the phase of REM-dream. That is why the phase of REM-dream is called as a vision. Plants are also subjected to life rhythms. The heads of the sunflowers during the day period are always directed toward the sun and follow it. About two hundred years ago Botanist Linneus made hourly flowerbed, where time indication was connected with dehiscence of flowers. It is known that all plants are rhythmically subjected to different seasons of the year.

Thus running of all daily functions is accomplished in three principal states: wakefulness-energy consumption; NON-REM-dream (deep dream)-physical relaxation, accumulation of energy of REM-dream-psychical relaxation.

Equilibrium of these three principal states provides harmony, health and work capacity.

We can state that space, biosphere and geo-sphere are subjected to fluctuation processes of movement. These fluctuation processes are arranged into hierarchy of frequencies, due to which this system preserves optimal conditions of functioning.

Interaction of different frequencies within hierarchy of solid system is subjected in its dynamics to laws of quantum physics.

By means of fluctuation movements we can establish different functions of life processes, movement of constellations, ways of development of social and economical processes. Accurate predictions of earthquakes are also possible applying regularities of geo-sphere rhythms. Conclusive prediction of Elchin Khalilov serves as a proof of above mentioned.

This small fragment of scientific discipline-chrono-biology, dealing with biological processes running in time, in other words, biological rhythms and spheres of their influence witnesses about their big importance for society, human being, science and medicine.

**„ONE STEP INTO OLD AGE“  
A project to help create a society fit for all ages**

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The theme for the International Year of Older Persons in 1999 was „A Society for All Ages“. The aim of that year was to promote awareness for the issue of aging in our society. Researchers, policy-makers and practitioners were called on to take the initiative in ensuring the integration of old people into all sectors of society and in creating opportunities integral to all stages of life.

Our lack of empathy for the aged, not seldom resulting from a lack of knowledge and awareness, may lead to a loss of independence and eventually to a growing need of special care or even illness.

In 1999 we presented the first stage of the preventive geragogic project „One step into old age“ as a practicable answer to age-related problems. We aim at ameliorating the quality of life for the elderly by conserving their health, maintaining security and, last but not least, by reducing the number of nursing cases.

All present measures can only treat the symptoms, but they can never change the causes effectively and permanently. Therefore, we have taken a different approach based on the idea that our children are the constructors of tomorrow's world. It will be their responsibility to create an environment which ensures security and quality of life for all generations – a world without barriers and obstacles, with products designed for old and young.

Together with the young we try to develop visions of a future worthwhile for all. For this purpose we have set up a special workshop with the aim to:

- promote empathy for older people's circumstances already in youth
- create a vision of what a community worth living in at all stages of life should look like (design a community worth living in at all stages of life)
- develop the awareness of a handicap-friendly environment and of products suitable for all ages
- point out stumbling-blocks and traps in everyday life

- improve the understanding and solidarity among all generations and have a part in bridging the generation gap
- contribute to a more positive image of old age
- provide primary prevention to maintain independence and competence in old age
- contribute to health care and health promotion
- invest in our own future

Based on a completely new scientific and didactic approach, we start raising awareness of the “WE” already in our children - that means we want all generations to participate in social commitments. This aim is not achieved by wagging one’s finger to the children but through play and fun. The message behind this approach is: „ Not old age is a handicap to man but man is a handicap to old age.”

**The three main elements of our project are:**

- 1) The „Adventure Arena“ located at the Universitaetsklinik fuer Geriatrie (Christian-Doppler-Klinik in Salzburg), is a three hour adventure world especially adapted for the young ranging from fourth-graders (elementary school) to teenagers.

During the adventurous afternoon the pupils work with special devices designed to experience old age by imitation. They learn that this stage of life may still offer a high quality of life provided that the environment and the products designed meet the special needs of senior citizens. Together with the children, we develop visions of a future worthwhile living in for all generations, and this is done in an entertaining way.

As we know, the conceptions of old age are determined early in life, therefore we have implemented a special research on this subject. It is a key priority and an integral aspect of the workshops to promote images highlighting a positive view of aging; thereby misleading and negative stereotypes are eradicated.

- 2) The junior magazine „Wahn-Sinn!“, a magazine for schools, is published regularly with the aim to motivate children to work for a barrier-free environment on the basis of competitions, experiments and thrilling reports.

**The magazine is distributed to all elementary schools four times a year.**

- 3) The textbook for children „Das macht Sinn“ („That makes sense“), subtitled “A book about our five senses“, comprises adventure, games, experiments and background information on aging.

Until today about 4000 children and teenagers have travelled through time on their visit to the „Adventure Arena“ at the Universitaetsklinik fuer Geriatrie in Salzburg.

Global acceptance of and a high interest of different occupational groups as well as of the elderly themselves in our project encouraged us to extend the scope of research to the next two generations.

Finally, we were strengthened in our resolve by the International Plan on Action adopted at the Second World Assembly on Aging in Madrid 2002. Again people from every country, from all walks of life, individually and in groups, were invited to participate in the implementation.

The three priority directions respond to the opportunities and challenges of aging in the 21<sup>st</sup> century:

- 1) *Older persons and development*
- 2) *Advancing health and well-being into old age*
- 3) *Ensuring enabling and supportive environments*

These directions deal with deficiencies holding a high-risk potential for the elderly, in as far as their environment is concerned. To some extent the directions represent existential needs neglected even in rich industrialized countries. Active gerontology is requested. Thus, the society as a whole is committed to improving the quality of life for the elderly by promoting awareness, developing educational programs, creating an enabling environment and raising funds.

These goals are not new, as Bergener argued in 1985: *“Taking gerontology as a model, a decisive alteration could and should take place to end the tyranny of a synthetic heuristic which predominates in all thinking throughout our occidental civilization. I am convinced that the clarification of gerontology’s inner legitimacy depends very much on whether this change in our way of thinking really can be achieved. Otherwise gerontology may come to be regarded as a short-lived, pseudo-scientific fire fuelled by fashionable words and phrases.”*

With respect to older persons, “quality of life” could be defined as their “successful integration into the social, economic, political and cultural life of the particular society.”

Now let us discuss some recommendations for action concerning the project “One Step into Old Age”:

### ***Priority direction I: Older Persons and Development***

Measures to strengthen autonomy and self determination in the elderly are the best assets to positive aging:

- *Participation of older persons in decision-making processes at all levels*
- *Providing opportunities, programs and support to encourage older people to participate in cultural, economic, political and social life, and in lifelong learning*
- *Providing access to information to facilitate mutual self-help in order to enable the elderly to tap their full potential*



- *Development and dissemination of user-friendly information to assist older persons in responding effectively to the technological challenges of everyday life*
- *Encouraging the design of computer technology, of print and audiovisual materials, a design that makes allowances for the age-related decline (changes) in physical ability and sight*
- *Integrational solidarity*
- *Promoting understanding of aging through education of the public, an issue of concern to the entire society*
- *Development of initiatives aimed at promoting mutual, productive exchange among the generations, focusing on older persons as a societal resource*
- *Promoting and strengthening solidarity among generations and reciprocal support as a key element of social development*

The realization of these goals requires both comprehensive intergenerational communication and a positive image of old age, which makes it possible for the fellow men to appreciate the professional skills and competencies of older persons and to agree to lifelong learning. Otherwise innovative tutors are needed.

### **Priority direction II: Advancing health and well-being into old age**

So far the outcome-criteria of geriatric medicine have been emphasized. In addition to preventive and curative care as well as rehabilitation, all interventions need to be focused on maintaining independence, delaying or preventing disease, supplying disability treatment and preconceived on improving the quality of life.

Priority is given to the self-responsibility of older people; however, equally important, is the Government's commitment to create a supportive environment in which such efforts may prosper.

*Reduction of the cumulative effect of factors that increase the risk of disease and eventually the potential dependence in old age.*

*Identify and address the main environmental and socio-economic factors that contribute to the onset of disease and disability in the elderly.*

*Design early interventions to prevent or delay the onset of disease and disability*

### **Rigorously implement and reinforce, where applicable, national and international safety standards that aim at preventing injuries at all ages**

*Prevent unintentional injuries by developing a better understanding of their causes and by undertaking measures to safeguard pedestrians, implementing fall prevention programs, minimizing hazards and providing safety advice*

These recommendations for action are cornerstones for healthy aging guaranteeing that geriatric medicine will take effect intramurally as well as extramurally.

### **Priority direction III: Ensuring enabling and supportive environments**

Promotion of an enabling environment for social development was one of the central objectives agreed upon at the World Summit for Social Development. Apart from good housing and an adapted environment, transportation is a growing concern. It is a fact that as people age they rely more heavily on appropriate public transport. Even as to this issue, actions are elaborated.

- *Promote “aging in place” in the community with due regard to individual preferences and affordable housing options for older persons*
- *Improve the availability of accessible and affordable transportation for older people*

Meeting these demands requires a developed awareness of the stage in life called old age, mutual understanding as well as active solidarity and serves as a basis for the willingness of the generations to take on mutual responsibility. Demographic changes and our fast-moving, success-hungry world of superlatives are causing the generations to drift apart.

Ageing as a natural stage of life with individual needs often is not taken into account by our youthdriven society. Presently the environmental conditions give rise to a serious menace for the ever increasing number of older persons.

It is evident that stress in general and stress of psychosocial origin in particular affect health leading to a lot of stress-related troubles up to somatic and psychic diseases, i.e. depression. As early as 1987, Perlmutter described the day-to-day realities of the aging in an impressive manner: *“Feeling alarmed, the first step of stress reaction, that normally should help a subject to adapt and to improve cognitive skills may in individuals who are expecting to fail cause the exact opposite. They fall into routine unstimulating circumstances that promote atrophy for both physical and mental capacities....”*

There has been an apparent increase in stress-related diseases and accidents in old age; this fact means high costs for the health care system. The implementation of this priority direction also requires a good knowledge of the physiological changes in the aging process, of the effects and the infirmities of old age as well as the detection and elimination of traps and stumbling-blocks.

The geragogic project “One Step into Old Age” refers to each recommendation of action in a specific way.

To work with children means to work for the future. Problems exist already today and it is in all our interests to fight them as quickly as possible. To design

products, provide services and to shape the environment – all that is frequently dependent on the personal and physical potentials of the designers. Working people are hardly familiar with the shortcomings resulting from the physiological aging process. It is small wonder that there are wrongly designed products as well as failed adaptations of the environment. Whoever has put himself into someone else's shoes experiencing the other's physical reality, thinks and plans differently. Consequently, the adaptable simulation arena appropriate to instruct various occupational groups and the interested party is at the centre of presentation. A theoretical section dealing with the physiological changes in old age and with barrier-avoidance is adapted to the participants and their occupational interests. Equally, corresponding written information material is supplied.

Modules have already been introduced into university teaching, nursing schools and academies; these on adequate shop design and product development have been supervised.

Apart from advice, we provide product and service evaluation to help analyse criteria concerning user-friendliness and barrier avoidance; we also test younger and older individuals for the same purpose.

We have a team of qualified partners assisting us with meeting the special needs. For this reason, we cooperate closely with the International Academy of Sciences. About 600 adults took part in the seminars within a year.

### **Special attention is given to the work with the elderly.**

Decades of clinical experience have sharpened our awareness of the cardinal problems of the aged. Being in close touch with real-life situation, we have reached the conviction that not old age is a handicap to man but man is a handicap to old age. This conviction has been adopted as our motto.

### **With our programme for senior citizens we aim at improving their quality of life by**

- informing them about physiological aging and the specific risks involved in this process
- teaching self-responsible and preventive thinking to the elderly
- influencing the complex action of falling and stress-induced diseases in a positive manner
- motivating those affected to participate actively in the decision processes and in pushing ahead with necessary environmental changes
- improving the self-image
- maintaining competences

- programmes of mobility training
- booklets of selective measures
- prevention of nursing

To grasp selective and specific age-related problems caused by the environment, we offer a helpline called “Troubles in everyday life”, and for this purpose we drew up standardized questionnaires. Along with the handouts, we developed a series of 12 geragogic lectures to be held at the Universitaetsklinik fuer Geriatrie and, if desired, at various other institutions. Special attention is drawn to the complex issue of falling, to stress conduct and mobility. Self-responsible prevention is assisted by competence training. All in all, about 800 persons have already taken part in that training programme.

Today we still tend to ascribe typical behaviour patterns to the elderly: Certain things are just taken as given. Old people failing to handle a product properly either put the blame on themselves or on old age, not on the producer. Books in small print are regarded as the rule and (just) put aside. The elderly frequently respond by resignation and withdrawal. Such a reaction may be the first step on the road to immobility, the loss of independence and to depression.

Neither from an economic, nor from a humanitarian point of view is an increase in people needing care and attention acceptable. Besides, the future generation of the aged will not be prepared to take the blame for environmentally-induced problems. In view of their proportion of the population (by 30%), the elderly will claim their rights.

Our indifference toward these issues in the last few decades might come back and haunt us by 2030 at the latest – the time when the climax of demographic transition is reached.

Our project focuses on primary prevention. Every group of society will benefit from the changes we are striving for, particularly the large number of disabled people.

## PHILOSOPHY OF TIME IN MEDICINE\* THE PROBLEM OF ETHICAL TIME

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The review of literary data on Time definitions, examples and interpretations of one or another Time scale /2, 3, 4, 6, 7, 9, 10, 11, 12, 15, 16, 17, 18, 20, 22, 23, 24, 25, 26, 27, 29/ clarifies the following provisions.

The scientific vision of Time is assumed to be common to all disciplines. At the same time, each discipline develops a *Time scale* of its own, *divisible by a certain quantum of action*, accepted in the given scientific discipline. In classical mechanics, for instance, the standard quantum of action is the *1s swing of pendulum*, in quantum mechanics it is *Plank's constant*,  $h=6.626 \cdot 10^{-34}$  J-s, and in the biology of poikilothermic animals the quantum of action, divisible by *the period of synchronous cleavage division*, is called *Dettlaff*.

The natural perception of Matter, Space and Time remains discrete, because natural perception is perception of the common world in its reduced form. It is impossible to perceive the whole immense world at one conceivable glance. Man's imagination is not capable of grasping the whole unknown universe. Therefore natural perception is a superficial perception of an object (phenomenon, event, process). We attribute it solely to science achievement that now these categories are perceived as an indissoluble global trimorpheme. Scientific perception is perception of the natural, rather than common world; it is the perception of contents of an object (phenomenon, event, process). Science made its first steps in line with man's natural perception of his common world and followed the way of investigation of each of the abovementioned categories individually. This period was the longest one in the history of science. (We discussed that in detail in the first part of the present research.) As the perception of each component of the abovementioned trimorpheme in the mind of *homo cognitiuus* (lat. 'investigating man' /21/)

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\* The present article is an abridged version of the review on the problem of Time in natural history, the definition of Time in medicine and the research of some Time construction patterns. The size quota of the present symposium doesn't allow us to include the main part of the research, Introduction to the Common Practice. Part II. Philosophy of Time in Medicine /21/.

transformed, the coherent zones of these categories were defined more clearly, as well as the zones of their contact, interpretation and mutual causation. Thus, gradually, the man developed a scientific perception of the world, which in contrast to the natural perception is formed as objective, corresponding to the natural reality. Such is the dialectics of the cognitive process.

Science achieved the best results in cognition of Matter (lat. *materia* – ‘substance’ /19/). This epistemological phenomenon is, in the first place, determined by real Matter's being visible, tangible and discreet. (Researchers have also found the way to experiment, record and measure invisible forms of matter, such as physical fields and elementary particles.) Being discreet as well, neither Space nor Time has a visible or tangible form. Therefore, it is impossible to draw the infinity of Space or Time from nature in a way a painter replicates a landscape, still life or portrait on canvas. A painter may only create an impression of Space infinity on canvas. In actual fact, a viewer, contemplating the painter's work, having got an emotional message (impression) involuntarily tries to "finish drawing" the infinity. By "finishing drawing" the infinity we mean an attempt to complete the infinity virtually. That's the paradoxical way man's imagination works. Matter appeared to be convenient for physical research. The virtual nature of Space and Time requires another method. Virtuality is reality. But in contrast to man-made virtuality (like on the motion-picture or computer screen), Space and Time are truly virtual. Therefore the measurement/investigation of Space and Time by means of Matter is only justified to the degree the physical (material) reality may be equivalent to the virtual one. At that, by the Space category we mean static or geometrical space, and by the Time category we mean the space of changes, or metabolic space.

And with it, we assume the following: before the Time "arrow", there was Proto-Time (*πρώτα* - gr. 'before, earlier, at first' /8/). The thesis is clarified below.

When astrophysicists register the appearance of a Supernova (SN), it evidently emerges in the pre-existing Space and Time of the Cosmic Space, on a par with the pre-existing Cosmic Matter, i. e. the reality of the supernova is preceded by the differentiated reality of the Cosmic Space, which may be rightfully qualified as proto-reality with reference to the SN.

When a baby comes into the World from mother's womb, it is as bright an event as the SN outburst and no less deserves a thorough investigation than the registration of a SN. The man comes into the World following the same rules as the SN: it is an instance of finding an unsteady balance among the countless probabilistic states in a hyper-complex system of Existence. But before coming to the World, the man indwells in his protoreality, i.e. in each of his parents individually. Then, at some moment, as a result of the well-known kinetic-energy act two parental cells connect and a phase of new living body formation begins. By analogy, had there be no Proto-space before the Great Explosion (GE), our Universe (Cosmos) would have had no space to "expand".

Let's proceed. The GE occurred at some particular moment. It follows that that particular moment was linked to some Proto-time. It is appropriate here to turn to I. Prigozhin's thesis, "order of chaos". Developing this thesis, we have a right to state that the Great Chaos (gr. *χάος* – 'abyss', 'uncertainty', 'indeterminacy' /8/) is determined by the undifferentiated, triunique proto-reality — Proto-space, Proto-time and, of course, Proto-matter. Let's call this proto-reality Pro-Existence.

In its turn, as a result of the GE, i.e. a sort of super-kinetic-energy act, the Proto-time transformed into the arrow of Time. This transformation determined the systematization within the new Hyper-Space. The man called all that Cosmos (*κόσμος* – gr. 'order' /8/). The Proto-Time could not have had that property, as any property assumes an intrasystem differentiation.

There are likely to be other (alternative) Time arrows, which had rested in an invisible quiver of the Proto-existence and were realized in alternative worlds.

With respect to the studies of Time phenomenon we suggest a virtual experiment, which, in our opinion, reveals structural features of Time's actual part of "now", "currently", "the present".

Suppose the future has come to its Limit. People who live in the Future Limit see the rest of the time as the Past only (the Past time). A research group ☺ in the Future Limit inspects the Past using nucleon telescopes with  $\times 10^n$  magnifying power, which allows them to discern any "nucleon"-event in the Past. And ☺ find out with amazement that in the Past, a research group ☺ tries to discern them through their optical-mechanical telescopes. The Past researchers ☺, in their turn, see the rest of the time just as the Future. The Future Limit Research group ☺ makes sure of it by watching the Past group through the nucleon-telescopes and reading their lips. Thus, "the present", "now", "currently" doesn't exist to either experimental research group. At the same time, there is only one time existing for ☺ and ☺, - only the Past or the Future, respectively. Who then describes the time of "now", the time of "currently", the time of the Present? Apparently there should be some third research group, ☺.

The position of the third research group ☺ is similar to standing in the middle of the road in the mist, when one can't see either the beginning or the end of the way, but only as far as fog density allows to see. Sometimes the fog thickens, and the visibility limit contracts to the distance less than arm's length. Sometimes the fog gets thinner and a longer fragment of the roads both ways becomes visible. Nevertheless, the third group ☺ orients well on their way thanks to their ability to watch and analyze, high-tech equipment and the baggage of knowledge which is being improved and accumulated with every step. All that makes the progress of ☺ well-coordinated and steady. Meanwhile, the mist rises for good... and our experiment is over. From our virtual experiment we may draw the following conclusions:





(continuance quantum),  $m_2$ , a set of second-order events, that is the effect-events (phenomena, processes, actions),  $A_2, B_2, \dots, Z_2$ , and so on occur/are registered. The presented set (1) visually demonstrates event (phenomenon, process, action) *simultaneity phenomenon* in each "now", "currently" moment (continuance quantum) of Time's actual metabolic space polymer.

Now let's take the same set of cause-effect events (phenomena, processes, actions) in the context of hypothetic linear reality:

$$\begin{aligned}
 & {}^m A \rightarrow {}^{m_1} A_1 \rightarrow {}^{m_2} A_2 \rightarrow \dots \rightarrow {}^{m_n} A_n \rightarrow {}^{m_{n+1}} B \rightarrow {}^{m_{n+2}} B_1 \rightarrow {}^{m_{n+3}} B_2 \rightarrow \dots \rightarrow {}^{m_{2n}} B_n \rightarrow \dots \rightarrow {}^{m_{26n}} \\
 & {}^{+1} Z \rightarrow {}^{m_{26n+2}} Z_1 \rightarrow {}^{m_{26n+3}} Z_2 \rightarrow \dots \rightarrow {}^{m_{27n}} Z_n
 \end{aligned}
 \tag{2}$$

It follows from the demonstrated hypothetic set (2) that without the simultaneity phenomenon, only one event (phenomenon, process, action) corresponds to each "now", "currently" moment (continuance quantum), which is in contrary to physical reality.

Thus, the time has come when science revealed the inextricable connection between the categories of Space and Time. Then it has clearly seen the inextricable connection of Matter and Time. The indissoluble unity of Matter-Space-Time categories is evident nowadays.

We should also add that the structure of the actual part of Time's metabolic space is seen as *polymer*. The *polymeric structure* of Time's actual metabolic space *determines the phenomenon of the simultaneity of events* (phenomena, processes, actions).

Undoubtedly, the problem of Time in medicine is the problem of prolonging man's life in the first place. This, however, is a biological problem in a greater degree, and a virtual time scale on the "clock" that counts off man's lifetime is very heterogeneous: according to the World Health Organization it is presented by purely medicinal potential by ~10%, and by ~90% by heredity, environment and life style factors.

We are concerned with the ethical aspect of Time in medicine.

The philosophy of ethics considers the historical development of the man in the space between the poles of good and evil. (It was analyzed in detail in the first part of the present research.) But the space of actions between the two poles may be vast, while the choice of actions of *homo medicus* (lat. "healer man" /21/), who aspires to help a patient, is often limited. How are these actions to be qualified?

Let's consider the choice of physician's actions by taking a classical infectious disease of pneumonia as an example.

It has been known that pneumonia is caused by pathogenic bacteria, mycobacteria, mycoplasmas, rickettsias, fungi, parasitic protozoa, clamidia, actinomycetes, legionella, viruses.

In a general sense pathogens are parasites (gr. παρασιτήρα - a sponger) /8/.\*\* But why do many other microorganisms of the abovementioned species (except for the viruses) remain saprophytic and don't attempt macroorganism's health, while the pathogens "don't want" to be saprophytic?

It is possible that saprophytes appeared earlier historically and occupied vacant niches in the polymeric structure of Time's metabolic space, i. e., while the arrow of Time is infinite, the actual part of Time's metabolic space is limited in terms of the density of simultaneous events (phenomena, processes, actions). It means that the late-emerged species became the "castaways" among the free living (saprophytes) and had to parasitize. Indeed, normal flora lives in any healthy macroorganism. Numerous microorganisms that represent it had once been saprophytes but in the course of time became macroorganism's symbiotes. Now if one or more species are missing in normal flora composition (in the event of dysbacteriosis), a macroorganism incurs discomfort. In the context of our research the term "symbiotes" acquires the meaning of macroorganism's "time producers". Respectively, the term "parasites" acquires the meaning of hosting macroorganism's "time reducers". The normal flora has occupied its niche in the polymer of Time's actual metabolic space on the terms of hosting organism's time producer. It happened in a natural way: according to one of the theories accepted in biology, in the course of evolution monocellular organisms incorporated into metazoa (macroorganisms to-be). Only the distribution of functions between the united monocellular organisms might have provided vitality maintenance of the resulting conglomerate. The distribution and cohesion of functions assumes both their sequence and simultaneity. In the context of our research it means that the emersion of a living multi-level system is possible due to the life of each being formed into the polymer of the actual time of the metazoan organism.

With the complication of living systems on every next development level the density of their actual metabolic Time space for simultaneous phenomena (events, processes, actions) approached its limit. And on one of the levels of evolution there was no room for new species of microorganisms in the actual part of macroorganism's metabolic space of Time, which was previously enough for potential symbiotes. These species had to play the part of time reducers for the hosting organisms of their time. Therefore they are referred to the class of parasites. Parasites don't conglomerate, perhaps because they have no phylogenetic experience of the saprophytes or maybe parasites are just unable to

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\*\* Speaking about pathogens we mean their influence on the man, since in other living systems, the same microorganisms may happily remain symbiotic /21/.

be saprophytes and Time producers. It only remains to register how time after time (in our example, in each case of pneumonia) pathogens make an attempt to become macroorganism's symbiotes and enter the structure of the normal flora. But the limit of density of phenomena (events, processes, actions) in the actual metabolic space of the macroorganism's Time has been reached already. It is proved by the immune system function. The cell-mediated and antibody-mediated immunity tries to exclude off-normal phenomena (events, processes, actions) in the limit-occupied actual metabolic space of Time of the given macroorganism. This fact demonstrates macroorganism's self-sufficiency.

That said, we may assume that in contrast to the cellular pathogen the precellular pathogen is still likely to become a macroorganism's symbiote, because the precellular organism has no "clock-work" of its own, unlike every cellular one. The precellular organism is a potential part of its host's "clock-work". Every time, sneaking inside a cell of the macroorganism like a scout in the enemy's rear, the precellular organism accumulates information about the shortcomings of those particular cells' "clock-work". Finally, at some n-"attempt", the precellular organism will occupy a place of the missing "diamond spar" of its host. Since it is practically impossible for the cellular pathogen to adjust its "clock-work" in synch with the host's rhythm, it would be easier for it to become a symbiote on a "spare parts kit" basis, with respect to the macroorganism's clock-work. After all, it doesn't matter to whom that hypothetical symbiosis would be of more importance to – the precellular organism or the macroorganism – nobody will notice it: Time will go on. With respect to that, it is appropriate to quote the words of P. K. Anokhin: "A biologist doesn't care much, which combination of structures and which architecture of physiological processes provide this function, if it successfully adapts an animal to the exterior conditions and allows it to follow the way of progressive evolution". /1/

The assumption outlined is however impossible, as everything happens right in the opposite way.

A precellular carnivore organism – "prion" or "plasmid" /22/ – is pathogenic just because passing into a victim cell it uses the cell's "parts" to create a precellular clock-work of its own – a virus. The carnivore phenomenon – theft or reduction of somebody else's actual time – remains the same for living system of every level. At that, biologically, the mission of the carnivore (others' actual time reducer) is to realize one of the natural selection mechanisms. Philosophically, the carnivore is a relative concept. The man doesn't put up with the attacks of his health's time reducers. Today he looks for the solution of the problem researching the coherent zones of the macroorganism's system organization, information theory and synergetics.

Suggesting the *time reduction* morpheme, we assume the definition of the *pathological time reduction* as evident. In context of the natural biological time

reduction, there is a long-standing term of *ageing process* or just *ageing* both in practice and literature.

In conclusion of this part of our discourse we may formulate a thesis that the symbiosis (the concerted distribution of functions) gives place to competition and parasitism, when the density of simultaneous events (phenomena, processes, actions) reaches its limit in the actual part of Time's metabolic space. The phenomenon of density limit in the actual part of Time's metabolic space is probably an attribute of physical reality.

At present, the treatment of light course of pneumonia is performed domiciliary. The treatment of severe course of disease is performed in hospital conditions. Before choosing an antibiotic therapy, a physician defines etiology of pneumonia the given patient has and may assess the activator's sensitivity to the antibiotic as required.

We considered the scheme of pneumonia antibiotic therapy taking into account recommendations by authoritative clinicians /28/.

The degree of freedom of physician's actions may be presented in form of the list of alternative drugs, if the drug of choice is missing or unacceptable for a patient. If no alternative drugs are available, physician's actions appear to be forcedly no-choice. I. e., the polymeric structure organization of the actual part of ethical time – the time of waiting for /rendering of help – assumes the availability/creation of coordinated alternative actions. It is worthy of note that in order to remove time reduction of a contagious patient, a pathogen's time reducer is applied. It is antibiotics that play the part of these reducers. The curative effect is based on the same property of an antibiotic, experienced by the diseased macroorganism; it is aimed at the pathogen's time reduction. When the pathogen is removed, the antibiotic's effect may be directed to the macroorganism's time reduction. Antibiotics may become a macroorganism's time reducers when a patient takes them behind physician's back, i. e. performs self-treatment. Medications that reduce the time of antibiotics are provided for these occasions.

Now let's consider the choice of physician's actions by the example of arthroplasty. When, say, a hip replacement indication is appointed to a patient as a result of disease or trauma, a surgeon faces the problem of choice of implant and endoprosthesis method. The choice procedure on an individual case basis developed in Lahey Clinic (USA) /13/ is believed to be the optimum. Surgeon's degree of freedom is not confined to this choice. Some endoprosthesis manufacturers develop the design and installation procedure of their products taking into account the option of individual components interchangeability. In PLUS-ORTHOPEDECS<sup>®</sup> endoprostheses, for instance, the standard and anti-dislocation inserts are interchangeable, or the standard stem is implanted in the same way both into the right and left hip, and so on. Undoubtedly, this option considerably expands the degree of freedom of surgeon's effective actions when rendering

operative service. But even when the choice of implants and endoprosthesis methods is limited, surgeons sometimes achieve a masterly performance of their work. For instance, in 1979 V. V. Klyuchevsky successfully performed hip hemiarthroplasty to patient R., 99 year old, on the occasion of right hip subcapital femoral neck fracture. The recovery period showed no complications. The patient "walked with full weight bearing without pain and lived to be 106 year old" /13/.

Similar examples may be given for any pathology. They will differ by a higher or lesser degree of physician's choice of actions, which may be presented as follows:

$$E_{\text{xtent}} = n \cdot ({}^aA_c) \quad (3)$$

where  $E_{\text{xtent}}$  - the degree of freedom in choosing what to do,

$n$  - the number of alternative coordinated actions,

${}^aA_c$  - alternative action concerted.

Below these examples are described in more detail.

This part of the research allows us to conclude that every clinical implication of disease may be regarded as a result of the pathological time reduction. We classify every action of the physician concerted with the patient as an alternative action. The number of alternative concerted actions determines the degree of freedom of physician's actions (3). In case of emergency care, when a patient is unconscious, a physician concerts his actions with patient's relatives, if those are available. In terms of circumstances, physician's no-choice actions are always constrained. In terms of effect, no-choice actions are always aimed at helping the patient – the reproduction of affected system's Time. The no-choice actions feature the minimum degree of the freedom of choice (for instance with cardiopulmonary resuscitation). It may mean there are still vacant niches for new alternative actions concerted in the polymeric structure of the actual part of Time's ethic space.

Unfortunately, at present we see the problem of patient's life being solved by the Supreme Court of some state rather than by physicians' efforts on the way of alternative actions concerted. The Supreme Court condemns a *diseased* person to death [5]. An action on the evil pole is chosen for a severely ill person - a forced deprivation of life, in spite of the patient's relatives asking to keep him on artificial life support equipment. If life is given to the man by the God, why does some supreme court take the title to *take life of a diseased* person? Not a *criminal*, but *diseased* person! What offence has he committed to the society so that the Supreme Court condemns him to death? Still, nobody is insured against a severe disease, even the members of the Supreme Court who played the part of pathogen themselves ...

With respect to that, the euthanasia act in effect in some countries, which allows a physician to kill a severely diseased person can't help arousing bewilderment: one doesn't need to graduate and get medical qualification to kill a man, i. e. to play the part of someone else's Time reducer.

The research results allow us to draw the following conclusions.

1. The physical world develops according to the laws of the differential calculus. The biological world develops according to the laws of logarithmic calculus. The social world develops according to the laws of degree of freedom of ethical actions choice calculus.

2. The actual part of Time's metabolic space, which consists of "now", "currently" continuance quanta, makes up the Time polymer. The structure of the Time polymer determines the phenomenon of simultaneity of events (phenomena, processes, actions).

3. It is probable that in the physical reality every system has its limit of density of simultaneous events (phenomena, processes, actions) in the actual part of Time's metabolic space.

4. When the density of simultaneous events (phenomena, processes, actions) in the Time's actual metabolic space reaches its limit, the coordinated distribution of functions gives place to competition and parasitism.

5. In the context of the present research, every clinical implication of disease may be regarded as a result of the pathological reduction of the macroorganism's own time.

6. Alternative is a quantum of action the virtual scale of ethical time is divisible by. Alternative is a noema – a vehicle of meaning, a meaningful unit of ethical time perception. The more alternative actions concerted are provided, the wider is the space between the poles of good and evil, the greater is the degree of ethical actions choice, the higher is the probability of happy outcome for a person who needs help.

7. The degree of freedom of ethical actions choice is determined by the polymeric structure of the actual part of Time's metabolic space. No-choice actions only mean the minimum degree of freedom of choice, i.e. the option of new alternative actions concerted being generated remains in the polymeric structure of the actual part of Time's metabolic space.

8. In terms of circumstances, physician's no-choice actions are always constrained. In terms of effect, no-choice actions are always aimed at helping the patient – the reproduction of affected system's Time.

9. The ethical time is actually experienced time, the time of waiting for help and the time of rendering help.

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## COMPARATIVE STUDIES OF IMMUNOSTIMULATE AND ANTIHYPOXANT PROPERTIES OF AZEOMED AND GLYSIRAM

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The development of food addition, possessing immunostimulate and antihypoxantine activity from natural raw material for application as medical-prophylactic means are actual and necessary. They present special interest for sports medicine, so that the sportsmen being in the special situations, provoked by a great exercise stress, complicated natural, climatic and ecological conditions require in additional food stuffs, which are not dopes. Regular usage of food addition with immunostimulate activity bring to stability of all index complex, characterized of man's physiological state: reduces perception keenness during stressed situations, decreases physical and emotional fatigability, raises capacity of work, secures comfort and gives confidence in own possibilities. As it was earlier informed, the mineral composition of Azeomed based on Azerbaijan natural zeolite, dolomite and silicon manufactured as tablets of 500 mg, in packs of 60 and 120 pieces. Mineral food addition was clinically approved in Germany, where a series of pharmaceuticals activities including immunostimulate that allows to use it as prophylactic means in series of respiratory organs diseases, gastric and intestinal diseases, stomatological, oncological, infections and others and its physical and chemical constants, have been defined, normative-technical documentation have been approved and the certification of preparation was carried out in national and international levels.

Glysiram-preparation represents monoammonium salt of glycyrrhizin acid, excreted from liquorice-liquiritiae. Manufactured as tablets of 0,05g, in packs of 50 pieces. The lymph stimulate antihypoxant and anti-inflammatory properties of Glysiram have been studied in detail and scientifically settled. The preparation jointly with succinic acid snows immunostimulate effect and is widely used by sportsmen during sport contests. It does not have any collateral actions, it is not listed among dopes. Glysiram also have been studied in the upper respiratory tract, diseases, in timico-lymphatic states, in allegorical diseases, in chronic lassitude syndrome, in rheumatic arthritic, in inflammatory diseases, in large intestine, in hypoglycemia, in disturbance of sugar balance in blood, where its effective action has been proved. Taking into consideration the abovementioned,

we aimed to carry out comparative studying of immunostimulate and antihypoxant properties of Azeomed and Glysiram in order to develop immunotrope preparations of medical-prophylactic direction.

**MATERIAL AND INVESTIGATION METHODS:**

Investigation material were: Azoemed and Glysiram preparations in 0.05 dose accordingly. Investigation methods: Laboratory and Biochemical

Investigation objects were 124 healthy sportsmen.

In the first stage of investigation participated 46 healthy sportsmen volunteers at the age of 18-22 years. All volunteers arbitrarily have been divided into 2 groups of 10 people each. The participants of the first group received Glysiram in the dose of 1,56 per day during 10 days, 10 participants of the second group received Azeomed in the dose of 1,56 per day and 10 person of control group received placebo. During the same period. It was proposed to participants driftly to increase the load of (at a speed of 33 watt/min) veloergometry up to magnitude in which the frequency of heartbeat reach 170 beating (stroke) minute. The received results showed the considerable raising of efficiency in receiving Glysiram (table 1). So, the participants could fulfill the work, equal to 64,8 kilojoule. In receiving plasebo this index, as it was expected, practically did not change, while after receiving Glysiram the volume of work, fulfilled by the volunteers, receiving placebo.

**Effect of Glysiram and Azeomed on exercise aeorformance**

*Table 1*

<i>Index</i>	<i>Unit</i>	<i>Plasebo</i>	<i>Glysiram</i>	<i>Azeomed</i>
Maximum capacity	watt	188 ± 14,0	206 ± 57,0	19,5 + 40,1
Volume of accomplished work	kilo joule	65,9 ± 2,2	76,1 ± 5,1	70,1 + 4,2
Duration of accomplishing	second	688 ± 21,0	743 ± 25,0	603 + 24,0
PWC <sub>170</sub>	watt	202 ± 5,0	215 ± 15,0	201 + 13,0

P < 0,05

**Note: PWC<sub>170</sub>-load capacity, at which the frequency of heartbeat reaches 170 stroke (beat)/minute**

These results allow to come to a conclusion, that Glysiram ingreased the fulfillment and duration of a B16 capacity loads and for 10% in average. At the next stages of in investigation the effect of Glysiram to the exercise performance of professional sportsmen of high level training have been evaluated. In the first test 15 masters of sports on cycle racing, who were examined twice a week in a veloergometer in regime of driftly increasing loads (33 watt/min) up to reaching of

pulse frequency, which is equal to 170 strokes/min. One hour prior to testing the sportsmen received Glysiram in the dose of 0,036 or plasebo only once. The testing was carried out in double touch system regime.

#### **Glysiram and Azeomed effect on sportsmen exercise performance.**

*Table 2*

<i>Index</i>	<i>Unit</i>	<i>Plasebo</i>	<i>Glysiram</i>	<i>Azeomed</i>
Maximum capacity	watt	200 ± 11	231 ± 9	22,0 + 6
Accomplished work volume	kilo joule	87,8 ± 4,1	113,7 ± 4,0	110 + 2,0
Duration of accomplishing	second	662 ± 24	727 ± 33	624 + 25
PWC <sub>170</sub>	watt	231 ± 13	275 ± 11	257 + 9,0

**Note:** PWC<sub>170</sub>-load capacity, in which the frequency of heartbeat reach strokes/min.

The received results, as a whole, confirmed the capacity of Glysiram and Azeomed to increase the physical efficiency (Table 2). The volume of a accomplished work after receiving Glysiram and Azeomed increased in average as much as 120%, but integral index of efficiency, intended for database, increased in a verge of 10%, even on one time receiving of preparation. The efficiency of using of Glysiram and Azeomed by sportsmen-slayers, who have high level of training and expressed motivation to the trainings, have been evaluated in the next test. The test took place in sprint of 6 km. Totally 24 sportsmen participated in the test, 8 of them received 2,06 of Glysiram one hour prior to the test, 8 persons-Azeomed, but other 8 persons-plasebo.

Trial and control groups have been formed as equivalent of control run results. The efficiency of using Glysiram and Azeomed was determined based on running duration, heartbeat frequency, measured before start, right after and in 5 minutes after the finish, also the temperature, measured in auxiliary cavity.

The comparative analysis of received results showed a rather big frequency of heartbeat of runners, receiving plasebo before start, in 5 minutes of recover after running, pulse normalization degree was a big in a trial group, differences between groups were trustworthy. Duration of running by sportsmen, that received Glysiram and Azeomed before round which was 1 minute less in average was of special interest. In modern sport 1 minute is not a short time (table 3).

The Glysiram and Azeomed effect the effect the efficiency of sportsmen-swimmers evaluated in the last series of test. The test carried out in a special stand training equipment, allowing quantitatively evaluation of exercise performance carried out by sportsmen during training. It is important to note that the training of sportsmen was carried out in hypobaric conditions at the height of 2230m above sea level. 8 persons of 16-22 years old participated in the test, having sport qualification from master of sports up to the master of sports of international class.

**Glysiram and Azeomed effect on efficiency in test of running of 6 km (M±T).***Table 3*

<i>Index</i>	<i>Plasebo</i>	<i>Glysiram</i>	<i>Azeomed</i>
Running time (min)	25,2 + 0,3	24,2 + 0,2*	23,4 + 0,1
Heartbeat frequency in peace (stroke/min)	85 + 14	88 + 16	85+ 13
Heartbeat frequency after running (stroke min)	174 + 23	169 ± 19	160 + 15
Hertbeat frequency in 5 minutes after recovery (stroke/min)	124 + 12	114 + 6*	110 + 4
Body temperature (°C)	36,8 + 0,4	36,3 + 0,8	30 + 0,7

**Note: The truthworthy differences with plasebo marked by the asterisk.**

The initial indexes of sportsmen the physical efficiency was determined during the initial training. Before the next training the sportsmen received the preparation in average dose of 30mg/kg in 40-60 minutes before the loads. Under the effect of Glysiram and Azeomed the volume of accomplished work in average increased up to 30% (from 87,8±4,1 kilojoule to 113,7±4,2 kilojoule), and maximum capacity of developing load for 20% (from 231±13watt to 275±11watt).

In conducting the tests during training in hypobaric condition it has been determined that being in moderate hypoxia during 7-10 day the main results of sportsmen in test rounds (swimming on back and free style on distance of 50m) became worse for 0,23±0,06 second with respect to results in plain. The usage of Glysiram and Azeomed in dose of 0,056 three times a day during 7-10 days in test round reduces the time to 0,31±0,04 second, it secured not only recovery up to norms of reduced result, but also the growth of sport exercise.

Besides of track and field athletes the bodybuilders, who exposed themselves to the massed physical loads during training, participated in hypoxia testing. As a result of Glysiram and Azeomed peroral receiving during 2 month in conjunction with ribose and monohydrate of creatinine, 30% of time increasing was observed in a load of working mucle. The increasing of muscle mass for 5-7 kg without increasing of fat components was noted during the test. These results allow the author to form new approaches to the problem of nutritions support of training regime of sportsmen-bodybuilders.

Thus, the carried out researches convincingly showed that Glysiram with Azoemed can be related with good reason to the means of exercise performance growth in heavy loads. The main effect in acceleration of recovery process and reducing the "Payment" of organizm work. It is important to note, that Glysiram and Azeomed, in contrast to anabolic preparations, does not contain substances in its composition, related the dope groups. So long as not trained persons, as well as professional sportsmen of different specialty participated in the tests, this can confirm that Glysiram and Azeomed are effective means of increasing of sports

trainings results. It is important to note that Glysiram and Azeomed essentially reduce the time postload recovery of exercise performance.

Effect of Glysiram and Azeomed  
Functional condition and efficiency of  
Man in condition of hypoxia.

The results of Glysiram and Azeomed tests presented in previous section have been received based on the test on sportsmen, worked in normbarical conditions and just only in one case they acted in a moderate hypoxia. It was shown, that as a result of weekly staying at the height of 2230m above sea level the personal indexes of sportsmen had became worse, however, as a result of receiving Glysiram and Azeomed effect to the functional condition was observed. These results served as basis for a more wide studying of Glysiram and Azeomed effect to the functional condition and efficiency of healthy persons in hypoxia condition.

30 healthy men-sportsmen at the age of 24-29 years old during 2 days were in pressure chamber in condition of vacuum corresponding to the 3000m above sea level in the first stage. All the volunteers have been divided into 3 groups consisting of 10 persons each. In the first group the examinees received Glysiram of 16 before start of hypoxia effect, in the second group the examinees received Azeome of 16 and then after each 8 hours during all the time of staying in a pressure chamber. The volunteers of control group received plasebo. Before test and immediately after the test completion the complex inspection of volunteers have been carried out staying in hypoxia condition was accompanied by the regular changes, of a number of physiological parameters (Table 4).

**The Glysiram and Azeomed effect to some physiological indexes of organism after 48 hours staying at the height of 3000m above sea level.**

Table 4

<i>Index</i>	<i>Unit</i>	<i>Normoxia background</i>	<i>Hypoxia</i>		
			<i>Plasebo</i>	<i>Glysira</i>	<i>Azeomed</i>
Running time (min)	Stroke/min	63 ± 3	76 ± 5	6014	6011
Heartbeat frequency	MM.Mercury	72 ± 1	78 ± 1	6711	6702
Diastolic	MM.Mercury	117 ± 2	130 ± 1	117 ± 1	101 + 1
Consumption	ml	273 ± 12	354 ± 8	308 + 5	290 + 4
Coefficient of using	%k	83 ± 4	71 ± 4	74 ± 6	60+3
Maximum consumption	ml/kg-min	47,8 ± 1,0	37,6 ± 0,6	46,3 ± 1,8	38 + 1,2
PWC <sub>170</sub>	watt	172 ± 6	151 ± 2	162 ± 8	156 + 7

**Note: PWC<sub>170</sub>-load capacity, in which the heartbeat frequency reaches 170 strokes/min.**

In particular, the heartbeating frequency, systolic pressure had been increased. At the same time the oxygen consumption had been increased and coefficient of its using had been reduced, physiological shifts reflect hightened activation of sympathoadrenal system and reduction of organism 15 functional reserves level.

During receiving Glysiram and Azeomed the changes of physiological indexes were either absent or statistically insign-nificat.

At the second series 27 healthy men at the age of 20-26 participated in the tests. The condition of the test stipulated 2 days staying in pressure chamber on rarefaction, cores ponding to the 4000 m. Above the sea level. During staying in hypoxia condition the testers constantly, except the time of sleeping (6 hours per day) and food receiving, were engaged in the test of implemented the different tasks, initiated operational or physical activity. The volunteers of the testing group (9 persons) received Glysiram in the dose of 1,56. 3 times a day and volunteers of the second group (9 persons) received Azeomed in the dose of 1,56. 3 times a day, the volunteers of the control group received Plasebo in analogical scheme.

Just as in the previous test, some physiological indexes of organisms were evaluated. The results of these measuring demonstrated the usual reaction of organism, observed in climbing to the height of 4000 m. above the sea level. The frequency of heart beating relatively observed in the height of 3000 m. above the sea level, raised in average for 10%.

Approximately in the same range the indexes of arterial pressure and oxygen consumption raised (table 5). The hypoxial changes were statically insignificant or quite absent in the testing 6 group. The received results indicated, that Glysiram compensated unfavorable influence of hypoxia to the physiological condition of organism during the climbing of the person to the height of 4000 m. Above the sea level for a short period.

**Influence of Glysiram and Azeomed to the some physiological indexes of organism after staying 48 hours at the height of 4000 m. Above the sea level**

Table 5

<i>Index</i>	<i>Unit</i>	<i>Background</i>	<i>hypoxia</i>		
			<i>Plasebo</i>	<i>Glysiram</i>	<i>Azeomed</i>
Heartbeat	Beat/min	63 ± 1	84 ± 5	61 ± 1	59 ± 0,5
Diastolic arterial pressure	Mm. mercury column	73 ± 1	84 ± 1	79 ± 1	69 ± 0,4
Sistolic arterial pressure	Mm. mercury column	122 ± 2	142 ± 1	129 ± 2	110 + 1
O <sub>2</sub> consumption	ml	275 ± 14	372 ± 8	354 ± 1	350 + 0,5
Maximum O <sub>2</sub> consumption	Ml /kq-min	42,5 ± 0,6	37,3 ± 0,3	45,1± 0,9	44 + 0,7

For estimation of subjective perception of hypoxial influence, the participants of the test filled special “mountain form”, considering the point of mountain disease symptoms (table 6).

**The results of filling the form for mountain disease symptoms in the process of 2 days staying at the height of 4000 m.**

*Table 6*

<i>Index</i>	<i>Plasebo</i>	<i>Glysiram</i>	<i>Azeomed</i>
Number of points as per mountain Form after 8 hours	13,9	11,1	9,1
After 16 hours	15,4	14,6	12,5
After 32 hours	13,3	7,1	6,1
After 42 hours	14,8	6,3*	5,4
Total number of points for the whole period	57,4	39,1	26,1
Number of cerebral complaints	25,0	25,0	27,0
Number of cardio respiratory complaints	30,0	9,0	8,0
Number of digestive complaints	16,0	14,0	13,0
The average number of complaints per person	6,7	5,6	4,7

**Note: Trustworthy differences with Plasebo are marked.**

As showed the results of fourfold questioning on list of possible symptoms in acute mountain disease, Glysiram and Azeomed essentially alleviated the condition heaviness and considerable reduced the period of bad feeling while staying at the height.

The number of points, characterizing not only the number of appeared symptoms, but also their heaviness, remained the same in all the phases of progressively reduced on the second day of staying in the pressure chamber, which states the acceleration of adaptation to the hypoxia in preparation receiving.

The largest effect of Glysiram and Azeomed showed in the respect of cardio respiratory complaints (short breath, heart beating). The results of questioning were confirmed and in oxygen balance quantitative estimation, it showed that Glysiram and Azeomed contribute to normalization of oxygen consumption by organism (Table 7).

Thus, the model tests in pressure chamber showed the high pharmacological activity of Glysiram and Azeomed and expediency of its application in hypoxial hypoxia influence.

The next test have been carried out in Caucasus mountains at the height of 3000 m. Above the sea level. In the test after seep medical survey in plain consition 30 healthy men at the age of 19-21, who were engaged with the accomplishment of construction work staying during 2 weeks in mountains participated in this test.

Beginning from the first day staying in mountains 20 persons received Glysiram and Azeomed and 10 persons received Placebo in the dose of 0,56. 3 times a day.

Upto the third day the growth of complaints quantity it was observed in the control group, characterizing the development of mountain disease with the following reducing in adaptation development to the height of 3000 m. however, even up to the 12<sup>th</sup> day of staying at the height the essential expressing of cerebral and cardio respiratory complaints were observed (Table 7).

**The dynamics of feeling during the period of work at the height of 3000 m. below the Sea Level (according to the mountain from)**

Table 7

<i>Preparation</i>	<i>Investigation day</i>	<i>Average number of points</i>	<i>% of people with dissatisfied peeling</i>	<i>Expression of complaints, points</i>		
				<i>Cerebral</i>	<i>Cardio respiratory</i>	<i>Digestive</i>
Plasebo	1	7,3	5	20 30	22	9
	3	10,4,7,9	0	24 13	22	11
	6	4,7	0	9	18	8
	8	2,1	10		12	7
	12		0		11	1
Glysiram	1	4,2*	0	11* 6*	5*	0*
	3	3,7*	0	4* 6*	5*	2*
	6	3,1*	0	1*	6*	0*
	8	3,5*	0		4*	1*
	12	0,7*	0		2*	0
Azeomed	1					
	3					

**Note: The trustworthy differences with Placebo are marked with asterisk.**

It is also determined, that in the high mountain condition (2500m. and above) the necessary for recovery of vegetative functions (circulation of the blood and breathing) is more than in plain. Shortage of oxygen, appearing due to the



mentioned reasons, bring it to the reinforcement of the processes of anaerobic Glycolize with accumulation of Lactat, which in conjunction with developing oxygen debt rapidly bring it to the increased fatigability, appearing in feeling deterioration and growth of cerebral and cardio respiratory complaints.

Thus, accomplishment of exercise performance in the high hypoxia condition is accompanied by the adaptation reactions of organism. In the following moderate physical load the adaptation condition can rise, but if the load of heaviness ok duration exceeds the compensation resources of organism, disadaptation condition arises, which can require definite correction by pharmacological means. One of such means is Glysiram and Azeomed, which increase oxygen supply to the tissue, reducing the depth of tissue hypoxia, and on the other hand, as it was already shown, they optimize the oxygen balance, adapt it to the changed barometric and gas characteristics.

In our tests, the volunteers who received Glysiram and Azeomed, the number of complaints reduced for certain during questioning on mountain form. Otherwise, the mountain disease was expressed weakly, but what is especially important, is that Glysiram and Azeomed recovered the oxygen consumption and exercise performance up to the level, which was noted in volumeers for test on plain before test (table 8).

**Exercise performance condition on the 6<sup>th</sup> day of work at the height of 3000 m. in comparison with the indexes, received on plain.**

Table 8.

<i>Preparation</i>	<i>Aerobic capacity, PWC<sub>170</sub></i>		<i>Maximum oxygen consumption, ml/min. kg</i>	
	<i>plain</i>	<i>mountains</i>	<i>plain</i>	<i>mountains</i>
Plasebo	2,8 ± 0,1	2,0 ± 0,1*	48,3±1,1	40,1 ± 1,0*
Glysiram	2,6 ± 0,1	2,4 + 0,1*	45,6±1,0	44,8 ± 1,3*
Azeomed	2,6 +0,1	2,3 + 0,1	45,1+1,1	44,5 + 1,1

**Note:** PWC<sub>170</sub> – Load capacity, where the frequency of heart-bean reach 170 beats/minute, the trustworthy differences with placebo are marked with asterisk, p<0,05.

Exercise performance, as is generally known, is an integral index, formed from many physiological reactions. It was important to define the dynamics of main physiological indexes of organism in dosed physical load (table 9).

Just as expected, dosed physical load of persons, who received Plasedo resulted in essential changes of most of the physiological indexes. So, the breath frequency grew twice, minute volume of breath for 3,5 times and especially,

power consumption almost for 5 times. The different result received in volunteers, receiving Glysiram and Azeomed; certain, but not deep changes were observed. Anyway, in the most of the tests the results were trustworthy near to normal, than in receiving Plasedo. The integral test of power consumption in receiving Glysiram and Azeomed grew less than twice as a result of dosed load influence.

The oxygen consumption grew in the same ratio. Comparing the two groups, it can be concluded, that is a result of Glysiram and Azeomed receiving the physical load bear was discovered in average twice higher, than persons, who received Plasedo. These data are well confirmed with the opinion of O.T. Kasymov and co-authors (1993), who think, that typical labour regime, developed for plain areas, can't be applied in high mountain conditions without appropriate corrections.

One of the such correction methods can be course receiving of Glysiram and Azeomed. As the questioning of the volunteers, who participated in described tests, showed that for certain the preparation often improved physical load bear, reduced the degree of tiredness and shortened the period of exercise performance recovery.

**The dynamics of physiological indexes in veloergometric test on the 6<sup>th</sup> day of staying in high level conditions.**

*Table 9.*

Index	Plasebo		Glysiram		Azeomed	
	Rest	Load	Rest	Load	Rest	Load
Heartbeat frequency	68 ± 2	135 ± 4*	69 ± 2	131 ± 2*	60 + 1	130 + 1*
Arterial pressure mm	113 ± 1 73 ± 2	130 ± 2* 72 ± 2	110 ± 2 73 ± 1	123 ± 3* 73 ± 2	100 + 1 70 + 1	122 + 2 70 + 1
Oxygen pulse	5,6 ± 0,3	10,9 ± 0,7*	6,0 ± 0,2	5,8 ± 0,4	5,0+0,1	
Minute volume	4,4 ± 0,2	11,1 ± 0,5*	4,3 ± 0,2	9,3 ± 0,3*	4,0+0,1	8,9 + 0,2
Percussive volume ml	65 ± 2	76 ± 4*	66±2	71 ± 2	60,1	69 + 1
Breath frequency	18,4 ± 0,9	37,6 ± 2,2*	15,4 ± 0,	202, ± 1,5	14,2	19,0 + 1
Minute volume	10,5 ± 0,5	36,9 ± 2,3*	9,3 ± 0,5	18,1 ± 0,5	80 +0,2	17,0+0,3
Consumption	376 ± 25	1587 ± 106*	379 ± 27	743 ± 27*	369 +25*	730+26
Power consumption	28,2 ± 0,2	120,0 ± 4,9*	31,3 ± 1,	61,3 ± 2,3	30,0 + 1	59,0+0,5

**Note: The trustworthy differences with the results of testing on plain are marked with asterisk.**

Thus, in model and field tests of Glysiram and Azeomed it was determined, that the presence of expressed immunocorrective and antihypoxant influence to the sportsmen's exercise performance. This action was displayed in normobaric

and high mountain conditions. In this connection Glysiram and Azeomed can be successfully used by mountaineers and also by the workers, who are engaged in Physical works in mountain or other hypobaric and hypoxia conditions. It can be supposed, that Glysiram and Azeomed are also helpful for miners and mountain rescuers, who often work in hypoxia conditions.

The actprotecting properties of Glysiram and Azeomed and their ability to recover oxygen-energetic balance interested the professional sportsmen. Who used it as means of pharmaceutical support during training. In the final analysis this brings to the rapid achievement of maximum level of training. Taking into consideration, that Glysiram and Azeomed do not contain substances, related to the group of dope-means, the actprotecting properties of the preparation are very valuable.

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**INTERNATIONALIZATION OF PRIMARY HEALTH CARE:  
A COLLABORATIVE STRATEGY TO DEVELOP  
COMPREHENSIVE CARE IN SEMANU  
PRIMARY HEALTH CARE, GUNUNGKIDUL,  
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*A. Background and Theoretical Concept*

*A.1. Collaboration in Primary Health Care Development*

Developing primary health care via collaboration programs is often conducted. Hopton and Heany (1999) reported a Designed to Care program to develop health care system in Scotland employing collaborative approach with England and Wales. Fisher et al. (1999) describes public involvement in the effort of developing community and primary care in Wales. Rowlands et al. (2004) wrote an article on the concept of Primary Care Organization aimed at developing the organization of public health care in which primary care is developed into a research site and linked to its original function as a community health services. Collaboration concept provides advantages for the program of developing health center because there have been resources available from various parties, which is not limited to the local stakeholder (home country), but is very likely the foreign party.

Community-based health center has been known to provide optimal advantages for the community. The history of the community-oriented primary care has shown the development in connection with the aspects of involvement, sharing and utilization (Longlett et al. 2001; Pickens et al. 2002). This concept, besides providing an opportunity for the collaboration and networking, offers equal advantage to the health care organization and the community. According to Sibthorpe et al. (2005), the Australian Primary Health Care Research Institute (APHCRI) has defined primary health care as:

“..socially appropriate, universally accessible, scientifically sound first level care provided by suitably trained workforce supported by integrated referral systems and in a way that gives priority to those most in need, maximises community and individual self-reliance and participation and involves collaboration with other sector. It includes health promotion, illness prevention,

care of the sick, advocacy and community development” This definition broadened the understanding of primary care regarding its comprehensiveness. By using this definition possibility to collaborate with other sector is widely open.

Referring to the primary care development strategy in Malaysia and Thailand, various new concepts have been applied in both countries in terms of the physical building and human resource contexts. Adequate health service, according to the two countries’ perspective, will encourage the community to use, which in return, it will save the cost of the health service. Even, NHS (National Health Service) in England, has suggested that the primary care must be more developed and equipped with adequate facilities in making the community able to afford more qualified health services without spending more costs (Hospital Post, July 2005).

## **A.2. Semanu Primary Health Care**

Semanu Health Center in the district of Gunungkidul is a primary health care which is located in the most underprivileged district in Jogjakarta, Indonesia. The local resource, in terms of the quality and quantity, was not adequate to develop this health center.

Per definition, in Indonesia, primary health care is a technical unit in the sub district that run the community service and health development. In ideal manner, the functions of primary care encompass 5 levels of health prevention, health promotion, curative care including emergency services, supporting the referral system and providing planning, program and sustainable community development program.

Semanu Primary Health Care (SPHC) covers 10,290,871 square meters area in Gunung Kidul District, which is inclusive in the poor level district in Jogjakarta Special Territory. It is completed by 2 primary care buildings to cover 7555 houses and 9626 families within 3 villages. The community that is served by SPHC consists of around 131.892 inhabitants who mostly work as farmers. It became the supervisor of 50 schools and many public offices. It is a huge responsibility for primary care level. Therefore as the health frontline in providing health care to the community, Semanu Health Center is very strategic to be developed by using a collaboration concept due to its limitation.

### **B. Description of the primary health care service**

#### **B.1. Health Center is only intended to the poor, villager or suburb people**

Having heard the word ‘health center’, people will immediately imagine a very minimal service, unrepresentative place, expired generic drugs, service given by an unpleasant staff, worn-out medical records and many other unpleasant

descriptions. A health center is always related to the poor, suburban and urban, but poor people. “Puskesmas” (health center) stands for “Pusat Kesehatan Masyarakat”. Considering the name, it was a promising name, ideally it should serve the community comprehensively but eventually it was on the other way around. This was probably due to the inequality between large functions of the health center and the very simple managerial concept, as well as the unclear health funding. It was assumed that, before decentralization, a health center performed 18 functions, even for certain health centers, the functions performed were more than 20 kinds of services and other community health-related activities (conducted by the local women joining family welfare education, mother groups or so called PKK and health cadres to serve in the integrated health post).

### **B.2. The Loads of the Health Center Services: The Loads of modern and classic diseases are the present challenges of health services.**

Polio, *honger-oedema*, diarrhea became hot news again after so many years. Tuberculosis, Dengue, Malaria are still the main problems in many health centers; although they have been recognized and solved so far. In addition, avian flu, HIV/ AIDS add the number of diseases which should be taken care of. Obesity, heart disease, diabetes, kidney disease, high blood pressure, stroke and mental disorders have been also included in the list of diseases which should be taken care of by the health center staffs. The phenomenon of double burden of diseases (or even triple, because of the re- emergence of diseases as an effect of the economic crisis as it has been predicted before) becomes the challenge of the health center service nowadays. The health center does not take care of headache, sprain and cold any longer.

The community who is sensitive to the cost of the health service will prefer a service with reasonable price. The cost that one should spend not only for the medication, but also the transportation cost and other costs which are quite burdensome. Therefore, the community would prefer a health center to get the treatment, either out- patient or in- patient treatment (if any), because the treatment cost was relatively more affordable and the location was reachable. Does this become an opportunity for the health center to develop themselves? Or, does the health center keep to carry on their business as usual by ignoring such positive momentum?

### **B.3. The Structure Gaps**

A modernized health center was demanded to provide the needs for its users, either the internal users or the external ones. Considering the fact that the health center service was so complex due to its internal problems (human resource, facilities, funding, regulation, etc) and the external ones (economic crisis, natural disasters, etc).

The management of human resources in primary health care has been long recognized as a hard challenge. Staff available in a limited number and with limited capabilities has been loaded with various informal and formal tasks, leading to and task duplications and overloads.

It has been recognized that the intention of a junior doctor to become a primary health care doctor has been decreasing (Chan, 2002; Laven et al. 2003). In Indonesia, it was shown with less doctors working in health centers, especially those in remote areas (Meliala, 2004). The compulsory placement policy has been changed, this compulsion may be done in other places or even postponed.

The main reasons were concerning income and life style and there has also been the assumption that working in a health center will degrade the medical science level obtained from studying hard in the medical faculty. It is necessary to think of how to make a health center a convenient place for young doctors to work in, in order to develop their competency.

Medical doctors who work in primary care tend to be dual job holders, both in the public and the private sector with blurry borders. Therefore, working in the private sector which is more beneficial economically becomes the main job, whereas the health center became the side one.

Lots of medical equipment in the health center was useless regarding its function and quality. The Health center was considered as the public service for non- clinical treatment (Leeuw & Voermans, 1999). This resulted in unsatisfactorily service for the internal users (doctors, nurses, midwives) as well as the external ones (patient and their families).

The Information system in health center is also in very bad conditions. One has to imagine that in this digital era, all patient's records are documented in worn-out books, fully-added with additional notes.

Building and facilities in primary care are also sub-standard. Other service facilities, such as the support equipment for service rooms, management and administration rooms and other rooms need to be improved, both the appearance and its function.

Considering those facts, the community keeps some distance from the health center as well. Those who are rich are consulting private providers when they are ill. The others who do not have any choices go to the health center. This happens when there is no other health services nearby which are usually conducted by religious organizations or NGOs.

## **C. Developing Primary Health Care through Collaboration**

### **C.1. Comprehensive Care as the Answer**

The comprehensive care is developed with the basis of a desire to make a health center convenient for its users. This concept does not separate the service

to “public health” and individual health, medical and non- medical services, curative, rehabilitative, preventive and promotion as separate parts but as a continuity in service process (Leeuw & Voormans, 1999; Sibthorpe et al. 2005).

From the internal user perspective, the comprehensive care will be very beneficial, because it opens an opportunity to take care of a patient completely. Adequate facilities in the health center, especially the medical equipment, would support the clinical tasks of the doctor and other health staffs. It would affect the referral system as well, when primary care fails to fulfill its function as a gate keeper due to its sub-standard input and competence.

## **C.2. Momentum**

Now is the precise momentum to empower health centers through the comprehensive care concept. Decentralization in Indonesia, which has been running for 5 years, creates many chances for the district governments to develop local health systems, including the strengthening of primary health care (Meliala, 2004). In this new era, four health centers in Sleman district have acquired ISO 9001-2000 certificate. Several health centers in the capital, Jakarta, have also obtained such pride. This initiative was conducted by local health authorities within the decentralized system. Also in South Africa the new political era offers unique opportunities for more equitable health care policies to be formulated and implemented (Rispel et al. 1996). Referring to the theory of improving service quality of Donabedian, this momentum must be used to develop the structure, process and the output of primary health care services (Meliala, 2004).

## **C. 3. Solving Problems through Collaboration/Partnership**

Semanu Health Center in Gunungkidul may become the pilot of a comprehensive plan development. The health center has been developing clinical service for the community nearby, besides the promotion and preventive service as the standards of health center services, by using the support from other parties. Concept and strategy in this health center apply specific service standard and they do not separate blindly between individual and public services. It is realized that the costs for applying those concepts are high.

## **C.4. International Partnership to build Health Center**

The development of Semanu Health Center, Gunungkidul District, Jogjakarta received special attention during the International Academy of Science (IAS) Congress in Innsbruck, Tyrol, Austria on September 19-20, 2005. This opens new perspectives on the partnership concept for developing public health



institutions. Prof. Walter Kofler from the School of Public Health, Innsbruck, Austria, is the supervisor of this partnership program.

It was a coincidence that the congress which was attended by scientists from many countries such as Germany, Austria, Brazil, Azerbaijan, Italy, Cyprus, Russia and Indonesia was held in Innsbruck located within the Alps in the midst of Europe. The geographical condition of this city is similar to Gunungkidul. This world tourism resort has been visited by the Governor of Jogjakarta Province, Sri Sultan Hamengku Buwono X. Even his name is inscribed on a monumental plate in one hotel together with other kings who have visited this city.

The presented paper on “Developing Comprehensive Care in Semanu Primary Health Care, Gunungkidul, Jogjakarta, Indonesia”, became unique because it involved 2 provincial governments and 1 fellowship organization between international universities. It is very rare that 1 organization of health service equal to the level of health center is developed by 3 parties in which the beneficial is far from economy and politics. This opinion was accentuated by Prof. Y. T. Lee, the Nobel Prize winner for Chemistry in 1987, who became the distinguished figure in the congress attended by experts from various sciences.

The development of comprehensive care in Semanu Health Center was fully supported by collaborations among the governments of Jogjakarta Province and the Tyrol and ASEA Uninet. Each party performed different roles but having the same goal, i.e. improving public health service through the improvement of infrastructure and service system, the usage of technology and international standardized medical equipment and improving the capacity of the human resource.

The government of Jogjakarta Province, led by His Royal Highness Sri Sultan Hamengku Buwono X, which was in collaboration with the government of Gunungkidul District and supported by the provincial health office and Gunungkidul Health Office developed the physical building of Semanu Health Center, so that it is able to serve a large number of visitors with various cases. Today, the physical building of Semanu Health Center is able to carry out the comprehensive service.

The government of Tyrol, Austria, contributed medical equipment, patient beds, tricycle vehicles and a number of presentation tools. The medical equipment, especially the patient beds have been used by the patients in the health center. It is very likely that Semanu Health Center is the rare health center which has patient beds equipped with such modern facility. The government of Tyrol observed directly the service situation in Semanu Health Center, in which the Governor of Tyrol, Dr. Herwig van Staa, and the team directly visited the field. The result of the field visit in 2003 was then followed-up by providing aids in forms of medical equipment and other support equipment, such as ECG, Roentgen devices and surgical devices, and many others, with the hope that the people of Gunungkidul who visit Semanu Health center are served well and

comprehensively. Besides, the government of Tyrol also realized that many poor people visit the health center, so they equipped the health center with tricycle vehicles to support the service outside the center. Those vehicles, like other equipment, are free contributions from the Tyrolean government.

ASEA–Uninet, a fellowship organization among universities in Asia and Europe, contributed trainings and seminars for health staff in health center level. Starting in 1999, a seminar on new paradigm in public health service was held. Then, an international seminar on ethics and technology in health center service was held in 2002. Besides seminars, ASEA-Uninet also contributed software to Semanu Health Center which is beneficial in supporting the development of health center service. Tricycle vehicles given by the government of Tyrol were also recommended by ASEA-Uninet that has identified the existence of a community group which are not covered by the health center. The last scientific activity was a mini workshop in 2005 facilitated by ASEA Uninet to discuss the tracing and control of the malnutrition cases.

The collaboration between the government of Tyrol, Austria and Jogjakarta Province is maintained up to now. The collaboration covers various sectors, namely: tourism, education, transportation and health. At present, the focus of the collaboration is on health, with Semanu Health Center as the pilot project. The progress of the collaboration on health is indicated with the advances of the service facility in Semanu Health Center. This progress is also supported by the planning and development bureau of Jogjakarta Province who has provided aids and facilities so all programs run well.

Specific job division among the three parties, the ability to maintain the actions taken are in harmony with the original goal. This is the key success of such collaboration.

#### **D. Today's Services**

Services provided in SPHC can now meet the need of the community, referral system and financial system. Continuum of care, starting from health prevention up to curative care as well as rehabilitation is available in daily services.

The new building of primary care becomes a shield for the sophisticated equipment installed in it. The traditional style of primary care building has changed into a modern and ergonomic building. It affected to the safety of patient as well as workforce and to the installation of medical equipment. Curative care provided in hospital standard equipment and it covers elective as well as emergency services. Patient could be treated in a comfortable room even they use a social insurance. Medication and ethical standard has been kept by providing continuing medical education program regularly. Medical school is about to put Semanu primary care on the network.

Mobile service provided in weekly program dedicated to remote area which has no good infrastructure. The three-wheel vehicle supported this program and has made an expanded coverage through its flexibility. Vulnerable community in severe area could be accessible by this measure.

Since the equipment and building had met the requirement of health workforce, it also attracted the faculty of medicine to link it with the education program for the medical students who take credit in primary care subject. Students might learn about tropical medicine from prevention aspect to curative aspect as well as rehabilitation aspect. Semanu primary health care and its facilities has become the new standard of education program in the field since it provides equipments, cases and management, widely from prevention to curative care.

Information system in primary care linked the administration and epidemiological data between primary care and district health office. Reporting and recording process run faster and be more effective. In sentinel case, it would support the outbreak management.

District hospital as a higher referral level might run efficient and effective services by reducing primary service. Facilities and standard of care that has been developed in Semanu Primary Health Care creating a sub-hospital services which has taken up the primary service of hospital, which is unnecessary to done in hospital level. In terms of referral system, patient comes to hospital more likely as a referral of the primary care.

Social insurance might easily implemented since the reporting and recording process had been standardized. Community in Semanu who have a social insurance program is registered in primary-care's data base. It would ease the administration of insurance system (e.g. reimbursment) and would support the function of primary care as a gate keeper in the referral system. Admission to hospital could be done completely, medically and administratively, from primary care.

### **E. Conclusion**

Semanu Primary Health Care has been developed towards a comprehensive care provider for the surrounding community. It has been implementing a wide range of programs and activities to strengthen general practice services and primary health care.

Semanu Primary Health Care provides a possibility to other sectors, regionally and internationally, to collaborate. The school of medicine and the government of Indonesia as well as Austria have been doing a plethora initiative aimed at strengthening Semanu Primary Health Care. Various scale efforts from physical aspects to competence of human resource have been built as an expression of the initiatives.

On an international level, lessons from Semanu can be learned to enrich the strategy in the development of community-based primary care systems through international collaboration approaches. On a more local level, other primary care units may use this model in their development strategies. However, support from government and school of medicine is strongly needed.

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## **DIFFERENTIAL ROTATION OF LONG-LIVED FEATURES' OF SOLAR MAGNETIC FIELDS BY MEANS OF SOLAR SYNOPTIC CHARTS**

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**Abstract.** *Based on Solar Synoptic Charts the differential rotation of the large-scale magnetic features during 1965-1986 is investigated. Variations of the rotation rate of the large-scale formations both in the northern and southern solar hemispheres for various latitudinal intervals are revealed. The large rotation rate of magnetic formations is obtained for patterns having the sign of the global magnetic field. The change of rotation rate of magnetic features studied in all latitudinal intervals coincides with the sign reversal of the global magnetic field.*

### **Introduction**

The solar differential rotation in spite of its thorough study (Howard, 1976; Schroter, 1985; Stix, 1989; Howard et al., 1999) is not a conclusively investigated phenomenon.

Sunspots have been used as tracers for solar rotation since they were first recognized as features on the sun (Scheiner, 1630). Other features visible on the solar surface that has been used as tracers of solar motion fields and, in particular, rotation, are faculae (Newton, 1924) [3], hydrogen filaments (D'azambuja, D'Azambuja, 1948) and plages (Belvedere et al., 1990).

Another class of features that have been used to track the large-scale solar motion fields is neutral lines in filtergrams and spectroheliograms.

### **A study of the differential rotation of large-scale magnetic elements**

McIntosh and coworkers made Carrington maps of large-scale magnetic elements and the results were published in the form of the atlas of stack plots (McIntosh et al., 1991).

Large scale stackplots for the entire range of data for solar cycles No 20-21 (1965-1986) include a series of plots displaying 10°- zones of solar latitude, stepped from 60°N through the solar equator to 60°S. Five identical plots have been placed side-by-side, each stepped up by one row and displaced to the left. This improves the visibility of the features that drift beyond the edge within 360° of solar longitude.

Grids to measure rotation rates of drift patterns accompany the plots. These allow a quick determination of the synodic rate of rotation for patterns.

Segmentation of the charts into stackplots with narrow latitude zones is a valuable method of isolating the differential rotation of the Sun. This differential rotation causes long-lived features at same latitude to move relative to those at adjacent latitude, resulting in complicated interactions among large-scale patterns (McIntosh et al., 1991).

### **Observational data and method of treatment**

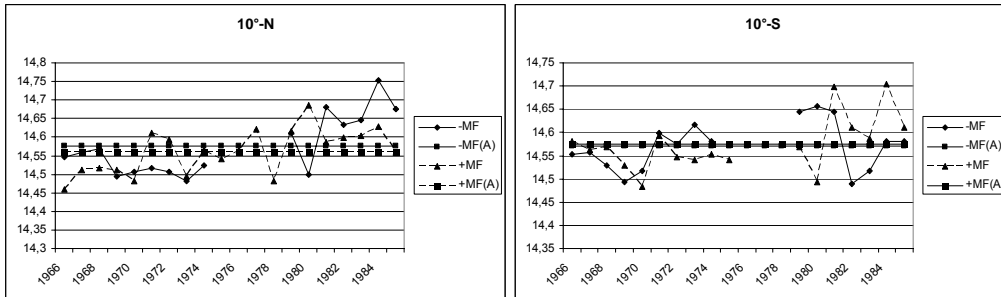
To study the differential rotation of large-scale magnetic elements for cycle of solar activity No 20 (1965-1986) we used the atlas of synoptic maps, but instead of using grids for determination of rotation velocity, we have developed the following method: we measured the corner between the symmetry axis of a chosen magnetic element and the horizontal line parallel to the horizontal edge chosen among five identical sites and calculated the rotation rate for a given magnetic element with the help of the formula (Japaridze et al., 2006):

$$\Omega(\varphi) = 1000/(36.664 - \text{ctg}\alpha),$$

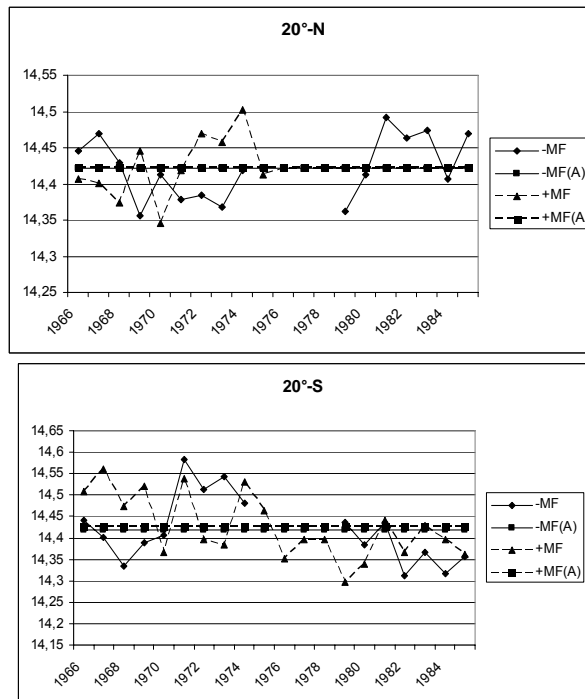
where  $\alpha$  is the corner measured and  $\Omega$  is the rotation rate.

A choice of magnetic elements for measuring the differential rotation is performed by the following method: we have chosen symmetric structural formations from many magnetic data in order to have the best possibility to measure rotation rates by identifying the structural elements chosen by us with the synoptic maps we found that the structures chosen really correspond to the regions with the same sign of polarity. The characteristic details of the structural elements chosen were also noticed. In most cases they were separated from the surrounding field with the opposite polarity by quiescent H $\alpha$  filaments having sometimes the same sign of polarity as the magnetic elements and sometimes - the opposite sign (*Solar Geophysical Data*, 1966-1975).

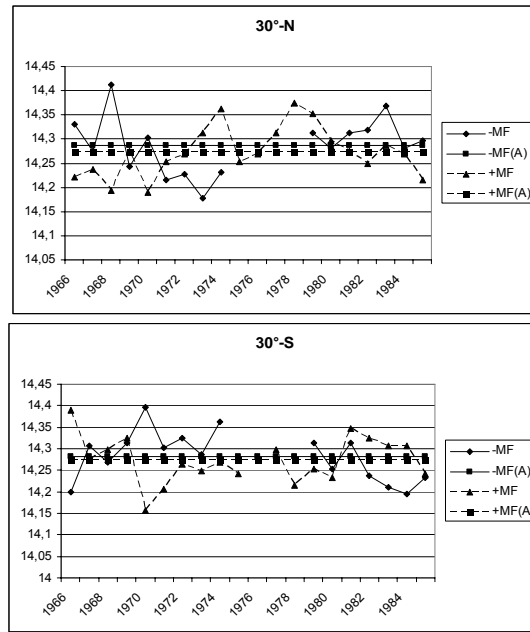
For each chosen magnetic element five measurements have been made and as average velocity have been calculated. 1675 (990 for the cycle No 20 and 685 for the cycle No 21) measurements have been carried out for 335 (198 for the cycle No 20 and 137 for the cycle No 21) large-scale magnetic elements. The diagrams for every 10° zone were constructed separately for the northern and southern hemispheres for magnetic elements with the positive polarity and negative polarity (Fig. 1,6).



**Fig. 1. Rotation rate of magnetic elements with the positive and negative polarity for the northern and southern hemisphere for 10°-zones.**

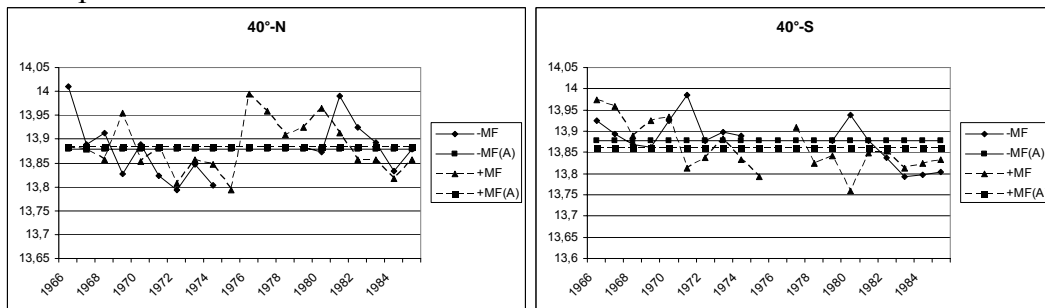


**Fig. 2. Rotation rate of magnetic elements with the positive and negative polarity for the northern and southern hemisphere for 20°-zones.**



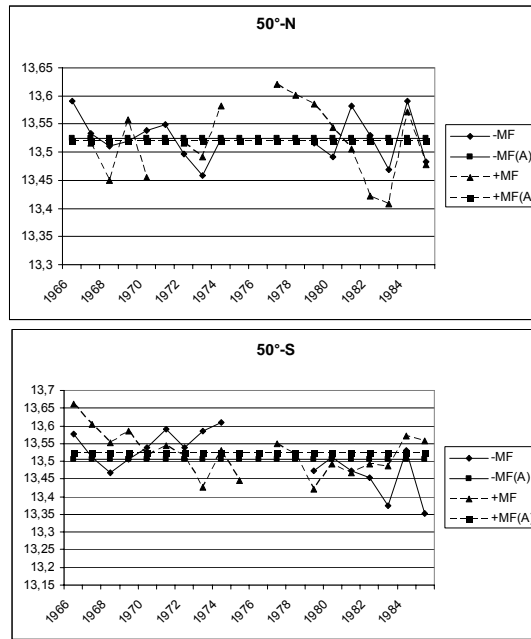
**Fig. 3. Rotation rate of magnetic elements with the positive and negative polarity for the northern and southern hemisphere for 30°-zones.**

As seen from these figures, magnetic elements, which have the same sign of the general magnetic field of the sun, have a larger speed of rotation than those with an opposite sign. In all 10°- zones the average rotation rate of magnetic elements with the negative sign of polarity is little higher than that of magnetic elements with the positive sign of polarity, except for 50°S -zone of south hemisphere.

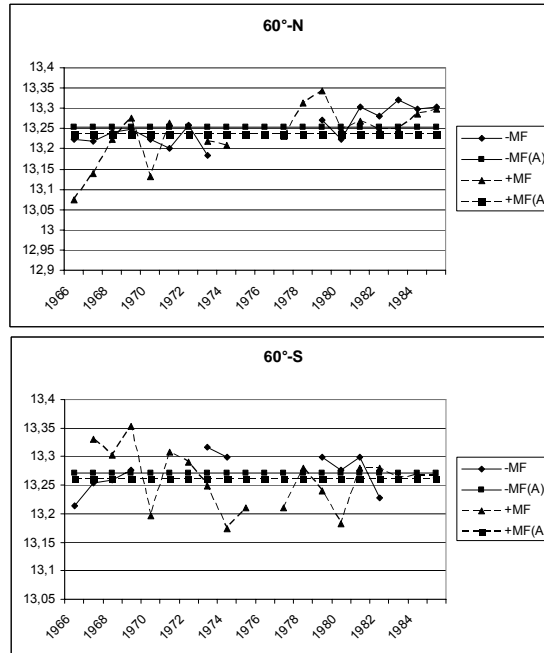


**Fig. 4. Rotation rate of magnetic elements with the positive and negative polarity for the northern and southern hemisphere for 40°-zones.**





**Fig. 5. Rotation rate of magnetic elements with the positive and negative polarity for the northern and southern hemisphere for 50°-zones.**



**Fig. 6. Rotation rate of magnetic elements with the positive and negative polarity for the northern and southern hemisphere for 60°-zones.**

For cycles No 20-21 the rotation rate varies at reversal time of the general magnetic field of the sun. As three-multiple reversal has taken place in solar cycle No 20 in the northern hemisphere, in 1969-1970, for each 10°- zone of the northern hemisphere variations of the rotation rate for magnetic elements both with the positive and negative polarity can be noticed.

For the cycles No 20-21 all large-scale magnetic elements with positive sign for both hemispheres have the same character for all 10°- zones. Large-scale magnetic elements with negative sign have the same character except for 20° and 30° -zones. For these zones rotation rate curves of the large-scale magnetic elements with positive sign are directed each other for both north and south hemispheres.

### Discussion

Due to the comparison of solar differential rotation data obtained by different authors there is market disagreement.

Observational studies of the large-scale motion fields on the Sun and tracer measurements are discussed by Snodgrass.

By Beckers and Canfield (1976) was given a review of the large-scale motion. Measurements of the solar mean magnetic field showed the presence of three groups of stable peaks connected with rotation of two-, four- and six-sector structures of the solar magnetic field (periods are about 26.<sup>d</sup>9, 13.<sup>d</sup>6 and 9.<sup>d</sup>0).

The data also show a temporal change of the mean period of rotation of the solar mean magnetic field within the range of 26.<sup>d</sup>6 - 27.<sup>d</sup>4, which clearly indicates a motion of the magnetic pattern to the solar equator during the 11-year cycle of solar activity. The solar mean magnetic field measurements also reveal the presence of a 22-year wave, which coincides in phase with changes in the predominant polarity of the interplanetary magnetic field. This 22-year periodicity can rather be explained by so-called north-south asymmetry of the magnetic field of the Sun (Haneychuk, 2000; Gigolashvili et al., 2003a, b;)

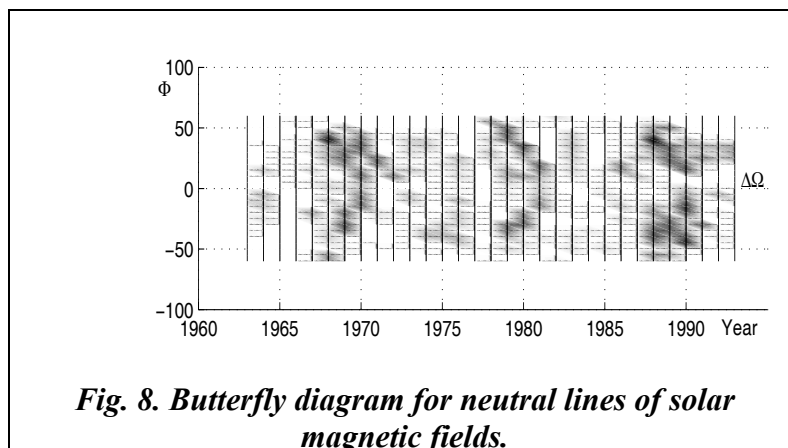
An auto-correlation analysis was performed using digitized synoptic charts of the photosphere magnetic fields for the past three solar activity cycles (1965–1994). It is shown that the large-scale system of the solar magnetic fields is rather complex and comprises at least three different systems. The first one is a global rigidly rotating system. It determines the cyclic variation of magnetic fields and is probably responsible for the behavior of magnetic fields in the polar zones. The second one is a rigidly rotating 4-sector structure in the central (equatorial and mid-latitude) zone. The third one is a differentially rotating system that determines the behavior of the Large-Scale Solar Magnetic Field structure elements with a size of ~30–60° and less. This one is the most noticeable in the central zone and absent in the polar zones (Ivanov et al., 2001).

Comparison of polar plots of the solar magnetic fields with the available H $\alpha$  filtergrams shows that the polarity boundaries are consistent in these two data sets where they overlap. The polar field reversal involves a complex sequence of

events. Although the details differ slightly, the basic patterns are similar in each hemisphere. First the old polarity becomes isolated at the pole, shortly thereafter the isolation is broken, and the polar field includes unipolar regions of both polarities. Then the old polarity moves to the polar region, but when the isolation of this field is established for the second time, it declines in both area and strength (Snodgrass, 1992).

The rotation characteristics of large-scale (global) magnetic fields and their relation to the activity of the local fields are studied over a long time interval (1915–1996). The large-scale magnetic fields rotation rates and local magnetic fields activity vary in ant correlation. Both variations have similar periods (11 years and a quasi-secular period of about 55–60 years), but are shifted relative to each other by half an 11-year cycle. The large-scale magnetic fields rotation rate increases at the minimum of the 11-year cycle of local magnetic fields activity. The large-scale magnetic fields rotation rate is faster in a less active hemisphere. The large-scale magnetic fields rotation period slows down at the maximum of the secular local magnetic fields (Obridko and Shelting, 2001).

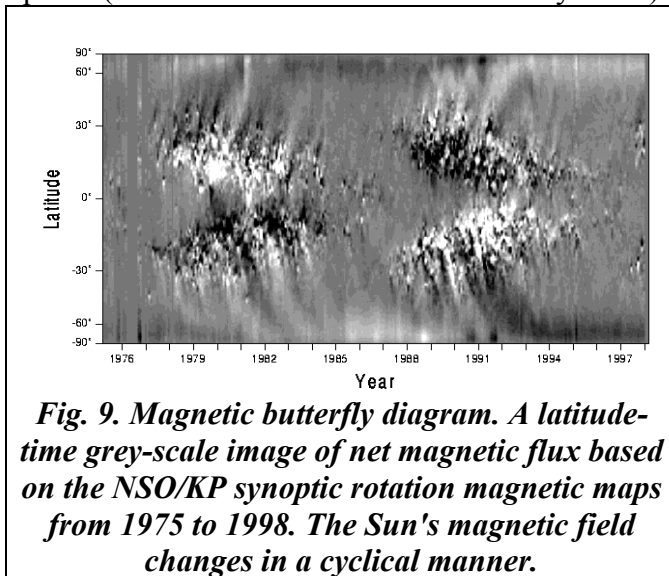
The Sun's magnetic field changes in a cyclical manner. The cycle of the large-scale magnetic field begins during the polar field reversal. At the beginning of the large-scale magnetic field cycle, a narrow bridge connects the polar and mid-latitude magnetic field systems, but later they evolve independently. The polar field has completely open configuration latitude above  $60^\circ$  and fills the whole area of the polar caps near the cycle minimum of the local fields. At this time, essentially all open solar flux comes from the polar caps. The mid-latitude open field regions occur at latitudes of  $30\text{--}40^\circ$  away from the solar minimum and drift slowly toward the equator to form a typical 'butterfly diagram' at the periphery of the local field zone. The regions with open magnetic fields have more rigid rotation than the sunspots. The rotation characteristics are shown to depend on the phase of the solar cycle (Obridko and Shelting, 1999).



Taking into view of these results we investigate the temporal variations of solar differential rotation using observations of neutral lines of solar magnetic fields (quiescent filaments) and received distribution of rotation residual as a 'butterfly diagrams' (Fig. 8) (Gigolashvili et al., 2005). We received the reversal of the polar magnetic fields near cycle maximum as it is seen on the magnetic 'butterfly diagram' (Fig. 9). We also received that the curve of differential rotation for large-scale magnetic elements with negative and positive signs have the same character as the magnetic 'butterfly diagram'.

### Conclusions

For cycles 21-22 magnetic elements, which have a sign of the general magnetic field of the sun, have a larger speed of rotation than the elements with an opposite sign. In all  $10^\circ$ - zones the average rotation rate of magnetic elements with the negative sign of polarity is little higher than that of magnetic elements with the positive sign of polarity, except for  $20^\circ$ - zones of both hemispheres and  $10^\circ$ - zones of the north hemisphere (in these zones the difference is very small).



The rotation rate varies at reversal time of the general magnetic field of the sun. As three-multiple reversals has taken place in solar cycle No 20 in the northern hemisphere in 1969-1970. For each  $10^\circ$ - zone of the northern hemisphere variations of speed of rotation can be noticed for magnetic elements both with positive and negative polarity.

The rates of differential rotation for large-scale magnetic elements with negative and positive signs are similar.

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## **TO THE QUESTION OF ECOLOGY OF INFLUENZA VIRUSES IN AZERBAIJAN**

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The origin of A influenza viral strains having an epidemic potential is the most complicated and detable issue. And necessitates the regular epidemiological control for infection with the aim of revealing and studying the influenza viral strains circulating in human population and also detection a certain regularity of their circulation in biosphere as according to one of the theories, pandemic strains arise as a result of recombinations of human and animal influenza viruses. Hence, the existing conception about the possible participation of animal viral gene pool in formation of pandemic influenza viral strains (V.M.Zhdanov et al., 1978; D.K.Lvov, 1979, 1982) /8/. It is advisable to complex-ecological and epidemiological study of specificity of influenza infection with the aim of obtaining the real data about the existence of genetic circulation of influenza virus in nature, especially in zones with climate-geographical conditions very similar to the conditions of South-Eastern Asia with assumed focci of pandemic strain rise. This suggests that the conduction of ecological researches in subtropical zone of the Azerbaijan Republic with a series of the most ecological features may be an important one.

Considering an approved possibility of influenza A viral epidemic strain reservation in various avian and mammalian populations in the composition of virus-recombinant (Webster, 1972; Schild, 1978; Schortridge, Webster, 1979; Schortridge, 1980) /2, 7/, there is a direct evidence to slove this fundamental problem as revealing the causes of deep antigen changes depends upon the elucidating the correlation of epidemic and epizootic, detection of particulars of viral circulation in the zones of wild bird's collection.

In this connection, a complex control for influenza viral circulation among peoples and environmental biosphere, namely among birds-domestic, wild, migratory was first performed in subtropical zone of the Azerbaijan Republic. The ecological researches were carried out in Kyzyl-Agach reserve (subtropical zone) in netting colony of *Larus argentatus* on Glinyany island of Baki archipelago, in some poultry farms and live-stock farms of Baki and its suburbs combined with epidemiological control among the peoples of Baki. The above researches were carried out using generally accepted viral methods of study /5/. The fact of wide circulation of human and animal influenza A virus among wild birds and animals of Kyzyl-Agach reserve and Glinyany island of Baki archipelago was outlined as a result of viral researches. Influenza viruses are isolated from new 5 avian-species (*Nycticorax nycticorax*, *Fulcia atra*, *Phalacrocorax pygmeus*, *Circus aeruginosus*, *Aythya ferina*) A/H10N8/-/Hav2, Neg2/.

Under subtropical conditions the influenza A virus A/H1028/ is isolated from the soil of alinovski estuary of Kyzyl-Agach reserve. The A strain/migratory *Larus argentatus* /Baku/843/79 being an antigenic analogue of influenza A virus /Brazil/1/78/H1N1/. The presence of antibodies to human influenza virus in avian serum and in human serum to avian influenza virus has been revealed.

Thus, in the light of above our views of influenza virus circulation have been widened and natural correlation of human mammalian and avian virus population has been proved. As a result of regular epidemic control for influenza infection in human population, it was observed that the particulars of epidemic process of A influenza in Azerbaijan along with A influenza viral strains typical for human population, the origin viral transfer from birds or other animals with single species-specific barrier overcoming have been traced. An example is A influenza viral isolation A/Baku/900/79/H10 N7/ fig. 1 identical to A/chicken/Germany/№49/H10№7/-Hav2Neq1/from a 3-year child from Sabunchi in Caspian seaside with acute respiratory disease (ARD) /3/ and isolation first in the science of natural recombinant strain of A influenza virus A/Baku/799/82/H1N3/from a 6-year patient with ARD in Caspian zone at Govsany settlement /1, 4/.

Few studies report the cases of avian influenza viral isolation with hemagglutinin Hav2 from humans (Cambell et al., 1970) as well as Hav1 (De Lay et al., 1967) that indicates the influenza virus with hemagglutinin Hav1-Hav2 can also be encountered in diseased peoples. Speaking about the isolated recombinant of A influenza virus. A/H1N3/H0N2av2/, it should be noted that as Hi in detailed analysis found to be different from drift-variant of epidemic strain of current period and closely affined to A/PR/8/34(HO) which is far ago isolated from the circulation, we may suppose that this recombinant is not formed in human population. For example: formed animal and avian recombinant have been transferred to the humans.

The mechanism and place of this recombinant formation, however, is not clear. But a fact is of increasing importance that sporadic transfers have been recorded in peoples in our zone besides influenza viral epidemic strains not realized in epidemic of original viruses typical for birds or recombinants consisting of N3 and H1. Simultaneous circulation of influenza viral epidemic strains in nature and animal influenza as well as relict forms of A influenza give us the grounds to suppose the possibility of recombinant processes in the organism of wild or domestic animals, and perhaps humans as well.

Virus H1N3 isolated from a sick child having antigenic analogous virus A/Kit/TO/19/76, previously isolated from a whale and strain PR/8/34 with identical hemagglutinin (HO) [6].

By conduction of wide ecological researches, we increased our views of influenza A viral circulation between humans, birds and animals. The isolation of A influenza virus from a child A/chicken/Germany/№7/49/H10N7/-/Hav2 Ned1/ from the animal added to solitary facts concerning the problem of possibility of species-specificity barrier overcoming and direct viral transfer from animals to humans. The isolation of natural recombinant strain A/Baku/799/82/H1N3/ from a 6-year child in Govsany settlement of Azerbaijan Republic justified the theoretical and experimental data about the possibility of such recombinant formation in the process of simultaneous circulation of influenza virus of various origin in nature.

The investigation results indicate to target complex control for influenza infection including the observation for circulating virus among humans, animals and birds both wild and domestic. The isolation in Azerbaijan zone of atypical influenza viral strains from diseased individuals, that is influenza virus of animal origin A/H10N7/-/Hav2 Neq1/ and recombinant strain A/H1N3/-/H0Nav2/ confirms a hypothesis that in warm subtropical zones with efficiently close contact of people, animals, domestic birds and migratory birds near water complexes, there may occur a transfer of influenza virus to animal population and from animals to humans with species barrier overcoming, that may serve as one of the factors causing natural influenza viral variables.

Taking into account the registration of human flu virus, caused by bird flu virus A /H5N1/ in some neighbour countries, complex prophylactic and anti-epidemic measures had been implemented by the Ministry of Health of Azerbaijan.

In accordance with the resolution of the President of Azerbaijan Republic from February 16, 2006, the State Commission on the prevention of bird flu virus in the territory of the Azerbaijan Republic and coordination of all types of activities in this direction had been performed. In the first meeting of the state Commission a "Plan of Extreme Measures on the prophylaxis of bird flu in the territory of Azerbaijan Republic had been confirmed. In all towns and regions of the Republic there had been formed the staffs aimed to the prevention of bird flu to the activity of which relevant officials were involved.



In the process of monitorings the presence of flu virus A /H5N1/ had been revealed in specimens picked from migratory birds in Caspian coast. (According to the data of Veterinary Service of the Republic).

The virological diagnosis using the PCR-method was carried out in London.

In February 9, 2006 just receiving this information the media had been notified about that.

The Ministry of Health and the Ministry of Agriculture of Azerbaijan addressed the people of the Republic.

The Ministry of Health provided two specialized medical institutions (the department of pulmonology in the Research Institute of Lung Diseases and the Municipal Hospital # 3 of Baki) for hospitalization of patients with suspected bird flu.

The epizooty among birds in Salyan district has started in January 2006. The patient A.Kh., 1989 year of birth is the first patient with suspected influenzal infection, a resident of Sarvan village of Salyan district, 20.02.06 was hospitalized in Baki. Unfortunately, despite the emergency therapy 23.02.06 she died with symptoms of acute pulmonary insufficiency.

Thereafter 10 patients were transferred from Sarvan and Daikend villages of Salyan district into the Research Institute of Lung Diseases. Regardless of therapy, four of them died. Seven patients were recovered and discharged from the hospital.

Though the patients were in close relationship and communicated with each other, the cases of person-to-person transmission had not been revealed (fig. 1).



**Case 1. The patient A.Kh., case report # 2190 (Sarvan village of Salyan district).**

Before admittance at the Clinical Medical Center she was ill within a week: at admittance (20.02.06) her temperature was 37.4 degrees, she complained of headaches, abdominal pains, general weakness.

The onset of a disease was characterized by a high temperature – 39 degrees, foot pain, acute abdominal pain, diarrhea, vomiting, retention of urine.

The roentgenogram revealed a “homogenous shadowing” in the right lung. The clinico-roentgenologic diagnosis is: “Right-sided exudative pleuritis, tumour (blastoma) of right pulmonary lobe?”. Hemorrhagic exudate was revealed in pleural cavity as well.

23.02.06 at 12<sup>50</sup> a.m. a patient is in agony, 23.02.06 at 18<sup>00</sup> p.m. she died.

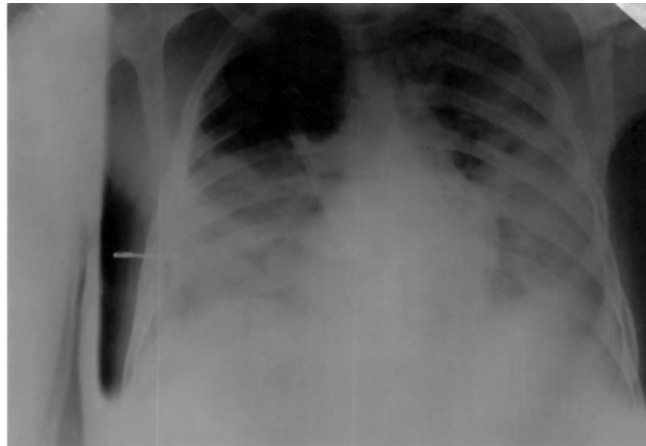
The epidemiologic analysis: According to the questionnaire of the members of family the patient was in direct contact with poultry in her private house where the epizooty had been revealed.

The virological investigation: The PCR showed the presence of flu virus A /H5N1/ in blood specimen.

The pathologic diagnosis.

The main disease was acute tracheobronchitis and bilateral hemorrhagic pneumonia, right-sided hemorrhagic pleuritis.

Complications: Hemorrhagic pulmonary edema, intoxication of the organism, dystrophic changes in heart, liver, kidneys, erosive-desquamative enteritis and acute respiratory insufficiency.



**Case 2. The patient A.Sh. Case report # 397  
(Daikend village of Salyan district).**

The patient A.Sh. is a 16-years old, 04.03.06 was admitted at the Research Institute of Lung Diseases with the diagnosis of acute respiratory disease and signs of diarrhea, temperature – 38.2-39.2 degrees, which lasted within 7 days (before admittance).

**The roentgenogram** revealed a pleural thickening in the right side with intensified vascular picture in both sides.

**USI shpwed** splenomegaly, consolidation of liver, renal parenchyma; hemorrhagic bleeding-syndrome.

**The result of blood count** showed the following dynamics: thrombocytic reduction, then its increase and sharp reduction. Thrombocytopenia, lymphocytopenia and leukocytopenia had been traced as well.

The clinical course was characterized by rapid progressive process of a disease within 7 days and continuous high temperature, diarrhea and catarrhal signs in throat.

The results of lung auscultation within the first days were not informative – a slightly harsh breathing had been observed.

The X-ray from 04.03.06 revealed no pathology in lungs. The repeated roentgenological investigation of right lung from 06.03.06 showed some focal-inflammatory shadows. The X-ray from 07.03.06 revealed progressive changes like gross-focal dissemination. 08.03.06 the plain film of lungs showed the arising of shadows in the left and right sides, sharp worsening of the picture manifested by subtotal massive inflammatory changes (fig. 2).

The increasing dyspnea, cyanosis, wet cough have been seen in the development of bilateral pneumonia and also moist bilateral rale of various caliber in lung auscultation.

09.03.06 and 10.03.06 total bilateral inflammatory changes and bilateral effusion in pleural cavities had been revealed.

**The result of virusologic investigation in PCR** revealed the presence of flu virus A /H5N1/ in throat.

**Epidemiologic history:**

The contact with sick poultry (chickens) and dead wild birds (swans).

The lethal outcome: 10.03.06.

**Conclusion:** Bilateral pneumonia, stage III pulmonary insufficiency.

The analogous picture had been also observed in two other lethal cases with patients (G.G. and A.N.) (see the relationship degree in fig. 1).

The rest 7 patients of the same relationship were hospitalized with the signs of acute respiratory diseases and some intensification of vascular picture in lungs with symptoms of perebronchitis, general weakness, high temperature. They were discharged after the recovery.

Virologically in 3 out of 7 above said cases, flu virus A /H5N1/ had been determined in throat swab specimen using the PCR-method.

**The epidemiologic analysis:** contact with sick poultry (chickens) and wild dead birds (swans) during their infected pinna cleansing.

**Case 3.** The patient M. Kh. Case report # 1559 (Begim Sarov village of Ter-Ter district).

The patient M.Kh. was ill from 01.03.06, contacted with tuberculous patients, had a high temperature, general weakness, retention of urinary.

07.03.06 she was admitted at Tuberculous Dispensary # 1 of Baki in severe state. BP – 80/60 mm Hg, acute respiratory insufficiency, general weakness, acute renal insufficiency. The X-ray revealed infiltrative pulmonary tuberculosis, non-specific pneumonia.

Specific therapy was not efficient. The patient was transferred into the Clinical Medical Centre (CMC) in intensive therapy department and was maintained by artificial ventilation of lungs. The result of virological investigation, using the PCR-method showed flu virus A /H5N1/ in two blood specimens.

The lethal outcome was 10.03.06 at 13<sup>50</sup> a.m.

**The epidemiologic history:**

Contact with sick poultry (chickens).

**The result of pathologic investigation:**

**The diagnosis:** Acute hemorrhagic tracheobronchitis and bilateral hemorrhagic pneumonia.

**Complications:** Hemorrhagic edema of both lungs, intoxication of the organism, the dystrophic changes in heart, renal parenchyma, erosive-desquamative enteritis, acute respiratory insufficiency.

**Side effects were:** parenchymatous-albuminous hepatitis.

**The cause of lethality** was acute respiratory insufficiency.

Summarizing the data of clinical and pathomorphological investigations, based on the materials of patients with flu A /H5N1/, it should be outlined the main features characterizing a specific character of human influenzal infection, which is etiologically associated with flu virus A/chick/Scotland/59 /H5N1-/Hav5N1/.

Rapidly progressing course of a disease within 7 days with a high temperature, diarrhea, retention of urine, general weakness, catarrhal signs in throat can be referred to them, and thereafter within the last 4 days before death subtotal massive inflammatory changes in lungs like bilateral pneumonia with lethal outcome with acute respiratory insufficiency.

The pathologic picture is as follows: bilateral hemorrhagic pneumonia with hemorrhagic pleuritis and complications such as hemorrhagic edema of lungs, dystrophic changes in heart, liver, kidneys, erosive-desquamative enteritis.

The material presented by us, gives us the basis to state that virus infection of humans and animals is a process determined by the whole complex of ecological factors.

The cases of bird flu virus A /H5N1/ contaminating the humans in the territory of Azerbaijan were the example of transmission of animals' virus into people's population and single prevention of species-specific barrier. They occurred in epidemiologic situation favourable for this circumstance, that is close contacts with contaminated poultry.

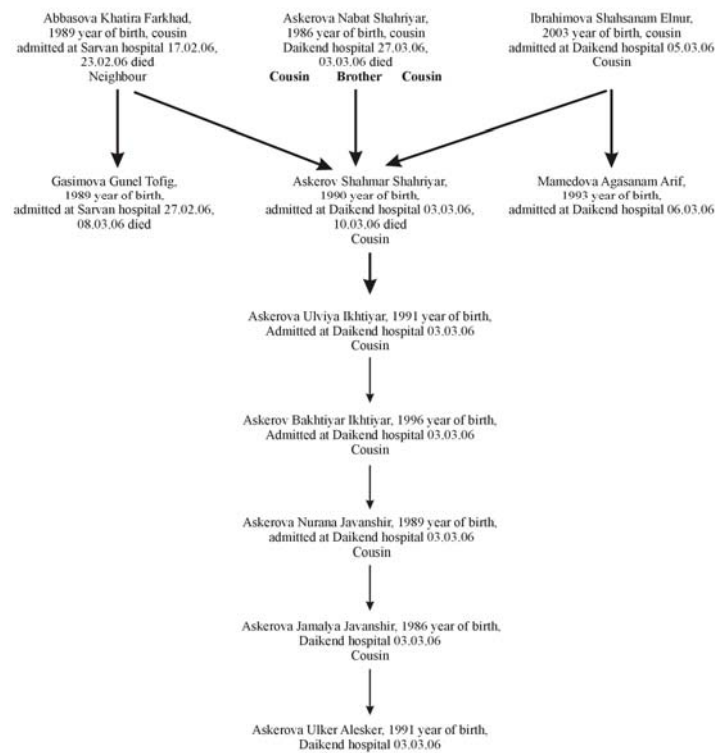
The existence of migration ways of wild birds (swans, gulls, ducks, Fulica Atra) through Salyan and Ter-Ter districts created favourable conditions for contamination of poultry of residents' private houses with their following close contact in the process of care and cleansing of sick poultry. The data obtained aimed to the prevention of species-specific barrier of bird flu virus A (H5N1)-A/chick/Scot/59/Hav5N1/ open the perspectives for the interpreting the mechanisms of virus adaptation to reproductive varying conditions in the organism of different hosts and reservation in surroundings.

Well known peculiars of virus biology including the opportunities to transmission of one ecological type of virus interaction with the host into another type (including the reverse integration of virus genome and cell genome) as well as different variations of biocenotic links of these agents in the nature – all this indicate to virus extremely large adaptable potency and rich reserves of their evolution.

And on account of that the prevention of virus infections more and more oversteps the limits of isolated and even systemic anti-epidemic measures growing into a serious problem of generally biological character.

**Acknowledgements:** We wish to extend our thanks to NAMRU-3 staff for their assistance in the diagnosis of human flu using the PCR-method.

Figure 1.  
The relationship degree of Salyan district residents sick with flu and contacting with infected bird.



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## **PSYCHO-EMOTIONAL FIELD OF DIFFERENT POWER ON THE MAGNETIC STORM DAYS**

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As is well known, sharp changes of Earth geomagnetic environment in consequence of solar activity rising mark risk factor of neuropsychic and cardiovascular disorders not only at patients but also at practically healthy people /3,5/. In the opinions of several authors /2,4,6,7/ biological activities of geomagnetic fields can be due to their informational interactions with body control systems, receiving information from the environment and accordingly regulating vital activity processing.

Earth geomagnetic field disturbances first of all tell upon the body central regulating system which should be related to, first, responsible for the current body activity organization and adaptation to the environment changes, high cortical regulation mechanisms and subcortical integrative devices. Under the influence of geomagnetic disturbances arises dynamic tension of body regulating systems /1/, is reduced tolerance to intellectual and physical stresses. At the same time last years at increasing interest of scientists to the actual problems helio-medicine most its questions either are not adequately and inconsistently explored or generally remain untouched yet. At that it is enough in general features described influence of magnetic storms on physiological systems and is not considered degree of geomagnetic disturbance at most works.

Taking into account above-stated, at the present work is set a problem to analyze magnetic storms influence of different disturbance level on emotional – affective field and personal characteristics, mature age healthy people, femininity.

### **METHOD**

For the inspection have been examined practically healthy probationer women at the age from 20 to 40 years on the days with weak disturbed and strong disturbed geomagnetic situation. All women were examined at menopause period. Cosmic weather forecast and geomagnetic condition of Earth were being

determined by the collaborators of Shamakhi Astrophysical Observatory of Azerbaijan republic NAS (National Academy of Science). With index AA (Antenna Array) equal to 10-15 units considered as a weak magnetic storms, strong – more 30 units.

For the emotional-affective field condition determination was used Lusher's non-verbal color test (Lusher, 1970). The Anxiety level also was being determined by personal scale of anxiety demonstration, suggested by J.Taylor and adapted by T.A.Nemchinov. The reactive and personal anxiety levels were being determined on self-appraisal Scale, <http://www/stars.ru/>, elaborated by Ch.D.Spilberg and adapted by Y.L.Khaninim. Depression level was being determined on depression Scale, elaborated in SRI (Scientific Research Institute) of psychoneurology called after Behtereva.

The received figure data on psychological tests were being mathematically processed and was being counted authenticity on Student Fisher's critery  $P > 0/05$ . Differences were considered authentic at  $P < 0.05$ .

### **RESEARCHES RESAULTS AND THEIR DISCUSSION**

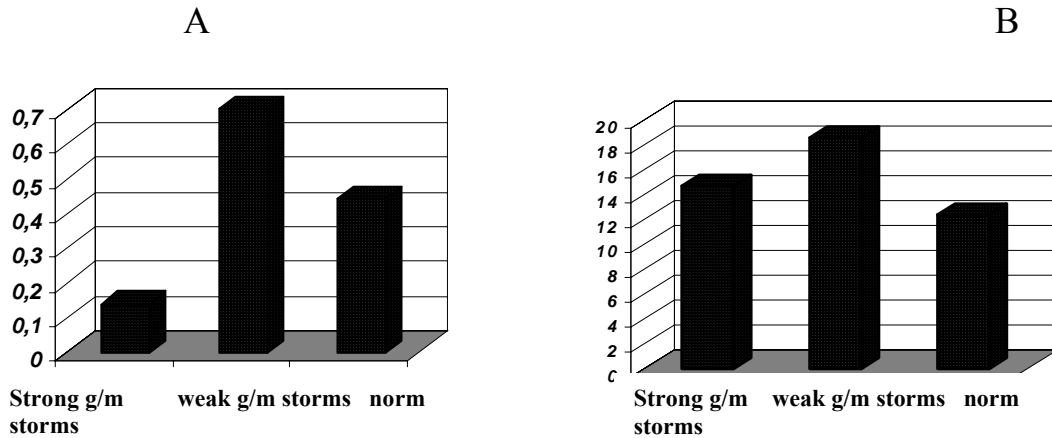
As a consequence of presentation to tested Lusher's non-verbal color test was established that most informative characteristics, related to geomagnetic storminess degree, are coefficient of vegetative balance, efficiency and stressor. The characteristics, reflected personal particular qualities on the magnetic storms days of different power, essentially did not differ from calm days. At the same time it should be noted that on the days with weak magnetic storms predominated sympathetic direction of vegetative reactions ( $2,2 \pm 1,3$ ) (pic 1.A) and increased efficiency ( $18,0 \pm 1,7$ ) (pic 1.B) and also the most high level of stressor ( $24,4 \pm 3,5$ ). Reflected reactive anxiety indicators were higher on the same days. ( $37,8 \pm 1,7$ ) (pic 2).

On the strong magnetic storms days predominated parasympathetic direction of vegetative reactions ( $-1,8 \pm 0,9$ ) (pic 1.A). Regarding ability to work, then on the days with strong magnetic storms in comparison with weak its indices were severely lower ( $13,3 \pm 1,0$ ), (pic 1/B). The level of stressor as distinct from the days with weak disturbed geomagnetic situation was noticeably lower ( $6,2 \pm 4,5$ ). Slightly low indices were observed at reactive anxiety data ( $33,8 \pm 2,1$ ), (pic2). At the same time characteristics of personal anxiety at geomagnetic situation disturbance in comparison with quiet days changed slightly and did not correlate with its degree (pic.2). Ascertained at some tested easy raising on depression scale was not found out connection with magnetic storms and their degree.

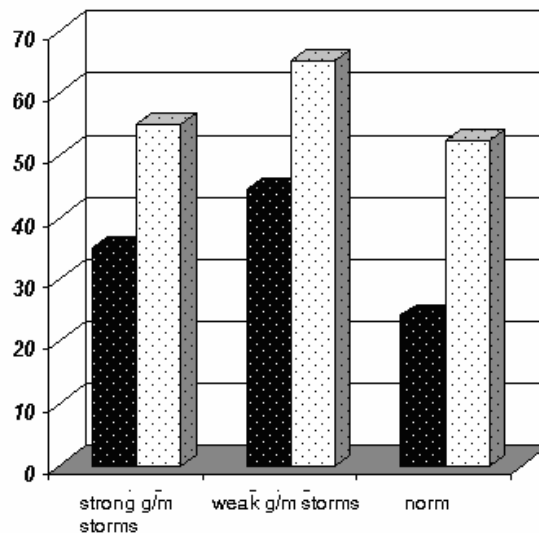
At the researches of some authors is shown on close connection efficiency with solar activity and weather conditions. There are information about high



sensitivity of vegetative nervous system to geomagnetic influences (5,9 and others). It is at received by us data, indicating on predomination at tested sympathetic tone of vegetative system, raised capacity for work and raised reactive anxiety. /5/.



**Pic.1 Indicators of vegetative balance (A) and capacity for work (B), on the days of different power geomagnetic disturbance.**



**Pic.2. Indicators of self-appraisal scale on the days of different power geomagnetic disturbance. Black columns – indicators of personal anxiety. White columns – indicators of reactive anxiety.**

At the same time extremely interesting thing is, that these interconnections are stable on the days with geomagnetic situation and changes by measure of magnetic storm strengthening. It is known that the point of geomagnetic fields are the body regulating system, main of them are related to integrative devices of the brain. Apparently magnetic storms first of all influence on nonspecific systems of brain, structures of limbic-reticular complex, which is responsible for the “reset” of high psychological functions, emotional reactions and vegetative regulation on realization of current body activity. Received ambiguity of research results on the days with different geomagnetic disturbance level apparently has connection with it, that at weak magnetic storms as justly note R.M. Baevsky and others. A.G. (2002), it is observed predomination of non-specific domination component is characterized with usually observed at stress-reactions of sympathetic direction of reaction stirring up. On the days with strong magnetic storms predominates parasympathetic link of vegetative regulation, i.e. for the first plan step forth observed at much work influence specific effects, devoted for the magnetic storm research. /8,6/.

Consequently received data testify to changes under influence of increased vegetative balance solar activity, the level of ability to work and reactive anxiety caused by magnetic storm influence on non-specific systems and vegetative centers, which are situated at the structures of brain limbic-textiform complex. At that weak magnetic storms make stimulation impact, at that time as strong disturbance of geomagnetic situation activate brake processes.

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## COMMON FEATURES IN RHEUMATIC ARTHRITIS ACCORDING TO THE ACTIVITY DEGREE AND STAGE OF THE IMMUNOLOGIC INDICATOR

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### Conclusion

In the article were investigated according to the level of activity and the stage of disease the comparative characteristics of various biologic indicators of immune complexes circulating (ICC) in rheumatoid arthritis (RA), of rheumatoid factor (RF), of main classes of immunoglobulin, of antinuclear factors (AF).

**Key words:** Rheumatoid Arthritis, circulating immune complexes, antinuclear antibodies, and rheumatoid factor.

Rheumatic Arthritis being a diffuse disease of connective tissue, etymology is not being clear, being characterized in autoimmune indicators is a chronic pathologic process with erosive synovitis occurs with internal and extraarticular injury. Autoimmune process progressing in connective tissue in RA patients reflects in serous tunic, synovial fluid, and peripheral blood, lymph, and bronchus fluid. The urgency of the problem was noticed in performances of the leading scientists in the International Decade - The Bone and Joint Decade 2000-2010 of Universal Organization of Health, spend in Geneva in 2000 as a grave matter of humanity. It was noticed that only in USA there are 39 mln. address to the doctor every year with the diagnosis of arthritis and more than 500.000 of them are hospitalizes. Expenses for medical care are 15 billion dollar, while common economic loses are 65 billion. In prognostic and statistic accounts in 2020 this number will 60 mln. and 11 mln. of these patients will be disabled which means the 20 % of the population.

The urgency of the problem is the characterizing of RA on one hand with irreparable injury of functions of the joint and early patient on another hand with deep injuring of essential organs and systems also heart-blood-vessel system,

kidney, serous tunic, lungs. As mentioned, because of being system disease, RA could not be adequate for immunologic indicators investigated in one part of the organism in enough characterizing of the pathologic process. Taking into consideration all this, depending on clinic variants in various biological situation of RA patients, in order to characterize the disease in wider sense, the prescription of Rheumatic factors (RF), rotated immune complex (RIC), and antinuclear factors (ANF) immune globulin (G, A, M) in blood fluid, in synovial fluid, bronchus fluid have main reason of the examination.

## **MATERIAL AND METHODS**

To achieve the object put forward according to the criterion (ACR) (1987) of America Rheumatologic Staff 60 suffering of Rheumatic Arthritis were examined. The change of the system of bones and joints was appreciated in Steinbrocker classification. Thus in stage examination there were 8 women and 5 men in the first stage, 12 women and 5 men in the second stage, 15 women and 3 men in the third stage, 6 men and 6 women in the fourth stage.

Prescription of anti-nuclear factors: ANF was conducted in blood fluid, in synovial fluid, bronchus fluid of the patients, who were examined using of the tissue of lungs and livers of white mouse and incorrect immunofluorescence according to Cups

Prescription of rotated immune complex: Was prescribed with the way of the amount of spectrophotometry.

Prescription of amount of immune globulin belongs to A, M, and G classes: The amount of LgA, LgM and LgG according to Mancini was prescribed with the method of immunodiffusion.

Prescription of crioglobulin: Prescription of crioglobulin was investigated according to J. Raymond and M.D. Euenner (6) method.

Prescription of Rheumatic factors: Rheumatic factors were conducted with a reaction of latex- agglutination reaction.

Prescription of C-reactive protein: was prescribed with micro precipitation test using commerce anti-fluid.

When Observation group examined 40 practically healthy men (men between 20-65, donors from blood transfusion station) they all were practically healthy. Statistic analysis: All number indicators obtaining during examination conducted Statistic analysis taking into consideration all modern recommendations. Average mathematical indicator (M), average quadratic inclination of this indicator (G), standard error (m), minimum (min) and maximum (max) estimations were counted for each variational series. In order to statistic appreciation of the difference among the indicators of the group there were used non - parametric way such as White criteria (W).

In order to investigate the connection between the results of laboratory indicators and spirometrics in the different situations there were conducted correlation analyze. In order to define the formula of the correlation analyze there were used Z - Fisher transformation.

All counts were held in EXCEL-97 electron table with Pentium processor. The results were put together in the tables and diagrams.

## THE RESULTS AND DISCUSSION OF THE CONDUCTED EXAMINATIONS

The quantity of RF in serous fluid of the blood of the patients who were on the I stage was  $46,7 \pm 12,02$  ( $p < 0,01$ ), on the second stage was  $52,0 \pm 0,63$  ( $p < 0,01$ ), on III stage was  $47,7 \pm 4,82$  ( $p < 0,01$ ).

The examination of the synovial fluid showed that the quantity of RF is  $37,14 \pm 1,84$  at the patients included into the I stage,  $36,15 \pm 2,13$  included into the II stage,  $34,44 \pm 1,45$  included into the III stage, 40 iu/ml was the quantity of RF at the patients included into the IV stage. The examination of bronchial fluid showed that 30 iu/ml RF was at one patient in the I stage; on the II stage RF was  $35,0 \pm 5,0$  iu/ml, on the III stage was  $32,0 \pm 2,0$  iu/ml; on the IV stage was  $35,0 \pm 1,51$  iu/ml.

According to the degree of activity of RF in the blood serum there was  $37,5 \pm 4,79$  ( $p < 0,01$ ) on the I stage,  $54,0 \pm 4,43$  ( $p < 0,01$ ) on the II stage,  $48,8 \pm 5,54$  ( $p < 0,01$ ), in the synovial fluid on the I stage was  $38,18 \pm 1,82$ ; on the II stage was  $34,21 \pm 1,64$ ; on the III stage was  $35,56 \pm 2,94$  iu/ml. According to the degree of activity of RF in the bronchial fluid there was 30 iu/ml at one patient on the I stage,  $35,0 \pm 1,67$  on the II stage,  $33,01 \pm 1,53$  on the III stage.

So, The examinations of RF showed that depending on the stage of the illness and the degree of activity in the blood serum, synovial fluid and bronchial fluid RF is found in each of three mediums.

According to the stages the ANF titre in the blood serum at RA patients was 1:8 – 1:32 lower and higher titres, 1:8 – 1:128 was on the II stage, 1:4 – 1:128 was on the III stage, 1:32 – 1:128 was on the IV stage. In the synovial fluid ANF lower and higher titres were on the I stage 1:4 – 1:16, on the II stage were 1:4 – 1:16, on the III stage were 1:8 – 1:64, the titre of ANF in the synovial fluid of one patient on the IV stage were in the ratio 1:32.

ANF lower and higher titres in bronchial fluid on the I stage were 1:8 – 1:32, on the II stage 1:16 – 1:32, on the III stage were 1:16 – 1:64, on the IV stage were 1:8 – 1:64. According to the degree of activity lower and higher titres in blood serum were in the ratio 1:8 – 1:128 on the I stage; 1:8 – 1:128 on the II stage; 1:4 – 1:128 on the III stage, in the bronchial fluid it was in the ratio 1:8 at the patient on the I stage, 1:16 – 1:64 on the II stage, 1:8 – 1:64 on the III stage. Passing of PA was comparatively hard at the patients who had many ANF titers.

So, RA changes in blood serum, synovial fluid and bronchial fluid depending on the stage and the degree of activity of disease. It is determined in the highest blood serum and bronchial fluid in the IV stage and III degree; in the synovial fluid it is determined in the III stage and II degree.

It is well known that the creation of complexes of antigen-antibody persistence is the necessary stage of humeral immunity reply. On the reason of that immune-complexes of complex tissues by setting can create different changes their capture and splitting is one of the most important functions of the organism. Pathogenesis of RA is connected with the pathology of the system, especially with the creation of IK. Playing an important role of IK in RA pathogenesis is well known from a number literature facilities (8). However we didn't meet their examination in the passing of RA in the blood serum, synovial fluid and bronchial fluid depending on IK measurements because of the degree of degree of activity in the literature facilities.

The large examination of IK showed that the quantity of large IK in the blood of healthy persons is  $34 \pm 0,83$  iu (30-39 iu). The quantity of large IK in the blood of RA patients on the I stage was  $19,6 \pm 3,06$  ( $p < 0,01$ ) (8-51 iu), it is 44% lower than norm. The reason of being the quantity of large IK lower than norm is explained by their high conglutination. The quantity of large IK on II, III and IV stages was gradually increased. It was  $35,5 \pm 6,15$  iu (2-80 iu) on the II stage,  $42,3 \pm 7,29$  iu (5-119 iu) on the III stage. In the IV stage this indication was  $54,9 \pm 6,26$  iu (13-88 iu) i.e. it was 62% more than observed group ( $p < 0,05$ ). According to the degree of activity the examination of IK showed that the quantity of IK in the blood fluid of I stage patients was  $29,5 \pm 6,69$  iu, of II stage patients was  $39,96 \pm 6,10$  iu, of III stage patients was  $40,3 \pm 5,10$  iu. It was determined that depending on the degree of activity as the degree of activity was increasing the quantity of IK was increasing as well.

During the period of examination of synovial fluid the quantity of IK on the I stage was  $7,5 \pm 1,57$  iu, on the II stage was  $20,69 \pm 3,66$  iu, on the III stage was  $17,94 \pm 2,91$  iu, there was one patient on the IV stage, the quantity of large IK at this patients was 15iu. According to the degree of activity there was determined  $18,1 \pm 4,35$  iu on the I degree,  $15,3 \pm 2,74$  iu on the II degree,  $17,8 \pm 2,86$  iu on the III degree. During the PA the creating of large IK can be explained by high titre of low density of antigen of RF plasma cells synthesized in the synovial stage. Large IK created by such ratio of antigens and antibodies are the reason of local inflammations. This time polymorph nuclear leucocytes having made phagocytosis of IK make the synthesis of lysosomal ferments responsible for injure of the plexus. So, the quantity of large IK increased according to the stages in the blood and synovial fluid at RA patients and according to the degree of activity and it became apparent in the process of RA.

The examination of bronchial fluid showed a definite number of large IK here. So, during the phased examination the quantity of large IK was  $5,0 \pm 2,0$  iu on the I stage,  $2,5 \pm 0,5$  iu on the II stage,  $9,0 \pm 2,3$  iu on the III stage,  $15,6 \pm 2,39$  iu on the IV stage. Depending upon the degree of activity one patient had 3,0 iu on the I stage,  $12,1 \pm 2,43$  iu on the II stage,  $12,3 \pm 2,84$  iu on the III stage.

During PA autoimmune process is often characterized by vasculitises creation of which can be connected with middle IK. Middle IgG type affine is included into the mixture of middle IK. During PA the quantity of middle IK in the blood fluid in the I stage was  $48,5 \pm 8,6$  iu, i.e. partially less than observation group; on the II stage  $80,8 \pm 10,1$  iu; on the III stage it was partially higher, i.e.  $81,2 \pm 11,42$  iu, increased on the IV stage, i.e.  $131,4 \pm 3,77$  iu and it is 30% more than observation group ( $p < 0,01$ ). On the degree of activity during the examination of middle IK it was determined that as the degree of activity increases the quantity of middle IK increases as well, i.e. the patients of the I stage had  $72,4 \pm 12,4$  iu in the blood fluid;  $81,4 \pm 10,53$  iu on the III degree;  $92,0 \pm 10,7$  iu on the III degree.

Middle IK was investigated in synovial fluid. There wasn't observed any change at them because of the stages and degree of activity.

There was observed increasing of the quantity of middle IK investigated in bronchial fluid according to the stages and degree of activity and it can be explained by increasing of RF and ANF in the same milieu.

It is known that in case of increasing of quantity of middle IK they become the reason of high constant compound and creating of dimerous polymerization, and by this they become the reason of inflammation. The basic factor of such inflammation is energization of complementation system.

During the examination of little IK there was observed increasing of quantity of IK in the blood fluid of RA according to the stages and degree of activity.

It is known, that the creating of little IK is connected with increasing of antigens in their mixture. It was determined that during the quantity of IK was  $1072 \pm 54,6$  iu at PA patients in the I stage, it was 6,5% less than in the observation group. Quantity of little IK gradually increased in the following stages. It was 3,3% higher than in the observation group on the II and III stages, it was 6,8% higher on the IV stage (picture 1).

During the examination of synovial and bronchial flood there was determined a great number of little IK here. It should be mentioned that during the comparison bronchial fluid with synovial fluid there was found that the quantity of large and middle IK was approximately equal. However the quantity of little IK in two fluids was comparatively high. According to the stage and the degree of activity during the comparison there was observed an inclination of increasing of IK in these fluids.



During RA the level of free immunoglobulin changed in the various directions according to the stages and the degree of activity. It is known that cells synthesize immunoglobulin and one part becomes freely dissolved and the other one is placed on the surface of cells in the blood in two main conditions. Breaking of dynamic equilibrium depends on changing of physical chemical, cellular and humeral mixtures.

During RA the examination of free immunoglobulin showed that their quantity increased according to stages and degrees of levels in the blood fluid. So, the quantity of IgA on the I stage was close to norm in the blood fluid, it was comparatively increased on the II stage and was  $2,27 \pm 0,22$  g/l and it was 32% more than observation group, in comparison with the observation group the quantity of IgA 13% decreased on the III stage, in comparison with the observation group the quantity of IgA 30,2% more on the IV stage. There was observed increasing of IgA according to the degree of activity. The quantity of IgA was 24% more in comparison with the observation group on the III stage.

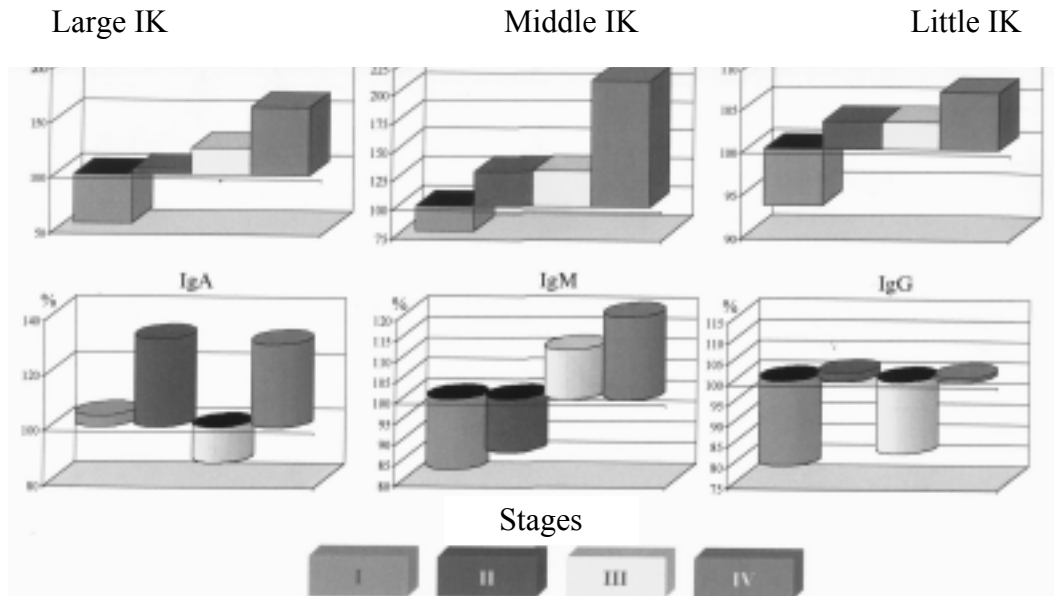
Such comparative increasing of the quantity of IgA according to the stages and degree of activity can be explained by chronic passing inflammation.

The examination of synovial fluid showed that the quantity of IgA on the I stage was  $0,99 \pm 0,22$  g/l, on the II stage was  $1,51 \pm 0,12$  g/l, on the III stage was  $1,02 \pm 0,12$  g/l, on the IV stage was 1,77 g/l, there was one patient on the IV stage.

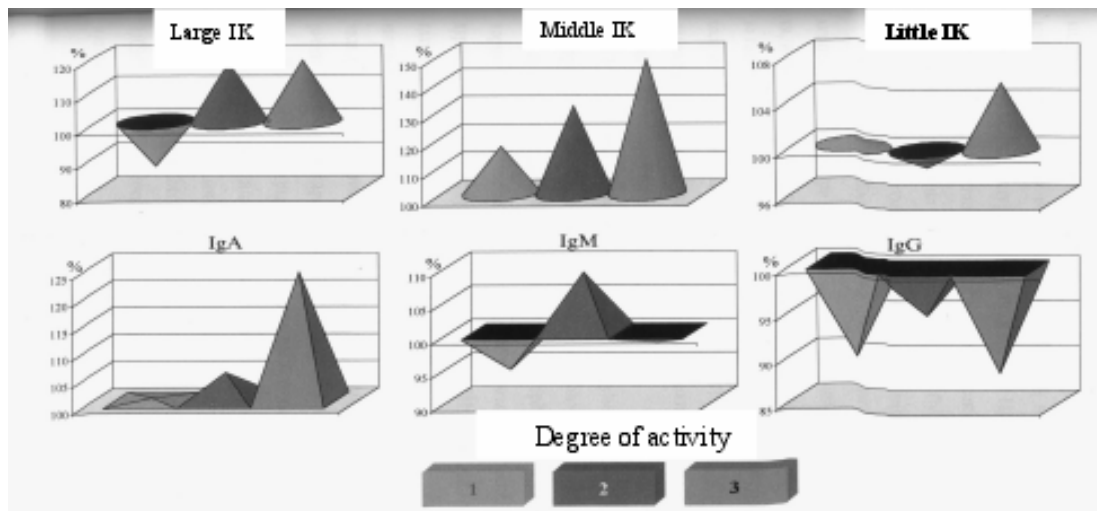
While investigating the amount of IgM it was determined that the level of IgM in blood fluid on the first stage is 17% and on the second stage 13% lower of observed group. On the third and fourth stages the level aroused corresponding to observed group to 12% and 20%. According to the level of activity the amount of IgM is varied on different directions. So the level of activity in blood fluid of patients on the I stage the amount of IgM comparing with observed group was lower, on the second stage to 9% was higher of observed group and on the third stage was comparatively lower of observed group. In the synovial fluid there was discovered IgM, but according to stages and level of activity there was discovered change of amount of IgM.

According to stages and the level of activity the amount of IgA in bronchus fluid gradually aroused and became higher the observed group. While determining the level of IgG in patients with RA there was determined change of amount of IgG in various ways. The received results showed that according to stages and level of activity the amount of IgG in blood fluid on III stage was mainly different from the observed group, i.e. was 17% lower the norm ( $p < 0,05$ ), on the other stages there weren't the main differences. The amount of IgG in synovial fluid was comparatively higher in bronchial fluid.

By degree of activity during the examination of little IK it was determined that depending on the degree of activity the quantity of IK gradually increased (picture 2)



**Picture 1. Changing of IK, IgA, IgM, IgG in the blood serum according to the stage RA (in % from the norm)**



**Picture 2. Changing of quantity of defferent IK and IgA, IgM, IgG depending on the degree of activity of RA (in % from the norm)**

So, the immune examination of blood flood, synovial flood and bronchial flood showed that by dividing these patients according to the stages and degree of

activity it becomes clear that RF and ANF are investigated in the blood, synovial and bronchial fluids. Being of IK, circulating at the lower stages of RA, at the low level can be explained by their high adhesiveness. In the result of the examination of immunoglobulin it was determined that mainly the quantity of IgA and IgG was high, but the quantity of IgM should be basely changed.

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## THE ADAPTIVE ANSWERS OF PLANTS TO THE INFLUENCE OF SMALL DOSES RADIATION FACTORS

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*In the present work results of researches of adaptive answers of plants subjected to the chronic influence of increased radiation background and short-term UV-B radiation are submitted. It is established, that adaptive answers of plants cover the morphological, physiological and genomic levels, and as a whole determine the cooperative transition of an organism to the new determined condition.*

All alive organisms are formed and developed in the certain condition of an environment and are exposed to various physical and chemical factors. At changes of an environment conditions adaptive answers of the alive organisms occurring in a direction of their adaptation to new condition, cover various levels of the structural organization /17/.

It is known, that response of plants to the small temperatures stress consist of various reorganizations of a metabolism and of physiological processes that is characterized by adaptation of a plant organism to changed condition. Thus there is an increase of the energy charges and efficiency of cell breath /13/. Results of the numerous works executed in this area confirm, that at stresses alive organisms have the damages connected to oxidation. Changes of a water exchange, the drought also influences on all processes of vitality, especially on the growth, photosynthesis and intensity of breath /1, 5, 6, 8, 12,16/.

At changes of air conditions, for example, at flooding, formation of roots on the stalks also is the adaptive answer of plants to changed conditions and it induces ethylene. There is an opinion, that ethylene participates in responses of plants to the various – physical, chemical and biological factors /9/.

It is known, that destruction of a stratospheric ozone layer results in increase of the level of UV radiation on a Earth surface, especially its B range ( $\lambda$ 280-320nm). The life on the Earth is impossible only because of the processes going on a gradient. Opposite directed reactions going with increase of chemical energy and with reduction of entropy are possible only due to processes of transformation by green plants and autotrophy bacteria in chemical energy of other energy forms. This transformation is carried out during the photosynthesis due to a solar energy. In photosynthesis green plants carry out chemical "reorganization" of molecules  $\text{CO}_2$  and  $\text{H}_2\text{O}$  due to a solar energy. Depending on environment conditions the sizes of cells, the morphology of assimilating tissues, a quantitative ratio of the basic photosynthetic pigments (chlorophylls and carotinoids), the structure of photosynthetic membranes also are changed. That the higher plants are deprived of adaptabilities, they are compelled to adapt to various and frequently varying conditions of an environment. Highly organized in evolution the photosynthetic machine of plants is located in chloroplasts, to be exact in thylakoid membranes. For the same reason they should have the adaptive ability and plasticity. In this connection, in such conditions simultaneously should be provided both optimum perception of solar energy and the prevention of destruction processes. The photodestruction can be caused by seen light, and also by UV radiation /10/.

UV radiation influencing independently or together with other factors of an environment (high intensity of photosynthetic active radiation, herbicides, presence of mutagens,  $t^0$  conditions, ionizing radiation) causes the changes in biochemical structure of components of a plant cell (proteins, pigments and lipids), in separate stages of electronic transport in chloroplasts, in some enzymes, for example ribulobiphosphatkarboxilase/oxigenase, and also changes in darkness stage of an  $\text{CO}_2$  exchange and in physiological functions of plants /7/. These changes, especially caused by short-wave UV radiation can be destructive. Because UV radiation of this range is intensively absorbed by nucleid acids (NA) and proteins, this radiation have the high biological activity. For this reason short-wave UV radiation ( $\lambda < 300\text{nm}$ ) causes the destruction first of all in NA (especially in DNA) and in the lipoprotein structures of membranes /14/.

But because of effective absorption by an atmosphere ozone cloud a short wave UV radiation does not reach the Terrestrial surface, and a long wave, UV radiation these macromolecules almost is not absorbed and has very low biological activity.

Recent researches have shown, that the long-wave UV radiation can cause the destructive reactions and it is less effective in comparison with the short-wave UV radiation /11/. The role of sensitizer in the photosensitization reaction caused by the long-wave UV radiation on plants play not molecules DNA as in case of the short wave UV radiation; this is an other endogen sensitizer. It is confirmed

also in strong dependence of photodynamic destruction processes caused by this factor from participation of oxygen /4/.

Thus, the photosynthetic machine of leaves of the UV-irradiated plants is damaged. For the “insurance” from these damages, or for the reduction of their quantity the functional changes of the photosynthetic machine and the neutralization of the damage causing intermediate products are inevitable.

The ionizing radiation causes the ionization of atoms in the cells of organisms. Alongside with it, there are excited atoms and the free radicals of the cellular components having the big superfluous energy. The excited atoms and free radicals, in turn, quickly enter reactions among themselves and with the other molecules. In result there are the structural infringements of macromolecules, which result in their functional changes. One of the major adaptable mechanisms of plants to influence of stressful factors, in particular to increased radiation background, is the activation of the anti-oxidant systems /3/.

Activated by the ionizing radiation adaptable mechanisms, including the synthesis of anti-oxidants substances, mainly are unspecific. It is known, that the basic adaptable mechanisms of protection from UV radiation is the synthesis and accumulation of flavonoid substances /2/.

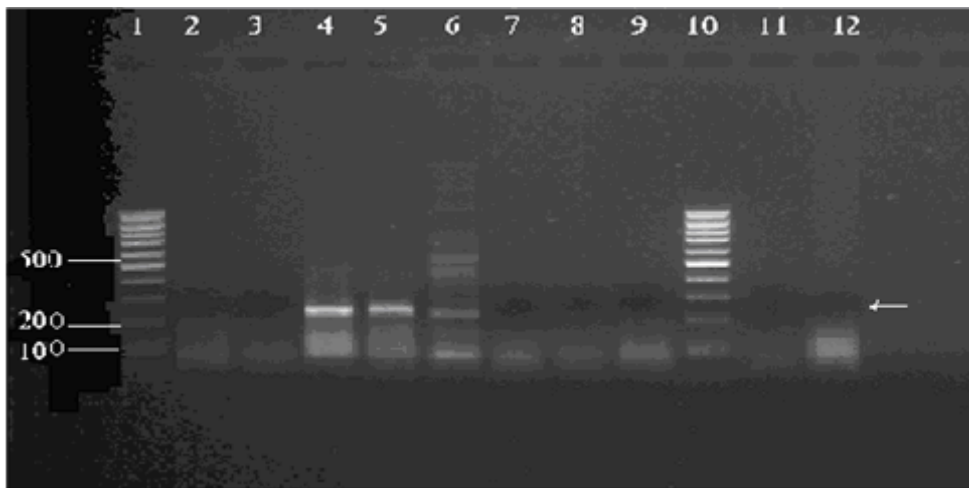
Under action of the biotic and abiotic stressful factors the content of reactive derivatives of oxygen in a plant organism is increased. The reactive species of oxygen render not only damaging action, they also participate as alarm molecules in the protection of plants. For example, the hydrogen peroxide ( $H_2O_2$ ) promotes an induction of gene expression of proteins, providing the plant stability to stresses /15/.

In present work the effects of irradiation of plants by short-term UV and chronic ionizing radiation are investigated. These effects of the radiation factors are considered as the adaptive answers of plants. Researches were carried out at various levels of the structural organization of plants with application of the various methodical approaches.

Features of the reproductive organs, of growth dynamics of the vegetative organs of the plants growing in condition of a chronic irradiation by small doses of ionizing radiation are investigated. The greatest development was observed at populations on sites with the moderate risen gamma radiation (200-300  $\mu R/h$ ). The adaptive answers of different plants to action of this stress factor were various. The interesting analogy is found out between the morphological and genetic results on 3 investigated kinds (*Zygophillum*, *A.pseudoalhagi*, *E.angustifolia*). The nuclear DNA of leaves of plants from the control and radioactive contaminated sites in the territory of Baku iodine plant were investigated in PCR with the primers of microsatellite locuses. It was shown, that with the nuclear DNA of the leaves *A.pseudoalhagi* amplicons are not synthesized. This should be the consequence of discrepancy of primers to the sites on nuclear

genome of *A.pseudoalhagi* and as result, elongation of polynucleotide chain there aren't. As result of the amplyfication of primer AG-110 with the nuclear DNA of *Zygophyllum* from the control sites and sites with the increased radiation background were synthezed 240-250 bp PCR-products. At plants *E.angustifolia* the PCR products of the AG-110 primer with the nuclear DNA from control and experimental sites are strong various. So, with the nuclear DNA of *E.angustifolia* leaves from the control area were synthezed 100, 230, 400, 450, 500, 600 bp amplycons, with the nuclear DNA of the experimental plants, growing in the radioactive polluted sites DNA-fragments are not synthezed. We assume, that in radioactive polluted conditions in the nuclear DNA of *E.angustofolia* there are DNA breaks and the locuses of the AG-110 primer are damaged. This may be also connected with the changes in the enzyme locuses.

Results of the researches of the nuclear DNA from leaves of the investigated kinds in PCR have shown, that the greatest changes has undergone at *E.angustifolia* L. The observation at a morphological level also has found out the greatest degree of changes – the reduced development, numerous “giant” leaves, the strong curvatures of leaves, the strong branching of a stalk. The level of polymorphism of the nuclear DNA from leaves *A.pseudoalhagi* (Bieb) is differed from the spontaneous. The comparative studying of the nuclear DNA from leaves *Zygophyllum* L., originated from the control and experimental sites have shown that this factor cause both the genomic and fenotipic changes.



**Fig.4. EP of PCR products of primers AG-110 with the leaves nuclear DNA, 2-3; 4-5; 6-7 generated on sites with normal and increased  $\gamma$  radiation background: *A.pseudoalhagi*, *Zygophyllum* and *E.angustifolia* accordingly 1, 10-molecular marker, 8 - 9 *A.pseudoalhagi* from a control site, and artificial in vivo irradiated accordingly.**

We have investigated changes of functional status of the photosynthetic machine of plants under the influence of short-term UV irradiation. It is necessary to note, that in the natural conditions in a nature the damaging influence of UV radiation is observed very seldom. The EPR researches have shown, that the UV-irradiation strengthens an electronic stream from the FS1, promotes the increase of the reduction unit content (NADFH and NADH). Alongside with it the UV irradiation of plants reduces the photosynthetic oxygen evaluation. With the help of interference filter the sheet of the leaves in the resonator is shined by light  $\lambda=707$  nm, simulating mainly FS 1. Thus, there is the growth of EPR I signal caused by increase of quantity oxidized  $P700^+$  centers. At replacement of the distant red light by white light the kinetic gets no monotonic character, i.e. reduction of an amplitude of signal EPR I, and then slow increase with return on a former level all over again is observed.

That will reveal a role of the various factors responsible for the occurrence complex of P700 oxidation-reduction transformations kinetic in leaves, the influence of illumination background (duration of the adaptation to darkness and light of various spectral structure) on photoinduced changes kinetic of signal EPRI size was investigated.

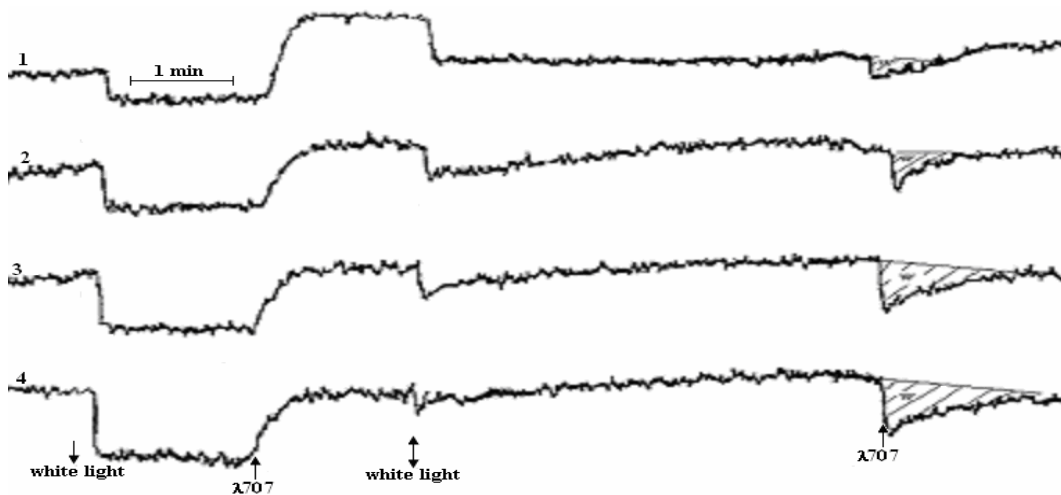
It was earlier shown, that multiphase non-monotonic kinetic of changes of the spectra EPRI in leaves is caused by the light depending changes of electronic transport speeds on two sites of a chain between photosystems and in acceptor side of FSI. Besides in these works it was shown, that the electron carry speed and the quantity of electron carriers between photosystems does not vary. On the basis of it the conclusion was made, that non-monotonic kinetic at  $\lambda=707$  nm  $\rightarrow$  white light transition is caused by the acceleration of the electron outflow from FSI, that it caused by the photoactivation of reactions on acceptor side of the FSI (fig.2). Our experiments have shown, that the irradiation of leaves by the UV light results in change of non-monotonic P700 oxidation-reduction transformations kinetic. Apparently from fig.3 the UV irradiation accelerate an exit of EPR I signal on a stationary level under action of the white light. It can be consequence: 1) reduction of electron inflow from FSII to  $P700^+$  because inhibition of the FSII; 2) due to activation of electron outflow from the FSI.

The UV irradiation changes the form of non-monotonic kinetic effect, and the exit on a stationary level was accelerated at the inclusion of white light. The directly proportional correlation between the size of effect and a dose of an irradiation (fig.3) is found out. Probably, it is not connected with the inactivation of the not cyclic electronic transport since the response to inclusion  $\lambda 650$  nm light stimulating both photosystems did not vary. It is possible to assume, that induced by UV irradiation acceleration of growth of EPR signal after inclusion of white light is caused by activation of reactions on acceptor side of FS I.





**Fig.2. The spectra EPR I, received from the oxidized P700 centers of control leaves V.faba (2-in light, 3-in darkness, 4-same signal with other speed of record) and 1- its light induced kinetic changes.**



**Fig.3. The light induced kinetic changes of the spectra EPR I received from P700 of the centers of intact V.faba leaves: 1- the control, 2- 5 mines, 3-15 mines and 4- 25 mines UV-B irradiated;  $\uparrow\downarrow$ -accordingly turn on and turn off of light.**

Apparently from fig.3 reduction of the spectras EPR I of the control and UV irradiated leaves at transition  $\lambda 707$  nm  $\rightarrow$  white light and size of the stationary level arising as a result of subsequent P700 centers reoxidation differ.

So, when at control leaves this level makes approximately  $\frac{1}{2}$ EPRI, with increase of a dose of an irradiation the stationary level practically does not differ from size of the appropriate spectra EPR I. The stationary level of the spectra EPRI of the UV irradiated leaves during 25 minutes, induced  $\lambda 707$  nm white light transition, even surpasses the EPRI signal induced by the light  $\lambda 707$  nm. The size of a deepening of a kinetic curve (w) at inclusion  $\lambda 707$  nm light after illumination by white light, describing the reoxidation of the P700 centers, allows to define the relative quantity of the electronic equivalents in a electronic transport chain between photosystems. The increase of this parameter with increase of UV irradiation doze shows, that the electronic transport between two photosystems decreases and it is connected to photodamage of the FSII. On the other hand, the opinion on the reason of increase of the electron outflow speed from FSI and about prospective physiological value of this effect is stated. It is supposed, that thus photorespiration for prevention of destruction changes of the photosynthetic machine is intensified. It is known, that at small doses of an UV irradiation, first of all weaken reactions of the cycle Kalvin-Benson. Our experiments show, that thus the acceleration of electron outflow, can be connected with activation of the glicolate ways of photorespiration.

The observation of the strong oxygen dependence of the effects arising at UV irradiation, and also at action of other stressful factors on plants allow to draw a conclusion that in all these cases the strengthened photorespiration promotes the additional charge of unduly formed reduction units in conditions of suppression of the cycle Kalvin-Benson, and in the greater degree to the neutralization of reactive species of oxygen. In our experiments the acceleration of electron outflow from FSI with the increase of UV irradiation doze confirms this assumption.

The analysis of a literary material and of own data demonstrates, that the dangers of lipid peroxidation of tylakoide membranes and by that, infringement of the membrane structures from the UV irradiation are prevented by any protective mechanisms. It is probably, that photorespiration is one of them. It is possible to believe that photorespiration has arisen during the evolution as adaptive function of plants. The essence of this process consists in reduction of the content of molecular oxygen, as potential predecessor of its reactive species in the extreme conditions. Thus, at action of the stressful factors on alive organisms, equilibrium condition is supported by the regulator mechanisms functioning at morphological, physiological and genetic levels, and transition to the new condition has the cooperative character.

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## PHYSICAL-MATHEMATICAL SCIENCES

### MATHEMATICAL MODEL OF MAGNETIC LEVITATION SYSTEM AND ITS PROBING FOR STABILITY

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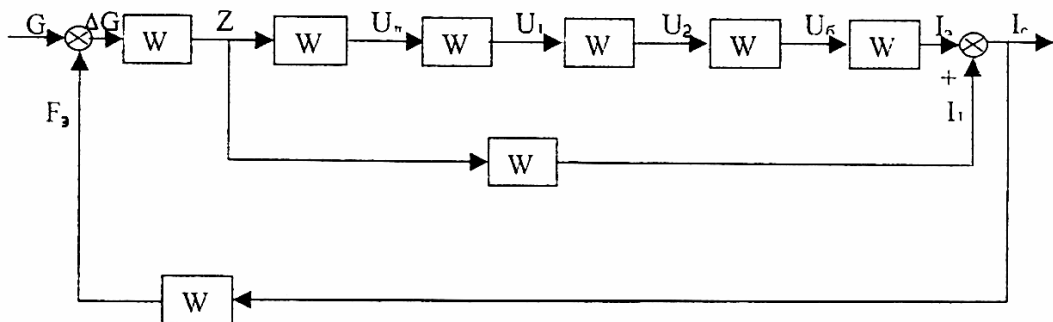
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Mathematical model of Magnetic Levitation System (MLS) is cited in the article. The structural chart of MLS is presented and mathematical model, as a transfer function of closed system of automatic control of current of solenoid, is given on its base. Necessary and sufficient conditions for provision of stable levitation of core are formulated. Successful approbation of obtained outcomes by example of operational model of MLS was conducted. With aim to raise stability of system operation, the search problem of radical measures was set at the cost of increasing of stability factor.

As magnetic levitation system (MLS) by its own structure represents closed system of automatic control of current of solenoid, so non-stability state, characterized by self-oscillations of levitating body - core, is specific to it.

Thus, with aim to define necessary and sufficient conditions for provision of state of steady and stable levitation of the core, it is necessary to conduct theoretical and experimental studies of dynamic properties of this system. For performing this, it is necessary to have mathematical model of studied system.

On base of schematic diagram of MLS (1), the structural chart, which allows constructing its mathematical model, is composed (fig.1).



**Fig.1. Structural chart of the magnetic levitation system**

The following indications of transfer functions are applied in structural chart (fig.1):

$W_0$  - is a transfer function of power node of MLS, including solenoid, core and measuring chamber, which contains core.  $W_0$  establishes connections between transition of core  $Z$  and difference  $\Delta G$ , between core gravity and electric magnetic tractive force  $F_3$  of solenoid:

$$\Delta G = G - F_3.$$

$W_1$  - is a transfer function of sensor of core transition, establishing connection between output potential  $U_n$  of sensor and transition of core  $Z$ .

$W_2$  - is a transfer function of the 1<sup>st</sup> amplifier stage of electronic block, establishing connection between output potential  $U_1$  of the 1st amplifier stage and potential  $U_n$  of transition sensor.

$W_3$  - is a transfer function of the 2<sup>nd</sup> amplifier stage of electronic block, establishing connection between output potential  $U_2$  of the 2<sup>nd</sup> amplifier stage and potential  $U_1$  of the 1st amplifier stage.

$W_4$  - is a transfer function of the potential divider, establishing connection between potential  $U_6$  on base of transistor and potential  $U_2$  of the 2<sup>nd</sup> amplifier stage.

$W_5$  - is a transfer function of the final stage of electronic block- current amplifier, made by scheme of emitter follower (EF). It establishes connection between current  $I_3$  of emitter circuit of solenoid and potential  $U_6$  on base of transistor.

$W_6$  - is a transfer function of chain of own electric magnetic damping. It establishes connection between dynamic current component  $I_n$  of solenoid and speed of transition of core  $dz/dt$ .

Current  $I_n$  is generated under influence of EDC  $E$  self-induction, directed in winding of solenoid at forward movement of  $Z$  of core along axe of solenoid.

$W_7$  - is a transfer function of the feedback circuit, defining dependence between electric magnetic tractive force  $F_3$  and line current of solenoid  $I_c$  H/A.

Correlations between input and output values of system, which allow defining transfer functions of individual chains of structural chart of MLS, as in differential type, so in operator form are represented in works (2,3).

For power node MLS let us represent differential equation, defining connection between transition of core  $Z$  and difference of forces ( $G - F_3$ ) as:

$$m = \frac{d^2 Z}{dt^2} + R_a \frac{dz}{dt} = G - F_3 \quad (1)$$

where  $m$  is a mass of core, kg

$\frac{d^2 z}{dt^2}$  - is a vertical acceleration of core transition  $m/c^2$

$\frac{dZ}{dt}$  – is a vertical speed of core transition m/c

Z - is a vertical core transition, m

$R_a$  - is a coefficient of aerodynamic damping, H \* c/m.

From (1) we find expression of transfer function of power node MLS in operator form, as follows:

$$W_0(p) = \frac{Z}{G - F\vartheta} = \frac{1}{mp^2 + R_a p} \quad (2)$$

Where

$p = \frac{d}{dt}$  – is an operator of differentiating,  $\text{sec}^{-1}$

Let us write equations of other links

-transition sensor:  $U_{\pi} = K_{\pi} Z$ ; -the 1<sup>st</sup> amplifier stage:  $U_1 = K_{y1} U_d$ ;

-the second amplifier stage:  $U_2 = K_{y2} U_1$ , -divider of potential:  $U_6 = K_d U_2$ ;

$F_3 = K_0 I_C$ -chain link of feedback.

In working modes of their functioning with sufficient degree of accuracy they may be represented without inertia links with transfer functions as constant rates, independent on “p”, i.e., as:

$$W_1 = K_{\pi} \quad (3)$$

$$W_2 = K_{y1} \quad (4)$$

$$W_3 = K_{y2} \quad (5)$$

$$W_4 = K_d \quad (6)$$

$$W_7 = K_0 \quad (7)$$

For final stage of electronic block of current amplifier, constructed by chart of emitter follower (EF) with inductive load of solenoid, let us represent differential equation, defining connection between current  $I_{\vartheta}$  of emitter circuit and potential  $U_6$  of the base, as:

$$R_0 \left( T_{\vartheta} \frac{dI_{\vartheta}}{dt} + I_{\vartheta} \right) = U_6 \quad (8)$$

here  $R_0$  is an equivalent resistance of emitter circuit, Ом

$T = L/R_0$  is time constant of emitter circuitry, sec;

L is inductivity of solenoid winding, Gn

From (8) we find expression of transfer function of final stage in operator form, as follows:

$$W_5(P) = \frac{I_3}{U_6} = \frac{K_c}{(T_3 p + 1)} \quad (9)$$

$K_c = 1/R_3$  is a conductivity of emitter circuit, Ом

Hence, let us define transfer function of link of own electric damping

Current quantity  $I_{\Delta}$  of this chain in dynamic mode we shall define on base of the 2 law of Kirchhoff:

$$E = R_3 I_{\Delta} + L \frac{dI_{\Delta}}{dt}$$

Whence

$$(10)$$

We shall define quantity E on base of law of conservation of energy for elementary section dZ:

$$\begin{aligned} EI_{\Delta} dt &= F_{\Delta} dZ, \\ T_3 \frac{dI_{\Delta}}{dt} + I_{\Delta} &= \frac{E}{R_3} \end{aligned} \quad (11)$$

Where  $F_{\Delta}$  is a force of electric magnetic damping, H.

We shall define force of damping  $F_{\Delta}$  as a force interaction of solenoid with magnetic leg by dynamic constituent of current  $I_{\Delta}$  as (2):

$$F_{\Delta} = K_0 I_{\Delta}, \quad (12)$$

Where  $K_0$  is a coefficient of force of solenoid, H/A.

Substituting (12) into (11), after corresponding transformations we shall obtain:

$$\begin{aligned} E &= K_0 \frac{dZ}{dt} \\ E &= K_0 \end{aligned} \quad (13)$$

Substituting (13) into (10), we find differential equation of the chain of own electric magnetic damping as:

$$T_{\mathcal{D}} \frac{dI_{\mathcal{D}}}{dt} + I_{\mathcal{D}} = \frac{K_0}{R_{\mathcal{D}}} \frac{dz}{dt} \quad (14)$$

From (14) we shall obtain expression of transfer function, as:

$$W_6(p) = \frac{K_0 K_C P}{(T_{\mathcal{D}} P + 1)} \quad (15)$$

In accordance with rules of transformation of structural charts of systems of automatic control (4) on base of structural scheme (fig.1) let us make transfer function of close system of automatic control of solenoid MLS, establishing connection between line current  $I_c$  of solenoid and weight of levitating core:

$$W_{3c}(p) = \frac{W_0 \cdot (p) \cdot (W_1 \cdot W_2 \cdot W_3 \cdot W_4 \cdot W(p) + W_6(p))}{1 + W_0(p) \cdot (W_1 \cdot W_2 \cdot W_3 \cdot W_4 \cdot W_5(p) + W_6(p)) \cdot W_7} \quad (16)$$

Substituting into (16) expressions of transfer functions of individual chains (2):(7), (9), (15) and making corresponding transformations, we shall obtain mathematical model in form of transfer function of closed system of current regulation of solenoid, as follows:

$$W_{3c}(p) = \frac{1}{K_0} \cdot \frac{\mathfrak{T} \cdot p + 1}{a_0 \cdot p^3 + a_1 \cdot p^2 + a_2 \cdot p + a_3} \quad (17)$$

Where  $\mathfrak{T} = \frac{K_C \cdot K_0}{K}$  - is a time constant of external force action, sec.;

$$K = K_n \cdot K_{y1} \cdot K_{y2} \cdot K_{\mathcal{D}} \cdot K_C -$$

is a transfer coefficient of section of direct circuit of system,

$$a_0 = \frac{m \cdot T_{\mathcal{D}}}{K \cdot K_0}, \text{ sec}^3$$



$$a_1 = \frac{R_a T_3 + m}{K \cdot K_0}, \text{ sec}^2$$

$$a_2 = \frac{R_a + K_c \cdot K_0^2}{KK}, \text{ sec};$$

$$a_3 = 1$$

For study of stability of the system let us apply Rause-Gurvitz criterion, in accordance with which, execution of the following inequalities is considered, as necessary and sufficient condition of stability of the system of the 3<sup>rd</sup> order:

$$a_0 > 0; \quad a_1 > 0; \quad a_2 > 0; \quad a_3 > 0; \quad (18)$$

$$a_1 \cdot a_2 - a_0 \cdot a > 0 \quad (19)$$

Condition (18) is always executed in this case, as all coefficients of characteristic equation  $a_0, a_1, a_2, a_3$ , defined by correlations of parameters of system, are positive numbers. Thus, for provision of stable levitation, it is sufficient to demand execution only of the second inequality (19).

Substituting into (19) expressions of coefficients of equation from (17), we shall obtain:

$$\frac{R_a \cdot T_3 + m}{K \cdot K_0} \cdot \frac{R_a + K_c \cdot K_0^2}{K \cdot K_0} > \frac{m \cdot T_3}{K \cdot K_0} \quad (20)$$

It implies from inequality (20) that for provision of stability, it is necessary to select correctly values of parameters of the system:  $R_a, T_3, m, K_c, K_0$ , and  $K$ , part of them,  $R_a, m, K_0$  are defined by constructive specific features of force part of the system and others  $T_3, K_c, K$  depend on schematic characteristics of electronic block.

While designing of specific MLS, it is necessary to define which of these parameters are to be selected independent on considerations, dictated by actual conditions of operation of future system and dimensions of its force part and, which are to be selected by means of selection of their values, proceeding from conditions of execution of inequality (20).

It is established, that among all parameters, entering into inequality (20), transfer coefficient  $K$  of the section of the straight circuit of the system is the most convenient one for selection by means of regulation.

Proceeding from these considerations and solving inequality (20) in relation to coefficient  $K$ , after corresponding transformations, we shall obtain necessary and sufficient condition of stability MLS as:

$$K > \left( \frac{R_a}{m} + \frac{1}{T_3} \right) \cdot \left( \frac{R_a}{K_0} + K_0 \cdot K_0 \right) \quad (21)$$

Cited methodology of composition of mathematical model of MLS and its study for stability passed approbation on operational model MLS, possessing following values of parameters of system (3):

$$M=8.5 \cdot 10^{-3} \text{ kg}; T_3=0.82 \cdot 10^{-3} \text{ sec}; K_n=0.7; R_a=17.7 \cdot 10^{-3} \text{ Hc/m};$$

$$K_c=0.067 \text{ OM}^{-1}; K_0=0.267 \text{ H/A}; K_n=6.25 \text{ B/m}; K_{y2}=16$$

Substituting these values into (21), we shall obtain:

$$K = \left( \frac{17.7 \cdot 10^{-3}}{8.5 \cdot 10^{-3}} + \frac{1}{0.82 \cdot 10^{-3}} \right) \cdot \left( \frac{17.7 \cdot 10^{-3}}{0.267} + 0.067 \cdot 0.267 \right) = 100.5, A/m \quad (22)$$

Among coefficients, entering into formula for calculation of transfer coefficient:

$$K=K_n K_{y1} K_{y2} K_n K_c, \quad (23)$$

coefficient of amplification of the 1<sup>st</sup> stage  $K_{y1}$  at constant coefficient of amplification of the 2nd stage, selected in operational model, equal to  $K_{y1} = 21.4$  is the mostly easily subjected to control

Then from (22) and (23) we shall obtain:  $K_n K_{y1} K_{y2} K_n K_c < 100.5$

Where

$$K \leq \frac{100.5}{6.25 \cdot 16 \cdot 0.7 \cdot 0.067} \leq 21.4 \quad (24)$$

Equality sign in (24) is applied with aim of definition of border  $K$  of stability by value of coefficient  $K_{y1} = 21.4$

Coefficient of amplification of the 1<sup>st</sup> stage of electronic block of operating model MLS was selected, as equal  $K_{y1} = 16.5 < K_{y1}$ , which provided stable levitation of core. However, in the process of system operation, the modes were observed, where core, even at the highest changes of parameters of the scheme was transforming into conditions of self-oscillations, which is non-admissible at application of MLS, as measurement device.

Such behavior of system is accounted for value of coefficient  $K_{y1} = 16.5$  is rather close to stability threshold  $K_{y1} = 21.4$  i.e. stability factor of system in this case is not sufficient for provision of stable levitation.

For removal of this defect of the system 2 methods of increasing of stability factor may be recommended:

- shift of stability threshold to right at the cost of increase of coefficient of damping  $R_a$  and decrease of time constant  $T_3$  of circuit of emitter follower;
- decrease of value of coefficient  $K_{y1}$  for shift of its value to the left from stability threshold  $K_{y1}$ .

The first method has restricted possibilities of application as parameters  $R_a$  and  $T_3$  are selected due to other considerations, constructive or schematic ones and, as a rule, they are subjected to insignificant changes.

The second method is also non prospective, as decrease of  $K_{y1}$  leads to decrease of upper threshold of range of current regulation of solenoid and even to loss of levitation status due to non-sufficiency of tractive force of solenoid. Besides, this point decreases sensitivity of scheme and accurateness of its operation.

In connection with this, necessity of search of radical measures on increase of stability factor of scheme, while preserving initial values of parameters of scheme ( $R_a$ ,  $T_3$ ) is created.

Solution of this task is to be searched at application of structural changes in the system, based on application of methods of theory of automatic control.

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## **NEW STAGE IN THE DEVELOPMENT OF QUANTUM GRAVITATION**

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Theory of gravitation, described in the general relativity by Albert Einstein in the beginning of last century, took firm positions during whole last century. It seems that it is impossible to deny the theory of gravitation of Einstein, as its many aspects were verified during astronomic and astrophysical researches. Meanwhile, during last ten years there became to appear more and more followers of alternative theory – the quantum theory of gravitation the foundation of which were laid by Pole Dirak. In 1928 Dirak solved the problem which Schrodinger couldn't solve: he derived a relativist equation for electron. This equation had an important peculiarity: it was followed by the notion of spin, which was absent in non-relativist equation of Shrodinger; besides, it explained the thin structure of the spectra of atoms of hydrogen and Zeeman's effect. In 1931 Dirak put forward the hypothesis abot availability of elementary magnetic charge – monopole, and in 1933 – the antimatter. Dirak made a great contribution into the creation of quantum statistics. In 1926 Pole Dirak independently of E.Fermi elaborated the statistics of particles with half-integer spin (statistics of Fermi-Dirak). In 1931 he proved the possibility of availability of symmetric quantum electrodynamics, based on the conception of elementary magnetic charge. In 1937 he elaborated the theory of muon, considering the latter one as a vibrational state of electron, was engaged in problems of Hamilton's wording of theory of gravitation with the purpose of further quantification of gravitational field. Among the main works of the scientist are *The Principles of Quantum Mechanics*, 1930, *The Development of Quantum Theory*, 1971), *Spinors in Hilbert Space*, 1974, *General Theory of Relativity*, 1975. Dirak and Schrodinger received Nobel Prize for physics of 1933 “for discovery of new productive forms of theory of atom”. “From philosophic point of view, a number of different types of elementary particles (at least, it seems at first sight) must be minimal, for example, one or at most two...But from the experimental data is known that a number of different types is much more. Moreover, during last years a number of types of elementary particles shows very disquieting tendency to

increasing”, Dirak said in his brief Nobel lecture. In conclusion Dirak pointed to coming from the symmetry between positive and negative electric charges the possibility of existence of “stars...containing mainly of positrons and antiprotons. May be, one half of stars belongs to one type, and another – to other one. These two types should have had the equal spectrums and it would be impossible to distinguish them by means of the methods of modern astronomy”.

Consequently, several greatest scientists-physicists tried to create a single theory of the field that would allow to unite the quantum gravitation with the general theory of relativity. This problem hadn't been solved till the end, but reasonable progress was reached in it. In particular, Nobel Prize laureate, a great American physicist-theorist Richard Feynman is famous not only as the outstanding scientist, who made a great contribution into the quantum electrodynamics and gravitation, but also as a talented teacher, with the books of whom were educated more than one generation of physicists. Works of Feynman, in particular, his lectures (for example, “Feynman's lectures on physics”) are very famous in the world. It's indubitable, that the knowledge of the foundation of general theory of relativity is necessary not only for specialists on the theory of the field and physics of elementary particles but also for astronomers /5/.

First deep research of the problem of quantification of gravitation, which has brought to non-trivial physical results, was done in works of M.P. Bronstein, published in 1933-1936. He was the first who realized that the quantum theory of gravitation requires the fundamental review of the notion of space and time in the plan of uniting the relativistic and quantum ideas of that time.

His scientific outlook covered not only relativistic quantum theory and gravitation, but also physics of semi-conductors, a quantum electrodynamics, cosmology, nuclear physics and physics of atmosphere. His works in the sphere of quantum electrodynamics were referred to the questions of dispersion of gamma rays and determining the borders of applying formulas of Klein-Nishina, and to physics of cosmic rays. In one of the last works on nuclear physics, he made calculations of influence of magnetic moment of neutron on the interaction with the substance in which it is moving. These calculations were made at the instance of I.V. Kurchatov.

In 1935 M.P.Bronstein was engaged in the problem of quantification of gravitation and soon he wrote two works, which became his main contribution into the spheres of gravitation and cosmology. They served as the basis of his dissertation “Quantification of gravitational waves”, which he successfully defended in November of 1935 in Leningrad. V.A.Fok noted that the carried out research is “the first work on quantification of gravitational waves where the work was brought to receiving of physical results”. One of the most important results which kept their meaning till nowadays, is in global analysis of compatibility of quantum and general relativistic ideas. M.P. Bronstein examined the gravitation as

approximation of a weak field when the geometric character of the gravitational field cannot be considered. He received two important physical consequences: firstly, the formula for intensity of gravitational radiation, which coincided in classic limit with analogous expression of Einstein, and, secondly, Newton's law of gravity as a consequence of quantum-gravitation law of mutuality. The researches of M.P. showed the deep connections of classic and quantum variants of description of gravitation, what was evidence of possibility and necessity of quantum generalization of the theory of gravitation. Particularly, he showed the reason for which it is impossible to quantize the gravitation on the similarity of quantum electrodynamics.

In 1935 researching the conditions of approaching of a weak gravitation, he made analysis of measurability of gravitational field and came to the conclusion: "In the sphere of general theory of relativity where the deviation from "Euclideanity" can be any as much as it is possible...the possibilities of the measurement are still more limited, what can be concluded from quantum-mechanic correlation", and " without deep processing of classic notions it seems hardly possible to disseminate the quantum theory in this sphere". Thereby, for the first time were determined the boarders of application of general theory of relativity and was determined the distinction of quantum electrodynamics, not taking into account the structure of elementary charge and quantum theory of gravitation where the gravitational radius of exploratory body cannot exceed its linear dimensions. This was qualitative analysis of the boarders of application of GRT and certainly for quantitative values it is necessary the exact theory of quantum gravitation and a single theory of all fundamental interactions which are not built yet.

Nearly 17 years the more speculative and mathematical activity in the theory of elementary particles concentrated around the idea of changing the quantum theory of the field with the one that was known as a "Theory of Superstrings", but now it is called "M-theory".

The strongest scientific argument in favour of theory of strings is that it includes theory of gravity. Meanwhile it is not the quantum theory of gravitation yet.

Theory of Strings brought to many new struck mathematical results. The conception of "mirror symmetry" was very productive in algebraic geometry, and conformal theory of the field opened a new deep sphere of mathematics /13,14/.

The attempt to "reconcile" the general theory of relativity and theory of quantum gravitation by means of theory of strings, to our opinion, hasn't been success yet. What is the biggest problem of this dispute? To our opinion, it is first of all, connected with the absence of experimental proofs of quantum nature of gravitation. Taking into consideration the fact that the gravitation has very weak influence, it is considered that for finding out the quantum effects of gravitation are required the supersensitive technologies which the science doesn't have nowadays. But is it really this way? In the applied science are often met the

phenomena which try to explain by inaccuracy and incorrectness of experiments. But if hundreds of experiments carried out with maximum correctness bring to the same result, it is necessary to pay attention to these researches.

In the works /10-12/ are given interesting results which will allow to suppose that the results received in the experiments are evidence of ingress of quantum effects (E.Khalilov, 2004). In particular, in the work /1/ is given the information about finding put the gravitational quantum effects by means of the plant G-QUANTUM. The results received during the experiments, are different from the theoretically calculated effects. In the description of the invention /10/ is offered the original idea (E.N.Khalilov, 2005), which in further development, probably, can approach the confirmation of quantum nature of gravity.

In any case, the appearance of new results of experiments in the plant G-QUANTUM will allow to answer a number of questions, connected with the deviations of theoretically calculated and received in practice the effects in the applied sciences, in particular, in geophysics, and in fundamental researches of modern astrophysics.

The finding out the dark matter is one more phenomena of modern fundamental science, which cannot be explained by the theory of relativity. About 30% of mass of the Universe consists of dark matter, which is called "dark" because it doesn't radiate photons in any range of electromagnetic spectrum. The astronomers suspected of the existence of such kind of substance as long ago as the middle of last century, when they began to learn the rotation of our and other galaxies. Later the existence of the dark matter was found out in the gathering of galaxies, and the speeds of separate galaxies and temperature of hot gas in the accumulation were evidence of it.

In the works of outstanding scientist Kip Thorn a big attention is paid to quantum nature of gravity and to gravitational effects near black holes. His nonstandard ideas and researches can also shed the light to the problem of dark matter /16,17/.

Our Galaxy is a giant star system consisting of 150 milliard stars and interstellar gas and dust. Spreading of stars in it can be compared with a giant disk, the shape of which is approximately 100 thousand light years.

Stars of our Galaxy revolve around its center the same way as the planets of Solar system revolve around the Sun. Analyzing their movement can be determined the spreading of gravitational field, more precisely the gravitational potential. According to theory of gravitation of Newton, the field is created by the masses (stars), that is why it seemed that the spreading of gravitational potential must follow the spreading of stars. Studying the movement of stars showed that it is not like this. Consequently, two opposite conclusions can be done. The first one, the theory of gravity of Newton, created on basis of observations of movements of



bodies in our Solar system, isn't fair on change to systems of big shapes and masses such as the galaxies.

The second conclusion: not whole mass is concentrated in stars, there exist another type of mass which is also the material of which our Galaxy is built, but it isn't shown during observations. This mass got the name "dark matter". Both conclusions were many times discussed by the scientists and had their followers and opponents. However, the overwhelming majority of astronomers have the conclusion of existence of dark matter, considering the laws of Newton unfair in galactic ranges. It is mainly connected with large observation material on the existence of invisible matter in the galaxies, gathered to the modern moment of time. There exist both the Galaxies where there isn't invisible matter and the galaxies with a large number of dark matter. If the law of Newton should have modified for ranges of Galaxies, then all galaxies should have shown the presence of equal deviations from the law of Newtonian attraction. Besides, the invisible substance was found out in the gathering of galaxies where the spreading of gravitational potential can be also studied. Of course, the astronomers cannot trace the movement of separate galaxies in the gathering, but they can calculate the speeds of these galaxies on Doppler effect and thereby to measure the spreading of gravitational potential. Such measurements also show that there are considerably more gravitating mass in the gatherings than the visible one.

In the gatherings of galaxies there is gas which is in the equilibrium, that is why it is the hot gas. Its temperature allows to measure the gravitational potential of gathering. These data are conformed to the measurements of virial speeds of galaxies and show the presence of dark mass. Observations of extragalaxy gravitational lenses and microlens in halo of our Galaxy also prove the presence of invisible substance.

The measurements of anisotropy of relic radiation give the most accurate measuring of the quantity of invisible substance in the Universe.

They were carried out during last year in WMAP satellite, which made the radio-map of the whole sky in several lengths of waves from 1,4cm till 3mm. The measuring of anisotropy of relic radiation allowed to understand the physics of the early Universe and to measure its global parameters. One of such characteristics is the density of invisible substance. If the density of the whole substance of our Universe to take for 1, then the density of invisible cold dark substance will be 30%.

The nature of invisible substance is still the mystery. One thing is clear – the substance consists of the particles, which extremely weakly interacts with the usual substance. Neutrino, then axons and other elementary particles were the candidates into the dark matter.

So, the development of science and receiving of new data in the sphere of gravity allowed not only to come closer to the true understanding of its nature after first works of Newton on the gravity, but also raised new questions and

problems. For us it remained only to hope that nevertheless the mankind will be able to guess completely the mystery of gravity in new century.

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## REMOTE SENSING DATA AND GIS -TECHNOLOGY APPLICATION FOR ANALYZE OF NATURAL AND SOCIAL-ECONOMICAL CHARACTERISTICS OF AZERBAIJAN OFFSHORE ZONE

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### Abstract

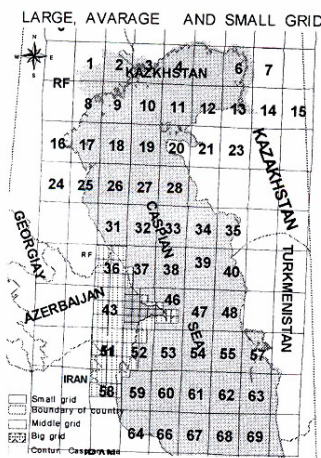
In this article will be consider the analyze of natural and social-economical characteristics of Azerbaijan offshore zone. These characteristics will be introduced in geoinformation system "Social- economical and natural offshore zone of Azerbaijan". Geoinformation system divides in three type's apriority information: space data from different times, digital thematically maps, ground information. Also thematically vector layers, which reflect different social-economical characteristics of offshore zone. The reason of creation this geoinformation system is that, Azerbaijan offshore zone we can call the zone of ecological disasters for many reasons: population density is much more than in whole Azerbaijan, developed industry and agriculture, oil industry and oil factory, migration of population, desertification, from natural factors is the influence of sea level fluctuation, windy and water erosion, and flooding.

The processing of materials of aerospace survey will be carried out in accordance with demands of GIS - technology that will permit in the form of layers to reflect on screen of monitor the influence of each factor of pollution separately and all taken together.

### Introduction

In the last century, the anthropogenic modifications of the coastal areas due to the increasing of human activities and to the exploitation of hydraulic and sediment resources of rivers have caused diffused beach erosion and more in general substantial modifications of the coastal asset.

Azerbaijani Caspian sea coast region is characterized by most concentration oil and gas industry, of population, overweening loading life and economic person activity, where technical actions on optimization an landscapes render alongside with positive influence, as well as negative, breaking their structure, transforming high potential geocomplexes in new, low fertile landscapes, with broken ecosystems. Taking into account adegree and scales of the phenomena occurring in coastal areas it is obviously, that the most essential problem is concluded in an establishment of interrelations between condition of natural processes in region and condition of steady development of region. That is, it is necessary to have the structured information on parameters of an environment for modelling of various modifications of the natural phenomena. The purpose of such modelling is the analysis and control of development of various ecological situations.



The main requirement at modeling is the reliability of the data. In model, represented by us, the reliability of the data is provided by the following ways: fixing of events through the data of remote sounding (on the last and present dates), presence of a cartographic material, field measurements, application of expert knowledge, observance of the greatest accuracy of geographical binding of an initial material. For perfection by process of information management, the structure of geoinformation model contains three levels of the description of environmental parameters: the first level corresponds to the description of Figure 1. Offshore zone in Azerbaijan parameters in small scale (in the basic

description of such large homogeneous areas as a surface of the sea); the second level corresponds to average scale (1:100 000) and to larger scale (1: 50 000) (Fig.1). According to this structure the territory is divided into squares, each square contains spatial-temporal information and geographically is adhered to a uniform cartographic projection. Such approach provides flexibility of structure and facilitates search system

The methods of local diagnostics of an environment can not give a complex estimation of a condition of natural object or process. Especially in the case when researched objects take vast areas {for example- the sea water surface) or locate in places difficult of access. It is well-known, that in such situations the role of the data received by devices and methods of remote sensing, satellite monitoring is very important. The satellite information in structure of model is systematized under the spectral resolution and is submitted by dates corresponding to

development of such natural phenomenon as a raising of the Caspian Sea level. In similar way the geo-ecological information was systematized through various scales.

The most difficult problem at construction of geo-information model in a digital type in the requirement of the greatest accuracy for geographical binding, for which performance was developed the special technique for transformation of the data in a uniform cartographic projection. GIS-technologies were used in these situations.

### Methodology

The overall methodology used for the study is presented in chart given in Figure 2. This methodology is based upon:

1. Processing and visual interpretation remote sensing data to obtain modification the coastal zone as on 1982, 1990, 1998,2000;
2. Arc View 3.2 GIS based integration of thematic information and land capability associations to develop modification map of coastal zone;
3. Analysis of existing infrastructures by processing space image;
4. Great the information models.

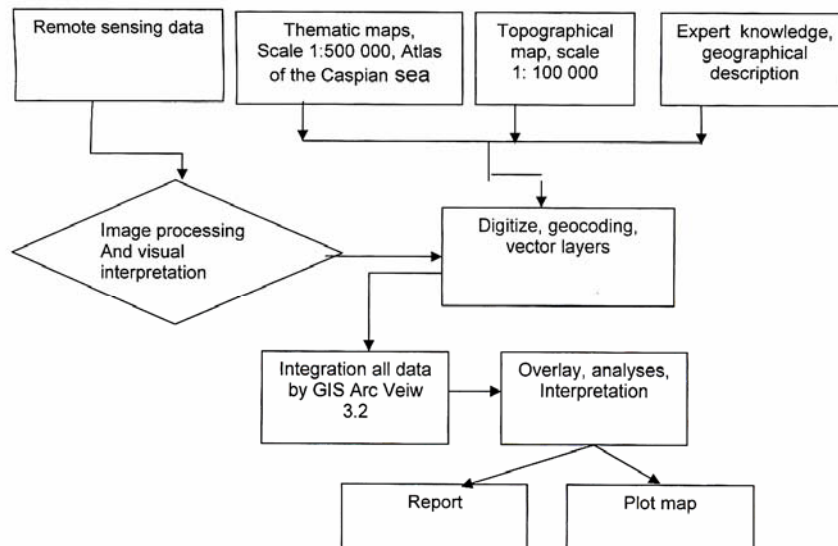


Figure 2: Flow chart of methodology

### Integration geoinformation and remote sensing data for mapping

The process of processing of RS data is traditional at the decision of the concrete task will be carried out in some stages: preliminary data processing; classification of test sites; recognition of all territory. Drawing up a-priori of the

model of investigated natural objects processes and post classification interpretation has become possible by GIS-technology and expert systems. Therefore optimum approach of processing of RS data is complex using of the automated and expert methods of the analysis, gathering and estimation of the received information. Using this complex method for the first time the digital model and unique database of geoinformation model for the territory of Azerbaijan offshore zone of a scale 1:50000 were formed.

### **Data processing**

The remote sensing (RS) signals the radiating image of natural objects are formed. The structure of a radiating image, obviously, is determined by structure and other characteristic properties of natural formation. So, for example, vegetation, water and soil the characteristic spectra have. However, not always it is possible to find unequivocal and strict conformity of a radiating image to his prototype. Taking into account depended to other type of space satellite and survey system space images can be have a different scale, view, spectral characteristics and geometrical resolution. Information of space images defines also natural conditions, season and time of survey, transparency of atmosphere, physical properties of investigated natural objects /1/. Usually a decision makes for natural procedure combination of various kinds of surveys (photographic, scanner, radar tracking, thermal etc.) is used. Most important is the correct choosing of the scale and spectral number of space images for reception of the maximum complete information about the investigated natural phenomenon. Therefore, we have unstable system of the space images, on which should decide a task for identification of natural formations. From the formal point of view the process of the analysis RS data includes: training on sample sites, during which is formed uniform elements of space and the images of investigated natural objects in the terms of the chosen attributes and distribution other data of training on all researched territory for allocation of natural objects, their classification etc. are described depending on a soluble task. The process of processing RS data is traditional at the decision of the concrete task will be carried out in some stages: preliminary data processing; classification of test sites; recognition of all territory. At drawing up a-priori of the model of investigated natural objects and processes the presenting concerning area of researches' basic characteristics and properties of investigated natural objects and processes are formed. At the stage of collection preliminary data and creation a-priori of model of researched object or phenomenon very perspective there is use of methods of electronic cartography.

The creation GIS on the basis of available a-priori of the data considerably raises efficiency of works reduces losses of the information and facilitates

coordinate binding multilevel of data. The complex of transformations for improvement of the initial images includes photometry and geometrical correction and other procedures. Besides for exact coordinate binding of results of processing SI at this stage makes the photoplay of researched territory in chosen scale with alignment of the image on brightness. The stage of the preliminary processing of RS data at present moment almost is completely automated. The influence of the expert form definition on the initial stage of character photometry and geometrical distortion of the image, their reasons and methods of elimination is necessary. The stage of processing of sample sites is very important. The sample sites get out on the well-investigated areas having the typical characteristics from the point of view of received earlier a-prior of model. A basis of the methodological approach at this stage is the transformation and complexes of spectrum bands of the images for increase by their visual information, i.e. reception of the integrated photographic characteristics of investigated objects and revealing of separate elements of their image in space information.

### **Image interpretation process. Materials**

Satellite snapshots of all territory of Azerbaijan offshore zone LANDSAT ETM, 2000; Topographic maps on the territory of Azerbaijan offshore zone (a scale 1:100 000); Thematic maps of different scales; Other data (statistics, instructions, theme books etc.);

The effective maps utilization of different scales at their computer processing is possible only under condition of their compatibility in unified for all maps cartographic projection. This problem was decided by selection of unified for all cartographic projection (projection G - K). ENVI v.3.2 and Arc View 3.2 program conformant complexes were used /2/.

### **Scheme of image interpretation process**

The preparation phase. On this phase all available thematic and topographic maps were scanned and located on HDD of the computer. For scanning the scanner EPSON GT- 12000 of A3 format was used. Naturally, that for maps, which format is more than A3 format, the scanning implemented by parts. Processing of raster data contains following stages:

Rectification of the scanned thematic and topographical maps. The processing of the raster data starts with rectification of all scanned thematic and topographic maps in an adopted cartographic projection. On each map 10-12 of like points were taken and the map to map transformation was implemented.

Rectification of the satellite images by separate. The process of rectification of the satellite images was implemented under the similar scheme. The main



requirement was legible identification of like points on the image and topographic map. For each display frame the greatest possible number of points was selected and image to map transformation was executed. Besides, a number of points were necessary for picking up on perimeter of a snapshot (not less than 3 on each side) for the subsequent docking of the maps on the same points with adjacent ones.

Masking of the urban areas and the territory of neighboring countries. At solving the problem of classification a number of objects yield to classification with difficulty. As a rule those are the objects such as cities, villages, plants and other industrial objects. It determines tangle at classification. At the same time, having some experience in work with the maps, it is possible already at visual image analysis to define legibly enough borders of cities, villages, industrial zones, water objects etc. Formation of the unified image.

The primary classification of main classes. The part, which has stayed after masking was subject for classification. Using thematic, topographic maps, and also image analysis it was possible to identify visually water objects, wood array, allotments etc. (according to a legend). Inside each of such objects were drawn the homogeneous sites - ROI. Statistics of such homogeneous sites was also, as a matter of fact, training classes. This statistics can be controlled and, if necessary new ROI can be removed or selected. After sufficient quantity of ROI was collected, the process of classification started.

### **Processing of vector data**

Clean-up of the resulting vector data. Classification of some number of pixels appeared unclassified. First, the flora on borders of two miscellaneous classes, as a rule, is always admixed. Second, for test classes we aimed to make picking of ROI on homogeneous sites of objects, but it did not mean, that the objects were uniform on all field of a snapshot. At last, on the image there could be objects, which were not included at all in number of test classes. One way or another at mapping of results of classification on a screen monitor they appear with some number of unidentified objects and the problem of the handler is to determine them. Thematic and topographic maps, and also the visual image analysis enable the handler to solve the indicated problem.

The vector data - GIS and database realization. The available in our disposal thematic maps of flora, administrative territorial division maps, geomorphologic maps etc. were of 1994-1995 yy. It is clear, that for 6-7 years flora of republic could not change cardinaly. It allowed to compare visually the data of a map to results of classification and to control them in indirect mode. On the basis of physical map, for example, were updated positions of open casts and mines, to recognize which on snapshots is rather difficult.

Creation of the general sketch of the project. The general arrangement of materials under the project for 9-th zone looked like this. Large squares are the space image. The part of a image inside state border was the subject for processing. A grid refers to the topographic maps.

Visual interpretation and manual digitization. The visual analysis and manual contouring with mandatory updating of the database are indispensable attributes of processing. The updating of separate results was conducted continuously in the process of obtaining the new data, estimation of the data field trip, judgment of the specialists, coming to the organization from places. As a matter of fact, this updating can be prolonged up to the moment of a beginning of maps printing.

Direct verification of the interpretation in the field. At image analysis, certainly, there were disputable moments. For example, in the given site of the map the vineyards were routine, and the analysis of frame of a snapshot did not confirm it. The same situation took place with tea plantations. For the solution of such conflict situations the field trips were organized and already in place these moments were concretely rendered. By GPS borders of those fields were determined, all this was fixed on the schemes, the data were entered in the workers' notebooks etc. Verification and correction of polygon vector files. On returning to the office the results of field trips, certainly, were laid down in the basis of activities on updating the results of processing. Under the indications of GPS in a field the precise place of the objects on the map was determined and already uniquely the class of the given object was indicated in the database.

- Verification and correction of line vector files (rivers, roads, channels, railways). Separately from range of \*.shp files dispositions of linear \*.shp files were also made. This work was also complex one requiring large accuracy and attention. For example, the motorways very often go parallels to railway, multiply intersects it, and consequently at digitization of the railways and motorways it was necessary to be very accurate.

- Check-up of the conformity of the image interpretation with the legend. The next step of the control was a check of conformity of the database and results of image processing.

## **Results and discussion**

Under the initial information 25646 units of natural formations were allocated. Further they were generalized on the most representative classes land use of the region in a legend. It is quite understandable tendency to include the most representative classes of the region in a legend and, consequently, after numerous discussions, field trips and consulting from our experts we have stayed on a legend, which contains classes: landuse, land cover, social-economical characteristics, change landuse, agriculture, oil industry and oil factory, migration

of population, desertification, the influence of sea level fluctuation, windy and water erosion, and flooding and e.t.c.

The multispectral image data was classified using a maximum likelihood operator. Before actually performing the classification, the reparability of training classes was estimated by both statistical (transformed divergence measure) and graphical methods (histograms), also by geoinformation modeling.

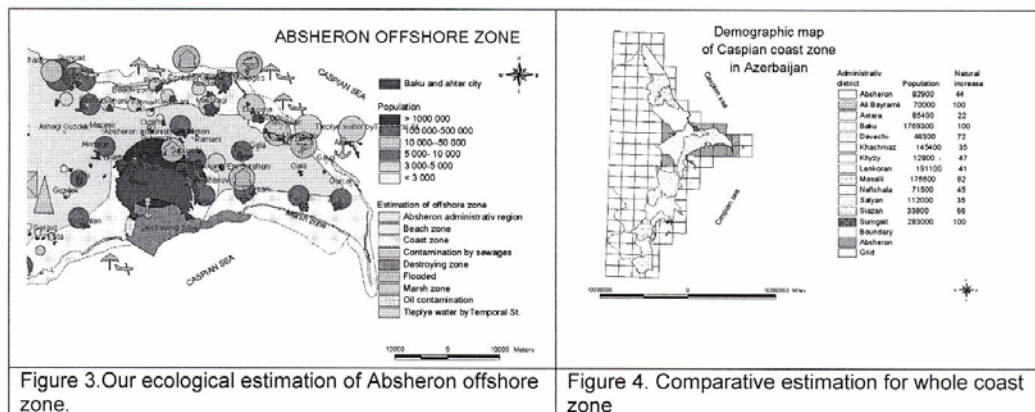


Figure 3. Our ecological estimation of Absheron offshore zone.

Figure 4. Comparative estimation for whole coast zone

**Demographic estimation happen to in table 1 for Absheron offshore zone and administrative region of the coast zone. The table 1 and demographic map show most density of the population on Absheron peninsula.**

Table 1

ID	REGION of COAST ZONE	Density of the population (1000)	Degree Urban (%)	Populati on 2000 year	Population 2004 year	BIRTH	Natural increase	DEATH
1	Lenkora	127	44	191100	197,9	17,1 -20,6	11,3	6.1-8.3
2	Khyzy	7	47	12800	13,9	15,1 -17,0	8,0	6.1-8.3
3	Masalli	222	82	175500	184,9	17,1 -20,6	13,2	3.1-6.0
4	Astara		22	83400	90,9	17,1 -20,6	15,0	3.1-6.0
5	Khachm	139	35	145400	152,8	7,1 -20,6	11,6	6.1-8.3
6	Devechi	43	72	46300	48,6	17,1 -20,6	12,1	6.1-8.3
7	Siazan	48	66	33800	35,8	17,1 -20,6	12,2	6.1-8.3
8	Baku	820	100	1769300	1855,0	0,6-15,0	7,6	3.1-6.0
9	Neftchal	49	45	71500	75,5	17,1 -20,6	10,9	6.1-8.3
10	Ali	233	100	70000	72,8	0,6-15,0	8,2	3.1-6.0
11	Salyan	63	35	112000	117,4	0,6-15,0	8,0	3.1-6.0
12	Khagika	0	0	0	61,0-	15,1 -17,0	14,8	3.1-6.0
13	Sumgait	341	100	283000	292,5	0,6-15,0	7,7	6.1-8.3
14	Abshero	61	44	829000	91,6	15,1 -17,0	9,2	6.1-8.3

Using this complex method for the first time the digital model and unique database of Land Cover/Land Use, of natural and social-economical

characteristics for Azerbaijan offshore zone were formed. The obtained thematic maps to scale 1:50 000 were bound to a system of qualifiers, designed in FAO (LCCS) /3/.

The formed digital model of Azerbaijan offshore zone can be utilized for the control of dynamic changes of a vegetative cover. Our own experience in solving similar tasks allows us to conclude that optimum approach of processing of RS data is complex using of the automated and expert methods of the analysis, gathering and estimation of the received information.

Our geoinformation system contains much information of social studies in the manner of thematic layers. It is population density is much more than in whole Azerbaijan, developed industry and agriculture, oil industry and oil factory, migration of population, desertification, from natural factors is the influence of sea level fluctuation, windy and water erosion and flooding. On figure 5 and 6 are shown as was used image Landsat TM for estimati

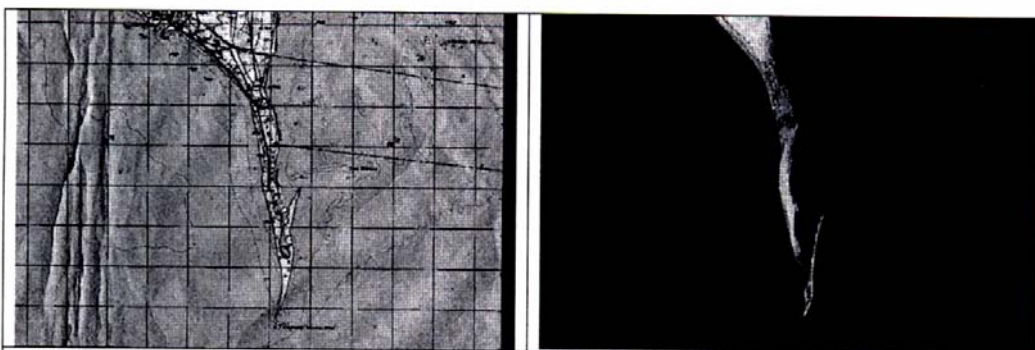


Figure 5. In contrast with topographical map is seen zone of the flooding the peninsula

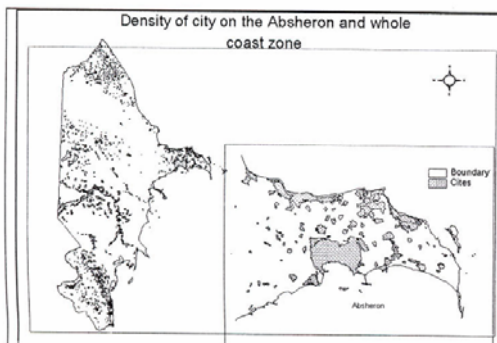


Figure 6 Scheme is received on image Landsat TM, 2000year

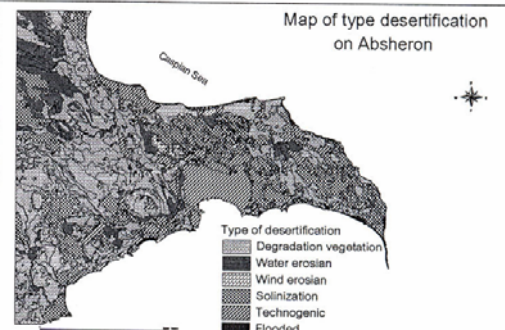


Figure 7. Map of type desertification is received when processing of image Landsat TM, 2000year

Otherwise on shown scheme we see as natural and human factors influence upon ecological condition of the coast zone. So much it is important to have got full geoinformation system for region. It is important that in creation geoinformation

system we used occurring at different times data of remote sensing as the most real image to reality.

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## **„DANCING THE QWANT“ – DUO FOR OBOE (ENGLISH HORN) AND CLARINET (2005)**

**Sebastian Themessl**

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The composition was written for the opening of the International Academy of Science in September 2005 in Innsbruck by commission of Prof. Walter Kofler. It should illustrate (a kind of parable) the fundamental thoughts of the Qwant-theory formulated by Walter Kofler in a musical-playful way. I decided for the composition to concentrate on one phenomenon: the acoustic touch of two instruments and their process of building up common ciphers of communication by re-acting on each other.

For the first performance we had a special room-situation: the musicians were positioned each in a different room, so that they could only hear but not see each other and had no possibility to interact but acoustically. The audience was sitting in a third room, from where it could follow the whole proceedings.

The piece is arranged in five parts:

- a) The approach: - meeting and imitation; first with the most “primitive” techniques – blowing, knocking – and afterwards with melodic motives (based upon a row of overtones).
- b) 1. Variation: a more free movement on the base of the material developed in “a”.
- c) Cadence: showing very different possibilities of the instruments and leading to the ...
- d) 2. Variation: a point of crisis (bass clarinet changes to clarinet), causing a process of changes, in which the really extreme limits of the instruments are to be heard.
- e) To conclude I chose a finale (“coda”), in which a very harmonic atmosphere is intonated - with a sense of “local colour” (“Ländler”). The instrument-change from oboe to English horn finally symbolizes the open character of the whole process.

The image shows a handwritten musical score for two instruments: E. Flute (E. Fln.) and Bkl. (Clarinet). The score is divided into six systems, each containing a staff for the flute and a staff for the clarinet. The measures are numbered 47, 49, 51, and 53. The notation includes various musical symbols such as notes, rests, slurs, and dynamic markings like *f*, *p*, *pp*, and *cruc.*. There are also some handwritten annotations and a small musical symbol with the number 5) at the top right.

The first performance on September 18<sup>th</sup> 2005 was played by Ning Ching Zeller-Chen (Oboe) and Stephan Moosmann (Clarinet). Sebastian Themessl (\*1975) is living as free-lance artist in Vienna and Innsbruck.

Within these few lines cited from the composition the changing from the initial approach to the 1<sup>st</sup> variation can be observed.

6)

Handwritten musical score for two systems, each with two staves (E-flat 4/4 and B-flat 4/4). The score includes various musical notations such as notes, rests, and dynamic markings like 'p', 'f', 'cresc.', and 'rit.'. The first system starts with a box containing '53' and ends with a box containing '54'. The second system starts with a box containing '54' and ends with a box containing '55'.

5)

Handwritten musical score for two systems, each with two staves (E-flat 4/4 and B-flat 4/4). The score includes various musical notations such as notes, rests, and dynamic markings like 'f', 'p', 'cresc.', and 'pp'. The first system starts with a box containing '47' and ends with a box containing '48'. The second system starts with a box containing '48' and ends with a box containing '49'.



## **ABOUT POSSIBILITY OF EXPERIMENTAL FINDING OUT THE GRAVITATIONAL QUANTUM EFFECTS**

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### **ARE QUANTA THE FUTURE OF THEORY OF GRAVITY?**

Quantum mechanics, the third constituent part of quantum theory of gravity, was created in 1925 by V.Geizenberg and E.Schrodinger, but in its initial wording the theory of gravity wasn't paid attention to. Nevertheless, it was a great success, as were waiting for their explanation for a long time the experimental observations, where dominated namely quantum effects, but relativist effects played little or trifling role. Despite the active researches during a few last ten years, the quantum gravity hasn't been built. The main difficulty in its construction is that two physical theories which it tries to connect together – the quantum mechanics and general theory of relativity (GTR) – are guided by different set of principles /5/. So, the quantum mechanics is formulated as a theory of moving of particles against the background of external space-time. There isn't external space-time in the whole theory of relativity: it is the dynamic variable theory itself.

In view of mentioned problems the attempt to do the quantification of classical theory of gravity (GTR) causes many technical problems. The situation is aggravated by the fact that the direct experiments in the sphere of quantum gravity aren't accessible to modern technologies. In this connection, in the search of right formulating of quantum gravity, it can be guided only by theoretical calculations. What way is the transmission of gravitational energy carried out in quantum gravity? It is supposed that the gravitational powers are transmitted by means of special particles, which don't have the masses – gravitons. The main distinctive peculiarity of elementary particles of different families is a spin, which can be represented as a result of revolving of particles on their axes. Spin of electrons, protons and neutrons is  $\frac{1}{2}$ , and the spin of particles which don't have mass, as, for example, photon, is 1. Consequently, all exchange particles of strong and electromagnetic interaction has a spin equal to 1, that is why the equal particles are repelled (for example, two electrons), and the particles with opposite charges are gravitated (for example, electron and proton). It is considered that

graviton has a spin equal to 2, as all interactions with the exchange with particles which have a spin equal to 2, are characterized only by attraction /9/.

In 1976 D.A.Freedman, P.van Nivenscheizen and S. Ferrara, and independently of them S.Deser and B.Zumino was elaborated a theory of super-gravity. In this theory is considered the only kind of particle – super-particles. This particle can be as any particle, which carries out the interaction, including a quark or lepton (“light” particle, for example, electron), connecting on this way the gravity with the rest interactions and particles. Using this approach, there appears the opportunity to build a theory of gravity, having been based on the notion of graviton which has a spin 2, at that the particles of the substance are interacted, exchanging with gravitons in accordance with the equations of the general theory of relativity of Einstein.

In this case a long-ranging power of gravity is a result of exchange with gravitons. Theory of super-gravity also supposes the existence of massive particles with a spin  $3/2$  – gravitino.

Meanwhile, theory of super-gravity aren't able to explain all variety of really existent particles and the variety of their masses yet, and most likely it isn't able to solve this task.

Theory of strings is a direction of mathematical physics, which studies the dynamics not of punctual particles as majority parts of physics do, but of one-dimensional extensive objects, the so-called strings. Within this theory is postulated that all fundamental particles and their fundamental interactions appear as a result of fluctuations and interactions of ultramicroscopic strings, the length of which is about  $10^{-35}$ m (Planck length). Theory of strings appeared in the middle of 1970-s as a result of development of string model of building of hadrons. The middle of 1980-s and the middle of 1990-s was marked by rapid development of theory of strings, and it was expected that in the nearest time on basis of the strings will be formulated the so-called “united theory” or “theory of everything”, to searching of which Einstein unsuccessfully devoted tens of years. last years the theory of strings was confronted with serious difficulty called problem of landscape, the essence of which is that the theory of strings allows the equitable existence of a great deal of different universes, not only the one where we exist.

Nevertheless, the elaboration of theory of strings stimulated the development of mathematical theories, mainly algebraic and differential geometry, topology, and allowed to understand the structure of substance and quantum gravity more exactly. During last years the original ideas of Kip Thorn hold much favour. He is considered one of the founders of modern quantum gravity /8/. So, it is considered that the direct experiments, proving the quantum nature of gravity are impossible now. But can be done the experiments, indirectly proving the existence of gravitational quantum effects. Possibility of carrying out such experiments was described in the works /10,11/. Subsequently, the works on planning of experiments in the sphere of

quantum gravity brought to creation of new technology of finding out the gravitational quantum effects, described in the works /1,10/.

### **THE RESULTS OF EXPERIMENTS AND QUANTUM GRAVITATION**

The experiments carried out by us in the G-QUANTUM plant, allowed to receive non-standard results which can't be explained by means of existent ideas, based on general theory of relativity. G-QUANTUM plant is the invention of the author, for which he had received a patent and the application PCT was drawn up (Geneve, 2005, /10/).

The plant consists of two big masses, 25 tons each. As a mass were used two standpipes, which can be filled with water and empty on necessary quantity. The vessels are placed one above another in such way that the distance between the roof of lower vessel and the bottom of higher vessel is 2,5 meters. Between two vessels on the weight of 1,25 meters from the roof of lower vessel were placed two gravimeters, which measure the changes of gravity  $\Delta_g$  during filling and emptying the vessels.

Different experiments have been become to be carried out in this plant since 2003, and 100 experiments have been done by now.

In this article we'll describe only two types of experiments. These experiments were repeated more than 30 times and their result has a coefficient of correlation 97%.

For carrying out these experiments four high-accuracy quartz gravimeters of GNU-KV and GNU-KS models were simultaneously used. Appearance of the plant is shown in the photo.

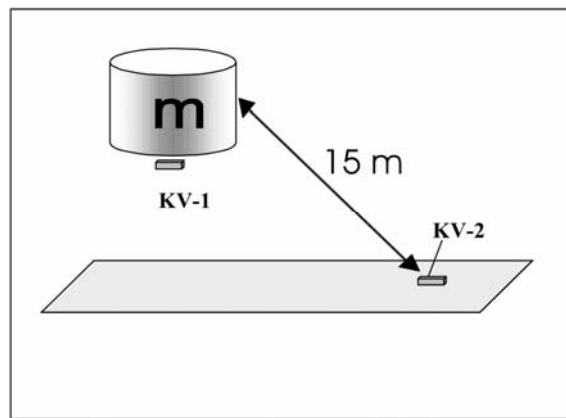


**Photo of G-QUANTUM plant (E.N.Khalilov, 2003).**

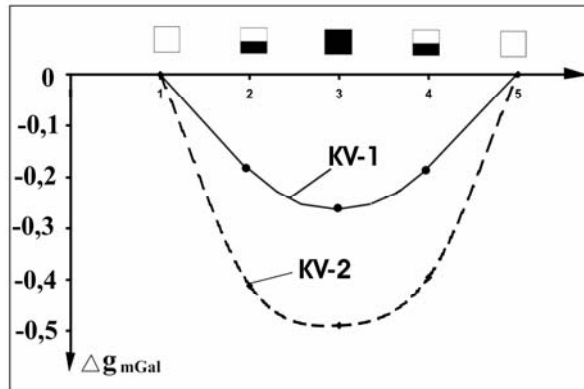
During measuring of gravity the tidal variations of gravity from Sun and Moon were subtracted from the results of measures. during using the gravimeters was also compensated the known effect, called “zero-drift”. Zero-drift is the changing in time of zero-mark of gravimeter, what is connected with constructive properties of the device. Zero-drift was taken into account in the following way. At the beginning of the experiment all gravimeters measure the gravity with empty vessels. After finishing the experiments, all gravimeters also measure the gravity with empty vessels. Then is determined the difference between first and last measurements, is built the rectilinear graph, and the compensatory value of gravity is entered for each position of measurement. Because of this operation, the compensation of “zero-drift” is evenly distributed for all measurements.

### EXPERIMENT 1

During first experiment two gravimeters were in the center between the vessels in the distance of 1,25m from each vessel. Other two gravimeters were on the Earth’s surface in the distance of 15 meters from higher vessel. In the experiment 1 the lower vessel wasn’t used and always remained empty. During measurements 1 higher vessel was empty and were carried out the simultaneous measurements of gravity with all four gravimeters. Then a higher vessel was filled with water by half with the weight 12,5 tones. Also were measured the values of gravity with all gravimeters. After that the lower vessel was completely filled with 25 tones water and made the third measurement. Then a higher vessel was emptied by half and made the fourth measurement. The last fifth measurement was done with empty higher vessel. As it was described above, from these results were subtracted the changes of gravity, connected with lunar and solar lugs and “zero-drift” of the gravimeter. The result of this experiment is shown in the graph, Fig.2.



**Fig.1. Scheme of the experiment 1. M – vessel with water;  
KV-1 – gravimeters under the vessel;  
KV-2 – gravimeters in 15 m distance from the vessel.**



**Fig.2. Practically observed values of gravity during changing the weight of the mass  $m$  (experiment 1).  
1-5 – numbers of measurements of gravity.**

It was to be expected that all gravimeters showed the decreasing of gravity as filling a higher vessel with water, as a mass of water in a higher vessel attracted a trial mass of gravimeters in a higher direction showing the decreasing of gravity. But the paradoxical were the values of decreasing the gravity, received for higher and lower gravimeters. It turned out that the gravimeters KV-1 which are placed directly under the vessel in 1,25 m distance showed more than 1,78 times less value of decreasing the gravity, than the gravimeters KV-2 which are in 15 meter distance from higher vessel on the straight line. The maximum value  $\Delta g$ , received by the gravimeters KV-2 was  $-48$  mGal and for KV-1 was  $-0,27$  mGal. We could consider this result mistaken and absurd, if it wasn't repeated 30 times in a row. So, this result contradicts the law of gravity of Newton and theory of gravity of Einstein. It is known that the power of gravitational interaction of masses is inversely as the square of distance between them. But we see the opposite picture.

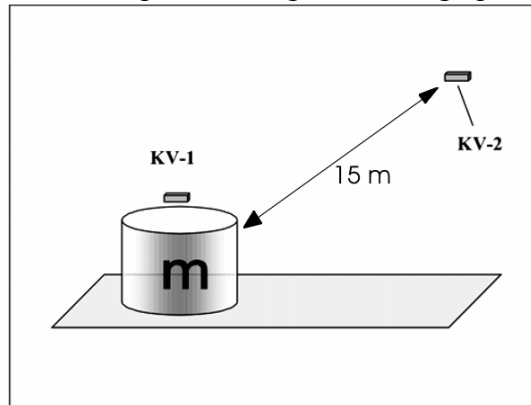
I think we mustn't hurry to explain everything by the malfunction of all gravimeters at the same time. For excluding the influence of possible errors of devices, higher and lower gravimeters were repeatedly changed their places, but the result was the same.

If we proceed on general theory of relativity, then this result indeed can be considered paradoxical. But if consider this experiment from the point of view of quantum theory of gravity, then the received result can be explained by development of gravitational quantum effects. We'll consider all interacting masses: Earth, vessel with water and trial mass of gravimeter. In quantum theory of gravity must be kept all principles of corpuscular-wave dualism, i.e. gravitational radiation must have both the properties of corpuscles and wave properties. In this case must be observed such effects as reflection and absorption of quanta by different substances. In this case the vessel with water can be considered as a screen

which partially reflects the quanta of gravity (gravitons). Gravitons, reflected from the vessel with water, are directed downstairs towards the Earth and influence on trial mass of gravimeter, decreasing the effect of attraction of mass of water. At the same time, on the gravimeters, situated aside the vessel with water in 15 m distance, don't affect the gravitons reflected from mass of water, and lower vessels register the clean gravitational effect, caused only by mass of water. So, to our opinion, the received result, can be explained by the presence of partial gravitational reflection of mass of water in higher vessel of gravitons, radiated by the Earth. Decreasing of this effect with decreasing of mass of water is evidence of the fact that mass of water has volumetric reflection which depends on thickness of sheet of water.

## EXPERIMENT 2

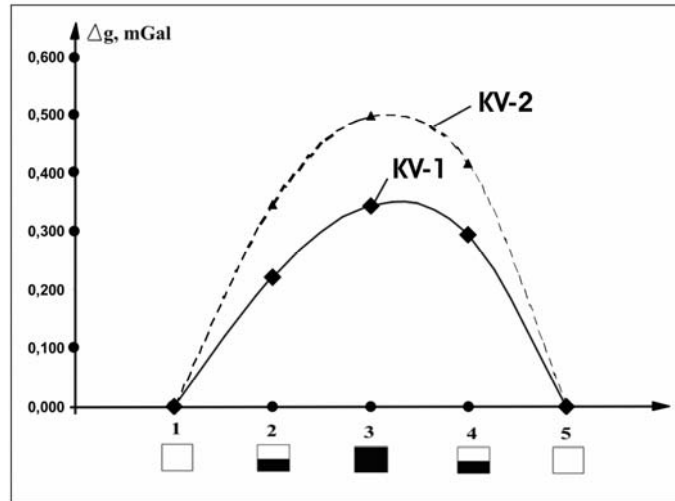
During the second experiment two gravimeters were situated in the center between vessels in 1,25 m distance from each vessel. Other two gravimeters were above the earth higher than a lower vessel in 15 m distance from a lower vessel. In experiment 2 a lower vessel wasn't used and was always empty. During the measurement 1 a lower vessel was empty and were done the simultaneous measurements of the gravity with all the four gravimeters. Then a lower vessel was filled by half with 12,5 tones of water. Also were measured the values of gravity with all the gravimeters. After that a lower vessel was completely filled with 25 tone of water and was done the third measurement. Then a lower vessel was emptied by half, and the fourth measurement was done. The last fifth measurement was done with empty lower vessel. As it was described above, from the results were subtracted the changes of gravity, connected with lunar and solar lugs and "zero-drift" of the gravimeter. The result of this experiment is given in the graph, Fig.2.



**Fig.3. Practically observed values of gravity during changing the weight of the mass m (experiment 2).**

**KV-1 – gravimeters under the vessel;**

**KV-2 – gravimeters in 15 m distance from vessel.**



**Fig. 4. Practically observed values of gravity during changing the weight of mass  $m$  (experiment 1). 1-5 numbers of measurements of gravity.**

It was to be expected that all gravimeters showed the increasing of gravity as filling a lower vessel with water, as a mass of water in a lower vessel attracted a trial mass of gravimeters in direction of the Earth showing the increasing of gravity. Again the paradoxical were the values of decreasing the gravity, received for higher and lower gravimeters. It turned out that the gravimeters KV-1 which are placed directly above the lower vessel in 1,25 m distance showed less than 1,46 times value of increasing the gravity, than the gravimeters KV-2 which are in 15 meters distance from lower vessel on the straight line. The maximum value  $\Delta_g$ , received by the gravimeters KV-2 was 0,5 mGal, but with KV-1 gravimeters it was 0,34 mGal. The difference in maximum registered changes  $\Delta_g$  reflecting the influence of mass 25 tones of water on indications of gravimeters KC-2 in first and second experiments is 0,37 mGal. The amplitude of the received deviations of gravity almost in 100 times exceeds the sensitivity of the gravimeters, which we used.

#### HOW TO EXPLAIN UNUSUAL RESULTS OF EXPERIMENTS?

In the first experiment the gravitons reflected from a vessel with water are directed down, towards the Earth and they influence on trial mass of gravimeter KV-1, which is situated under the vessel, decreasing the effect of attraction of mass of water.

So, the resulting power of attraction  $F_1$  of mass of water in a higher vessel on trial mass of gravimeters KV-1 will be:

$$F_1 = F_W - F_E,$$

where  $F$  is a resulting power of attraction for gravimeters KV-1,  $F_W$  is power of attraction of mass of water in the vessel;  $F_E$  is a power appearing as a result of screening by water the gravitational quanta, radiated by the Earth.

At the same time, on gravimeters KV-2, situated in 15 meters distance from vessel with water don't effect on the gravitons, reflected from mass of water, and these gravimeters register a clean gravitational effect, caused only by mass of water. For KV-2 the resulting power of attraction  $F_2$  is:

$$F_2 = F_W$$

So, to our mind, the received results can be explained by presence of gravitational quantum effects – partial gravitational reflection and absorption the gravitational energy of quanta by the masses.

So, the gravitational constant  $G$  in vacuum and  $G$  in medium will be differed. For calculating the absorbed energy we enter the coefficient of volumetric reflection of gravitational energy – the coefficient  $Kh$  (factor of  $Kh$ ) /11/.

$$Kh = G_m/G_v,$$

where  $G_m$  is gravitational constant in medium;  $G_v$  is a gravitational constant in vacuum.

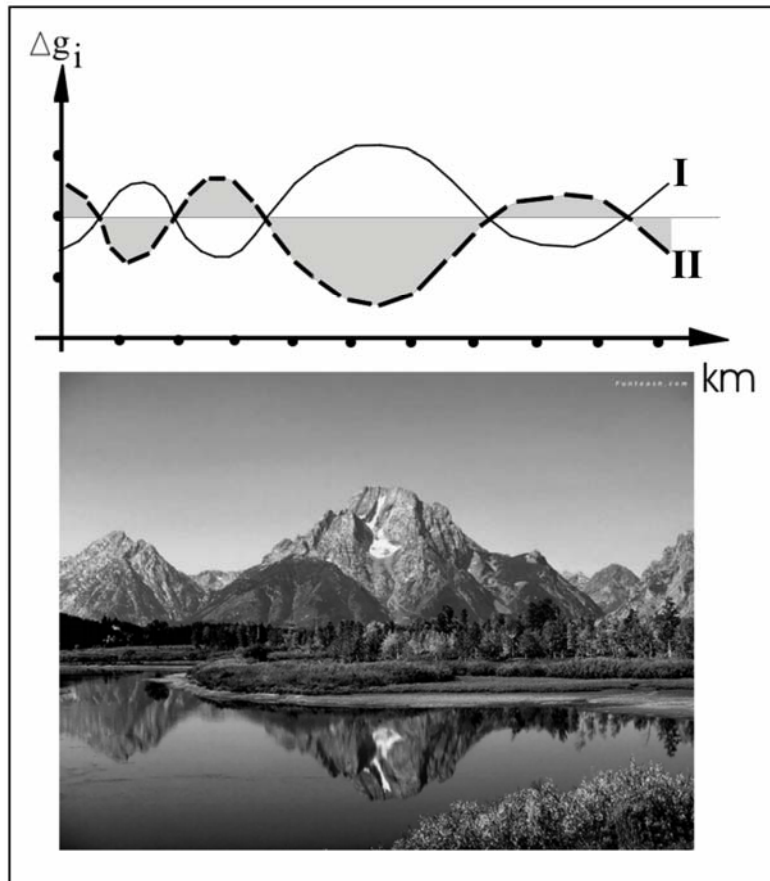
During interaction of masses in vacuum the coefficient  $Kh=1$ . During interaction of masses in medium the coefficient  $Kh<1$ .

Planning of these experiments and supposition of receiving such results we described as far back as 1989 in the book “Cyclicality of natural cataclysms and some problems of gravitation” /11/.

#### **POSSIBLE EXPLANATION OF PARADOX OF “ISOSTASY”**

Isostasy, isostatic equilibrium (Greek “isostásios” – equal in weight), equilibrium position of the Earth's crust, where it is situated on hard heavier substance quasi it swims on it according to Archimedean principle.



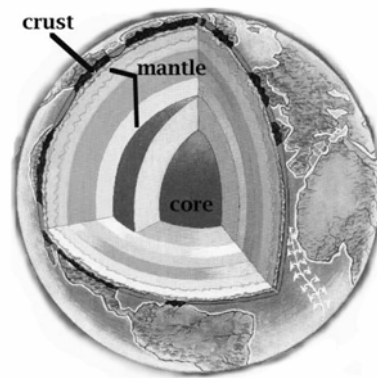


**Fig. 5. Distributing of practically observed values of gravity over mountains and cavities.  $\Delta g_i$  – values of gravity; I – practically calculated graph; II – graph on basis of practically registered results.**

Namely such isostatic model was offered by J.Eri in 1855. The same year F.Pratt offered a bit another model of isostatic compensation of relief irregularities. To his opinion, a bottom of the Earth's crust is flat, therefore the compensation must be realized at the account of change of density in different blocks of crust. Average density of the Earth's crust under mountain relief must be less than under cavities. The term "isostasy" was entered into the literature by American geologist K.Detton in 1889. The classical example of fulfilling the principle of isostasy can be icebergs the most part of which are situated under water. In connection with isostasy the bottom the Earth's crust is the deeper immersed into the substance of mantle, the thicker and heavier is the crust, because the mountains have "roofs", i.e. the situated under them the lugs of the crust down. In Fig.5 is shown that the practically observed value of gravity over

the mountains is lower, but over the cavities is higher than the values which must be observed basing of the theory of gravity. This paradox is observed on the squares of our planet and is found out by geophysicists during studying the gravitational field of the Earth /2-4/. Geophysicists tried to explain the observed fact by the existence of anomalous light substance of the mantle under mountains and anomalous dense substance under plains. Difference between practically observed values of gravity and theoretically calculated ones is called isostatic anomaly of gravity. Isostatic anomalies of gravity which were found out by geophysicists, reach several hundreds milligals over mountains and deep-water cavities. The calculated surpluses and lacks of masses are called “isostatic compensation” /2-4,7/.

In what way the results received during experiments can explain the isostatic anomalies of gravity over mountains and cavities? The matter is that the main gravitational energy of the Earth is concentrated in its core, which consists of hard and heavy substance. Earth core is a central part of our planet. It consists of iron-storage alloy with admixture of other elements. It has two parts: hard internal one with a diameter of about 2400 km, and liquid external one with a diameter of about 7000 km (Fig.6).



**Fig. 6. Internal structure of the Earth.**

In internal core is taking place the active convective heat transmission. This movement of huge masses of metal creates magnetic field of the Earth. In the core is concentrated 31,5% of all mass of the Earth. So, if to be guided by results of received experiments, then it can be assumed that a part of gravitational energy, radiated by the Earth core in the form of gravitons, is screened by the layers of the Earth – mantle and lithosphere, situated above the core. Of course, the more the thickness of the layer above the Earth core, the higher the screening of gravitational energy. If to take into account that the mountains are the most

reinforced areas of the Earth crust, then we can understand that namely above the mountains must be observed the biggest reflection of gravitational energy and the least values of gravity. Meanwhile, the Earth's crust is the thinnest over the deep cavities, consequently, the screening of gravitational energy, radiated by the core in this sphere will be minimal, and the observed values of gravity will be minimal. Namely such picture of distributing the gravitational field is registered in geophysics.

### **POSSIBLE EXPLANATION OF PARADOX OF "DARK MATTER"**

About 30% of mass of the Universe consists of dark matter, which is called so because this matter doesn't radiate the photons in any range of electromagnetic spectrum /6/. In what way was a dark matter observed? The matter is that the stars of our Galaxy are revolved on its centre the same way as the planets of Solar system around the Sun. Analyzing their movement, the distributing of gravitational potential can be determined. In accordance with theory of gravity of Newton, the gravitational field is created by the masses (stars), based on which the distribution of gravitational potential must influence on distribution of stars.

Studying the movement of stars didn't confirm the calculations, made on basis of theory of gravity of Newton. In connection with these results, the astrophysics came to the conclusion that not all the mass is concentrated in stars, but there is also another type of mass which a special kind of substance has and it is called "dark matter". Nature of invisible substance is still a mystery. One thing is clear: a substance consists of the particles which exceedingly weak interact with usual substance. The candidates into dark matter were neutrino, then axons and other elementary particles.

The put forward by us conception of partial screening of gravitational energy of the Earth core by the overlying layers is distributed on other stars and planets too. If to proceed from this assumption, then it becomes obvious that the registered on the Earth the value of gravity doesn't reflect the true mass of the Earth, which must be considerably higher that the observed value. Probably, namely this, absorbed and screened part of energy of cores of planets and stars is hidden mass and shows itself in the form of a "dark matter". Here arises natural question: if a part of gravitational energy of planets and stars, being radiated by their cores, is absorbed by the overlying layers, then, in what way can this gravitational energy be shown in the form of a "dark matter"? We'll try to answer this question. Holding the quantum theory of gravity, on which is being spread the corpuscular-wave dualism, we can affirm that the radiation of gravity by planets and stars in the form of quanta must take place in wide range of frequencies. In our experiments with gravimeters, we can register the gravitational energy only in very narrow high-

frequency range. It is stipulated by small sizes of trial masses of gravimeter, which plays a big role of antenna catching gravitons, radiated by the Earth.

Where is gravitational energy, absorbed layers of the Earth. Conforming to the law of conservation of energy, we may confirm that energy doesn't appear but is converted to more low-frequency part of the spectrum. The bigger is the diameter of the layer, absorbing the gravitational energy of the Earth core, the more low-frequency gravitational radiation proceeds from this layer. This low-frequency radiation with length of waves in thousands of kilometers cannot be registered by the devices on the Earth, because for registration of low-frequency gravitational quantum radiation is required the object (antenna), the sizes of which are commensurable with the length of the wave. I.e. low-frequency radiation cannot feel the gravimeter, but another planet or star can. So, we come to the conclusion that available information about masses of planets and stars doesn't take into account "latent gravitational energy", radiated from their cores and partially absorbed by overlying layers.

If to take into account the results of our experiments, then we can suppose, that in reality, mass of the Earth the same way as other stars and planets, is about 30% higher than it is officially considered. Consequently, our conception supposes that the Universe is permeated with low-frequency gravitational radiation of stars and planets, which aren't able to feel standard devices, but namely this radiation makes "additional contribution" into the trajectories of stars and planets and into unaccounted earlier potential of Universe, which is called "dark matter"

#### **CONCLUSIONS:**

Several important conclusions have been made in this work:

- experimentally were received the gravitational effects, which cannot be explained from the point of view of general theory of relativity.
- interpretation of results of the experiments bring the author to the conclusion about experimental finding out the effects of gravitational screening by substances the gravitons, radiated by the Earth;
- is put forward the conception, according to which, the calculated and taken as a basis in modern science, the masses of the Earth and other planets and stars are reasonably lower than the real value of their masses;
- is offered the explanation of paradox "ISOSTASY" in geophysics and paradox "DARK MATTER" in astrophysics from the point of view of latent mass of the Earth, discovered by the author;
- is supposed, that "dark matter" is the appearance of low-frequency gravitational radiation of stars and planets, which cannot physically be registered with standard devices because of extremely big length of waves of gravitational quantum radiation.

This article can symbolically be divided into two parts: actual and conceptual. The first part of our scientific researches is devoted to description of experiments and their results. The received results of experiments 1 and 2 are the facts, which require their explanation. Therefore, the experimental part of the work we have to accept as objectively existent reality.

In the second part of the article we made an attempt to explain the results of experiments by means of suggested conception based on quantum theory of gravity. Time and researches of other scientists in this sphere will show how much we could approach the truth in our argumentation. I invite the scientists of different spheres of science (fundamental physics, astrophysics and geophysics), who are engaged in modern problems of gravity, to the open dialogue and discussion of the received results.

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## STUDYING INFLUENCE OF ELECTROLYTES ON PERMEABILITY OF CLAY SCREENS TO WATER

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The permeability of clay soil is known to determine by the magnitude and kind of distribution of pores. The change of the balance of forces in the clay under a load because of the change of hydrochemical mode may cause different results. For instance, any decrease of ion electrostatic pushing because of the increase of the concentration of electrolyte in liquid phase of soil, especially because of the ions  $\text{Ca}^{2+}$ ,  $\text{Fe}^{3+}$ ,  $\text{Al}^{3+}$  brings to additional compressing clay. The process is conducted as lessening water contacts and accompanied on the first stage by enlarging the sizes of macropores, in other words interaggregate and interblock pores in which there doesn't appear wedging pressure. As a result, in the clay soil which is in a plastic state there takes place the process of redistribution and reorientation of microfractions bringing to filling large pores with thin – fractioned material.

The effect of decrease of permeability of clay soil to water under the force of filtering solution of electrolyte caused by possible structural changes of skeleton may be considered to be more characteristic for clay soil of both little and average condensation which hydrotechnicians run into.

The definite stereotype was made up by investigators which is the following: in all the cases permeability of clay to water for electrolyters is higher than for sweet water / 1 /. On the other hand, that can be explained by the fact of the carrying out of most of the experiments on systems with rigid skeleton of pore space (overcompressed clay, pored glass, capillaries of quartz and so on), and the process of reconstruction of pore space in plastic clay soil occurs very slowly and first goes through the stage of increase of sections of large pores which later on close up and cause the decrease of permeability of soil to water. The latter may be

used in order to carry out more perfect technology of making antifiltration clay screens of storage of poison wastes and dams of tailstores.

It is desirable to add some electrolyte while compressing the clay by road rollers. This way we, on one hand, increase real load forcing the clay ground because of reduction of surface forces of ion-electrostatic pushing away, on the other hand, as a result of that, the density of clay increases and its porosity decreases. For instance, if normal load of the roller is equal to 0,3 – 0,4 MPa, it may increase owing to the influence of electrolyte to 1,0 MPa.

But the effect of the influence of electrolyte is determined not only by the increase of real load. Its effect is two-staged process of redistribution of pores according to their dimensions. On the first stage compressing the contact net of micropores takes place because of the forces of ion-electrostatic pushing away of microfractions in the zone of their contacts and increasing the space of macropores where surface forces do not appear. That brings to contemporary increase of permability of ground. At the same time the process of decrease of the total porosity takes place under external load that process compensates the increase of the dimensions of micropores and brings to considerate reduction of permeability of clay comparing with the one typical for the same ground developing under only mechanical load of compressing machine.

In order to explain the processes mentioned above more visually we use our model of two-phased clay soil / 2 / in three levels: micro-, mezo- and macroones. In the microlevel the structure of clay soil is represented by elementary microagregates of “anchicristal” type. In the mezolevel the model of clay is described by microblocks with elementary microagregates placed along a single axis in them. The dimensions of microblocks are not constant, they are determined by the conditions of formation of clay soil, the compound and the state of disperse system. In the macrolevel the model of clay is represented by packing in different directions microblocks placed along a single axis. In this way the model reflexes anysotropy of soil properties naturally the joints of microblocks are not monolithic, in other words, there are clearances between adjacent microblocks which form the system of interblock porosity. As block or macroagregat dispersness of clay is considerably less than one of microagregate, naturally, the total volume of interblock porosity accounts for a little part of the total porosity of clay, approximately 1 – 3 % of the latter.

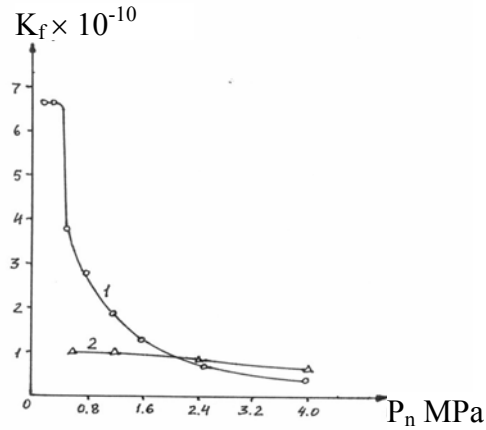
The carried out special investigations of compression – decompression of different kinds of clay and interpretation of the results from the poin of microreology while using the mentioned model showed that the diapason of the thickness of micropores ranges within 20 – 6 Å for the loads of 0,1 – 10 MPa . The diapason of changes of the thickness of macropores hesitates from 600 to 100 Å. The dimensions of interblock porosity, pores in the joints of microblocks having micron magnitude, are of from tenth to hundredth of micron. All

mentioned above let conclude that interblock porosity plays mainly the role of water ways in the process of filtration. Macroporosity doesn't take part in filtration behaving like semi-permeable membranes /2, 3/. According to the latest data gained by O.G.Usyarov, more that 90 per cent of filtrating current goes through interblock porosity. It is not possible yet to study the quantitative change, of interblock porosity using the worked out model, but using the method of rastr electronic microscopy (REM) reveal first decrease of interblock porosity during the process of the compression of clay by increasing loads, then after the transmission of clay into semi – solide state, its increase because of appearance of microcracks along the borders of blocks /4/.

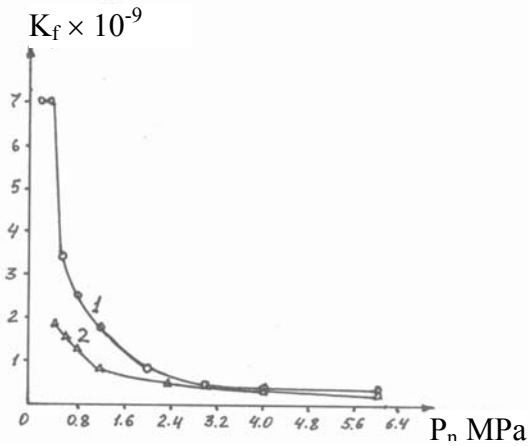
The influence of electrolytes on clay being under a load has its peculiarities regarding to redistribution of pore space for three mentioned categories of pores. Its influence reveales first of all in micropores and brings considerably to more or less reduction (or increase while swelling) of the forces of ion – electrostatic pushing off reduce, the thickness of water contact lays becoms thinner too. Contrary to that, while clay being under mechanical forces of compession thinnessening the micropores takes place side by side with plastic compression of ground under the tangential component of the load. In this case irreversible mutual upto movements of basis of microagregates takes place and gaps of micropores become less within each microblock. This second stage doesn't take place under the influence of electrolytes as the forces of wedging pressure in the system of micropores always act perpendicularly to the surface of basis. So the magnitude of compression of water filled influenced by electrolites is less intensive and reversible. It is revealed in a more degree in montmorillonit clay, less – in illite clay, much less – in kaolinit clay. Besideds, the compression of contact microporosity depends on the quality of the exchange cations. Causing more or less development of double electric layers at the basic surfaces of microagregates. So Na-clay react on the appearance of electrolyte in the ground more strongly than Ca-clay does.

The experiments showed the fact of reduction of promeability of clay to water when the concentration of electrolyte in the porosity solution increases. That is seen by comparing diagram 1 and 2 (figure 1 and figure 2) showing changes of coefficient of filtration of alluvial clay neogen soil (figure 1) and cover – alluvial loam (figure 2). The samples of natural humidity were placed in the kern holder of filtration device UIPK-1M as cylinders with the structure formed after rolling the natural ground with dump trucks BelAZ-540 after their passings along the same trace 8 – 10 times. Then they conducted stepped all-round compression of the sample by loads from 0,2 to 4 – 6 MPa. On each step after completing conditional consolidation of compression of the sample they measured the speed first of water, then the one of the solution  $\text{CaCl}_2$  with the concentration 10 gram/litre for the diapason of pressure gradients from 500 to 5000.





**Figure 1. Diagram of change of coefficient of filtration of alluvial clay according to pressure of beforehand compression: 1 – filtration of water; 2 – filtration of solution  $\text{CaCl}_2$  ( 10 gram/litre ).**



**Figure 2. Diagram of change of coefficient of filtration of cover-alluvial loam according to pressure of beforehand compression: 1 – filtration of water; 2 – filtration of solution  $\text{CaCl}_2$  (10 gram/litre).**

Analysing figures 1 and 2 we may conclude that even after the filtration of the solution of  $\text{CaCl}_2$  of concentration 10 gram/litre through quite dense clay its

permeability to water was reduced 6 – 7 time as little comparing with the filtration of standart water.

Our investigations allow to declare that the fact of considerable decrease of permeability of clay to water because of its little saltening is very prospective for using it in the screens of storages of toxic wastes and dams of tailstores. It should be kept in mind that during the exploitation of the screen furthur lixivation of electrolyte out will not be followed by the decrease of permeability to water because of partial closing the gaps of large interblock pores owing to swelling of clay within each block, in other words, redistribution of the volume of pores of different qualities.

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## ELECTRON TRANSFER IN PHOTOSYSTEM I EMBEDDED IN TREHALOSE GLASS

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**(Produced by the Academician of IAS E.N.Khalilov)**

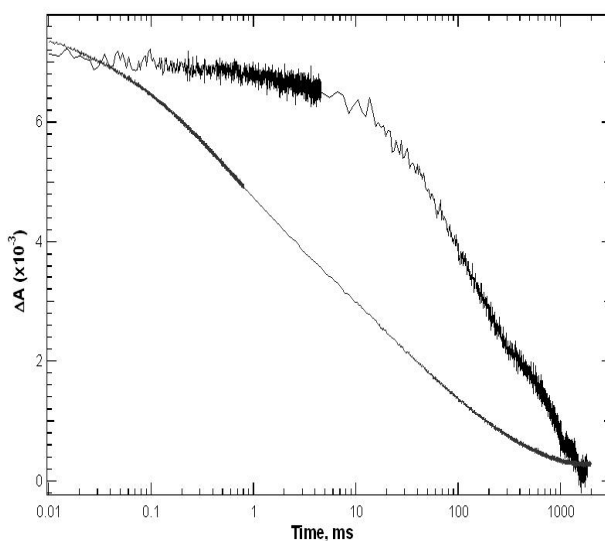
### INTRODUCTION

Temperature and dehydration parameters play important role in electron transfer reactions within proteins. It was found that protein conformational fluctuations can have a significant effect on electron transfer within bacterial photosynthetic reaction centers /1/. At low temperatures, protein-specific motions are slowed down and a heterogeneity of protein molecules frozen at different sub-states are observed leading to inhomogeneous reaction kinetics that can not be described by simple exponential functions /2, 3/. Photosystem I protein complex (PS I) is no exception to this rule.

In itself, PS I mediates electron transfer in photosynthetic organisms between cytochrome *b<sub>6</sub>/f* and soluble ferredoxin / flavodoxin thus enabling efficient electron transfer to the NADP oxidoreductase thereby converting light to useful chemical energy for the cell. PS I in *Thermosynechococcus elongates* species of cyanobacteria consists of 12 protein subunits, primary among them are PsaA, PsaB and PsaC /4/. These subunits harbor co-factors that are involved in the process of electron transfer. The co-factors that mediate electron transfer comprises of a chlorophyll *a/a'* primary donor pair (P700), a chlorophyll *a* primary acceptor dimer ( $A_0$ ), two vitamin  $K_1$  molecules ( $A_1$ ) which act as intermediate electron acceptors and three [4Fe-4S] clusters  $F_X$ ,  $F_A$  and  $F_B$ . All the co-factors, except the three iron-sulfur clusters, are arranged in a pseudo- $C_2$  symmetry /4/. Terminal cofactors,  $F_A$  and  $F_B$  clusters are placed in PsaC polypeptide anchored with its C-terminus loop to core proteins complex formed by PsaA and PsaB polypeptides and minor proteins. When electron transfer occurs via PS I, it creates a series of charge-separated states that are stabilized by these co-factors. In the absence of an electron acceptor from the terminal iron-sulfur cluster-  $F_B$  this charge separated state re-combines to the ground state /5, 6/. This process is called charge recombination or back reaction. It is believed, based on temperature

dependence studies on pre-reduced iron-sulfur clusters, that charge recombination occurs via a thermal re-population of  $A_1$  and subsequently recombines directly to P700 instead of the route forward electron transfer takes i.e., via  $A_1$ - $A_0$  pair /7/. In addition, the activation energy calculated by temperature dependence studies on pre-reduced clusters containing intact PS I suggest that the activation energy is equal to the potential difference between the terminal electron acceptors and  $A_1$ . There are however contradictory reports of the activation energy /8, 9/.

In the present work I have performed experiments in order to separate the dehydration and temperature effect on electron transfer back reactions within PS I complexes purified from cyanobacterial cells. Embedding of PS I protein complex into the solid glass transparent for optical studies formed by trehalose sugar at room temperature gives unique method to imitate the rigid matrix formed under the cryogenic temperature by water – glycerol mixture.



**Figure 1. Flash induced absorbance changes of PS I at 820 nm attributed to the formation and decay of P700+. Trace [1] belongs to Photosystem I preparation in 50 mM Tris-HCl buffer (pH 8). Conditions 60  $\mu$ M Chl a, 5  $\mu$ M DPIP, 5 mM Na-Ascorbate. Trace [2] belongs to Photosystem I preparation dried in trehalose glass. In both measurements  $T = 290$  K.**

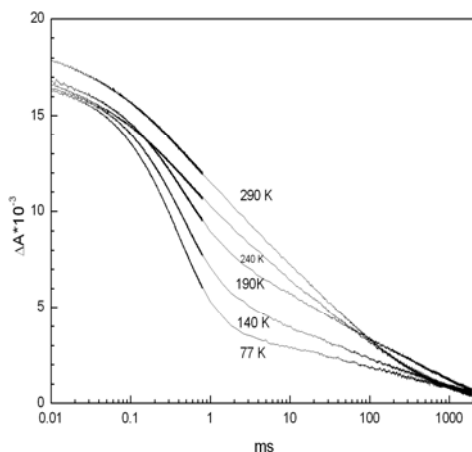
## MATERIALS AND METHODS

PS I trimeric complexes were purified from cyanobacteria *Synechocystis* sp. PCC 6803 according to /10/. Incorporation of PS I particles into the trehalose glass were achieved by drying mixture on the optical flat glass plates under the argon atmosphere in desiccators in the dark. Water content in the samples was

determined by Near-IR absorption band around 1980 nm and values in the samples were about 3% of weight. Kinetics of back reactions from acceptors to P700<sup>+</sup> induced by laser flash were monitored at 820 nm on the instrument with time resolution 1 μs as described in /6/. Temperature dependence measurements were carried out using He-flow cryostat. Data were treated with Igor Pro software package using least square algorithm.

### RESULTS AND DISCUSSION

Fig.1 represents comparison of laser flash induced kinetic traces detected at 820 nm for PS I samples in solution (trace 1) as well as incorporated in trehalose glass (trace 2) at room temperature. Trace 1 could be fitted with sum of two exponents and life-times for these processes are 82 ms (55% of total amplitude) and 1.2 s (45% of total amplitude). Trace 2 hard to fit with exponential functions type  $A(t) = \sum A_i \exp(-t/\tau_i)$  and sum of three stretch exponents type  $A(t) = A_0 \exp(-t/\tau)^\beta$  (Kohlraush function) /11/ were used. Life times were - 350 μs (34% of total amplitude) with stretch factor  $\beta = 0.53$ , 17 ms (50% of total amplitude) with  $\beta = 0.5$  and 360 ms (16 % of total amplitude) with  $\beta = 0.87$ .

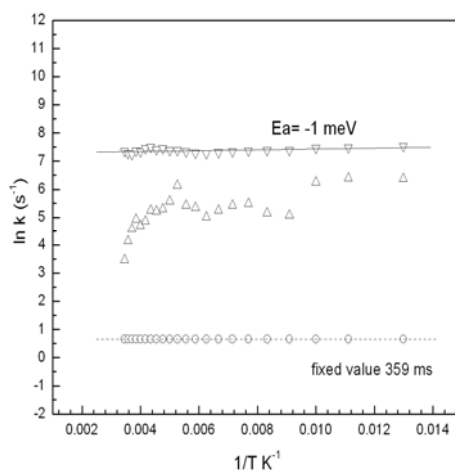


**Figure 2a. Laser induced absorbance changes of PS I in trehalose glass detected at 820 nm attributed to the formation and decay of P700<sup>+</sup> at selected temperatures. Conditions as in fig.1 for trace 2.**

Fig.2a represents behavior laser flash induced back reaction kinetics of PS I particles embedded into the trehalose matrix and recorded at temperature range

from 290 K to 77 K. Fig. 2b is the Arrhenius plot of the rate constants attributed to the back reaction electron transfer described by three phases.

Fixed value of slowest phase with life time 360 ms simplify fitting analysis for whole temperature range and yields good fit. It is seen from fig.2b that only intermediate phase significantly dependent upon temperature and cannot describe by linear dependence while fastest phase virtually temperature independent. Control experiments with PS I dried without trehalose shown no photochemical activity in such preparations. In liquid state with trehalose concentration 80% (w/w) there is no difference in kinetic behavior compare to PS I in buffer solution. Reconstitution experiment has shown that after dilution of dry PSI/trehalose glass in buffer the PS I kinetic exhibit normal bi-exponential decay as it would be without treatment (data not shown) indicating that trehalose treatment doesn't change integrity of PS I.



**Figure 2b. Arrhenius plot of the rate constant attributed to the formation and decay of P700<sup>+</sup>. Details in text.**

These primary data should be considered in terms of structure - functional relations of cofactors and polypeptide subunits of PS I. First interesting effect is that embedding PS I complex into the trehalose solid glass leads to significant changes in back reaction kinetics and appearance of three phases distinctive by their life times  $\tau$ . The fast phase with  $\tau = 350 \mu\text{s}$  could be attributed to the back reaction from intermediate acceptor  $A_1$  as described before /6/, the 17 ms as well as unchangeable 360 ms phases would be attributed to back reaction of electron from terminal acceptors  $[F_A, F_B]$  to P700<sup>+</sup>. Impossibility to use simple exponential function for fitting procedure of kinetic traces and usage stretch exponents is

indication that the certain level of system disordering is present. For comparison, such a disordering doesn't observe for PS I samples in buffer solution where kinetics represents mainly by bi-exponential decay components with  $\tau = 80$  ms attributed to back reaction of electron from terminal acceptors  $[F_A, F_B]$  to  $P700^+$  and component with  $\tau = 1.2$  s which is slow donation of electrons from artificial electron donors DPIP/ Na-Ascorbate to  $P700^+$  /6/.

Second effect observed with PS I particles embedded in trehalose glass is that the kinetic behavior of fast and slow components independent upon temperature indicating electron transfer reactions without any activation barrier. Compare to PS I in solution back reaction from terminal acceptors is temperature activated and activation energy about 220 meV was estimated /12/. Only intermediate phase activates but has nonlinear dependence. Behavior of intermediate phase rate constant looks like repeating the temperature dependence of dielectric relaxation rate constant for water/protein system /13/. In latter case, back reaction with life-time 17 ms smoothly accelerate and reach steady state rate constant with life time 1-3 milliseconds at 200-210 K. Such life time is characteristic for electron transfer back reaction from  $F_X$  cluster. The fluctuation modes of PsaC polypeptide related by bound (structural) water in the interface between PsaC polypeptide and PS I core protein formed by PsaA/PsaB polypeptide are freezing out and electron reach only  $F_X$ . That leads to non activated back reaction from  $F_X$  instead further electron transfer to terminal acceptors  $[F_A, F_B]$ . This fact indicates that some water molecules are still bound to PS I despite drying in trehalose. As it was mentioned earlier complete drying of PS I without trehalose leads to dehydration and lost of all photochemical activity of PS I.

Mechanism of charge stabilization on terminal acceptors  $[F_A, F_B]$  is basing on relaxation properties of these cofactors as well as fluctuation modes of protein matrix where these cofactors embedded /1/. Note that the terminal acceptors  $[F_A, F_B]$  responsible for kinetics with tenth of ms life times placed in PsaC subunit which is anchored to PsaA/PsaB core complex only with C-terminus of its polypeptide chain /14/. Such a structural feature of this subunit assume some fluctuations relative to the core complex of PS I and changes of the distance between cofactor  $F_X$  and  $[F_A, F_B]$ . On the other hand changes according to semi-empirical equation derived by Dutton with co-workers /15/ the change of distance between donor and acceptor only for 1 Å enough to slow down electron transfer rate factor of 4.

Following hypothesis put into the explanation of observed effects. Embedding of PS I trimer particles into the trehalose rigid glass leads to freezing PsaC polypeptide in the different conformational sub-states at room temperature differing by distances between electron acceptor  $F_X$  in PsaA/PsaB core polypeptide and  $[F_A, F_B]$  clusters in PsaC polypeptide. One can assume that observed heterogeneity of kinetic properties of PS I in trehalose glass can be

produced by such conformational sub – states of PsaC polypeptide. The similar multi component kinetics effect observed with PS I samples under the cryogenic temperatures in water-glycerol glass where three main sub-states explain heterogeneity of PS I /8/. Probably because of very fast fluctuation's rate of PsaC polypeptide around its average position relative to core polypeptide complex at room temperature detection represents integrated life times of electron transfer back reaction having maximum around tens of milliseconds.

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## STUDY, DESIGN AND APPLICATION OF ELECTRO-MAGNETIC HYDRO CYCLONE FILTER- SEPARATORS FOR WASTE WATER

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### 1. Introduction

Technological and waste liquids and gases usually have a great number of different kinds of micro admixtures (clay, ferrous, phenol, oil, organic, paint, nuclear particles, etc.), which can impair production quality. Consequently, improved filters-separators for these liquids and gases are in great demand. Waste liquids and gases should be filtered before disposal; otherwise, the producers must pay a heavy fine. There are a lot of methods and filter-separators constructions to separate the unwanted particles from technological and waste liquids and gases. Many of them are hydro or gas cyclones, magnetic or electrostatic traps, membranes etc. In most cases they meet the all demands of the industries provided that very small (less than 10 microns) impurities do not disturb their main processes. The efficiencies of these filters and traps are high and very well known for different types of admixture in liquids and gases /6-10/. But there are some delicate technologies, where even a very small amount of even micro admixtures can bring misfortune or accident. To understand this more clearly, some matter-of-fact examples are given below:

1. There is a very little amount of microscopic water bolls in plane fuel (less than 0.01% or 100gr in a ton) that can cause sometimes accidents. The water may freeze at any valve or at narrow pipe and fuel will not be pumped into engine. The filtration process of these micron size water particles is possible with the help of some chemical or other methods, but it is difficult and expensive.
2. There is a tiny quantity of some phenols and other light organic particles (up to molecule size) in the distilled water of thermal plant boilers. To separate these particles using mechanical or chemical methods is extremely difficult and expensive. Nevertheless those particles are very small, but they are very

dangerous. They make thousands of small bursts on the inner surface of high temperature and pressure boiler pipes, pluck out micro particles of the metal, slowly damage (erode) the pipes and increase the risk of boiler steam leakage or even explosions.

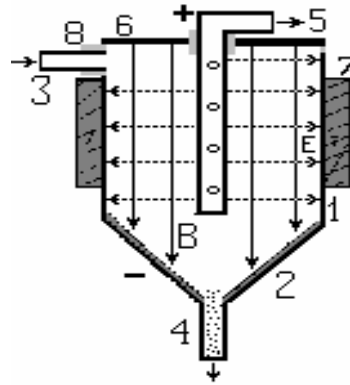
3. One of the methods of demineralization or desalination different liquids (in particular sea water) is to mix them with another active sprayed liquid (or a fine powder), which entraps the appropriate mineral salts, and then separates the liquid or the powder from the main one. The smaller micro particles of the entrapping liquid or the powder the more effective the entrapping process. One of these active and rather cheap liquids is kerosene. But to separate these salty kerosene micro particles from main liquid by using an ordinary hydro-cyclone is very difficult and expensive. Electric and magnetic forces are more effective than use only centrifugal force alone.
4. Finding and filtering out different nuclear particles from liquids and gases, especially after the Chernobyl Nuclear Power Station accident, became a very important issue. It is used in Ukraine to reveal and to filter out the electrically charged nuclear particles from milk using electric and magnetic forces.

Thus, in some cases where separation (filtration) of liquids from all admixtures up to even micro particles is very important and it demands application of even more effective forces for micro particles. Here it is important to stress that electromagnetic forces can help to increase the total coefficient of filtration efficiency, but only a little, perhaps as much as 1%, but generally less. The main effect comes from the higher quality of the specific technology, from higher reliability and a wider margin of safety for humans and the environment.

## 2. Discussions

Electromagnetic hydro (gas) cyclone (EMHC) is a combined apparatus for treating the technological and waste liquids and gases. A special construction of the EMHC joints together electric, magnetic, and centrifugal forces influences co-linearly. Similarly to traditional hydrocyclones, there are several different types of EMHC construction /1-5/: cylindrical and conic EMHC for two products, EMHC for three products etc. The first and especially second type of EMHC are most useful ones and will be mainly discussed in this paper (Fig. 1). EMHC consists of cylindrical diamagnetic metal (or plastic) main body 1, conic ferromagnetic metal inferior body 2, entrance 3 (tangential to the cylindrical main body), output 4 nipple pipe for heavy product, and central pore out nipple pipe 5 for light product (central electrode), flat and round ferromagnetic metal cover 6, bobbin 7 around main cylindrical body and the pipes' electrical isolations 8.

As illustrated by Fig 1, the electric field force is produced by applied DC voltage between main cylindrical body and the central pour out nipple (electrode).



**Fig.1. A Conic EHM Cyclone**

A bobbin around the main cylindrical body produces a magnetic field force between the flat ferromagnetic cover and the magnetic conical (or flat) bottom part of the EMHC. There is an inertial centrifugal force due to high-speed rotation of the liquid (gas) in cylindrical main body, because of the entrance nipple is tangential to the latter. The high incoming flow velocity is equal to the liquid (gas) tangential rotation velocity. For some special cases ozone (O<sub>3</sub>) can be produced around the central electrode to kill microbes, to burn off (oxide) poisonous natural or organic admixtures in outgoing pipe (central electrode). In such a case an additional high frequency voltage can be applied through a capacitor to this electrode.

Briefly, technological or waste liquid (gas) enters through the input nozzle and heavy particles, such as sand, clay, metals, silt, etc are displaced by the centrifugal force to main body inner cylinder surface, then down and leaves via the conic exit. Light particles, such as oil and organic traces, gas bubbles etc, are exhausted to the central electrode-pipe and pour out of the EMHC. In this system the quality filtration is very high (especially for micron size impurities) due to the additional electric and magnetic field forces applied co-linearly to the centrifugal one: these three main forces act in the same direction.

There are several vector forces that affect a particle in EMH in a common case:

$$F_m + F_e + F_s + F_i + F_a + F_w + F_c = 0 \quad (1)$$

where:  $F_m$  -magnetic force,  $F_e$  -electric force,  
 $F_s$  -Stokes' force (resistive),  $F_i$  - inertia force,  
 $F_a$  – Archimedes's force,  $F_w$  - weight force,  
 $F_c$  -centrifugal force.

Comparative analyses /10/ have shown that influences of  $F_a$ ,  $F_i$  and  $F_w$  on a very small (less than 50 micron) dispersed particles are imperceptibly small and so they can be omitted. The main influences belong to forces  $F_m$ ,  $F_e$ ,  $F_c$  and resistive force  $F_s$  (depends on viscosity of a liquid).

The effect of the centrifugal force on particle filtration is determined /8/ as:

$$F_c = \frac{\pi * d^3 (\rho_1 - \rho_2) * v_t^2}{6r} \quad (2)$$

where:  $d$  - diameter of particle [m],

$\rho_1$  - density of technological liquids. [kg/m<sup>3</sup>],

$\rho_2$  - density of particles [kg/m<sup>3</sup>],

$r$  - average revolving radius [m],

$v_t$  - velocity of particles, m/sec.

When  $\rho_1 < \rho_2$  (water-ferrous, sand etc admixtures) “cleaned” liquid is exited through the central pour out nipple and heavy particles are removed from bottom conical product pipe. When  $\rho_1 > \rho_2$  (water - oil, phenols etc), “cleaned” liquid is extracted through the bottom conical product pipe and oil is removed from the central pour out pipe. But most micro particles cannot be removed just by the cyclone application due to floatation effects, which occurs in liquids and gases: for  $d < d_{critical}$  the smaller weight of a micro particle (proportional to  $d^3$  of a particle) the higher floating force (proportional to  $d^2$  of a particle) as compared with weight.

Generally, 70-80% of particles in technologic liquids carry a negative electric charge /6-10/. Electric and magnetic forces have more influence on the negatively charged micro-particles than does the centrifugal force. They can be effectively repelled out or attracted to the electrodes. And so the central pour-out tube is often used as a positive electrode and cylindrical body as a negative one. There are some additional holes in this central tube for collecting light and charged particles such as oil, gas bubbles, acetone, phenols, etc. The electric force effect on a charged particle is characterized as:

$$F_e = E * q \quad (3)$$

where:  $E$  –electric field strength {V/m),  $q$  - average electric charge of a particle (C).

The EMH radial electric field intensity value  $E$  (similar to cylindrical capacitor electric field) can be determined by:

$$E = \frac{V}{r \ln \frac{R}{r_{CE}}} \quad (4)$$

where:  $R$  - EMHC internal diameter,  $r_{CE}$  -diameter of central electrode-pipe,  $r$ -diameter of a cross-section.

The electric field reaches its maximum around the central electrode when  $r = r_{CE}$  and its minimum around the outer (cylindrical) electrode when  $r = R$ . The average electric charge of a particle is calculated as:

$$q = \frac{\varepsilon_0 \varepsilon_m S \xi}{\delta} \text{ Coulomb (C)}, \quad (5)$$

where:

$\varepsilon$  -relative permittivity  $\varepsilon_m/\varepsilon_0 = 81$ ,  $\varepsilon_0 = 8.86 \cdot 10^{-12}$  Farad/m,

$S$  - surface area of  $d=10\mu\text{m}$  particle  $\pi d^2 = 3,14 \cdot 10^{-10} \text{ m}^2$ ,

$\xi$  - electrokinetic potentials  $\xi = 0.1-0.5$  Volt (for some organic matter higher),

$\delta$  - doubled electric areas' thickness  $\delta = 10^{-6} \text{ m}$ .

Thus, it can be obtained for  $d=10\mu\text{m}$   $q=(2 - 6) \cdot 10^{-14}\text{C}$ , for  $d = 5\mu\text{m}$   $q = (0.5 - 1.5) \cdot 10^{-14} \text{ C}$  and for  $d=1\mu\text{m}$   $q = (0.125 - 0.375) \cdot 10^{-14} \text{ C}$ .

There are two main magnetic forces that are recommended [5,6,9] to be considered. The first one is applied only for magnetic particles:

$$F_{qm} = H * q_m \quad (6)$$

where:  $H$  - magnetic field strength (intensity),

$q_m$  - magnetic charge of a particle.

Where oil, phenol, etc particles separation from water is concerned,  $q_m$  is too small /5,6/, the magnetic field is homogeneous and this magnetic force can be neglected. The second magnetic force - the Hole effect, - on the other hand is taken into account. Any movement of an electrically charged particle in the magnetic field creates the force that helps the filtration process:

$$F_H = q * B \times v \quad (7)$$

where:  $B$ - magnetic field induction,  $v$ - particle velocity.

In the designed construction of the EMH tree of the various forces (centrifugal, electric and magnetic) act along the same radial direction and help the filtration process especially in the case of micro particles. Compare the centrifugal with the electric forces effects on a particle, all calculations were made for this type of EMH: particles diameter  $d = 1; 5$  and  $10\mu\text{m}$ , average revolving radius  $r = 0.1\text{m}$ , velocity of input water (and charged particles)  $v = 0.5 - 1.0\text{m/sec}$ , particle charge  $q = (6 - 0.375) * 10^{-14}$  coulomb, applied voltage  $V = 600\text{V}$ , volume capacity  $V_v = 5$  liters,  $r_{CE} = 25\text{mm}$ ,  $r_{in} = 25\text{mm}$ . An emulsion of water with small amount of phenol was taken as a liquid under lab treatment in /7/. The calculations for several variants of particle diameter  $d$  and its charging ability  $\xi$  (electrokinetic potential) influence of electrical field force 5 – 15 times more efficient than centrifugal force ( the smaller diameter, the higher efficiency: for  $d = 1 \mu\text{m}$  and  $\xi = 0.3 \text{ V}$   $F_C = 0.026 * 10^{-8}$ Newton (N), while  $F_E = 0.225 * 10^{-8}$ N or more than 8 times higher /11/. The special particles pre-charging technique can raise these figure two to three times and even more. The electric field also helps particles to coagulate and this simplifies the separation process. It needs only 400-600V voltage on the main electrode. The magnetic force influence for this emulsion is very small and can be neglected ( $F_H = 4.1 * 10^{-10}$ N).

#### 4.EMH application in textile industry

Textile manufacturing is a very important branch of Turkish industry. Multi-cycle painting processes in textile industry use huge amount water: the higher quality water, the higher quality of the textile painting process.



**Fig.2. The Firist industrial prototype application**

There are more than twelve different operations during panting a textile tela (fabric, cloth) and each demands a new portion good quality water or recycled waste water. It is very easy to take out rather big specific textile particles (rubbish) from waste water, but taking out small admixtures less than 50 microns and especially less than 10 microns (dust, pant particles etc) is extremely difficult. Here it is reasonable to apply more effective electrical or magnetic forces for separation and to recycle waste water or, as a minimum, bring it to the required waste limit norm.

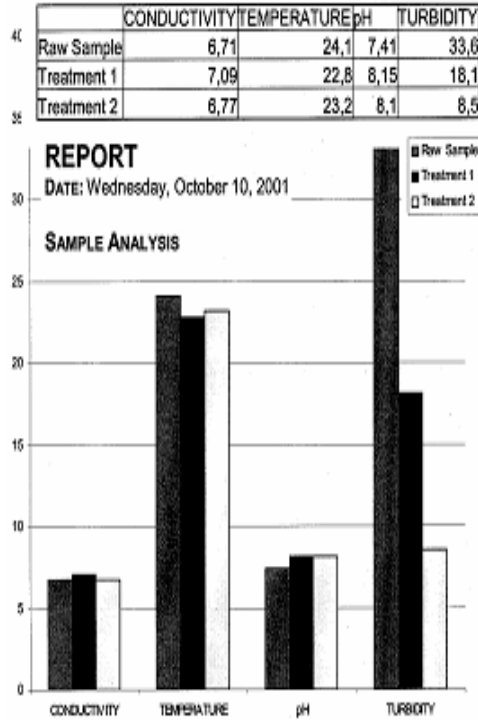
The first industrial type of the EMHC pilot project (Fig.3) was designed in accordance with /1-4/ and has been recently installed in the “VARDARLI” Textile Painting Factory, Istanbul, Turkey, 2001. Due to the nonmagnetic character of the color paint in use at the factory there is no need for a magnetic coil in the equipment. The pump parameters are 5-6 liters/sec (18 -21 ton/hour); DC power supplier voltages are  $\cong$  100, 200 and 300 V. Waste water is taken just from waste cannel (after commonly used silk filters).

It is clear that the instantaneous filtration of the waste liquid from the paint (color) during only one pass through the EMHC is impossible. Therefore filtration was made in the closed cycle form, i.e. the partially purified liquid merged into the initial tank, while the slime (paint) gradually settle down in the cone and bottom sides of the EMHC.

Hydro cyclone application alone (at  $V=0$ ) does not change Turbidity at all: it remains at almost the same level 32-33. Fig. 3. shows, that after DC voltage



application, both the conductivity and pH of the liquid, change just a bit, but the change of turbidity is significant almost for 4 times from 33.6 to 18.1 (for V=100V) and to 8.5 (for V=200V) and become below the limits, allowed by standards for such waste liquids. The sample transparency changes from strong to a very light tea color. The electrolyze current also helps to kill bacteria's, and to coagulate particles and to simplify the separation process. The EMH needs no more than 400-600V voltages on the main electrode.



**Fig. 3. Waste samples analyses before and after the treatments:  
1 – V≈100V and 2 V≈200V**

### CONCLUSION

The special construction of EMHC was designed for filtration and separation processes of different liquids and gases, which have micro admixtures along with rather big particles. Similarly, special constructions can be designed for many kinds of technological and waste liquids and gases taking into account their parameters, demands and performance attributes. Some advantages of the EMHC are the following:

1. Designed combine system uses the main three forces all acting in the same direction.

2. There is no any active rotating mechanical part in the EMHC. Because of that, this type EMH can be used in high-pressure technological systems without risk.
3. A simpler filtration process control by means of applied voltage and current.
4. Available for many separating matters (liquid/liquid, liquid/gas, liquid /solid particles, liquid or ferro-magnetic particles, etc.).
5. Possibility of ozone formation (by high frequency AC) to burn residue poisonous organic admixtures, microbes and microorganisms at the end of filtration.
6. The EMHC is an ecologically friendly system.

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## **ANALYSIS AND EXPERIMENTAL MODELING OF ADS-B PERFORMANCES WITH SECTOR ANTENNAS APPLICATION**

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Current status of development of global air navigation systems is characterizing by intensive implementation of perspective data link technology, satellite navigation and surveillance systems in ATM /1/. Nowadays ICAO considering number of programs and projects in order to improve the effectiveness of air traffic. Automatic Dependent Surveillance ADS-B mode are determined by ICAO as a strategic direction of observation systems' development in the future. This system based on transmitting of the data of position of all aircrafts in the airspace and on the ground, about their plans and data accuracy. Accuracy and reliability of aircraft position based on differential mode of calculation of the satellite system.

Nowadays the most intensive research on ADS-B implementation is ongoing in Europe. In 1995-1998 research of ADS-B prototype was carried out, which was accomplished by introduction of ADS-B network in Sweden, Denmark, Belgium, Germany, Italy, Spain and part of France. Certification process of the system was started in 1998 and completed in 2001. It is planned to implement some preliminary versions of ADS-B in Europe until 2007. Russia also active in this field. Demonstrative and research works of ADS on Russian airplanes and helicopters were carried out in Russia and abroad. There is no doubt in importance of this perspective and in Azerbaijan this works started since 2000. Since that time a number of research works in development of reliability and accuracy of this system were carried out by us /2/.

In ADS-B mode it is possible to calculate the amount of aircrafts that could be simultaneously served by the earth station on condition that each station has a certain speed of information renewal “H” about the amount of transmission per minute (5). One minute is equivalent to certain time slots “C”. In this case the admission capacity is equal to “H/S”.

The observing system for the ATC cannot have limitations as for the admission capacity. The system is to be able to continue functioning under the conditions of overload, i.e. when the bigger amount of time slots required than it is available, and to adapt in a manageable and secure way.

In case when the required admission capacity approaches the theoretical maximum, the information that is transmitted from the station outside the certain distance is either discriminated or mutually corrupted.

Supposing that in our case 4500 time slots are used per minute and according to the required standards of the speed of the information renewal in aerodrome zone gives the relation  $H/C=4500/12=375$ , that means 375 aircrafts theoretically can transmit their coordinate information to the ATC earth station with the speed of the information renewal 12 times per minute. However it does not mean that in that case a conflict between any of 375 stations cannot appear in case if they have chosen the same time slot for the sequential information transmission. Theoretically one time slot is sufficient for the principal coordinate information transmission by the mobile station, however, in case of necessity of additional information transmission to the board and to earth, meteorological, for instance, that would mean increase in the necessity of each time case for each station and the relation  $H/C$  reduces.

In case of channel overload and as a consequence insufficient amount of time slots, the situation can be improved, as it was mentioned above, by the discrimination of the most distant aircrafts, i.e. by automatic narrowing of the operating range of the earth station or by automatic speed of the information renewal decrease.

None of these methods that are used at the present is not permissible for the ATC purposes and contradicts the established standards for the observing systems on the whole.

Aim of this work is to improve the parameters of ATC system by means of ADS-B, using sector antennas for earth system.

As a result of research work, new antenna system, using ADS-B sector antennas was designed. Experiments was carried out, using one earth station and one airborne station mounted on car.

During experiments 4 sector antenna system with circular dipole antennas were used.

Due to difficulties in using of large number of airborne system, experiments were limited to the determination of range of the system.

Car, with mounted mobile station, was driving along radial directions, and position of the mobile station was monitored on earth station display.

Fall of the mobile station on display depending on the distance was monitored. Experiment was held in all possible directions.

Afterwards, the same experiments were carried out using 4 sector antennas. Based on research works, we arrived at a conclusion that implementation of ADS-B in Azerbaijan will promptly and effectively solve the issues of flight safety while traffic is rising.

Use of directed antennas significantly increase the technical capability of the system increasing the probability of determination.

Use of directed antennas significantly increase the technical capability of the system as it guarantee reliable communication with earth equipment, decrease the transmutation power of airborne, decreasing ether load, and increase the efficiency of information of aircraft position.

Theoretical essence of the ADS-B system based on the radio communication and practical experiments with the existing equipment, which was obtained by means of the various experiments.

Taking into account that aircrafts flaying within the airspace in the different directions and on different distances, to receive the signals from the different directions and on 360° angle, we need the receiving antenna with circular diagram, and for this reason we need to use minimum four directional antennas. On the other hand the high resolution of the directional antenna guaranteeing the more efficient reception in case when the level of wanted signal lower that the level of the noise.

It should be noticed that by means of the directional antenna, with 8dB gain, the level of the signal on the input will be two times higher. As we know that depending on the distance, drop of intensity of electromagnetic filed proceeding according to the quadratic law, the distance of reception of the directional antenna, with gain in 8 dB, is two times higher than the distance of reception of dipole antenna with circular diagram and gain in 2 dB. However to achieve the same results with antenna with circular diagram we should increase the power of the transmitter in 4 times.

Quality of the reception from remote distances directly depends on the selection of type of antenna, and this problem accurse due to the weak field of the transmitter on long distances. From the first glance it seems that this problem could be solved by additional amplifiers in the transmitter. However increasing the sensitivity of the receiver is limited to it internal noise.

Measures for increasing of signal/noise ratio are undertaking. The distance between the reception antenna and the earth should be enough big, because depending on the distance the field intensity is growing, but its pose technical problems to put antenna on the higher level.

Thus, considering all measures, most effective way is using the special antennas, by means of which we obtain higher voltage with the constant field intensity. In case of the low field intensity, resolution of antenna should be higher, i.e. the

level of the noise should be lowered without lowering the level of the wanted signals.

Resolution of antenna directly depends on its directivity factor (D). Directivity factor of antenna is ratio of the power that antenna creates relatively to the direction of antenna. There is simple relation between gain factor and directivity factor of antenna.

$$\varepsilon = \frac{D\eta_{\alpha}}{1.64} \quad (3)$$

:  $\eta_{\alpha}$  - coefficient of efficiency).

For the receiver antenna factor of efficiency is:

$$\eta_{\alpha} = R_{ex} / (R_{ex} + R_{nom}) ,$$

где:  $R_{ex}$  – input resistance of antenna vibrator.  $R_{nom}$  – loss resistance.

Factor of efficiency of receiving antennas (except loop aerial) is approximately 0,95. Thus achieving of high coefficient of efficiency serves for noise reduction, and increase in directivity factor leads to reducing of external noise. Usually directional diagram is laid on two inter perpendicular planes: dipole positioned on horizontal plane, perpendicular to the vertical plane. In general, propagation of electromagnetic waves in whole direction of antennas occurs not with the same intensity. Construction of the diagrams should be in the polar system. However, in practice we could manage with diagrams in two directions, horizontal and vertical. If antenna operates only in receive mode, in this case directional diagram is ratio of output voltage of antenna to the angle of signal source relative to antenna. Usually airborne antennas radiate in horizontal direction. However, graphical presentation of directional diagram could be done both in vertical and horizontal directions.

Based on theoretical researches, it is appeared that for full operational capability of ADS-B it is better to use antenna system with 4 directional receiving antennas. The difficulty of these systems is inter consistency of antennas. Practically, each antenna consists of two “wave channel” type of antennas, placed in horizontal and vertical directions within one traverse. Each antenna of antenna system is identical by electrical and mechanical characteristics and perpendicular to each other. In this case phase difference between the illuminations is  $90^{\circ}$ .

For transmitting, directional circular antenna without any mechanical connection to receiving antenna is used.

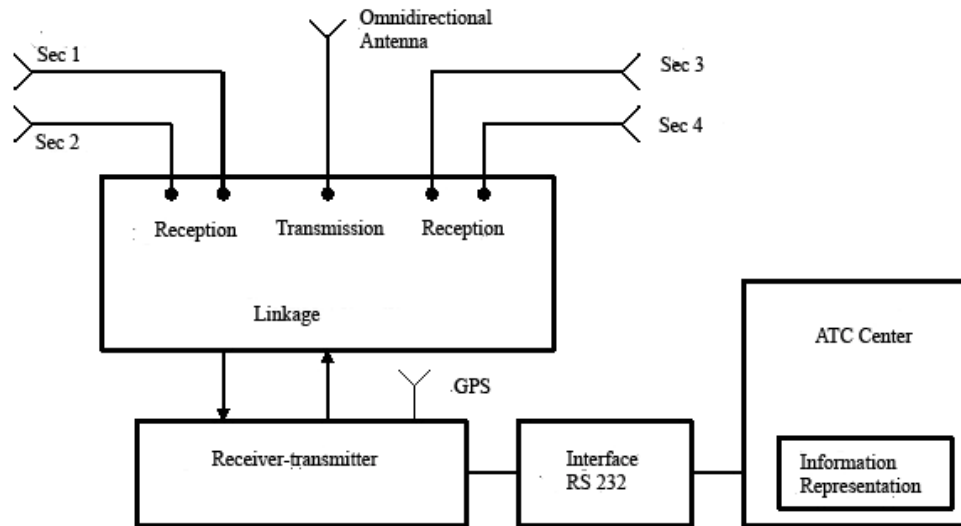
As was mentioned, the main point of used antenna is receiving the position of flying objects, increasing the efficiency of earth ADS-B system and as a result increasing the number of served aircrafts.

Thanks to the common case, it could be directed to any direction and fixed with the special wires. For antenna  $64 \text{ m}^2$  free space is required and it is recommended not to install additional conducting elements within this space. Special hooks is used for fixing of antenna system.

The Structural Scheme of the ADS-B Earth System is shown on Pic.1. Matching device is assembled from the calculated coaxial cables with defined length, and connected with one end to antennas, and rest endings are connected by special plugs in the case.

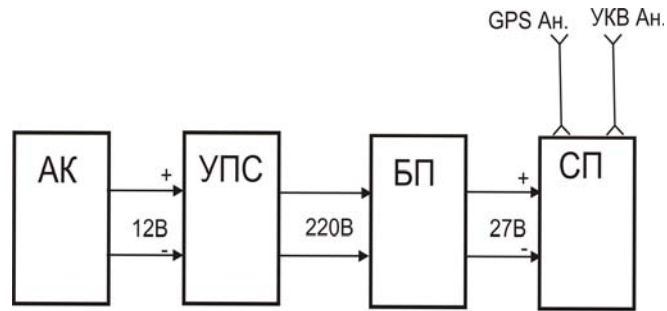
As we see from the Pic.1, signal processing, received by satellite and VHF link, is carrying out by transponder of the earth system, and then transmitting to the computer using RS-232 interface. Here GPS antennas and corresponding equipment assigned for determination of ATC point's position.

In order to obtain effectiveness of directional antenna During the experimental check with non directional antenna, preparatory works was held. Thus, taking into account economical and technical complexity of the work with flying objects, airborne equipment of ADS-B system, and VHF antenna together with GPS antenna were mounted to the chassis of the special car.



**Pic. 1. The Structural Scheme of the Earth System with 4-sector Receiving Antenna Application.**

For operation of the equipment +27 V power is required, and for that reason signal transducing device (STD) and standard power supply are used. STD is energized by car's accumulator. To conduct the experiment the special scheme (Pic 2.) was prepared.



**Pic. 2. Scheme of airborne equipment of ADS-B system mounted on car.**  
**АК – Accumulators , STD - signal transducing device, PS – Power Supply,**  
**SP – Spander.**

As we know, signal transducing device, transforms car accumulator voltage +12В into alternative voltage 220V, after that standard power supply generate + 27В for normal operation of transponder.

For fulfillment of the experiments, receiving zone form each direction of ADS-B complex were checked.

Earth complex was installed at the territory of National Aviation Academy, according to the map (Pic. 3.). Antennas mounted at 17–18 м high. Short range of operation is due to the fact that airborne equipment is installed at the car.



**Pic.3. Range characteristics of directional and non directional antennas.**

Here first circle is a result of experiments obtained by using of pin antenna with circular direction diagram in vertical plane.

The circle 2 on Pic. 3 is a result of experiments obtained by using of 4 sector antennas, developed by National Aviation Academy of Republic of Azerbaijan in order to extend the range. Antenna is receiving the signals in horizontal and vertical polarizations and located parallel to the Earth.



As you see from the picture, difference of range between antennas is positive enough for the second antenna. The main criteria – that finally we have consistent reception of the signals form different directions and levels.

**In Table 1 you can find range characteristics.**

Result of range for omnidirectional and sector antennas were based on the following formula:

$$D=3,57(\sqrt{H_1}+\sqrt{H_2})$$

Where: D-range (km),  $H_1$  – Height of Aircraft  $H_2$  - height of terrestrial antenna system.

Table 1

Reception range by direction, km.	North	South	West	East
Pin antenna	15 km	15 km	23 km	15 km
Antenna system	25 km	25 km	25 km	25 km

Objective of the task is: given function  $y(x)$  should be replaced by some function  $\varphi(x)$ , with unknown characteristics, in order to have minimum deviation in the given range.

In table 2 there is a range data for earth mobile station with circular and sector antenna, extrapolated information for range of the system with circular and sector antenna.

**Extrapolated information for range of the system with circular and sector antenna.**

Table 2

	Earth station with circular direction diagram+mobile station on car.	Earth station with the sector direction diagram antenna + mobile station on the car	Earth station with circular direction diagram+mobile station on the aircraft.	Earth station with the sector direction diagram antenna + mobile station on the aircraft.
H=0	27 km	32 km		
H=1000M			36,1 km	42 km
H=3000M			195 km	221 km
H=5000M			252 km	289 km
H=10000M			359 km	412 km

High of earth station, output power of the transmitter and sensitivity of receiver are constant.

For processing displaying of the information from earth and airborne equipment, special software – CATS was used. After installation of the software exact position of the earth station should be inputted to this system. There are a lot of applications of the CATS system which are very useful in operation.

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## **HUMANITARIAN SCIENCES**

### **ECONOMIC SAFETY FACTORS AT THE JUNCTION OF CENTURES**

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*Academy of Science*

The system of power in the independent Azerbaijan has come about in a unique way in some sense. Unlike the neighbors, the period of “soviet vicegerents” finished in our country much sooner, the government broke into pieces and then reunited around the common center in the way the distinguished politician Heydar Aliyev saw it and brought to the perfect and active position. More than ten years have passed since that-from the time we achieved a true state independence and new ideas regarding the further visions of development of our country. We have emerged taking into account the role and place of Azerbaijan in the world union with full clarity.

Certainly, the policy implemented by President Ilham Aliyev today has its historical roots. That policy is not accidental in this context and defined as the “Course of Heydar Aliyev” by analysts, it marks a new stage in the stable development of Azerbaijan statehood. If to regard the issue without a formal judgement typical of the populist speeches, but through dividing into several parts, we will see that the notion of the course founded by the national leader is in itself a complex and multifaceted process. Adherence to the political root means exactly the observance of the base standards inherited from Heydar Aliyev. This is the policy Ilham Aliyev is running. However, it is not as simple as it may seem at first sight: the entire load of responsibility of the management process at that time fell namely onto the head of state- the President. Although that stage of the history of politics had its own past, this process is not accidental in the current political context.

Usually the life and activity of famous politicians suffers a certain mental abstraction in some time and some mythological elements and traces are added to

the historical image of a real personality. In principle, it is fully natural and completely adequate to the logics of the mind of nation that wants to see the leader it has chosen a just humanist and humane person with endless love for his Motherland. Despite that, the modern world prefers the theory of pragmatism to everything and tries to avoid symbolism, it has been like this before, is now, and probably, will be like this further on as well. By the way, there are some nations, of which whose national identity is incomprehensible, or rather inexplicable apart from the international processes. These processes are encouraged by the logic of the New Time (in essence, always transnational), put the group of great leaders able to undertake the responsibility of forming a new environment to the forefront. Certainly, in this case, the responsibility turns into a multi-ingredient notion. Because, politics and ideology do not suffice with definition of new corporative relations in a particular geographic environment only-at the same time, they create a comparatively new way of living together in the current and long-term time. Here the modern communication specter, that is, the means of communication operating at the subconscious level, even new aspects of the notion of “Me” (capable of forming new conditions and fully satisfying its owner) come forth.

While thinking in this direction, one mechanically comes to such a conclusion that as the first sign of the future union, the relationship between the Personality and Time is linked with the natural activation of the reaction of invasion acting as the “previous circle of thinking” and speaking from the logic of traditional and easily comprehensible notions. At the micro-level, these notions impress as “good traditions” of sound constitutionalism. As a rule, the places not containing the programs targeted as accurate coordination are filled with false discussions and politicians playing the role of “buffer area”, progressive physiology of these programs provide an opportunity for de-escalation in the society and creation of “free breath” effect and finally, forms some traces of middle-class politicians portraits. In condition of absence of a strong charismatic national leader thinking in global categories, the social environment we characterized as “buffer area” is taken out from the management system, loses the logical development framework, causes jam-up of excessive negative force and finally, acquires the form of an uncontrolled center. Clearly, this center is not capable of any positive activity, since it is unable to create anything except for the condition of crisis and anarchy.

The statehood of Azerbaijan has clearly perceived the realities of current dissonance due to the experience it has gained in the short period after the restoration of its independence. If in 1993, Heydar Aliyev-the great politician, who gained the respect of international community as far as the 1970s as an experienced leader-was not brought to leadership of the country, it is difficult to

imagine the situation of Azerbaijan, the processes it would be driven into, the events that would take place here.

Let us consider our country from the aspect of global changes taking place in the world- from the aspect that has shaped in the last decade and prepares the world to a new order of forces. As well as other peoples of the Soviet Eurasia, we were not fully ready for any changes either. Consequently, the process acquired a different course and rendered negative affects represented by non-readiness to perceive the new standards and values, collapse of infrastructure and disintegration.

We would like to note it once again that the quantitative changes that had taken place before the new millennium were preparing the world community for a new system. It so happened that while the big and powerful states regarded the future global reforms quite seriously, Azerbaijan not only stayed out-of-the-way of these reforms until 1993, but also managed to represent itself in the best case as a half- Asian state with part of its territory invaded, which did not have an audible voice or a real political image, though it possessed satisfactory qualitative indicators in some fields of development. In other words, the place targeted by Azerbaijan among the world countries was divided and occupied by others.

At that time, our country had very little opportunities to make itself known and to represent itself. Internal conflicts and encouragement of centrifugal forces exhausted the situation even more at passage from the century of world-system confrontations to formation of informed society and pushed Azerbaijan away from civilization and development. The phenomenon of Heydar Aliyev fully displayed itself exactly at such a moment. The phenomenon that above all, gave precise value of self-perception and knowing oneself before knowing others in a short period. This provided an opportunity for the republic to hold a place in the world of civil development among the states, which managed to jump into the express train rushing towards the XXI century at the last moment and in the shortest period.

The dynamics of changes and the projects linked with it were so complex that the Azerbaijani society hardly perceived all of these in general and found it difficult to access distinctly the events taking place or convey a position. At that time, the vertical form of management was introduced as the most optimal option. As a result, many issues regarding the reforms were solved in most cases exactly due to the President's will. Despite of the separate reproaches sounded by the opposition regarding this, the society understood well the importance and urgency of that management in general. In some time, the reforms displayed themselves as a determinative factor in formation of the public mind. Consequently, Azerbaijan became a member of the European Council and a supporter of the NATO. The country held a position in the center of the mega-region's oil arteries and became a significant means carrying out the function of connector between Europe an

Asia. It is not a secret for anybody that there were other direction options of crude oil transportation also. However, precisely Azerbaijan was preferred from the standpoint of transit. Certainly, it may be supposed that quantity caused quality change. However, undoubtedly, this process is not simple and requires much time.

We have already mentioned the importance of the irrefutable role of the personality phenomenon in creation of a line defining the modern political course of Azerbaijan. In general, irrespective of the belonging to any state, the use of the mentioned personality phenomenon has played a significant role for Azerbaijan to find its worthy place in the world community. This has coincided as well with the international political tendencies where the transnational companies dictate their own rules of the game and the personality factor is put to the forefront.

Formation of a personality possessing analytical mind, implementing the measured out state policy and able to see the distant future is of great importance in the provision of a country's national, as well as economic safety. Usually the existing strategy that has already shaped and is able to protect the country's national policy's not sufficient. A leader, who is able to implement this strategy with his tactical moves considering national safety, is needed. Such a leader is able to coordinate the condition of the world community system and integrate the country into that community using the international rules of the game while taking into account the characteristics of the modern world, the country, in other words, Azerbaijan, where the interests of super-states collide. In our opinion, those including the Azerbaijan Republic in the list of the countries lucky from this standpoint are not mistaken. Heydar Aliyev is exactly such kind of a national leader. If to put by the way of the great Azerbaijani scholar and philosopher Nasiraddin Tusi, "a doctor is head of a state, one who is capable of curing the country when it catches an illness".

Unfortunately, the men, who were slow-witted in politics, headed the country in 1987-1993. Only the attention and care of our national leader Heydar Aliyev, who came back to power in 1993 at persistent demand of the people, the actual and successive policy implemented by him created an opportunity for radical changes in the activity of the State Customs Committee. With this regard, we would like to bring some ideas to your attention.

The provision of the county's national safety intends mainly two factors:

- The policy and strategy of military safety;
- The policy and strategy of economic safety.

Nevertheless, every country takes into account its place in the world community, potential opportunities, geographic territory etc. while preparing its own strategy of national safety. Although military safety is of the leading importance for the big and powerful states, provision of economic safety in

comparatively smaller states as Azerbaijan requires much more care and is characterized by the direction of the state's general policy.

Certainly, we do not mean precisely the current war condition of Azerbaijan and believe that it is temporary. At the same time, this situation confirms that every country must have certain military power against different probabilities.

As the extreme cases require separate, extraordinary decisions, they should be considered aside from the national safety strategy.

While saying that economic safety is put to the forefront for such states as Azerbaijan, the fact that provision of military safety of such comparatively smaller states does not fully depend on the country itself being taken into account. As it is known from the practice of the Kuwait-Iraqi war, small states are not able to fight alone against the military aggression of bigger states. Therefore, they enter into powerful and authoritative international unions and sign agreements on military cooperation with nearby and distant states. All of these provide good ground for provision of a country's military safety. In fact, in the present time, when the foreign policy stereotypes that have long been observed by the states have changed and the super-states prefer cooperation to military confrontation in their relations, one of the major means of providing military safety of any state, including Azerbaijan is creation of a global (regional) safety system. The European Safety Council or CIS Safety Council should be regarded from this aspect. The degree of efficiency of those councils' activity, the conformity or non-conformity of the methods and terms of realization of the tasks put before the interests of all the states included in them is quite another issue. However, the issue of provision of a country's economic safety depends directly on the country itself. For this reason, we will put the issues concerning the country's economic safety to the forefront and stop on their different aspects as far as we can.

Before expressing a profound idea about the economic safety, let us first try to establish the main factors defining it. For us, they are comprised of the following:

- The political-economic strategy of the state;
- The degree of a country's economic "openness";
- Accurate evaluation of economic and intellectual potential;
- The actual state of the geopolitical situation;
- The identification of the optimal limit in the finance and credit policy;
- Accurate evaluation of economic safety in the laws on special property, foreign and internal investment, and privatization;
- An average limit in utilization of the national resources;
- The protection and enlargement of intellectual property;
- Ecology;

- The state of political situation in the country and measures aimed at the reduction of probability of the possible conflicts;
- The identification of the priority fields needing development;
- Science and science-bearing technology;
- Food manufacture;
- The identification of the integration limit etc.

However, these factors are not a dogma and they undergo certain amendments in accordance with requirements of the time, which is not an anomaly, but an objective law. From this point of view, consideration of the transition period is of special importance for modern Azerbaijan.

Provision of the country's economic safety in the transition period depends greatly on identification and elimination of the factors directly causing that danger.

The transition period, which at first bears rather destructive features that constructive, is accompanied by the group selfishness and national selfishness within a country, and undergoes the strong influence of foreign investors and creditors. All kinds of deficiencies, as well as the national-ethnic dissatisfactions, which remained in secret, or failed to find a chance to emerge during the previous system, come out. The old laws do not work, while preparation of the new ones delays order. A kind of lawlessness reigns. Favorable condition emerges for the display of the features like greediness, avidity, vanity characteristic of men. In such a kind of situation, the minority trying to protect the country's wealth fails to fight against the majority trying to appropriate it. As a result, not only the level of production falls down catastrophically, but also the existing wealth is sort of plundered. Firstly, stability should be created in the country in order not to let this process keep on long. Creation of the stability does not happen automatically and puts the availability of the government's thought-out programme of stabilization policy to the forefront.



## **FACTORS DETERMINING FOREIGN COMMERCIAL-ECONOMIC RELATIONS**

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“Foreign economic policy” is meant to refer to a system of arrangements aimed at accomplishing the goals of the state in the area of international economic relations.

In a broad sense, foreign economic policy consists of the sum of all kinds of activities of the government that impact on the current, composition, and volume of the factors of foreign trade and production.

Foreign economic policy is a component of general economic policy and is closely linked with the whole economic activity in the country. The decisions adopted in the area of foreign economic activity affects all the aspects of daily life. For example, any government policy restricting international trade immediately affects the consumer situation through prices. At the current stage, it is impossible to separate domestic and foreign economic policies in the economic policy of the state, because the two directions concerned are closely related. For example, the means by which foreign economic policy is executed is through the national monetary and fiscal policy. Since national monetary and fiscal policy seriously impact international trade and capital investments and therefore are interrelated with the foreign economic relations of the country. Or again, the arrangements made in the area of employment will be reflected in the foreign economic relations and vice versa; the decisions adopted in areas of international trade, foreign aid, foreign capital investments and balance of payment will be reflected in the increase of national income and its distribution, employment and the level of prices.

Foreign economic policy is executed in the following areas:

- foreign commercial policy
- balance of payment policy
- foreign investments policy

- foreign aid policy

Foreign commercial policy is the sum of the system of arrangements aimed at regulating the foreign trade of the country. One of the leading areas of foreign economic policy. Foreign commercial policy, in a broad sense, helps achieve the establishment of financial resources and their use. Foreign commercial policy, without regards to whatever the goals are, affects redistribution of economic resources.

Major instruments of foreign commercial policy are tariff and non-tariff regulation. Herein the focus is only on the general aspects the balance of payment policy as a component of foreign economic policy. Balance of payment policy is the sum of arrangements made by the government to stabilize balance of payment. The arrangements made to fill the deficit in the balance of payment may be divided to short and long term measures. Short term measures include acquisition of funds from other states, international organizations or its own arrangements to fill the deficit. And long term measures include:

1. Ensuring the balance of payment do not yield deficit by means of creating devaluation in economy employing monetary and fiscal policy
2. Devaluation (revaluation) of the national currency
3. Exerting currency control over international economic activity
4. In case of foreign trade balance closing with deficit, raising the tariff rates and increasing the restrictions in import, taking measures to increase export.

These measures may be taken as a whole or individually.

The policy carried out to stabilize balance of payment has a 250 years history. However until the 30s of the last century the theory considered for stabilizing of balance of payment was by very elementary means of making shifts in exchange rates. No doubt this theory grew out of classical competition mechanism and the probability that prices were fully flexible. Starting from the 30s in the countries, which had the a deficit in their balance of payment to decrease the money supplies and on the opposite the increase of money supplies in the countries with positive balance resulted in changes in relative prices. The depression of 30s demonstrated that changes in prices could not ensure stable exchange rate. Therefore according to the British economist J.Keynes theory the stability of balance of payment must be ensured by wider economic means. Balance of payment directly affects the levels of income and employment; the lowering of prices results in the flow of money out of the market; and that in its turn results in even more lowering of income and employment. On the other hand in countries with positive balance the demand in money increases; the levels of income and employment rise. Because the prices increase a threat of inflation emerges.

For the solution of such serious problems as unemployment and inflation in the system of market economy, providing full employment and the stability of prices are major goals of economic policy carried out and focal issues of balance

of payment policy. That is because instability in balance of payment will be reflected by changes in the levels of income, employment and prices. Therefore the balance of payment policy is essentially a component of both general economic policy and foreign economic policy.

Foreign investments policy covers arrangements made in the area of long term international capital investments. These capital investments include direct foreign investments and long term portfolio investments. Direct foreign capital investments being a capital transfer in the international arena include at the same time proactive approach, technological innovations, enterprising and organizational activities. Foreign economic policy in relation to transnational corporations realizing international capital investments, which play an important role in modern economy is a leading area of foreign investments policy. Other than direct capital investments of transnational corporations, international equity shares, release of bonds and reserves relating to the purchase and sales of bonds in international markets are included in the movement of international capital.

Foreign aid policy covers the arrangements to receive aid given from one state or an international organization to another state as well as of the use of that aid in the benefiting country. This policy is the youngest area of foreign economic policy. At the current stage this policy has been directed at basically governing the issues related to the aid given by developed states and international organizations for different purposes (to ensure economic development, fill the deficit in balance of payment, ensure the stability of the national currency, national defense and etc.) to the developing countries.

Classical and neo-classical economists have examined the theory of foreign trade statistically and paid separate attention to the general issues of economic development. Consequently existing interrelations between economic development and international trade must be studied carefully.

Economic development makes shifts in society's demands and preference of goods. The populations of countries involved in foreign trade acquire a chance to purchase goods produced outside the country and satisfy their needs at their cost. In other words foreign trade creates new supplies and produces a need to obtain them. International trade becomes a reason why consumption levels equalize. And all of this demands changes in the internal structure of the country's production. The increase of import based consumption results in the increase of the volume of foreign trade, on the other hand export driven development results in decrease in the volume of foreign trade.

It is known that the increase of per capita income results in changes in the structure of individual consumption of the population and at this time two patterns in the nature of demand become apparent.

First of all as revenues increase, the demand of the population in a variety of goods and services also increase; the share of consumer goods in the volume of

demand decreases relatively; the share of industrial and household consumer durable increases.

In this pattern named after a German economist E. Engel, foodstuffs are related to essential goods, and deluxe items (refrigerators, TV sets, and etc.) to consumer durable. Based on this law, while prices and demographic changes keep stable, the increase in revenues brings about an increase in the share of consumer costs of food products. At this point the demand in food stuffs increase, however this increase often lags behind the increase in revenues. This law, which was established based on the studies of the family budget justifies itself both in terms of individual families and real life situation in all of the country; as a result of economic development the increase in income per capita creates changes in the structure of demand. This change turns against the producers of foodstuffs, above all of wheat, whose revenues are less flexible.

E. Engel's law allows one to conclude that the indicated pattern and essential goods affect the change in prices. The increase of income results in the increase of demand in the deluxe items and relatively of their respective prices. For owners producing essential goods and their countries the decrease of demand in those goods and relative decrease of their respective prices are expected.

As time goes by, production factors undergo quantity and quality changes. Economic development in any country takes place as a result of increase in production factors or innovations in production technologies. Out of the production factors the volume of capital and the number professions rapidly rise.

In each country the increase in production factors shows in different proportions. The comparison of variety of these factors in foreign trade is in the difference between the growth rates of different countries. This differing growth as time goes by results in the change of the country's comparable advantage. For example, in the second half the last century the USA was more of a country exporting mining industry products. But currently it imports those products from abroad. In other words the country has turned from a country that exported resource-demanding goods (raw materials) to a country that exports labor/capital-intensive goods. This process took place because the growth of material factor was slow and the growth of labor/capital factor was expedient.

The channels of the impact of the difference between the growth rates of production factors on the foreign trade is numerous. This becomes apparent in demand and supply. At this point the key issue becomes whether the expedient growth takes place in the areas competing with import or in the areas of export. In countries with small economic potential, which cannot affect the current economic climate of the world the policy of substituting import on scientific grounds will create favorable conditions for the efficient use of the advantages of the distribution of international labor and acceleration of economic development.

There is a greater need in the policy of substituting import in the countries, which are in transition and where the advantages of the distribution of international labor are not made use of efficiently. For example, the fact that the population of our republic, which is rich with natural resources and has favorable climatic conditions, buy certain part of consumer goods from abroad is one of the factors shaking the basis of the country's economic development. This situation can only be remedied by means of the targeted and scientifically grounded policy of substituting import.

In countries with limited economic potential the policy of expanding export, the efficient use of the world scale comparable advantages will accelerate the economic growth of these countries.

In the system of world economy the experience of new industrial countries shows that when executing the policy of expanding exportation the countries that direct all forces to the expanding of production potential achieve more effective results. Expansion of the exportation of goods creates favorable conditions for more secured development. In this regard it would not be correct to either theoretically or practically to put all hopes of expanding the export potential only on oil.

At the current stage the policies of substituting import and expanding export is an essential component of the economic policy of the developed countries. The experience of the countries with market economy demonstrates that while substituting import and expanding export in order to ensure certain areas' expedient growth using financial-credit tools additional capital investments must be attracted to those areas, tax rates must be lowered.

## THE THEORY OF SOCIO-CULTURAL EVOLUTION

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Evolution<sup>1</sup> is a form of change in a system which can be distinguished according to variation, selection and stabilization. This evolutionary system includes every structural change occurring through differentiation and the interaction of these above-mentioned mechanisms. Variation and selection offer solutions which are realized through stabilization in different subsystems. Thus evolution is structured self-reflexively; it explains evolution from previous evolution. The mechanisms of variation in society are fulfilled, among others, through language, which increases conflict and negation possibilities. Language serves as a selection mechanism that determines which topics are chosen and discussed. Following the transfer to high culture, interaction media develops, such as money, power, law, truth and love, which control the selection process. From here, systems develop through differentiation of subsystems for economy, politics, law, science and intimate relationships. The interaction media distinguish themselves more and more in their subsystems. In a later evolution level, inclusion processes arise, which cause interpenetration and generalizing. This leads to an increased level of abstraction and greater complexity within the social system.

Here the swells of socio-cultural evolution are recognizable: various levels of social development can be identified.

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<sup>1</sup> Luhmann, Niklas, Sinn, Selbstreferenz und soziokulturelle Evolution (*English: Sense, Self-reference and Socio-Cultural Evolution*). in: Günter Burkart und Gunter Runkel (Ed.), Luhmann und die Kulturtheorie (*English: Luhmann and the Culture Theory*), Frankfurt am Main 2004  
Ibid, Evolution und Geschichte (*English: Evolution and History*), in: ibid, Soziologische Aufklärung (*English: Sociological Enlightenment*), Vol. 2, Opladen 1975  
Ibid, Systemtheorie, Evolutionstheorie, Kommunikationstheorie (*English: System Theory, Evolution Theory, Communication Theory*), in: ibid, Soziologische Aufklärung (*English: Sociological Enlightenment*), Vol. 2, Opladen 1975  
Ibid, Weltzeit und Systemgeschichte (*English: World Time and System History*), in: ibid, Soziologische Aufklärung (*English: Sociological Enlightenment*), Vol. 2, Opladen 1975

The first level in this social development is called the archaic, which constitutes the longest part of human history so far. On this level the mechanisms of variation and selection are not clearly divided because on this level the spoken language contains both mechanisms.

Archaic societies are made evident through segmentary differentiation; meaning low endogenous caused variation, high environmental dependence and differentiation in similar units.

High cultures emerge through the conversion to stratifactorial differentiation - in other words, through stratum-like social construction, expansion of rulers and patriarchs and the centralization of resources. This leads to further separation of different social groups, especially the division between warriors and priests with their differing moral-religious beliefs. Larger groups appear and produce greater armed forces, build fortified cities and organize agriculture, trade and other areas of work. Social classification, division of labor, creation of armies, building of cities, growth in population and the complexity of symbol systems arise from a structural increase in evolutionary meaning.

Modern society represents the next level of social development, which is identified by functional differentiation, in other words, through the extensive autonomy of subsystems. Segmentary differentiation and stratum-like differentiation are included in this social form.

Since the mechanisms for variation, selection and stabilization are independent from each other, the speed of evolution is increasing in this social form. Furthermore, the time dimensions of past and future are stepping further apart, and the respective contemporary possibilities are presented, which, if at all, can only be realized in the future. The later acquires a worth of its own and is viewed as a basic chance, not as a danger.<sup>2</sup>

Selectivity of the future is more important than the past in modern societies. Evolutionary theory is a self-referential theory and, therefore, a theory of evolution about evolution. One must assume an evolution of social systems, organized into sequential levels of meaning. Habermas sees the establishment of a higher conception level according to the thesis of Piaget<sup>3</sup> and Kohlberg as an unfolding of

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<sup>2</sup> Nevertheless, there is also a tendency toward structure conservation in the political progressive groupings. A left-wing politician in Germany complained that the last technical modernization, which was completely welcomed by his party, was the introduction of color television in the 1950s.

<sup>3</sup> Piaget, Jean, Einführung in die genetische Erkenntnistheorie (*English: Introduction to the genetic-recognition Theory*), Frankfurt am Main 1973, esp. Die erste Vorlesung (*English: The First Lecture*)  
ibid, Das moralische Urteil beim Kinde (*English: The Moral Judgement of Children*), Frankfurt am Main 1973  
ibid, Gesammelte Werke (*English: Compiled Works*). College Edition, Vol. 1-10, Stuttgart 1975

certain operations and transformation systems. In accordance with this thesis, he determines the respective level of evolution, its causes, its degree of freedom and / or repression, its achievements and its possible changes. Thus, a large universality of norms shows a higher level of moral. Habermas interprets evolution<sup>4</sup> as the attainment of new rule structures in connection with the development of productive power.<sup>5</sup> He understands human development analog to the Ego-development as a hierarchical phased attainment of action competence<sup>6</sup>, which, in turn, resulting in differentiated systems of thought, speech and actions. The more recent evolution theory criticizes these kinds of level-models, which prescribe how evolution must act. There is reference to the contingency of the future.

With Luhmann, evolution stirs from the discontinuity of system and environment and presents an increase in logical combination possibilities of negation achievement. Here Luhmann tries to show which specific structures have been successful in evolution in the face of functional alternatives; in other words, which structures have better problem-solving capacities as others.<sup>7</sup>

Similarly, before Luhmann and Habermas, Parsons developed an evolutionary, three-part level schema, which was based on the 'development of a code element for normative structures'<sup>8</sup>. In his schema the development of script (handwriting) is the most important criteria for a transfer of the 'primitive' to the second level 'intermediate'. With the invention of writing and the rise of an elite, which had established itself in a differentiated monarchy or ruling system based on a family or relation system<sup>9</sup>, the increase in members of a group and the

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<sup>4</sup> See Habermas, Jürgen, Zur Rekonstruktion des historischen Materialismus (*English: On the Reconstruction of Historical Materialism*), Frankfurt am Main 1976

<sup>5</sup> Habermas, Jürgen, Zur Rekonstruktion..., see above

Eder, Klaus, Komplexität, Evolution und Geschichte (*English: Complexity, Evolution and History*), in: Maciejewski, Franz (Ed.), Theorie der Gesellschaft oder Sozialtechnologie (*English: Theory of Society or Social Technology*). Supplement 1, Frankfurt am Main 1972, esp. p. 29

Eder, Klaus und Jürgen Habermas, Zur Struktur einer Theorie der sozialen Evolution (*English: On the Structure of Social Evolution*), in: Lepsius, M. Rainer (Ed.), Zwischenbilanz der Soziologie, Verhandlungen des 17. Deutschen Soziologentages (*English: Interim Survey of Sociology, Negotiations of the 17<sup>th</sup> German Conference of Sociologists*), Stuttgart 1976

<sup>6</sup> Habermas, Jürgen, Zur Entwicklung der Interaktionskompetenz (*English: On the Development of Interaction Competence*), Frankfurt am Main 1975, p. 58

<sup>7</sup> Luhmann, Niklas, Zur systemtheoretischen Konstruktion von Evolution (*English: On the System-theoretical Construction of Evolution*), in: Lepsius, Zwischenbilanz..., see above

ibid, Funktionale Methode und Systemtheorie (*English: Funktional Methods and System Theory*), in: ibid, Soziologische Aufklärung (*English: Sociological Enlightenment*), Vol. 1, Opladen 1971

<sup>8</sup> Parsons, Talcott, Gesellschaften. Evolutionäre und komparative Perspektiven (*English: Societies. Evolutionary and comparative Perspectives*), Frankfurt am Main 1974, p. 46

<sup>9</sup> Habermas, Jürgen, Legitimationsprobleme im Spätkapitalismus (*English: Legitimation Problems in late Capitalism*), Frankfurt am Main 1973, p. 33



accumulation of a societal excess<sup>10</sup> collapsed. The development of the second level into a third is determined by an increase in universal principles, like formal rationality<sup>11</sup> and a procedure primacy in the normative area<sup>12</sup>; on this level the cultural factors taking on the control of the evolution.<sup>13</sup>

Sociological theory is constructed more efficiently by making theory dynamic, in other words, through the incorporation of the evolution theory, for one, in the above mentioned mechanisms of variation, selection and stabilization, and, for another, with Parsons' terms of adaptive upgrading, differentiation, inclusion and value-generalizations.

Differentiation succeeds mainly by separating the function systems. These separated systems must be summarized through inclusion. A further evolutionary mechanism represents the value-generalization, which is expressed in the idea of tolerance, after which the Western religion systems had separated themselves, e.g. in the Augsburg Religious Peace (Augsburg Religious Peace) and in the peace of Münster and Osnabrück after the Thirty Years' War in 1648.

Beings are interwoven in the developing process. They are self-referential systems. A dynamic system, which is self-regulated, exists within the body, which is divided by physical boundaries. Internal processes regulate metabolic process with the outer world.

A further aspect is generalisation or universalisation. In this way, the universalisation of the value system leads to the idea that all humans are defined as equal and there should be no ascriptive variations. This is then transferred to the disadvantaged, such as the Blacks in South Africa or women in Europe. Generalizations of cultural patterns from sections of other cultures sustain evolution, because advanced and modern forms, which have been developed in certain sections of a culture (perhaps attainment of equality and role-attainment through one's own achievement in a political system), are transferred to other sections.

The process of implementing such new forms in other areas presents an element of interpenetration. Thus, each environmental system is surrounded by

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<sup>10</sup> Childe, V. Gordon, *Soziale Evolution (English: Social Evolution)*, Frankfurt am Main 1975, p. 35

<sup>11</sup> See Weber, Max, *Wirtschaft und Gesellschaft (English: Economy and Society)*, 2nd Ed., Tübingen 1925

ibid, *Gesammelte Aufsätze zur Religionssoziologie (English: Collected Works on Sociology of Religion)*, Vol. 1, 6<sup>th</sup> Ed., Tübingen 1972

<sup>12</sup> See Luhmann, Niklas, *Legitimation durch Verfahren (English: Legitimation through Procedure)*, Darmstadt and Neuwied 1975

<sup>13</sup> Parsons, Talcott, *Gesellschaften...* see above

ibid, *Evolutionary Universals in Society*, in: ibid, *Sociological Theory and Modern Society*, New York and London 1967

interpenetration in an action system. Evolution is only possible in a mutually determining process between differentiation and integration. Since such processes refer to meaning in a contingent environment, communication media and interaction media are required.<sup>14</sup> Media such as money, power and love make up a code, which produce the balance of expectation and action. Codes are socially constructed selection opportunities. In the modern world, self-reference is built into such codes. A resulting problem is that the increasing expansion of self-reference produces, in turn, increasing demands of autonomy and self-realization, which, in turn, produce a greater demand for self-reference, and the processes feed off of each other.

Societies do not stem from a contract between various individuals, rather societies have always existed – our ancestors and even our animal ancestors had societies without a contract. Thus, the individual does not substantiate 'the society by deciding to live together and committing with the respective contract, but rather the society substantiates the individual by making it possible for the individual to act, to make contracts, to commit itself mutually, to be responsible, to sanction.'<sup>15</sup>

*Societies* represent a special form of social systems. As Aristotle, Parsons also sees societies as a class of social systems, which as systems have gained the highest scale of autarky (self-sufficiency) in relation to their environment.<sup>16</sup> A society depicts a social system with the highest degree of independence opposite its environment and is self-sufficient. A society must make itself a collectively organized communal being, enforcing a normative order, practicing control over a territory and usually recruiting its members by birth and socialization.

Talcott Parsons developed a four function paradigm.<sup>17</sup> He assumes four functions as central for a system, which must be fulfilled for each system but can be mainly categorized into certain systems. The functions are:

Adaptation (Adjustment to continually structural change in systems and in the relation to other systems) Goal Attainment (Goal-orientation of systems)  
Integration (Integration of constitutional elements of the system)

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<sup>14</sup> See Parsons, Talcott, *Zur Theorie der sozialen Interaktionsmedien (English: On the Theory of Social Interaction Media)*, Ed. by Stefan Jansen, Opladen, 1980

<sup>15</sup> Luhmann, Niklas, *Die gesellschaftliche Differenzierung und das Individuum (English: Societal Differentiation and the Individual)*, in: *ibid*, *Soziologische Aufklärung (English: Sociological Enlightenment)*, Vol. 6 *Die Soziologie und der Mensch (English: Sociology and Humans)*, Opladen 1995, pp. 129

<sup>16</sup> Parsons, Talcott, *Der Begriff der Gesellschaft: Seine Element und ihre Verknüpfungen (English: The Term of Society: Its Element and its Associations)*, in: *ibid*, *Zur Theorie sozialer Systeme*, see above, p 126

<sup>17</sup> Parsons, Talcott, Robert F. Bales and Edward A. Shils, *Working Papers in the Theory of Action*, Westport, Connecticut 1953

Latent pattern maintenance (Maintenance of the system structure by overcoming continually new tensions)

The beginning letters of these four functions is called the AGIL-schema. Parsons occupied himself intensely with the *evolution* of societies. He used them on AGIL-schema-based evolutionary terms, such as 'adaptive upgrading', differentiation, integration and value-generalization.<sup>18</sup>

*Adaptive upgrading* is a process in which more resources can be made accessible for a system (e.g. larger populations, introduction of agriculture). *Differentiation* causes a division of systematic units, which then acquire a greater functional meaning in a system (e.g. the differentiation of family or relative roles and career roles). *Integration* must coordinate the subsystems, which are trying to drift apart (e.g. by expanding participation). This is accompanied by *value-generalization* because a society requires appropriate justifications and orienting patterns, which are raised to a higher level of generalizations in a more complex social system (this becomes clear through modern demands: all humans should enjoy inalienable human rights).

Parsons distinguishes between three evolutionary levels, which he calls primitive<sup>19</sup>, intermediary and modern. They are based on diverse forms of layers; thus, the primitive (the archaic level) is marked by segmentary differentiation, the intermediary by stratifikatorical differentiation and the modern level by functional differentiation.

He established his evolutionary theory with evolutionary universals. These are at the transition point of animalistic action to earlier societies, among others the

- A Development of *technologies* (like the use of tools), which can be passed on and help to change the physical environment. One finds the rude use of tools with other beings, for example with apes; however, the perfecting of the use of tools is still reserved for humans.
  
- G Communication through *speech*, which first appeared in the form of mutual, elaborate conversation and gained a central evolutionary meaning for humans.<sup>20</sup>

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<sup>18</sup> Parsons, Talcott, Gesellschaften. Evolutionäre und komparative Perspektiven (*English: Societies. Evolutionary and comparative Perspectives*), Frankfurt am Main 1975, pp. 39

<sup>19</sup> The term 'primitive' was chosen carelessly, because these societies are not primitive in the sense of the word, but are rather more complex structures. Therefore, the expression 'archaic' is preferred.

<sup>20</sup> Parsons, Talcott, Evolutionary Universals in Society in: *ibid*, Sociological Theory and Modern Society, New York. London 1967, pp. 495

- I Integration through an *order of relation*, including various roles and allowing for a complex social order. The relation system regulates the continuation of the species over bisexual reproduction and the incest taboo.
- L The development of *ancestor worship and nature-gods*, influencing and legitimizing actions through symbols, cults and relevancy of assigned meaning.

The transfer from the first to the second level is based on 'critical developments of code-elements of normative structures'<sup>21</sup>, thus, on the appearance of a written language.

The following changes arise in the different areas in intermediary societies:

- A The differentiation of a *market organization* with the introduction of money as an exchange medium. *Money* and *market* make up the evolutionary universals in these societies. Money becomes a general symbolic medium, which is neutral enough to regulate the attainment of goods, for which many strive. The market is also an evolutionary universal of high culture, which brings consumption and production together, causing cities to appear and flourish.<sup>22</sup>
- G Communication through *written language*. Written knowledge became the core of *bureaucratic organization* in intermediary societies, which can then support political rulers, as they differentiate themselves in stratified societies, and keep them in power. The development and institutionalization of written language is limited to religious and bureaucratic experts at the beginning of the second level. In later levels of intermediary societies the access to this knowledge will be expanded to all men in the upper class.
- I The appearance of *social classes* and the accompanying hierarchy, which had been more functionally effective as other forms and had assigned its members clear-cut roles. Furthermore, the development of social classes in intermediary societies from the originally more equality-oriented system is accompanied by a differentiation of roles, which are bunched, e.g. in warrior knights and priest orders. These, then, are often taken over by single families. Stratifactorial differentiation is secured by a process of *cultural justification*, based on stronger emerging roles and power differences with reference to similar division of roles and of power in the hereafter.

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<sup>21</sup> Ibid, Societies, see above, p. 46

<sup>22</sup> See: Runkel, Gunter (Ed.), Die Stadt (*English: The City*), 2<sup>nd</sup> extended edition, Lüneburg 2000

L The *religion systems*, which further developed from nature religions, pantheistic religions to monotheistic religions<sup>23</sup>, take on the roles of cultural justification, resulting the inequalities and tension between diverse groups. In intermediary societies democratic associations arise, e.g. in the Greek polis, the Roman senate, the cardinals cabinet, the nobles' assemblies in the nobles republics and the guilds, fraternities and other early forms of cooperatives,<sup>24</sup> which have in part been passed on to modern societies.

Connected with this is an institutionalization of *generalized universal norms*, culminating in the introduction of a law state<sup>25</sup> and the English Common Law.

Constitutional systems arise during the course of societal development, having separated themselves from the religious references and making it possible for citizens to have more participation in the public and private affairs. According to Parsons, a development occurred in modern times toward more meaningful free space, expressing itself in the greater self-responsibility of those involved, legal elections and stronger solidarity – the result of societal development in which evolutionary universals have developed.

In modern, functional differentiated societies the processes of intermediary societies are set forth. Cultural patterns appear, which can be described as the following:

A separation of 'rational learning' occurs on the level of *Adaptation (A)* with an increased meaning of school and higher-level education, because in modern society being in command of the written language for all adults and youth became institutionalized, causing a further modernization boost.

The 'self-responsible personality' as a result of the self-referential process represents the *Goal Attainment (G)*. *Social Interaction (I)* occurs within the framework of 'rational capitalism'. Since other economic forms have historically survived, the political system is structured according to 'democratic, rational-legal ruling forms.' Forms of civil-society occur in the community system, and universal education and differentiated discourses based on arguments occur in *Socio-Cultural Areas (Latent Pattern Maintenance) (L)*. Individualism arises as a cultural pattern, linked to activism of influencing the world, universalism and rationalism.

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<sup>23</sup> See *ibid*, The Sexual Morality of Christianity, in: Journal of Sex & Marital Therapy, Vol. 24, No. 2, 1998

<sup>24</sup> Runkel, Gunter, Genossenschaft, Repräsentation und Partizipation (English: Cooperative Society, Representation and Participation), Hamburg, Münster, London 2003

<sup>25</sup> Parsons uses the German terminus 'Rechtsstaat' here in: *ibid*, Evolutionary Universals..., see above, p. 513

This produces the following schema of modern, secular culture<sup>26</sup>:

<b>L</b> Rationalis m	Universalism	Universalized Education and Moral	<b>I</b> Civic Society
	Cultural Pattern		Social Interaction
Individuali sm	Activism of Influencing the World	Rational Capitalism	Democratic Rational Legal Rule
<b>A</b> Rational Learning		Self-responsible Personality <b>G</b>	

<sup>26</sup> Similar to Münch, Richard, Die Kultur der Moderne (*English: The Culture of Modern Times*), Vol. 1, Frankfurt am Main 1986, p. 176

**Parsons also relates the evolutionary universals to the AGIL-schema.<sup>27</sup>**

<b>L</b> <b>Generalized Universalistic Norms</b>	<b>I</b> <b>Democratic Association with elected leadership and voluntary membership</b>
<b>A</b> <b>Money, Power</b>	<b>Bureaucratic Organization</b> <b>G</b>

Society presents a type of social system, distinguishing itself through the highest degree of self-sufficiency in proportion to its environment and other social systems.<sup>28</sup> Such a social system is integrated primarily over the personality system, status and roles, identification and over the coordination of various systems. Thus, a mutual orientation develops in the personality system regarding personal decisions, expectation of others and mutually shared values between Ego and Alter.

Socialization effects the adaptation of personality systems to a social system, made up of the steps learning, internalizing and external control. A principal element of socialization is internalizing the values and norms of the given society, into which an individual is led.

Status and Roles are other important categories, connecting the actors by their goal-orientation with social systems. In this way, those involved try to attain or defend a high status. A reinforcement of this status reveals the classification of society. The state of class and the roles involved arise from the following, among others:

1. Groups of relatives because status is also determined by the position in the family.
2. Personal characteristics such as gender, age, intelligence, beauty, psychological robustness, etc.

<sup>27</sup> See Parsons, Talcott and Gerald M. Platt, Die amerikanische Universität (*English: The American University*), Frankfurt am Main 1990. In this book Parsons formulated his last great and concluding theory, despite the confusing title.

<sup>28</sup> Parsons, Talcott, Das System moderner Gesellschaften (*English: The System of modern Societies*), 2nd Ed., Munich 1976, p. 16

3. Performance, meaning the result of the actor's actions.
4. Property – that which belongs to the individual as a result of his/her own actions or as a result of his/her own birth and that which is at further disposal.
5. Authority as a possibility to influence others.
6. Power as a possibility to gain influence over others by one's own actions, thus increasing one's performance, property and authority.

Roles represent the process-likeness of interaction relationships, in contrast to status. The role-play of the actors<sup>29</sup> covers an important area, into which the actors can introduce their intentions, making it possible to negotiate the goal of social systems anew. Roles are parts of the actor's orientation system, responsible for the expectations of a particular interaction relationship, complemented by a set of value standards controlling interactions.<sup>30</sup> Learned role behavior can become problematic and change, made apparent by the traditional gender roles.

Institutions are important elements in the integration of a social system for establishing economic, political, pedagogical and religious institutions for the long term. According to Parsons, institutions are a complex of role and status relationships, which display a similar pattern.<sup>31</sup> They appear in the particular subsystem; thus, organizations (like enterprises and associations), in particular, are suitable for the institutionalization of property and ownership rights in the economy, parties for the enforcement of power in politics, families and schools for the integration into the social system and churches and sects for the implanting of religion in cultural and social systems.

A social system can only function indefinitely when it is held together by a common value canon. The extent of commonly shared values guarantees continuity and, thus, a certain amount of consistency. Systems and their representatives strive to implant a common value canon, in order to establish motivation, roles and delegation of positions, to make institutions better able to act, to sanction negative deviations and to install moral demands.

The primary function of social systems lies in integration. An important element of integration is fulfilled in the societal community which, among other things, controls the internalization of norms through rearing, value agreement, role-taking and the interpenetration of politics in the sense of enforcing and stabilizing the normative order and economy in the sense of regulating economical and technological trade in the social system.

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<sup>29</sup> Runkel, Gunter, *Das Spiel in der Gesellschaft (English: Play and Games in Societies)*, Hamburg. Münster. London 2003

<sup>30</sup> Parsons, Talcott, *The Social System*, 4th Ed., New York, London 1968, pp. 38

<sup>31</sup> *Ibid*, *The Social System*, see above, p. 39



It becomes clear that Parsons does analytically separate a particular function, yet, nevertheless, assumes increases and cushioning in each particular interpenetration.<sup>32</sup>

For Parsons, modern society, having developed from the stratifactorally shaped society and originating first in northwestern Europe, is the result of three processes of revolutionary structure change:

1. The Industrial Revolution
2. The Democratic Revolution
3. The Revolution of the Education System<sup>33</sup>

These three revolutions mutually sustain each other. They are based on an *institutionalized individualism*, enabling the realization of goals and values of individuals and collective units. This is only possible if there is a certain consensus about the relevant values and basic pattern of cultural orientation, with which values are linked.<sup>34</sup>

1. The *Industrial Revolution* led to a rise in generalized material means, the resulting population growth and longer life expectancy. Some of the social advantages included increased work motivation, compliance to organizationally determined discipline and the reverse side of dangerous technology and environmental pollution, among others.
2. The *Democratic Revolution* loosened the federal control over its citizens, affecting control of authority and the elected official, which was tied to the institutionalized rights, and facilitated greater participation, political freedom of the individual and free enterprise.
3. The *Revolution of the Education System* led to a universalization of school education; first, the ability to read and write was made mandatory, and the attendance to institutions of higher education increased. This caused a decrease in ignorance and enabled people to use knowledge to realize their own goals and ideals.

These three Revolutions, which are not reversible in the long term, drive modern society into an open future.<sup>35</sup>

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<sup>32</sup> Münch, Richard, The Interpenetration of Microinteraction and Macrostructures in a Complex and Contingent Institutional Order, in: Alexander, Jeffrey C., Bernhard Giesen, Richard Münch and Neil J. Smelser (Ed.), The Micro-Macro Link, Berkeley. Los Angeles. London 1987

<sup>33</sup> Parsons, Talcott, and Gerald M. Platt, Die amerikanische Universität (*English: The American University*), Frankfurt am Main 1990, p. 11

<sup>34</sup> *ibid*, p. 12

<sup>35</sup> For a discussion of Parsons see: Black, Max (Ed.), The Social Theories of Talcott Parsons, Englewood Cliffs, N.J. 1961 (with Parsons' remark: 'The Point of View of the Author')

Furthermore, according to Parsons' theory architectonic a Cultural Revolution is having an effect, putting increasing pressure on the other systems of legitimation and including a pattern of individualism, activism for shaping the world, rationalism and universalism, in which more self-reference and more participation are (or can be) recommended.

The pattern variables (orientation alternatives of action) are influenced by the dichotomy of community and society introduced by Ferdinand Tönnies, furthered by Max Weber with the terms communization and socialization. They serve for an analysis of human action.

They are:

1.	Diffuseness	Specificity
2.	Affectivity	Affective Neutrality
3.	Particularism	Universalism
4.	Ascription	Achievement

Parsons bases his evolution theory on the 'Orientation Alternatives of Action' since there is a shift from the communal areas to societal areas occurs in the society development.

An ingredient of Niklas Luhmann's theory construction is an evolution theory, which he categorized under the terms of variation, selection and stabilization. Especially in his works on social structure and semantic<sup>36</sup> Luhmann's analyses the structural and semantic changes which have occurred following the modification of society from a mainly stratifactorial differentiation to a functional differentiation at the turning point of modernity. In social evolution processes of differentiation are at work, as are processes of separation of function systems. These separated systems are summarized through 'inclusion', resulting in 'value generalization'. The change from stratifactorial to functional differentiation of social differentiation types was first successful in Europe.<sup>37</sup> This was

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<sup>36</sup> Luhmann, Niklas, *Gesellschaftsstruktur und Semantik. Studien zur Wissenssoziologie der modernen Gesellschaft (English: Social Structure and Semantic. Studies on Scientific Sociology of Modern Society)*, 4 Volumes, Frankfurt am Main 1980-1995

<sup>37</sup> The discussion about this in Max Weber, *Gesammelte Aufsätze zur Religionssoziologie (English: Collected Essays on Sociology of Religion)*, 6<sup>th</sup> Ed., Tübingen 1972 and in power theoretical discourses: Mann, Michael, *Geschichte der Macht (English: The History of Power)*, Vol. 3, Frankfurt am Main. New York 1994 – 2001  
Luhmann, Niklas, *Die Gesellschaft der Gesellschaft (English: The Society of Society)*, and others, p. 711 "The hindrance of a theocratic establishment of government makes it possible to use regional, lingual and cultural differences in Europe for experimenting with theories of functional differentiation."

improbable; it is, however, now irreversible, and relies on path dependency and has caused new structural and semantic developments.

The transition from stratifactorial to functional differentiation requires an operative conclusion of functional systems under the primacy of self-reference. The integration of society through classification loses its central imprinting power, and functional systems now claim a right to autonomy and universal responsibility respective of their perspective of society. The result is a development of functional-specific semantics, in which individualization and rationality impositions increase. Symbolic generalized communication media develop in the various functional systems, which organizes the exchange process in this system and which are functionally equivalent.

Communication media rely on the neutralization of moral impositions in the modern functional differentiated society. They cannot primarily support themselves on classification and moral; rather, as functional system specific communication media they are self-supportive: on autonomy, self-legitimation and application. Coding can no longer rely on higher values.

The transformation of society from stratifactorial to functional differentiating has caused new problems, such as the decline in morals and an increase in the meaning of personal individuality.<sup>38</sup> Adaptive foreign reference is increasingly being replaced by self-reference and is splitting up hierarchically and religiously founded world order, making functional systems and persons autonomous. Exceptions are present, for example the protest and peace movements, which try to go back to a common moral.

Society as an inclusive social system, which orders all possible interactions and communications between humans, has separated itself into various functional systems, like politics, economy, science, education, intimate relationships, which update society from a specific viewpoint with specific system / environment perspectives. These functional systems connect high sensibility for certain specific questions with indifference for everything else. Every further development simultaneously increases sensibility and indifference.<sup>39</sup> Under certain conditions this leads to improved circumstances so that there can be more political freedom, economical productivity and scientific progress.<sup>40</sup> Systems can certainly produce additional problems: schools with more disinterested youth, medication-resistant viruses and new sicknesses from a scientifically and economically influenced agriculture.

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<sup>38</sup> Luhmann, Niklas, *Soziale Systeme (English: Social Systems)*, Frankfurt am Main 1984, p. 610

<sup>39</sup> *Ibid*, *Politische Theorie im Wohlfahrtsstaat (English: Political Theory in the Welfare State)*, München. Wien 1981

<sup>40</sup> A thought that Durkheim had expounded on in his work on the 'division of labor'.

System theory for the analysis of functional differentiation works with the idea of poly-contextuality of functional systems and their communication media. It has four implications: universalism, specificity, area-monopoly and self-referentiality.<sup>41</sup>

The development of modern society occurs on various levels, which possess social-structural elements and semantic elements.

Modern society is changing in a social-structural way through changes in modern capitalism, as the term 'globalization' makes clear.

Cultural patterns appear in modernity on a semantic level, such as individualism,<sup>42</sup> activism of influencing the world, universalism and rationalism,<sup>43</sup> which drive societal development on as well. These patterns are found in the functional systems' semantic re-specification and accompany societal transformation processes. These ideas developed in western societies tend toward universal standards and lead to a lasting irritation of functional systems and social conceptions, made evident by the controversial discussions about 'globalization'.

It will not work to reshape the world according to western standards of truth, judgment and taste,<sup>44</sup> and the sensible strategy remains a step-by-step change toward more democracy and prosperity. Yet, the future is wide open and can end in one giant disaster when humans realize that they alone are responsible. The "history of humans begins today, its dangers, its tragedies. Until now, the alters of the holy ones and the wings of arc angels stood behind man; from ladles and baptism bowls history ran over his weaknesses and his wounds. Now begins the series of the great unsolvable traps of humans themselves..."<sup>45</sup>

The working group, Theory of Socio-Cultural Evolution<sup>6</sup> discussed these problematic with the paper of Gunter Runkel. Especially was indicated, that the socio-cultural evolution is grounded in the biological and physical evolution.

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<sup>41</sup> Schimank, Uwe, Theorie der modernen Gesellschaft nach Luhmann – eigene Bilanz in Stichworten (*English: Theory of Modern Society According to Luhmann*), in: Giegel, Hans-Joachim und Uwe Schimank (Ed.), Beobachter der Moderne, Frankfurt am Main 2001, p. 266

<sup>42</sup> Friedrichs, Jürgen (Ed.), Die Individualisierungs-These (*English: The Individualization Thesis*), Opladen 1998

<sup>43</sup> Aretz, Hans-Jürgen, Individualisierung und Modernisierung (*English: Individualization and Modernization*), in: Kron, Thomas (Ed.), Individualisierung und soziologische Theorie (*English: Individualization and Sociological Theory*), Opladen 2000, p. 90

<sup>44</sup> Bauman, Zygmunt, Gesetzgeber und Interpreten: Kultur als Ideologie von Intellektuellen (*English: Lawmakers and Interpreters: Culture as an Ideology of Intellectuals*), in: Haferkamp, Hans (Ed.), Sozialstruktur und Kultur (*English: Social Structure and Culture*), Frankfurt am Main 1990, p. 476

<sup>45</sup> Bennis, Gottfried, Lebensweg eines Intellektualisten (*English: The Life Journey of an Intellectualist*), in: *ibid*, Gesammelte Werke in acht Bänden (*English: Collected Works in Eight Volumes*), Vol. 8, Wiesbaden 1968, p. 1933

In the discussion interesting parallels came about with the model of Walter W. Kofler – He has a look at a „critical extended evolution related view“ of reality as a basis for an „extended view“ of health<sup>46</sup> - and the approach of Oleg Glazachev, The Functional System's Theory: Applied Aspects for the diagnostics and recreation of health state of a human person as a social an biological being.<sup>47</sup>

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<sup>46</sup> In: International Council For Scientific Development, International Academy of Science, Science Without Borders, Transactions of the International Academy of Science H&E, Volume 1, 2003/2004, Innsbruck

<sup>47</sup> Paper presented at the 'International Symposium' of the 'International Academy of Science' in Innsbruck September 18 and 19, 2005

## THE CULTURE OF ATROPATENA

**N. Hasanzade**

*The ancient Greek geographian. Strabon.*

1) Atropatena-had remained in the history with the name of the founder of the state, an outstanding military leader and clever head of the country-Atropat.

2) The development of monuments in architectural respect was preferred more than courtyards, churches and public buildings in Atropatena.

3) Ancient Azerbaijan had a special role in the development of horse-breeding, even the name of a horse was also introduced in the list of family members.

4) Diogen Layersi wrote about the attitude of Plato and Aristotle towards the philosophy of Zoroaster in the preface of the "History of Philosophy".

The ancient Greek geographian Strabon (the 1<sup>st</sup> century B.C- the 1<sup>st</sup> century A.D) had given a thorough information about this state founded at the end of the 6<sup>th</sup> century B.C for the first time.

This great state which covered the territories of the South and North Azerbaijan and also of Iran Kurd had existed 350 years: it was famous for tillage, cattle-breeding, horse-breeding and trade relations it had with many countries of the world.

Its cities and city life had developed gradually, a great success had been gained in the fields of politics and culture.

Atropatena had remained in the history with the name of the founder of the state, an outstanding military leader and clever head of the country – Atropat.

After Alexander of Macedon had defeated the Empire of Ahamanis (Khahamanishes), Atropatena was one of the independent states in the North-West province of it.

Alexander of Macedon enthroned as the king of Iran due to his being the legal heir of Ahamani dynasty had accepted Atropat and had entrusted him the rule over the state in dependently, taking into consideration his military services.

During the heated war Atropat had suppressed a violent revolt against Macedon, he had captured the ruler of Midi- Bariax, had delivered him together with the participants of the revolt and all of them were punished.

In the marriage ceremony held by Alexander in Suz city, one of the king's military leaders- his friend Perdikka had married the daughter of Atropat.

Despite this, some of the authors who had written the history of Hellenism remarked wrongly that Atropat had been removed from the province of Midi and even his being one of the close men of Dara.

It was impossible as Atropat was one of the close men of Alexander, not of Dara. In the 2<sup>nd</sup> Perdikka- the outstanding military leader of Alexander and his friend had married the daughter of Atropat- family strings connected them.

In the 3<sup>rd</sup> Strabon even once gave an information that Midi was separated in two parts: The first part was called Great Midi and the second part Atropat`s Midi. This territory carried the name of the military figure Atropat.

Atropat didn`t let this country to fall under the power of Macedon as a part of the Great Midi. Really, Atropat- appointed by Alexander had declared his country independent according to his own decision.

In the first millennium B.C states as Manna, Midi, Atrpatakan (in the territory of the South Azerbaijan), Ashguz and Albania-Aran (in the territory of the North Azerbaijan) appeared in Azerbaijan one after another.

Twenty five toponyms marked on the earthenware stratum belonging to that period of Azerbaijan in the written sources of countries as Urartu, Assyria in the 8<sup>th</sup>-7<sup>th</sup> centuries B.C connected with it were found out. The researchers cited as an example the names of Araz river, Tabriz, Nakhchivan, Shaki, Gabala and many other places.

The ancient historians wrote about the Byzantium emperor Irakli`s visit to Ganja of Atropatena from Nakhchivan during his attack to the East. They came to the conclusion that, Ganja of Atropatena also existed along with Ganja of Arran at that time.

The unrejectable facts are so.

The troops of Alexander of Macedon who continued the battle heard about the running of Dara the 3<sup>rd</sup> away from Midi and returned to Ekbatan (present Hamadan) without entering there and came across a miracle there: oil holes boiled. The earth flamed from an ordinary spark. When they spilled the oil on the child and brought the torch nearer, the child flamed and they were hardly able to put it out.

The researchers wrote that, during the reign of Sasanis, Atropatena was called Adarbadagan, Arabians called it Adarbijan, Persians Azerbaijan and Strabon "Small Midi".

Besides it, the North part of Azerbaijan-Albania was known as Aran or Arran among people and the South part as Atropatena.

Along with agriculture- town-building, construction work, architecture, money turnover, mourning ceremonies and other material cultural fields developed rapidly.

The names of some cities were mentioned in the sources and an information was given that Kazaka city was the winter residence and Vera city the summer residence. It was mentioned that agriculture had highly developed. The

land was ploughed by wooden plough. They drew irrigation canals and dried the bogs. Artificial irrigation system played an important role. Gardens and verdures were planted in the suburbs of the cities, earthenware plates and underground water supplies were used.

It was mentioned in the sources that Fraaspa (Faraspa) city situated around Maragha, Kazaka in the territory of Leylan village and Vera city in the foot of Sahand mountain. Burnt brick, fast dried lime and clayey liquid was used in construction works and in different buildings. The production of earthenware materials proves the wide spread of ceramics. Fraaspa was an ancient religious center and the temple of Anahita acted in this city. Religious leaders-mags were engaged in training of nobility and treated the patients. Mags were interested in the guest ions concerning astrology and were aware of medicine. High level family schools, temples of fire and courtyard education system existed in Atropatena. Princes, the children of courtiers and nobility were educated in courtyard schools. The children of villagers, craftsmen and city poor were deprived of the opportunity of studying.

The lessons usually began in the morning. The children who got the religious education spent the night in the temple of fire and the education fees were paid by them. They were taught religious-ethical and physical (sport) knowledge, reading and writing lessons.

Celebration was held for the children at the ages of 7-15 and friends were in invited. Special religious cults were fulfilled, children recited "Kalmeyi-Shehadat" (the prayer recited by Moslems at night and before death) with the order of the temple after they bathed, they dressed "sadra" (holy shirt) and tied "geshti" (holy belt). So, Zoroastrianism was adopted to the adulterants (among 20-24 ages).

Ancient Azerbaijan had a special role in the development of horse-breeding. Horse-breeding developed in Manna, Midi, Atropatena, Albania, even the name of a horse was also mentioned in the ranks of family members.

Sport games as hunting, shooting an arrow and chovgan (national game) had a wide spread.

During the excavations in the territories of present Astara-Ardabil the fortresses as Sasan, Novduz built of ceramic materials and many other fortresses which had acted as nameless fortresses for along time were found out.

These fortresses were built in inaccessible places, on the rocks and grand water barrels were constructed on their walls.

The geographical location of Atropatena improved the construction work. The main building materials were rocks, river stones. The cities, fortress walls, towers and fortifications were mainly meant for defense.

Stones and river stones (gravel) hardened with clayey or gypsum liquid were also the building materials laid on the foundation of the pavilion built in Zohhak Fortress, but it was second grade in comparison with the other buildings.



In the construction of public buildings and architectural ornaments, lime stones were especially widely used. In the building of Zohhak Fortress courtyard such ornamental details were widely used.

The working of monuments out in architectural respect was preferred more than courtyards, churches and public buildings in Atropatena. The first of these monuments was residential area built in Zohhak Fortress which conveyed a civil character, the second was Kerefto complex temple erected on the rock.

People of Atropatena buried the dead in big pitchers (as in mother's womb), the expression of "big pitcher graves" used in the scientific literature were taken from here. These big pitchers were not especially prepared, they were ordinary big clayey pitches (height 1,5-1,8, width 1m). Monuments were not erected on them, constructive works were not carried out. They put the dead in to the pitcher in the horizontal form, they bended the dead` necks both on their left or right shoulder. They buried the men on their left and the women on their right side. They put little equipments around the buried pitches and jewelry: bracelet, ring and beads into it. And there were earthenware crockery engraved with red and black colors near them.

These pitcher graves found in Nakhchivan and Aghjabadi (the plain of Mil) prove their being the memories of the 3<sup>rd</sup> year B.C and of our era, not the late ages. Money turnover had widely developed in Atropatena: 600, then 110 dirhem (ancient Arab coin) monetary unit found in the rest of treasure in late years (1923) in the territory of this country and also Roman dinar (monetary unit used in some Moslem countries) proved that wide trade relations, money turnover existed with Parfiains and Romans during the reign of August.

The historians wrote that, the development of productive forces in Azerbaijan created fertile condition for the appearance of private property, the urgency of class relations and new religious views along with the ruin of primitive communal system.

So many researchers remark that, the religion of ancient Azerbaijan-the first homeland of Zoroastrianism was prototurk, taking into consideration Zoroaster's being born around Uremia lake. According to the ancient Roman historian Plini, the primary volume of Avesta consisted of 2 billion hemistiches.

After occupation of Iran Alexander of Macedon burnt it. Nizami Genjevi also gave a thorough information about it in his "Iskendername".

Alexander ordered:

Iranians must give up the fire worship,  
They must renew their ancient religion,  
The dresses of Mugs must be burned,  
The fire-worshippers must be rudely treated.  
Such a rule existed at that times,  
The teacher sat in the temple of fire,

He kept the treasures in secret there,  
Nobody could reach them,  
The rich gave their property to the temple of fire  
If they didn't have any heir,  
The skies were in torture because of this custom,  
Every temple of fire was a house full of treasure,  
While Alexander ruined these buildings  
The treasure flowed like water.

### **Interlinear translation**

According to the philosophic conception of Zoroaster, the world is based on the unity of opposites: that's light-darkness, good-bad, goodness-hostility, white-black and so on.

In one of the world's ancient states and cultural centers of the world civilization –in China the endless movement and ceaseless changes in the galaxy were realized as the clash of opposite cosmic powers – light and darkness.

Academician Aslan Aslanov wrote in his "last word" about "the position of Aristotle's "Poetics" in the Eastern philosophy and literature" added to the translation of Aristotle's "Poetics" that, "Diogen Layersi mentioned in his preface to the "History of Philosophy" about the attitude of Aristotle and Platoon towards Zoroaster's philosophy.

We appreciate Zoroastrianism (it is not thoroughly studied though it has disputable sides) as a religious-philosophical view having a great effect of a wide spread among the world's nation. Later the religious-philosophical outlooks as Mazdakizm and Manilik were also based on philosophical views in Zoroaster's "Avesta".

The scientists suppose the existence of seats of young Avesta beliefs in ancient Atropatena. "Avesta" which reached us consisted of Yasna, Yashtlar, Visprat, Vendidad (Videvdat) and small Avesta.

The authors came to the conclusion that, Atropatena Zoroastrianism was one the main stages in the history of ancient Iranian religious instructions. During the reign of Sasanis Atropatena was the shelter of Zoroastrianism during several ages.

From the blessing songs of Zoroastrian:  
Hey Ahura Mazda! I ask you, tell me,  
Who is keeping this earth below and this heaven  
Which is not let to descend, above?  
Who is the creator of water and fire?  
Who taught the quick moving cloud to be quick?  
Hey Mazda! Who is the creator of the pure nature?

Hey Ahura Mazda! I ask you, tell me the truth,  
Who is the creator of this useful light and this darkness?  
Who is the creator of the pleasant dream and wakefulness?  
Who is the creator of the dawn calling people to worship,  
Of afternoon and evening?

Hey Ahura Mazda! I ask you, tell me the truth,  
Can I entrust the lie to the truth for his exposing  
The lie to tortures as the happy news are conveyed  
In your cult.  
Those-who worship the lie would draw a moral  
From this great breakage.

People! If you make use of the eternal order  
Given by Mazda, if you are aware of the pleasantness  
Of this and the next world, eternal torture, harm  
Of those worshipping the lie, the use of those worshipping  
The truth, then you will always have a happy future.

Hey Mazda! Not the followers of the truth, but those  
Who worshiped the lie got into trouble because of this  
Holy wit, it doesn't matter whether he is rich or poor,  
He must be the friend of those who worship the truth  
And must counteract those who worship the lie.

Hey Mazda! When will the light morning come  
And when will the human race worship the truth?  
When will that great savior achieve his wish  
With wise sayings?  
Who are those men assisting Vahuma (One of the  
Good forces in Avesta) with coming?  
Hey Ahura! I hope you will let it to fall to the lot of me.

Hey Ahura Mazda! Tell me, as you are aware,  
Whether the followers of the truth will win  
Those who worship the lie before the punishment  
Day you have decided will come.  
Yes, this victory will be a neatness task for the world!

**(Interlinear translation)**

## **AZERBAIJAN - A NETWORK CELL OR A TRAP OF GLOBALIZATION**

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The system paradigm of studying of Azerbaijan history on a boundary the II and III millenniums, allows to consider political, economic, philosophical aspects in a retrospective show and to identify Azerbaijan in the modern world.

According to Hegel «we perceive truth, - totality of specific interrelations - only looking back at whole historical process with dialectic tensions and jumps ». /1/

Going up logically from simple to complex in the historical sequence was formed the understanding of laws of a society, as reflection of the Eternal Law of Space, since doctrine Plato (the V-IV centuries BC) about the Ideal State. «The economic person», conducted by “an invisible hand” in A.Smith's works (1723 - 1790), declared full freedom of the personal initiative which should solve in the best way public tasks in conditions of market economy.

The basic moments of this system around which disputes are conducted till now hereinafter:

- Necessity of a private property, as legal basis of economic life
- Free competition
- Free entrepreneurship
- Role of the state as a passive or active condition.

The society based on free market economy in the last quarter of the XX century, began to get features of globalization. The phenomenon of globalization is caused «by free movement of capitals and growing dependence of national economies on the global financial markets and transnational corporations». /2/

The beginning of globalization can be related to the XV century (from an epoch of the initial discoveries up to the end of the II World War), what implies territory expansion and international trade activation. The essence of this period is

an accumulation of the capital worldwide. In the last quarter of the twentieth century economic, political and cultural changes were intensified by revolutions in information technologies that have given to them globalization features.

First, internalization of an economic life has captured all world, becoming global. Management of the capital is carried out continuously worldwide: labour, knowledge interchange, commodity markets and services become more and more global;

Second, many ecological, population and etc. problems became global;

Thirdly, the market economy became universal after collapse the world system of socialism;

Fourthly, alongside with the national states transnational corporations appeared on the scene. /3/

Characterizing the modern condition of a society as "informational", M.Castels emphasizes value of generating, processing and information transfer as fundamental source of productivity and authority.

The informational-technological paradigm developed by Charlotte Peres, Christopher Freeman and Giovanni Dosi has captured all spheres of a public life, including science, manufacture and represents a flexible and comprehensive network.

... No other arrangement - a circuit, a pyramid, a tree, a circle, etc. (except dynamical network T.X.) cannot contain the true variety that works as a whole.

A global economy «capable to work as a uniform system in a mode of real time and in the planet scale» has developed /74/.

The destiny of the national states to a greater extent depends on their ability to master technological innovations on which the informational economy is based. Inability of countries to get connected to innovative processes and to compete in terms of global economy was expressed by the example of the hyper industrial Soviet Union collapse. The economy of etatist state based on the administrative-command management method occupied the first place in the world on volume of total industrial production sharply lowered pace of development.

In the second half of 80s in comparison with 70s, rates of growth of industrial development decreased in 1,8 times, and agricultural productivity in 2,3 times. /5/ Vague programs of "acceleration" and "reorganization" disoriented the debugged mechanism and provoked chaos. After the Soviet Union

dissolution, Azerbaijan appeared before necessity of carrying out political and economic reforms.

This event period has a historical-economic peculiarity. Political instability, loss of controllability in economic sphere, the armed conflict to Armenia – are tragic realities of 90s. In these conditions the motion path of the new – the Third Azerbaijan Republic was developed.

The state participation system in an economic life of the country has sources from the moment of origin of statehood in antiquity. In particular «Set phrase of Epusera» dated the XVIII century B.C., were deduced rules for government by Confuciy (VI-V c. BC).

The state is the same family, only big;

Major management principle is force of an example.

Known earlier unification world models – etatistic, communistic, based on necessity of strategic planning and liberal, excluding the state from a practical life provided to be insolvent.

Historical specificity of new informational global economy study allows considering it in a metaeconomy angle, i.e. in an organic connection with authority. Here appears synthesis of the strong state as an organic - etatistic version of political conservatism with the adjustable market economy developing in the evolutionary way.

The newest history of Azerbaijan showed that the main role in association of people in the whole state belongs to the power structures. Structuring of management in the First (1918-1920 years) and the Second (1920 – 1991) Republics formed a corresponding social and economic basis.

Processes of general transformation have begun since the political stabilization establishment in 1993 and are connected to H.Aliyev's name. He corrected politics notion that based on an economic matrix for the benefit of economic heterodocsalism. Its attributive sense that the national economy is a projection of philosophic, religious, metaphysical and cultural installations occurring in a society, in a nation's history.

Transformation strategy included politics with stage-by-stage realization:

- Using of hydrocarbon stocks and the importance of this factor as "a locomotive";
- Privatization of the state ownership;

- Creation of the financial and tax environment promoting formation of a private sector in economy, development of business.

Emphasizing complexity and importance of last decade, H.Aliyev has noted that “the XX century left indelible traces in Azerbaijan people life. In essence at the end of this millennium, it was certainly formed completely new Azerbaijan. /6/”

Strategic tasks of the Third Republic government were opened on the background of celebrating a victory by liberal capitalism. So-called «the Washington consensus» (the term invented by Williamson in 1989) included the arch from 10 principles with the general resume: the national governments «should have the balanced budgets and to struggle with inflation»/7/and to do almost nothing. The main architects of "the Washington consensus», transnational corporations, such key world players as IMF, WTO, G-7, etc., began to base a model for all post Soviet space:

- Liberalization of prices and trade;
- Financial stabilization;
- Privatization

The central element of economic reforms was the price liberalization which destroyed the savings and made macroeconomic stabilization the prime program of reforms. In 1991-1994 monthly inflation in republic made 25-30 %, and annual 1600-1800 %. The first round of "the shock therapy" put before necessity of bridling of inflation, toughening of a monetary policy that is increasing of interest rates.

Trying to improve economy, according to the synergy theory, i.e. through chaos, disorientation of a society to the order, "the shock therapy" drove economy to the stressful condition. Nobel Prize winner in the field of economy G. Stieglitz marked that on all the post Soviet space fast transformation generated the chaotic Wild East instead of easy functioning market economy./8/

Large-scale market transformations began in 1994-1995. The so-called «Contract of a century» signed on September 20, 1994 drew attention and investments from more than 30 large oil transnational corporations of 15 countries. The realism of politics allowed to revive the petroleum industry and to stabilize economy in republic. Strong social and political stability and the considered formulation of public interests are necessary for transformation of natural resources into the important factor of social and economic progress. /9/

From 1994 to 2003 the total amount of the investments arrival in republic made 16,4 billion dollars, including oil sector on the average 68%. /10/

Working with the world oil companies attached Azerbaijan to progressive ideas in the technology field and the management organization. Realization of oil policy allowed Azerbaijan to join actively region geopolitics, in particular, and global economy in general.

The formation of the international economic infrastructure is proceeding. It is the system of transport communication "TRASEKA", «Silk way», oil pipelines Baku-Tbilisi-Ceyhan, the Baku-Tbilisi-Erzurum, Fiber the optical cable line Trans-Asia-Europe (TAE) connecting Shanghai- Frankfurt-on-Main through Azerbaijan.

The Azerbaijan side should amend its national, trading-political system in order to bring to conformity with the international trading regulations and norms almost on all positions. Since 1999 Azerbaijan has been conducting work to entry into WTO.

Entry into ECO is of interest of Azerbaijan (Economic Cooperation Organization, established in 1985). The main tasks are: the analysis of conditions of countries - member's economy and opportunities of deepening of cooperation development.

Azerbaijan aspires to integration into the European Economic Community, trying in new historical conditions to show democracy as a way of existence.

"EU" actively supports:

- the Caspian oil factor using strategy
- Active steps on realization of the Great Silk Way policy and promotion of this economic transport corridor.
- Steps on education updating, its inclusion in European educational area.

/11/

"EU" supports Azerbaijan through TESIS program. Areas of power engineering, agriculture, ecology, communication, professional training, both, small and medium enterprise sectors and other important spheres of economy have been covered by the volumes of the technical help.

Globalization having quantity of forms and aspects points out that main of them are mutual relations between modern multinationals and the national states. On the one hand, the parade of ethnosovereignities causing activation of cultural identity, on the other hand destruction of civilized originality, easing national complicity.



The Washington consensus poses problems to minimize the state role, but it is represented not casual that at the end of 90s not only China, India, but also Poland carried out the strategy that was nothing else but an interdiction:

- On the accelerated liberalization of the capital
- On the privatization outstripping creation of new workplaces on new private enterprises.

While developing countries past the capital market liberalization have actually gone through falling incomes, rate of growth in India has exceeded 5 %, and in China was close to 8 %.

Unexampled income growth and poverty reduction in East Asia during last three decades are provided with the correct state policy that based on experience of traditions:

- High norm of savings;
- The state investments in education;
- The competent industrial policy encouraging the manufacturer.

The method of making up the interbranch balances offered by Nobel Prize winner V.Leontyev is used in 40 countries of the world. In Japan it is made up to 18 thousand interbranch balances on the basis of which strategic planning is carried out. In France the system of five-seven year plans of economic development operates.

The problem consists not in the globalization, but how it manages.

The mimicry of the traditionally - etatisic states, for the sake of the western investments, under democratic civil societies does not lead to replacement of base principles. Finally it leads to splitting of "globalizing" and "localized" states.

This process pointed out by economists as "Westernize", does not lead to formatting of a "network" society, and creates the world controlled from uniform center, on the basis of uniform features. /12/

The logic of the reformatory reforms in the country which lost democratic traditions during 70s, assumes contradictions and difficulties. But, right now, it is predicted whether the state will become a worthy "network" cell of the world community or fall into "the trap" of inevitable globalization.

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## **RUSSIA IS SICK WITH RUSSIA ONE OF THE VERSIONS OF THE DISEASE DIAGNOSED IN THE CAUCASUS**

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While reviewing and understanding that system crisis of Russian political technology formulae of which for many years were importunately introduced into the bosom of political environment of the CIS countries the experts were quick with the diagnosis: «Russia is sick with Russia». But recently especially after the «colored revolutions» in political establishment of the country a tendency towards changes has appeared that prove the tendency of refusal from the former ideological stereotypes even on the level of physiognomistics and proving traditional Russian search for vassals and Imperial philosophy of search for vassals on the whole. I will try to softly-softly analyze what this pseudo-political technology has brought to at the example of Azerbaijan.

### **Anti-nomenclature – anti-Russian?**

As known at the beginning of the 90s of the last century Azerbaijan having gained its independence started to actively realize the projects of choosing alternative communication lines, sometimes extremely expensive, and to modernize all economic infrastructure with them running a risk of causing social outbreaks. But Azerbaijan ran this risk. I will especially underline the fact that laborious task was going on at the background of available and created in the Soviet times stable communications capable to serve a trustworthy corridor not only of transit route North-South but in other directions, too.<sup>48</sup>

But still...

Another example: in Russia, as known, there lives quite a broad Azeri community that has close contacts with the Republic. It is from the community's pocket there is provided a part of families of Azeri visitors whose total sum of

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<sup>48</sup> Azerbaijan in the context of external challenges. // Rebirth – XX I century, 1998, № 8-9

revenues make, by different estimations, at least \$2 billion per year. Still this quite attractive business project formed very naturally does not work in the context of ideology on integration ties of Azerbaijan with Russia. I am talking about the ideology on purpose. That is the reason: the form is not right, completely wrong if the economy as reality is not at all regarded by Russian political and technological groups as argument of new European idea. Though, we will come back to it a bit later. While for the time being about why Russia is irreversibly losing on the whole CIS, besides is losing even there where the advantage was evident. In the basis of the crisis is the thesis that logic of reality is ruined by anti-logics of political technologists. Imperial inertial search for regional vassals in new countries, creation the net made of odious sometimes corrupted officials defining tactic decision of cadre, humanitarian and privatization policy at places – these are faded outline of outdated Russian-Mongolian empire in new time and new society. So I see the identity between the countries – Russian regional satellites and all that whole net of pro Russian officials in independent countries where they have failed yet to lay their hands on highest power levers. In this sense conflict turns up as natural clashing between normal, logical and abnormal basing on anti-logics: should it be the conflict in Nagorno Karabakh, Chechnya or Abkhazia or contradiction between opposition and power and within the power itself. The solution explanation was quite simple: there is struggle going on against dominance of vassals and any social activity in this direction either struggle for liberation of occupied land or war against corrupted officials inevitably takes form of anti-nomenclature, i.e. anti-Russia revolutions. I will clarify.

#### **On philosophy of search for vassalism**

As I have already mentioned even on the level of simplest methods of physiognomy it is possible to define those Russian eager to bow who have found their places in higher circles of power and opposition of the CIS countries. Slang of Brezhnev's times as shameful seal on everything created by them. And there is something else: flattery and genetic shyness before everything and everyone who to their opinion illustrate Messiah of foreign policy course of imperial traditionalism. Russia, one would like to believe, can change but the vassal-countries created by its political search, the net of high rank officials will demand urgently from Russia the former Soviet image, i.e. their atmosphere where it is possible to knit pseudo scientific brows and fawn in the name of the times never to return. The factor of fawning as methodology of philosophy of search vassalage was sounded by the poet Evtushenko back in the 60s of last century: "I think that our fawning gave birth to a crocodile in Volga". I am recollecting it not accidentally as it is on such regional monsters black PR Russian political technology bases on. That is the image that Russian political technological though has fostered in the countries of the former USSR. But how successful choice it

was for Russia itself to bet on such countries and such agents of its influence who like pendulum at the beginning of the 90s rushed from side to side and then having discovered certain moment of balanced rocking among all revealed creative possibilities for political choice on the territory of the former Soviet Union started realizing mini-Stalin plans trying to turn counter productive moods in own administrative and financial resource. But Russia supports this process though sometimes it comes to absurd: not willing to conduct negotiations with leaders of Chechen separatism Russian political technology actively and honestly praises its regional vassal at the low Caucasus – Armenia that occupied a part of the territory of the sovereign Azerbaijan and which is the main source for spreading regional separatism and world terrorism. At the same time there is not noticed the fact that for Russia itself, i.e. in understanding and comprehension of the logic of the things as single image of disposition – Chechnya and Karabakh, in fact, are phenomena of the same kind!<sup>49</sup> It is not a double standard but wish of agents of high rank of influence as special factor of Russian political technology to create schemes on splitting personality in normal people who differ from them. And that is the inner conflict thus more dangerous. I understand it perfectly well that modern Russian political technology is diversified and even many-sided notion and refers to phenomenon of non-institutional level. But no matter what we would speak with you if on the basis of some social important activity there is laid not the idea of right but spiritual idea (popular, cathedral, communist, etc.) then in political sphere we will definitely get senates and councils. The search for holism of village gatherings is going on the whole post Soviet territory and the main ideologist of this tragic and comic procession as before is Russian political technology.

Thus if modern Russia is sincere in its attempt to correspond to the spirit of new time then I guess it should perform some action, move towards break – technological, innovation, humanitarian. To overcome the situation in ever-lasting struggle between xenophobia and admiration of the West in favor of the latter. By the way, modern perception of the model of federalism demands it as well.

### **Azerbaijan: at the crossroads along ruins**

The system of power in the independent Azerbaijan has undergone its unique way. Earlier than with the neighbors the epoch of the Soviet governing has ended, the power has fragmented and later on has been collected the way the prominent politician pictured it, in case with our context – experienced manager Heydar Aliyev. More than ten years have passes since that time; the time of gaining true

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<sup>49</sup> Caucasus in the world under globalization: new model of integration. E. Ismaylov, Z. Kengerly // *Central Asia and Caucasus*, 2003, № (2) 26

state independence; there have appeared new ideas about the place and role of Azerbaijan in modern world space. And the present President having started to rule the country is trying to support the process of making Azerbaijan among developed world countries. To stick to his political roots means to follow the former basic standard, that is the policy being conducted by Ilham Aliyev and that is not that easy as it might seem: Heydar Aliyev alone bore all administrative responsibility at that time. That stage of political history had its own prehistory. But in modern political context this policy is far from being accidental.

Let us have a look at Azerbaijan in the context of global changes that were happening to world community during the last decades preparing the world for new world order. We like other nations of the Soviet Eurasia were not ready for transformations and as a result of it this process turned out to be negative for us: inability to quickly perceive new standards and values and as a consequence of it collapse of infrastructure and disintegration.

Obviously, the revolution has taken place; certain layers of ideas that used to seem unshakable have started moving. It was not easy to come out of the ideology of international barrack to the world of free choice.

The possibilities to self-identify and somehow to show one's worth were scarce. All this has been aggravated with inner contradictions, appearance of centrifugal forces and rolled away the country to the edge of the civilization while the whole world was moving forward to the end of the century of system confrontations and the beginning of informative society. It is in this moment the personal "mark" of Heydar Aliyev became apparent in full measure, who managed at the earliest possible date to give Azerbaijan its special "mark" of self-identification as well. It helped to quickly take the place in the world and find oneself on the same side of civilized development with the countries that manage to jump on the train going to the XXI century.<sup>50</sup>

The use of «mark» of personality the attitude to which did not depend on belonging to certain country did good for Azerbaijan in the process of searching for its place in the world. This clashed with world political tendency where factor of personality is brought to the forefront. To all appearances, the present President is disposed to realization of a complex modernization of the country following Western humanitarian and technological standards. While describing the system of power of today the tendency to arrange components of corporative state order should also be mentioned, such a combination could give a good result as it corresponds to most modern challenges and ideas about government. One of the most important tasks for today is to create symmetry in the society – to straighten

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<sup>50</sup> Following the strategy of the Silk Road. S. Brownbek // *Rebirth – XX I century*, 1998, №15

the indices in different social groups. President has already declaimed this path rightly suggesting staking on technocrats.

Thus the beginning of the new tactical action is marked as it looks as if the Republic has defined its strategy. And on this very stage, I think, there took place the first serious contradiction with that part of the nomenclature that, as it was mentioned before, traditionally made tactical decisions in the field of humanitarian, cadre (middle echelon) and policy on privatization. It was these spheres that fostered with the help of Russian political technology home-bred mini-emperors came from. By the way, the paradox is that none of the independent Russian-language editions in the Republic, be it the newspaper "Zerkalo" that has very high status of public significance, or the newspaper "Echo" the same way perceived by the society, or the commencing oppositional «Bakinskiye vedomosti» do not show positive interest towards Russian factor in this struggle. By the way, unlike Baltic Russian-language editions where the presence of the language to certain extent forms the ideology of geopolitics. Rejecting everything that is read and is significant for the public Russian political technologists staked on most odious, pro-nomenclature in Azerbaijan that even in voluntarily-forced order is taken for *idée fixe*. That is why between the President and part of his old vassal (by way of thinking) environment there appeared a gap proportionate to difference between Ancient and Modern Greek. There is the same difference between democratic public opinion in the Republic and the same commune-conservative nomenclature chronically identified by Azerbaijan public opinion with Russian challenge. As to overcome the gap called «nomenclature class» is not easy there appears certain niche that could become a chance for the new generation of Russian political technologists supporting, I hope to believe, European values of political culture and making first steps that we present today. I will proceed from what could be welcomed both in Azerbaijan, Russia and European countries. First of all, it is the source common for all us – new European cultural tradition perceived sometimes differently by our nations but no doubt more uniting us. The task is to overcome the heritage of totalitarian past and there are precedents how to do it not only at the example of post-Franco Spain. Joint defining of mechanisms of active rapprochement with Euratlantic structures will let avoid force majeure risks and create conditions for gentle incorporation into Western civilization model. That is the aim.

From the tactical point of view common semantic field of our cultures also allows filling the abstract notion of human rights with meaning. Perhaps, it is the best example on the whole post Soviet space when national interests and rights of the Azerbaijanis living in Russia and the Russians living in Azerbaijan are taken into consideration. At the minimum we are talking about 400 Russian schools in Baku the graduates of which traditionally continue their education in the biggest intellectual centers of USA and Europe.

Being equal in rights participants of common European process in the framework of the Council of Europe, for example we have not been taking Russia for regional dominating country for long, that is the passed way, but we would like to see it as the bearer of intellectual potential, kind of mediator of the new global modernization. And there are necessary prerequisites for that and there is tradition of Russian thought worthy to become an example. The thing is that historically the role of adapter of the new European culture has been assigned to Russia but on the other hand how much that cultural Russia corresponds to the present one. Whether the country of Alexander Pushkin and Dostoyevsky conceive itself as a new power source and growth of the new generation. If it has the personalities who can influence and capture the minds the way Dostoyevsky, Tolstoy did it, if it has Solovyev, whether it has Tchaikovsky or Bulgakov? Of course, some people can tell me: the world is ruled by pale handwriting and we get serial instead of novel.

### **Bitter pills**

Another question is how much Russia as a country with minimized potential for creative development for today is ready to perceive different civilization advantages not only of the West but, by the way, the East as well. Why is it so important? Because in the politics there are no minor or unnecessary things. Multilevel dialogue will add new energy to the intellectual elites – participants of this process, moreover, this elite can consist of different groups both oppositional and pro-governmental ones. The most important is that the new intellectual leaders of the Baltic, Caucasian, Asian countries and Russia could define the high political level of their countries in future.

Another line is connected with the challenges of the modern epoch, the epoch of globalization when even local political action can cause most powerful effect on a planetary scale. It becomes especially obvious at the example of our regional conflicts. At the example of Nagorno Karabakh of Azerbaijan it became obvious that Karabakh as well as Eastern Armenia could not be free without the Azerbaijanis, Kurds, Lezghins; the same way the whole Caucasus cannot be free from certain ethnic group. The time of ethnic cleanings and mass migrations traditionally carried out by Russia in lower Caucasus through Armenian committees is over. In 1918 at Russia's urgent request Azerbaijan handed over the Irevan city to Armenia as the capital for the future Armenian Soviet Republic and in 1920 - Zangezur.<sup>51</sup> The new Russia should remember about it. And the task of the real truly courageous politician is not to use arsenal of powerful methods it possesses but make use of it as a factor of special influence to make the international law work in the end. In this context Russia can act as a

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<sup>51</sup> Caucasian House. R. Mustafayev // Rebirth – XX I century, 1998, №2



subcontinental bridge being bearer of idea of high humanism based on European right. Issuing from the mentioned above the outline of the new Russian political technological thought are defined that is from one side able to project the image of subcontinental transit for spreading new European political culture and from the other one to alter radically the image of Russia in the world. At the same time a complex approach to the realization of this idea should be mentioned as the level of democratic processes is always defined by the level of modernization of the whole politics forming the appeal of the ideology of challenge. That is the last chance. In case Russia keeps on seeking for vassals, lobbying in contrast to liberal reformers positions of corrupted commune-conservatives then defeat to multi-colored anti-nomenclature revolutions are irreversible while its political technologists will just get the doors slammed in their faces.

## LANGUAGE AND THE EXTENDED VIEW ON A HUMAN PERSON

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The ideas of Walter Kofler presented in his paper *The importance of Sechenov for the development of the theory of “an extended view of a human person as a social being”*<sup>52</sup>, devoted to the comprehensive understanding of Homo sapiens eco-socio-finalis are quite applicable for considering language and the human person in terms of “the given world” and Restricted Autonomous Actors theory. This is relevant as the human language is so closely related with human physiology, mind, social life that the extended view of our world would be limited without considering human persons as “speaking” persons, because the Human Thinking is first of all the Human Speaking, language being a necessary instrument for abstract thinking and this type of thinking cannot be executed without language.

This inseparable interrelationship of thinking and language was confirmed in the research conducted in the 1970s in the laboratory of pathological physiology of central nervous system in the Sechenov Institute of Evolutionary Physiology and Biochemistry in Moscow, as well as in the research of American scholars. It was found out that the right and left brain hemispheres “govern” different types of thinking. The right hemisphere of right-hand people “governs” sensual visual thinking performed without verbal means, while the left hemisphere “governs” abstract generalised thinking performed on the basis of language. When the left hemisphere is inhibited, verbal memory is damaged, when the right hemisphere is inhibited, the memory of images suffers. Animals do not have these specific features of brain hemispheres, which means that these features are specifically human features which developed in the process of

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<sup>52</sup> In: 14th Sechenov Readings: Moscow, 2005, pp. 3-69.

evolution<sup>53</sup>. This can be explained by the fact that abstract thinking is specific only for humans and that it emerged and developed together with language, as it is only on the basis of the language sign system that abstract theoretical thinking could develop.

This means that for a comprehensive understanding of the highest living being a comprehensive theory cannot fail to consider the human as a Homo speaking. On the other hand, the human ability to speak also requires a comprehensive theory, as this ability is based on diverse but very closely interrelated factors. They are biological (physiological) factors: the organs of articulation and hearing and also the corresponding brain zones (the brain mechanisms of speech production and interpretation) which are correlated with mental processes and thinking, with psychological mechanisms of speech production and perception, with mechanisms of language acquisition, and also social factors: children deprived of social contacts up to the age of ten are not able to develop the ability to speak, they can acquire only separate words of a human language. These physiological, psychological and social factors are prerequisites for the human ability to speak. And, as N. Chomsky suggests, the language ability is a special ability of the humans.

Thus, if we think about the language ability in terms of the evolutionary process, it is possible to claim that this ability is intrinsic only to humans. According to N. Chomsky, language ability is a biological ability. But at the same time, to acquire the language, the child needs to be exposed to the language, there should be some language input which will be internalised. This external language (E-Language N. Chomsky's terminology) is the "given" language for the child, it is a part of "the given world". The biological basis of the language ability develops in childhood under the influence of social factors in the process of communication with adults. In other words, the continuous influence of social factors is a condition for preserving and developing the biological basis for language ability of Homo sapiens.

What kind of phenomenon is the human language? What is its impact on the human? What is the impact of the human on the language? Is the human as a restricted autonomous actor restricted by the language?

There are various definitions of language depending on the school of linguistics, the goals of the research, but most of scholars agree that language is a unique complex multi-layer structural system of signs which includes three interrelated subsystems: phonetical, lexical, grammatical. There are also different approaches to the understanding of language signs. For example, phenomenological understanding of I. Kant and Ch. Morris focuses only on the material representation of signs and differentiates acoustic and optical signs. An

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<sup>53</sup> A. Luria *Foundations of Neuropsychology*, Moscow, 1973, p. 222-227.

operational approach applied in logic and psychology considers a sign as an ideal and functional formation. But the most common is a bilateral approach which assumes that a language sign is a combination of a material and ideal aspects. The material aspect is perceived by sensory organs, a sign substitutes something else – an idea (a notion) or an object. There are two basic features of a language sign:

- 1) It is a material perceptible object.
- 2) It refers to (represents, signifies) some other object

Unlike symbols (which symbolise objects they refer to), a sign is neither acoustically nor graphically similar to the object it refers to. This feature of language signs is a necessary component and a condition for abstract generalised thinking. The possibility to abstract and to generalise is provided only due to the fact that the material aspect of language signs represents objects with which it has no similarity or commonality. A sign refers to a class of objects that have some commonalities, and are represented as an image. So the material side of a language sign is a condition for creating an ideal image in the human mind.

Thus a language sign is not related directly to the object it refers to, its meaning is not motivated by the sounds. Although, sometimes there is some correlation between the sounds (the acoustic effect) and the meaning: in all languages there are sound-imitating words. But these words are in the periphery of the vocabulary system in all languages. The imitation of natural sounds is often fairly relative and usually words imitating sounds of nature in various languages differ.

The language sign is motivated socially, as its meaning is conventional, there is supposed to be agreement among language users that a certain sign has a certain meaning.

**The language sign is motivated structurally, as a part of the lexical and grammatical systems of the language it is embedded into these systems.**

At the same time, language as a system is a pure construction of the human brain, an abstraction, because the way the elements of this system are classified, and the way the grammar rules are formulated depends on the views of the scholar, on the assumptions of the linguistic school. It usually takes years for people to learn the system of their native language at school. But at the same time people use the elements of this system all the time, as it is language that is a means of communication with other people, it is the human language that is the instrument of thought and thus of understanding the reality. It is through the language that reality is reflected in our mind, it is by means of language that our thoughts are formed and formulated, it is through the language that we express our ideas and influence other people. Thus, the role of language in our life, in life of Homo Sapiens is indispensable, but this fact does not describe this phenomenon.

There are various approaches to this phenomenon and its relationship with its

users – people, and with reality. For example August Schleicher<sup>54</sup> (1821-1868), the founder of natural school in linguistics, made an attempt to apply Darwin's theory to the studies of language. For A. Schleicher language was a natural organism (*Naturorganismus*) that lived as all natural organisms, and namely: like natural organisms, it emerges and develops independently of the human will, the basis of some laws, it gradually gets old, and dies. That is why A. Schleicher applied in his research of language the methodology of natural sciences (even the term 'morphology' he borrowed from natural science). He assumed linguistics should be based on observations of organisms and on objective deductions made on the observable facts. Although A. Schleicher's research made a valuable and significant contribution to the development of linguistics, especially morphology, his argumentation concerning language as a natural organism was not generally accepted.

The theory that found recognition among most of linguists belongs to Ferdinand de Saussure (1857-1913) who was the first to formulate the basic features of language and to suggest that we should distinguish in this phenomenon (*langage*) between: language (*la langue, die Sprache*), and speech (*la parole, das Sprechen*).

F. de Saussure's theory of language is based not only on the linguistic tradition, but also on the philosophy of I. Kant and E. Durkheim in his understanding of a social fact as an expression of collective mind that forces the individual follow the social.

The main method of linguistic analysis applied by F. de Saussure was the method of antinomies. The main antimony of language, according to de Saussure, is the antimony of *la langue* and *la parole*: the former is social while the latter is individual; the first is systemic, while the latter is asystemic; the first is potential, while the latter is real; the first is synchronic, while the latter is diachronic.

Thus, speech is individual, but at the same time social. Language is independent of people existing at a certain time, but it is inseparably linked with these people. Language is either social, or it does not exist.

The theory of F. de Saussure explains the complicated nature of language and the antimonious relationship between language and speech, between the social and the individual. This relationship provides a basis for the application of the restricted autonomous actors theory, that is, if we could understand people (speakers) as autonomous actors who are "restricted" in the usage of the language in the sense that they can not change the language if they want to be understood by others. Some insights into the issue we can get if we identify the relationship between the human person (as the speaker, the user of the language), the reality,

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<sup>54</sup> August Schleicher *Die Darwinsche Theorie und die Sprachwissenschaft*, Weimar, 1963.

and the language. For this the theory of Karl Popper may be applied.

Karl Popper<sup>55</sup> divides reality into three parts:

The physical world (world one)

The world of psychic states (world two)

The world of the content of thinking (world three). This world correlates with our internal world, but it still remains external. This is the world of theories and hypotheses. K. Popper suggests that language was the first to become a part of the third world. Things belonging to the third world are relatively autonomous. They exist in the form of material things and thus belong both to the third and to the first worlds. A book as an object is physical, it belongs to world one, its content belongs to world three. The objects of world three are abstract, but at the same time real. The human person as a physical entity is a part of world one, his spirit and mind are parts of world two.

The theory of Karl Popper is very close to the considerations presented in the paper of W. Kofler about Harry Potter and the “existing” and the “assumed” given<sup>56</sup>. The book about Harry Potter belongs to world one as a physical entity, Harry Potter belongs to world three. The human person as a reader of the book belongs to world two. Thus language and Harry Potter belong to the same world. As Walter Kofler says, Harry Potter is not an autonomous actor because he cannot modify himself, he exists only when an autonomous actor, the human person, reads the book. What about language? It also exists only when it is used by people. If it is not used by people it cannot exist. The books written in a language, as well as the books about this language (e.g. dictionaries) belong to world one. But Harry Potter, as well as the characters of all books, as well as theories and hypotheses cannot modify themselves. For the human his language is the given that he cannot change or modify if he wants to be understood by others. But we know that languages do change and develop. Language at any moment is speaking activity and the product of the past. We also know that language, as it was stated by de Saussure, does not depend on the people existing at a given period of time, and in this respect it is fairly autonomous. Is it unlike other constituents of world three an autonomous actor? What is the difference between language and Harry Potter and other phenomena belonging to world three?

The basic difference is that it is the matter of one's own choice if one takes a certain book and reads it. If I do, I will know about some theories, hypotheses, Harry Potters, and thus they will become for me my “assumed given”. As for the language of my environment, it leaves no choice for me. If I do not acquire it, like a Maugli, I will not be able to ascend in my development to the level of the highest living being Homo Sapience. Then language is not just the first element of

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<sup>55</sup> K.R. Popper, John C. Eccles *Das Ich und sein Gehirn*. Muenchen, Zuerich, 1977.

<sup>56</sup> Pp. 52-53.

world three. Maybe it is a special world by itself. This idea, that language forms a special world, and that this world is situated between the human person and the real world, was developed by W. von Humboldt and his followers.

According to Humboldt, language is situated between the human being and nature. It draws a circle around the human person, it is the environment of the human, it is an organ of thinking and perception. W. von Humboldt was the first to state that language is also a necessary condition for abstract thinking. He pointed out that thinking being deeply internal and spiritual, gets materialised by means of sounds of speech and thus becomes accessible for sensory perception. That is why thought and language are inseparable. The inseparable relation of thinking, organs of speech and hearing with language is conditioned by the primary and unexplainable human nature<sup>57</sup>.

The critics of the approach of W. Humboldt say that it overestimates the role of language in the assumption that language is directly related to reality. But the theory cannot be completely denied. Language does provide the specifically human, i.e. abstract generalised thinking and cognition. Language does to some extent keep the results of the previous knowledge (in the meaning of words, in grammar categories) and thus it influences the further stages of cognition, that is why it is possible to assume a kind of language apperception and an active role of language in cognition. The concept of Humboldt was further developed by American and European linguists.

In the USA the researchers of Indian languages (F. Boas and later A. Sapir and B. Whorf) found out that these languages differ not only in phonetical elements and acoustic groups, but also in ideas expressed<sup>58</sup>.

A. Sapir and B. Whorf, the founders of the theory of linguistic relativity, claimed that people lived not only in the objective world of things, and not only in the world of social activity, as it is generally assumed, but they are to a certain extent influenced by the language that is used for communication in their society. People see, hear, and perceive various phenomena mainly because language norms suggest this. Comparing the English and Hoppy languages, Benjamin Whorf comes to the conclusion that Newton's understanding of space, time, and matter were deduced not from the experience, but from culture and language. This understanding of the speakers of European languages ("Standard Average European") is absolutely incompatible with that of the speakers of Hoppy which is influenced by the structure of their language.<sup>59</sup>

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<sup>57</sup> W. von Humboldt *Ueber die Kawi-Aprache auf Insel Java, nebst einer Einleitung ueber Verschiedenheit des menschlichen Sprachbaues und ihren Einfluss auf die geistige Entwicklung des Menschengeschlechts*, Berlin, 1836, S. LXVI.

<sup>58</sup> F. Boas *Handbook of American Indian Languages*, pt. 1. Washington, 1911.

<sup>59</sup> B.L. Whorf *Language, Thought, and Reality*, New York, 1956.

The basic assumptions of Sapir-Whorf hypothesis are:

1) Language determines the character (type) of thinking, its logic. The Grammar of any language is not just an instrument for reproducing thoughts, the grammar forms the thought. Thus this hypothesis denies the universal character of thinking.

2) The character of cognition depends on the language the person speaks and thinks.

3) Human knowledge is not objective, as it depends on the language systems. That is what B. Whorf called “the new principle of relativity”.

The European follower of W. von Humboldt’s ideas, L. Weisgerber, came to the similar conclusions<sup>60</sup>. He understood language as an intermediate world (*Zwischenwelt, Wirklichkeit*) between the reality (*Aussenwelt, Sein, Realitaet*) and thinking (*Innenwelt, Bewusststsein*).

So we can conclude that different languages as intermediate worlds between our mind and reality draw in our mind different language pictures of the reality. These ideas seem to be similar to the ideas of I. Kant discussed in W. Kofler’s paper that the human person is not able to make objective statements about objects in the real world. They are similar also with the idea of Helmholtz that a person is limited by his sensory organs. And according to the view of Humboldt and his followers, a person is limited in his perception of the world by his language. At the same time there is a difference to be pointed out. The language picture of the world is for the human a part of the given world, this is the picture created by the language in our mind. While both I. Kant and Helmholtz implied that it is the mind of the person that is creating the scientific view (which is not objective because of the prior knowledge or limited because of the limitations of our sensory systems). So the scientific view is created, (it is not the given) and scientists strive to make it as close to the reality as possible. What is common between the language picture of the world and the scientific view of the world is that they are not realities, they are pictures, views, they exist only in our mind.

If we assume that language constitutes a special, an intermediary world (*Zwischenwelt*), and in this it is different from Harry Potter, it is not clear, if it is an autonomous actor or not. The theory of the origin and development of language presented in the book of Rudi Keller *Sprachwandel. Von der unsichtbaren Hand in der Sprache*<sup>61</sup> seems to be a good bridge to applying the theory of restricted autonomous actors and understanding the nature of influence of people on

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<sup>60</sup> L. Weisgerber *Muttersprache und Geistesbildung*, Goetingen, 1929; *Die Sprache unter den Kraeften des menschlichen Daseins*, Duesseldorf, 1949. *Vom Weltbild der Deutschen Sprache*, Duesseldorf, 1950. *Das Gesetz der Sprache*, Heidelberg, 1951. *Verschiebungen in der sprachlichen Einschaeztung von Menschen und Sachen*, Koeln - Opladen, 1958.

<sup>61</sup> Rudi Keller *Sprachwandel. Von der unsichtbaren Hand in der Sprache*, 1994, A. Francke Verlag Tuebingen und Basel.



language and language on people. Rudi Keller differentiates three different kinds of phenomena:

1. natural phenomena - things which are not purposes of human intentions and the result of human actions (weather, the Alps). Natural phenomena do not depend on human will, they are studied by natural sciences. R. Keller calls them evolutionary phenomena, as a rule, they are collective phenomena. They emerge as a result of actions of many entities, these actions repeated many times cause certain consequences.
2. artefacts - things which are results of human actions and goals of their intentions - (a cake, Esperanto, the Cathedral of Cologne)
3. things which are results of human actions but not the goals of their intentions (inflation, language).

Like artefacts, these latter phenomena are resulting from human actions. Like natural phenomena, they are not goals of human intentions. So human languages are not natural phenomena, and they are not artefacts either.

The theory of Rudi Keller about the development and changes of languages highlights the role of the human in this process. Rudi Keller turns to Mandeville's *Fable of Bees: or Private Vices Public Benefits* and proves that the origin of the phenomenon described in the fable is similar to the origin and development of languages. The idea of Mandeville was that there are social phenomena caused by individual actions, although individuals did not intend to cause them. Mandeville's idea was later formulated by Adam Ferguson<sup>62</sup> cited by Rudi Keller: "nations stumble upon the establishments, which are indeed the result of human action, but not the execution of any human design". Thus language really is the result of human action, but not the execution of any human design.

To explain the origin and the development of language R. Keller suggests applying a conjectural theory, an Invisible Hand Explanation. The idea of conjectural history was proposed by a Scotch philosopher Dugald Stewart (1753-1828). Applying his theory, Rudi Keller suggested that it is impossible to determine with certainty what steps were by which any particular language was formed, but it is possible to supply a conjectural history. The Invisible Hand, a metaphor created by Adam Smith, is also a conjectural theory which explains the genesis of well-being. The Invisible Hand is the best way, according to Rudi Keller, to explain such a phenomenon as language, as well as any phenomena which are unintended consequences results of human actions.

The Invisible Hand Explanation of the origin and development of language is very similar to the explanation of self-creation of social structures (E. Durkheim) mentioned in the paper of W. Kofler in his considerations concerning

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<sup>62</sup> Adam Ferguson *An Essay on the History of Civil Society*, Edinburgh, 1767.

social structures as “para-autonomous actors”<sup>63</sup>. This term is used in the extended view to characterise institutions and other social structures. They cannot be observed directly but they are similarly effective as physical existing objects. The term “para-autonomous actors” in the extended view also means that these actors as parts of our physical reality have no own physical or mental power by themselves (that is why they are not “restricted autonomous actors”), but their relevance is based on consensus of the humans which are directly or indirectly integrated. Thus it can be concluded that the human person as an autonomous actor in his usage of the language is restricted by the language which is a social and conventional phenomenon, and in this respect people are restricted autonomous actors. While language as the result of human action is a para-autonomous actor which has an essential impact on the human.

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<sup>63</sup> (pp. 67).

## INTERNATIONAL LAW AND NAGORNO-KARABAKH CONFLICT

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### **I n t r o d u c t i o n**

The conflict known throughout the world as the “Nagorno-Karabakh” conflict arose during the disintegration of the U.S.S.R. The situation that had taken shape in the Soviet Union at that time was conducive to the emergence of this conflict, while the confrontation over Nagorno-Karabakh, encouraged by the country’s authorities led by Mikhail Gorbachev, served as a catalyst of centrifugal processes, triggering off numerous ethnic and territorial conflicts in the post-Soviet space and transforming the evolutionary process of the U.S.S.R.’s disintegration into a revolutionary breakup.

The active phase of the conflict started in February 1988, when the separatist forces of the Nagorno-Karabakh Autonomous Region (NKAR) of the Azerbaijan Republic, instigated by the Republic of Armenia, began to organize rallies, strikes and other civil disobedience actions, seeking a secession of the region from the Azerbaijan Republic and its incorporation into the Republic of Armenia. Ethnic cleansing of Azeris started in that Union republic of the U.S.S.R. and in the territory of Nagorno-Karabakh, with the creation of monoethnic Armenian areas.<sup>64</sup> As a result of the first stage of the conflict, the parliament of the Republic of Armenia took a decision to incorporate the NKAR into the Republic of Armenia, whereas the Azerbaijan Republic abolished the NKAR and extended its uniform administrative-territorial division to that territory.<sup>65</sup>

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<sup>64</sup> See: The Conflict over the Nagorno-Karabakh Region Dealt with by the OSCE Minsk Conference. Resolution 1416 (2005) of the Parliamentary Assembly of the Council of Europe [<http://assembly.coe.int/Documents/AdoptedText/TA05/ERES1416.htm>], 22 August, 2005.

<sup>65</sup> See: “Ob uprazhnenii Nagorno-Karabakhskoi avtonomnoi oblasti Azerbaidzhanskoi Respubliki. Zakon Azerbaidzhanskoi Respubliki ot 26 noiabria 1991 goda,” (On the Abolition of the Nagorno-Karabakh Autonomous Region of the Azerbaijan Republic. Law of the Azerbaijan Republic of 26 November, 1991), *Vedomosti Verkhovnogo Soveta Azerbaidzhanskoi Respubliki*, No. 24, 1991, p. 448.

The conflict moved into the phase of armed hostilities in late 1991 and early 1992, when the U.S.S.R. had ceased to exist and the last legal and organizational (except international legal) barriers to the forcible annexation of Nagorno-Karabakh by the Republic of Armenia had been removed.

By mid-1994, Armenia's armed forces, supported by illegal Armenian armed formations of Nagorno-Karabakh, occupied areas of Azerbaijan bordering on the Republic of Armenia, the territory of the former NKAR proper and other areas adjacent to it, totaling about 20% of Azerbaijan's territory. All Azeris were expelled from these lands, tens of thousands were killed and hundreds of thousands wounded. A so-called "Nagorno-Karabakh Republic" (NKR) with its own government bodies and attributes was established in the occupied territories. However, not a single state in the world and not a single international organization has recognized such a state as the "NKR."

On 19 June 2005, yet another round of elections - this time parliamentary elections - was held in the self-proclaimed "Nagorno-Karabakh Republic." But can these elections, just as the "NKR" itself, be regarded as legitimate?

### **Approach to the Problem**

Any international conflict can be resolved only when the world community makes an objective political and legal assessment of that conflict. A thorough study of the root causes of the confrontation and a comprehensive analysis of the current situation is absolutely essential for:

- (1) the adoption of a fair decision by the parties (with the participation of mediators);
- (2) legally correct and effective use of generally recognized rules of international law;
- (3) and the establishment of a stable and lasting peace guaranteed by the international community as represented by authoritative international organizations such as the United Nations, OSCE, European Union, Council of Europe, NATO and others.

Their immediate duty is to maintain and restore peace and stability both on a global scale and in various parts of the world, and to apply sanctions against the aggressor state.

On 25 January 2005, the Parliamentary Assembly of the Council of Europe adopted its Resolution 1416 (2005), "The Conflict over the Nagorno-Karabakh Region Dealt with by the OSCE Minsk Conference"<sup>66</sup> (rapporteur David Atkinson). In this document, acknowledges the occupation of a significant part of Azerbaijan's territory by Armenian troops and reiterates that "the

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<sup>66</sup> See: [<http://assembly.coe.int/Documents/Adopted-Text/ta05/ERES1416.htm> /accessed 2005-03-31/].

occupation of foreign territory by a member state constitutes a grave violation of that state's obligations as a member of the Council of Europe." Consequently, this resolution can be hopefully regarded as the first, albeit belated, step in this direction. Such documents containing a political and legal assessment of the Nagorno-Karabakh conflict should also be adopted by other international organizations, primarily the OSCE, which provides the framework for the ongoing Minsk negotiation process. The lack of an objective assessment does not encourage the parties to the conflict to show goodwill for the purpose of resolving it and serves (as is the case today) to prolong the confrontation and to create illusions among certain forces that in this way it is possible to overstep the rules of international law, to occupy a sovereign state's internationally recognized territory and, once these acts have been committed, to draw the desired dividends from the negotiation process. It should be remembered that Azerbaijan and Armenia signed the Helsinki Final Act, so recognizing, in accordance with their constitutions, the supremacy of the provisions of this Act in both internal and external legal relationships and the principles of inviolability of borders and territorial integrity of states.

Only an objective position of the world community will make it possible to withdraw the armed forces deployed in the conflict zone and to resolve the conflict by peaceful means, without military pressure, on the basis of the principles of international law.

The importance of studying the legal aspects of a settlement of ethnoterritorial and ethnopolitical conflicts in Europe and other regions of the world is due to several factors. First, such conflicts have existed (Aland Islands in Finland, Flanders in Belgium) and continue to exist (Basque Country in Spain, Northern Ireland in the United Kingdom, Corsica in France) for decades and sometimes even for centuries. Second, throughout mankind's entire history such conflicts have often been resolved by means of specific legal solutions pivoted on a distribution of powers between different levels of authority, between the center and the region, the state and the autonomy, the federation and its constituent entity. Theoretically speaking, the range of distribution of these powers stretches from "full sovereignty" to "total lack of authority." Naturally, a conflict can hardly be resolved if only one of these categories is ensured, so that in practice its fair settlement (at a particular stage) should lie somewhere in the middle of the given range. A characteristic example here is provided by the recent history of Belgium, which used to be a unitary state but, with a gradual phase-in of appropriate changes, has turned first into a regional state and then into a federation.

In the event, we take into account that the situation in Azerbaijan's Nagorno-Karabakh differs from the situation in Finland, Belgium, Spain, Britain or any other country or region.

## “Legitimacy of the NKR”

It goes without saying that any electoral system is based on the legal system. Let us examine the “legal system of the NKR” and try to prove that the “NKR” today has no law, no legal system and, accordingly, no electoral system. If this is the case, the elections held in that territory cannot be regarded as legitimate.

In order to support the **first thesis**, let us consider the essence of law in general. In Ancient Greece and Ancient Rome, the content of human rights was connected with the polis (city-state), which made it possible to generate and to pass on to future generations immense spiritual wealth, including the ideas of citizenship and democracy.<sup>67</sup> According to ancient beliefs, law in general and the rights of individual people (members of the polis) do not derive from force, but from the divine order of justice. Neither law in general nor the rights of individuals are possible without a general standard of behavior expressing the measure of what is permitted and prohibited that is the same for all subjects, an equal measure of freedom. Where there is no equal measure (common standard, single scale), there is no law either.<sup>68</sup>

Solon (c. 638 BC-559 BC), the famous statesman and legislator known as one of the Seven Sages of Greece, understood “law” (and its rule) as a combination of “right” and “might.” Apart from drawing a distinction between right and law, such a construction included an understanding of polis law as a universal form and generally valid measure of the official recognition and expression of the rights of polis members. Such universality of the law signifies a demand for legal equality. All citizens are under equal protection of the law and have to comply with its universally binding rules.<sup>69</sup>

So what do we find in the “NKR”? The Armenian community numbering 120 thousand out of the 180 thousand population of the NKAR (part of the Azerbaijan Republic) refuses to obey the laws of the Azerbaijan Republic, a state recognized by the world community; with the support of the armed forces of the Republic of Armenia invading the territory of the Azerbaijan Republic, it expels from this territory the Azeri community numbering 60 thousand, seizes other lands adjacent to Nagorno-Karabakh, driving out hundreds of thousands of Azeris, and gets down to building a “democratic” state with a “democratic legal and electoral system.” What is the substance of this legal system, covering territories from which most of their indigenous inhabitants have been expelled? Incidentally, the number of those expelled is six times larger than the Armenian community

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<sup>67</sup> See: S.L. Utchenko, *Politicheskie uchenia Drevnego Rima*, Moscow, 1977, p. 41.

<sup>68</sup> See: *Prava cheloveka v mezhdunarodnom i vnutrigosudarstvennom prave*, ed. By Editor-in-Chief Prof. R.M. Valeev, Kazan State University, Kazan, 2004, p. 9.

<sup>69</sup> See: Aristotle, *Afinskaia politika*, Moscow, 1996, pp. 17-18.

remaining in these territories. As we see, **the “creation of law” in the “NKR” violates the basic principles of law: justice, equality and freedom, without which it is impossible to create a democratic legal system.**

Let us turn to the **second thesis**. Any law student knows from his very first days in college that law does not exist without the state, and the state without law. Evidently, in order for the rules regulating life in the “NKR” to be recognized as legal, it is first necessary to recognize the “NKR” itself as a state. In the theory and history of the state and law there are numerous scientific doctrines on the origins and nature of the state. From this diversity, modern science singles out two basic and particularly popular theories: natural law theory (also known in the literature as contractual theory or the theory of the **contractual origin** of the state and law) and the theory of coercion, which sees the main reason for the emergence of the state in **conquests, violence and subjugation by others.**<sup>70</sup> (It should be emphasized that the advocates of both these theories advance compelling arguments.)

The world community today does not encourage the emergence of new states, so that in practice such cases are quite rare. This happened, for example, when the Soviet Union fell apart into 15 independent countries, when new states emerged in place of the Socialist Federal Republic of Yugoslavia (SFRY) and the Czechoslovak Socialist Republic (CSSR), and when Germany was unified. Despite the dramatic events that accompanied these processes, the emergence of new independent states was based on legal treaties (in various legitimate forms), that is, agreements on the creation of these states recognized by the world community. This made it possible to go over in a civilized way from state entities created with the use of arms, through violence, conquest and subjugation (U.S.S.R., SFRY, CSSR) to independent states set up on the basis of voluntary treaties and therefore recognized by other democratic states.

In that period, other events took place as well. On the tide of democratic processes, certain forces using democratic and nationalist slogans as a cover tried to create new states by force (Nagorno-Karabakh in Azerbaijan, Abkhazia and South Ossetia in Georgia, Transdniestria in Moldova, Chechnya in Russia). However, none of these cases has to do with a treaty recognized by the world community. The reason here is obvious: **the world community does not regard violence or coercion as a way or method of creating a new state. The creation of such a state in today’s democratic world is possible only in the presence of a legal treaty, concluded by voluntary mutual consent of all the parties concerned.** If one of the parties is coerced into signing a treaty with the use of

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<sup>70</sup> See, for example: *Teoria gosudarstva i prava. Kurs lektsii*, ed. by M.N. Marchenko, Zertsalo, TEIS, Moscow, 1996, pp. 23-39; *Osnovy teorii gosudarstva i prava. Uchebnoie posobie*, ed. by S.S. Alekseev, Yuridicheskaiia Literatura Publishers, Moscow, 1971, pp. 38-41.



arms, this treaty can have no legal force; such a document is legally null and void and, sooner or later, is bound to be violated or denounced. It will constantly be a potential source of instability in the region. **The fact of international recognition of a state created through the occupation of another state's territory could be regarded in the world as a precedent, entailing unpredictable consequences for the global community.** It is no accident that none of the above-mentioned entities has been recognized by a single state, including the Republic of Armenia.

Since duly authorized government bodies make law, it necessarily follows from the above that rules adopted in unrecognized illegal entities are not legal by their very nature. Consequently, the system of elections to illegitimate government bodies created in these entities is not legitimate either.

### **Armenian Speculations about the “1991 Referendum in the NKAR”**

In trying to justify the legitimacy of “NKR independence,” virtually all Armenian sources refer to the referendum held in the NKAR on the issue of secession from the Azerbaijan Republic<sup>71</sup> in accordance with the U.S.S.R. Law on the Procedure for Resolving Issues Related to the Withdrawal of a Union Republic from the U.S.S.R., adopted on 3 April, 1990.<sup>72</sup> The illegal and unlawful nature of that referendum, and also the absurdity of references to the aforesaid U.S.S.R. Law are evident even after a cursory examination of the content of that document.

- First of all, let us note its title: it deals with the possible withdrawal (secession) from the U.S.S.R. of a Union republic, and not of an autonomous region or even an autonomous republic. An explicit statement to that effect is also contained in Art 1 of the said Law.
- Second, the Law considers the possibility of a separate referendum for each autonomy in the Union republics holding a referendum on secession from the U.S.S.R. and having constituent autonomous republics, autonomous regions or autonomous areas. In this case, the autonomous republics and other autonomies retain the right to an independent solution of the question on whether to stay within the Union of Soviet Socialist Republics or within the Union republic seceding from it, and also the right **to raise the question**

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<sup>71</sup> See: “Karabakhski konflikt: vzgliad izvne,” *Zerkalo*, 13 August, 2005, p. 9; “Polnyi tekst doklada ministra oborony Armenii na parlamentskikh slushaniakh po probleme Nagornogo Karabakha” [<http://www.regnum.ru.news/437271.html>], 22 August, 2005, etc.

<sup>72</sup> See: “Zakon SSSR ‘O poryadke reshenia voprosov svyazannykh s vykhodom soiuznoi respubliki iz SSSR,’ Verkhovnyi Sovet SSSR 3 apreliia 1990,” *Vedomosti Syezda narodnykh deputatov SSSR i Verkhovnogo Soveta SSSR*, No. 15, 1990.



**of their state-legal status.**<sup>73</sup> This is by no means what happened at the 1991 referendum in the NKAR and of what S. Sarkisian, defense minister of the Republic of Armenia, spoke at the parliamentary hearings on the Nagorno-Karabakh problem on 30 March 2005.<sup>74</sup> In order to support our thesis, let us cite the following factors.

- (1) The right to “constitute themselves as independent entities of the Union Federation, including secession from the Union republics of which they were part (in case of the Union republics raising the question of secession from the U.S.S.R.),” as S. Sarkisian says, could arise under the Law of 3 April, 1990, not from the time of “the Union republics raising the question of secession from the U.S.S.R.,” but at the holding of a referendum by the Union republic on the issue of secession from the U.S.S.R.<sup>75</sup>
- (2) In accordance with Art 4 of this Law, “in order to organize a referendum on secession from the U.S.S.R., to set the date for the referendum and to sum up its results, the Supreme Soviet of the Union republic shall set up a commission with the participation of representatives of all the parties concerned,” including the autonomies. As we know, that was not the case.
- (3) A referendum on the secession of a Union republic from the U.S.S.R. (pursuant to Art 2 of the Law of 3 April, 1990) could be held not earlier than six months and not later than nine months after the day of adoption of a decision on raising this question. The Supreme Soviet of the Azerbaijan Republic passed the Constitutional Act of State Independence on 18 October 1991, so that in accordance with the Law, so shamelessly and confidently invoked by Armenian sources, no referendum could take place before 18 April or after 18 July 1992. So, in accordance with the Law of 3 April 1990, the right to hold a referendum on self-determination did not and could not arise for the NKAR. Theoretically speaking, it could have arisen only in the period between 18 April and 18 July 1992, at the holding of a referendum by the Azerbaijan Republic itself.

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<sup>73</sup> See: Art 3 of the said Law.

<sup>74</sup> See: “Polnyi tekst doklada ministra oborony Armenii na parlamentskikh slushaniakh po probleme Nagornogo Karabakha.”

<sup>75</sup> See: Art 3 of the said Law.

- (4) Finally, the Law of 3 April 1990 did not say a single word that would entitle autonomous regions to hold a referendum on their own.
- Third, let us turn once again to Art 3 of the given Law. Part one of that article, as we noted above, says that at the holding of a referendum on secession from the U.S.S.R. by a Union republic, its constituent autonomous entity retains the right **“to raise the question of its legal status as a state.”** Let us note the following: not the right to self-determination and secession from the U.S.S.R., but only the right to “raise the question,” whose decision (in accordance with the given Law) was within the competence of the Union.<sup>76</sup> This provision was included in the Law with only one purpose: in case of attempts by any Union republic to secede from the U.S.S.R., to have a legal mechanism for keeping its constituent autonomous republics or other autonomous entities within the Soviet Union. It would be naive and unprofessional to think that the U.S.S.R. sought to create conditions for a withdrawal, in the wake of a Union republic leaving the Federation, of its constituent autonomous entities as well.
  - Fourth, under the Law of 3 April 1990, the results of a referendum on secession from the U.S.S.R. of a Union republic together with its autonomous entities did not as yet provide sufficient grounds for an actual withdrawal from the Federation. In order for these results to have legal force, it was necessary to go through a long and complicated procedure ending with an examination of the results of such a referendum by the U.S.S.R. Supreme Soviet and the U.S.S.R. Congress of People’s Deputies.<sup>77</sup> Naturally, that did not take place.
  - Fifth, at the time when a referendum in Nagorno-Karabakh was being prepared in December 1991, the NKAR itself as an autonomous entity was no longer in existence: the Nagorno-Karabakh Autonomous Region had been abolished by a law of the Azerbaijan Republic adopted on 26 November, 1991, in accordance with the Constitution of the Azerbaijan Republic and the Constitutional Act of State Independence.<sup>78</sup><sup>14</sup>

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<sup>76</sup> See: Arts 3-12 of the said Law.

<sup>77</sup> For more detail, see: Art 7 of the Law of 3 April, 1990.

<sup>78</sup> See: “Ob uprazhnenii Nagorno-Karabakhskoi avtonomnoi oblasti Azerbaidzhanskoi Respubliki. Zakon Azerbaidzhanskoi Respubliki ot 26 noiabria 1991 goda,” (On the Abolition of the Nagorno-Karabakh Autonomous Region of the Azerbaijan Republic. Law of the Azerbaijan Republic of 26 November, 1991), *Vedomosti Verkhovnogo Soveta Azerbaidzhanskoi Respubliki*, No. 24, 1991, p. 448.

Consequently, the provisions of Art 3 of the U.S.S.R. Law of 3 April, 1990, no longer applied to that territory of the Azerbaijan Republic.

- Sixth, by the time of the referendum in the already abolished NKAR, the Soviet Union itself had also ceased to exist as a result of the “Belovezhskaia Pushcha Agreement” between the Russian Federation, Ukraine and Belarus of 8 December 1991. In other words, in this case even an attempt to appeal to the laws of a nonexistent state is incorrect.

So, the myth about the establishment of two equal independent states (the second of which is the “NKR”) in the territory of the Azerbaijan Republic after the breakup of the U.S.S.R. and the myth about the legitimacy of “NKR independence” are just another two falsifications propagated by the separatist regime.

### **On the Right of Peoples to Self-Determination**

It should be noted in this context that, basing ourselves on the norms of international law, we categorically rule out from the very outset, for a number of well-known reasons, the possibility of applying the “self-determination of peoples” principle to the problem of Nagorno-Karabakh.

- First, Nagorno-Karabakh is part of the territory of Azerbaijan. The Republic of Azerbaijan as a sovereign state is the result of an expression of the will and the self-determination of the entire Azerbaijani people (including ethnic Armenians) living throughout the whole territory of the republic, and not of a part of this people. A part of the people cannot make decisions that are crucial to the future of the whole people. In accordance with U.N. General Assembly Resolution 47/135 of 18 December, 1992, “Declaration on the Rights of Persons Belonging to National or Ethnic, Religious and Linguistic Minorities,” the principle of self-determination of peoples is not included among the rights of national minorities; the international community did not consider it possible or necessary to reflect this principle in the Declaration.<sup>79</sup>
- Second, having signed the Helsinki Final Act in 1975, the countries of Europe, the U.S. and Canada tied in the principle of equal rights and self-determination of peoples, as written into the Declaration on Principles of International Law Concerning Friendly Relations and Cooperation among States in Accordance with the Charter of the United Nations (24 October, 1970), with the principle of territorial integrity of states. The Declaration says that effective application of the principle of equal rights and self-determination of peoples “is of paramount importance for the promotion of

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<sup>79</sup> See: [<http://www.un.org/documents/ga/res/47/a47r135.htm> /accessed 2005-03-31/].

friendly relations among states, based on respect for the principle of sovereign equality.” The principle of self-determination can find its solution only in the context of the principle of territorial integrity of states. The Declaration proclaims that “any attempt aimed at the partial or total disruption of the national unity and territorial integrity of a state or country or at its political independence is incompatible with the purposes and principles of the Charter.”<sup>80</sup> This is precisely why the Helsinki Final Act put this principle in eighth place (out of ten) and called it “the principle of equal rights and self-determination of peoples.”

- Third, Nagorno-Karabakh is a region of Azerbaijan where, prior to the ethnic cleansing organized by Armenians, there were two communities (Armenian and Azeri) constituting the population of Nagorno-Karabakh, but by no means a “people.” “People” is a political category, and peoples in this context are the Armenians and the Azerbaijanis, who have already implemented their right to self-determination within the framework, respectively, of the Republic of Armenia and the Republic of Azerbaijan. The term “people” cannot be applied to the population of Nagorno-Karabakh as part of the Azerbaijan Republic.
- Fourth, even if we assume the impossible and say that the population of Nagorno-Karabakh consisting of Armenians and Azeris is a people with a right to self-determination, this will not mean that Nagorno-Karabakh should secede from the Azerbaijan Republic. In the 1970 Declaration on Principles of International Law, advocacy of the principle of self-determination is not equivalent to encouragement of secession or fragmentation of countries. This document explicitly states that the principle of self-determination can and must find its solution within the framework of the principle of inviolability of borders and the principle of territorial integrity of states. This principle “should not be construed as authorizing or encouraging any action which would dismember or impair, totally or in part, the territorial integrity or political unity of sovereign and independent states... Every state shall refrain from any action aimed at the partial or total disruption of the national unity and territorial integrity of any other state or country.”<sup>81</sup>
- And fifth, neither the theory nor the practice of international or constitutional law has ever had to deal with cases of repeated exercise of the right of peoples to self-determination. If we assume the impossible and

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<sup>80</sup> See:

[[http://www.sam.sdu.dk/samnet3/jura/F05\\_Folkeret\\_valgfag/UN\\_GA\\_resolution\\_265\\_XXV.pdf](http://www.sam.sdu.dk/samnet3/jura/F05_Folkeret_valgfag/UN_GA_resolution_265_XXV.pdf) /accessed 2005-03-31/].

<sup>81</sup> Ibidem.

such a precedent is actually created, the world community will be faced with the inevitability of Armenian self-determination in Russia, the U.S., France, Turkey, Canada, Australia, Iran, Georgia, Uzbekistan, Kyrgyzstan, Ukraine, Spain, Holland, Bulgaria, Lebanon, Syria and many other countries.

In view of the above, I would venture to disagree with “self-determination without the right to secession,” a formula suggested by R. Mamedov for the solution of the “Karabakh problem.”<sup>82</sup> The right to self-determination belongs to the people. A settlement of the Armenian-Azerbaijani (Nagorno- Karabakh) conflict should be based exclusively on compliance with the generally recognized principles of inviolability of borders and territorial integrity of states. Among the indisputable principles of such a settlement should be guaranteed protection of the rights of national minorities, their security and existence within the Azerbaijan Republic.

### **Form of Government**

Questions connected with the concept, subject and even the terminology of territorial structure are reflected in the legislation of different states with considerable diversity, which is due not only to difference of opinion between these states, the fact of their belonging to different legal systems or the domination of a particular legal conception, but also to certain political motivations.

The former U.S.S.R. is a case in point. Thus, the concept of constitutional law in the U.S.S.R. was replaced with the concept of state law, and this had an effect on all institutions within the given sphere, particularly on the institution of territorial structure, renamed “state structure” in the narrow sense of the term, which did not include the political aspects of the problem. In 1977, this unfortunate term introduced into legislation by Stalin’s 1936 Constitution, was replaced with two other terms: “national-state structure” and “administrative-territorial division,” which covered both the political and the territorial aspect of the given problem.

Another example is when the desire of some states to ensure their sovereignty and territorial integrity and to assert their rights to the natural resources located in the territory belonging to them has led to an actual description in their constitutions of the geographic territory of these states (such as the Philippines, Cuba, etc.).

As a result of the evolution of society and law, the component parts of the state, just as the state as a whole, have their own public authorities, which are

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<sup>82</sup> See: “Vremia rabotaet na nas. Karabakhskaja problema mozhet i dolzhna reshat’sia na osnove mezhdunarodnogo prava (Kruglyi stol),” *Azerbaidzhanskije izvestia*, 25 January, 2005, p. 2.

interconnected by systems of mutual relations regulated by the rules of constitutional law. Today's self-governing territorial units (sub-national entities) often enjoy a measure of autonomy under the basic or other law. Such entities are designated by the generic term "territorial autonomy."

So, in some cases the geographical parts of a state are its administrative-territorial units devoid of political autonomy, and in others, they are state-like entities (statoids) with their own legislation. The decisions of the public authorities or the population of such entities adopted within the limits of their autonomous rights established by the constitution (or law) often cannot be overruled by any government or public bodies of the larger structure that includes the given entity.

In the current classification of forms of territorial state structure (government) based on the relationship between the state as a whole and its component parts, two main forms predominate: unitary and federal. Naturally, we take into account that confederation, as a community of states (associated states), has no direct bearing on the problem of territorial state structure, since it is an association of sovereign countries and not of the component parts of a single state. The doctrine of constitutional and international law is sufficiently conservative in its definitions. That is why scholars have tried for many decades to fit all the models of actually existing states into the framework of the concepts of "confederation," "federation" and "unitary state." However, a political and legal analysis of empirical reality shows that in pure form these categories are virtually nonexistent and that their elements are interlinked to an extent resulting in the emergence of various hybrid forms. For example, there are generally recognized federal states whose constituent entities are entitled to conclude international treaties (Austrian lands, territorial entities of Bosnia-Herzegovina).

At the same time, use of inductive methods to investigate these problems, leads to certain definitive generalizations. In my view, an analysis of the various methods of state organization suggests the conclusion that, depending on the relations between the state and its component parts, today we can speak of the following generalized forms of state structure (forms of government by autonomy of regions): confederation, federation, unitary regional state and unitary state with special autonomous status for some of its territories. In this context, a "blind" approach to traditional concepts, definitions and classifications often produces an opposite effect. An attempt to fit current realities into a definitive framework could lead to a simplification or, even worse, to a distortion of today's constitutional diversity, and in the process of conflict resolution this could become an obstacle blocking the way to a settlement. That is why in resolving an ethnoterritorial or ethnopolitical conflict one should bear in mind the doctrinal concepts and definitions of constitutional and international law, consider the constitutional and international legal realities existing in the world, and be prepared to make unorthodox, non-routine decisions in order to resolve the given conflict.

## **Federalism**

As a legal means for resolving the Nagorno-Karabakh conflict between Armenia and Azerbaijan, this form of government (state structure) has been repeatedly examined at different levels: mass media, expert, scientific, diplomatic and political, including the very top. It should be pointed out in advance that Azerbaijani society takes a negative view of federation as a form of government for the republic. There are many reasons for this, primarily the existence of aggressive separatism, which has been a feature of life in the country for many years.

However, the introduction of federal relations has made it possible to settle a number of ethno-political conflicts in Europe (Belgium, Britain, Spain). It is precisely federalism (in a form yet to be elaborated) that can enable us to resolve the Nagorno-Karabakh conflict based on the principles of liberation of the occupied territories and retention of Nagorno-Karabakh within the Azerbaijan Republic. At the same time, a concession on the part of the Azerbaijan Republic (incidentally, there is much talk in the world community about the need for such concessions) could theoretically consist in a renunciation of vertical relations between the Nagorno-Karabakh region and Azerbaijan's central authorities. In this case, relations between the center and the autonomy would depend on the distribution of legislative powers. The scientific concept of federation implies that each level of government derives its authority from the constitution, that is, there are no relations of direct administrative subordination between them. Any changes in the distribution of legislative powers between the levels of government are possible only with the direct or indirect participation of both the sub-national entity and the federal center.

It is quite obvious that upon the resolution of the conflict the relations between the Azerbaijan Republic and the Nagorno-Karabakh region will include elements of a federation, even if the peace agreement does not contain such terms as federalism, federation or federal.

### **Some Forms of Federal Relations and Autonomy**

In drawing a distinction between unitary and federal states, let us note that the component parts of a federation (its entities) usually have their own constitutions (as, for example, the states of the U.S., the lands of Germany or the republics of the Russian Federation) or laws (such as the charters of RF regions, territories and autonomies). That is how the system of government bodies of federal entities, their powers, etc., is established in these countries. Dr. Konrad Hesse, a professor at



Freiburg University, formulated this idea as follows: “Despite common structural principles, each federal state is a historically-specific individuality.”<sup>83</sup>

The system of government bodies of administrative-territorial units in a unitary state and their powers are established by the constitution and laws of the whole state.

In contrast to the component parts of a unitary state, the constituent entities of a federation have a large degree of political and state autonomy. But it would be a mistake to think that public administration in all unitary states is centralized, whereas decentralization and a clear division of powers between the center and the regions characterize federal states. Every unitary and federal state has its own specific features, which are often very significant. For example, in such unitary countries as Spain and Italy the highest-level territorial units enjoy a greater measure of state autonomy than the constituent entities of some federal states. In this context, one could recall the practices of the U.S.S.R., Yugoslavia and Czechoslovakia in the conditions of totalitarian regimes, where the central authorities in effect monopolized all power.

The status of some component parts of unitary and federal states often differs from the status of other component parts of the same state. This means that territorial state structure can be either simple (symmetric) or complex (asymmetric). Under a symmetric structure, all the component parts of the state have equal status. For example, the lands (states) of Austria and Germany, the provinces of Poland and the regions of Belarus have equal rights. Under an asymmetric structure, the component parts of the state have unequal status. Thus, alongside regions with equal status, unitary Ukraine includes the Crimean Autonomous Republic, which has been granted special status. Sicily, Sardinia, Venetia, Giulia and other regions of Italy (under the country’s constitution) enjoy special forms and conditions of autonomy by virtue of their special status approved by constitutional laws. In Spain, autonomy has been granted to the Basque Country, Catalonia, Galician, Andalusia and other regions.

Each of the self-governing regions has its own assembly elected by its population, which issues laws that are effective in the given territory. The United Kingdom, being a unitary state, consists of historically evolved parts: England, Scotland, Wales and Northern Ireland. As regards their administrative- territorial division, England and Wales are divided into counties, Northern Ireland into districts, and Scotland into council areas. Greater London is a separate administrative-territorial unit (local government area).

Consequently, as noted above, the degree of territorial autonomy may differ, and depending on that degree such autonomy may be divided into two

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<sup>83</sup> K. Hesse, *Osnovy konstitutsionnogo prava FRG*, Yuridicheskaya literature Publishers, Moscow, 1981, p. 114.



forms: state (legislative) and local (administrative). Under the former, the given territorial entity has the outward signs of a state: parliament, government, sometimes constitution, citizenship, etc., with the range of legislative powers of the autonomous parliament usually established by the constitution of the whole country. The local form of autonomy has no such signs, and the range of autonomous rights of territorial units is established, as a rule, by ordinary laws. Constitutions and other laws usually provide that autonomous units are entitled to draft (and sometimes also to adopt) basic normative acts determining their internal structure (constitutions, statutes, self-government charters, etc.).

Territorial units with a large proportion of people of different ethnic origin with their own specific features of daily life determined, say, by the insular position of the given territory are often granted special autonomous status, characterized in certain cases as national-territorial or ethnicterritorial. For example, such autonomy is enjoyed by the Swedish-speaking Aland Islands in Finland, by insular and border regions in Italy, autonomous areas in China (mostly inhabited by indigenous non-Han peoples), the Eskimo island of Greenland in Denmark, Zanzibar in Tanzania, and others.

In particular, the Aland Islands, which are a province of Finland, have their own parliament and government with guaranteed powers, guaranteed territorial integrity and their own citizenship (native Alanders automatically acquire Finnish citizenship, whereas other Finnish citizens, even when they settle on these islands, do not automatically acquire Aland citizenship). At the same time, the president of Finland has a right to veto Aland laws. The law on the autonomy of the Aland Islands is adopted by a two-thirds majority of the Finnish parliament, and the Aland parliament approves it by the same majority. Another noteworthy fact relates to autonomous Greenland: in 1985, it withdrew from the European Economic Community, while Denmark remained a member.

A territorial government model largely similar to the Finnish and Danish systems will be found in the United Republic of Tanzania, which in the literature is usually referred to as a federation. In actual fact, there is no reason to call it so, in spite of the treaty origins of that united state. Tanganyika, the mainland part of the country, does not have any special government bodies of its own that would operate alongside the state authorities. In effect, Tanzania is a unitary state with Zanzibar autonomy.

Scotland's autonomy within the United Kingdom also has its peculiarities. Scotland has no legislative or executive bodies, but under the 1707 Act of Union it is entitled to have its own legal and judicial system, its own (Presbyterian) church, and special representation in the House of Lords (in the House of Commons, Scotland is represented on a general basis).

Territorial or national autonomy or self-government can range from very broad to very narrow. Switzerland, the U.S. and partly England provide examples of

very broad self-government. The Swiss republic consists of separate states or cantons, and each of these enjoys full autonomy: its elected government is entitled to run local affairs without permission or authorization from the central government. This includes matters of war and peace, cooperation with other states, railroads, industrial legislation, telegraph services, finances, customs and other areas.

### **The Powers of the State and the Autonomy**

In the distribution of powers between the state and the autonomy (autonomous community), it is necessary, in my opinion, to specify the following: the exclusive powers of the central authorities; the exclusive powers of the autonomy; the possibility for granting residual powers either to the central authorities or to the autonomy; the conditions for applying a legislative technique known as “concurrent powers” without the granting of residual powers either to the central authorities or to the autonomy; and the possibility for the adoption by the central authorities of framework laws specifying the law-making powers of the autonomy.

The principle of concurrency without the granting of residual powers either to the central authorities or to the autonomy was used to resolve the problems of the Aland Islands. Nevertheless, in my view, its implementation is a technically difficult matter and can subsequently lead to complications: it is very difficult in practice to draw up an exhaustive list of powers and then to divide them between the state and the autonomy. At the same time, the object of division in the case of Finland and the Aland Islands was legislative and executive power. Matters of judicial power are not covered by the agreement on self-government, so that the application of Aland laws is referred to the competence of Finnish courts, including the country’s Supreme Court and Supreme Administrative Court.

As I see it, the division of legislative powers between the state and its autonomous entities should be based on a clear delimitation of the exclusive powers of the state and the autonomy. In other areas, it is possible to take several paths: to create competing powers, when the autonomous entity will be entitled to adopt legislative acts on matters that are not regulated by the relevant laws of the state; to adopt framework laws; and to delegate (by mutual consent under an authorizing law) a number of the state’s legislative or administrative powers to the autonomous region.

International practice shows that such areas as foreign policy, defense, monetary system, customs services, intellectual property, bankruptcy and some other areas remain under the jurisdiction of the state (the central authorities).

The adoption by the central authorities of framework laws specifying the law-making powers of the autonomy means that the central authorities establish certain limits for the operation of the autonomous authorities. Within these limits,

the central authorities cannot intervene in the activities of the autonomy, and beyond these limits all power belongs to the center.

### **Compromises**

#### **On the part of the Republic of Armenia:**

- (1). an end to the occupation and a withdrawal of its armed forces from the territory of the Azerbaijan Republic;
- (2). disbandment and disarmament of the armed formations of Nagorno-Karabakh.

#### **On the part of the Republic of Azerbaijan:**

- (1) granting of the highest autonomy status to Nagorno-Karabakh;
  - (2) renunciation of claims to the Republic of Armenia at the International Court of Justice for the rehabilitation of areas destroyed during the war or for payment of compensation for the more than thirteen years of forced expulsion of their inhabitants, for the inflicted economic and moral damage;
  - (3) consent to the temporary stationing of U.N. peacekeeping forces in Nagorno-Karabakh;
- consent to the establishment of horizontal relations between the center and the Nagorno-Karabakh autonomy with clear division of powers under one of the aforesaid variants.

# EARTH SCIENCE. ECOLOGY

## TIDELESS VARIATIONS OF GRAVITY BEFORE STRONG DISTANT EARTHQUAKES

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Studying the tideless variations of gravity is the most important aspect of researches of modern geodynamics. This problem is at the heart of one of the most perspective directions of short-term forecasting of the earthquakes.

Professor Bart in many of his works gave his theoretical proves of possible changes of gravity of global character. These variations were substantiated by possible movement of the Earth core relative to its mantles, what, according to the scientist's opinion, should have brought to the changes of gravity about 0,5 mGal/year. Afterwards, these results didn't find their confirmation. Meanwhile, the calculations made by N.N.Pariisky show that if the variations of gravity were connected with the processes, made an influence on inequality of rotation of the Earth, then they can reach the first tens of mcGal/year (Pariisky, 1984). This conclusion is coordinated with the results of researches, made by E.Linder (1979). Influence of deformations, taking place inside the Earth, on the changes of gravity on its surface was theoretically calculate by Walsh (Walsh, Rice, 1979), and a number of other researchers (Tarakanov, Shleynikov, 1977; Bursha, 1972) and it turned out very little, within some mcGal.

Displacement of masses, caused by geodynamical processes, according to the opinion of Stolz, can bring to moving of the centre of the masses of the Earth on the value about 10 km, what must arouse the change of gravity on the surface of the Earth 2-3 mcGal/year (Stolz, 1976).

In his works R.Adams notes that before and after Heichen earthquake in Cina with  $M=7,3$  in 1975 were recorded the changes of gravitational field up to 350 mcGal, a little fewer variations of gravitational field were observed in the period of disastrous earthquake in Tien Shan in 1976 (R.P.Adams, 1977).

When analyzing of the record of observations by means of gravimeter Askania during the periods including the strongest earthquakes Kizawa T. noted the before the earthquake in Alaska in 1964 (M=6.4), approximately 3 days before the earthquake appeared the so-called “vibration of the record” (relatively high-frequency oscillations of readings of gravimeter), which had finished right away after the end of the earthquake on 28.03.1964 (Kizawa T., 1970).

The changes of the gravity in the zone of epicenter of the preparing earthquake, as it was said above, were more than once observed by many researchers before the strong earthquakes. These variations of gravity near the center zone may be stipulated by a number of geophysical and tectonic reasons:

- Reached the critical level the stress condition of center zone brings either to squeezing and, consequently, to compacting of the rocks, or to stretching and decreasing of their density.
- The critical stresses in center zone of the preparing earthquake bring to active movements of fluids in the layers of the Earth, as a result of which, in the shafts and bores is observed either increasing or decreasing of the level of subsoil waters before the earthquakes;
- During reaching the stresses of critical sizes begins the mass cracking in center zone and in the sphere adjacent to it, which causes breaching of entirety of rocks and their demultiplexing;
- Deformational processes, arising in center zone before the earthquake bring to appearance of the area with high and low density.

Probably, there are also other factors, bringing to the changes of the gravity, but all of them don't have big radius of range near center zones of the prepared strong earthquakes. It is connected with the fact that this effect of change of gravity connected, directly with geodynamical processes in center zone, is quickly decreased with distance and can be observed in the radius from tens till hundreds of kilometers from center zone.

Meanwhile, at “Binagadi” prognosis station of the ground of Scientific Research Institute on prognosis and studying of the earthquakes (Baku city) during several years are permanently registered the changes of gravity before strong earthquakes, the centers of which are in the distance of tens thousands kilometers from the station of registration.

So, since 2002 the Scientific-Research Institute on prognosis and studying of the earthquakes of the International Academy of Science has made uninterrupted measuring of tideless variations of gravity at “Binagadi” station, located on Absheron Peninsula in 25 km distance of Baku. Registration and primary processing of the data are made by the group of specialists under the leadership of B.Aslanov, which is a head of geophysical laboratory and a station on prognosis of the earthquakes.

The measurements are carried out by simultaneously four high-accuracy quartz gravimeter of KV and KS type.

The gravimeters are chosen so that their readings can be equal to the maximum, i.e. the graduating marks and zero-point shift in absolute values can be characterized among themselves with little difference.

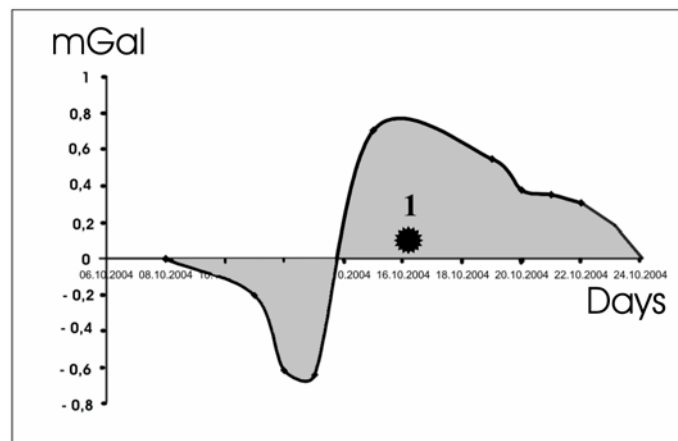
As a result of measurements and interpretation of the received data were revealed the gravitational signals in the variations of gravity, previous to strong earthquakes, the epicenters of which are in big distance (in the radius from one thousand till tens thousands km) from the registering station.

The statistic data show that the gravitational signals were registered in 90% of cases, on average 8-15 days before strong earthquakes.

Some most typical results of registration of the variations of gravity before strong earthquakes during 2004-2006 are shown in the graphs below. The analysis of these graphs shows that in most cases before the distant strong earthquakes is firstly observed decreasing, then – increasing of gravity. In overwhelming majority of cases is observed “vibration of the record” – relatively high-frequency oscillations of gravimeter readings with the frequency 0,1 – 0,4 Hz, which is stopped right away after the earthquake. Meanwhile, in some cases, before distant strong earthquakes the changes of anomalies of gravity have more complicated character. In the table is shown the catalogue of strong earthquakes taken place in 2004-2006, before which at “Binagadi” station were registered anomalous changes of gravity.

#### **THE EARTHQUAKE IN TAIWAN WITH M 7 (15.10.2004)**

A strong earthquake took place on 15 October in the shore of Taiwan. In the epicenter which was at the bottom of the ocean, more than one hundred kilometers to the South-East of the capital Taipei. The force of the tremors reached 7 according to Richter scale. According to available information 3000 people died during the earthquake.



**Fig.1 Variations of gravity before strong earthquakes in Taiwan (N 1).**

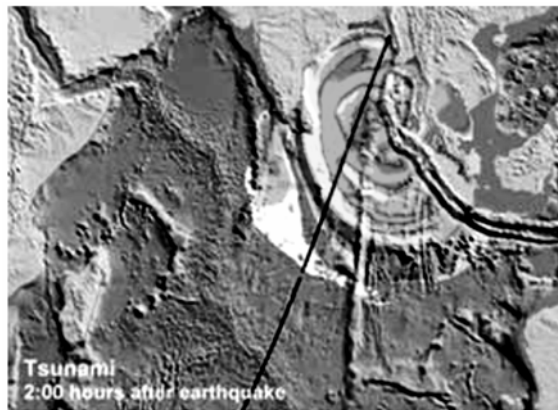
In Fig.1 is shown the graph of change of gravity before the earthquake with M 7 (N 1), which took place in Taiwan on 15.10.2004. So, the quasi-wave variations of gravity (QWV) were registered. The complete period of  $\Delta_g$  quasi-wave variations is 15 days.

#### **DISASTROUS EARTHQUAKE WITH M9 AND TSUNAMI IN INDONESIA (26.12.2004)**

The disastrous earthquake of 26 December 2004 with magnitude 9 near North Sumatra, spawned the strongest tsunami has become the reason of loss of about 300 thousand people and went down in history of humanity as one of the most grandiose natural disastrous events. And the matter is not only in the monstrous number of victims of the earthquake and tsunami made from it (Fig.2). The matter is, first of all, in astonishing geological event, the scales of which are so big, that they influenced on planetary processes in the Earth.

This event is described in details in fundamental article of V.I. Starostenko and others (V.I. Starostenko and others, 2005). The disastrous earthquake on South-East Asia has changed the geophysical characteristic of the Earth. As it is said in the site Spaceflight Now, the scientists from NASA determined that earthquake tremors had influenced on the speed of rotation of the planet, had decreased the duration of days and a little changed a shape of the planet. Besides, as a result of the earthquakes the location of North geographical pole shifted. It shifted on 2,5 cm in the direction of 145 degrees of east longitude. The change of the speed of rotation of the planet aroused increasing of duration of days on 2,68 microsecond, and shift of masses brought to change of form of the planet. As a

result of the earthquake the proportions of the planet have changed on one ten milliards, that is the Earth has become less flattened out and more compact.



**Fig.2. The scheme of spreading of tsunami from epicenter of catastrophic earthquake in Indonesia on 26 December 2004.  
The image is from site [www.wikipedia.org](http://www.wikipedia.org)**

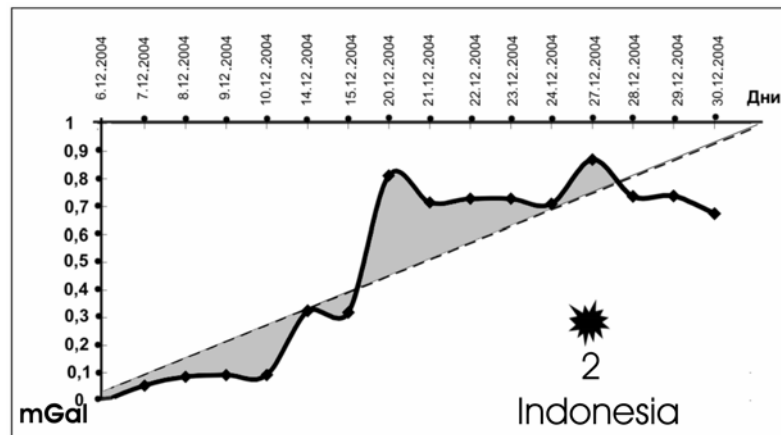
According to the data given in the work of V.I. Starostenko and others, the catastrophic earthquake of 26 December 2004 took place in the form of thrust-fault at the turn of Indo-Australian and Eurasian plates in the zone of North Sumatra. Approximately 2 minutes before the break realized the elastic deformation, which had been gathered in this center zone during hundreds of years as a result of continuing subduction (underthrust) of Indo-Australian plate under the Eurasian one. The zone of aftershocks on 26 December had the length of about 1300 km. Even if we suppose that only a part of aftershocks reflected the surface of the break of the main tremor, then, to the opinions of a number of researchers (2005) the geodesic observations and computer modelling allowed the scientists to come to the conclusion that the maximum underthrust during the given earthquake in the depth of 18 km, made approximately 20m. At that the bottom of the sea has moved considerably less: in vertical direction – approximately 5m, and in horizontal – 11m.

To our opinion, exactly from the point of view of planetary range of this event, the researching of the process of geodynamic preparation of this event reflected in global changes of gravity is the most interesting.

The analysis of records of changes  $\Delta_g$  before and after Indonesian earthquake (N2) showed that in contrast to other strong earthquakes, the process of preparation, which appeared in the form of quasi-wave complete cycle of variations of gravity, has considerably longer period (Fig.3). So, decreasing of the



value of gravity of relatively average magnitude has begun to be shown on 3 December 2004.



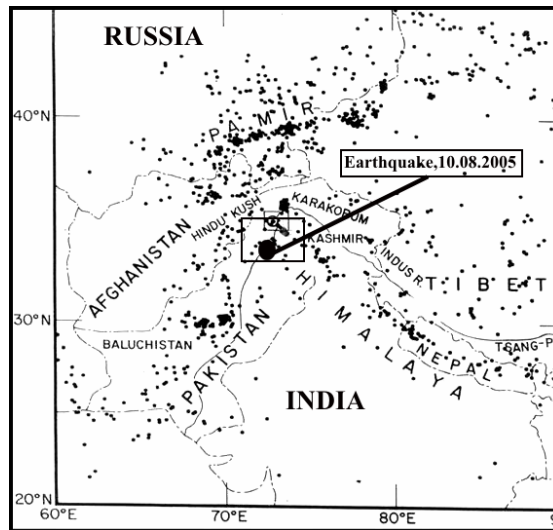
**Fig.3. Variations of gravity before strong earthquakes, which aroused the tsunami in Indonesia on 26.12.2004**

Beginning from 10 December there is observed rather abrupt rise of the value of gravity, at that by 20 December the gravity has increased on 0,8 mGal, after what by 21 December a little decreased on 0,1 mGal and remained unchangeable up to 24 December. On 24 December the value of gravity again becomes to increase, having reached its maximum on 26 December, jumping on 0,15 mGal during 1 day (Fig.3). After the earthquake the value  $\Delta_g$  begins to decrease slowly, reaching the average value by 1 January 2005. So, a complete cycle of gravitational quasi-wave signal was 28 days during the Indonesian catastrophic earthquake on 26 December 2004. At that, the beginning of these changes was fixed 23 days before the main tremor. This period of time approximately in three increases the average period of time of beginning of appearances of gravitational precursor for other strong earthquakes. The maximum amplitude of QWV was 0,82 mGal. QWV was accompanied by “vibration of the record” of gravimeter readings. This fact once more approves the considerable difference of this remarkable geological event on all the planet scale from the rest strong earthquakes occurred during last 100 years.

#### **THE DISASTROUS EARTHQUAKE IN PAKISTAN WITH M7,7 (08.10.2005)**

The disastrous earthquake that took place on 8 October 2005 in Pakistan with magnitude 7,7 is referred by the specialists to the strongest and destroying earthquakes in this region during last 100 years. The first tremor with magnitude 7,7 took place at 8.50 a.m. on Saturday. According to the data of geological

survey of the USA (USGS), the epicenter of the earthquake was in 100 km of North-East of Islamabad – in Pakistan’s Kashmir, near the line of demarcation which divides India and Pakistan, at a depth of 10km. According to USGS, on Saturday and Sunday in Pakistan were fixed at least 45 tremors more; the strongest of them - with epicenter in 110 km to the North of Islamabad – reached magnitude 6,3 according to Richter scale. The cities Muzaffarabad, Bagh and Ravala-Kot and adjacent to them territories have suffered most of all. The serious destruction is observed in the regions Batagram, Bala-Kot, Mansehra, Abbottabad and Patan. According to available data, this earthquake has taken about 50 thousand human lives in Pakistan. In India mostly suffered the boundary cities Uri, Tangdar, Pouch and Srinagar. According to the data of Indian officials, about 2000 people died.



**Fig.4. Scheme of location of epicentral zone of Pakistan earthquake**

The analysis of the changes of  $\Delta_g$  before, during and after Pakistan earthquake, shown in Fig. 4 is also of a big interest. In contrast to considerably more scaled earthquake in Indonesia on 26.12.04, relatively short period of time of  $\Delta_g$  variations preceded the earthquake in Pakistan. Decreasing of values of  $\Delta_g$  relative to average values began on 2 October, having reached the minimum, after what began increasing of values of  $\Delta_g$ , which by the moment of earthquake on 08.10.05 (N 7) raised on 0,73 mGal. Finishing the cycle of quasi-wave changes of gravity was on 09.10.2005. The period of cycle was 7 days (Fig.5). QWV was accompanied by “vibration of the record” of gravimeter readings.

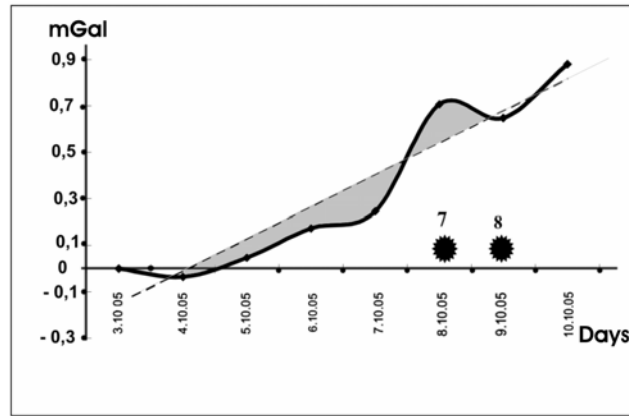


Fig.5. Variations of gravity before strong earthquake in Pakistan (N 7 and N 8)

In a day after the main tremor the value  $\Delta_g$  decreased on 0,1 mGal, and at this moment occurred perceptible aftershock with magnitude 5,7 (N 8), after which the value  $\Delta_g$  had increased on 0,2 mGal. Then the value  $\Delta_g$  begins to decrease, reaching the average value by 14.10.05.

#### THE DISASTROUS EARTHQUAKE IN INDONESIA WITH M7,7 (27.01.2006)

On 27 January 200 in the region of Indonesia took place the earthquake with the magnitude 7,7 according to Richter scale (N 9). The tremors were fixed in the Banda Sea, to the East of one of the biggest Indonesian islands Sulawesi. Fortunately, this event hasn't brought to serious consequences and victims because of considerable distance of epicenter of the earthquake from inhabited localities. At the same time, from the point of view of energy ingress, this event can be considered rather important. The pattern of change  $\Delta_g$  before the earthquake and after it can also be evidence of it.

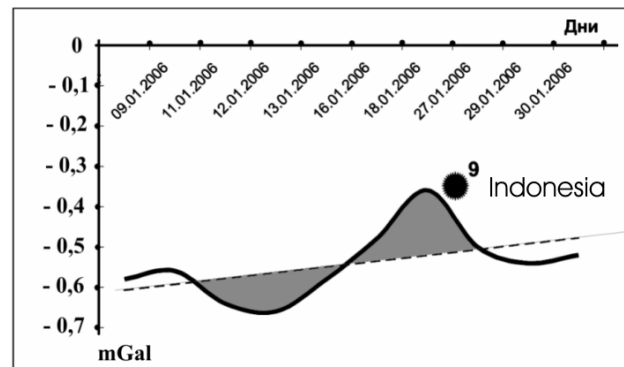


Fig. 6. Variations of gravity before strong earthquake in Indonesia (N 9)

In Fig. 6 is shown the graph of changes of gravity in the process of preparation and after the earthquake in Indonesia on 27.01.2006. The process of decreasing of the values of gravity began on 10.01.2006, having reached the minimum on 12.01.2006, after what was observed its increasing on 0,32 mGal with the maximum on 25.01.2006. From 26.01.2006 begins the decreasing of  $\Delta_g$  which comes back closely to the background value by 28.01.2006. So, a complete cycle of QWV is 18 days. As it is seen, the period of cycle is reasonably higher than the average period for strong earthquakes, but lower, than the period of QWV of the disastrous earthquake in Indonesia on 26.12.2004. The maximum amplitude of changes of  $\Delta_g$  is 0,32 mGal. QWV was accompanied by “vibration of the record” of gravimeter readings.

### EARTHQUAKE IN PHILIPPINES M 7,1 (05.02.2005)

On 05.02.2005 in Philippines in the region of the Mindanao Island took place a strong earthquake with the magnitude 7,1. The interpretation of graph of tideless variations of gravity before, during and after this event, given in Fig.8 is vary interesting. So, on 31 December of 2005 began decreasing of values  $\Delta_g$  having reached the minimum on 03.02.2005.

By 04.02.2005 the value  $\Delta_g$  increases on 0,96 mGal, after what is observed the abrupt decreasing of gravity on 1,2 mGal with minimum on 10.02.2005. so, the complete period of quasi-wave change  $\Delta_g$  was 10 days.

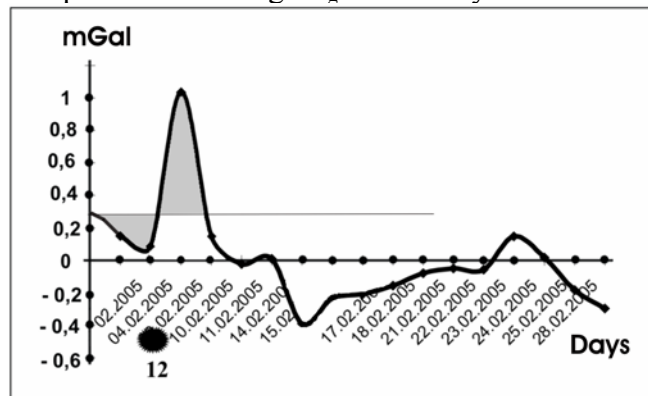


Fig. 7. Variations of gravity before strong earthquakes in Philippines (N 12).

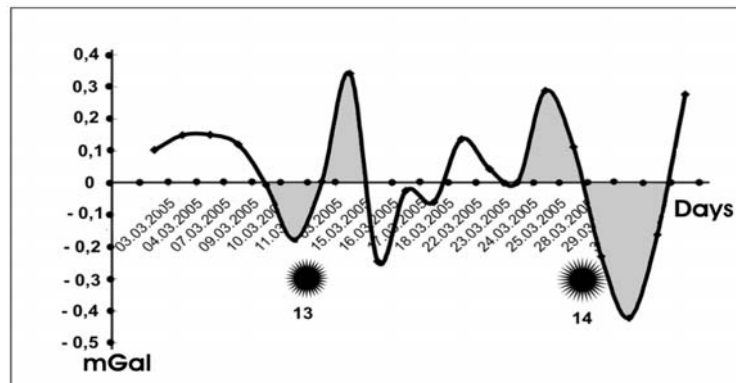
As it is seen in Fig. 7 the amplitude of  $\Delta_g$  variation was rather perceptible (1,2 mGal), what is the evidence of the range of geodynamic processes, accompanying this earthquake. QWV was accompanied by “vibration of the record” of gravimeter readings.

**EARTHQUAKES IN SOUTH IRAN ON 13..03.2005 (M 6)  
AND IN INDONESIA ON 28.03.2005 (M 8,7)**

Two events, unequal on their energy significance, distinctly enough appeared in  $\Delta_g$  variations, preceding and accompanying the earthquakes in South Iran (13.03.2005) with the magnitude 6 and in Indonesia (28.03.2005) with the magnitude 8,7.

Not describing in details the Iran earthquake we think it rather interesting to consider the events taken place during the strongest earthquake in Indonesia.

On 28 March 2005 in the Indian Ocean at about midnight the earthquake with the magnitude 8,7 according to Richter scale took place. The earthquake was felt in the distance of more than 700 km from epicenter. The tremors were felt by the inhabitants of Thailand, Malaysia and Singapore. The epicenter of the earthquake was at the bottom of the ocean not far from the Indonesian Island Sumatra. The tsunami with the height, which occurred as a result of the earthquake, fell in the Indonesian Island Simelue, at that the wharf of the main port of the island was partially destroyed, the wave of tsunami reached even the airport of the littoral city Sinabang. According to the evaluations of the officials, the death-roll as a result of the earthquake taken place on 28 March 2005 in the coast of Sumatra is more than 2 thousand people.



**Fig. 8. Variations of gravity before strong earthquake in Iran (N 13) and in Indonesia (N 14)**

In Fig. 8 is given the graph of  $\Delta_g$  variations preceding and accompanying the earthquakes in South Iran (N 13) and in Indonesia (N 14).

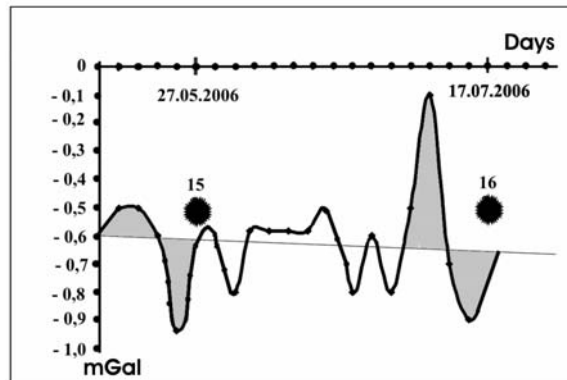
First of all we'll consider the Iran earthquake. On 04 March 2005 begins the decreasing of values  $\Delta_g$  which firstly reach their minimum between 10 and 11 March 2005 decreasing on 0,27 mGal. From 11 March begins decreasing of  $\Delta_g$  and on 13 March takes place the earthquake in South Iran with the magnitude 6, at that the values of gravity continues to increase, reaching the maximum by 15 March, and the maximum amplitude of increasing  $\Delta_g$  is considerable and is 0,56

mGal. After it there is observed the abrupt decreasing of the value  $\Delta_g$  on 0,62 mGal with reaching the minimum 16.03.2005. A complete period of QWV covers the time from 09 till 15 March 2005 and it is 6 days.

During the following five days takes place the increasing of  $\Delta_g$  against the background of fluctuations. To our opinion, the beginning of the process of preparation of Indonesian earthquake is reflected in the graph from 23 March, when  $\Delta_g$  has a background value. Between 24 and 25 March  $\Delta_g$  increases on 0,3 mGal, then it abruptly decreases on 0,72 mGal and in the process of this decreasing on 28.03.2005 takes place the strongest earthquake in Indonesia with the magnitude 8,7. At that  $\Delta_g$  reaches its minimal value between 29 and 30 March 2005. A complete cycle of quasi-wave change in time  $\Delta_g$  covers 23-31 March 2005 and is 9 days. QWV was accompanied by “vibration of the record” of gravimeter readings.

**EARTHQUAKES IN INDONESIA ON 27.05.2006 (M6,3)  
AND ON 17.06.2006 (M7,7)**

On 27 May in Indonesia in the region of Jokyakarta in the Island Java took place the strongest earthquake, the magnitude of which was 6,3 according to Richter scale. A death-roll as a result of the earthquake in the Island Java was 5115 people. About 20 thousand people were wounded, and 100 thousand people were left without a roof over their heads. After the main tremor followed hundreds of less strong ones. Almost whole region was without electricity and communication. In Bantul city were destroyed 80% of buildings. In Fig. 9 is given the graph of  $\Delta_g$  variations where is clearly observed the anomalous change of gravity in time before the main tremor (N 15). A form of graph of the change in time has a quasi-wave character with a full period of 12 days. The maximum amplitude of variations (from maximum till minimum) is 0,45 mGal. QWV is accompanied by “vibration of the record” of gravimeter readings.



**Fig. 9. Variations of gravity before strong earthquakes in Indonesia (N 15 and N 16).**

On 17 July 2006 in Indonesia took place the next strongest earthquake with the magnitude 7,7. Its epicenter was at the depth of 48 km in the Indian Ocean in 360km from Jakarta. Then more than 20 tremors followed. The earthquake spawned the tsunami with the height of more than 4 meters, which fell in the western coast of Indonesian Island Java. A main tremor of the element was in the resort town Pangandaran (the province Western Java) and in the region in 40 kilometers to the east of the Chilachap port.

Approximately in the 300km area at the coast of Java the tsunami destroyed and washed thousands of people into the ocean. Energy supply and telephone communications was broken. Jokyakarta also suffered because of the earthquake and tsunami. As a result of the earthquake and tsunami about 1000 people died and 500 people were wounded.

In the graph appeared the pronounced anomaly of  $\Delta_g$  variation, which considerably increases the anomaly during the earthquake on 27.05.2006. To our opinion it can be explained with a big magnitude of the earthquake on 17.07.2006. A form of anomaly  $\Delta_g$  preceding the earthquake, also has a quasi-wave character with the period of 13 days. The maximal amplitude of  $\Delta_g$  variation is 0,92 mGal. QWV was accompanied by “vibration of the record” of gravimeter readings.

Below are given the photos of the author near the destroyed chouses in Yogyakarta as a result of strong earthquakes and tsunami, occurred in Indonesia on 27.05.2006 and on 17.07.2006.





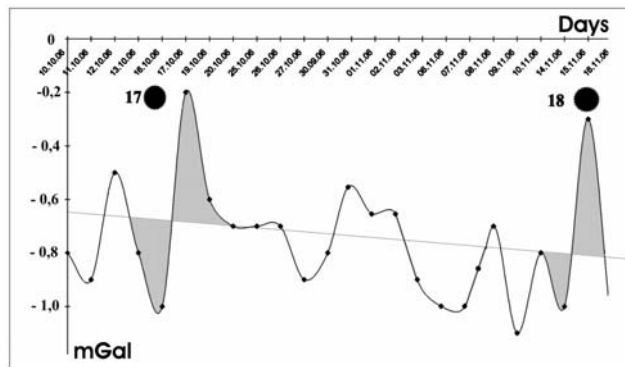
**The photo is made during trip of Prof. Elchin Khalilov  
in Yogyakarta (Indonesia) in July in 2006**

### **THE EARTHQUAKES IN JAPAN ON 10.10.2006 (M 6) AND IN THE KURILES ON 15.11.2006 (M 8,3)**

On 10 October 2006 in the northern part of Japan took place the earthquake with magnitude 6 according to Richter scale. The epicenter of the earthquake was in the sea near the Fukushima city which is in 240km to the north-east from Tokyo.

The earthquake didn't cause the big destruction, but its preparation was accompanied by the pronounced anomaly of variation of gravity. The period of quasi-wave variation was 7 days. The maximal amplitude of changes of  $\Delta_g$  was 0,8 mGal. QWV wasn't accompanied by "vibration of the records" of gravimeter readings. Fig.10.





**Fig.10. The graph of variations of gravity before the earthquakes in Japan (N17) and in the Kuriles (N18)**

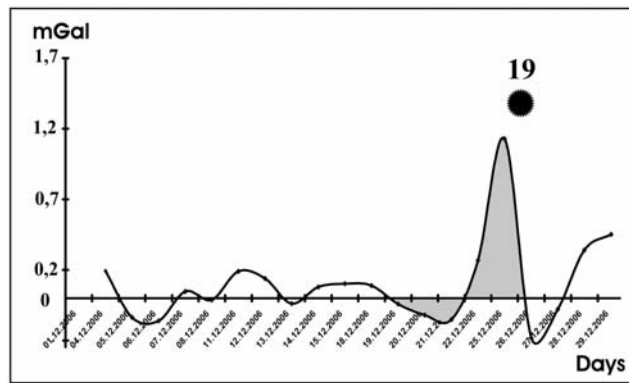
On 15 November 2006 in the Kuriles took place the strongest earthquake with the magnitude 8,3 according to Richter scale. The tremors were felt approximately in 390km to the east of the Iturup Island (the Kuriles Island).

The earthquake was preceded by the anomalous variation  $\Delta_g$  which has the quasi-wave character with the period 5 days. The amplitude of variation was 0,72 mGal. QWV was accompanied by “vibration of the record” of gravimeter readings.

#### **THE EARTHQUAKE IN TAIWAN ON 26.12.2006 (M7,4)**

On 26 December 2006 at 12:26 by Greenwich time near the south coast of the Island Taiwan took place the strong earthquake with M 7,4. The epicenter of the earthquake was near the south coast of the Island Taiwan in 90km to the south-east of the city Gaosyun.

According to the data of the National center of information about the earthquakes of Geological Survey NEIC the earthquake was felt on the whole island Taiwan and at the eastern coast of China. There were destruction and victims: under the heaps of the destroyed furniture factory died 2 people, more than 30 were wounded.



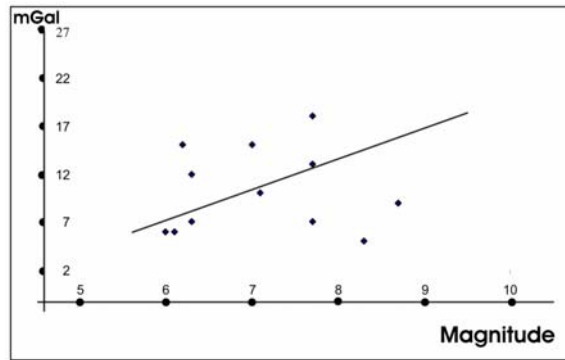
**Fig. 11. The graph of variations of gravity before the earthquakes in Taiwan (N19).**

In the Fig. 11 is shown the graph of quasi-wave variation of gravity before the earthquake in Taiwan. On 19 December began the decreasing of gravity which reached its minimum decreased by 21.12.2006 on 0,1 mGal, after what began its decreasing.  $\Delta_g$  reached its maximum between 25 and 26 December, at that the general amplitude of decreasing of  $\Delta_g$  was 1,2 mGal. On 26 December took place the earthquake.

It is remarkable that this graph could be called reference one for short-term prognosis of the earthquakes. QWV was accompanied by “vibration of the records” of gravimeter readings.

#### **THE REGULARITIES OF APPEARANCE OF FAR-RANGE PRECURSORS OF THE EARTHQUAKES**

The carried out researches of tideless variations of gravity allowed to reveal the quasi-wave anomalies of  $\Delta_g$  variations and to make the conclusion about their connection with strong earthquakes. Meanwhile, the establishing of regularities among different parameters of quasi-wave variations and strong earthquakes is of interest. With this purpose was made the graph of dependence of the periods of QWV on the magnitudes of the earthquakes, accompanying QWV.

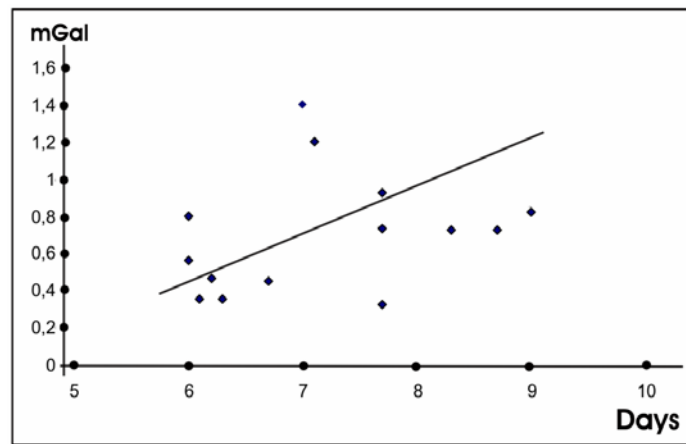


**Fig. 12. The graph of the magnitude from the period of quasi-wave variation  $\Delta g$ .**

In the graph (Fig. 12) is shown the straight-line trend which characterizes the dependence of periods of QWV on the magnitudes of the earthquakes. As it is seen from the graph, these two parameters have the directly proportional dependence, i.e. the higher the period of QWV the higher the magnitude of the earthquake.

It can be logically explained by the fact that the higher the energy of the earthquake the more time is needed for the process of accumulation and discharging of the stress in the interior of the Earth.

Another interesting aspect, to our opinion, is the possibility to determine the presence of dependence between the magnitude of the earthquake and amplitude of QWV. In Fig. 13 is shown the graph of dependence of magnitudes of the earthquakes on the amplitudes of QWV. As it is seen in the graph, this dependence is also described by the straight-line trend, which is the evidence of the fact that the magnitudes of the earthquakes is in directly proportional dependence on the amplitudes of QWV, i.e. the higher the amplitude of the ingress of QWV the higher the energy of the earthquakes. To our opinion, this conclusion is rather logical, because the amplitude of QWV can be the evidence of the scale of geodynamic process in the interior of the Earth.



**Fig. 13. The graph of dependence of the amplitude of quasi-wave variation of  $\Delta g$  on the magnitude of the earthquake.**

The received results completely change the notions about the approaches to forecasting of the earthquake and about the scales of appearing of precursors of strong earthquakes in giant territories.

Starting from received results is becoming to be clear the reason of many unsuccessful attempts of forecasting of the earthquakes by means of registration of changes of gravity and, most likely, of a number of other precursors. The researchers registering the anomalies of the gravity in time referred them only to appearance of preparation of neighboring to the registering device of the center zones whereas actually these precursors reflected the preparation of the earthquakes the centers of which were in big distance from the station of observation. The opinion of M.Tadzimu is the most eloquent evidence about this mistake. He says that the short-period changes of the gravity till 0,2-0,3 mGal occur before and after the earthquake in consequence of monoaxial horizontal pressure of the masses of the crust near the epicentral zone (Tadzimu, 1970).

As a result of carried out researches we made the conclusion about the availability of two types of precursors of strong earthquakes:

- local precursors, the main reason of which is the tectonic processes located in the radius of hundreds of kilometers from the center zone of the preparing earthquake;
- far-ranging precursors of the earthquakes, the reason of which is the large-scale deep layers of the Earth.

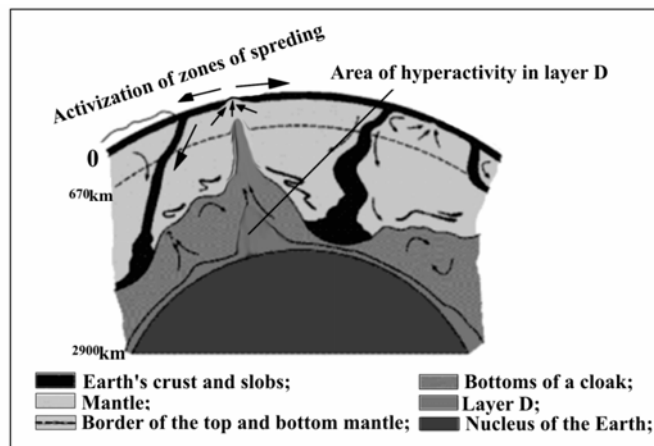
Table

No.No	Name of district	Date and time	Magni - tude	Coordinates	Distance up to Baku Km/ Mile
1	TAIWAN REGION	2004/10/15 04:08	7	24.53°; 122.694°	
2	INDONESIA (TSUNAMI)	26.12.04 0:58	8,8	3.316°; 95.854°	6169,3 Km; 3833,43 Mile
3	HALMAHERA, INDONESIA	2005/08/19 15:48	5,5	2.646°; 128.143°	
4	NEAR EAST COAST OF HONSHU	2005/08/24 10:15	6,2	38.564°; 142.987°	
5	EASTERN GULF OF ADEN, INDONESIA	2005/08/26 18:16	6,2	14.417°; 52.365°	
6	OFF EAST COAST OF HONSHU, JAPAN	2005/08/30 18:10	5,7	38.495°; 143.151°	
7	PAKISTAN	08.10.05 3:50	7,7	34,43°; 73,54°	2182,33 Km; 1356,04 Mile
8	PAKISTAN	09.10.05 0:00	5,7	34,27°; 73,69°	2202,26 Km; 1368,42 Mile
9	BANDA SEA, INDONESIA	27.01.2006 16:58	7,7	-5.45°; 128.1°	16116.44 Km; 10014.29 Mile
10	NORTHERN SUMATERA, INDONESIA	09.01.2005 22:12	6,1	4.926°; 95.108°	5980.88 Km; 3716.35 Mile
11	NICOBAR ISLANDS, INDIA	24.01.2005 4:16	6,3	7,33°; 92.482°	5588.20 Km; 3472.34 Mile
12	MINDANAO, PHILIPPINE ISLANDS	05.02.2005 12:23	7,1	5.293°; 123.337°	8221.74 Km; 5108.75 Mile
13	SOUTHERN IRAN	13.03.2005 3:31	6	27.115°; 61.891°	1839.87 Km; 1143.24 Mile
14	NORTHERN SUMATERA, INDONESIA	28.03.2005 16:09	8,7	2.085°; 97.108°	6364.02 Km; 3954 Mile
15	JAVA, INDONESIA	27.05.2006 5:545	6,3	7.962° 110.458°	
16	SOUTH OF JAVA,INDONESIA	17.07.2006 08:19	7,7	-9.222°; 107.320°	
17	HAWAII REGION, HAWAII	15. 10. 2006r. 17:07	6,7	19.820° 156.027°	12793.53Km 79495.53Mile
18	KURIL ISLANDS	11.15.2006r. 11:14	8.3	46.616° 153.224°	7722.06 Km 4798.27 Mile
19	TAIWAN REGION	26.12.2006 2:26:21 (UTC)	7,4	21.825° 120.538°	

It is becoming to be evident that the availability of two types of gravitational precursors of the earthquakes, on the one hand, complicates the interpretation of the received data of monitoring of gravity, and on the other hand, it allows to exclude the errors during short-term forecasting the earthquakes, when the far-ranging

gravitational precursors of the earthquakes are taken as local ones. But the most important is that there appeared the possibility of registering the moment of origin of future seismic activation, most likely connected with the ingress of geodynamic activity in deep layers near the Earth core.

Being guided by the described above newest data of seismic tomography and the formed in definite degree the renewed model of the deep geodynamics of the Earth, we can surmise the next mechanism of appearance of far-ranging precursors of strong earthquakes. In the deep layers of the Earth presumably in the layer D with the definite quasi-periodic cyclicity, arises come energy splash, which have the short-tern character. This splash of energy must spawne the formation of the field of the high pressure, temperature and low density, injecting the plume which creates the additional impulse in convection current and in the mantle. In some period this impulse brings to acceleration of convection currents in asthenosphere what brings to activation of moving of definite lithospheric plates, depending on the fact in what part of the layer D is taking place the energy splash. There is no doubt that definite time passes from the moment of energetic impulse in the layer D before the beginning of seismic activation in the borders of lithospheric plates. Most likely, namely this period of time (8-20 days) has passed from the start time of registration of variations of gravity before strong earthquakes. And in this case can be two reasons of arising the registered anomalies of gravity: 1. Forming of giant fields of anomalous density, aroused by energy splash, in the layer D; 2. Radiation of tectonic waves in the zone of energy splash in the layer D. The nature of tectonic waves is different from seismic ones and they reflect not only the alternate interchange and moving from the emission source of the fields of increased and decreased density, but also a partial moving of substance of the mantle. Fig.14.



**Fig. 14. Model start moment of energy splash and forming of the field of increased pressure and temperature and decreased density, injecting the plume.**

From physical point of view the observed anomalies can be explained more likely namely by registration of super-long tectonic waves, radiated in the layer D and alternately changing the density of the rocks during its moving, what, in its turn, registered by gravimeters in the form of variations of gravity. The tectonic waves cause the abrupt increasing of stress in center zones, where the stress have reached the critical values, what brings to the earthquake.

The registered in Scientific-Research Institute of prognosis and studying of the earthquakes the variations of gravity before strong earthquakes, the epicenters of which are in the distance of 4-7 kilometers from the registered station can shed the light on the spatio-temporal character of the process of rise of deep geodynamic activity. The main question during interpretation of gravitational anomalies before strong distant earthquakes is in the fact whether these anomalies are directly connected with preparation of center zone of the earthquake or reflect the zone of rise of geodynamic activity in the deep layers of mantle.

The calculations carried out by us show, that if the source of gravitational anomalies, registered before strong earthquakes in Pakistan, Indonesia and other earthquakes, 4-7 kilometers distant from "Binagadi" station, then in them should have been formed improbable giant fields of decreased density with a diameter of 100 kilometers. In this case near the center zones were registered the gravitational anomalies in hundreds of milligals, what actually aren't observed. Consequently the source of gravitational anomaly is at the big depth and is distant from the center zone of the earthquake the same way as from the registered station.

So, we offered fundamentally new conception, explaining the observation of variations of gravity before distant strong earthquakes.

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## **ON PERSPECTIVES OF APPLICATION OF NEW TECHNOLOGY OF SEISMIC RESISTANT CONSTRUCTION IN YOGYAKARTA, SPECIAL REGION OF INDONESIA**

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Each year, catastrophic earthquakes take hundreds of thousands of human lives on our planet. The strong earthquake that caused the tsunami on December 26, 2004 took about 300 000 human lives, even more people were injured, several million people lost their shelter. A catastrophic earthquake occurred October 8, 2005, 100 km northeast of Islamabad in Pakistani Kashmir, resulting in death of about 50 000 people. Unfortunately, there are too many tragic examples of consequences of strong earthquakes.

The reasonable question which arises when reflecting over such facts is: “Why up to now does the humankind fail to protect itself against earthquakes and what is the way out of the existing situation?”

Let’s ask ourselves a question - why do people perish at earthquakes? The answer is very simple - their death is caused by destroyed buildings fragments of which cover and hit the victims. But it was people themselves who built those buildings. Therefore, the cause of such a heavy death toll at strong earthquakes is the fact that people have built the houses that kill them while getting ruined at earthquakes.

Today, there are perfect modern technologies of seismic resistant construction, which allow erecting multistory seismic resistant buildings capable to stand strong earthquakes. But the problem is that all those technologies cost too much and cannot be used by ordinary people of modest means for constructing their own houses.

If we review location statistics for countries with high population density and relatively low living standard, we will see that those countries mostly are situated in seismically active regions: Indonesia, India, China, other countries of South-East and Central Asia, Middle East, west coast of Latin America, etc.

Major part of the Earth's population lives in these countries. It means that overwhelming majority of people in the world does not have economic ability to build expensive seismic resistant buildings, while wealthy people and countries do. Thus social inequality is created in regard to the most important human right irrespective of the person's welfare - right to live.

One of the programs of International Academy of Science (IAS) - Health and Ecology is a program for providing seismic security for population of seismically active regions of the world. Within this program fulfillment, a new technology of seismic resistant construction has been developed, which is intended for constructing inexpensive and maximally simple seismic resistant buildings of up to 2 floors for broad masses of population with average and low living standard. Those buildings are expected to stand strong earthquakes with magnitude not less than 9 by MSK64 12-degree scale.

This technology has undergone expert examination and received a positive decision of experts of International Academy of Science, and was discussed and approved at IAS Presidium session on November 18, 2005 (Austria, Innsbruck, 2005).



**PHOTO**

**At International Academy of Science, Presidium**

**On the left - Honourable President IAS, Nobel Laureate, Prof.Dr. Y.T.Lee;  
In the center - President IAS Prof. Dr. Walter Kofler; on the right – Chairman of  
the International Commission on Seismic Risk and Aseismic  
to Construction Prof.Dr. Elchin Khalilov (Austria, Innsbruck, 18.11.2005).**

As a result of discussion over this technology, an appeal by IAS to the Secretariat of UN Habitat Organization was adopted recommending that the new technology of seismic resistant construction be widely used.

The new technology of seismic resistant construction has two applications for an invention (PCT, Geneva), three Eurasia patents, three Azerbaijan patents, and the process of its national patenting in Indonesia, Malaysia, Philippines, Pakistan, Turkey, Iran, and in a number of other countries is in progress.

In Azerbaijan, this technology has received the most advancement today. Supported by the Ministry of Economic Development of Azerbaijan, work on experimental checking of the new technology on a minor seismic platform was started and on receiving positive results, a national standard on seismic resistant construction for the new technology was set. The standard was confirmed by the State Committee for Construction and Architecture of Azerbaijan as well as by the State Agency on standardization, metrology and patents. At present, a large construction company in Azerbaijan together with the Scientific Research Institute for prognosis and studying of earthquakes has established a joint company (Dancing Building Technology - DBT), which has obtained a license for using the new technology of seismic resistant construction in Azerbaijan.

The new technology of seismic resistant construction received support from NATO. After a long and difficult procedure of detailed examination of that technology, NATO awarded a big grant for a 3-year period for approbation and wide application of the technology worldwide. Three countries - Turkey, Azerbaijan and Kazakhstan - are participating in the International NATO Project **(NATO PROJECT SFP 982167)**.

Meanwhile, the most seismically dangerous country of the world is Indonesia. It is in this country that several catastrophic earthquakes take place each year, often followed by tsunami. Indonesia lies on islands and has population of over 250 million people. It is not a country of the rich and its people live in constant fear of strong earthquakes. Despite the fact that the world community has provided vast subsidies for rebuilding of houses, schools and hospitals destroyed during the earthquake and tsunami in 2004 and subsequent natural disasters, nevertheless, those houses are built with traditional non-seismic techniques again since seismic resistant construction is very expensive. Therefore, every new strong earthquake ruins newly built houses and the process repeats again.

That is why the International Academy of Science has opted for Indonesia to introduce the new technology of seismic resistant construction. Indonesia needs inexpensive seismic resistant buildings for ordinary people most of all. The new technology will make it possible to quickly and cheaply build in Indonesia not only houses for millions of country residents, but also kindergartens, schools, hospitals and other social and governmental facilities.

Within the NATO Project, one of the objectives of the new technology is specified as raising stability of the building against blast wave caused, for instance, by an act of terrorism. As is well known, water's blast wave during tsunami affects buildings as well. Therefore, the new technology will be maximally effective for protecting people from tsunami, which is frequent in Indonesia.

May 27, 2006 in Indonesia, near the city of Yogyakarta on Java Island a strong earthquake with magnitude of 6,3 by Richter scale took place. The death toll after the earthquake on Java Island reached 5115 people. Up to 20 thousand people were injured; about 100 thousands lost their shelter. The basic impulse was followed by around a hundred of weaker ones. Almost the whole area was cut off from electricity and communication. Taking into account long-term scientific and educational contacts between International Academy of Science and Gadjah Mada University of Yogyakarta as well as other scientific and public institutions, a decision to start introducing the new technology within the Special (Autonomous) Region of Yogyakarta in Indonesia was adopted.

While visiting the Special Territory of Yogyakarta in Indonesia late in July of 2006, the authors of the new technology of seismic resistant construction (Prof. Elchin Khalilov and Prof. Walter Kofler) minutely examined the nature of destruction of private dwellings and social institutions buildings during earthquakes and tsunami and came to the conclusion that the new technology might be maximally efficiently used on this Territory.





**At the left – His Excellency Sultan of Yogyakarta Hamengku Buwono X.; to the right – President IAS, Prof. Dr. Walter Kofler;**

We selected some specimen of different types of sand for examination in order to determine the optimal composition for aseismic construction blocks. After a meeting with expert groups at Gadjah Mada University and several scientific institutions, the authors were invited to a meeting with His Excellency Sultan and Governor of Special (Autonomous) Region of Yogyakarta **Hamengku Buwono X.**



**In the center the His Excellency Sultan of Yogyakarta Hamengku Buwono X.;  
To the right of him - President IAS, Prof. Dr. Walter Kofler;  
at the left - Prof. Dr. Elchin Khalilov.**



**At the meeting of the authors Prof. Walter Kofler and Prof. Elchin Khalilov  
with His Excellency Sultan of Yogyakarta Hamengku Buwono X.**

During the meeting, topical questions of providing seismic security for the population of the Special Territory of Yogyakarta were discussed. In the course of discussion, a plan for successive introduction of the new technologies in Indonesia was worked out.

**It was planned to start the work in two priority directions:**

1. Application in Indonesia of the new earthquake forecast technology developed in IAS Scientific Research Institute for prognosis and studying of earthquakes (Baku). The technology is based on recording of long-period quasi wave variations of the gravitational field before strong earthquakes. For that purpose, it has been planned to set up an earthquake forecast station in Indonesia under the direction of Prof. E. Khalilov with use of ultra-long gravity waves detector invented by E. Khalilov.
2. Application in Yogyakarta and later throughout Indonesia of the new technology of seismic resistant construction based on use of aseismic construction blocks. As a first seismic resistant building constructed with use of the new technology, it has been planned to erect BUSHKOSHMAH hospital building destroyed by a strong earthquake.

**The beginning of the new technologies application is planned for 2007.**

Application of the new technology of seismic resistant construction in Indonesia will allow not only saving many human lives but also starting a new stage of providing seismic security for the population of Indonesia when millions of the country's ordinary people can live without fear, not being afraid of falling a victim to strong earthquakes.

## **TWO HUNDRED YEARS IN PURSUIT OF AN ECO-SOCIAL SUSTAINABILITY – A TROPICAL EXPERIENCE**

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### **1.Introduction**

To achieve sustainable development conditions in a tropical environment is a challenge faced by various countries that have to balance the social, economical and ecological variables, with limited professional talents and scarce financial resources. Although the human presence in newly discovered lands usually caused adverse impacts on the natural environment, a number of actions taken in Brazil along its history became well-succeed pioneer solutions, also applicable to other countries in pursuit of a sustainable eco-social future.

Brazil covers roughly one half of South America and embraces several biomes, from the pampas prairies in the South to the huge Amazon rainforest that extends for about four million square kilometres in the North, with a rich biodiversity yet to explore. Since the discovery, in 1500, Brazilian population grew from just few million of native Indians, slaves brought from Africa, and Portuguese colonials, to about 180 million inhabitants, descendants of practically all ethnic groups in the world.

The country will soon complete two hundred years as an independent nation and during this span of time nature was submitted to many anthropic impacts whilst the natural environment was affected by agriculture, cattle raising, mining activities and road and city building. The eco-social consequences of these human interventions were particularly acute in some forested areas, where the ecosystems are more vulnerable, but on the other hand new solutions were conceived to face the local difficulties: extensive bio-fuels production programmes were stimulated by the shortage of fossil fuels soon after the oil crisis of the 1970s; the recovery of metals and other imported materials, from rubbish, was a common practice decades before the recycling programmes became an environmental icon; some sources of renewable energy like hydroelectricity and planted trees used for firewood were successful options taken more than a century ago.



The examples given above illustrate authentic shifts in paradigms that led, as a logical consequence, to enduring environmental benefits, notwithstanding the prevailing economic motivations assumed initially. Although the connection of ecology to economy is a move already under way, this link must be extended to the community's health and education as well, in order to ensure an effective sustainable development. This extended view approach would be crucial to attain the eco-social sustainability conditions in this tropical milieu.

## **2. First concerns about the environment**

Although political independence from Portugal - the colonial ruler since its discovery in 1500 - occurred only in 1822, Brazil had reached a unique status as a colony that hosted the royal ruler since 1808, when the Portuguese court moved hastily from Lisbon and established itself in Rio de Janeiro, the colony's capital, to escape the invading French troops of Napoleon.

In 1815 Rio de Janeiro became the official capital of the United Kingdom of Brazil and Portugal, from where the Portuguese possessions in Africa and Asia were also ruled. A new approach to commerce was established after that, and the natural resources of the Brazilian vastness began to be exploited at a quicker pace, with obvious consequence on the natural environment. Until then local agriculture was concentrated on sugar cane plantations, while the export of forestry products was controlled by the colonial rulers, and mineral exploitation was restricted to gold and precious and semi-precious stones, channelled directly to Lisbon. Coffee plantations were concentrated in areas not far from the capital city, and the forestry exploitation was largely focused on the brazilwood trees (*Caesalpinia echinata*), an endemic redwood exported to Europe since the early colonial times to be used as a dyer for textile products.

The status of a united kingdom brought in new challenges, but generated also new opportunities. Several institutions moved from Lisbon to Rio de Janeiro and remained there after the court moved back to Lisbon, in 1821. The Brazilian Naval Academy, the National Library, and the Academy of Fine Arts are examples of this interesting period that endowed the colony with centuries old institutions, which became the first centres of reference for culture and research in the new country.

The development of the hinterland, based solely on slave labour, lacked qualified manpower, and new agriculture techniques were needed to replace the cut-and-burn method, inherited from the native Indians, largely used to open forested areas for new plantations. Some farsighted landowners however, foreseeing an end to the slave labour, started to make use of European immigrants. The first to arrive were the Swiss, in 1819, soon followed by

Germans, in 1824. At that time coffee plantations started to spread out to the south, taking advantage of a milder climate and special soil conditions.

Although the agrarian practices were improving with the introduction of the newly imported manpower, the devastation of the Atlantic forest that originally covered the coastal areas and some eastern parts of the hinterland accelerated, to yield space for new farms. Fortunately this advance was concentrated mostly along the coast and the huge rain forest that covers most of the Amazon River basin was left practically untouched during the 19<sup>th</sup> century and the first decades of the 20<sup>th</sup>.

The news of an extraordinary natural environment, encompassing very rich flora and fauna, soon reached the leading scientific centres of the early 19<sup>th</sup> century, and scientists and naturalists from various European countries began to visit the new reign and to write about its nature and natural resources. Among them it should be mentioned Auguste de Saint Hilaire (1816), Karl von Martius and Johann von Spix (these two members of an Austrian scientific mission arrived in 1817), and also Charles Darwin that sojourned in Brazil for a couple of months during his famous voyage around the world, in 1832.

In 1816 a mission integrated by several artists, including painters, illustrators and etchers, arrived from France to settle in Rio de Janeiro. Their works-of-art depicting the new country contributed to call the attention of the local society to the exuberant nature in which they lived, enhancing in some way their consciousness to protect and preserve this tropical environment. The influx of artists and scientists that visited or lived in the colony during the first years of the 19<sup>th</sup> century would have a lasting influence and, to some extent, would help to mould the character of the new country.

### **3. An empire in the tropics**

In 1822, following constant dissensions with political groups in Portugal that disputed the presence of the king in Lisbon after the retreat of the French occupants, the union of the two countries was broken up and Brazil became completely independent from Portugal. The Portuguese heir to the crown, prince Pedro de Orleans e Bragança, was designated Brazilian Emperor under the auspices of the local politicians, influenced by the movements of independence that had already swept the Spanish colonies in the Americas, following the creation of the United States of America in 1776. During these events the role played by a Brazilian scientist educated in Portugal, José Bonifácio de Andrada e Silva, was of major importance.

After years of studies in several countries in Europe, Jose Bonifácio returned to Brazil, where he was born. Although a prominent mineralogist and naturalist, and an active member of several Academies of Science in Europe

(Berlin, Jena, London, Paris, Stockholm among others), José Bonifácio had contacts with political leaders not only in Europe but also in the new independent colonies of North America. He brought home, together with his baggage of books and mineral samples, also the ideas and concepts of national integrity that influenced profoundly the early years of the new country. In his writings while he lived in Portugal, Jose Bonifacio raised the first protests against the misuse of the tropical environment. As a naturalist, his voice was the first to criticize the forest depletion and the bad land-farming practice of “queimadas” (slash-and-burning procedure) that impacted the environment in the most populated areas of Brazil. His most important role, however, was that of tutor of the emperor’s son, Prince Pedro de Alcantara, a young boy who was left as the heir to his father throne, when the first emperor sailed to Portugal in 1831 to recover the Portuguese crown from usurpers that tried to break the royal lineage.

Pedro de Alcantara, the son of the first Brazilian Empress, Leopoldina of Habsburg, daughter of the Austrian Emperor Francis I, was educated under the influence of Jose Bonifacio’s political and economic ideas, and was crowned the second (and last) Brazilian emperor, as Pedro II, ruling from 1840 to 1889, when Brazil became a republic like all other countries in the Americas. Jose Bonifacio environmental concerns soon captivated the young ruler, who took important steps to protect the luxuriant nature around the imperial capital city of Rio de Janeiro.

The tropical forest that surrounded the city had been severely cut down to set free new areas used for sugar cane and coffee plantations. The coffee farming had already climbed the hills, almost to the top of the high mountain where now stands the Christ’s monument, well known to the tourists of today. Under the Emperor’s instructions, however, a law was issued in 1861 turning all this land into a forest park “to conserve the climate and protect the natural springs that supply water to the city”. A prolonged drought in 1824 had already led to the decision to expropriate the areas around the water sources, in anticipation of the modern practices of protecting water’s edge vegetation, and well in line with the current concepts of water resources management. The whole area was then replanted with the same native species that covered it before deforestation. During a period of 12 years more than seventy thousand saplings were planted under the emperor’s personal supervision, giving origin to the world’s largest urban forest that stands until today. The concept of protecting the water sources, together with the clear understanding of the direct relationship between the local climate and the existence of forests, can be easily traced at this early stage of the ecological science. Tijuca forest, as it is called, is a national park since 1967 and was listed as Unesco Biosphere Reserve in 1991. Its revival as a “forest amidst a large city” can be considered as a milestone in the human fight against the depletion of the nature.

Notwithstanding the extraordinary wisdom shown by the imperial government with regard to the forests protection, a new menace threatened this primeval environment in the tropics - the railroads. Due to the absence of mineral coal in the country (with the exception of Brazil's two southernmost states), the native woods became the natural option for feeding the locomotives, until the exhaustion of the native forest along the tracks forced the railways operators to bring in an exotic species, the eucalyptus, imported from Australia. After the first specimens were introduced one hundred years ago, this tree has found in Brazil its best habitat to grow fast, as a source of renewable energy, as firewood, and also for the manufacture of railroad sleepers.

Years of continuous research with several eucalyptus species led Brazil to a position of world leadership in its use, replacing the scarce mineral coal as a metallurgical reducer, using it as charcoal for cooking, and converting it, more recently, into a fast-growing source of cellulose for pulp and paper production. So, due to a nature's apparent avarice, Brazil was spared the inconveniences of the mineral coal cycle that darkened the cities and still pollutes the air in many regions of the world since the early years of the Industrial Revolution.

The problems exposed by slave labour were also cause of several environmental strains in the second half of the 19<sup>th</sup> century. Firstly, the low cost of manpower didn't contribute to an efficient use of the land. Farmers neglect and lack of skill led to the abandonment of large areas already cultivated; agriculture was predatory and sustained by a continuous assault on new virgin areas, advancing like itinerant miners use to do, leaving behind exhausted land, improper for use. Secondly, the lack of professional qualification of the slaves and the poor level of education of the farmers did not encourage the introduction of modern and efficient farming techniques. This scenery changed drastically with the abolition of slavery in 1888, foreseeable years before when slaves started to be replaced by immigrants coming from Europe. The arrival of thousands of immigrants eager for opportunities in the New World was to the benefit of the environment too, because of the introduction of new farming methods, brought in from countries where land was scarce and nature was not so indulgent to its users.

To complete this panorama of changes induced by the end of slavery and by the new republican ideas introduced during the last decades of the 19<sup>th</sup> century, Candido Rondon, a Brazilian army engineer born in the western frontier in 1865, was entrusted with setting new telegraphic lines in areas of the country still hardly known to the European settlers. His easy contact with native Indian tribes (Rondon himself had native Indian blood) led to a natural and peaceful interaction with yet unknown tribes, bringing in precious knowledge on the local flora, fauna and traditional medicine practices. Some basis for the eco-social sustainability could also be identified at this moment.

#### **4. The early years of the 20<sup>th</sup> century**

At the end of the 19<sup>th</sup> century the stage was set for a friendlier interaction between man and nature, and the introduction of the republican system of government in 1889 opened the way to the modernization of the capital cities of the new federated states. The abrupt growth of these cities however had sad consequences on their health and living conditions, which led to outbreaks of epidemics of yellow fever, malaria and other tropical diseases. Investments in sanitation and the structuring of medical public services contributed to restore healthy conditions in these urban areas, and the struggle against these evils led to establish a local competence in fighting tropical diseases that endures to the present days. The level of excellence of some local research institutions is indebted to these years of fierce fighting against tropical diseases that had decimated many in the native population. On the other hand, a correlation between unchecked deforestation and some tropical diseases was then clearly revealed. Along the border with Bolivia the construction of the Madeira-Mamoré railway repeated the tragic experience already suffered by the constructors of the Panama Canal: malaria and other tropical diseases, together with ferocious native Indians killed thousands of workers, justifying the legend of “one dead man for each railroad sleeper laid”.

During the first decades of the 20<sup>th</sup> century new streams of immigrants, coming from southern Europe and also from Japan, start to change Brazilian society and contribute to the growth of São Paulo city, now competing with the older and traditional capital city Rio de Janeiro. Industry, massively concentrated in São Paulo, required electric power, which came mainly from hydroelectric generation projects.

The conquest of the huge Amazon basin was then at its beginning and Brazil was entering a new cycle of exports: rubber. The natural rubber, a resin extracted from the “seringueira” rubber-tree (*Hevea brasiliensis*) that grows disseminated among hundreds of other native species in the heterogeneous Amazon rainforest, was highly valued for its use in the fast growing automobile industry. The boom in the rubber export drove distant villages to grow into towns at a mushroom’s pace, bringing in richness, sophisticated social customs and also crime. Full opera ensembles coming from Europe sailed up the Amazon River to Manaus, then a boom town, and returned to Europe without even coming to the larger and older cities of South America’s east coast, including Rio de Janeiro. The Manaus Opera House is prized until today as a centre of classical music.

Curiously however, this so called Rubber Cycle did not impact the forest to a noticeable extent, because the latex extraction is an environmentally

sustainable practice that does not require cutting down the trees. This rubber production method, based solely on natural extractive principles, is still practiced in the Amazon in a perfect alliance with the sustainable development concept.

It is also worth mentioning that large projects based on extensive land use in the Amazon do not work as elsewhere. A good example is the huge investment made by Henry Ford in the years 1920s to produce rubber in large plantations that would replace the native Amazon forest. Based on his industrial production concepts, Ford invested large amounts of resources in a project that included even the construction of two complete and modern cities - Fordlandia and Belterra. But his one million hectares project, intended to be the world's largest rubber tree plantation, failed completely and was abandoned after few years. The same ill fortune followed, five decades later, the one billion US dollars investment made in the Brazilian Amazon during the years 1970s by the investor Daniel Ludwig. His intention was to produce cellulose pulp using an exotic species, the melina tree (*Gmelina arborea*) native to Southeast Asia (the Amazon forest is unsuitable for pulp and paper production for the hardness and heterogeneity of its native wood). Thousands of hectares planted with melina resulted in a complete fiasco for its inadequacy to the local conditions. In both examples given, the environmental obstacles imposed by the forest and the soil of the region were not sufficiently studied in advance and led to disastrous unforeseen effects.

These successive and unexpected failures explain, at least in part, why only 15% of the extension of the Brazilian Amazon forest has been deforested up to the present days.

### **5. From coffee plantations to the industrial complexes**

The crash of the world economy in 1929, soon followed by World War II, introduced new challenges into the country's economic and social scenarios, with consequences on the environment as well. The sudden collapse of the imports flow forced Brazil to stand on its own feet to supply its needs in machinery, fuels and all sorts of industrial products. This was good to the local industry that was forced to adapt itself to the new world reality at a quick pace, fostering the exploit of local raw materials and stimulating the development of new sources of energy.

From the environmental standpoint, this late industrialization process was also good, as compared to the early industrialized countries of the Northern Hemisphere, because it was based on modern industries, independent of the use of coal, using mostly hydroelectric power, and installed in areas that allowed future expansions. The basic conditions were laid for an industry that could comply with future environmental restrictions and adapt itself to new environmental laws. Brazilian steel industries are a good example of these environmental adequacies, although they were not intended as such at their planning stage.

As far as it concerns agriculture, the substitution of regional monocultures, like coffee, cocoa etc, was also favourable because it led in many areas to crop rotation practices that are aligned with the current environmental concepts of land use. Coffee had already been responsible to a great extent for the depletion of native forests in large areas of the Brazilian Southeast, and the advance of the agrarian front to feed a growing population also took its toll on native people and natural environment, leaving its scars along the new roads built for regional integration.

Not differently from other immigration countries, relations with the native population have always been a complex issue by reason of a dilemma: should these native tribes be integrated into the new cultural patterns brought in by the settlers (and have consequently their culture absorbed), or should they preserve their own traditions untouched as much as possible, by living in reserve areas? From the years 1940s on, this delicate process of setting up the first contact with tribes still unknown was conducted by three brothers, Cláudio, Orlando and Leonardo Villas Boas, who were responsible for an extraordinary humanitarian and sociological work. Due to Villas Boas brothers' efforts, many tribes have been peacefully approached and settled in an area of 28.000 square kilometres set aside in Central Brazil, in what is now the Xingu National Park created in 1961.

During the years 1970s the country's industrial expansion was once more accelerated, a fact that exposed new environmental challenges. Although the concept of industrial districts, adopted by some municipalities, stimulated the concentration of industries far out of the living areas, this led to highly polluted regions in some parts of the country. Cubatão industrial district in São Paulo State was the most notorious among them, and became known for its high level of pollutants in the atmosphere, which brought severe sanitary and health problems to the local population. But the 1970s was also the decade of the first initiatives to curb the impacts on the environment with the enforcement of legal instruments. Federal and State environment protection agencies were created, a legal framework started to be set, and popular concern with quality of life became an issue to be reckoned with. The planning concepts valid at the time, based only on the economic feasibility of a project, started to be revised. The large petrochemical complexes built in those years began to incorporate the social and ecological variables as well, what led in some cases to the installation of common facilities for treating solid waste and wastewater. To some extent this change in attitude was due to the pressure exerted by non-governmental organizations – the NGOs, - a new player that came in to stay.

The growth of the industrial activities led to the migration of millions from the countryside to ill-planned and unhealthy peripheral districts around the large cities. About 70% of the Brazilian population live now in urban areas, what implies in serious problems of sanitation, rubbish collection and lack of satisfactory

healthcare. One half of this urbanized population have no access to sewage systems, and more than one half of the solid waste generated in the 5500 municipalities that cover the whole country is conveyed to open dumpsites, resulting in subsequent health risks brought about by this bad practice of waste disposal.

The impacts caused by so many concomitant projects and interventions in the natural ecosystems were soon exposed to criticism and it was evident that their effect on the environment had to be curbed by legal means. As a consequence of the United Nations Conference on Environment, held in Stockholm in 1972, a Special Secretariat on Environment was created by the Brazilian Federal Government. That was the starting point for a series of legal documents issued thenceforth, having as its keystone the Federal Constitution of 1988 that dedicates one of its articles exclusively to the environment.

## **6. New paradigms for a new century**

The complexity of the environmental theme, with all its technical and social implications, makes its understanding somehow difficult to the population - particularly to people holding only a basic education. Some global environmental threats like water shortage, climate change, and endangered species extinction require a comprehensive approach that is not easy to disseminate among the population. In such cases new paradigms are required to convey these anxieties to common people, implying programmes of mass education for stirring consciousness and sensibility to the environmental theme.

At the beginning of the 21<sup>st</sup> century Brazilian society still fights against several environmental challenges which require a change of paradigms. In spite of the existent legal framework, considered by most jurists as a very advanced system of eco-social laws, its effectiveness is questionable. The large extension of the country, the shortage of specialists in some technical, social and medical areas, and the lack of monetary resources are obstacles difficult to overcome. To these barriers it should be added a cultural propensity to bureaucracy - and also to corruption in some cases - inherited from colonial times. Relevant changes are under way, however, in at least three areas of eco-social interest that deserve further analysis: energy conservation, management of natural resources, and social accountability.

**6.1 Energy conservation** - In what concerns production and consumption of energy in the country, some points are remarkably positive. The petroleum world crisis that erupted in the 1970s was to some extent beneficial to Brazil, because important steps have been taken since then to replace fossil fuels with renewable sources of energy. The successive increases in petroleum prices since the year 1973, in addition to Brazil's severe dependence on imported petroleum at that time, has encouraged vigorously the development of substitutive fuels based on



biomass. The most successful of these efforts was Proalcool, a programme that in few years led to a drastic change in the conception of vehicles manufactured locally. During the 1980s more than 95% of the new automobiles were running on hydrated ethanol, replacing completely the use of petroleum. Even the older cars, originally conceived for the use of gasoline, have a 25% addition of ethanol in the fuel they spend. Another programme proposed in 2004 by the federal government envisages the production of large amounts of diesel oil – the so called bio-diesel – based on biomasses that can be extracted from various tropical palms, soybeans, cotton, peanuts, castor beans and several other vegetables which yield excellent results in the tropics.

At present, about 70% of all electricity used in the country is generated in hydroelectric power plants. This figure, together with the substitution of biomass fuels for petroleum in several of its uses, leads to a share of 58% of renewable energy in the country's total consumption, against only 42% coming from fossil fuels. Furthermore, the processing of the biomasses at the plantations sites enhances the use of local manpower, easing the problem of labour migration to large cities, what represents a true eco-social approach to the energy problem.

This growth in the use of fuels based on biomass can lead gradually to a complete transition from fossil fuels to renewable sources of energy in private and public transportation. In spite of a steady increase in the local petroleum production – that brings Brazil now to the enviable condition of a self-sufficient country and even an exporter of oil – the increase in the use of biomass for electric power generation is also noticeable. Cogeneration projects using bagasse (crushed sugar cane waste) as a subsidiary fuel reduce the environmental impact caused by sugar/ethanol production units, and are fully eligible for the Clean Development Mechanism established by the Kyoto Protocol on climate change, fact that increases additionally the competitiveness of the project. The replacement of fossil fuels with biomass renewable fuels is clearly identified as a trend that will influence permanently both private and public uses of energy, consisting of a relevant shift in paradigm.

**6.2 Management of natural resources** - In what concerns the management of natural resources, the need to enforce limits to nature exploitation is already assimilated by most stakeholders in the Brazilian society, while a slower population growth, due to lower birth rates, is clearly observed and results in lesser stresses on the natural environment.

Notwithstanding the existence of land disputes and confrontations in some parts of the country involving lumber merchants, gold seekers and also native populations, some recent actions point towards a gradual change for better in this picture. Large forested areas are being set aside to remain permanently as conservation units, including national parks, managed extractive units,

biodiversity corridors, private preservation areas etc. The total surface of these protected areas adds up to more than 500.000 square kilometres in the whole country. Strong surveillance is being exerted to protect native fauna, particularly birds but also larger animals. Fishing of some native species is prohibited during mating season and hunting is prohibited in most regions of the country.

The practice of third-parties certification for products extracted from the forests or manufactured with native wood is spreading fast, particularly in the Amazon region. Internationally accredited certification entities like the FSC – Forest Stewardship Council - are being requested to testify the origin of the products and the sustainability of the ecosystems that originated them. Fruits, wooden furniture, cosmetics, oils and essences are among such products.

Water, a natural resource considered inexhaustible for many years and consequently taken as inexpensive, became recently the object of new regulations that introduced the concept of river basin management and the pay-for-use principle. The possession of about 14% of all the fresh water ready for use in the world does not mean much if it is taken into account that in the very populated areas of the Southeast and also in the dry hinterland of the North-Eastern states the water consumption already exceeds its local availability.

A long time tradition in scrap collection and raw materials recycling, based originally on plain economical motivation, has led to a fast adoption of the new “recycling-for-environment” approach, with very successful results in what regards paper, metals, glass, plastics and other recyclables. The already existent sorting and processing facilities, conceived originally for handling scrapped materials, together with the low cost of labour, sustain nationwide recycling programmes like, for instance, the aluminium beverage cans that are voluntarily collected and have their metal recovered up to the exceptionally high figure of 97,5% of all cans produced.

**6.3 Social accountability** - The voluntary adoption of social accountability principles by many enterprises, together with the changes observed in consumption habits that encourage the insertion of the environmental theme in daily life, are remarkable changes of paradigms to mention. A quest for foodstuffs of better quality (that includes natural and organic products), the choice to buy energy-saving home appliances, the voluntary recycling of recoverable materials, are some examples of the involvement of consumers and manufacturers which contribute to an eco-social future. Elimination of toxic substances in the composition of consumer goods can be identified in many areas: for several decades tetraethyl lead is already absent from the gasoline sold in the local market; chlorine is being banished from pulp and paper production; and CFCs are not anymore produced or employed in new refrigerators and other industrial products, in anticipation of the limits imposed by Montreal Protocol.

Some social initiatives taken by the federal government and its counterparts at the state (provincial) level have been very successful, as for instance, the free vaccination programmes covering the whole country, that became annual civic events in which millions of citizens, mostly children, are immunized against diseases like polio, meningitis and measles, in “national vaccination days” announced well in advance.

As far as it concerns labour safety, efforts to curb national statistics of accidents, still very high, are expressed by a system of Regulatory Norms already set in practice by the Labour Ministry, in close contact with the International Labour Organization. The presence of specialists in health and labour safety, required by law at all medium and large size enterprises, also enhances the introduction of the environmental concepts in such organizations, acting as bridges to cross the gaps between these three closely related themes: labour safety, health care and environment quality.

With regard to the environmental conditions at the workplaces, it should be noted a relevant and constant participation of Brazilian delegates in the international forums that elaborate and review the ISO standards series 14000 that deals with an organization’s environment management. In recognition of these proactive attitudes with regard to the international norms that include environment, health and labour safety, Brazil has been appointed, having Sweden as a co-leader, to elaborate a draft for the future ISO international standard of social responsibility (system ISO 26000) that will deal, amongst other themes, with child labour, forced labour and other types of discrimination within an organization.

In what concerns environmental certification, at the beginning of 2005 more than two thousand organizations already had their environmental management system (EMS) audited and certified according to the international standard ISO 14001. The commitment to a safe and clean environment is endorsed by a growing number of enterprises that already produce goods or render services with a noticeable allegiance to sound ecological principles.

## **7. Conclusions**

In his writings two hundred years ago Jose Bonifacio, scientist and mentor of the Brazilian independence, prophesied facts that became truths - he foresaw how important is to conserve the natural habitat and preserve the wooded areas, and he went even further when he proposed the protection of whales against indiscriminate killing. He was ahead of his time in the 19<sup>th</sup> century, several decades before the word “ecology” was used by Haeckel for the first time. He did not live to see the petroleum era that dominated the 20<sup>th</sup> century, but he would

certainly be an advocate of the biomass renewable energy era that will probably replace the fossil fuels in a few more decades.

During these two centuries, new scientific expressions were created – e.g. ecosystem, sustainable development, greenhouse effect, among many others – and converged gradually to the broader concept of eco-social sustainability.

In the early years of the 21<sup>st</sup> century, society is changing the focus of its environmental concerns, moving from the solution of specific impacts to the rather global concept of sustainability. A global approach to alleviate the environmental stresses should not ignore however the importance of developing new technologies to face local conditions and requirements, preferably with the employment of local manpower and other local resources.

Brazil is now using the experience that was amassed during these two hundred years of struggles against eco-social inequities to confront the environmental challenges faced at present by its society. Given the great dissimilarity found between its various biomes and the richness of its biodiversity, the country has had to develop new techniques and break with old paradigms. In this regard the link between environment and human health has been strengthened to the point of becoming a most important object of attention.

Notwithstanding this new approach to the environmental debate, two other important concepts, which are collective health and the social accountability of the organizations, have to be considered in order to cover the full spectrum of the eco-social sustainability model. Without any doubt only environmentally conscious, healthy and socially responsible communities would constitute a sound basis for such an eco-social sustainable future.

Undoubtedly the global environmental issues that human society will have to face in the coming decades will require plenty of creative thinking, and shifts in well established paradigms. The given view of the problems should give way to an extended view, enhancing the identification of weak points and showing the best paths to follow. Learning with the past while improving for the future could be the most effective approach to the threats to come.

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## INCREASE OF EFFECTIVENESS OF APPLICATION OF COMMUNICATION SYSTEM AND INFORMATION TECHNOLOGY AT EMERGENCY SITUATIONS

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Effectiveness of coordination of actions of all systems public administration, rescue services ministries and institutions, involved during the emergency situations, caused by natural and technogenic disasters at liquidation of its consequences, depend mostly from distinct and faultless work of communication systems and telecommunications resources.

Thus expert of U.S. indicate that powerful communication network of U.S., which includes along with system of communication of special (government, diplomatic, intelligence, military) and common (telephone, paging, trunk, cable satellite etc.) use, interment resources, may instantly lose significantly its effectiveness, at move out of natural disaster, accident, terrorist act or other emergency situations.

The head of U.S. state department Colleen Powell speaking about tragic events, when he was in Lima (Peru), indicated: "I have never felt in my life my uselessness, as on 11 September. During seven hours (flight to U.S.) I could not contacting by telephone and getting information about events in capital Washington), though 2 radio translation centers were on our routes. Though I am State Secretary.

And it is not worth while surprising, that in Washington and New York, at these tragic hours telephone communication of common use (wire and cell) was actually paralyzed due to calls of hundred thousands calls of subscribers practically blocking simultaneously, overloaded exchanges. By estimate of American experts admissible number of calls from subscribers of telephone communication in New York 11 September exceeded by fourteen times, whereas during the earthquake in San Francisco 17 October 1989 -by ten times. By other data, the biggest national operator of communication AT &T received by 100 million telephone calls more than usual.

After events of 11 September, the following programs as priority direction of the future development and improvement of NCC, as basis of US telecommunication infrastructure for the period of emergency situations were defined: "Hotline" Emergency Responce Link-ErLink, Advanced Intelligent Network-AIN, Alerting and Coordination Network-ACN, Government Emergency Telecommunications Service-GETS, National Coordination Center-NCC, Communications Resource Information Sharing-CRIS, Shared Resources-SHARES, Telecommunications Service Priority-TSP, Wireless Priority Service-WPS, Training Planning & Operational Support-TPOS

For operational notification and information of governmental organization and rescue services within frames pilot project of the program "Hotline" ERLNK, corresponding site in Internet is created, where whole necessary information about accidents, natural disaster, terrorist acts, hurricanes, floods, earthquakes and other emergency situations at the US territory is placed.

The objective of program of modernization and development of "Governmental emergency telecommunication service GETS is technical provision by guaranteed communication of subscribers of U.S. government the emergency situations, when, corresponding communication resources (lines, channel, switching centers) may be put out of the order, blocked or overloaded. Technical possibilities of the system are provided on base of flexible and operational redistribution of resources and reconfiguration of traffic, taking into account, priorities as at the cost of Federal (FTS, DISN, DTS), so commercial (AT&T, MCI WorldCom, Sprint) telephone networks of corporate on base of digital technology and Internet. Access and connection of subscribers (more than 50 thousand) are accomplished by common of automated procedure (tonal dial of combination "710-NCS-GETS"+PIN+ number of subscriber) independent on its location on base Personal Identification Number - Pin) in accordance with which category of urgency and priority of call are fixed.

The final purpose of realization of this program is a gradual transition of all results, achieved during it accomplishment (engineering decisions, technologies, standards, procedures and regulations of communication) to national level in interest of creation of national system of communication in emergency conditions Emergency Telecommunications Service-ETS). Thus, not only continuous work of government will be guaranteed, but activity of the whole U.S. population at the liquidation of consequences of the emergency situation. For priority provision and rehabilitation of telecommunication services in the interest of national security and quick responce at emergency situations the Federal commission on communication opened the special program telecommunication services priority TSP. Within frames the of the program TSP, operators of communication with corresponding instruction on rendering of services HCC, have priority among other operators in sequence of rendering and rehabilitation of telecommunication

services and are supported on behalf of governmental organizations.

For organization of joint action operators of communication on rehabilitation of telecommunication resources and services in the emergency situations, when wire telephone network of communication of common use is completely blocked or overloaded, the special Alerting and Coordination Network-ACN Is created, and with its assistance in regime of conferences exchange of information is accomplished between regional center of quick response. At that, designated telephone lines, organized n base of short wave and satellite systems of radio communication. Depending on level of destruction and losses, connected with emergency situations, three categories of of complexity of operation of rehabilitation of telecommunication resources and services NCC are distinguished. Operations of rehabilitation of the third (highest) category (NTMS Response level III) are conducted in emergency situation directly touching national security of USA or by personal instruction of the president as it was the case on 11 September 2001. Special groups and headquarteres of responce National Emergency Management Team, Communications Functional Group, Regional Emergency Management Team, NTMS Operating Centers are formed from representatives of the Federal government, industry and executive power (state, county, district, city) in this operations, which estimate losses and organize all works on rehabilitation telecommunication resources and services in necessary volume.

Within frames of the project SHARES for organization wireless communication of authorized bodies of government of USA at emergency situations, presently acting national network of short wave communication, including practically all receiving and transmitting centers short wave radio communication of civil and military ministries and institutions at the territory of USA (total-1040) and also personal stations of radio amateurs, is modernized. By existing agreement "Memorandum of understanding" between U.S. radiorelay league and national system of communication radio amateurs of USA (more than 400 thousand) in accordance with regultion and rules, confirmed by Federal commission on communication on base of Law about liquidation of natural disasters from 1974, are obliged to present to U.S. government on behalf of NCC their equipment and frequencies for transmission of urgent information at emergency situations"

In accordance with regulators of communication any subscriber at the territory of USA has possibility of to get an access access to resources of this network at fixed frequencies (more than 250) for transmission of urgent formalized information in the interest of national security and urgent information of population. The objective of modernization of this system is to two increase its readiness at emergency situations at the cost of: automatic sensing and prediction of status of conducting layers of ionosphere, conducting of training, quarterly and



regulating weekly checking of communication, unification of standards and equipment of communication, introduction of technology of package switching and IP protocols.

"Wireless priority service WPS is one of the key program of modernization and development of NCC of U.S. after events of 11 September. The point that process of its accomplishment is traced not only in Pentagon, but in the White house, where subscriber No.1 of this system of communication at emergency was located, states clearly and persuasively about importance of this program. Possibilities of the new system were demonstrated during ceremony of commemoration of victims of terrorist act in New York, when the president George Bush being among compatriots of many thousands, literally from the first attempt contacted by his cell telephone with White house, in contrary to pressmen and other presenting people, who desparately attempted calling in overloaded telephone network of Megapolis.

Russia, also understanding actuality of this problem, starting refusing from use of common systems of cell communication in system of public administration, bodies of legal enforcement, security and rescue services. For creation of more reliable system of communication, for example, in Saint-Petersburg Common System of Operational Trunking Radio communication was created. Before creation of Common System of Operational Trunking Radio communication (CSOTRC) state bodies and services of Saint Petersburg were additionally using different systems of communication. As a result of these effectiveness of direct interaction of different services of municipality and emergency services of the city, as in everyday activity, so at emergency situation was not sufficiently high. The order of the governor of Saint-Petersburg V.A.Yakovlev, signed in 1999 about creation Common System of Operational Trunking Radio communication (CSOTRC) defining principles of interaction of different city services became not only basic for selection of system of communication, but principal solution in the area of city management.

This system incorporates with operational radio communications all city and institutional services for effective work on management of life of the city and coordination of actions at emergency situations. It is well known that at emergency situations, for example, big accidents, fire, or terrorist acts, other types of communication turn out to be noneffective. Particularly, cell systems at big load from one point simply become faulty and for making a call by radio telephone many minutes pass, whenever even few seconds cost much in such situations. And dialing of seven digit number of telephone in critical situation is not so simple as in daily life. CSOTRC Is a close hierarchial system of communication, purposed for operation in the regime of daily activity and in the regime of emergency situations. CSOTRC includes: city administration, territorial management of district administrations, management of civil defense and

emergency situations, the Committee on transport of Saint-Petersburg, management of the state department of internal affairs, state auto inspection and biggest enterprises of the city, such as "Leenergo" TEK SPB" etc.

Before creation of CSOTRC Employees of administration of Saint-Petersburg, as mobile radio communication were using morally obsolete system "Altay" and in the Management of service radiostations were installed, connected with department network of management of internal affairs. Standard EDACS was selected as basis for construction of CSOTRC after the management of telecommunication and information provision of administration of Saint-Petersburg conducted comparative analysis of different systems of trunking communication. The results of analysis indicated that network "Radio Tel" constructed on basis of EDACS Is considered as optimal one.

According to decision of the State commission on electric communication No.57 from 02.07.2003, standard TETRA and its modifications are acknowledged, as more prospective for creation in Russia of networks of professional trunking radio communication for bodies of the state management of all levels, especially, in the area of provision of defense of the country, security and legal enforcement, and also for needs of some institutions and big corporations.

Presently, practically, each of these structures has its own network of radio communication. In majority of cases standards of applied radio communication are obsolete and do not process necessary functionality. Thus, presently, the process of selection of modern standards of digital trunking communication for construction of new networks of communication increases.

Azerbaijan also witnessed breakdown of systems of cell communication and drastic aggravation of operation of common exchanges during 6,5 points-earthquake, which took place on 25 November 2000 in city Baku. Population of the city remembers perfectly well, when during those tragic days for Baku, it was impossible to call by cell systems of communication and toll telephone lines were functioning badly. This was connected with overloading of cell communication lines and city exchanges.

Introduction in Azerbaijan of digital exchanges and new telecommunication technologies, will certainly significantly improve the quality of telecommunication technologies, however, meantime cell systems of communication remain, as the weak point in common system of communication.

At emergency situations certainly, the main role is to be given to designated systems of communication - trunk, satellite, HF radio stations, VHF radio stations. Meanwhile, tendency of quick development of technologies of cell communication, its convenience, availability of additional services made this type of communication more attractive for users and widely distributed. Thus, tendency of replacement of targeted systems of communications - trunk systems

and portable radio sets by more convenient in use and more convenient in application mobile telephones is observed in Azerbaijan. As a matter of fact, cell communication provides maximal protection of information access during calls. However at emergency situations, cell communication becomes the weakest chain of communication system and quick continuous information transmission. This represents great hazard for provision of quick communication during coordination of rescue works in the area of disaster.

Finally, it is necessary to touch upon application of geoinformation systems (GIS) during solution of tasks on quick exchange and analysis of information. From viewpoint of application of GIS telecommunication may be divided into two parts. The first part is radio communication and cell telephony. In this area raised issues are connected with territory, covered with radio signals, and mostly, with mobile subscribers. The second part is trunk lines of communication and common telephony.

Application, as a whole, of GIS technology and cosmic researches (remote sensing of the Earth) allows qualitatively changing approach concerning provision of continuous communication at emergency situations. Combination of these two technologies allows accomplishing modelling of networks of cell communication, establishment of databases about character of passing and reflection of radiowaves, making of digital models of relief and visualization of location of communication objects.

Particularly, application of cosmic stereo images of high resolution of allows establishing high precision three dimensional projection model of location. Applying GIS technologies, particularly ArcView and other software complexes in cosmic researches, one may create maps of action area of stations of trunking systems of communication and retranslators of VHF radiostations in zones of emergency situations, which is extremely important for rescuers, using these systems of communication. For many regions of Azerbaijan with localities of complex relief, this problem is especially current.

Taking into account, that territory of the Azerbaijan Republic is fully located in seismically active zone, subjected to strong earthquakes, it is necessary to develop and create common state system of targeted communication during emergency situations, particularly, strong earthquakes. Such system will enable providing more effectively coordination and management of all state structures, involved in liquidation of consequences of natural and technogenic disasters.

## **THE METHODOLOGICAL AND THEORETICAL ASPECTS OF ECOETHICAL PROBLEMS OF AZERBAIJAN**

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The humankind has met with the large-scale aggravation of global, including ecological problems in the beginning of the 21<sup>st</sup> century. Against these problems background the value system of our civilization the unity of world culture, also the necessity relation of human- nature had been begun perceiving in real form.

As it is all over the world, our republic is having the period of “ecological crisis” too.

Since the beginning of the 20<sup>th</sup> century the development of capitalism in Azerbaijan growth of the mountain- main, especially oil –mine and heavy industry, the expand of the agriculture and districts and raising of the transport and infrastructure have been caused to the degradation of the natural ecosystems, erosion, salinization of the soils pollution of the industry waste or absolutely destruction in some region. It is happening with the highest intensive during the last 60-70 years

There is a special place of the forest cover among the other natural resources. In comparison with other natural complexes, the forests of Azerbaijan undergo much more to the human interference. The holding inquiries show that in recent times more than 30 % of the area of our republic was covered with forests. However, at present this indicator was reduced more than three times. In some sources, it is shown as 10-12%, or 1.0- 1.1 million hectare, but in others, it is shown 700- 800 thousand hectare. Although their severe measures the real situation informs, about the degradation of the forests and their systematically dieing out. Except of the third age’s relict forests which remained as a tract form at the north-east hang of the Great Caucasus and Gusar Plains the flat and foothills forests was completely felled or remind as a fragment forms at the rest territories of our republic. In former times the forests, which covered more than 60% of the area of Lankaran region, especially the damp-and semi damp forests of Lankaran plain got decreased, and now this arranges only 23% of the total territory.

At a result of investigation, it was known that the 36.4% of the republic territory has exposed erosion at different extent. 14.1% of them consist of weak, 10.7% middle, 11.6% strong erosion soils. The 70% or 630.8 thousand hectare soils of the areas that spread alpine-subalpine, meadow-steppe landscape complexes which assuming ecological importance have undergone such kind of erosion and 40% of these soils are in the Great Caucasus, rest of them are in the Little Caucasus, Lankaran and Nakhchivan geographical regions. However, we cannot link the increasing of the erosion process only with the human's economy activity. In the last ten years the striking disturbances of the global changing climates in Azerbaijan, anomalies of the rainfall and temperature and the raining of the spring and summer rains as a shower, increased the repetition of the torrents, accidents, landslips and foods. But the cutting down of the forests in the mountainous areas and foothills stimulated these processes and increased the speed of the erosion process.

There is a special place of the salinization and solonchic process of the flat lands in our Republic's ecological problems. About 60% soils of Kur-Araz plain, which the 2.2 million hectares area consist of the middle, and strongly salined soils. Except this, the saline soils extended also in Siyazan-Sumgait, Geyranchol massifs and in Nakhchivan AR. The total area of the middle and strongly salinized soils in our republic is more than 1.3 million of hectares. This shows that 15% of the area of our republic is befallen by this ecological problem. But the total area of the saline soils is 508.3 thousand hectare.

In 80-90-es years of the last century associated with many difficulties which arisen in the country economy the collector-drainage systems destroyed and at result the areas of the saline and salinized soils increased partly.

Now some measures, carried out in this direction including the reconstruction and repair of the collector –drainage systems gave opportunity to detain the negative process and to stop it partly. However, the natural radioactivity does not over step the dangerous limit, according to G.Aliyev and M.Abdullayev's researches the amount of the strontium – 90 and cesium -137 radioactive nuclides increased three times after the accident in Chernobyl AES. The artificially radioactive nuclides arrange the radioactivity of the soil 2-10%.

The pollution of Azerbaijan soils with oil and oil wastes especially takes places in the Absheron Peninsula. The wrong exploit of the oil deposits, during ten years the extracting oil without guarding to the elementary demands under the protection environment, floating the oil, gas, chemical matters, strong mineralized and radioactive dirty waters to the land's surface were reason for the pollution and shattering of the different landscape areas of the Absheron Peninsula. According to the reckonings, the total areas of such soils arrange 20 thousand of hectares. The density of the soils layers, which polluted with oil are more than 2 metres in some areas. The most of the problems, which we touch upon their manifestation and

procreated sows, show itself at the republic scale. It is one of the most important problems for all humanity and for our country to put into practice the measures of the nature protection and to use the natural resources with in wise and rational form. It seems clearly that the duty of the ecology at the modern stage of the development is not only to learn the activity laws of the organism systems. The main duty consists of the finding rational form of the mutual link between the nature and society and grounding them.

Today the leading fundamental investigations at the sphere of the ecology were concentrated over the protection problems of the environment. So the ecology science entered the legal, economy, ethic, administrative regulating stage of these links from the learning the links between society and the nature as a logical result of the development.

The ecoethic coming up to the ecological problems spring up at the disturbing of the ethic basics at the "society-nature" relations. Both these problems and their way of the solution grouped in a different blocks at the conception of the Azerbaijan's ecoethic problems which we offered.

According to these conceptions, it is possible to divide the nature-society relation complexes into the three groups corresponding the character of the ecological problems and the direct and roundabout ways of their solution. The direct ecological problems of Azerbaijan and the way of their solution include to the first group. They are the followings.

- The protection of the forests and the problems of their restoration;
- The problem of the soils erosion and to arrange driving against the erosion;
- The degradation of the natural forage areas and the problems of their correct uses;
- The problems of the technical destroyed soils and their recultivation;
- The driving measures against the pollution of the soils with the radioactive nuclides;
- To drive the salinized and salined problems at the irrigated soils;
- The problems of using of mineral fertilizer.

The scientific and scientific-applied matters, which can help to the solution of the ecological problems, include to the second group. They consist of the followings:

- Organize the ecological monitoring over the soils in the areas.
- The composition of the ecological fertility passports of the soils.

**The problems associated with the ecological culture, ecological law, education and other matters, which has a roundabout impact for finding the solution of these ecological problems or help to them. They are the followings:**

- To form the ecological culture in the society;

- Problems associated with perfecting of the ecological criminal code and the ecological rights.
- Creating the Ecological Aids and Pension Fond;
- To found the ecological coordination center.

According to the ecoethic conception, it must be come up as a followings to the environment and its resources. The development of the country economics or concrete social-economical projects (enlarge the districts, land reclamation measures and etc.) must not change the natural ecological parameters of the natural complexes (natural-historic structure, hierarchic system, areal and biological productivity).

2. The way of the ecoethic solution of the ecological problems base to the same thesis.

a) Restoration works must be done according to the initial ecological parameters of the natural complexes and must service to its restoration as a protection measures. For example, during the forest planting or the restoration it must not be used the oak, pine or other plants and trees instead of the beech, or beech-horn, beam trees.

b) The restoration works and use of the resources in the next stages must be based to the most modern technologies.

For example, the salinized soils must be ensured with the progressive irrigation systems and perfect collector-drainage after the land reclamation. Restriction of the obstacles to the development of the country economics, must protect its interest, must give superiority to the nature protection and resource protection technologies and must give a solid reduction to the businesspersons who use these technologies. The ecological examination of the row material, prepared products, and the technologies bringing to the country must be strengthened and must be combined to the Europe standards.

3. The people who use the resources (farmers, forest men, fishermen) must own ecological knowledge at a necessary level, information about using of resources, ecological position of the environment must be supplied periodically to the community and enlightenment must be strong and the ecological knowledge must spread among the population.

4. The legislation system of the nature protection must be improved matching to the ecoethic demands, must be combined to the international laws, conventions, protocols and international obligations and must be published as a magazine forms.

5. The stage program of the ecological education must be prepared suitable to the level of the pre-school and the highest education and must be busy with the instructive and education of the youth.

One of the most important things at the ecoethic solution of the available ecological problems in our republic is to make the ecology education system and

the social, economic relations ecology and to form the ecological culture in Azerbaijan society. The deformation of the ecologic relation system is a source of the ecological crisis. The relation of the consumption to the nature is created from slackness of the ecological education. Therefore, the purpose of the ecological education must be to form the responsibility feeling to the relation of the nature to the people. The ecological education is difference from the ecologizing of the educational systems. Though they are in the mutual links, they characterize the different education process. The ecological education is mastered the direct different knowledge. It divides into two directions. The bringing up the general guarding of the environment and to get the special professional knowledge about the general objective laws of the natural and anthropogenic ecosystems.

The most important attributes of the ecological culture is penetrating of the ecological ideas, principles and approaches to the different sides of the economics. The deeply connection between the economics and the ecology was known after appearing negative influences for the health and economy of the people of the changed nature. The ecological crisis is a result of the traditional economical politics and the prime cost of the harvest was descended with the pollution of the environment.

But at the ecological economics, the purpose of the produce is definite with the ecological principles and with the safely labor condition for the human health. It does not let to be earning with exhausting the nature. To ecologise the economics arrests attention both the at main direction of the social production and to do changing at the character of consumption and the cultural level.

Today the most necessary conditions of the ecologising of the Azerbaijan economics are the followings.

- To give a form to the nature and the legal, economy, ethic and ecoethic parameters of their rational and natural use.
- To create the scientific-technical potentials and to enlarge scientific researches.
- To change the character of social production and to direct it to increase the last consumer harvest.
- To create the closed produce cycles, to down the produce garbage into minimum.

**The ordinary farmers and businesspersons defined the situation of the environment.**

Therefore, the creating of the new producing branches by the society accepting new economical politics which leaned to the all society's corporation at the reception of the decision about using of the alternative reserves are very important.



Therefore, as it seems from the presented material of the ecology is not only a science to get a necessary ability of the nature protection and is a part of the manner way of the thought and thinking of the cultural society.

The international image of any nation, any state and its cultural level began to measure with its relation of nature and natural resources at the time when the global thinking and civil relations were formed. So forming the ecoethic relations of the environment, natural ecosystems, also our subsoil and over soils reaches began to attain a big urgency.

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## **THE GIVEN WORLD: ENVIRONMENT AND LIFELONG LEARNING**

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I am happy to be among friends and feel privileged once again to have been given the chance to address this distinguished group of scientists from all over the world. I would like to extend my special thanks to my good friend and President of IAS H&E Professor Walter Kofler and through him to his colleagues, for their hard work in organizing this symposium and also say “happy birthday” to him on his 60th birthday. I would like to start by reminding what Sultan Suleiman the Magnificent, the ruler of the Ottoman Empire at the zenith of its power once said when he fell ill. “Nothing in this world is as precious as even one breath of health”.

### **INTRODUCTION**

I would like to start by quoting the motto of the symposium:

“To think is a pleasure by itself (By Galileo)

“to think for the future should be a pleasure for others too”

I suggest that “lifelong learning for a sustainable environment might be a lifelong pleasure” if scientists and educators take up the challenge.

Secondly I would like to point out that the general theme of the Conference - “extended view of our world” as a basis for understanding of a human person for a better understanding of health is particularly relevant to the topic on sustainable environment. The learning and action to achieve a sustainable environment is inevitably an effort to improve the conditions/ prevent the worsening of conditions for human health. Because what can be more healthy for humans than achieving a sustainable environment, which would strike a balance in the use of the environment and it’s renewal.

The central dilemma on environmental issues is the clash between pressures for rapid economic development/investment on one hand and the need

to protect the environment on the other. Pressures for economic development are driven by short term commercial-profit motive backed up by well organized business firms. Environmentalists are driven by concern for the environment and usually have longer term view. While the scene has been transformed much, the basic conflict between the two still remains. The overall challenge is to reconcile the two.

Much remains to be done however and we are far from having reached the “critical mass” of ideas and steps to ensure sustainability.

### **EDUCATION FOR SUSTAINABILITY**

The United Nations Conference on the Environment and Development (UNCED), held in Rio de Janeiro (June 1992) led to various education recommendations. It said “education is critical for promoting sustainable development.” The topics addressed in some chapters of *Agenda 21* drew up a platform upon which education in the future must be organized. *Agenda 21* peaks not only of the need for international cooperation, but also of the necessity of maintaining a global perspective while taking action and responsibility in the context of local communities. This proposal came to be used by people as “think globally but act locally” /1/.

It must be emphasised however that the broad scope of the Conference posed a problem and in 1996 the Commission on sustainable development initiated a special program on education which was instrumental in establishing priorities and focussing efforts. Since then major steps have been taken in advancing the new vision of education.

### **FROM EDUCATION TO LIFE LONG LEARNING FOR SUSTAINABLE ENVIRONMENT**

In recent years increased public attention, involvement of professional organizations and intensified activities by non-governmental organizations as well as impetus provided by the Earth Summits internationally are catalyzing increased public attention to education for sustainability and more recently to lifelong learning for sustainability /2/.

The phrase "lifelong learning" is used here as an umbrella term that bridges formal and non-formal education. It is employed in this broad sense to emphasize the integrated nature of all education, throughout one's life. All forms of formal and non-formal education are part of the process of lifelong learning /3/.

The potential for learning about sustainability of environment throughout one's life exists both within formal and non-formal educational settings. But increasingly lifelong learning is acquiring major importance

a) as human beings constantly need to update their knowledge and know-how to keep up with changes

b) Research shows that human learning is a complex process which involves learning throughout ones lifetime a lot of it outside formal schooling and in daily life

- Maybe we have already reached the point described by futurologist Alvin Toffler:

**“The illiterate of the year 2000 will not be the individual who can not read and write, but the one who can not learn, unlearn and relearn.”**

-Why lifelong learning is necessary?

**“A critical point is reached when information and technology become obsolete faster than the approximately 20-year time frame in which the leadership of one generation is taken over by the next one.”** (Abraham Pais, 1997)

A general metaphor on the role of life-long learning might be useful here: Individuals in a community or the wider world are like the individual cells of the brain which may stimulate the thinking process. While each may not alone shape the thinking of the whole, if enough individuals (cells ) can be mobilized to think and act in the same direction , the thinking process of the brain as a whole, which transmits instructions for the hands, legs and the body as a whole will be influenced.

Scientific communities are like the nerve centres- or the power stations- which can constantly inform, motivate and encourage the brain cells to act in a well informed way. This is their challenge. If this challenge is met, individuals through continuous learning and organized/collective action tied to each other nationally and internationally can make a major difference. As an English saying goes “You take care of the pennies and the pounds will take care of themselves”

#### **CHALLENGES AHEAD: WHAT ROLE FOR THE SCIENTISTS?**

Clearly educators/scientists face a compelling responsibility to serve society by bringing about the transformations needed to set us on the path to sustainable development. The time has come to ensure that the concepts of learning for sustainability -- in the broadest sense -- are discussed and formed into a framework upon which current and future educational and the wider teaching/learning policy could be based.

To achieve the kind of public awareness necessary, infusing the concepts of sustainability throughout learning experiences is necessary. Involvement of all

the actors -educators, government, businesses, and nongovernmental organizations working toward common goals- will lead to an understanding of multiple perspectives and informed decision-making needed on environmental issues (3).

### **I.The need for developing inter-disciplinary perspectives**

Environmental issues by its very nature traverse studies of the natural sciences (biology, earth sciences), social studies (anthropology, geography, economics and history), and the humanities (the arts, philosophy ethics, and literature).

Learning about sustainability in the final analysis necessitates breaking down the walls between disciplines, perhaps by focusing on a single real-world issue addressed from various perspectives. To support this kind of experience, existing education standards need to be revisited to embrace the major elements of sustainability.

For example, education for sustainability will prepare policymakers for merging economics and the natural sciences with other disciplines when developing environmental policy.

Equally important, interdisciplinary approaches should be encouraged as part of non-formal educational experiences. "Non-formal education" is used by educators to indicate those forms of learning acquired in informal contexts, such as the media, workplaces, and community activities. All learners-- both children and adults-- need to see the connections among discrete bits of knowledge gained on a daily basis if they are to respond to the challenges posed by sustainability.

### **II. Systemic thinking**

There is a general agreement among the educators that the first goal of learning is to impart knowledge and the second is to teach skills such as problem solving, conflict resolution, consensus building, information management, interpersonal expression, and critical and creative thinking. Education encompassing the concepts of sustainability offers an exemplary vehicle for developing and exercising many of these skills which are increasingly being sought by employers. Increasingly, these are the skills that employers are seeking in a world of complex problems requiring integrative solutions.

The importance of systems thinking cannot be ignored. Any concept-- including sustainability-- should be open to informed debate and sustainable development should not be taught as an ideology or as a goal, but rather as an ongoing process: not as a set of irrevocable answers, but as a way of continually asking better questions.

### **III. Expanding partnerships**

In addition to bridging disciplines and developing interdisciplinary approaches, education for sustainability will mean reaching beyond schools to involve businesses and individuals with specialized expertise throughout the community. It is now the responsibility of the public and private sectors, communities, businesses, and individual citizens worldwide to learn about economic and social development as well as the built environment and natural resources. Partnerships among governments, educational institutions (from K-12 schools to community colleges and universities), industries, nongovernmental organizations, and community groups are increasingly important /4/.

Increasingly, businesses require a workforce that is both environmentally literate and skilled in interdisciplinary systems approaches to solving problems. Therefore involving the private sector with education and training more and more is quite useful and should be widely encouraged.

Governments can support educational activities in the public and private sectors and build intergovernmental alliances to advance lifelong learning and training by supporting educational activities. Educational institutions should seek ways to collaborate with nongovernmental organizations and industry to advance common objectives on sustainability /5/.

### **IV. Making Educational Material Relevant To People**

To be effective in reaching people across the country and around the world with a message that is relevant and meaningful, education for sustainability must include an appreciation of diverse geographical locations, cultural perspectives and other such factors.

This requires that the content of educational materials reflect divergent cultural or local approaches to sustainability. Educational materials and programs should be made accessible to all interested communities.

Furthermore, educational programs should be rooted in the actual experiences of people in their own communities. These programs should not assume a common understanding of sustainability's political and social context.

### **V. Empowerment**

All of the above challenges- Lifelong learning, interdisciplinary approaches, systems thinking, partnerships, and relevant education/ learning- in the final analysis empower individuals and institutions to contribute to sustainability.

Education is generally agreed to be the most effective way to impart knowledge and skills that can be applied outside the classroom in everyday life. The objective is the informed citizens who are prepared to participate responsibly in a sustainable society.

Students can be empowered by giving their voice to new ideas and through action, such as voluntary community service, which is, by itself, an educational tool.

Non-formal education programs also provide good opportunities for learners to act individually and collectively by providing the knowledge and skills necessary to evaluate and discuss complex issues.

Sharing experiences about successful actions that are engendered by education for sustainability in its formal and non-formal modes will accelerate the transition to sustainability. Information about existing models of sustainability can be disseminated through the media, multimedia technologies, information clearinghouses, and other means, both nationally and internationally.

### **TRANSFORMATIONS VERSUS OBSTACLES AND INTERESTS**

While setting out the above challenges, the difficulties should not be underestimated. Maybe stating few of them here briefly might help us to get a balanced view. There are major interests involved in and obstacles in the way of transforming the societies along this path. For example developing interdisciplinary approaches will face the difficulty as it may be difficult to breakdown the frontiers between academic disciplines. It is a slow process at times. Equally education is under-financed in many parts of the world and may find such restructuring not easy to do. It is worth noting that while formal education systems are hard to change, informal education- lifelong education might more quickly adopt new concepts and methods.

The best example to show the difficulties in pursuing global policies for sustainability is the refusal of the US to sign the Kyoto Protocol on Gas emissions. Despite major steps taken internationally to reduce pollution, develop sustainable environment and pursue global policies, the world sees that because of the huge interests involved in maintaining the status quo rather than take expensive steps to reduce gas emissions, the Us alone refuses to sign the protocol /6/.

This by the way brings us to the central question I mentioned between economy and ecology, between profit versus environment discussed in the introduction section

## **NEAR EAST UNIVERSITY AND LIFE-LONG LEARNING**

Our small country, the Turkish Republic of Northern Cyprus is a good example to show how sustainable environment is critical for the future of people and countries. The country is small with a population of 200 000 and has no natural underground resources. It's most precious asset is it's beautiful and clean environment – beaches, mountains, plains and Mediterranean climate. - It's largest sector is tourism which is also the biggest foreign exchange earner.

Firstly as a small country we have a shorter time within which to take steps to formulate environmentally sustainable policies. Because rapid economic development - particularly in the tourism sector- if not carefully planned within the framework of sustainable environmental policies, might bring about the loss of our environment. Beaches, mountains, scarce water resources might all be overexploited and polluted within a relatively short period compared to much larger countries with less suitable climates.

At this point I would like to say a few words about the efforts of the Near East University which I work for. In view of the critical importance of the sustainable environment and lifelong learning, the University has taken a lead in setting up a lifelong learning centre to help the community. By the time you visit our University in 2007 for the international conference on “Environment and Water: for Survival”, this centre will be a well developed centre providing opportunity for learning for individuals and organizations locally, nationally and hopefully internationally.

### **CONCLUDING COMMENTS**

- The fundamental question needs to be restated to establish the general perspective. Environmental problems arise in general due to a clash between the activities of the commercial profit motivated firms and the environmentalists driven by longer term perspective to preserve the environment.
- There is a general acceptance of the critical role for the education in increasing the public awareness of the need for environmental sustainability
- Over the years however the need to broaden the concept of education increased to include the formal as well as non-formal education. The process of learning is complex and continues throughout one's life. The new term is indeed called life-long learning to stress the continuation of the learning process for the individual until death.
- Lifelong learning for environmental sustainability is now seen as the main vehicle to increase public awareness of sustainability. Scientists face a particularly strong challenge in setting the stage for sustainability.



- Yet there are difficulties however as there are major interests and other technical obstacles involved in meeting the challenge

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## **A COMPLEX SCIENTIFIC APPROACH TO THE PROBLEMS OF PREVENTION AND ELIMINATION OF EMERGENCY SITUATIONS**

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Emergency situations (ES) have become the attribute of today. According to different estimates, the disasters that occurred in the world in the last decade killed 750 thousand to 3 million people, and 2 billion 110 million people suffered from injuries and property damage. It is difficult to estimate the scale of damage done by ES. According to the reports of leading world insurance organizations, the cost of catastrophes in the past 40 years increased by 14 times. At the same time, the real economical “cost” of catastrophes remains unknown due to a number of reasons.

Solution of the problems connected with prevention and elimination of technogenic and natural ES is becoming one of the most important directions in the activity aimed at ensuring national security, defense capacity and sustainable development of the Azerbaijan Republic. Nowadays, the criterion factors which influence creation, development, elimination and aftermath liquidation of ES in the Republic are:

- degradation of the environment which triggers intensification of dangerous natural processes. Meantime, it should be taken into account, that 36% of the republic’s territory is covered with forests, and 20% - with peatbogs;
- powerful industry which presents a potential threat to people, animals and vegetative world. Fifty industrial sites which use in production and store more than 20 kinds of virulent poisonous substances are operated;
- avalanche-like creation and wide introduction of new technologies, synthesis of a large number of substances and, correspondingly, an increase in application of explosive, fire-prone and chemically dangerous substances and technologies;
- location of potentially dangerous and harmful production facilities close

to inhabited territories and life support systems. More than 1 million people live directly in the area of probable initial contamination in case of ES;

- inadequate training of the population and specialists in the field of safe life activity; consequently, 98% of occurring ES are of anthropogenic origin and character;

- continuing inadmissible deterioration of technological equipment, transport facilities and main productions funds;

- absence or insufficiency of K-10 and low capabilities of the equipment which is used to detect and control dangerous and harmful factors; absence or insufficiency of the means of collective and individual protection from these factors;

- deficiency of financial and material resources, inability to adequately finance struggle against ES;

- low reliability of safety securing systems in industry, transport, energy production and agriculture, as well as low reliability of management systems, information communication systems and population notification systems;

- deficiency and, very often, complete absence of modern technical means and facilities needed for wrecking and survival work;

- absence of objective scientific data on parameters and safety requirements of new inventions, without which application of obtained results may trigger and triggers emergence of threat to people and considerable social-economical damage;

- insufficient level, or sometimes, complete absence of fundamental and applied research in the field of ensuring safe life activity and systemic complex work aimed at solving the problems of protection from ES;

- almost absence of scientific schools and insufficient number of qualified specialists trained in prevention and elimination of ES.

Of course, all the above-mentioned also determines the character of scientific provision and the directions and priorities in conducting research.

The fact that the problem can be solved only by means of science is apparent and does not require proving. It should be noted that the issue of securing safe vital activity as a subject of scientific research touches upon many spheres of knowledge and may be investigated by means of applying the research methods and achievements of physics, chemistry, philosophy, economics, pedagogic, culture science, informatics, psychology, medicine and many other sciences. At the same time, it is apparent that it is time to elaborate a specialized branch of science which would address the issues of preventing and eliminating ES of natural and technogenic character. Such a science would not only integrate all the existing knowledge and elaborate its own methodological base, but also ensure working out and theoretical schematization of new objective conceptions about reality.

Major work should be carried out in the Republic in order to work out and implement a single state scientific-technical policy in the field of preventing and eliminating ES of technogenic and natural character:

- scientific ensuring of safe vital activity should be defined as the priority direction of development in domestic science;
- state scientific-technical programmes on “Emergency situations” planned for 2005-2010 should be implemented;
- a complex prognosis of scientific-technical progress for the Ministry of emergency situations should be prepared;
- a scientific-research institute on safety and emergency situation related problems, as well as a scientific-technical Council of the Ministry of emergency situations should be created;
- an interdepartmental scientific-research and “safe vital activity” center of the Ministry of emergency situations should be created.

Apart from that, we have to solve a number of problems in the field scientific ensuring of ES prevention and elimination.

It is important to achieve realization of operative measures carried out in view of the changing social-economical conditions, as well as to ensure actualization and legislative backing for the effective, optimal and scientifically-founded measures, activities, normative indicators and criteria which should replace the currently effective laws and regulations adopted on basis of empirical conclusions, subjective notions and administrative decisions.

There are interrelated and integrated social, economical, scientific, legal, organizational-technical and other components in the activity aimed at ensuring safety and these components altogether acquire the qualities of a new integrity and demand creation of a specialized branch of law - legislature on safety and security.

Security legislature must form legal conditions for responsibility and interest which would urge all subjects of social life to ensure technically possible and economically expedient level of protectability.

Elaboration of scientific-practical commentaries to the laws “On fire safety”, “On Civil Defense”, “On population’s radiation security” and “On industrial safety of dangerous production facilities” of the Azerbaijan Republic should be the first step towards scientific research and creation of legal-foundation and legislature on safety (security).

One of the acute problems and tasks is creation of a complex of economical measures which admit only such expenses on the security system that would guarantee return of additional expenditure through reducing the scale of damage from ES.

It is relevant to hold investigations on economical estimation of the consequences of fire, industrial accidents, natural, natural-technogenic and

transport catastrophes. Elaboration of such methodology will allow to work out a strategy of preventing and eliminating catastrophes in view of the suffered damage and its minimization. The latter will, in its turn, promote creation of economical basis for expertise of projects, elaboration of economically-grounded requirements to potentially dangerous technologies, and elaboration of economical norms and standards for safety of life activity.

It is necessary to carry out scientific research aimed at revealing and studying threats and dangers, and risk problems. A special system must be created to provide operative and authentic estimation of the ES risk and forecasting of possible damage. As a result, the state and interested organizations will be able to objectively approach the task of estimating the risk of emergency situations and to elaborate all necessary counter-measures, inferring from the estimation results.

One of the ways to solve the mentioned problem is to introduce mandatory insurance of civil responsibility of potentially dangerous objects in the Republic. This measure will not only allow to create conditions necessary to make the industrial facilities compensate the damage caused to the citizens, but also will become a factor of economical stimulation of security strengthening.

In order to provide an educational basis for ensuring safety of life activity, it is necessary to elaborate and implement an entire complex of measures, that is, an organizational-pedagogical system. Its main components would be:

- continuous training of the population in prevention and protection from ES of natural and technogenic character (two blocks – general civil and professional); the result of such training would be preparedness for safe life activity, i.e. educational preparedness of an individual for performing reliable actions aimed at ensuring security of personal and social life activity;
- training of specialists of wrecking (survival) services and achievement of special professional preparedness which would provide the specialist's reliable, fast and optimal performance of the functions aimed at eliminating and preventing ES.

High effectiveness without application of additional resources and even with economy of available resources can be achieved through solution of organizational-managerial problems. Solution of such problems implies scientific substantiation of ways to optimize the structure, quantity and functions of subdivisions in the Ministry of Emergency Situations (MES) and to optimize the means and facilities of the state system for preventing and eliminating ES. It is necessary to scientifically plan the creation of an information-management system of MES and a system of complex monitoring and forecasting of ES; as well as centralization of control over the systems of industrial and fire safety; elaboration of effective technologies, ways and methods of carrying out coordinating activities, control and inspection activities, supervision and prophylaxis activities and operative-technical activities; ensuring of fast response to ES, decision-

making and realization of correct decisions. It is required to create automated information-analyzing bases.

It is necessary to expand invention of modern technical and chemical means of localizing and eliminating the consequences of ES. This implies creation of new means used for eliminating accidents involving oil, oil products and microbiological preparations, and means which help to purify soil and water basins polluted with hydrocarbons. Among such means are fire-extinguishing facilities which help to extinguish fire caused by inflammation of oil and oil products. They are invented on basis of fluorinated surface-active substances which produce a special layer on top of hydrocarbons, stop evaporation of liquid hydrocarbons and not only extinguish the flame, but also protect the fuel from repeated inflammation.

The fire-fighting technical facilities and robotized equipment must help to apply telemetry in struggle against ES, must process the information about dangerous materials from a distance and control the environment. The helmet will be equipped with a video-camera and will have lighting facilities; heat will be measured and displayed on a standard small-scale monitor; lazer devices will work within appropriate range with diagnostic tools. Textile and technology of protective military clothing must substantially influence provision of the rescuers' safety.

In future, when artificial intelligence is formed, it is necessary to invent the robotized equipment's ability to automatically differentiate between the types of incidents.

At this point of society's development, the science becomes an irreplaceable basis for securing safety of life activity. This conclusion finds its proof in the practice of numerous catastrophic emergency situations both in our country and abroad.

Nowadays, ensuring of safety demands creation of not only technologies, methods and means of protecting the population from various threats, but also a social-economical mechanism. From this point of view, the problem of society's safety must be considered in close interrelation with the problem to its transition to sustainable development.

Today it has become evident that it is impossible to protect the mankind from upcoming catastrophes without changing the existing trends of society's development. Nowadays we are witnessing the situation when the dominating type of social development substantially multiplies various threats. As a result, prevention of dangers and protection from them turn out to be less and less effective; certain features that can no longer be considered progressive appear along with problems resolution of which is the necessary condition for people's survival.

It is necessary to scientifically provide safety of life activity which is the

priority direction in the development of domestic science.

Research conducted by foreign and domestic scientists ensured acquisition of modern scientific-technical products.

At the same time, the topical question of today is “how to organize sufficiently high quality protection of people and industrial production from dangerous technogenic damaging factors despite the deficiency of economical, financial and material means”. “What needs to be done in the first place?”

Here we face the task of coming up with a principally new approach to the solution of the problem of protecting the population and territory from emergency situations.

Reduction of overall technogenic and natural risk and the peculiarities of work in conditions of emergency situations give rise to a large number of problems of fundamental and applied character, and demand creation of an effective system for working out, planning and operatively managing corporate complexes of activities aimed at preventing and eliminating emergency situations.

Absence of a scientifically substantiated methodology for complex analysis and economical evaluation of ES consequences is the reason for insufficient economical justification of the made decisions and fulfilled activities, and in some cases it is the reason for their complete ineffectiveness. Elaboration of such methodology will allow substantiation of a strategy for prevention and elimination of catastrophes “in view of the suffered damage and its minimization”. Such a strategy will, in its turn, promote creation of economical basis for expertise of projects, elaboration of economically justified requirements towards potentially dangerous technologies, and elaboration of economical norms and standards of safe life activity.

In order to prevent death of people and to minimize the social-economical damage suffered from emergency situations of natural and technogenic character, the Ministry of Emergency Situations of the Azerbaijan Republic must implement a single state policy in this field with the following priority directions:

- creation of an effective state “system of preventing and eliminating emergency situations”;
- forming of financial-economical mechanisms designed for increasing the level of safety and protectability of people and production facilities from the consequences of emergency situations, and for stimulating the activity at macro- and micro- levels;
- educational ensuring of safe life activity;
- innovational, scientific ensuring of creation of modern technical and chemical means used to localize and eliminate the consequences of ES, and to carry out radiation control; as well as creation of hardware-and-software packages for ensuring operative response to ES;
- medical rehabilitation of persons exposed to the conditions of physical

and psycho-emotional overloads during emergency situations.

Realization of activities in the field of preventing and eliminating emergency situations will let us achieve the following:

- ensuring of sustainable economical growth mainly through considerable reduction of economical expenditures on prevention and elimination of ES and their consequences;
- optimization of social expenditures on provision of technogenic and fire safety through increasing effectiveness of their application;
- decreasing of technogenic and fire danger, as well as guaranteed exclusion of catastrophic social-economical and ecological consequences of emergency situations;
- creation of new effective domestic methods, ways and means of preventing emergency situations, conducting wrecking and fire-fighting activities;
- replacement of foreign imported means of preventing and eliminating ES with new domestically produced ones;
- creation of new jobs and an increase in population employment through introduction and application of elaborated technologies at the production facilities of the Azerbaijan Republic.

The system of activities aimed at prevention and elimination of ES in the Azerbaijan Republic must provide formation of new quality and new level of social culture which will help not only to protect ourselves from ES, but also to harmonically interact with the natural and artificial environment.

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## METHODS OF CONSTRUCTION APPROXIMATIVE DYNAMIC MODELS OF DEFORMATION OF AN EARTH'S CRUST

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The theory and a technique of construction of contiguous models of modern deformation of an earth's crust predicting time has been offered. Modelling is based on the whole complex of data of geodynamic modelling. It is offered to use the direct and indirect data on geodynamic monitoring when determining kinematic parameters of model, and peak parameters to calculate exclusively on direct data of the modern geodetic monitoring. The family of flat deformation fronts is used as the basis for the approximating design. In order to calculate free parameters of the model it is offered to use the two-phase method that is based on decomposition of a problem with respect to the inverse kinematic problem and inverse problem on peak parameters.

The system of the equilibrium equations which connect pressure and deformations in an any point of geological environment /1,8,9/ is used for studying development of process of deformation:

$$\begin{aligned} \frac{\partial \sigma_x}{\partial x} + \frac{\partial \tau_{xy}}{\partial y} + \frac{\partial \tau_{xz}}{\partial z} + \rho X &= \rho \frac{\partial^2 u}{\partial t^2} \\ \frac{\partial \tau_{xy}}{\partial x} + \frac{\partial \sigma_y}{\partial y} + \frac{\partial \tau_{yz}}{\partial z} + \rho Y &= \rho \frac{\partial^2 v}{\partial t^2} \\ \frac{\partial \tau_{xz}}{\partial x} + \frac{\partial \tau_{yz}}{\partial y} + \frac{\partial \sigma_z}{\partial z} + \rho Z &= \rho \frac{\partial^2 w}{\partial t^2} \end{aligned} \quad (1)$$

Here  $u, v, w$  – are components of the vector of deformation displacement,  $X, Y, Z$  – are components of the vector of volumetric specific forces which cause deformation,  $\sigma_x, \sigma_y, \sigma_z, \tau_{xy}, \tau_{xz}, \tau_{yz}$  – are normal and tangents components of the

pressure tensor,  $\rho^-$  is the density of environment,  $t^-$  is the time. For the equations of type (1), which exclude pressure because of their connection with deformations through physic and mechanical properties, some boundary problem can be revealed and solved further. Result of solving of such boundary problem will be the elements of the deformation displacement calculated for the various moments of time in terms of the set area of the studied environment. Generally, such approach to the problem can be treated as solving the direct problem on the deformation process on the basis of the known power influences and elastic (rheological) properties of the studied environment. Problems of heterogeneity and variability of pressure because of various and badly known as whole in space and in time, power influences on the environment create the basic difficulties in setting and solving of the tasks on the boundary problems on the basis of the equations (1). It is possible to try to study the deformation process by another way, not as some boundary problem on the environment of certain rheology and the set system of operating forces, but on the basis of any formal mathematical approximations, in which the influence of numerous uncertain values will be considered by means of free parameters of an approximating design. Such models are called usually as the phenomenological models. Certainly, the selection of the class of formal approximations shall not be at random, it should be based on preliminary studying of structure of experimental data and some general representations about the physicist of the phenomenon. Definition of free parameters of an approximating design is carried out on the basis of defining and the decision of a corresponding inverse problem which as a result is reduced to the optimization problem. Such principle of modelling is also used in the present work.

The basic problem in construction of dynamic models through any methods is the problem on correct information on or full supervision over the studied process. In geological sciences full supervision over process is practically not applied. Therefore, one always is to operate on the basis of the partial supervision. For the partial supervision creation of dynamic models on the basis of approximations is even more important, as such models allow not only to restore and understand the phenomena but also to reveal lack of experimental supervision in the process of their creation. The general view on the method of creation approximative 4D-models or models which represent functions of four variables  $(x, y, z, t)$ , is that some function  $F(\vec{p}, x, y, z, t)$  is introduced for consideration on the basis of the previous experience or existing hypotheses. In this function the vector  $\vec{p}$  is understood as set of parameters which describe the studied process and part of which is unknown to us. The  $F$  function or functional is unknown generally. A priori it is supposed, that the introduced  $F$  functional is adequate to the natural phenomenon. It is understood also, that on the basis of alternative

consideration of models of  $F$  different types it is possible to prepare the most adequate description of the studied natural phenomenon. On the basis of partial selection of  $\{F_i, i = \overline{1, n}\}$  supervision the inverse problem is posed, i.e. the problem on restoration of  $\vec{P}$  an unknown vector. Such approach is, actually, the general method on empirical search and formalization of natural laws /18/.

Methods of approximation of multivariate processes are complex enough, technically. Until recently, the quantity of free parameters, which were results of some inverse problems solution, did not exceed several hundreds. Now, after the description of complex natural processes the quantity of free parameters of model can reach many thousand. Already, this allows for an approach of the good accuracy complex instrumental supervision. For the substantiated determination of an optimum class of approximating functions it is necessary to consider a number of the complex phenomena, which were studied in various sections of physics and mathematics during the last century from the different points of view. These phenomena concern various sections of nonlinear interaction of mechanical, hydrodynamical, electric and other systems. The main thing in a question on studying of such phenomena has been finding-out of the mechanism for formation and spatial motion of individual waves or solitons, deformation dispositions and their electromagnetic analogues.

The Review of the nonlinear wave equations - /2-7, 10,11, 12-16/, the phenomena describing a wide class including many aspects of dynamics of deformation processes have allowed to receive analytical decisions of the various wave equations and to establish existence of the specific localized dynamic objects; to investigate a problem of stability of lonely waves, to receive concrete models of interaction for their some aggregate (for example, three solitons). It is considered, that complex multivariate problems of the given class can be investigated effectively, basically numerically at present time. We shall emphasize following problems met in this way, which arise in applied geodynamic modelling:

- Dimension of a problem of  $(x, y, z, t)$  according to the present modest grid of digitization  $1000 \times 1000 \times 1000 \times N$  makes  $N \times 10^6$ ;
- The Isolated points  $u(x, y, z, t)$  of deformation and indirect supervision are to be preliminary in some way adjusted to the set computational grid for maintenance regional and entry conditions. In terms of the designated digitization and actual rare networks of monitoring, an error of adjustment for such regions as Kazakhstan and Urals Mountains can make 20 km on spatial variables and half a year or a year as to the time. As such an accuracy, especially with respect to

the time is absolutely unacceptable, it is needed to introduce even more dense grids. This, will at once solve a problem of practical realizability ( $N \times (10^7 \div 10^8)$  dimension);

- Convergence for multivariate problems practically with respect to all numerical schemes of the account is not proved. For a substantiation and research of conditions on convergence of the numerical scheme it is required to construct complex enough test problems;
- The quantity of solutions taking part in solution of real problems or the deformation fronts of created model is not known in advance.

The listed problems, that seem in many respects insuperable today, also, compel us to consider essential simplifications of the process of creation approximative decisions of 4D-models of process of modern deformation of an earth's crust of a region.

If there is a defect ("hole") in crystal structure of a firm body, the atoms around of defect are displaced. Such total defect is called Frenkel-Kantorova disposition. The disposition of the other object can occur because of appearance of additional (superfluous) atom in crystal structure. It is shown [20], that the disposition, which size considerably exceeds a step of the lattice, can freely move on a crystal. The function describing the moving disposition can be presented according to Frenkel-Kantorova disposition in an one-dimensional case by formulas:

$$\begin{aligned} \varphi(t, x) &= \pi - 4 \operatorname{arctg} [e^{-(t-x/v)/l_v}] , \\ \varphi'(t, x) &= \frac{-(t-x/v)/l_v}{e^{-(t-x/v)/l_v} + e^{(t-x/v)/l_v}} , \end{aligned} \quad (2)$$

Where  $v$  - speed of displacement,  $l_v$  – half-width of dispositions, which depends on the speed of movement  $v$ ;  $\varphi(t, x)$  - an angular measure of displacement of the disposition from position of balance  $l_v = l_0 \sqrt{1 - v^2 / v_0^2}$ ;  $V_0$  - speed of a sound in the crystal environment. Idealization of an earth's crust as a liquid, results in similar formulas. For the liquid environment many authors, starting from Rassela D.S., in connection with other problems considered the various differential equations of movement, including the so-called “КДФ”-equation /6/ from which the Russell’s soliton, or “КДФ”-soliton follow:

$$\left. \frac{\partial y}{\partial t} \right|_{x=x_0} = v_0 \left( y + \frac{3}{4h} y^2 + \frac{h^2}{6} \cdot \left. \frac{\partial^2 y}{\partial x^2} \right|_{t=t_0} \right) \quad (3)$$

Where  $h$  - depth of a reservoir:  $V_0 = \sqrt{gh}$

Soliton of Russell or the soliton are described by the exact solution of the “KdΦ”-equation /7/

$$y(t, x) = y_0 / ch^2 \left( \frac{x - vt}{l} \right) \quad (4)$$

Let's transform this formula to more habitual appearance it is contained in geophysical appendices, expressing hyperbolic cosine through indexes

$$y(t, x) = \frac{4y_0}{\left[ e^{\frac{x-vt}{l}} + e^{-\frac{x-vt}{l}} \right]^2} \quad (5)$$

If one to compare the structure of soliton formulas according to Russell (KdΦ) and Frenkel-Kantorova it is easy to see, that they are the same. Thus, idealization of object "elastic/liquid" leads to formally identical results for the deformation processes described by the mobile dispositions of the crystal environment or soliton functions for the liquid environment.

The reduction of deformation of an earth's crust to a case of dispositions of the lattice assumes, that the certain blocks of an earth's crust can elastically be displaced as to each other due to tectonic dissociation and cleat. Tectonic disturbances and cracks play a role of "atoms" in a disposition. Relative displacement of up to 10-100 mm for distance of 10-20 km and furthermore for the greater distances, can be seen from the systems of cracks and disturbances. Such displacements give picture of relative deformations of 10<sup>-6</sup>-10<sup>-5</sup>, that is quite comparable to a real experimental picture. We shall consider simplification of formulas (2-5) in terms of decomposition of indexes according to the power series:

$$\varphi'(t, x) = \frac{-(t-x/v)/l_v}{e^{-(t-x/v)/l_v} + e^{(t-x/v)/l_v}} =$$

$$\left| \begin{array}{l} \text{обозначая } (t-x/v)/l_v = z, \\ \text{и заменяя экспоненты рядами, получим} \end{array} \right.$$

$$= \frac{-z}{1 + \frac{z}{1!} + \frac{z^2}{2!} + \dots + 1 - \frac{z}{1!} + \frac{z^2}{2!} + \dots} \cong \frac{-z}{2 + 2\frac{z^2}{2!} + 2\frac{z^4}{4!} + \dots}$$

$$\varphi'(t, x) \approx \frac{l_v}{2} \cdot \frac{-(t-x/v)}{l_v^2 + (t-x/v)^2 + \dots}$$

(6)

Drawing above: bottom-up 1) identifying; 2) and changing the indexes by the lines of

This asymptotic formula and its names coincides with formulas of deformation dynamic displacement which are used in the given work, and have been received /17/ on the basis of simple heuristic reasons, without taking into account of the corresponding differential equation on a deformation disposition movement. Simplification of the Russell-Frenkel-Kantorova classic formula consists in decomposition of the exponential member in a denominator in power series and rejection of members of the fourth power. These members decrease themselves and, besides factorially. The consequence of such a replacement is that in the simplified formulas deformation displacement will decrease depending on a distance a little bit more slowly. Considering the further problems of the solution of the inverse problems, rather short experimental lines, errors of instrumental supervision, etc., it is possible to admit, that such simplification is not principal. For fixing of distinctions under the classical soliton theory we shall everywhere below in the text, where simplifications are of principal value use the terms of «dynamic deformative front», «deformative front» or simply "front", instead of «deformative soliton».

Transition to dimension of bidimensional and three-dimensional space has been investigated by various authors for a long time. Kadomtsev and Petriashvily first discovered analytical decisions in the form of bidimensional solitons, and then such real objects were found in the nature /15/, for example, in the water environment. However, full clearness has not been achieved with respect to a three-dimensional space till now, as it has already been mentioned, the analytical decisions in this case has not been constructed yet. For this reason, application of

classes of approximation of type (4-6) for the three-dimensional case is quite justifiable in present, though it is, strictly speaking, clearly phenomenological.

Summarizing the above, we come to a conclusion, that potential function of elastic deformation of dynamic model of family of flat deformative fronts in the boundless environment can be defined as the simple additive sum

$$E(x, y, z, t) = \sum_{i=1}^n m_i \frac{1}{q_i} \quad (7)$$

Here and below the following names are used:

$$\left. \begin{aligned} q_i &= (p_i^2 + \varepsilon) \\ p_i &= (y - a_i x - b_i z - c_i t - d_i) \\ Q_i &= \frac{(q_i - 4p_i^2)}{q_i^3} \end{aligned} \right\} , \quad (8)$$

Where  $(x, y, z, t)$  are the cartesian coordinates and time;  $(a, b, c, d)$  are kinematic parameters of model;  $2e$  is the effective thickness of deformation fronts;  $m_i$  is the peak or power characteristics of model,  $n$  is the number of deformation fronts.

Here it is necessary to note, that in case of half-space instead of distance of  $P_i$  it is necessary to use in calculations the minimal distance to the axial plane deformative soliton. The finding of this distance in terms of the «surface to air» level is made according to the known formulas of analytical geometry, however if the relief application is applied the special computing subroutine is required.

Participating elements (components) of deformative displacement of family of dynamic fronts are defined according to (6-8) formulars:

$$E_x(x, y, z, t) = \frac{\partial E}{\partial x} = \sum_{i=1}^n m_i \frac{-a_i p_i}{q^2} , \quad (9)$$

$$E_y(x, y, z, t) = \frac{\partial E}{\partial y} = \sum_{i=1}^n m_i \frac{1}{q^2} , \quad (10)$$

$$E_z(x, y, z, t) = \frac{\partial E}{\partial z} = \sum_{i=1}^n m_i \frac{-b_i p_i}{q^2} , \quad (11)$$

$$E_l(x, y, z, t) = \frac{\partial E}{\partial l} = \sum_{i=1}^n m_i \frac{-a_i p_i \cos(\alpha) + \cos(\beta) - b_i p_i \cos(\gamma)}{q_i^2} \quad (12)$$

In the formula (12)  $l$  is an any direction, with directing corners (a,b, g). It follows from (9-11) that the components of speed of deformations can be presented in the form of

$$\left. \begin{aligned} E_{xt}(x, y, z, t) &= \frac{\partial E_x}{\partial t} = \sum_{i=1}^n m_i a_i c_i Q_i \\ E_{yt}(x, y, z, t) &= \frac{\partial E_y}{\partial t} = \sum_{i=1}^n m_i \frac{4p}{q^3} \\ E_{zt}(x, y, z, t) &= \frac{\partial E_z}{\partial t} = \sum_{i=1}^n m_i b_i c_i Q_i \end{aligned} \right\}, \quad (13)$$

Change of distance between two points  $A_1(x_1, y_1, z_1)$  and  $A_2(x_2, y_2, z_2)$  as it follows from (12), is expressed in the formula

$$dR_{12}(x, y, z, t) = \sum_{i=1}^n m_i \int_{A_1}^{A_2} E_{l_{12}} dl_{12}, \quad (14)$$

And inclinations of a daylight surface proceed from (9-12), formulas

$$\left. \begin{aligned} \varphi_{xz}(x, y, z, t) &= \arctg\left(\frac{\partial E_z / \partial x}{\partial E_z / \partial z}\right) = \arctg\left(\frac{\sum_{i=1}^n m_i a_i b_i Q_i}{\sum_{i=1}^n m_i 2b_i^2 Q_i}\right) \\ \varphi_{yz}(x, y, z, t) &= \arctg\left(\frac{\partial E_z / \partial y}{\partial E_z / \partial z}\right) = \arctg\left(\frac{\sum_{i=1}^n m_i (-b_i) Q_i}{\sum_{i=1}^n m_i 2b_i^2 Q_i}\right) \end{aligned} \right\} \quad (15)$$



The formula (7-15) resulted from above approximately describe all instrumental methods of monitoring of deformations that are known now and that are below the formal basis for statement of inverse problems in creation of the dynamic model of family of deformative fronts on a complex of data.

The selection of a formal class of approximating functions (7-15) is the first step for construction of a model. The second step is finding of the system of free parameters of model  $\{a_i, b_i, c_i, d_i, m_i, i = \overline{1, n}\}$ , which would provide the optimum description of experimental supervision. As we see, the chosen approximations allow to directly set and solve inverse, nonlinear optimization problem for finding of system of required parameters. Methods of the solution of such problems and the problems of instability arising at the decision are well studied /19/.

Let's pay attention to the fact that it is convenient to divide the aggregate of free parameters of the model, according to their values in expressions (7-15) in two parts: kinematic parameters  $\{a_i, b_i, c_i, d_i, i = \overline{1, n}\}$  and peak parameters  $\{m_i, i = \overline{1, n}\}$ . Kinematic parameters of the model are connected with the experimental data nonlinearly, peak parameters - linearly. On its basis, the approach of experimental supervision of deformation process will be various for the direct and the indirect data of monitoring.

Data of any direct and indirect types of monitoring is used at a stage of formation of the table of indicated points. The total table of indicated points is more compact, than primary time numbers, but it displays all characteristic space-time features of the supervised processes in full and forms an informationary basis for solution of the inverse kinematic problem, i.e. the problem of definition of all kinematic parameters of the future model.

The effective algorithm of solution of the inverse kinematic problem for (5-12) and solution of a linear return problem has been developed for peak parameters. The aggregate of two inverse problems on the kinematic and peak parameters of model defines the common decision on a problem of approximation of supervision.

The analysis and comparison of various ways of determination of concrete parameters of the models received as a result of preparation of models of deformation of an earth's crust in various regions of Kazakhstan is the subject of the other article.

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## **DISTURBANCE OF GRAVITY FIELD OF THE EARTH AS CONSEQUENCE OF CHANGING OF LOCATION OF PLANETS OF SOLAR SYSTEM**

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During the solar eclipse the Moon passes between the Sun and the Earth. Depending on orbits of these three planets of solar system, solar eclipse is considered, as partial or full. Full eclipse means, the Sun is covered completely and partial eclipse, means the Sun is covered partially.

During the Lunar eclipse, in contrary to the Solar eclipse, the Moon, as the biggest satellite of the earth, passes between the Sun and the Earth. Depending on their mutual orbits, the Earth's shade on the Moon creates two darkened areas - the Earth area is half shade, and the Earth area is shade. This event is sometimes called in literature as full or partial Lunar eclipse.

According to astronomic site "Galaktika", which is cited in <http://moscowaleks.narod.ru/astrosos.html>, in 2004 from 10.20 up to 16.22 (Baku summer time), very rare event took place- the planet Venus gradually crossed visible Solar disk. This phenomenon is similar to the Solar eclipse, however, in this case the Venus was between the Sun and the Earth, and not the Moon, as in Solar eclipse. The phenomenon is called passing of the Venus by the Solar disk. As visible diameter of the Venus is significantly smaller, than the diameter of the Sun, it didn't close the Sun, but gradually crossed its visible disk.

Mutual location of orbits of the Earth and the Venus are: the event is repeated in such sequence: 8, 121, 105, 5 years. The next one will take place in 2012.

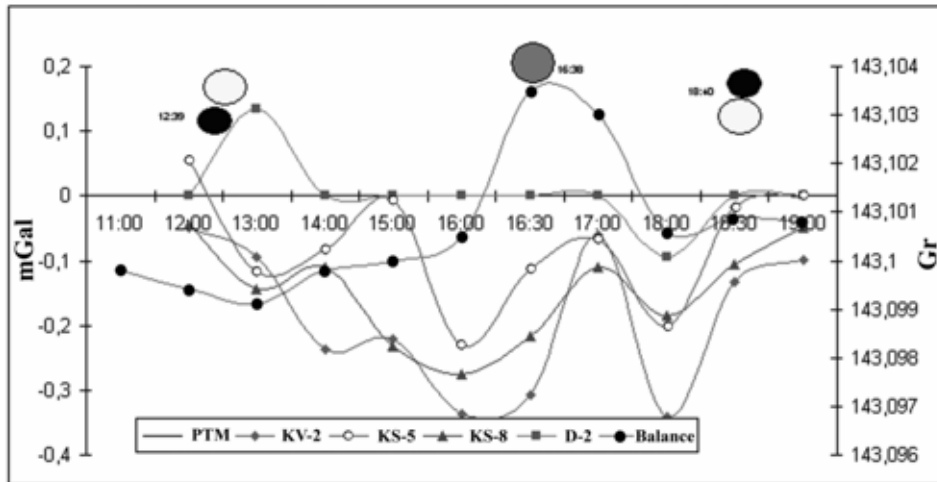
During days of solar eclipse, at the period of 2004-2006 observations were conducted by means of 4 gravimeters.

During observations weak, but rather moderate oscillations were reflected at indications of gravimeters. Approximately, 6-6,5 hours before eclipse drastic disturbances of gravity field (up to 0,3mGal), were observed, but gradually it returned to common state.

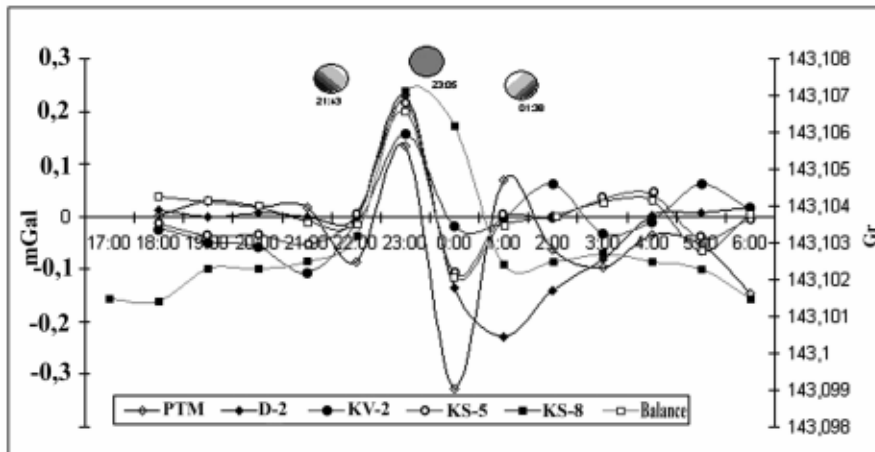
Simultaneously, measurements with electronic weights, having trial mass

were made too. Significant dispersal at indications of scales was examined. After eclipse dispersal at indications of scales resumed.

One of examples of results of measurements by gravimeters and scales during the Solar eclipse is cited in fig.1 and 2, which illustrate disturbances of gravity field.



**Fig.1. Charts of change of gravity field (mGal) and changes of trial mass during the Lunar eclipse 22 September 2006.**



**Fig.2. Charts of change of gravity field (mGal) and changes of trial mass during the Lunar eclipse 07 September 2006.**

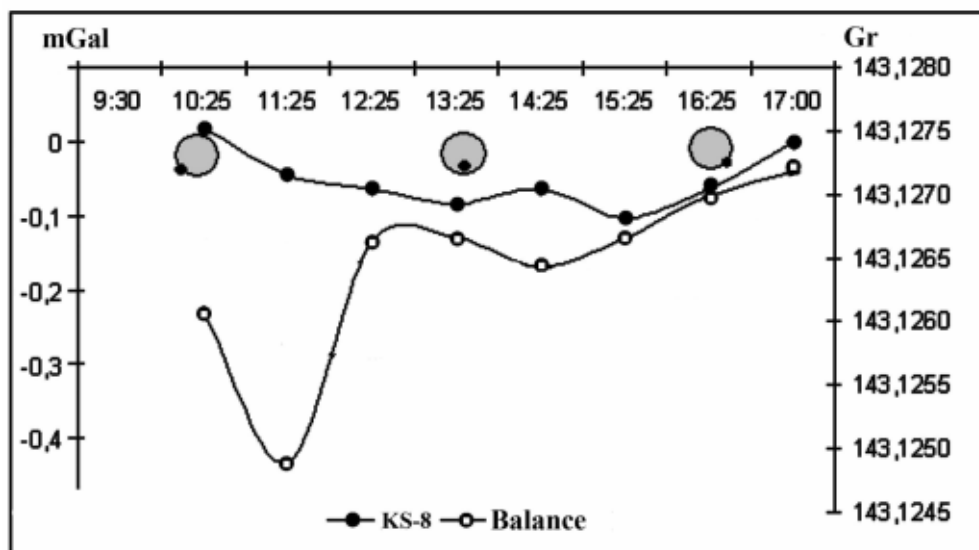
During days of the Lunar eclipse at the period of 2004-2006 at night time similar measurements were made. The dispersal was examined during eclipse too.

During the Lunar eclipse the same gravimeters register changes of gravity field almost similarly and very weakly. This witnesses about the fact that in contrary to the Solar eclipse, disturbance of gravity field at the Lunar eclipse was weaker, despite of the point, that time duration at the Lunar eclipse is much stronger, than at the Solar eclipse.

The interesting fact is, that in all cases disturbance of gravity field, which retrieved afterwards into normals state, was observed. The devices, applied during eclipse, as a whole, measure one and the same factor: gravimeters measure relative change of gravity field, but scales measure change of weight of trial mass, which is connected with changes of gravity weight. Precision of scale is significantly higher than at gravimeters, which were used by us during eclipse and therefore during days of Lunar-Solar eclipse weights behaved with more disturbance, than gravimeters did.

One of examples of results of measurements by gravimeters and scales during Lunar-Solar eclipses is cited in fig. 1 and 2, which illustrate disturbances of gravity field. General disturbance of intensity of gravity field is observed in all gravimeters and electronic scales.

Similar observations were also made during day of passing of Venus by disk of the Sun, starting from 09.30 till 17.00. During the working day slight increase of indications of gravimeters were observed. Scales behaved more quietly. At the same time, when Venus was on the Solar disk, standard weight of trial mass decreased slightly. (fig.3)



**Fig 3. Charts of change of gravity field and changes of trial mass during passage of the Venus by the Solar disk 08.06.2.2004**

Results of measurement at the day of passing of the Venus by the Solar disk are cited in the fig.3, which illustrates disturbances of gravity field. Change of standard weight of trial mass during passage of the Venus by the Solar disk witnesses about weak disturbance of potential field. The weak disturbance may be connected with small size of the Venus, and this is confirmed by indications of gravimeters. It is necessary to indicate one circumstance- during passage of the Venus by the Solar disk, indications by gravimeters and scales were taken easily, i.e. potential field of the Earth was more stable, than at the Lunar-Solar eclipse.

Obtained results in our opinion witness about the point, that gravity field was disturbed during above indicated events . The cause of disturbances are changes of mutual position of the Sun, the Moon and the Venus.

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## SUSTAINABLE MOBILITY IN LARGE CITIES<sup>84</sup>

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### 1. Introduction

In recent years the word “mobility” came up to the attention of the public opinion in such a way to be perceived as one of the main urgent problems to face. It sounds as if all traffic congestion, air pollution, energy consumption, and even quality of life in large cities depend on mobility.

However looking into the huge amount of papers, reports and regulations, dealing somehow with this issue, it is hardly to find a clear explanation of the mobility concept.

Definitions of mobility may be found as “*the quality of moving freely*”, “*the movement of people and goods*”, “*the ability to move or be moved easily*” or “*the ability to move safely and efficiently from one point to another*”. Mobility is confused with vehicle flow or average velocity.

On the other side several measures for the traffic management, which are adopted in the name of a better mobility but actually are based on heuristic choices, sometimes contradict each other, and after a while reveal insufficient or inefficient.

The effort of this work has been to look for a “rational” approach to the mobility concept in order to figure out and analyse within a congruent framework the wide variety of measures which may be conceived at local level for a sustainable urban transport system. The proposed approach, based on an analogy with the fluid property balance and transport processes and with the concept of mobility as defined in physics, is able to link technology, planning and demand management measures. Some considerations about situations which may be found in some large cities, when not otherwise specified, reflect recurrent Italian circumstances which not necessarily may be straight extended to other countries.

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<sup>84</sup> This paper is a wider revision of a presentation given at the 16<sup>th</sup> Regional Conference of Clean Air and Environment in Asian Pacific Area, and at the Third International Seminar on “Managing the Impact of Vehicles on Urban Air Quality”, Tokyo, 2-4 August 2005



## 1. Mobility

In physics, particles that are induced to move by a “driving force” ( $f$ ), due to an external field (as the gravitational or electric one), are counterbalanced by a resistance force which opposes to the movement. In a steady state the two forces are equal and the velocity  $v$  (for low values) of each particle is proportional to the resistance force:

$$v = bf \quad (1)$$

where  $b$  is a coefficient called *mobility*.

Therefore, in physics, mobility is defined as “*the velocity of particles attained under the influence of fields and forces*”.

By analogy, mobility in urban area may be approached in the same way as a process induced by driving forces, which are the circumstances forcing vehicles (people) to move from one place to another, and resistance forces due to traffic conditions. Eq. 1 states that mobility may increase either by increasing velocity or by decreasing the driving force.

Actually, in many large cities attempts to improve mobility are made through measures which should increase the average velocity. Bus Rapid Transit lanes, Exclusive Bus Avenues (Santiago-Chile, Bogotá-Columbia), high-occupancy vehicle lanes are examples of measures which allow some privileged categories of vehicles, public and/or private, to drive at higher velocity. Also highways or “green” traffic lights flow improve mobility along specific roads or lanes. However all these measures reduce the degrees of freedom to the trips of other categories of drivers or in other part of the urban area. For example, to cross those roads or lanes one might have to find out the few possible passages, that is to drive for a longer way than it would be necessary without constraints. Likewise, highway extensions which penetrate into the urban area encourage the private transport generating congestion at the exit/access gates and/or in some close critical areas.

The point is that any reallocation of road space or in general any “local” measure, which concerns a small part of the urban area, actually change arbitrarily the “velocity field” within the city and may affect negatively the mobility of the urban area in its whole.

In any case, the average traffic speed in large cities, which may be as high as 15 to 20 Km/hr, may hardly be increased significantly through “local” measures as those just mentioned.

A more effective improvement of mobility could be achieved through the reduction of the driving forces (mobility demand) which in principle may concern the whole urban area.

In the city of Milan nearly 63% of the residents (70 % of residents in the hinterland) moves by cars every day with an average of 3,6 displacements/day (4,7 displacements/day for residents in the hinterland). About 37 % of the displacements are for working, 16% for shopping, 6% for studying, 10% for exchange visits, 10 % for amusement. Only 42% of the residents in the city and 16% in the hinterland use the public transport service, while private cars are preferred by 43% of the inhabitants in the city and 60% in the outskirts where the public transport system is less efficient /1/.

The mobility demand is mainly related to schools, hospitals, universities, commercial and industrial zones, administrative offices, business districts. In some cities like Milan and London, the hearth of business, government and heritage is in the centre of the city, requiring a daily commuting wave which the public transport system only partly is able to cover. When these “attractors” are concentrated in close zones and not served by an efficient public transportation service, congestion all around is difficult to avoid.

A further consideration on mobility relates to Einstein /2/ found that for spherical particles (with radius  $R$ ) in a fluid of viscosity  $\eta$ , the resistance force (in a gravitational field) is :

$$f = 6\pi\eta Rv \quad (2)$$

so that mobility equals to :

By analogy, mobility of a car (particle) moving in a city (viscous fluid) may increase if both, “viscosity” of the city and dimension of cars decrease. Viscosity is an intrinsic characteristic for a fluid. Similarly for an urban area “viscosity” may be linked to its structure and to the way the road network is managed, that is to aspects which somehow create dissipation of energy like *narrow streets, one ways, traffic lights, limited or forbidden traffic access zones, parking lanes along the streets*. The structure of the city cannot be modified, neither the old narrow streets may be enlarged, but the road network management may do. For example, the use of *one ways* is very much abused, even for large roads, forcing to drive for a distance much longer than it would be necessary. Also *traffic lights* are often abused, located in places where (or regulated in time than) the only effect they produce is a stop-and-go traffic dynamic. *Limited or forbidden traffic access zones* sometimes interrupt relevant traffic directions or are not brought to the attention of drivers who have to suddenly change directions and loose time to find the right way out contributing to slow the traffic.

One more contribution to the “viscosity” of the city comes from *parking lanes along streets*. They reduce the road capacity, may create congestion or at least slow the normal flow of the vehicles due to the parking operations. The

increased number of cars per capita in the last decades caused an increased demand for parking areas which may hardly be recovered in old part of the city other than along the roads. In Milan during the night 56% of cars are left on the road and 27% in box or private areas, while in the outskirts 30% are left on the road and 70% in a box. During the day in the city 75% of the cars are left on the road, 22% in a box and only 4% in a charged parking areas, while in the outskirts 64% are left on the road, 35% in a box and 1% in a charged parking areas /1/.

In some large cities a local policy is adopted to encourage the construction of private underground parking-lots, but the contribution to withdrawn cars from the roads is quite irrelevant.

According to eq. 2 mobility is inversely proportional to the dimension of a car (particle). In recent years the diffusion of mini-cars, motorcycle and motorbikes has been greatly promoted even by the national policy, for ecological and economical reasons, but lastly one car has been substituted by several mini-cars or motorcycle or motorbikes, also because these vehicles are allowed to be driven at the age of sixteen. In Rome, motorcycles, estimated to be more than 650.000, contributed to reduce the number of normal cars circulating in cities, as well as to increase air pollution since most of them still have two strokes engines which are significant sources of particulate matters and hydrocarbons. Furthermore mini-cars, motorcycle and motorbikes are allowed to circulate in restricted access zones so that a consistent traffic, noise and pollution are still dominating the centre of large cities. Motorcycle and motorbikes feel free to pass trough the normal car lanes or suddenly overtake cars, inducing them to a stop-and-go pace, so that the number of incidents increased very much within the urban area of large cities as well.

### 3. Car fleet balance

Let write an overall balance equation for the cars which are within a control area ( $A$ ) that is a defined urban area. The accumulation rate of cars in the control area, which may be expressed in terms of density (vehicles per unit of area –  $\rho$ ) multiplied by the area itself, equals the rate of vehicles driving in the city ( $\dot{V}_{in}$ ), the rate of those leaving out the city ( $\dot{V}_{out}$ ) and the new car “generation” rate ( $\dot{V}_p$ ):

$$\frac{d(\rho A)}{dt} = \dot{V}_{in} - \dot{V}_{out} + \dot{V}_p \quad (3)$$

Let apply eq. 3 to two different scenarios referred, respectively, to a short time interval, that is the hours of a day, and to a long time interval, that is tens of years.

In a short period of time,  $V_p$  is practically zero and the urban extension (A) does not change so that eq. 3 becomes:

$$A \frac{dp}{dt} = V_{in} - V_{out} \quad (4)$$

If the inflow exceeds the outflow the density of cars increases within the control area, most likely with all the related traffic problems. For example, in the greater Milan, which has always been the hearth of the industrial productive activities in Italy, the daily incoming vehicles amount to about 800.000, while the vehicles leaving the metropolitan area are only 400.000.

The only way to avoid congestion situations is to strongly discourage the use of private cars in the whole urban area especially to non residents. Actually in many towns the restrictions to the use of cars (through road pricing, congestion charge, access permits, number plate management) are adopted for small parts of the urban area, generally the centre, called Low Emission Zones or Traffic Restricted Zones. These measures may cut traffic-delays or increase traffic speed inside the controlled zones, but on the other side they contribute to increase traffic all around the same zones since people try to approach them and to park as close as possible.

Once again, they are “local” measures which change the distribution of vehicles, mobility, velocity and emission sources within the urban area and may even affect positively some zones but in the whole may reveal inefficient and generate critical situations for traffic, mobility and pollution in other zones.

In any case the use of private vehicles may be discouraged when the public transport system is really efficient. This is not the case of many large cities, particularly in Italy. Comparing the transport modes by bus, auto and motorcycle, taking into account walking time to reach the transportation mean, waiting time and running time it has been found that the overall time spent going by bus is twice that by car and three times that by motorcycle /3/. The cost of the trip using the own vehicle may be the highest compared to other transport modes but it may not influence too much since the “value” of the own time is up a personal perception and evaluation. The mentioned study refers to a situation in Sao Paulo (Brazil) which, most likely, does not differ significantly from that in other large cities in the world.

In the last decade the high-capacity buses have been privileged but in many cases they did not revealed convenient. Trend seems to evolve towards low-capacity modes (like *colectivos* in Mexico).

A measure in this direction which is strongly promoted to discourage the use of private vehicles is the ridesharing (carpooling and vanpooling) through which groups of persons share a vehicle to reach the working place. In return, they save money and may be allowed to cross restricted access zones of the city covering shorter distances. In Italy any public institution with more than 300 employees and any private firm with more than 800 workers is bound by law to organize a commuter plan for workers. However this measure is not easy to organize in large cities in an efficient and economic way when has to be conceived only for a restricted group of workers.

As a second scenario let apply eq. 3 to a long time interval (tens of years). The last term regarding the new car generation may be assumed proportional to the population ( $P$ ) through a coefficient ( $c$ ) which corresponds to the number of vehicles per capita. The net flow of cars may be assumed constant in a first approach, while the urban area normally grows through subsequent suburbanisation. The density rate depends on the way the city expands. Also the number of new vehicles increases, particularly in developing countries, since it express somehow the welfare growth rate and has been shown to exhibit a linear correlation with the Gross National Product. Therefore, for this second scenario eq. 1 becomes:

$$\rho \frac{dA}{dt} + A \frac{d\rho}{dt} = c \frac{dP}{dt} + P \frac{dc}{dt} \quad (5)$$

For example, in the last half century Milan has grown up to join together, without solution of continuity, 38 small towns all around to form a metropolitan area which covers 630 Km<sup>2</sup> with a population of about 2.5 million. In its side the concentration of vehicles increased from almost zero after the second war to 0,4. In particular 600.000 families in the city have 0.86 cars /family, while 400.000 families in the outskirts have 1.21 cars/family /1/.

One more example is Mexico City, the second largest city in the world, which grew six times from nearly three million of inhabitants in 1950 to over 18 million in 2000, while the urbanized area increased by 13 times from 118 Km<sup>2</sup> to over 1500 Km<sup>2</sup>. The population density decreased from nearly 25.000 to 12.000 inhabitants/Km<sup>2</sup>, but the number of cars per inhabitant grew to nearly 0,13 and in recent years has been estimate at a growing rate of six percent annually /4/.

Equation 3 does not allow to say whether density of cars and density of population in an urban area may be preferable low or high. With low density mobility improves and pollution concentration may be lower, but the mobility demand increases and the energy consumption as well, together with the polluting emissions in the whole.

It has been shown /5/ that the petrol consumption per capita is negatively related to the density of population with a sharp decline in the use of vehicles with a density higher than 5.000-6.000 inhabitants/Km<sup>2</sup>. For higher values density of population may not be seen as a crucial parameter any more. This is the case of several large European cities (density in the range of 6.000-14.000 inhabitants/Km<sup>2</sup>) which compared, for example, with Tokyo (18.000 inhabitants/Km<sup>2</sup>) and Hong Kong (28.000 inhabitants/Km<sup>2</sup>) show a little difference in the petrol consumption per capita.

#### 4. Energy consumption and air pollution

The final goal is to provide a “sustainable” urban transport system rather than a better mobility as an end in itself. This means that any kind of measure taken in the name of a better mobility must contribute somehow to limit emissions, support a competitive economy, reduce the use of conventional energy resources, reduce the impact on the human health and the ecosystem and improve the quality of life in the city /6/.

Energy consumption and air pollution due to urban traffic depend, first of all, on the number of displacements per day per capita and from the reference population. This means that mobility demand is the most important parameter to reduce. Then, let consider a general displacement from one place to another within the urban area for which a distance  $L$  could be covered following the ideal shortest way at a given constant velocity without any stop. In that case the fuel consumption should be the minimum. Actually this never happens and an extra-distance ( $\Delta L$ ) has to be covered, due to the infrastructure of the city (one ways to follow or forbidden areas, green areas, privileged arterial roads to avoid), and an extra-time ( $\Delta t$ ) has to be spent due to congestion, stop-and-go traffic dynamic, crossroads traffic lights, etc.

Therefore the effective fuel consumption (E) may be seen as a sum of three contributions:

$$E = k_n (L + \Delta L + v_c \Delta t) \quad (6)$$

where  $k_n$  is the theoretical fuel consumption of the car per unit distance and  $v_c$  is the average velocity.

Notwithstanding in the last couple of decades substantial improvements in vehicle technology have been achieved in terms of efficiency and specific fuel consumption ( $k_n$ ) the situation seems still critical in large cities. In fact, eq. 5 states that improvement of  $k_n$  may be ineffective if at the same time the second

and/or the third term increase. This is exactly what happened in the last decades, other than the dramatic increase of mobility demand coupled with population.

To reduce the second term in eq. 5, the extra-distance  $\Delta L$ , it is absolutely necessary to work on the infrastructure of the city which has been linked to the “viscosity” concept.

Measures should be undertaken to ban parking lanes along the roads, at least during the working hours, to replace, when possible, stop signs and traffic lights with roundabouts, to adopt one ways only for narrow streets, to avoid unnecessary restricted zones distributed in the city as leopard’s spots.

Some of these measures may be effective also to reduce the third term, the time-delay  $\Delta t$ . To this purpose the Intelligent Transport Systems should be encouraged in that they are able to provide information useful to traffic-actuated control solutions or traffic-responsive models, other than to give, through electronic panels placed in strategic locations, direct and timely communication to drivers (air pollution levels, rough traffic paths to avoid, available parking areas, deadlines for periodic inspections on vehicles, access restrictions in some zones, works in progress on roads, etc.).

The energy consumption (E) may be derived from conventional fossil fuels ( $E_C$ ) or from renewable energy sources ( $E_R$ ):

$$E = E_C + E_R \quad (7)$$

On its turn pollutant emissions (PE) for each substance are related to both energy sources in a schematic form as:

$$EP = \alpha E_C + \beta E_R \quad (8)$$

$\alpha$  and  $\beta$  being emission factors for the pollutant under consideration.

A great reduction of the emission factors for many pollutants has been achieved in the last decades. A further 50% reduction of carbon dioxide, nitrogen oxides and hydrocarbons, from both gasoline and diesel engines, should be achieved with the adoption of EURO IV standards (which have to be met by 2005) and 50% more (with respect to 2005 levels) complying with EURO V standards within 2010.

An important contribution to the reduction of air pollution derives in any case from the vehicle inspection and maintenance programmes.

At local level, incentives for the acquisition of electric and low emission mopeds and motorcycles, circulation banned to cars without catalytic converters and “not ecodiesel” or access only to authorised or commercial vehicles equipped with catalytic converters in the centre of the city or special zones are measures

which somehow promote the renewal of the car fleet with lower pollutant emissions.

In Italy a special law establishes that the public administrations at local, regional or national level, in renewing old vehicles must substitute them up to 50% with electric cars, hybrid ones or feed with natural gas, LPG or non-conventional fuels. However the time span of vehicles is in the range of 10 to 25 years.

A reasonable shift towards renewable energy sources and hydrogen may be expected in the medium-long term.

Other traffic management measures /7,8,9/ could be better evaluated within the frame here proposed.

## **5. Conclusions**

The urban traffic problems may be tackled only through an integrated policy within a coherent rational framework rather than through measures based on heuristic choices.

Several measures adopted in the name of a better mobility or a lower air pollution or a less energy consumption actually contradict each other.

High speed roads, rapid transit lanes, even highway extensions which penetrate into the urban centre, which foster the use of private cars, are adopted as well as calming zones or low emission zones or restricted access zones; high occupancy vehicle lanes and car-pooling are promoted as well as the use of mini-cars and motorcycles which are allowed to drive in traffic restricted zones and to be driven by underage young people; the renewal of car fleet is promoted allowing the new vehicles to be used in restricted access zones so that mobility never improve and air pollution and noise may still remain high.

Any “local” measure, which concerns small part of the urban area, changes the “local” density of vehicles, mobility, average velocity and emission sources but the situation within the city in its whole may be affected negatively or inefficiently.

Reallocation of road space together with one ways, traffic lights, parking lanes along the streets, etc. introduce constraints within the urban area and reduce degrees of freedom to the trips reducing, in principle, mobility.

Measures to discourage the use of private cars must not be counterbalanced by other which, on the contrary, promote that use, must concern the whole urban area, must be coherent with a “sustainable” mobility and, on the other side, a suitable public transport system must be provided.

Technology, through new cars at lower consumption or less polluting fuels or renewable energy sources may help to reduce air pollution, but planning and demand management is equally important.



The only final aim must be the quality of life in the large cities achievable through a low impact on the human health and the ecosystem.

Regarding the impact on the human health the relevance is given only to air pollution and noise. Let imagine that in a couple of decades conventional fuels have been completely substituted by hydrogen and air pollution has disappeared in the urban atmosphere but the mobility remains the critical problem. May this situation be considered without any impact on the human health? What about psychological and physiological stress for those who has to spent hours a day into the urban traffic.

Kofler /10,11/ supported and demonstrated that there is a great need of an “extended view” of human health in order to understand the relevance of the environmental factors. This need seems infeasible in the case of the urban environment, to avoid that the debate focus only on the level of the limit values for few pollutants ( $O_3$ ,  $PM_{10}$ ,  $PM_{2,5}$ ) which, after all, are even difficult to meeting.

Therefore the urban traffic problems require an integrated approach to reduce energy consumption and air pollution improving, at the same time, air quality, but the crucial parameter to improve mobility and quality of life is the mobility demand.

In short term mobility demand may be reduced through teleworking and different forms of telecommunications to avoid physical travel (distance meetings or learning, electronic business and government activities).

In the medium-long run the suburbanisation development and the land use management strategies should carefully reconsidered.

In the last decades the policy adopted to move residential areas far from commercial, administrative and industrial areas, generated a dramatic increase of the mobility demand.

Local markets, small grocery stores or small commercial centres have been substituted by large shopping centres or supermarkets which are no more within walking distances from houses. This tendency was justified only by economy of scale without any consideration for social and environmental implications.

Now is time to review that tendency applying also to urbanization and land use management the “polluter pays” principle, through mechanisms like environmental impact evaluation, cross-media effect evaluation, life-cycle assessment. We could find more appropriate to go back and promote small markets, small grocery stores and commercial centres within walking distances from houses to reduce the mobility demand for a better social life.

In other words we should draw inspiration from the “ancient” structure village, which now may be found only in few well organized university campus, rather than from the deceptive “global” village concept.

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## **MITIGATION OF EMERGENCY SITUATIONS AND SUSTAINABLE DEVELOPMENT OF THE REPUBLIC**

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The main goals of civilization development at different stages of its existence were to achieve still higher quality of life for the citizens and to secure their wellbeing and security. These priorities are relevant now at the beginning of the twenty first century, too, however the significance of safety and its specific weight in the general characteristics of life quality nowadays have considerably increased. It can be confidently stated that the issue of securing all-round safety of people, society, state and world community has become the most important priority for the upcoming decades and has turned into one of the main goals of strategic existence of the civilization in modern and forecasted conditions.

The scientific-technical and social-economical progress of the past centuries has radically changed the world and considerably improved labour conditions, the quality of life, education and culture. At the same time, the technological progress revealed its negative side connected with exhaustion of resources on the Earth, intensive development and consumption of available resources, a number of crisis phenomena in the social, economical and political spheres, and emergence of new technogenic threats. The interdependence of the natural and technogenic spheres has considerably strengthened.

There is also another global phenomenon that stands out against the background of the mentioned processes in recent years, and that is the increasing interdependence of countries and peoples which is listed as one of the most important phenomena in the life of mankind. The processes of globalization are witnessed in all spheres of its life activity. Different components of these processes bear both positive and negative character. The negative side of globalization is represented by so-called global problems, most significant of which are natural catastrophes, demographical imperative, the war and peace problems, international terrorism and technogenic safety.

One of the prospective ideas which mark the way out of today's systemic

crisis of civilization, is the idea of sustainable development. It implies coordinated solution of environmental problems and problems of social-economical development, which are to be solved within the framework of global cooperation. Many countries are now elaborating national strategies of sustainable development. The world summit of representatives of states held in Johannesburg in 2002 marked the beginning of transition to practical measures. Numerous initiatives were demonstrated in the field of global climate changes and problems connected with water resources, energy resources, agricultural production, protection from toxic substances, preservation of biodiversity, etc. The resolutions of the Johannesburg summit are particularly important because the world community officially acknowledged the issues of security to be the main constituent and component of sustainable development.

Azerbaijan makes considerable efforts in order to create economical, political and scientific basis for sustainable development of the country and partner-states. The concept of Azerbaijan's transition to sustainable development has been confirmed and an appropriate state strategy has already been elaborated in the republic. Particular attention is, in the first place, paid to parry ecological and economical threats. Nowadays, the Azerbaijan strategy first of all envisages resolution of issues connected with provision of national security.

In recent years, scientists and specialists pay particular attention to elaboration of a conceptual basis for the state policy aimed at securing sustainable development and national security of the country in the new historical conditions. This necessity is results from the systemic character of threats and national security. The proof of it is the assessment of factors reflecting the social-economical development of the country.

Comparison with the least tolerable levels in the world practice shows that a whole number of key factors reflecting the state of security in Azerbaijan are beyond the critical point. So, this situation demands a special approach to decision-making at a state level. To our opinion, such an approach can be elaborated on basis of the concept of strategic risks. The corner-stone of the mentioned concept is the theory and risk management systems. When applied to the sphere of national security they transform respectively into the theory and system of strategic risk management.

One may ask, why it is the "Fovgal" Association that addresses the problem of investigating and managing such risks? If a state is viewed as an integral organism, the factors of strategic risks emerge in all spheres of its vital activity, and these factors constantly interact. The crisis phenomena or even the evolutionary processes in the economical, political or social spheres may lead to changes in the manifestation tendencies of emergency situations of natural and

technogenic character. Timely revelation of such regularities and tendencies will equip us with a powerful tool for preventing emergency situations and mitigating their consequences.

Global changes in climate are the example of how evolutionary processes initiate an increase in the frequency and scale of natural and technogenic emergency situations. Foreign experts believe that global warming may lead to a change in the extreme meteorological and climatic conditions on the territory of European countries, including Azerbaijan. Changes in the regime of rivers' runoff and an increasing likelihood of major floods are possible. Negative consequences are also expected in connection with the increased level of underground waters and waterlogging, which will lead to an increase in occurrence of emergency situations in underground constructions. However, most serious consequences of climatic warming will occur in northern regions of Europe. Thawing of frozen strata will trigger irreversible natural processes, an increase in the number of technogenic emergency situations due to collapse of buildings and constructions and damage done to communication lines.

Thus, strategic risks, which pose a threat to national security and sustainable development of the country, may become the object of management in the sphere of national security. Strategic risks are such combinations of probable crisis phenomena, catastrophic situation processes and their possible consequences, that their occurrence may lead to considerable fall of the protection level of individuals, society and state.

The principal peculiarities of strategic risks are, firstly, the probabilistic nature of the threats which result not only from the existing and potential sources and factors of danger, but also from the insufficiently effective protection of the society and environment in which it exists; secondly, measurability and quantitative interpretation of the threats; and thirdly, emphasis on only those risks which pose a threat to national security and sustainable development for medium and long periods of time, i.e. for five, ten and more years.

Inferring from the definition suggested above, the objective of management in the sphere of national security may be formulated as prevention or reduction of strategic risks down to an acceptable level in order to provide sustainable development including safety of individuals, society and state on the whole. The mechanism of achieving this objective comprises political, administrative, legal, economical and technical solutions, while the feedback in the management system comprises monitoring of strategic threats and calls with relaying of all necessary information to the organs of state power.

The important and complicated problem in management is to define the composition of strategic risks. The solution of this problem implies, on one hand, specification of vitally important interests of individuals, society and state which are subject to the threat of dangerous impact. On the other hand, the problem's

solution implies structuring of threats according to the fields and spheres of the country's vital activity. As a rule, this involves application of expertise-analytical methods, on basis of which the specialists define and quantitatively estimate the significance of threats from the point of view of national security and sustainable development in concrete spheres of vital activity such as politics, economics, healthcare, etc. Later, the priorities of threats are defined on basis of this estimate. Apart from that, it is necessary to learn the public opinion on the significance of strategic risks and to compare the results of the population's subjective assessment with the priorities of threats determined by the experts.

Learning of the public perception of strategic risks and comparing of this perception with the results of experts' estimation are the subject of special analysis. A preliminary estimate and forecast of strategic risks were made in the process of the first stage of scientific-research work conducted by the specialists of the "Fovgal" association and scientists of the "Safety of Vital Activity" Chair with participation of a number of Azerbaijan institutes. The experts have defined the main spheres of the state's vital activity which are the sources and factors of threat posed to national security and sustainable development of the country. Those spheres are: the political, economical, social, natural-technogenic and scientific-technical spheres.

Quantitative interpretation allows to transform strategic threats into strategic risks. Correspondingly, a portion of national security management tasks is transformed into management of strategic risks. The process of state management in the considered sphere must include two stages: assessment and forecast of the mentioned risks and their reduction down to the acceptable level.

On the whole, the goal in managing strategic risks may be expressed as a solution of a two-fold problem, i.e. ensuring of sustainable development and national security of the state. Meantime, it is assumed that crises, emergency situations and their elimination are an objective component of the development process which along with negative sides also contains new opportunities for society development.

The priority tasks, aimed at substantiation of the strategic risk priorities as management goals, include definition of system-forming connections, enumeration of threats and the realization degree of the threats in the medium- and long-term perspective. The result derived from the solution is a ranged enumeration of strategic risks.

Acquisition of a ranged enumeration of national security threats on a general quantitative basis allows to compare these threats one with another. This approach also gives the opportunity to quantitatively interpret the criteria of security management as a certain measure of reducing the level of strategic risks.

As the result of conducted research, 35 factors of strategic risks in the main spheres of a state's vital activity were differentiated and ranged.

Identification of such factors bears rather the character of a “photograph” and gives notion about a set of significant threats at the current moment. Both the threats and their place in the ranged sequence may change in time. Let us bring a few examples.

In recent years, the significance of terrorism as of a factor of strategic threats to national security has considerably increased. Terrorism must be viewed not only as a potential probability of separate acts, but also as a systematic large-scaled threat which affects the political, economical and social interests of a state.

Another example would be development of an energy crisis in winter in the sphere of housing and communal services. Mistakes committed in implementation of reforms in housing and communal services, as well as abuses and incorrect determination of priorities in this reform resulted in a situation where the issue of providing sustained heat supply turned from a routine problem of technical reliability into a pre-crisis interregional problem to be solved by the President and Government of the Republic. This example demonstrates growing of a particular risk into a strategic risk.

Another example has to do with natural extreme phenomena. The catastrophic floods that recently occurred in the southern and western part of the Republic led to large-scaled consequences.

What must the strategic risk management system be like and which mechanisms secure its realization? In its most common appearance, this system includes two levels of decision-making, i.e. the republican and territorial levels, as well as some appropriate mechanisms. The measure of possessed authority in decision-making must be determined for each level: to determine the amount of authority at the republican level for making decisions concerning management of external and internal strategic risks and at the territorial level for making decisions concerning management of internal risks.

Making of such decisions requires availability of appropriate methodical recommendations and information which would ensure fulfillment of a number of interconnected tasks, including identification and evaluation of private and integral strategic threats, choice of methods for reducing the threats, and elaboration of a complex programme for ensuring national security. Solution of these tasks is mainly based on application of expertise-analytical methods successfully applied during estimation of risks connected with natural and technogenic dangers.

It should be noted that effective management of strategic risks is impossible without forming an overall security culture at all levels of the society’s social structure, but in the first place, this applies to persons who make strategic state-level decisions. Actually, in its essence this task is about forming national mentality in which a risk must become a category defining the world outlook and values.

As to the practical realization of managerial activities, they require application of political, economical, legal and organizational-administrative mechanisms.

Among the political measures to be taken we must first of all emphasize the necessity of admitting officially and at the highest level the concepts of strategic risks and their management as the methodological basis for solving the problems and tasks of sustainable development and provision of national security of Azerbaijan. One of the forms of such admission might be elaboration and acceptance of a conceptual basis for strategic risk management in Azerbaijan. Apart from that, this process at the political level requires appropriate support from the system of state programmes and activities aimed at reducing strategic risks, including solution of problems of scientific-methodological and methodical character.

The following groups of activities must be implemented for providing legal foundation to the state policy aimed at reducing strategic risks. First of all, the effective legislature must be replenished with normative acts which would encompass the most important and significant (from the point of view of providing sustainable development and national security) types of threats and related strategic risks which so far are missing in the domestic legislature.

Further, it is expedient to bring all the republican laws, normative acts and programmes effective in the given sphere into correspondence with the new paradigm of ensuring national security based on the concept of strategic risk management.

And finally, it is necessary to toughen (in the renewed republican legislature within the given field and in court practice) punitive measures and responsibility for delinquency of ranked officials who caused an increase in strategic risks and mainly in the amount of damage done during realization of certain threats in form of large-scaled emergency situations or social-economical risks.

In order to improve the organizational-administrative levers of managing strategic risks, to our opinion, it is expedient to define the new role of the Security Council of the Azerbaijan Republic as a peculiar "strategic risk-manager" who coordinates the activities in the field of estimating and forecasting strategic risks and determines the directions of reducing them following the objectives of the national security policy. The reform carried out in organs of state authority must take into account the necessity of training and actively involving professional risk-managers in all state authority structures at the republican, territorial and local levels.

It would be particularly fit to implement the above-mentioned measures in the framework of the administrative reform carried out in the country today. Improvement of state supervision and control systems, optimal distribution of



executive controlling functions among the levels of state management, as well as optimization of the activity carried out by all organs of state power which are involved in the process of managing such risks will play an important role in the matter of shaping the organizational levers of strategic risk management.

Apart from all the above-mentioned, participation of public community representatives is required in the process of decision-making aimed at reducing strategic risks in control over their fulfillment. In particular, the community must take part in the process of testing the appropriate projects.

Qualitative changes in the process of information exchange play an important role in the issue of improving organization of strategic risk management. Information exchange must be coordinated by the republican center: starting from the content and figures of strategic risks, expected damage from realization of such risks, and all the way to the issue of presenting relevant information to Mass Media and community in an easily comprehensible and perceptible form. At this point, the role of Mass Media and, consequently, the demands towards its level of competence, increase.

Taking into consideration the increasing role the science plays in solution of tasks aimed at sustainable development, including provision of national security, it is necessary to improve organization of scientific-research activity in the field of strategic risks in order to create an adequate scientific-information base for transition to a new strategy of developing the country. It is particularly important to strengthen the public-scientific component of research and exploration in the field of strategic risks and their reduction, as this component is connected with perception of risks and with estimation of acceptability of the expected (estimated) damage.

The economical mechanism of reducing strategic risks must include two directions. One of them is direct economical regulation carried out on basis of purposeful means from state budgets in order to implement measures aimed at ensuring the acceptable level of strategic risks. In the framework of budget allotments, it is most effective to transfer the focus of financing in budget articles over to fulfillment of measures aimed at preventive reduction of risks, including in particular, monitoring of threats, forecasting and planning of actions in case of realization of risks. It is just as important to preserve the purposeful character of expenditure on implementation of measures aimed at ensuring operative response to realized threats and post-crisis activities which reduce the damage; meantime, doubling and dissipation of resources must be ruled out.

Another direction is indirect economical regulation, including improvement of the tax and credit mechanisms, and the system of reduced tariffs and rates connected with realization of measures aimed at reduction of strategic risks. This direction also envisages development of the insurance system which would ensure mandatory state insurance of places (objects, sites) that are sources

of strategic threats and insurance of population in territories most vulnerable to the impact of such threats. These measures must be complemented with activities aimed at voluntary insurance of life and property of physical and legal persons against strategic risks.

The catastrophic floods which occurred in Azerbaijan in 2001-2003 showed that insurance still plays a miserable role in risk management and in compensation of damage. One of the first steps towards strengthening the role of insurance might be delivery of a certain portion of financial reserves of the Government, cities and regions of the Azerbaijan Republic to the specialized insurance companies dealing with catastrophic risks.

The scope and form of the state's participation in financing risk management must directly depend on the level of the country's economic development. The analysis of historical experience shows that even in such countries as USA, France and other European countries, the government has never assumed covering of all expenses entailed by catastrophes and crisis phenomena. Depending on affordability, the budget compensated only part of the reported damage and at the same time various non-budget sources were actively involved. The state must rather act as an insurer, not as a philanthropist. Increasing of the state's share in compensation of damage has always resulted in reduction of responsibility on the part of individuals and in unjustified pressure on the part of public organizations. This is particularly important to understand now, when Azerbaijan is in state of systemic crisis and any withdrawal of considerable sums may trigger crisis phenomena.

Practical implementation of diverse and large-scaled measures aimed at political, economical, legal and administrative regulation of issues connected with strategic risks demands propping against the entire length of the vertical line of authority in the country, assignment of appropriate authority to each of the levels of state power, and synchronization of efforts made at all levels.

The above-mentioned mechanisms of strategic risk management must be flexible enough to correspond to the changes in various aspects of the state's vital activity and to the dynamics of global processes. Our state is growing more and more open, not only entailing positive changes in economy and politics, but also stepping up the tempo of structural changes and intensiveness of information streams. Such processes demand constant adaptation of the national security providing structures to the new conditions.

Implementation of the above-mentioned directions in development of the national security strategy and transition to a new model of management based on the concept of strategic risks would allow more effectively solution of the most important state task – ensuring of sustainable and secure development in Azerbaijan.

The offered paradigm of management is nor free of drawbacks and needs

further substantiation and development, therefore, it is necessary to continue the profound scientific research in this field with focus on elaboration of methods and models of quantitative estimation of integral factors (indicators) of strategic risks. In the nearest future it is expedient to initiate drafting of legislative bills which would reflect the changes in the character of threats and the responsibilities for actions which lead to reduction of the national security level. Another important step towards realization of the strategic risk management system must be elaboration of a system of monitoring the factors of strategic threats at the republican, city and regional levels.

It is time to combine efforts of scientists and specialists in the framework of creating an Azerbaijan society of risk analysis. One of the main tasks of such a society, apart from identification, evaluation and forecast of threats and dangers of modern Azerbaijan, would be the task of working out proposals and mechanisms in order to assist the organs of state authority in their efforts of strategic risk management in various spheres of vital activity of the Azerbaijan Republic.

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## **SEISMOTECTONIC AND GEODYNAMIC MODELLING IN KAZAKHSTAN: CONDITION, PRIORITIES AND TENDENCIES**

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For inhabitants of seismically dangerous regions of Kazakhstan the problem of an estimation of seismic danger and forecasting of earthquakes is vital. It is the large complex problem, which includes basic researches on a deep structure and dynamics of the Earth, physics of a seismic center, a seismic mode of all planet and separate regions, geological and physical conditions for earthquakes. The role and the place of the modern geodynamic phenomena, opportunities of satellite technologies of monitoring have been radically revised. Methods of geodynamic monitoring are in the process of improvement and methods of modelling of deformation and seismic processes are being developed.

### ***Structure and Seismic Mode of Lithosphere, Seismotectonic Modelling.***

The regional seismic methods are dominating among the geophysical methods of studying of a structure of an earth's crust and the upper mantle. These methods include a correlation method of the refracted waves (CMRW), deep seismic sounding (DSS) and its combinations with a method of exchange waves of earthquakes (MEWE), a method of the general depth point (MGDP) and 2D and 3D seismic tomography for the last decades.

The Institute of Seismology has developed and implemented the technique of a profile seismic tomography on the basis of experimental data of regional seismology. All materials of DSS on the territories of Kazakhstan have been recognized as informative and have been processed from the uniform methodical positions, and, also, have been generalized and presented in the form of volumetric P-speed models of an earth's crust for a southeast of Kazakhstan, lithosphere of the Central Asia and the Caspian region. The basic experimental and methodical components of the created information base are: structures DSS and DSS-MEWE for the historical and last years processed on the basis of a

technique of formation of high-speed models; a profile seismic tomography of an earth's crust and the upper mantle on the longitudinal and cross-section waves, combined and coordinated with "GSZ"; the volumetric seismic tomography of tectonosphere of Tyan-Shan and adjoining Kazakhstan, Kirghiz and Chinese territories up to the depth of 500 km; volumetric seismic tomography of lithosphere of the East Europe with inclusion of the Caspian region; seismogravity modelling providing for designing of high-speed, density, isostatic and geometrical models of tectonosphere and their interpretation from positions of new global tectonics /8/ and plumtectonic /1/; joint processing and interpretation of materials orogenes and platform territories; a modern level of a computerization of processing of geophysical data.

During volumetric P-speed modelling an earth's crust and the upper mantle of the highly seismic regions of Kazakhstan and the comparative analysis of its results with distribution in the geological environment of strong earthquakes it has been established that:

It is characteristic of *geosynclinal (subduction)* orogenes that its oceanic segment of a crust moves under the subduction (transitive) orogene. This process is accompanied by the immersing of the high-speed (cold) crustal plates in asthenosphere. The complex picture heat-mass flows, reflected in high-speed structure by alternation of high-speed ledges and low-velocity deflections is observed in the subcrustal space above the subduction zone. The greatest quantity of centurms is observed in the depth up to 130 km and less often in the depth exceeding 200 km. The crustal seismicity is connected with sialitic layer that reacts sensitively on to the shift pressure on border with basic layer being the result of influence the mantle ledges.

High-speed subductive weights and low-speed funneled structures are established in a zone of interaction epogeosynclinal conflict and epi-platform teleconflict orogens. Deep subcrustal seismicity is connected with the pressure in the zone of counter heat-mass flows subductive slabs and ascending plums.

In the Caucasus and Caspian region epi-geosynclinal orogeny the active mantle has no local deep roots, and seismicity is connected with the moving of the orogenic block of the crust under Turan plate in a zone of increase of its subcrustal power.

The upper mantle is differentiated on the high-speed (cooled clabs) and low-speed in the form of hot plums that split up on their way upwards and spread in subcrustal space under the epi-platform orogenes of the Northern Tyan-Shan. Seismicity ( $M \geq 8.2$ ) is connected with the regional faultings and oversteps of blocks of an earth's crust over the active mantle.

The crustal and subcrustal structure of the slab boundary epi-platfrom Ural orogene is caused by rapprochement of the East-European and West-Siberian

platforms. The crustal seismicity is connected with zones of destructions of the overstepped kind over the "swellings" of the active mantle.

The seismicity of the peri-rift Baikalsk orogene is connected with the asymmetric block and waste structures located over the active mantle.

As a whole, as a result of deep geophysical researches, for the first time within the limits of Northern Eurasia the technique of formation of a high-grade deep geophysical basis for the geodynamic modelling of lithosphere, estimations of the seismic danger and the forecast of the earthquakes has been developed and, basically, implemented.

Seismicity and Seismic mode.

On the basis of the analysis of the regional instrumental supervision that has been carried out since 1927, the following /2,9/ has been made:

- The uniform unified catalogue of earthquakes of territory of Republic Kazakhstan has been completed. The basic seismically active regions, zones have been determined and their seismological parameterization has been completed. The prevailing type of deformation in the territory of the Dzhungar-Nothern-Tyan-Shanski region has been determined. It is the monoaxial compression in N-S trending horizontal direction is revealed; prevailing type of motions in the centers is thrusting and shifting and the most probable azimuths of planes of center breaks extending is northeast and northwest.

- The seismological criteria of the seismic danger consisting in confinedness of the centers of the majority of strong earthquakes to the linear zones have been determined to be the high capacity seismically active layers of an earth's crust and a high level of seismic activity, density of epicenters and specific power-weight ratio of sources of seismic energy, and also their gravitation to contrast borders of sites with various values of the divisibility coefficient and types seismotectonic deformations.

- The technique of the integrated analysis of a complex of seismological and geophysical data has been developed for the purposes of an estimation of  $K_{max}$  value, which served as a basis for the physical and mathematical model of interrelation  $K_{max}$  having the initial seismic and geophysical attributes is created. It is established, that parameters of the excessive geodynamic activity of the environment is the temperature on border of Mokhorovichich, capacity of an earth's crust, height of a relief of a terrestrial surface, capacity of sources of seismic energy, thickness of the seismically active layer and the seismic activity of the weak earthquakes. The received results served as the methodical basis for the prepared map of zones of the centers of earthquakes (ZSE) in the south and a southeast of Kazakhstan

- It has been established that the spacio-temporal distribution of earthquakes in Tyan-Shan has the block and cyclic character. Numerical values of parameters of a seismic cycle, and also the sizes of blocks (seismically active structures)

increase with growth of the magnitude of earthquakes. The probable reason of quasicyclicity is a seismic mode are the long-period deformative waves migrating along the core seismically active zones.

· Analysis of the spatio-temporal features of distribution of seismic prognostic characteristics in the periods of preparation of strong earthquakes on an example of the Dzhungaro-Tjan-Shanski region and their informational benefit for the seismic forecast has been demonstrated. The generalized image of behavior of the complex of parameters of the seismic mode has been prepared and the physical model of formation of the source zones of strong earthquakes has been developed. The physical and mathematical model on the interrelation of the seismic mode complexes of parameters calculated as to the size of expected earthquake has been developed.

· The system of the long-term forecast based on the established models of the seismic mode and process of preparation of earthquakes, and also on interrelation of the seismic process with the global geophysical factors has been developed and introduced. The results of researches are used in development of the various maps of seismic districts, the long-term and intermediate term forecasts of strong earthquakes in the Almaty prognostic zone.

Development of Ideas of Mobilism in Connection with the Seismotectonic.

On an example of the Central Asia and Northern Tyan-Shan the paragenesis of the newest structures, which have formed in conditions submeridional, tangential compression has been established /10/, as a result of which there the movement of the litho-plates of the upper part of an earth's crust in the form of the conveyor between subtransform shifts takes place and the formation of the asymmetric (vergent) thrusting and overstepping folded and clumpy orogene morphostructure happens. The subtransform breaks extend to C3 subparallel in step of 170-180 km in the area of a young platform thereby influencing formation of folds of the craton basis and "con-cediment" folds of the platform complex. The further development of this hypothesis has allowed to state that the global and regional newest morphostructures create the paragenesis /7; 11/ within the frames of the mobilise concept. As consequence of this paragenesis, the newest orogenes are subdivided into some geodynamic types, each of which is characterized by the corresponding tectonic position, geomorphological expression, a deep structure and localization of the centers of earthquakes. The important criterion of geodynamic activity lithosphere is the presence of an active mantle. It is established, that the centers of strong earthquakes ( $M \geq 6.0$ ) appear under orogenes, with a layer of an active mantle with the capacity more than 10 km. On the non-seismic territories the active mantle is absent, and in transitive zones, i.e. from the non-seismic to the highly seismic zones it appears again ( $0 = H \leq 10$  km). The upper mantle structure under the various types of orogenes is not the homonymic.

The practical value of the seismotectonic models is that they allow to make maps of active breaks at the first stage and then to estimate their seismic potential both by various criteria, and with respect to it as the complex. The last version of the seismically active zones of territory of Kazakhstan was prepared in 2002 /10/ and on its basis the Map of the general seismic zoning of Republic Kazakhstan /3/ has been developed. These maps helped to prepare maps of the seismic zoning of some administrative areas (Atyrauski, Kyzylordinski, Mangistauski, Aktyubinsk), and also evaluations of seismic danger of the oil-and-gas objects /5,6/. Results of the seismic and tectonic researches of the Institute of Seismology of the Ministry of Subsurface Protection of the Republic of Kazakhstan were used to prepare for the international projects on preparation of the map of active breaks of Northern Eurasia, the map of the newest tectonics of Eurasia and the map of a global evaluation of seismic danger.

### **Priority scientific researches**

1 - Studying of the deep structure of an earth's crust and the top mantle according to Kazakhstani geotraverses with the help of the complex of geophysical works. 2 - construction of 3D models of lithosphere of Kazakhstan with viscoelastic rheology for the numerical modeling of the fields of deformations and pressure. 3 - identification and parametrization of active faults, studying paleo-seismic. 4 - Creation of parametrical models inter-plate tectonic blocks. 5 - development of kinematic model of the newest Tyan-Shan orogene on the basis of the system analysis of geomorphological structures and explosive forms. 6 - Creation of physical and mathematical models of the seismic mode and the processes of occurrence of strong earthquakes on the basis of deformation characteristics of the lithosphere, dynamic and kinematic parameters of the source.

### ***Modern Geodynamics, Modelling of Deformative and Seismic Processes.***

Modern geodynamics of the lithosphere of Kazakhstan is a component of geodynamics of the Central Asia. The following complex researches on the interconnected problems have been carried out:

- specification of the deep structure of the lithosphere on the basis of modern tomographic methods;
- finding-out of structural laws and the organization of a fragile part of the lithosphere, thus, the special attention has been paid to fault and block tectonics, its kinematics and evolution of the intense condition;
- Physical and mathematical modelling of developments of the lithosphere.



By present time the three-dimensional model of Kazakhstan with viscoelastic rheology, that is prepared to carry out numerical experiments with use of a method of final elements is constructed. Rheological features of layers of an earth's crust and the upper mantle are reflected in detail in the model. There have been completed the first calculations of the displacement caused by movement of Hyndostan plate with speed of 55 mm/year and the role of the viscous component in the change in due course of the initial displacement has been estimated. The integrated analysis of all actual data has allowed to allocate in the elastic lithosphere of the Earth six prevailing types of the intense state. The main of them are as follows: neutral ( $\delta_z > \delta_x = \delta_y$ ), stretching ( $\delta_z > \delta_x > \delta_y$ ), compressive ( $\delta_x > \delta_y > \delta_z$ ), shifting ( $\delta_x > \delta_z > \delta_y$ ) and intermediate, i.e. stretching with shift ( $\delta_z = \delta_y > \delta_x$ ) and compression with shift ( $\delta_x \gg \delta_y = \delta_z$ ).

Structures Tyan-Shan, Dzungaria and Altai relate to the zone of hummocking of the lithosphere, that is genetically connected with the Hyndo-Euroasian collision. The researches of the international group of scientists have shown, that modern deformations Tyan-Shan are result of the movement of Tarim block with a speed up to 20 mm/year to the north. Horizontal displacements of separate breaks do not exceed several millimeters a year and correspond to the available geodetic estimations. Speed of deformation increases in time. Characteristic structures of the field of vertical movement spatially coincide with structures of a base of an earth's crust, and according to the GPS data sites of modern background seismicity (weak earthquakes) coincide with areas of all-round compression.

Transition of seismology from mainly observant to a mature science with precisely certain object of research and with the method based on the firmly substantiated physical laws, is impossible without constant search and perfection of methods of geodynamic monitoring and modelling of deformation and seismic processes. The basic progress of seismology, including the objective forecast of seismological events is possible only in this direction. The certain results have been received in this direction. The discovery of new proofs of objectivity of existence in an earth's crust of slow deformative wave movements which can be described as the flat deformative fronts or deformative solitons with progress can be considered as of general scientific value. The family of such slow deformative fronts established as a result of solution of the inverse problems, with a satisfactory as of today time accuracy, describes all data on direct methods of monitoring of deformations in the region, including global and local networks GPS, data on continuous monitoring by the quartz deformographs, repeated levellings, and also data on the indirect monitoring of a sea level (PSML/PSWL) and a level of underground waters in wells. It confirms that the created formalized

4D-model of family of deformative fronts not only formally describes the process, but also adequately enough displays the basic properties of the given natural phenomenon. Considering objective complexities in studying the characteristic dynamics soliton deformative movements of an earth's crust, some additional requirements to networks of monitoring and methods of the analysis of the data, which will provide fuller studying of the so important scientific question have been prepared.

Therefore:

- The experimental data of complex geodynamic monitoring can be classified as to the natural property of the direct and indirect description deformative tensor. In view of it, the base of the basic and auxiliary data on Kazakhstan and its adjoining territories (35-55N, 45-95E) has been collected, and their preliminary and basic target processing for use in the modeling of the modern deformations and seismicity has been completed. The dividing of the data on geodynamic monitoring in the direct and indirect and introduction of the corresponding formalization of the various monitoring types, for the first time has allowed to include practically all the isolated data in the uniform process of quantitative modelling.

- The created and analysed approximative 4D-model of deformation process in the earth's crust of Kazakhstan can be used with respect to the medium-term and long-term seismological forecasting, and also with respect to the estimation of speeds of the deformation phenomena in the separate points and at the local sites. The 4D model is based on the description of deformative process by the family of the flat dynamic deformative fronts. The effective decomposition of a problem of two stages, i.e. of consecutive definition of kinematic and of peak parameters has been proposed and implemented with respect to determination of free parameters of the model. During search for the kinematic parameters of model the following elements were used: the composite seismological catalogue for the period of 1800-2006, the composite timing row of displacements and of the speeds of displacements for the period of 1992-2005, timing rows of monitoring of deformations as to networks of geophysical observatories, and also separate timing rows on monitoring of a sea level for the period of 1900-1999. The various computer animation films representing process of deformation of the various deep surfaces, sections and complex composit surfaces have been prepared on the basis of the received model. The realized dynamic visualization is now the most adequate method for representation and studying of the complex natural processes.

4D-models possess the necessary system completeness and include all minimally necessary components of the completely formalized models. For this reason, they allow to study the modelled processes in time and space for the future and retrospectively. The formalized records of models are universal and are not

connected with the concrete region, i.e. verification of their local adequacy can be carried out in the various seismic regions.

### **The Priority Scientific Researches**

1 – Development of the fundamental and applied researches on studying the deformations of an earth's crust and soil, as the phenomenon and system process on the basis of the multidisciplinary approach. 2 - Creation and the analysis of uniform global dynamic model for the globe. 3 - researches of thermodynamics of the lithosphere of Kazakhstan and modeling of the convective currents. 4 – Creation of 4D-models of modern movements according to continuous space monitoring and GIS -TECHNOLOGIES. 5 - creation of local geodynamic zones and detailed researches of deformation processes of the zones of compression, shifting and stretching in plates. 6 - Construction of the 4D dynamic deformative models of the lithosphere of Kazakhstan, Northern Tyan-Shan, the Caspian region that are adequate to the natural process. 7. Calculation and the analysis of the theoretical prognostic seismological catalogues for up to 2050, solution of the problems of seismic division into districts and an estimation of the seismic danger. 8 - Creation of global databases, development of GIS-TECHNOLOGIES, technologies of modelling and forecasting which compile data in the form of the scientific information products.

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## **VIDEOECOLOGY**

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### **Abstract**

We formulated the conception of “videoecology” as a result of long term studies (during 30 years) on eye movements in healthy and pathological patients (myopia, blindness, strabismus, disorders of oculomotor system). Videoecology is a new scientific direction that deals with an interaction of human beings and its visual environment. It is based on a new idea on eye movement mechanisms namely the concept of automation of saccades (V.A. Filin, 1987).

Visual environment has been deteriorating within the last years. There were created many homogeneous and aggressive visual fields in cities and towns - especially in large urban areas. Aggressive visual fields are areas where a lot of identical visual details are evenly distributed on the some surface. For example a multi-storey building with a great number of windows creates an aggressive visual field (many identical visual elements). The observers eye can not determine which window it is looking at, for all the windows are similar. There is nothing of such kind in natural environments: in any case the eye “knows” for sure what it is looking at and which element it is fixing at the moment. In every city people live in an entire surrounding of aggressive fields. No mechanism of vision can work properly under such conditions. In our opinion the quantity of myopic patients in cities is higher than in rural areas because urban visual environment is worse than it is in the countryside. Besides we believe that unfavorable visual environment is one of the reasons for the increasing number of psychic diseases. Aggressive visual environment forces a person to aggressive actions. The increasing number of aggressive visual fields increases even the crime rates.

Vigorous actions of specialists (ophthalmologists, physiologists, and psychologists) are necessary to prevent negative consequences of visual environment deterioration. Videoecology must be a phenomenon of mass consciousness.

Videoecology has been registered by Russian copyright society as an object of intellectual property (№ 008, 1999).

## **Actuality**

In many countries of the world the problem of ecology has merged as a real matter of economic and social importance. At present, this matter attracts close attention of scientific, public and parliamentary circles. However, when speaking about ecological problems it usually relates only to sufficiency of polluted air and water, extremely high noise and radiation level but the constant visual environment and its condition are never mentioned as an ecological factor which is not of the least importance. Moreover, it is a common thing to consider that all we need is fresh air, clear water and silent life and we care nothing about what we look at. Being governed by such an attitude, one often handles urban environment design, new labor vacancies creation, industrial and living areas interior development. And meanwhile, as it was discovered by the science, the constant visual environment full of visual elements exerts an immense influence upon the human being especially affecting its organ of sight, i.e. it acts the same way other ecological factors of inhabited environment do. This new scientific trend developing visual perception of environment was named videoecology by us [V.A.Filin, 1989]. This is a high-priority scientific trend being of great interest for experts in ecology, psychology, physiology, medicine, architecture and art.

The problem of videoecology has particularly aggravated in recent 50 years due to the total urbanization which isolated the human being from its natural visual environment. This isolation was made possible mostly due to the use of new materials in urban development. As a result we have a lot of cities with drastically changed visual environment, i.e. prevailing dark-gray color, straight lines and right angles, urban buildings being mostly static with a great number of vast surfaces. Homogeneous and "aggressive" zones are especially disturbing for a man. In case of homogeneity these are bare walls made of concrete and glass, solid fences, subway crossing and asphalted surfaces, whereas in case of "aggression" we are facing standards elements predominance, e.g. rows of windows on the flat walls of many-storeyed buildings.

Visual environment has been transformed for city population due to the nature of urban labor. People work in rooms, i.e. in closed space - at plant and factory workshops, at schools and colleges. The interior is full of new materials of artificial nature, such as polished furniture, plastics, linoleum, tiles, films, glass, corrugated aluminum, net screens, grills and bars, design structures, etc. Visual environment in private apartments is made up with same kind of materials.

### **Visual environment as an ecological factor**

Visual environment means an environment with all its diversity a human being perceives through the organ of vision, i.e. woods, seashores, mountains,

buildings, constructions, interiors of dwellings and industrial premises, motor-cars, ships, aircraft, etc. Natural visual environment fully complies with physiological standards of vision since the nature "fashioned" an eye as if it was making it for itself. Artificial environment is another pair of shoes. It differs even greatly from the natural one, and in many cases come into collision with laws of visual perception of a human being. Such environment gave birth to another problem of human ecology, i.e. problem of videoecology.

Speaking of visual environment as an ecological factor, one should pay attention to the fact that 90% of his history a human being has been in harmony with the nature, existing as its integrated part. First, all activity of a human being consisted in getting food by hunting, fishing, picking up berries and root crops. Visual environment, surrounding a human being at that time, was natural, complying completely with vision standards. Having exhausted resources for hunting in places where a human being used to live, a human being had, by opening up new territories, to get over to another, new - settled - way of life, having engaged in agriculture and livestock breeding. And during that period his visual environment did not change considerably either. Industrial revolution in Europe started changing visual environment, and that took place nearly 8 generations back. For 250 years that passed, it has amplified power of a human being, but just then the exterior and interior of a dwelling changed abruptly and everywhere. Global changes of visual environment have taken place for 50 recent years when capacities of building industry, computer-aided production lines, production of new materials increased to the greatest extent.

On the other hand, in the course of evolution a human being, during a day, for just a little time, was busy gazing at specific surroundings, and that took place probably only when hunting. During the greater part of his time he was within familiar environment which did not attract much attention. In our opinion, a primitive spent up to 80% of his time to freely perceive surroundings. Nowadays, the correlation between specific and nonspecific type of information perceived has radically changed: now for up to 80% of time, we deal with objects requiring special attention. Civilization has radically changed the nature of visual process. This tendency is growing, thus aggravating our situation, since, though a human being possesses great power, they are limited.

Escalating strains on our vision contradict physiological ability of eyes movements, and in particular saccadic automation phenomenon. Experiments demonstrated that the number of such saccades, with rather different visual activity, remains on the same level - approximately one saccade a second.

### **Saccadic automation concept**

A lot of works have been dedicated to study the occurrence of saccadic eye movements. Special attention has been given to microsaccades [R.Ratliff, L.A.Riggs, 1950; V.D.Glezer, 1959; T.N.Cornsweet, 1956; R.W.Ditchburn, 1980; A.L.Yarbus, 1965; V.A.Filin, 1987; Z.N.Yargina, 1991; R.M.Steinman, H.Collewijn, 1980; E.Spigel, G.Sato, 1926]. In spite of this fact, researchers failed to come to a joint opinion as per microsaccadic occurrence mechanism. As we think, researchers have made an unjustifiably great orientation towards the canonical scheme of homeostasis support with traditional feedback.

This was contributed by the fact that hypotheses of microsaccadic occurrence mechanism appeared when the cybernetics approach in biology (1950-60s) was being formed as well as when military homing systems were being designed. As a result many authors tended to consider microsaccades as a deterministic process initiated by certain error signal. Based on this principle are two hypotheses of that time: correction [T.N.Cornsweet, 1956] and desadattitional [R.W.Ditchburn, J.A.Foley-Fisher, 1967; A.Fiorentini, A.M.Ercoles, 1966]. According to one of them, an error signal appears with an object image displacement in the retina, according to the other one - with occurrence of first attributes for its extinction. A reply saccade is further reflectively patterned. The second methodological mistake made by researchers, in our estimation, was their attempt to consider microsaccades as an independent type of eye movements apart from other saccadic movements which, to a greatest extent, confined the search for resumptive concepts. The result is an absence of a reasoned point of view as per microsaccadic mechanism in spite of the efforts of many researchers which they have been making for 40 years. Probably due to this fact, answering the question on the microsaccadic mechanism and role of microsaccades, Kowler and Steinman [E.Kowler, R.M.Steinman, 1979] said: «We do not know. It might be a tic douloureux». A serious methodological mistake in studying mechanism of other types of saccadic eye movements was disunity between experts.

Each of them studied principally his own aspect: physiologists - microsaccades, neuropathologists - various types of nystagmus, psychologists - saccades with visual perception, ophthalmologists - saccades with strabismus and weak vision. As a result, there were no efforts made to consider saccadic activity in complex as a single process. In addition, experiments themselves, in many ways, were of a fragmentary nature and concerned only one saccade type. Having the purpose of considering saccadic activity as a single process, we collated saccadic parameters. It turned out that with absolutely different vision missions as well as with spontaneous nystagmus, the interval range has close values. Mean values of a big group of subjects were close to 1. (Table 1).



**Performance of saccadic movements under different conditions***Table 1*

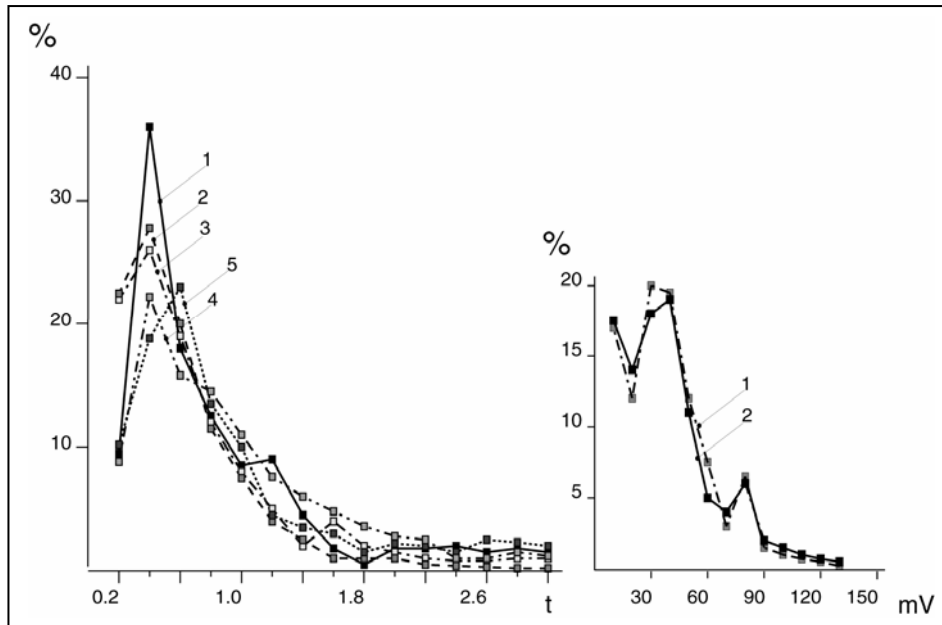
<b>Conditions of eye movements registration</b>	<b>t, sec</b>	<b>A, angle degree</b>	<b>K</b>
Real dot fixation	0.35-1.60 (0.96)	0.06-0.46 (0.2)	0-0.3 (0.15)
Virtual dot fixation	0.52-1.83 (1.30)	0.13-0.70 (0.4)	0-0.4 (0.17)
Reproduction of a given figure	0.62-0.99 (0.77)	0.06-15	–
Optimum rate of random jumps with students of two groups	0.91-0.99	30	0
Miner's nystagmus	0.12-1.87	0.36-2.0	0-1
Vestibular spontaneous nystagmus	0.5-0.85	4-6	1
Spontaneous nystagmus with vernal encephalitis		4-8	1
Easy conduct of the rabbit	0.46-0.75 (1.16)	1-90 (19)	–

It is interesting that the rabbit had approximately the same interval under easy conduct with remote sensing registration of eye movements [H.Collewijn, 1981]. Differences as per amplitude and asymmetry coefficient under given tasks were great.

Many researchers paid attention to close values of intervals between saccades when subjects performed various vision tasks. Thus, when the same subject performed six different vision tasks (dot fixation, change of fixation dots, optokinetic nystagmus, tracking, convergence and reading, intervals between saccades amounted to 0.1-0.5 sec [K.J.J.Ciuffreda, S.G.Goldrich, C.Neary, 1982]. According to American researchers [E.Kowler, R.M.Steinman, 1979], two subjects, with dot fixation and when reading, had not only average values of micro- and macrosaccades intervals but also intervals distribution curves coincided. That is what L. Mitrani wrote regarding this matter: "It is rather remarkable: one and the same subject had the same number of saccades at each trial with a small spread in values" [L.Mitrani, 1973]. According to our data, with multiple fixation of a steady dot during one year, the average interval varied by 20%, and saccadic frequency for the first and second six months amounted to 1.40 and 1.36 Hz respectively, i.e. the difference was minimum: 0.04 Hz only [V.A.Filin, 1987]. Thus, whether a subject fixes a physical or virtual object, draws

a given figure, looks at a picture, or voluntarily turns his vision from one object to another, the total number of saccades is within a fixed value. This, unconditionally, points to a consistency of the operating condition of structures generating saccades. The similar situation is observed not only when one is awake but when one is sleeping as well [V.A.Filin, T.F.Filina, 1989], and in pathology and with various nystagmus [V.A.Filin, 1987]. Moreover, not only a man but a rabbit as well had the same number of saccades and the nature of interval distribution [H.Collewijn, 1981]. One cannot explain this fact by a mere coincidence. This, as we think, points to certain consistency of the operating condition of structures generating saccadic eye movements.

Basing on the data we received in 1987, we drew up a concept about saccadic automation [V.A.Filin, 1987]. Pursuant to this concept, saccades are stipulated by brain structures capable of rhythmogenesis with no extraneous stimuli as per pace-makers. Automation, as a physiological phenomenon, is oldestablished: such are automation of heart, automation of breathing, and that of digestive system [M.M.Levashov, 1984]. We are supplementing the automation list in the human organism with saccadic automation. At present, there a lot of data speaking in favor of saccadic automation. And that is for saccadic automation, in our opinion, that one can explain the coincidence of interval distribution curves under five different observation conditions (Fig. 1). The same number of saccades with the blind and with those who can see may be explained by automation as well as with new-born kittens before afterlight [G.Berlucci, G.Moruzzi, G. Solvi, P.Strata, 1964], and with animals raised in complete darkness from the moment they were borne. Automation, as we think, is an endogenous process performed without extraneous stimuli and based on performance of irregular pace-maker neurons which generate pulses with these or those intervals. In this case, irregularity of intervals within the saccadic automation process is stipulated by plastic attributes of the pace-maker potential which is of great importance for general biology. Irregularity of intervals between saccades, their orientation and different amplitudes obscured a phenomenon of saccadic automation as such for researchers. Physiologists, psychologists, and physicians, when facing saccadic automation during experiments, took it for an amusing incident, accordingly evaluating similar saccadic eye movements as voluntary, spontaneous, nondeterministic, inaccurate, involuntary, search, quasieffectual, erection, torsion saccades, vestibular physiological nystagmus, nerve tic, etc. Such definition diversity masks misunderstanding of a genuine saccadic mechanism. Meantime, all this, as we believe, is nothing than saccadic automation with which researchers could not but occurred in their research activities.



**Fig.1. a - Distribution of intervals between saccades under various observation conditions. 1 and 2 - during babies' and adult's quick sleep respectively (470 and 2343 intervals between saccades processed, 7 and 3 subjects); 3 and 4 - fixation of a steady and virtual dots respectively (2362 and 1215 intervals between saccades processed, 11 and 8 subjects); 5 - free seeing of a picture (2000 intervals between saccades processed, 5 subjects); X-axis - intervals between saccades, s, Y-axis - number of measurements, %; b - Distribution of intervals between saccades with babies (1) and adults (2) tested in quick sleep stage (520 and 1626 saccades processed, 7 and 3 subjects). X-axis - saccadic amplitude, mV, Y-axis - number of measurements, %**

Microsaccades appearing with fixation of real and virtual dots are being considered by us an instance of automation of saccadic eye movements, namely automation of minimum saccadic amplitude with saving a previous interval and orientation mode. Microsaccades do not mean a "nerve tic" [E.Kowler, R.M.Steinman, 1979] but a normal physiological phenomenon under special conditions, that is under conditions of fixation of a steady small-size object. A nystagmus may be another instance of saccadic automation. In this case, when saving previous saccadic intervals and low amplitude, patients face a short change in their orientation (all saccades are oriented in one direction). Saccadic automation, if we put it "clearly", shows itself within a paradoxical phase of a dream [V.A.Filin, T.F.Filina, 1989], and with the blind [V.A.Filin, 1987]. Thus,

unlike the routine opinion on the deterministic nature of the greater part of saccadic eye movements, we have brought forward a concept about saccadic automation being a principal consistency for saccadic activity with diversity of oculomotor activity as a background [V.A.Filin, 1987; V.A.Filin, 1990; V.A.Filin, 1991; V.A.Filin, T.F.Filina, 1989]. An apprehension about saccadic automation means a new trend in physiology, a promising one when studying psycho- and neurophysiological aspects of visual perception, matters of functional selection and diagnostics of a number of diseases.

### **The ecology of urban visual environment**

Visual environment is one of the principal components of life-support of a human being. Up to the moment a human being stayed in natural environment for a greater part of his time, there were practically no problems in the field of videoecology. Moreover, using the words of poet A. Belyi, "around the soul is drinking a diamond current from the eyes". Urbanization processes completely ruled out the possibility to enjoy surrounding environment, and instead of "diamond current around" a human being has got homogeneous and aggressive environment which, being unnatural one, not only fails to afford aesthetic delight but brings forth a great number of social problems. Videoecology which studies interaction of a human being with surrounding environment constitutes an actual problem among the problems of human ecology.

From our point of view, creation of unnatural visual environment was caused by the following reasons: revolutionary approach in solving urban development issues, erroneous aesthetic positions of specialists whose viewpoints were based on industrial methods and necessity of fighting against extravagances, rapid growth of cities when there was a practical lack of creative potential from the part of architects, rapid growth of construction industry with its automated production lines of similar construction materials, separation of a human being from the nature, and finally, a lag of videoecology as a science. We would like to speak in detail about the latter one. That is associated with the fact that if architects had been guided by the laws of visual perception in their creative work, we may say for sure that such serious blunders in forming urban visual environment could have been avoided.

We can hear objections that there have been reproaches against modern architecture before as well. Yes, it is true. However, in general these reproaches were subjective: "faceless boxes", "monstrous geometry", "technocracy", "environment is injured with inexplicable and alien forms" [Ya.Vuec, 1990; V.I.Gusel'nikov, 1983], etc. With little exception [E.L.Belyaeva, 1977], there were practically no attempts to analyze visual environment, where townsmen found themselves, in its integrative form. On the other hand, those researchers who

touched the mechanism of visual perception of modern architecture had grounds based on dated conceptions. They did not take into account the fact that the eye is working in the active mode, it is searching for what it can "seize" in urban environment, what "to catch", what "to go at". Speaking scientific language, the eye is scanning surrounding environment. Such activity of the eye is achieved owing to the nature of its rapid movements - saccades. Saccades are performed constantly and involuntarily, both with open and closed eyes, when we are awake, and when we sleep [V.A.Filin, 1987; V.A.Filin, 1990; V.A.Filin, 1991]. The total number of saccades under different conditions have comparable values. On the basis of these data we have laid down a concept about saccadic automation [V.A.Filin, 1987]. It means that in most cases a saccade is primary. And that fact that the eye will see after the saccade is secondary. In this case, after saccade the eye must "catch" something. As soon as that happens, the eye calms down, and the amplitude of its saccades is decreased up to minimum values, the number of saccades, in this case, remains the same. In 2-3 seconds the eye scans surrounding environment another time by several saccades and again stops on a detail minimizing saccadic amplitude.

There are individual cases when a saccade is secondary, for instance, as a response to light flash. In order to fix a look on an object which appears in the vision field, saccadic center selects a saccade of corresponding amplitude and orientation, that is their modulation is performed, and the interval is given in a previous form.

The concept on saccadic automation is a new idea on visual perception of surrounding environment. That is what allowed us to study the problem of videoecology. From the position of new experience we have analyzed urban visual environment: we have found fields not complying with saccadic automation and other vision mechanisms.

Thus, we may say that videoecology is based not only on subjective statements but on regularities of visual perception. That is the principal difference of our analysis of modern architecture from previous reproaches to its address.

Aggressive visible field is a field with concentration of a great number of similar elements. Such environment is created by multistory buildings with a great number of windows on the wall, attached vertical rustics, panels of houses coated with glass "toffees", walls coated with tiles, brickwork with concealed joint, doors padded with "lining" as well as various bars, meshes, perforated boards, corrugated aluminum, asbestos-cement board, etc. Under urban conditions one aggressive field is often applied over the another one, for instance, a house wall with attached rustics behind a metallic bar.

Fundamental vision mechanisms such as saccadic automation, binocular apparatus, conversion, on- and off- systems and vision centers cannot operate in aggressive and homogeneous environment to the full extent. In particular, in

homogeneous environment impaired is the feedback between sensor and motor systems since after successive saccade illumination difference on eye photoreceptors is insufficient. Accordingly, after the saccade the brain receives a minimum pulse insufficient for reliable feedback actuation. In other words, an action has taken place - saccade, but there is no confirmation to this action. As a result vision centers and the nerve system as a whole are confused. That in turn causes a perception of discomfort.

Decor of buildings does not mean "architectural extravagances" which our literature has written a lot about. These are essential functional elements comprising the basis of visual environment. Without them the eyes cannot operate to the full extent. As in the air there must be a sufficient quantity of oxygen, in visible environment there must be a sufficient number of elements. Abundance of same elements in visible environment - windows on the wall of a big house, tiles or rods - we may say, completely "switches off" such a powerful sensor channel as a vision analyzer since the eye simply "does not know" what particular element it is fixing. In natural environment no such things can happen. In the nature, if the eye looks at something, it "knows" that. The vision apparatus, in this case, correctly evaluates reality, and easily and rapidly orients in it accordingly.

In all big cities the number of mental diseases has recently increased. Specialists called this disease "a syndrome of a big city" which often shows itself in human aggressiveness. Among many factors unnatural visible environment greatly contributes, in our opinion, to the growth of mental diseases. The statement made by Avicenna: "All that the nature managed to accumulate invisibly enters the nature of the body". If we intend to further build cities as we do it nowadays, lunatic asylums in cities should be built dozen times as quicker.

The problem of videoecology does not relate only to medical aspects. The point is that aggressive environment makes a human being perform aggressive actions. As a rule, in new communities with unnatural visual environment the number of breaches of law is more as compared with a central part of a city. This means that not only lunatic asylums should be built dozen of times as quicker, but it is also necessary to increase the staff of militia. It is quite obvious that errors committed in evaluation of human ecology become global every time.

Architecture is a durable, expensive and raw material intensive layer of culture where giant physical and intellectual efforts of the civilized society are materialized. These efforts should not be made in vain. Above all, architectural objects should please the eye. They should positively affect, in emotional and ethic respect, a human being who stays under their influence all life long, and of course, they should not damage health of townsmen.

Architecture constantly affects a human being and mainly at the back of its mind. Right was Victor Pelevin when he was writing: " Things you see every day for many years gradually pass into a monument to your own... To see actually

means to put your soul on a standard copy on the retina of a standard human eye" ("Anthology of childhood"). If an adjoining aggressive house is "put" on a human soul, "a monument to your own" is converted into a multocular monster.

According to Aristotle, a city should provide security for people and make them happy. Unfortunately, this rule was broken in all times, and in recent 50 years it has been forgotten at all. As a result, a human being has become a victim of his own creative work surrounding himself by aggressive visual environment.

"To embrace the space, cognize how to see it (accentuated by us) - that is the key to correct comprehension of a task" (Bruno Dzevi [E.A.Likhacheva, E.B.Smirnova, 1994]). In old times many architects managed this. It was often achieved not only by embracing the space but also by variety of forms, lines, multistory level, diversity of stories in buildings, small sizes of surfaces and different decorative elements. In a word, everything was done for sufficient saturation of an object with visible elements in order "to oblige" saccadic automation (Fig.2, 3). On the other hand, such saturation was not to the detriment of aesthetic merits since diversity of details is an objective basis for the beauty of an object. It is quite obvious that it is impossible to create a beautiful object and, certainly, very difficult to create comfort visual environment of a city only with right angles and straight lines which the eye "does not like" and which prevail in modern architecture. It would rather be a cacophony characterized by the worst combination of sensor stimuli.

As it was stated in the enactment of the CPSU CC issued in November 1955 ("On elimination of extravagances in designing and construction"), decorative details in architecture are not extravagances. They are necessary elements for formation of visual environment. It is not by accident architects have used them for many centuries. They have functional meaning, they are needed for manifestation of saccadic automation as the air for breath automation. He who was the first to say about "architectural extravagances" hurt us all; suffered was not only aesthetic part but fundamental vision mechanisms and lives of townsmen were also threatened. A human was living in natural visible environment for millions years. 90 per cent of his history he spent in harmony with the nature. Now in XX century he found himself in quite unusual environment – in stone and asphalt jungles.

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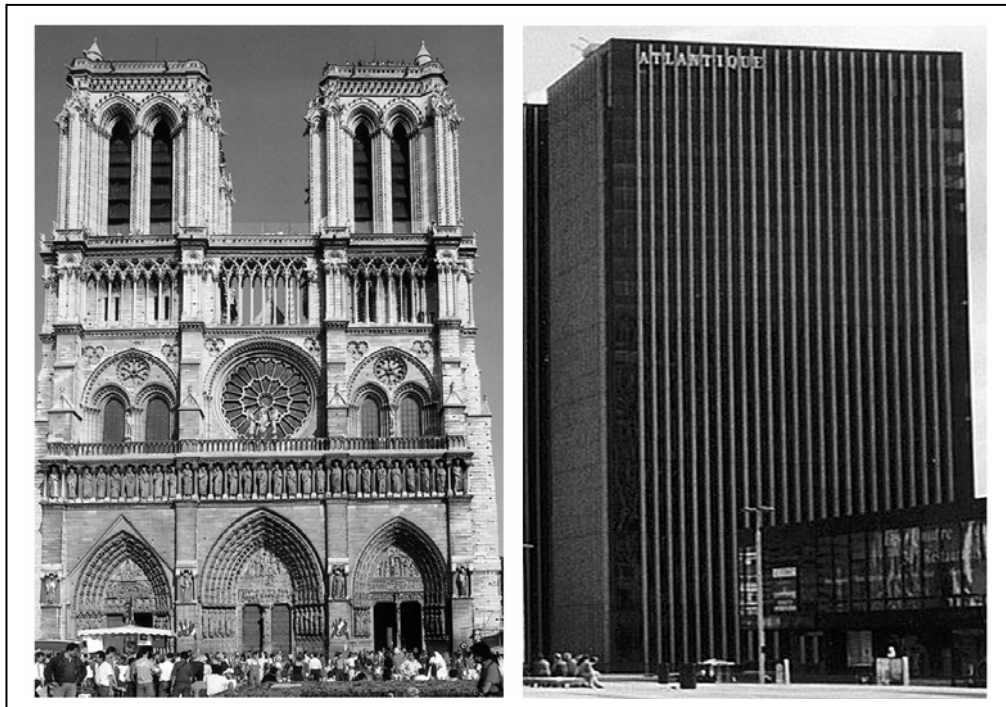
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Until now problems of theoretical investigations have borne a stamp of traditional approach to architecture as three-dimensional designing. Ignored are general issues of urban development including issues of visual environment. The lack of valuable theory enables to get effective and justified practical recommendations. Many architects are aware of this reason. Here what A. Gutnov writes in this regard: "It is necessary to direct all efforts in order to develop a new type architectural theory based on the knowledge of general regularities of artificial environment created by a human being, of mechanisms of its formation and development" [V.I.Gusel'nikov, A.F.Iznak, 1983].



*This is good for the eye*

*This is bad for the eye*



*The past*

*Nowadays*

**Fig.2. Paris, France**

*This is good for the eye*

*This is bad for the eye*



*The past*

*Nowadays*

**Fig 3. Moscow, Russia**

It is, probably, worth to remind what the source is to create artificial environment and urban environment in particular. Such components as air, water, temperature, noise and radiation level, homogeneous fields are known to be a basis of human environment. However, all these components, though very important, are indirectly related to the theory of architecture since architecture, as it may be directly comprehended, means an external appearance of buildings. This an object we look at with our eyes, or, speaking by architect Melnikov's words "architecture is a game for eyes". Thus, "development of new type architectural theory" should be carried out taking into account requirements of visible environment. And it should base on general regularities of visual perception.

We are glad to remind that architect N. Ladovskiy related this issue with understanding yet in 20-s. "Architect, – he wrote – should, though just a little, be familiar with perception laws and means of influence in order to use in his work everything that modern science can give. Among sciences contributing to

architecture a serious place should be taken by rather young science "psycotechnics" (accentuated by us). We won't argue with terminology of those years, the main thing is the backbone which in many ways coincides with our point of view since both videoecology and psycotechnics are based on the laws of visual perception. It is fair to say that nowadays we know more about these laws than in 20-s. In particular, we know that saccadic automation is the basis of visual perception [N.Ladovskiy, 1926]. However, the approach of N.Ladovskiy was correct. And if it was further developed, many errors in formation of urban environment could have been avoided.

In places where laws of visual perception were followed to the full extent, architecture has no reproaches. Let us take, for instance, Novodevichiy monastery on the territory of which a man feels comfortable though as per the state of air, water as well noise and radiation level this territory does not differ from other Moscow areas. Replace mentally monastery temples with modern "box-houses" and you will feel horror of a modern city and understand the main problem of architecture based on satisfying physiological needs of visual perceptions and aesthetic norms. And we learn to follow these requirements, we will decide many problems of the architectural theory. In the most common form the theory of architecture goes easily with the triad of Vitruvius: reliable, comfortable, lovely. We can say with confidence that we have learned to make everything reliable. In many cases engineering issues of urban development are solved successfully. We can build houses with amenities: elevator, gas, cold and hot running water, bathroom, lavatory, chute have become a norm of our life. But, unfortunately, we have unlearned to make lovely. Everywhere we violate requirements on visual environment. In fact, in this regard the era of spontaneity has recently come. Abundance of aggressive and homogeneous visual environment makes a modern city practically unfit for human habitation. Modern urban development is often given the credit of elaboration of sanitary and hygienic aspects and insolation standards. We can say that transport and engineering mains are also built rather well.

Unfortunately, we are not sure that we will learn to solve as quickly the problems of videoecology. That is connected with the fact that textbooks, articles, sanitary norms and regulations have created "blindness" which limit professional conscience of architects. "It is difficult to puzzle out in a boodle of words and symbols, - writes Yacub Vuc, - which today mean something new than when they were declared for the first time, it needs a lot of time" [24Ya.Vuc, 1990]. On the other hand, it is difficult to dispute the advance of the construction industry which dictated its approaches in urban development. That is why elaboration of issues of videoecology is quite relevant. Videoecology may be a theoretical basis capable of solving many key issues in the development of the architectural science. As any theoretical development, this is a painstaking job but

that is this job which seems far from today needs is the only reliable way to effective practical recommendations.

What shall we do in this situation? First of all, specialists on ecology, architects, artists, doctors, physiologists, psychologists as well as law-making and executive public bodies should be aware of the problem of videoecology. Videoecology should become a phenomenon of mass conscience. If we want that to happen, videoecology should occupy a corresponding place in the educational process. Videoecology as a subject should be taught in architectural institutes, artistic colleges, schools.

Only if we make definite efforts, we can make a progress in improving visual environment. First of all, it is necessary to analyze and make maps of "pollution" of visual environment of cities. Such maps can give an idea about the nature of the disaster and will permit to develop measures in order to change the situation to the best. Certainly, in this case, it is necessary to preserve all valuable things we have - everything that pleases the eye. To make maps it is necessary to work out a method and devices on evaluation of visual environment.

A program on population displacement should be made out on the state level. With our vast territories it is much easier to solve this problem as compared with other peoples. Every Russian citizen can live "inside" the nature and in full harmony with it. By no means one should increase the number of cities and their sizes as it has been done until now.

Sometimes when reading lectures I have to hear reproaches saying that videoecology is no business of Russia at present. There are a lot of other urgent problems. Indeed, there are: decline of the production level, cost-in-living increase, inflation, moral and ethic problems, discord between nations, and wars. It seems to us that Yu.Koryakin was right when he wrote about the reasons which led to such consequences: "We found ourselves on a razor-edge first of all because we have lost love to life. We will be saved not only by repulsion from death but by attraction to life".

How can preconditions to attract our fellow citizens to life be created? That is the main question. We can a lot of food, good hospitals and good medicines, but if a man has no "attraction to life", there cannot be a question about active longevity. And if a man does not value his own life, he does not value all that is living around him, and he kills forests, rivers, animals. We can go the already known way and create another committee at President's level. For example, "Committee on attraction of Russian citizens to life". But such a committee will hardly be capable of fulfilling such a global task. To solve it is necessary to attract the whole intellectual potential of the country, that is - scientists, religious personalities, personalities of culture and art, academics. Videoecology can make a great contribution in solving this problem. We have owned a principally new

knowledge which radically changes our conception about the practice of urban development.

In our opinion, comfort visual environment may contribute to attraction to life. Cheerfulness of inhabitants of south coasts of Greece, Italy and other favorable corners of Earth is explained namely by comfort visible environment. Surrounding beauty is a key to solution of many problems. It can fill the life with contents and "attract" a man to life. Architects and other specialists responsible for urban environment should aim at creating the beauty. F. Dostoyevskiy did not say that abundance of foodstuffs would save the world but he said: "The beauty will save the world". This statement may be evaluated as a large scientific discovery the implementation of which we have not started yet. Abundance of foodstuffs can secure physiological welfare of a human being but it cannot guarantee attraction to life, whereas the beauty has a universal influence upon a human soul. And that is the beauty which is able to fulfill this task.

Further developing his expression which has become very popular, F. Dostoyevskiy wrote: " If a people preserves the ideal of the beauty and the need for it, that means there is a need of health, norm, and accordingly, that guarantees a superior development of that people". It is quite obvious that it is impossible to awake a need for the beauty with people surrounding it by aggressive visual environment everywhere. People should constantly stay in comfort visual environment. Only in such a way we can develop a need for the beauty with Russian people, thus achieving its superior development. Videoecology may serve as a methodological basis for solving this global problem. Principles and methods of videoecology permit not spontaneously, as it has been done until now, but consciously to form visual environment of Russian cities which completely complies with physiological norms of vision.

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## **ENERGOENTHROPIC ANALOGY OF CHANGING OF QUALITY OF COMPLEX ENGINEERING – GEOECOLOGICAL OR GEOTECHNICAL OBJECTS**

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Characteristics of real state of any engineering – geoeological or geotechnical objects both on any stage of its forming, building, restoring and during its exploitation may be introduced by two ways:

1) according to average parameters of properties of engineering – geoeological or geotechnical object itself (steadiness, durability, isolation, liveness and others).

2) according to separate real values of parameters of engineering – geoeological or geotechnical object( local deformations, wear and tear, results of separate measures of parameters of quality and so on)

Both the ways of considering the state of the object allow to use some axiomatic principles concerning to forming the properties of engineering and geoeological or geotechnical object basing on some energy – entropic analogies of changes of quality.

We should like to explain what “engineering – geoeological and geotechnical objects” are meant by us.

Engineering – geoeological object consists first of all of natural area with its proper relief, landscape and biota, which is in geological equilibrium, but because of different causes (objective and subjective) influenced by antropogen or technogen and catastrophic natural phenomena which can disturb geoeological equilibrium of the object. In such a case some management solutions are required to be settled providing positiv properties of the object basing on natural selfrestoring and necessary protection measures, according to laws and special engineering – ecological rules.

As a result, the appointed object must get a new form of geoeological equilibrium with additional permissiable antropogen – technogen potential without the loss of natural attractiveness.



Engineering – geocological object is also the natural territory having degraded or degradating (having lost or losing the former natural attractiveness), because of negative natural processes, with geopathogenic relief, landscape, geo-environment and ill biota, which demands to be lead out of the state of extremely negative equilibrium or unsteadiness by means of engineering land reclamation in order to give the object the ability of getting the state of positive geocological equilibrium reaching the condition man-causedly supported by natural attractiveness.

Geotechnical object may be introduced as an anthropogen – technogen influence on the determined territory with internal and closing to its borders geological environment expressed as technological, constructional and ground structural potentials leading to changes of properties and functions of the appointed natural area as result of man's activity. In the end the object comes into a new state of the geocological equilibrium under strict following engineering – ecological and management solutions according to the normative documents.

It is out of doubt that in complex developly engineering – geocological objects there exist geotechnical elements, and in complex geotechnical objects there appear engineering – geocological elements with various degrees of entropy.

Among the mentioned ways the first one basing on common laws of transition of complex engineering – geocological or geotechnical object from one state into another one provides the final result of the real state. The other one basing on detailed study of nature of internal ties taking place in elements of complex engineering – geocological or geotechnical object provides special features of intermediate states of the object.

The central place in axiomatic construction of the principles of forming properties of complex engineering – geocological or geotechnical object during its designing, forming (building) and during exploitation belongs to the condition of equilibrium of the object according its different criteria of its state. From ergoentropic point of view the complex engineering – geocological or geotechnical object is in equilibrium in the case of average values of parameters of its properties remain constant within regulated limits. Real processes of forming (building) and exploitation of complex engineering – geocological or geotechnical object may be described by schemes of transition of equilibrium

states of the object by means of the system of parameters of its quality  $\sum_{i=1}^n \omega_i$ .

The degree of quality of complex object changes gradually. During the form action (building)

$$\Omega_1 \rightarrow \Omega_2 \rightarrow \Omega_3 \rightarrow \dots \rightarrow \Omega_i, \quad (1)$$

and during the exploitation.

$$\Omega'_1 \rightarrow \Omega'_2 \rightarrow \Omega'_3 \rightarrow \dots \rightarrow \Omega'_i, \quad (2)$$

Coming through intermediate states determined by external natural and anthropogen – technogen influences, physical and mechanical, physical and chemical and other properties of mountain ground and coils, as well as the materials of which engineering structures are made.

Transitions of equilibrium states of complex engineering – geological or geotechnical object are interconditioned from the point of view of development of causal and effective ties according to thermo – dynamic (ergoentropic) principle of shift of equilibrium by Le-Shatelie if the object in steady equilibrium state is influenced from outside changing one of the conditions of equilibrium, the process which weakens the influence of the occurring effect will grow and the equilibrium will move in the same direction. From the physical and mechanical and physical – chemical point of view, using this principle regarding to the complex engineering – geocological or geotechnical object we may say the following: during the transition from one stage of forming (building) or exploitation of the complex object to another one a new equilibrium state of the object appears.

$$\Omega \left( \sum_{i=1}^n \omega_i \right)_I \rightarrow \Omega \left( \sum_{i=1}^n \omega_i \right)_{II} \quad . \quad (3)$$

Directed influence on the complex engineering – geocological or geotechnical object causes the respond reaction of the object, expressed by flowing or spasmodic changes of real degree of quality (changes of stressed – deformed state, growth or removal of defects, reducing or increasing sustainability of biota and so on). The shapes of displaying the reaction of the complex engineering and geocological or geotechnical object don't influence the transition itself into a new equilibrium from the point of view of interconditioned of such a transition.

The introduced principle of shift of equilibrium is a convenient analogy of the formation of quality of the complex object according to criteria of its state or the stage of damage.

We consider for the first approximation the example of formation of quality of complex geotechnical object with engineering and geocological elements (properties) according to ergoentropic analogy of changes of quality.

Natural slope is introduced as a complex geotechnical object being in equilibrium state and characterized by some real level of stressed – deformed state  $\Delta_I$  and damage (defectness)  $d_I$ . Cutting the slope up and placing engineering structures there cause the transition of the complex object into a new equilibrium state  $(\Delta_{II}, d_{II})$ , which differs from the first one. The degree of quantitative difference between the stages of the object considered depends on the reaction of the object to the changes taken place and is caused by many factors (geometrical changes of slope, physical and mechanical properties of the ground, properties of constructions of the engineering structures and materials of which they are made, conditions and technology of work and so on).

Functional process of the transition of states of the complex geotechnical object may be described by entropy. As the real process of formation (building) and exploitation of the complex object on any of its stages brings quite certain proportions of the parameters being formed it is methodically correct to consider entropy as a function of the state of a complex object. If we suppose the process of formation (building) and exploitation of a complex engineering and geocological or geotechnical object happens spontaneously (without norma or rules), has unmanaged character (under the lack of control), such a process according to analogy may be considered ergoentropically irreversible with growing entropy. Real process of formation (building) of the complex engineering – geocological or geotechnical object is usually under productive and ecological control, the aim of which is to get the most comfortable equilibrium state of the complex object on any stage. As a result the common tendency of increasing of entropy of quality of complex engineering – geological or geotechnical object gains some different character demanding the control of magnitude of entropy of quality of object under not letting its being more than the permissible one.

Using entropy as a function of state of complex engineering – ecological or geotechnical object, in other words, measures of its quality, lets any change of its state be introduced as result of infinitely a great number of infinitely little changes.

Under each infinitively little change of state the complex engineering – geocological or geotechnical object either increases or reduces its complex ground – structural potencial or, in other words, the object either gathers or loses its quality.

We use the following main characteristics of formation (building) and exploitation of complex engineer – geocological or geotechnical object. We designate the work at the complex object to shift it from one state with the proper degree of quality into another one with another degree as  $A$ ; the quality of complex object as a complex ground structural, constructive its state as  $\Omega_0$ ;

exploitation quality of complex object determining the level of its reliability as  $\Omega_e$ .

$\Omega_0$  characterizes the energy abilities of the complex engineering – geoeological or geotechnical object,  $\Omega_e$  – the work done by the complex object with complex ground – structural, constructive and technological potencial within the range of real exploitation loads.

Basing on the law of preserving energy we have:

$$dA = d\Omega_0 + d\Omega_e \quad (4)$$

where the characteristics of the state of the complex engineering – geoeological or geotechnical object while changing one degree of quality into another is introduced this way:

$$\int_I^II d\Omega_0 = \Omega_{II} - \Omega_I = \int_I^II d\Omega_e - \int_I^II dA. \quad (5)$$

We consider  $dA$  positive when the complex object increases its complex ground – structural, constructive and technological potencial or negative when the object reduces its complex pontencial. We designate integral complex characteristics of the state of the complex object as

$$S_\Omega = \int \frac{dA}{\Omega}, \quad (6)$$

here  $dA/\Omega$  – the work spent on the complex object;  $\Omega$  – integral quality of the complex object.

Calculated by this way, the magnitude of  $S_\Omega$  is called the entropy of quality of complex engineering – geoeological or geotechnical object according to ergoentropic analogy.

The change of the entropy of the complex engineering – geological or geotechnical object at which infinitive little work  $dA$  has been done can be determined as follows:

$$dS_\Omega = \frac{dA}{\Omega} \quad (7)$$

Using equations and analogically to the first beginning of thermodynamics (ergoentropy in our case) we have:

$$\Omega dS_\Omega = d\Omega_0 + d\Omega_e \quad (8)$$

The level of productive control of the object will be considered as the criteria of changes of the quality of the complex engineering – geocological or geotechnical object.

While gathering damages entropical change of the state of the complex object may be described using equation (7):

$$dS_{\Omega} = \left( \frac{1}{\Omega_{II}} - \frac{1}{\Omega_I} \right) dA \quad (9)$$

If the total loss of quality of the complex engineering – geocological or geotechnical object increases, the entrophy of the system increases.

So the important demand required to the process of forming(building) and exploitation of the complex engineering – geocological or geotechnical object is the tendency of increase of the entrophy of the quality of the object must be strictly regulated by building and ecological norms and laws.

# **ARCHITECTURE AND CONSTRUCTION**

## **ABOUT BUILDING ART OF EARLY MEDIEVAL AZERBAIJAN**

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Architecture researchers have always paid a great attention to technical issues, architectural constructions of buildings with a special emphasis on an indissoluble connection between layout and design, on the one hand, and constructive principles of buildings, on the other hand. It is technical progress in construction, i.e. new building materials, new methods, that contributed to the development of new designs in the architecture. Thus, a breakthrough in construction engineering that took place in Ancient Rome under Emperor August led to the appearance of stone and plaster facing. It covered main constructions, made of brick or stone, and involved considerable changes in the treatment of buildings and erections (1, p. 17).

In was the use of burnt brick in the architecture of Azerbaijan in early A.D. that made it easier to erect domical-vaulted constructions and create compositionally complex and constructive systems, specifically, round temples. It was no more coincidence that they first sprang up in the regions where the brick was used on a wider scale.

Research into construction and engineering methods is of particular importance, since these methods are integral components of monuments' architectural image. There is also another reason, which makes us to be careful about this issue. The reason is in exceptional importance of constructions and engineering methods of the past in restoration operations. Ignorance of typical elements, widely spread methods and devices results in improper restoration of monuments, violation of main principles of scientific restoration and even falsification. An increased emphasis on the analysis of architectural structures is accounted for by the destruction of the monuments of Albanian architecture and the need in restoration work.

It was various natural resources and specific social-economic factors of Azerbaijan that led to the use of stone and brick as building materials. Brought to

perfection in early Middle Ages, methods of masonry and brickwork were brought to perfection.

It should be noted that masonry played a key role in monumental architecture of early Medieval Azerbaijan- Caucasian Albania. Basalt, tuff and limestone were used as wall material. Wall construction was ordinarily composed of three layers: inner and external rows of stones with space between them being filled and cut away to enlarge an adhesion area. Surface tooling depended upon type, hardness and grain effect of the material. Frequently found in the ancient monuments is a coarse masonry composed of various boulders. Note that these boulders were combined ignoring horizontal position of rows. Along with surface tooled masonry, there was widely spread in Albania the solid laying of rubble stone. In doing so, architects managed to lay identical stones on inner and external rows; note that inner rows were somewhat disregarded.

Of interest is the fact that hard basalt rocks were cut away without finishing off. Lime and tuff were largely processed to make stone's surface smooth. Limestone was used both as wall and facing material. It applied to poles, vaults and conches of altars, arches, framework of doors and windows. As years passed, trimming level increased. At the same time, coarse masonry was also applied. It was not coincidental that rough surfaces were often plastered.

It has to be kept in mind that burnt brick was used in the Albanian architecture as far back as in early era. It is mainly found in the cult architecture of early Middle Ages in combination with stone. Vaults, arches, lintels, supporting poles, i.e. constructively important units were laid of brick.

Heterogeneous, not uniform in quality materials was used in the structures of walls and ceilings of early medieval monuments. The number of hitherto survived erections, made of identically stones, is scanty. These were Mohranis, Kedabey church, Ayrivank, built of coarse hard stones, archaeological monuments and temples in Gyavurkala (Agdam region) and Torpakkala (Tovuz region), made of surface trimmed limestone, etc.

A closer look reveals that two or three types of building materials were used in most monuments. Stone of two types was used in Agoglanchay basilica – basalt and tuff in cross-domical temple Yeddi Kilse and Jalute – limestone and cobble stone. Stone and brick were combined in the most outstanding monuments of early medieval Albanian monuments. These were in Kilisadag – limestone and brick; in Mamrukh, Lekit, Yeddi Kilse – limestone, cobblestone and brick; in Kum, St.Elyseus temple, Tazakend basilica – brick and cobblestone.

The above-cited facts are illustrative that the architecture of Azerbaijan in the 4-7 centuries, as distinguished from Georgia and Armenia, is characterized by the variety of building materials used. Burnt brick, together with stone, was principal building material. It would be appropriate to recall that in the reviewed period these materials were used for their designated purpose.



**Temple in Kish village, Sheki region of Azerbaijan**



Each material was used for a specific construction; rubblestone and cobblestone in the massive laying, limestone in facing and framing of apertures, burnt brick in the laying of vaults, arches, supports (2, p.18)

As for stone rocks, there were frequently used hard coarse types. These were wall materials used in the temples of Khudavank, Mohranis, Ayrivank and Jalut. When laying these monuments, architects ignored horizontal joints. In the meanwhile, stones forming Kum basilica are well processed, have regular size. Note that on territories with limestone deposits the laying was composed of cobblestone and the facing of surface tooled limestone. These include Mamrukh, Lekit, temples and chapels of the monastic complex Yeddi Kilse. In some monuments, walls were faced with limestone. Cited as example may be Kilisadag and the said archeological temple in Torpaggala.

Separately standing supports were widely used in three-nave basilica. Columns were rarely used (Kilisadag, Lekit, a gallery of Great Aran monastery); in most structures support are notable for rectangular are complex sections (2, p.17). The structure of supports is largely in accord with wall constructions, consisting of liming and inner filling (Mamrukh, Yeddi Kilse). In some cases, they are laid of one and the same material-brick or stone (Lekit). There are also found unbroken stone supports.

The structure of vaults and domes is of particular interest for study of construction engineering. Unfortunately, none of domes erected in pre-Islamic period has survived hitherto. There are just lower parts of the dome drum, so we get an idea of the dome through remains of half-destroyed churches.

The analysis makes it possible to insist that Albanian architects built domes on circular, square and octahedral foundations, resting on walls or separately standing supports. Suffice it to recall that a dome of Kilisadag had a circular foundation, that of Mohramis – octahedral, yet, most of them relate to domes on square foundations. Projects of the restoration work have been drawn up to comply with domical cult monuments of Transcaucasia and Iran when adjusted for the current state of temples and the logic of their architectural constructive treatment. Note that the projects provide for a semispherical or oviform dome with hipped roof on octahedral drum. A dome of the oldest Kilisadag temple was made of limestone, walls surface-tooled limestone. The construction engineering of Mamrukh and Lekit temples, as distinct from Kilisadag, underwent substantial changes. Walls were three-layered, limestone used for facing only, and vaults and arches laid of burnt brick. Such a construction engineering was typical for the monuments of left-bank Albania, 5-7 centuries. As viewed by archaeologists and architects, domes of Mamrukh and Lekit temples were made of brick. Transition from foundation square to dome was carried out with the help of trumpet vaults, perhaps as a conch trumpet in Kum basilica.

Thus, the two earliest domical structures on square foundation were made of brick. It was not a mere coincidence. A spherical laying was visibly facilitated through the use of brick, since no bow members were required. A brickwork with a thick layer of lime mortar, as was the case with Lekit pylons, quickly turned into monolith to ensure stability of the construction. Another early domical temple – Mohranis (6 century) was laid of cobblestone, while a flagstone was used in conchas of the eastern altar and niches. As is known, a mortar plays an important role both in spheric masonry and brickwork. To all appearances, in the early Christian period Albanian architects were proficient in preparing highly effective mortars to attain their construction goals.

Pertaining to “free cross” type and going back to the 6-7 and 10-11 centuries (Kedabek and Zeyzit respectively), the two domical monuments are a simplified version of traditional domical temples. Note that dome drums of the two temples rest on a square foundation of three-tiered arches, one tier hanging over another to reduce a diameter of the dome. Transition was carried out by spheric pendentives, and an octahedral drum ended with an hipped roof.

Of interest is the fact that diameters of domes of early medieval churches are small. Maximum size is typical for Lekit ( $d=7m$ ) and Kilisadag ( $d=6.4m$ ). Minimum span is 3-4 m, typical for “free cross” type churches. Material used is diverse. Trumpet vault or pendentive type transition from foundation square to dome drum was used.

There is a common feature typical for monuments, different in architectural type, date of erection and importance. This is a constructive scheme, based on domical system with four freely standing supports. The scheme is inherent both in domical basilica and cross-domical temples, as well as circular temples in Lekit and Mamrukh.

As viewed by many researches, folk dwelling with domical or dome-shaped roofing, widely spread in the East, was a prototype of four-column domical design. At the same time, among pre-Christian cult erections of Caucasian Albania and contiguous countries there are direct predecessors of a design that formed the basis of the above-mentioned group of temples.

Worthy of note is that domical temples were built as far back as in ancient Rome, however, Roman architects were successful in placing a dome on square foundation. It is accepted that a design of dome on square foundation was drawn up in Iran, 3 century. It was Iranian architects who first applied a conic trumpet vault (3, p.332). The trumpet vault design formed the basis of chakhartag and fire temples, widely spread in the Sasanid period.

Chakhartag is the most widely spread type cult erection, it sprang up the engineering practice much earlier. There is a fire altar in the village of Govuran, Lenkoran region, dated from the 3 century B.C., which is considered to be the earliest version of chakhartag (4, p.23). Subsequently, a dome was introduced in

the chakhartag design that survived till the 18 century. In some cases, chakhartags were supplemented with detour galleries, which were bond up with the central core constructively.

Identical fire temples were built on the territory of Azerbaijan in the pre-Muslim period as well. As is known, in spite of the fact that Christianity was adopted in Albania in the 4 century, it was not so deeply rooted here like in Georgia and Armenia. Note that Christianity was widely spread in the western part of North Azerbaijan, while Zoroastrianism was stuck to in the east. At the same time, some ancient heathen cults were still spread all over the country. Trever points out: "In the reviewed period a number of religions systems and cults co-existed, influencing outlook of Albanians. Christianity, forcibly implanted since the 4 century and adopted, in the first turn, by the court and nobility; Zoroastrianism introduced by Sasanides; various sects of Christian and Zoroastrian trend; and finally offensive Islam – all these religions and cults were, to an extent, rooted in Albania (5, p.297).

Regretfully, the monuments of cult Zoroastrian architecture did not survive, nor yet discovered by archaeologists. An eloquent testimony to the above-stated is a great quantity of these temples on the territory of Iran, including that of South Azerbaijan. A brilliant example of such a temple is the one in Jerr (3 century). Inner space of the square structure is composed of central cell with two pairs of cross-shaped columns and a dome rising above them, as well as a detour corridor from four sides. Arches are thrown over from columns to walls (two from each column, total 8). Divided by the arches into light parts, the detour is spanned by semicircular and cross vaults. In all probability, the temples of this type were also built in North Azerbaijan, so Albanian architects when creating Christian temples borrowed a constructive scheme of Zoroastrian fire temple, which, beyond any doubts, goes back to the folk dwelling with four supports and a wooden dome shaped ceiling over the central square.

Vaulted ceilings were, as a rule, used in the monumental architecture of Northern Azerbaijan- Caucasian Albania. Historical sources refer to the construction of wooden ceilings of early Christian temples, however, they failed to survive hitherto.



**Monasterial complex "Yeddi kilse", Gakh region of Azerbaijan**



**Church in Orta Zeyzit village, Sheki region**

Researchers were successful in examining partly survived ceilings in Mamrukh, Kum, Agoglanchay, Yeddi Kilse, Great Aran, etc. Note that early medieval Albanian vaults were laid of surface-tooled stone, cobblestone and brick. An inner space of vaults in Lachin basilica (Agoglanchay), Yeddi Kilse and others was laid of surface tooled plates of limestone by horizontal rose, in parallel to the axis of the vault. A smaller cobblestone was used in Kum basilica, Gedabek and Mamrukh. Remains of brick vaulted ceiling were found in Mamrukh and Jalut temples.

Formally, the most frequently found are semi-cylindrical, gabled and egg-shaped vaults. In the main, spans are small. To reinforce vaults, architects often applied bellyband arches with forms consistent with vault curve. Bellyband arches rested on pilasters and freely standing supports, but there are also console foundations of arches on side walls, which came as a result of architects' desire to avoid narrowing inner space of structures.

Vaults in the Albanian architecture are supported by transversal walls, two rows of columns and arches, as well as a wall from the one side and a colonnade from the other. A cylindrical vault is ended with apse and semi-dome, which is logical and well thought-out treatment. It is an integral combination of two spatial forms, where an arch separates a transversal vault from the semi-circular one (6, p.15). In the Albanian Christian architecture, together with semi-circular apse for transversal vault, there were successfully applied rectangular apses, whose triumphal arches separated a vaulted ceiling of the hall from the vault of altar. As distinct from neighboring Christian architectures, a rectangular altar was widely used in the Albanian architecture.

Of interest is the fact that arches play an important role in the history of the architecture of Caucasian Albania. They are principal bearing constructions and important component of decor. Forms of arches varied throughout the Middle Ages, and some of them were applied on a certain stage of their development.

The most spread and typical is a semi-circular arch. It was used as bellyband arch, formed a square foundation, on which a dome rose, and which connected supports and walls. A triumphal arch above altar apse, arched lintels over window and door apertures, played a key decorative role.

A horseshoe-shaped arch in the architecture of Albania, like Transcaucasia as a whole, is found in the early Middle Ages only. Horseshoe-shaped are arches connecting supports of Kum basilica (5 century), under Lachin temple in Agoglanchay (6 century), a peculiar version of horseshoe-shaped arch was used in Mohranis. Rounded forms of abutments of concha arches of Mohranis impart them a form of "omega" letter, not found in other monuments of Transcaucasia.

It was anti-seismic factor that played an important role in choosing forms of arches, as well as other structures of monumental architecture. It is no mere coincidence that a seismic horseshoe-shaped form in constructive arches was

applied in early Middle Ages only and did not exceed the bounds of the 9 century. It was supplanted first by semi-circular and later seismic-resistant gabled arch. Arches in the horseshoe-shaped form are found throughout the period in question. An eloquent example are edges over windows in Gyandjar cathedral.

A gabled arch was differently applied in the Albanian architecture from the early Middle Ages to the 19 century. Its oldest form is a bellyband arch of the vault of side nave of cross-domical temple in Yeddi Kilse (6 century). The geometry of this type of arches is close to semicircle and slightly sharpened key-stone segment.

Poles, used in the monuments of Albania, even despite insignificant dimensions, produce an impression of might and stability. Formally, capitals and bases are strict and severe. Plastics of temple interiors is composed of horseshoe-shaped, semi-circular or gabled arches on supports or two-three tiers of sub-domical arches hanging over each other. In the architectural design of temples there are constructive forms, which, together with various laying, are used as important means of artistic expressiveness.

Architecture of Azerbaijan is characterized by different building materials used in the monuments. One could say that the specific building method of Albanian- Azerbaijanian architecture is usage of the burned brick and stone and of stones of different facture at the same building.

The ceilings of the monuments mostly were of cupola or vaults structure. The parabolic structure is the most ancient one. The cylindrical and trumpet vaults were used as well. The cupolas were based on the rectangular basin formed by four arches. The tendency to build the cupolas and under cupolas constructions of vertical proportions is seen during all the above. Simplicity of the stone décor is one of the specific characteristics of early medieval Albanian architecture. Architectural forms and shapes of different construction details create d the artistic appearance of the monuments. An effective combination of the building materials of different colors, factures and quality, for example, bricks and cobble stone, lime and cobble stones, is characteristic of this architecture. Usage of brutal stones in the architecture led to existence of frescos.

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## **NEW TECHNOLOGY FOR SEISMIC RESISTANT CONSTRUCTION (NATO PROJECT SFP 982167)**

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The problem of safe and inexpensive dwelling easy for construction is one of most important issues in this part of the world. Majority of people residing in Azerbaijan, Turkey, Kazakhstan and other countries of the region located in seismically active zones live in non-seismic resistant buildings. In all districts of Azerbaijan excluding urban areas of Baku, Gandja and Sumgayit, 90% of buildings are 2-3-storeyed masonry buildings. Plus, 15% of buildings in Baku, 35% in Gandja and 20% in Sumgayit are masonry buildings as well. They are built from bricks, natural stones or construction blocks made of clay and hay and therefore, are not earthquake-proof. This is because of high cost of up-to-date seismic resistant constructions and their inaccessibility for the majority of local people.

Another type of construction widely used in Azerbaijan, Turkey and Kazakhstan is frame-house construction technology. This technology is as follows: first, concrete frame-house of the building as supports and coverings of concrete between floors is constructed. Then, brick walls in spans between supports are erected.

Neither of the mentioned construction types has proved quite effective during strong earthquakes which took place all over the world.

During the earthquake with magnitude of 7,2 in Kobe, Japan 17 January 1995, more than 5500 people died. Over 90 percent of the earthquake victims resided in wooden 1-2 storey houses which were seismically unstable (Ayzenberg). The December 2003 Bam earthquake in Iran with magnitude of 6,3 resulted in death of 35 000 people. Likewise, 90 percent of the houses were 1-3 storey masonry buildings made of bricks and clay. These buildings were not earthquake-proof and therefore almost 100 percent of them were destroyed. The



similar situation was witnessed during the earthquake in Pakistan, November 2005, when death toll exceeded 25 thousand people. The city of Muzaffarabad where over 90 percent of the houses were 1-3 storey masonry buildings of bricks and clay suffered most. All those buildings were destroyed.



The main reason for construction of such unstable buildings is lack of cheap and simple ACT for common construction. In many countries of Middle East, South, Southeast and Central Asia, Africa and Latin America majority of population have a low level of life. That is why they have to build cheapest houses of available materials. Masonry buildings of bricks, clay or wood, inexpensive but seismically unstable, are very popular there.



This project is targeted to create a new, cheap and simple ACT of mass seismic resistant construction enabling creation of seismically resistant buildings up to several floors with the same or lower price than standard masonry buildings, for great masses of population in cities and rural areas.

This application for support is made to investigate the feasibility of building low-cost masonry dwellings that are resistant against strong earthquakes. The concept of building interlocked load bearing walls for increased in- or out-of-plane resistance is not particularly new. The novelty contained in this proposal is the enhanced damping capacity of these walls achieved through the application of affordable binding material used in the joints of the masonry elements. Thus, mechanical interlocking that prevents sliding or dislodgement of the units coupled

with energy-absorbing layers is capable of increasing the earthquake resistance of the structure. No splitting occurs in the walls of such buildings. Verification of the proposed ACT will be achieved by conducting dynamic tests on a shaking SSP with harmonic and random motions applied to model components or mock-ups.

In many modern cities of industrially advanced countries such as USA, Japan, Canada and others, present day ACTs are applied intensively in the process of erecting high-rise buildings. It has been proven that developments in the art and science of earthquake engineering have enhanced the seismic safety of such structures. These ACTs prevent buildings from destruction during high magnitude earthquakes, as a result of which human victims are minimal. In most developing countries human losses and physical destruction occurs in dwellings and simpler types of construction. In many cases these dwellings are self-built, and rely on traditional techniques that do not reflect sophistication required for seismic safety.

Modern seismic resistant building constructions can be classified into several general types.

1. Buildings with steel framed structures and light multilayer synthetic slabs used as internal and external walls. They are capable of elastic deformation without collapsing at high magnitude earthquakes.

2. Buildings where steel structures, for example central bearing column and special elastic tension elements are used. The elements are connected with the base at the bottom and with the upper part of the flexible column at the top, and are under constant tension. During an earthquake, the steel pillar and elastic cables let the building bend but not collapse.

3. Buildings with floors connected to each other with flexible mechanisms allowing the floors to make certain shifts relative to each other. Such buildings can also change their form when a seismic wave passes through joints of the floors.

4. Seismic isolation systems. The system uses special sliding units that isolate the building from the Earth's surface. When a seismic wave passes through, the building's base firmly attached to the Earth's surface makes oscillatory movements relative to the upper part of the building. Due to inertia, the building on special units slides on special platforms fixed in certain points of the base. This system allows reducing vibration of the building to the minimum during an earthquake preventing the building from collapsing.

5. Damping system of bearings. In the base of the building, special damping mechanisms such as shock-absorbers, springs, rubber layers etc. are placed. These bearings partly absorb seismic vibrations and reduce seismic impact on the building.

6. Active control units of seismic vibration. Special mechanisms in the form of flywheels and counterbalances system are placed on the building roof.

During an earthquake, these counterbalances are set in motion with a frequency equal to the frequency of a seismic wave but being out of phase. As a result, the seismic oscillations are compensated and the building is not subjected to intense vibration and destruction.

Common for all these construction types of seismic resistant buildings is their high cost and technological complexity of construction that requires use of special construction materials as well as special skills and equipment. They also require training of the builder. Besides, these technologies are planned to withstand only earthquakes, not explosions or other abnormal loadings.

Construction/operation of SSPs is another issue of importance. Known SSPs are designed for simulating seismic vibrations and thereby testing seismic stability of buildings and various facilities. As an example of such a platform, 35-ton SSP by IHI Company, Japan can be mentioned here /1/. The SSPs can also be used for testing pipelines (oil, gas, etc.). Among the known platforms, there is a SSP produced and used by “CKTI-Vibrozeism” Structural-mechanical consulting engineering firm. The SP10-100 M CBC SSP is intended for 20 tons of weight and 1 to 50 Hz of seismic vibration frequency.

American SSP for simulation of earthquakes located at Buffalo University is operated by the University’s Structural Engineering and Earthquake Simulation Laboratory (SEESL)

Another Japanese testing facility, one of the most known SSPs of the kind named “E-Defense” intended for 300 tons of weight which can simulate high level ground motions, is under construction /2/.

As for the state of the art in Azerbaijan, there have been rare attempts to conduct some seismic stability tests using SSPs. Azerbaijan State Committee for Construction and Architecture developed a centrifugal platform of 6 sq.m for simulation of seismic vibrations which does not function now. Thus, this Project is generally a pioneer research for both Azerbaijan and Kazakhstan.

The Project teams have completed the theoretical part of the work (calculations, computer design and modeling of ACBs). For testing the building models, a special SSP for simulation of a strong earthquake has been made at the Institute. The specialists have also developed the composition the ACBs will be made of. The composition includes cheap local raw materials – sand, waste remaining after building stone and gravel production as well as a small quantity of cement. A laboratory machine for producing ACBs in actual size has been developed and made.

Scientific Research Institute for Prognosis and Study of Earthquakes has Technical Conditions of Azerbaijan Republic (National Standard) for ACB. The document has been confirmed by the State Committee for Construction and Architecture, State Agency for Standardization, Metrology and Patents, and “Azerzeolite” Scientific Industrial Corporation which will be applying the ACT in

Azerbaijan. An application for obtaining an invention patent for ACB was registered at International Patent Organization PCT in Geneva (WO 2005/106134 A1; PCT/AZ2005/000004).

As a whole, the Project is aimed at lowering the number of victims during high magnitude earthquakes and strong explosions of various nature (for example, committed by terrorists).

*The main objectives of the Project is as follows:*

- *Simplification of the technology allowing construction of small (1-2 floor) seismically stable houses capable of withstanding earthquakes and explosions.*
- *Reducing the prime cost of seismic resistant buildings that will make construction of earthquake-proof houses available for majority of local people*
- *Theoretical and experimental research and comparative analysis of seismic stability of buildings in Azerbaijan, Kazakhstan and Turkey compared with seismic resistant buildings on base of the new ACT.*
- *The new ACT is planned to be applied during construction works of settlements for refugees the number of which in Azerbaijan exceeds 1 million. The priority will be given to schools and other child institutions. Azerzeolite Scientific Industrial Corporation as a local company experienced in rural constructing will be playing the most active part in sales/distribution of the end product among buyers/contractors.*

*The project objectives are in line with NATO policy based on providing people's security and reducing human victims and damage at earthquakes and strong explosions committed by terrorists.*

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## **RESIDENTIAL HOUSES OF NORTH-WESTERN DISTRICT OF AZERBAIJAN**

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***(Produced by the Academician of IAS Gulchohra Mammadova)***

The north- western district of Azerbaijan, which includes Zaqatala, Gakh, Sheki and etc. regions, is one of the richest ones by architectural monuments. Of especial interest are the monuments built in the early medieval period during existence on this territory of the state of Caucasian Albania. Ruins of fortifications and cult erections are testimony of the Albanian period in Azerbaijan history. Historical resources divide the territory of Caucasian Albania into the left-side and right-site in according to the Kura- river stream. The right-side Caucasian Albania is situated from Kura-river to Araz-river and Caspian Sea. This territory is rich by architectural monuments, appearance, proportions and planning peculiarities of which are testimony of high skills of the architects and deep local building traditions /1/.

The left-side Caucasian Albania (modern north and north-western district of Azerbaijan) played an important role in political and economical life of the country in antique period /2/. The most important cult monuments of late antique and early medieval periods were built here, in left-side regions Sheki and Kabala. Ancient Greek historians Pliny, the eldest (1-st century), Claudius Ptolemy (2-nd century), Strabo mentioned this country, its towns and fortresses, its citizens etc /3/. Strabo paid an especial attention to north- western district of Albania because of the main temple devoted to the Moon- Selena that was built here. Of especial interest is fact that saint Eliseus began his predication of Christianity here /4/. Thus he started with Christianity in Caucasian Albania and built the first church of Albania and all the South Caucasus as well /5/.

The local traditions caused by natural climatic peculiarities and local building materials have defined the architectural type of residential houses of the district.

The historically usual traditional image of Sheki *residential house* was created by a deep verandah "eyvan" and a bright tile roof. Not only the abundance

of architectural details, but plastic development of the walls erected from natural stones and a bricks amazes us in the houses of region /5/.

One can say that the houses of this region are presented mostly by parastas type /6/. The initial element of such a house is small room with “eyvan”- loggia and side walls. Simplicity, laconicism and architectural significance of the houses are the result of contrast of shadowy eyvan and walls- ants. All the element of such a house is well- taken and artistic valuable. Change of architectural characteristics depends on change of rooms’ quantity and their placement. Increase of rooms led to existence of columns, which supported the eyvan’s roof.

The importance and main role of eyvans led to concentration there of the decorative details. One can say that the carved columns and trimmers as well as shebeke- window filling are such details. Sometimes the wall surface with combination of natural stones and brick play an active role in architectural appearance of the house.

But the open verandah of the main façade with massive arcade of one or two circles or with wooden colonnade on the second floor is still the main architectural element in houses. In comparison with the other regions of Azerbaijan where the houses had the south or south-western orientation, here orientation can be different. Wooden carved columns with bolsters and color glass panels "shebeke", filling window apertures are frequently used in houses. Original figure of the wall laying mixed from a brick, a fragmentary stone and a cobblestone, an arcade of open verandahs, a combination of gray-green stone to dark-red color of a brick and a tile on a background of green vegetation creates the colorful shape of the town.

The main facades with the spacious verandahs are inverted in a garden or in a court yard and focused on the south or south-east. The thought over lay-out of a site represents all convenience for economic works and for rest. The food can be prepared, bread baked in special furnaces "tendir", fruit dried on a court yard in summertime. In the plan decision of Sheki houses of this period the arrangement of premises (two, three and more rooms) on a longitudinal axis, with a covered verandah adjoining to them is typical. The similar arrangement of rooms was caused by that fact that light apertures left on the main facade, that is on a verandah. In rare cases when the building settled down on middle of a site and differentiated the main and economic court yard, on a back facade one more terrace was under construction, but it influenced an internal lay-out of a house a little. Residential buildings settling down frequently on slopes had a low ground floor which was used for economic needs.

Two-storeyed residential houses repeat basically the same circuit of a lay-out, with that only a difference that the verandah is only on the second floor before inhabited rooms. It connects them to ladders. In the majority of buildings of similar type the rooms of a ground floor used as kitchen and economic rooms

besides in the winter-time they are used for habitation. Richly decorated rooms intended for visitors, settle down, as a rule, on the second floor. In prosperous houses the quantity and size of rooms is increased, but the general principle of accommodation remained constant.

Very simple in their volume- space composition residential houses are of rectangular plan. Thanks to skillfully handled details houses got the unique architectural appearance. Back and side facades are without any decorations or details. All the skills of the architects are shown in the main façade.

As the basic composite centre of a facade is the spacious verandah, with wooden profiled columns, which is sometimes equal to the general area of premises. It used the most part of year due to a soft climate. The importance of a verandah is emphasized by riches of its decorative processing. Deeply shaded verandah, with an openwork carved protection and a colorful surface of ceiling beams in a combination with smoothly plastered light surface of the ground floor gives intimacy and a cosines to architecture of a facade quite appropriate to shape of dwelling.

The richly decorated fireplace “bukhara” underlining a longitudinal or cross axis of a room is the main ornament of interiors of main rooms. The small wall niches intended for fixtures and storage of fine household goods are symmetrically placed on both sides of a fireplace. The larger niches of longitudinal walls were used per day bedding. The main characteristic of the houses is absence of furniture. The “takhcha”- nishes play the role of the furniture.

The residential houses of Sheki of 18-19-th centuries are of great interest not only as architectural monuments. Cumulative century-long building experience led to creation of perfect for this region house type with compositional planning methods, which caused by climate conditions and perfect skills and usage of local material as well /7/.

For residential houses of Sheki the original frame system distributed in Azerbaijan is characteristic /8/. The rigid box from thick wooden bars, stick in solid thickness of walls, besides perception of a part of loading, creates additional connections and solidity of all design, so necessary in areas of high seismicity. For the same reasons internal cross walls were built of the same thickness, as well as external.

The laying from adobe brick is conducted on a clay solution. Designs from a burnt brick are carried out on gyaj solution. They differ by the big mechanical durability and moistureproofness. Such way of a laying creates a fine smooth surface. The most thin ornamental weaving, different details of arches, thin drafts in interiors and on facades are carried out from gyaj.

Mixed brick-cobblestone laying used in building construction of the town, testifies to skill of national masters to use a local building material to take into



account its constructive and decorative qualities. Erection of walls from only one cobble-stone on a solution, certainly, could not provide necessary durability and consequently masters entered horizontal lines of a brick. It was frequently excluded the formation of cracks. At the same time conducting the lines of red or pink bricks liquidated monotony and created decorative effect. Brick lines were successfully combined with cobble-stones in different variations.

The brick was skillfully used for an ornament of facades, and the considered placing and scale of an ornament integrally included it in art shape of a building. The figured bricklaying of walls was not limited to one vertical inserts of a brick. The friezes recovering a laying were made of this brick also. Ornamentation of the walls had original character. The laying could consist of a fur-tree pattern, or the step form occasionally close to a meander. Sometimes the figured laying was made of alternation of vertical and horizontal bricks so, that each overlying line was shifted forward owing to what the laying got diagonal figure.

The brick was used not only as a decorative material. Usually the main constructive elements of a building were erected from a burnt brick. This type of a laying was used in region for many centuries. Alongside with other kinds of building ceramics, such as an architectural terracotta, a tile, water pipes, manufacture of bricks was especially widely spread from the Hellenic period. Numerous finds of this type of products testify to it at excavation of antique towns and settlements on all countries of Hellenic cultures, including Caucasus. A burnt brick, which was the basic kind of building ceramics, has received a wide circulation since 10 century taking the important place in architecture of Azerbaijan and being the basic meaning of creation of shape of significant number of constructions.

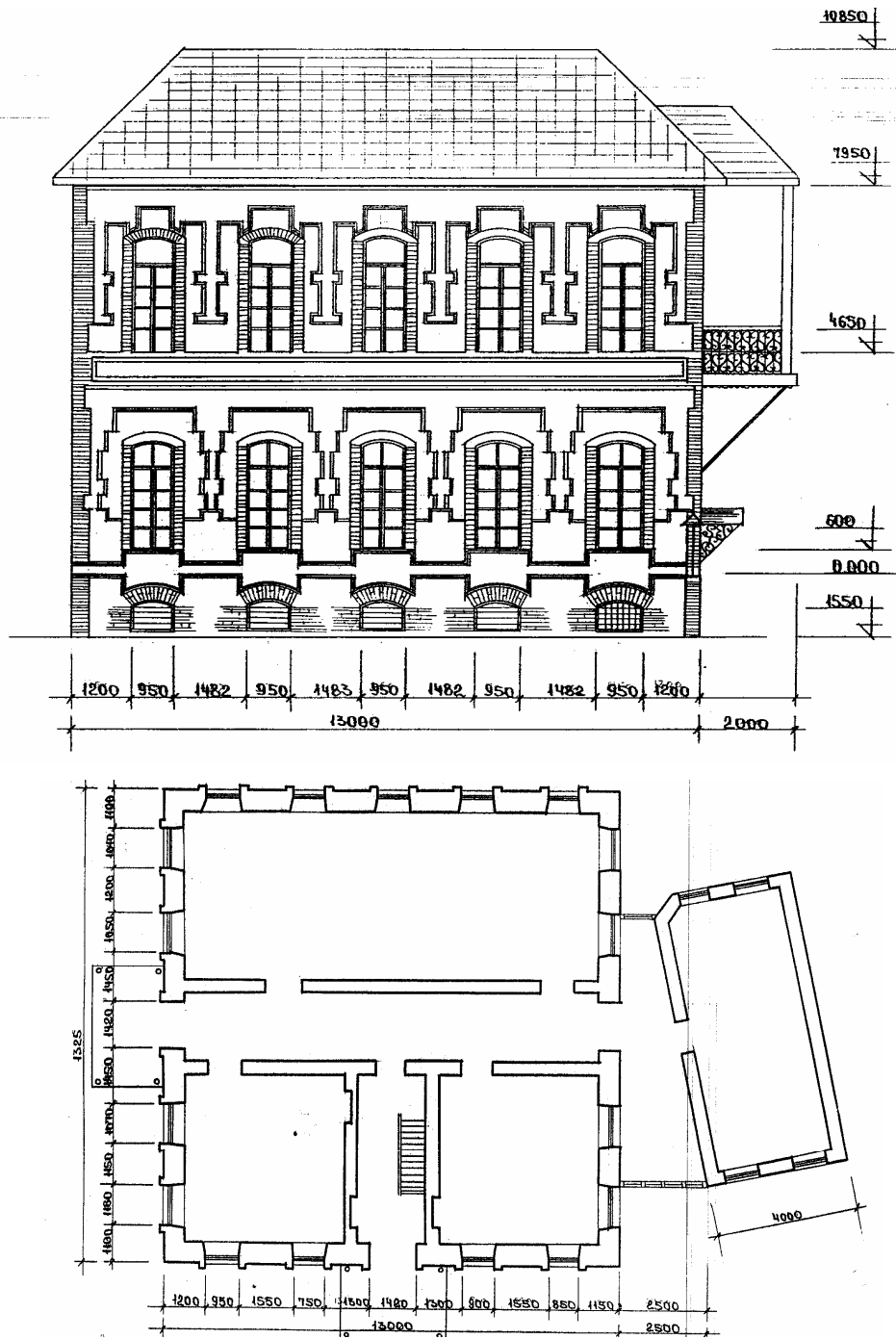
The brick had the square form traditional for the countries of Near East. This form was kept in Azerbaijan down to second half 19 century when it was superseded by a rectangular "Russian" brick. The laying from a burnt brick basically was made without external and internal facing (plaster). Full nakedness of a design when each brick is seen, obliged to a careful laying which was carried out masterly. The size of a burnt brick was not a constant. The brick of size 45x45x8 cm was replaced with a brick of sizes from 22 up to 28 cm that is 22x22x5 and 28x28x6 cm. The basic size of bricks of 12-15 cent. was the brick of 20x20x5 cm. Reduction of the sizes of a brick was connected to necessity to receive uniform roasting in all weight. Therefore the size of a brick 22x22x5 cm was recognized as the most expedient both on technology and by amount of a solution required for a laying. Besides it gave more perfect art kind to a construction.

The junctions inevitable at bricklaying and forming figure on a wall, light and shade at presence of ledges and hollows in a laying- all these properties of bricklaying were widely used as meanings of art expressiveness.

*An analyze of the residential houses lets to create the under mentioned classification of the main houses' types in according to their planning peculiarities:*

1. Simple one storied houses with one or two rooms, where the rooms are placed along the "eyvan" or verandah
2. One storied houses with several rooms along the verandah
3. Simple two- storied houses with few rooms along the verandah
4. Houses with several rooms without verandah
5. Houses of complicated configuration with many rooms
6. Semi-palaces or palaces

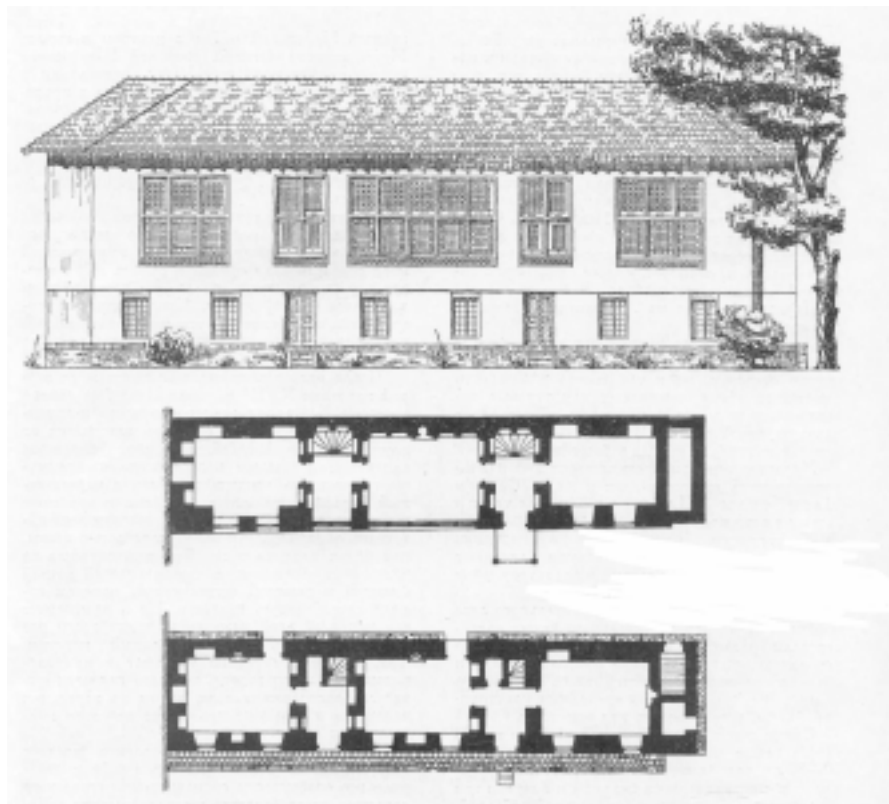
The houses of last two categories are of especial interest. Thus, the houses of fifth type are mostly architectural monuments, for instance houses of Dadanovs', Zulfugarovs' and etc. in the historical- architectural preserve "Yukhari Bash" in Sheki. The houses of the sixth type are famous Shekikhanovs' house and Palace of Sheki Khans, which appeared under the effect of decorative elements, patterns and murals having been introduced in the practice of construction.



**House of Dadanovs, Historic Architectural Preserve “Yukhari bash”  
(Drawings of architect I.Ismayilov)**

**The house of Shekikhanovs** is notable for its decorations, a monument as an intermediate link between dwelling and palace erections. Strongly elongated, the rectangular layout draws a distinction between office premises and residential space. Thus, there are three large halls and two small rooms with stairs on each floor. Rooms of the first floor are equipped with fireplaces “bukhary” to heat the building.

Artistic value of the house is in trimming of its inner surfaces. No ornaments are available in the lower floor, while the interior of the second floor is of particular interest. Splendidly painted “bukhary” serves as the central axis of the interior. Symmetrically placed rectangular niches are entirely covered with pictures, depicting heroes of the poems of the greatest Azerbaijanian poet Nizami Gyandjevi “Seven beauties”, “Leyli and Madjnun”, overlapped by stalactites from the top. Note that the stalactite cornice also supports a traditional for Sheki shelf “ref”, placed above openings and niches.



*House of Shekikhanovs*

Of particular interest among architectural monuments of Sheki is **the Palace of Sheki khans**. Built in 1762 by Huseynkhan in the upper part of the town, the Palace had once been a part of the greater complex. At present, just a pool and ancient trees have survived as a part of the complex.

The Palace of Sheki khans is a summer place – pavilion. This is a two-storeyed building facing the south. Layouts of the floors repeat each other, three large premises alternate to rank with antechambers. In all probability, the first floor was designed for official receptions. The second floor was used by khan family members. An eloquent testimony is the lack of internal connection between floors: an outward staircase leads to the second floor.

The most interesting facade of the Palace is southern. Its design and decorative division are reflective of the internal layout of the building, halls and antechambers. The design of the central part of the facade is an entire vitrification covered with geometrical wooden pattern “shebeke” filled by colored glass. Each square meter of shebeke is composed of 5,000 elements fastened together with no nails. Thus, a carpet of colored shebeke is used as the southern wall of entrance halls of both floors. The same device is applied in the decoration of lateral halls. Entrances into the first floor are composed of deep portals with mirror stalactite vaults. A distinctive feature is a combination of colored glass shebeke with portals, as well as an all-round ornamentation which covers the remaining surfaces of walls.

Of particular interest are interiors of the monument, notable for wall paintings of the 18-19 centuries. Paintings are available in the halls of both floors and two side rooms of the second floor. They are scattered on the surfaces of the walls, niches, stalactite passages, plafonds. Among the murals of the Palace of Sheki khans, researches give preference to geometrical and vegetable pictures, sometimes with depictions of birds. Particularly interesting are paintings depicting various hunting and battle sketches, placed in the hall of the second floor in the form of breeze between niches. Paintings of the Palace of Sheki khans are characterized by richness of colors, wider use of golden color.

The Palace of Sheki khans is an eloquent testimony to the unsurpassed craftsmanship of its creators who were successful in realizing century-long traditions of the folk art. A project of the restoration of the Palace of Sheki khans was drawn up in 1952 by leading architect of the Azerbaijan Republic, candidate of architecture Niyazi Rzayev. Monument was opened in 2004.



*Sheki khans Palace*

Study of the residential houses lets to come to a conclusion that:

1. The residential house is the brightest symbol of the region. Usage of the local building materials and traditional building methods (combination of the bricks and river-stones in the masonry) and adaptation to the local climate conditions (high ceramic roofs, eyvans) are seen in the houses.
2. The process of houses formation is appropriate. Study of the different monuments of the region (cult, civil, defensive, etc.) lets to come to conclusion that architecture of the region was formed on the basis of century-long practice, building methods and usage of local building materials. The elements used in the houses are characterized for buildings of other functions as well.
3. Change of each element (of ceramic roof for slate roofing, glazing of the balcony-eyvan or plastering of the brick-stone masonry) led to the demolition of the whole appearance
4. It is necessary to understand the importance of the houses preservation. In this connection could be interesting to create the museum of the residential house with exposition showing the everyday family life, main peculiarities of houses etc. Besides, it is possible to create the museum of carpet making, silk weaving, and handicraft in different houses, probably with training in real interior.
5. It is particularly important to preserve the cultural heritage in the conditions of tourism increase. It is necessary to regulate the construction in historical parts to prevent negative results.

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# **OIL INDUSTRY AND CHEMISTRY**

## **CONCEPT ON THE FORMATION OF THE OIL AND GAS FIELDS IN THE SOUTH CASPIAN BASIN**

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### **Annotation**

The basic principles of the Concept on the formation of the oil and gas fields in the South Caspian oil-and-gas bearing basin were presented and successfully defended by the author to the geological elite of Azerbaijan and Moscow in 1989-1990. Later this Concept was submitted for the judgment of foreign experts who had worked at the separate theses of the Concept more thoroughly and in more details independently or in joint researches with the author.

First of all specifications were made to the geological history of the formation of collectors and traps as well as oil-gas generating potential of rocks from cretaceous to post-Pliocene periods through detailed molecular study of oils, gases and extracts from drill core samples of different horizons.

Thus, the Concept on the formation of the oil and gas fields in the South Caspian Basin, represented by the author, went through thorough probation during 15 years modified with new details, amendments and withstood the test of time.

**The Concept of Dr. Narimanov is rather well-balanced and reasoned, incorporating the results of researches of prominent Azerbaijani scientists and industry specialists, which allows unifying the separate theses of the Concept and using it successfully in exploration of oil-and-gas reserves in Pliocene rocks of the extensive South Caspian Depression.**

### **Preface.**

This study focuses on the issues of peculiarities related to the formation of hydrocarbon reserves in middle Pliocene rocks taking into account the fact that the bulk of reserves of 92 oil and gas fields found in South Caspian Depression (within the boundaries of middle Pliocene basin) is attributed to the rocks of middle Pliocene with about 2.5 billion tons of proved recoverable oil reserves



(more than 1.5 billion tons of which has already been recovered during the period of 1.5 centuries) and considerable forecast volumes of oil and gas reserves.

It is noteworthy that 39 out of the discovered 92 oil-gas fields are located onshore and 26 of those offshore in Azerbaijan and 20 onshore, 7 – offshore in Turkmenistan respectively.

Different aspects of regional geology and geochemistry of South Caspian oil-and-gas bearing basin were studied at various times by A.A.Alizade, A.K.Aliev, E.N.Alihanov, A.I.Aliev, M.Ashirmammadov, F.M.Bagirzade, B.K.Babazade, A.N.Huseynov, I.S.Guliev, F.G.Dadashev, F.R.Babaev, M.Allan, M.Abrams, Sh.F.Mehtiev, K.M.Karimov, I.S.Hasanov, A.Sh.Shihlinsky, F.Ahmadbayly, E.Sh.Shikhalibayly, M.I.Rustamov, A.N.Hajiev, S.G.Salaev, L.A.Buryakovsky, P.Z.Mammadov, A.D.Ismailzade, F.I.Samadova, G.G.Huseynov, J.Renaldy and many other scientists who made substantial contribution to the process of learning the dynamic formation of the South Caspian Depression (SCD) through time as well as formation of oil and gas fields.

During many years of his activities aimed to study different aspects of geological formation of SCD, its separate areas and traps as well as the processes of generation, migration and accumulation of HC, the author prepared and published a few dozens of articles and monographic works. The basic theses of the Concept were approved at several distinguished international forums. Therefore this account of the Concept is given in summarized thesis form.

### **Brief history of the formation of the South Caspian Depression.**

According to the author the brief history of the geotectonic formation in the South Caspian Depression looks like approximately as follows.

The South Caspian Depression developed in the central part of the Alpine-Himalaya folded belt.

This depression located within geo-synclinal belt has developed separately which had an effect on its structure.

The depression is surrounded by the belt of mountainous structures of the Big and Small Caucasus, Elbrus, Big and Small Balkhan, Kopetdag and is parted from them by the major deep fractures.

The whole stage of the alpine formation of the South Caspian Depression can be divided into several phases:

- Early geo-synclinal, embracing early-middle-Jurassic period
- Late geo-synclinal, embracing the period from the Jurassic to Eocene
- Early Orogenic, embracing the period from Oligocene to the beginning of the late Pliocene

- And finally, late Orogenic, lasting from the beginning of the late Pliocene up to present time.

On the whole, in pre-Pliocene phase of development of the depression the highest activity is attributed to the Mesozoic period when began the development of large structures of sub-latitudinal stretch and the major deep fractures. Influence of secondary folding is observed up to middle-Eocene period.

Formation of the new structural floor of the sub-meridian orientation took place in Neozoic (Cenozoic) period and, as the results of researches have shown, this period played the main and dominant role in the formation of the discovered oil and gas fields in SCD.

It should be noted that the formation of thick – up to 5-6 km. – deposits of terrigenous rocks of middle Pliocene was taking place in the background of active bending of the depression with the speed of about 600m per thousand year and sometimes 1200 m per thousand year and that bending was almost always compensated by sedimentation.

The main sources of the inflow of sediments into Pliocene basin were paleorivers among which of the great importance was Paleo-Volga, delta of which, as it is determined nowadays, was then located 600 km further south of its contemporary position.

In the west part of the depression, belonging to Azerbaijan, the main role was played by the Paleo-Kura and Paleo-Araz rivers, but in the east, which geographically corresponds to the present territory of Turkmenistan, the main rivers were Paleo-Amu-Darya and Paleo-Uzboy.

The formed thickness of middle-Pliocene rocks represents, in a general way, a single formation of sedimentary rocks consisting of clay and sand in different interstratifying combinations.

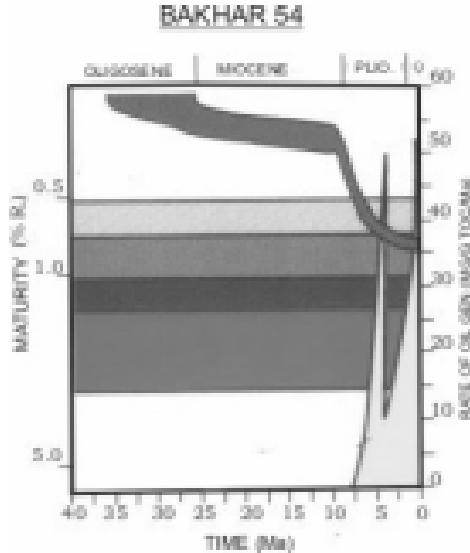
But due to the fact that the formation of the middle-Pliocene thickness was taking place through sedimentary material from various sources, there can be clearly traced different sub-formations through it in time and space within which the sand horizons are limited in area.

#### **Age of oil.**

Prior to passing to the issue of the age of oil in the South Caspian basin a reservation should be made that the conclusions made are based on the results of researches of limited number of oil samples from the wells of only some discovered oil and gas fields of the basin. However the identity of all obtained values practically excludes the other interpretations.

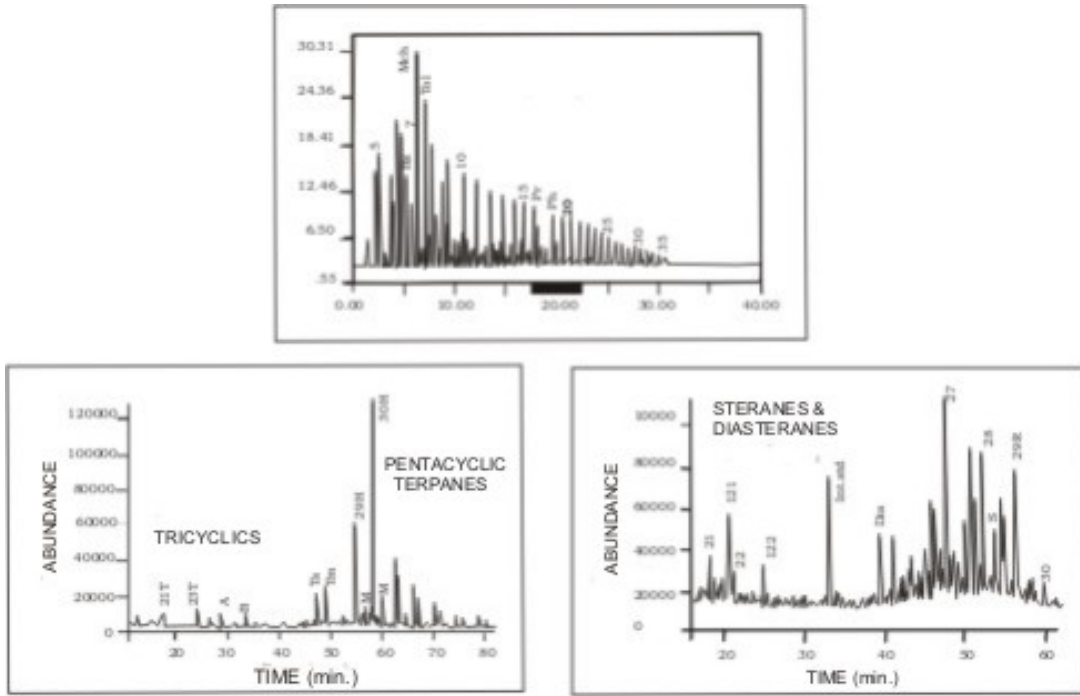
Also analyzed were the rocks specimens from cretaceous rocks to Pliocene inclusive. The poorest, in terms of the general content of organic carbon, were the rocks of middle Pliocene i.e. the rocks containing the bulk of oil reserves. At the same time younger rocks contain from 0.12 to 0.65 % of organic carbon, whereas clay of bottom horizons –from 0.7 to 1.6 %.

It is noteworthy that general content of organic carbon in the clay of cretaceous age is quite high and ranges mainly within 0.9-1.7%. But clays of Oligocene are characterized with the highest content of organic carbon – from 0.8 to 7.8%. The high general content of organic carbon in the core samples of Maikop deposits is also confirmed by analysis of rock specimens taken from outcrops. (picture 1).

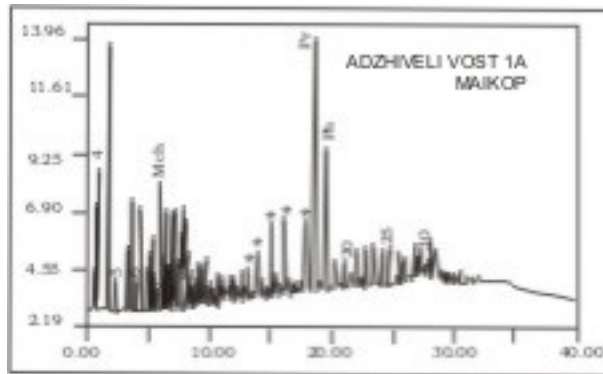


Estimation of the maturity of organic substance in core samples based on the definition of the reading of the maximal temperature in the process of pyrolytic decomposition of rocks and average reflectance of the vitrinite taking into account low geothermal gradient of 20<sup>0</sup> C/1000m allows to assert that rocks reach their maturity in the main part of South Caspian Basin mainly at the depth of 10-11 km. Thus, this conclusion excludes the hypothesis of oil generating in the rocks of middle Pliocene which leaves no doubt about the fact of epigenecity of the oils of Pliocene fields.

The analyzed samples of oils have in general similar characteristics on biomarkers but gas chromatograms of those are often different in their nature. At the same time the oils of some oil and gas fields passed the stage of biodegradation. (picture 2) ( picture 3)



Most of the oils of the oil and gas fields located in the area under research have similar molecular structure indicating similarity of fascial origin. The main characteristics of these groups of oils are the following:



- Low sulfur content
- High content of saturated carbons
- Ratio of saturated hydrocarbons to aromatic ones ranges from 1.5 to 4.0
- Low content of nitrogen-sulfur-oxygen complex
- Proportion of pristan to fitan exceeds 1.0

- Low ratio of diosterans to normal sterans
- Low ratio of sterans to triterpanes
- Low ratio of gopans to sterans
- Low ratio of tricyclic to gomogopans
- Excess of the gopan C<sub>30</sub> over the gopan C<sub>29</sub>
- Excess of the gomohopan C<sub>34</sub> over the homohopan C<sub>35</sub>
- Considerable exceeding of tricyclic C<sub>26</sub> for tricyclic C<sub>24</sub>
- Excess of sterans C<sub>29</sub> over sterans C<sub>27</sub> (from spikes ββ)
- Availability of oleanics

Study of geochemical data produced from the results of deeper analysis of many oils samples shows that the oils of almost all horizons were formed in the tertiary low calcinated sea clastic facies containing material of sea and partly terrigenous origin. Almost all the oils were formed before the main phase of their generation.

Complex analysis of all the data indicates that the most probable main source of generation of those oils is Oligocene-Miocene clay shales.

### **HC migration and accumulation.**

Through comparison of the results of analysis of mud volcanic activity in geological past and paleo-tectonic researches it may be concluded that periods of time are defined stand out within the South Caspian Depression which are characterized with highest extent of tectonic activity.

By drawing direct correlation between tectonic activity and intensification of migration of layer fluids and, therefore, of carbons within the selfsame folded area against the background of the continual process of the migration, the main periods and phases can be defined during which accumulation of the bulk of carbons takes place in traps. This is time of low Absheron, the mid of middle-upper Absheron and quaternary (from the end of Baku age) with two last phases having crucial importance for formation of the discovered oil and gas reserves. (picture 4)

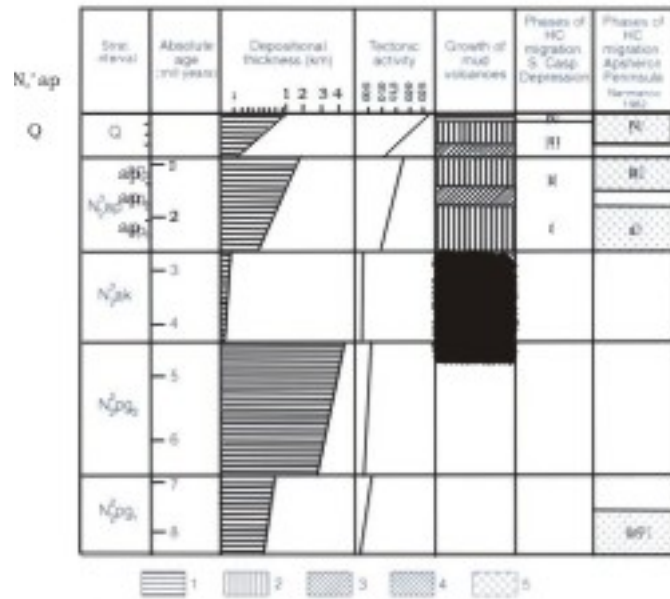


Fig. 11. Timing of the main elements of petroleum geology relevant to the entrapment of hydrocarbons. Key to mud volcano activity: 1 = intense, 2 = strong, 3 = weak, 4 = insignificant. From Bagir-Zade et al. (1988, fig. 22).

Intensive migration of carbons through the cracks of fractures at the beginning of middle Pliocene couldn't be of great importance for accumulation of oil and gas in structural traps due to absence of such at that period. However that phase could have importance in providing with carbons lithologically and stratigraphically screened traps which certainly were widely spread on the side of the large depression.

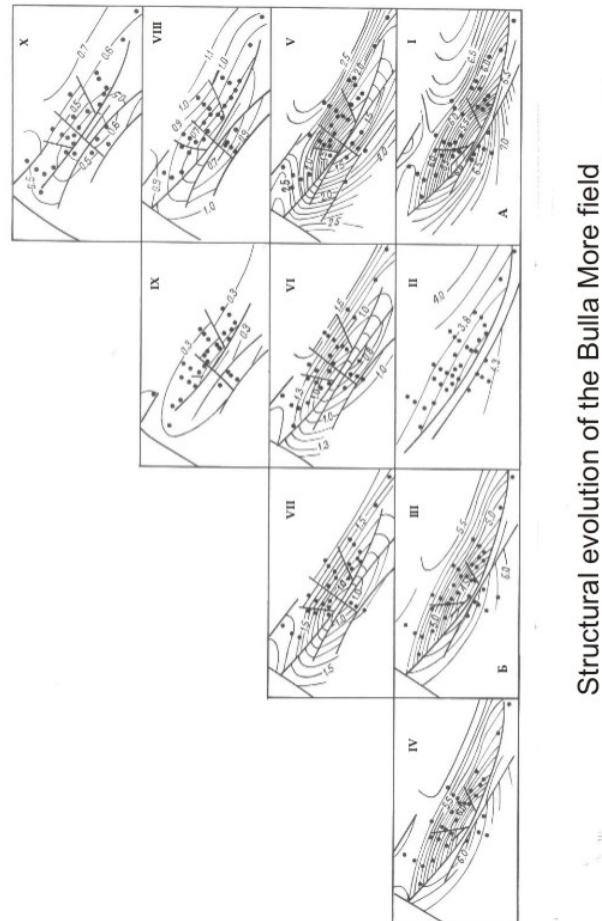
The following conclusion can be made on the basis of the afore-said:

For Pliocene-quaternary period 4 main phases of HC migration took place within South Caspian Depression with only general saturation of the section of the early Pliocene depositions and low section of the middle Pliocene by carbons entered through faults at the first phase / K<sup>a</sup>C-KC/possible to take place; at the second phase (early Absheron) mainly filling of the regional litho-geological-stratigraphic traps could take place in the depositions of early Pliocene; the third (the mid of middle – late Absheron) and the fourth (Mezopliocene – the present time) phases of the migration brought about the formation of the discovered and putative accumulation of oil and gas in the South Caspian Depression

Taking into account the fact that discovered oil and gas fields in the SCD and prospects of oil-and-gas detection are related mainly to young traps of middle Pliocene and that their filling could take place in little period of time of late

Pliocene and post-Pliocene, as earlier was mentioned, the factor of speed and scale of HC migration and accumulation the is of highly serious importance in the prediction of oil-and-gas bearing capacity of new sectors, areas and regions. The importance of this factor considerably increases in prediction of possible availability of large and giant HC accumulations.

Favorable conditions for appropriate calculation of speed and scale of the HC migration and accumulation are available in condensed gas deposit of Bulla-deniz. Calculations have shown that 350 t. m<sup>3</sup> of gas can be contained in natural conditions in 1 m<sup>3</sup> of a collector of similarity of “intermission” pereryv series (picture 5)



Structural evolution of the Bulla More field

Based on the fact that for two late phases of migration 103 billion m<sup>3</sup> of gas could enter the trap, it is concluded that the speed of gas entering into the collector in the bulk of 1m<sup>3</sup> in average constituted 41.5 t.m<sup>3</sup> per thousand years.

The author believes that this figure can be used for calculation of the size of oil and gas fields of HC being predicted within the Absheron lithologo-fascial subformation.

Passing to review of the total issue on formation mechanism of oil and gas fields in the South Caspian Basin it should be noted that the real natural conditions put forward into the first place the factor of vertical HC migration through the cracks and planes of the tectonic faults of rocks uniformity. That means that dominating role is given to the jet migration of HC and that lateral migration is recognized within limited space, i.e. mainly plays role in distribution of HC over the space of the collector.

Under the real geological conditions of formation of the South Caspian Basin it is hard to give preference to the lateral migration having numerous natural restrictions to begin from the size of granules and their selection and placing, the composition of the fastening cement and its quantity, the size of the pores and their inputness and profile, tightenedness of the rocks and to end with different overthrust upsettings.

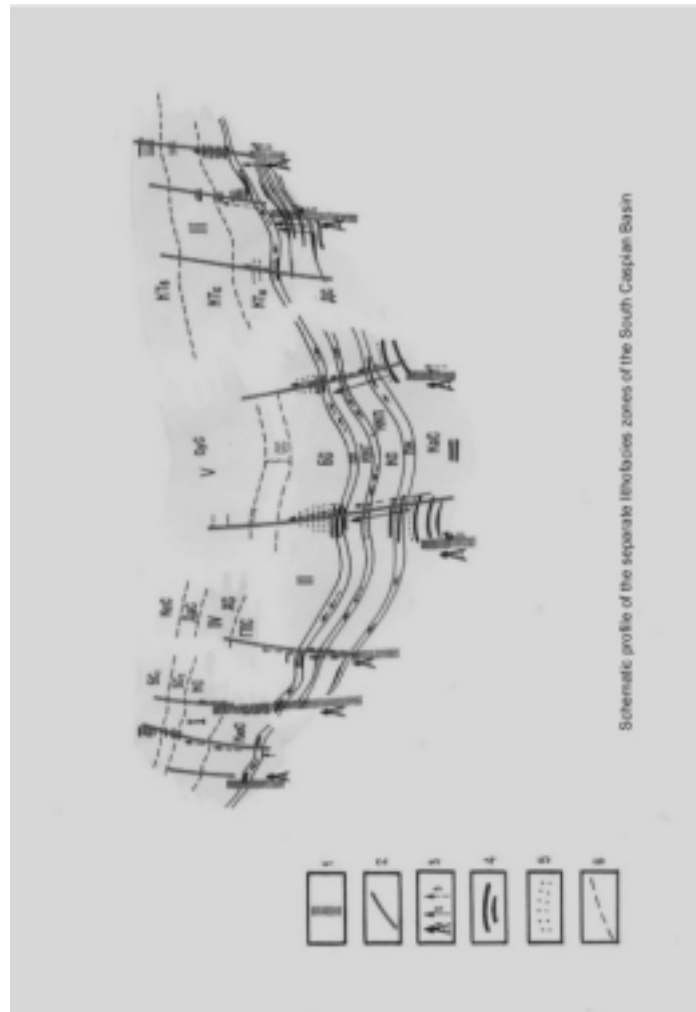
The speed of the movement of the layer fluid through the collector, calculated by A.Gurevich, with the gradient of the head of water and lithological restrictions equal to 0.1-1m./t. year taken into account, leaves no chance to the factor of lateral HC migration to enter the list of dominating mechanisms of the formation of the young oil and gas fields in the South Caspian Basin.

### **Mechanism of oil and gas accumulations formation.**

Having idea about the place and time of HC formation as well as ways, scale and time of their migration and accumulation, a scheme of the formation of carbon accumulations in the middle-Pliocene sandstone collectors of the South Caspian Basin can be created.

The results of researches are given in sketchy form in the picture which, above all, clearly shows the division of the whole middle-Pliocene thickness of the South Caspian Depression into separate lithologo-faciesal subformations (the sketch is given according to longitudinal section of the depression). The whole process of oil and gas formation passes in 4 stages (picture 6).





During the first stage when diagenesis of the falling terrigenous material of the lower half of the middle Pliocene thickness (more precisely, before the age of the Kirmakinsk series inclusive) was accompanied by active tectonic movements caused by fading overthrust processes in finishing stage of the geo-synclinal evolution of the South Caspian Depression, by the movement of its geoblocks of the secondary Mesozoic- Palaeogene-Miocene depositions through the abyssal fractures which brought about the creation of the series of the new disjunctive upsettings and the bending of the Pliocene layers along the breaks, the first phase of the amplified migration of HC took place through cracks of the zones of the abyssal fractures. Mass saturation of the weakly dislocated depositions with carbon compounds takes place at that period, the effect of which was increased due to petty breaks. The considerable amount of HC, certainly, evaporated due to

petty breaks. In the subsequent period, tectonically calm and continuous, with slight breaks nearly before the Agchaligsk age (at the last stage of the sedimentation of the thickness some overthrust activity occurred), when a whole series of the abyssal fractures finished its evolution, a weak inflow of mainly gaseous HC again in the sandy cuts of lower section of Middle Pliocene took place, thus enriching, dissolving and saturating with gas the oil contained in it (this process was characteristic for all periods of temporary decrease of tectonic activity).

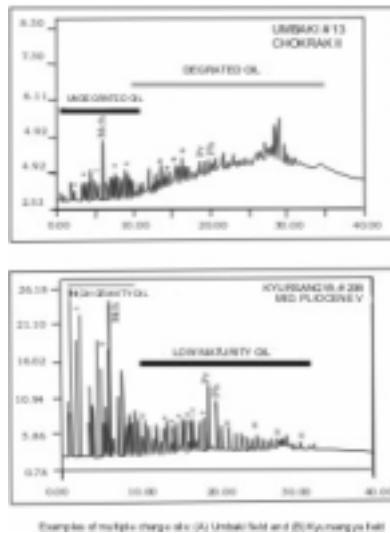
In early Absheronian a new mass injection of hydrocarbon compounds into the thickness of Middle Pliocene rocks takes place marking the second stage of oil and gas accumulation. In this period the active vertical migration of HC including jet migration of oil along the fissures of rare fractures and craters/crater-adjointing areas of many formed mud volcanoes takes place for the first time, partially filling sandy layers of upper half of Mid Pliocene mass. But the main volume of hydrocarbons due to lack of turn of layers rushes to the original ground evaporating and forming brea coating.

The third stage commences from the center of period of Mid sub-floor of Absheronian and continues up to completion of the whole Pliocene period. The strengthened tectonic activity which caused active folding processes alongside with formation and revival of fractures and mud volcanoes, has actually formed the structural plan of SCD. The important quality of this time is formation of structural traps and regional bend of layers. For the first time lateral migration of HC takes place within the lithofascial sub-formations. Mass cross-flows of oil from the lower series of thickness to overlying series is observed. Good collecting properties of horizons and series among which noteworthy are "truncation" series, X horizon of Balakhan series, some horizons of upper red layer, characterized by improved filtering properties and maturity along its areal limits, conditioned oil and gas saturation, first of all of collectors of the mentioned stratigraphical intervals. At that, the main role in accumulation of HC in traps is played by lateral migration due to limits of the trap itself where HC enter by voids of fractures running in synclines, on plunges of anticline belts flanks, from opening traps due to their involvement in regional bend of layers on the side of depression and large internal depressions.

A part of HC accumulating in the traps from collectors of base horizons cross-flows by local lateral, radial and crest-adjointing fractures to overlying sandy horizons, at that the excess formation pressure in crest parts leads to re-position, which leads to formation of mainly gas deposits with oil fringes.

By the end of the third stage practically all SCD fields had already been formed, at that the majority of them are mainly gas fields or with significant gas content.

The fourth stage started with commencement of still lasting Mezopleistocene period has contributed cardinal changes to the structural character of depression, on the sides of which the folds have seen significant tectonic impacts that conditioned their high tectonic disunity and abnormality as well as deep corrosion of sediments up to series of the lower part of Mid Pliocene. Such a high tectonic activity alongside with strengthened inflow of new portions of HC in the Mid Pliocene thickness and filling of increasing volumes of large traps in the plunged part of depression and separate zones of highs, resulted in intensive re-distribution of HC accumulations, their active degasification due to traps being broken by fractures and in a number of cases (mainly in peripheral side parts of depression) – to full destruction of gas parts of deposits and strong degasification of oil, destruction of some deposits due to exposure on the original ground. On the represented figures the two-phase HC migration can be seen clearly, when after the first phase the oil was subjected to partial biodegradation, after which the inflow of fresher portion of oil was registered (figure 7).



Playing a constructive role in formation of oil and gas accumulations in the plunged structures with relatively calm structure, the fourth stage of oil and gas accumulation accounts for actual destruction of many oil and gas accumulations, the traps of which have been subjected (are being subjected) to intensive tectonic impact.

In the long run the 4-stage formation of Mid Pliocene oil and gas fields of SCD, distinguished by independent process of oil and gas accumulation subject to general laws in each lithology-fascial subformations with consideration of

individual peculiarities of their geological structure, resulted in actually observed zonal placement of oil and gas accumulations. Such interpretation of oil and gas accumulation process, despite some shortcomings, provides answers to many questions, including (very important!) issues of prediction of oil and gas bearing capacity of new unstudied areas and regions, excluding mechanical referral of middle part to dry gases zone based on the observed tendency of increase of share of gaseous HC from the fringes of depression to its centre.

Thus, the main conclusion is boiled down to the fact that formation of oil and gas accumulations of Mid Pliocene thickness of SCD took place by stages owing to migrationing downwards hydrocarbon mixture according to the submitted scheme, in the process of which the third stage has the important creative role (period range from the middle of Absheronian floor up to its end) when the formation of practically all fields took place, while during the fourth stage (period range of Mezopleystocene up to now), intensive destruction of fields on depression fringes takes place alongside with deformation of plunged traps.

### **CONCLUSIONS**

1. Oils of discovered fields of the South-Caspian Basin are mainly referred to the same low maturity "system/family".
2. Main oil generating rocks of discovered fields of the South-Caspian Basin are Oligocene-Miocene clays.
3. Oils of Pliocene fields of the South Caspian basin are epigenetic to bearing strata.
4. Formation of fields of the South Caspian Basin took place mainly in two phases of mass HC migration: from the middle of period of Mid subfloor of Absheronian.
5. Main ways for jet migration of HC mixture were active tectonic fractures.
6. Space distribution of HC in Pliocene thickness took place directly depending on the characteristic features of lithologic-fascial subformations.
7. Main regional oil and gas bearing complex of sediments which opens up prospects for detection of new sediments including huge and giant oil and gas accumulations is Middle Pliocene rocks mass.

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## GEOMETRICAL STRUCTURE OF HYDROCARBONS

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Chemistry as a science actually has not the borders. Number and assortment of synthetic organic compounds is increased with all growing temps.

Hydrocarbons long since were considered as the base for construction of all other organic compounds. Just therefore German chemist, the member of London King's Society Karl Shorlemmer in the middle of XIX century determined the organic chemistry as chemistry of hydrocarbons /26/.

According to R.D.Chambers and S.R.James from Dirhem University of USA /7/ "in principle all synthetic organic chemistry may be based not on carbon skeleton of hydrocarbons but on skeleton of halogenhydrocarbons with various functional groups and reaction centers".

A great number of chlorosubstituted analogues corresponds to each molecule but an exhaustive substitution of hydrogen atoms in them for chlorine leads to a special class of organic compounds called hydrocarbons. However, as noted by Wiland /36/, Tatloy /34/ and Ballester /1/ it can be expected the limits stipulated by unusual spatial requirements of chlorine atoms, which is seldom occurred in the chemistry of hydrocarbons. The spatial difficulties restrict a stability of some perchloralkanes where the forces of repulsion rapidly decrease dissociation energy of C-C bonds according to the increase of hydrocarbon chain length /7/.

**As the history of synthesis of chlorocarbons is not paradoxical it is also deep as well as the history of synthesis of hydrocarbons.**

After preparation of chlorine by Sheele (1774), in 50 year (1821-23) Faradey has synthesized the first chlorocarbons – tetrachloride carbon, tetrachlorethylene, hexachlorobenzene /12/.

Then Dzhulin (Julin) /20/ in 1821 has described hexachlorobenzene and in 40 year Muller [8] when investigating the chlorination of benzene in the presence of iodine observed the formation of beautiful needle crystals of hexachlorobenzene identical with Julin chlorocarbon.

Benzene itself was first isolated from oil by M.Faraday in 1825 for which the formula of six membered ring was proposed by A.Kekule in 1865 /22/.

Later on the title consisting of combination of words chlorine and carbon with prefix "per"- indicating to exhaustive substitution of hydrogen atoms and hydrocarbons by chlorine atoms /16/ was accepted for all compounds consisting of only atoms of carbon and chlorine atoms.

It is not difficult to show the chemical formula of chlorocarbons by means of substitution of hydrogens in hydrocarbons by chlorine ones. For them as well as for various classes of hydrocarbons the homological numbers of total formula are true:  $C_nCl_{2n+2}$  – saturated;  $C_nCl_{2n}$  – unsaturated and alicyclic;  $C_nCl_{2n-2}$  – diene and acetylene;  $C_nCl_{2n+6}$  – aromatic and so on.

A phenomenon of isomerism, existing in hard and conformation-mobile states, analogous or distinctive geometry of molecule is characteristic for chlorocarbons as well as for hydrocarbons. However, unlike hydrocarbons, in a number of cases, the conformation of chlorocarbons and their compounds may be considered as anankomer systems, i.e. molecules existing in the only stable form due to deceleration of rotation around C-C-bonds.

Unlike oil hydrocarbons chlorocarbons were prepared by synthetic way /15/, although according to the data of national management on study of ocean and atmosphere of USA /18/ the amount of tetrachloride carbon in atmosphere is much greater than could be produced due to activity of man.

The results of investigation of organic compounds of atmospheres of some volcanic regions show the existence of natural sources of haloid-organic compounds of volcanic origin /18/ (Table 1).

The data of Table witness that the concentration of freons ( $CFCl_3$  and  $CF_2Cl_2$ ) and also chloroform ( $CHCl_3$ ), tetrachlormethane ( $CCL_4$ ) and tetrachlorethylene ( $C_2Cl_4$ ) in volcanic gases exceeds not only background but also typical for city air which shows an existence of natural source of these compounds. By authors opinion, the results of analysis of air from arctic ice with age of 1100-2600 year /21/ may be served as confirmation.  $CFCl_3$  in concentrations from 4 to 17  $trln^{-1}$  have been detected in them.

### Concentration of halogen-carbon compounds in air and background regions in atmosphere of some regions

Table 1.

Place of selection of test	Concentration, trillion <sup>-1</sup>				
	CFCl <sub>3</sub>	CF <sub>2</sub> Cl <sub>2</sub>	CHCl <sub>3</sub>	CCl <sub>4</sub>	C <sub>2</sub> Cl <sub>4</sub>
Sea of Okhotsk	186	270	–	–	–
Mendeleev volcano	470	270	6420	1120	240
Golovin volcano	630	390	6160	2340	–
Tatya volcano, Crater Brave	1020	740	–	–	–
Japan Pacific Ocean shore (1978)	159	208	–	104	7
Tokyo (1978)	372	268	–	242	719
Los-Angeles	473	–	88	215	1480

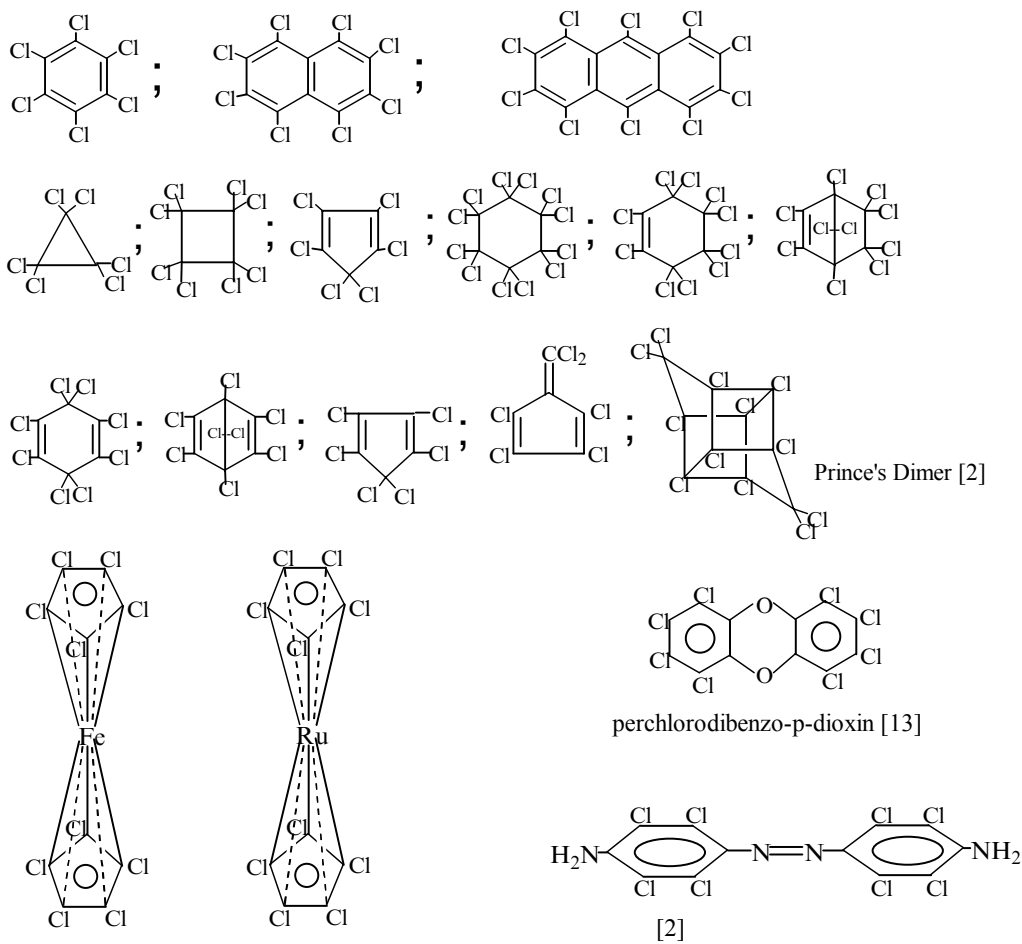
The inhabitants of Hawaii islands were long since used the red water-plant (*Asparagopus taxiforius*) as seasoning which they called "Lima Kokhu" which means "the best water-plant". The investigation of this water-plant and also relative type of "A armata" brought the results which might create a deep wonder: in living organisms six of possible 70 haloid methanes – bromoform, iodoform, chlordibromethane (CHClBr), dibromiodmethane (CHBr<sub>2</sub>J), tetrabrommethane and also dibromacetamide, diiodacetamide, bromacetone, iodacetone, hexachloracetone and so on /8/ were firstly found.

These examples show the possibilities of formation of haloid-carbon compounds and also tetraatom chlorocarbons in natural conditions not only by antropogeneous action.

It also follows from facts presented that chlorocarbons like hydrocarbons form the various classes of chlorocarbon compounds containing carbon and heteroatom functional groups.


The title of chlorocarbons and their compounds is usually composed on substituent nomenclature from title of corresponding hydrocarbon analogs with addition of prefix "perchlor". Thus, perchlormethane is originated from methane, from perchlorethylene, from ethylene, from perchlorbenzene, from benzene, from perchlorcyclopentadiene, from cyclopentadiene and so on. The titles indicating to number of chlorine atoms in molecule, for example: tetrachloride carbon or tetrachlormethane, tetrachlorethylene, hexachlorbutadiene, hexachlorbenzene and so on are often used for chlorocarbons.

Now a great number of chlorocarbons and a number of their hydrogen, nitrogen, sulphur, metal and other element-containing compounds /25/ are known.



perchloroferrocene [17] perchlororutopocene [32]

**There are no gaseous chlorocarbons. Dichloroacetylene with b.p.=33-34°C is the most low boiling chlorocarbon.**


 Most of chlorocarbons are hard substances. The liquid chlorocarbons are: tetrachloromethane (CCl<sub>4</sub>), tetrachlorethylene (CCl<sub>2</sub>=CCl<sub>2</sub>), hexachlorpropylene (CCl<sub>3</sub>-CCl=CCl<sub>2</sub>), dichlorodiacetylene (CCl≡C-C≡CCl), hexachlorobutadiene (CCl<sub>2</sub>=CCl-CCl=CCl<sub>2</sub>), octachloropiperilene (CCl<sub>3</sub>-CCl=CCl-Cl=CCl<sub>2</sub>), hexachlorodivinylacetylene (CCl<sub>2</sub>=CCl-C≡C-CCl=CCl<sub>2</sub>), octachlorohexatriene-1,3,5 (CCl<sub>2</sub>=CCl-CCl=CCl-CCl=CCl<sub>2</sub>), decachlorohexadiene-1,4 (CCl<sub>2</sub>=CCl-CCl<sub>2</sub>-CCl<sub>2</sub>-CCl=CCl<sub>2</sub>), hexachlorocyclopentadiene and so on.

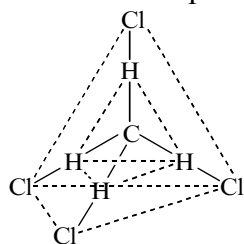
Chlorocarbons, basically, are incombustible and undangerous substances, with the exception of dichloroacetylene easily bursting in action of air and moisture. Many liquid and some hard chlorocarbon have a sharp smell, steams of which act irritatingly to mucous membranes, are toxic substances.

All chlorocarbons are heavier than water; they have high density and refraction coefficient. They are poorly soluble in water, well soluble in hydrocarbons of oil, best soluble in acetone, dimethylformamide, dimethylsulfoxide.

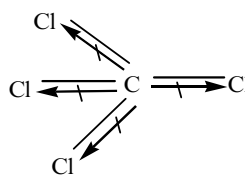
The molecule of tetrachloride carbon (95,95%) that is called "liquid chlorine" has the largest content of chlorine.

The large content of chlorine in molecule of chlorocarbon gives it property of incombustibility. Therefore chlorocarbons and their compounds are used as antipyrene for giving self-extinction /27,37,38/ to polymer compositions. Chlorocarbons are often highly thermostable compounds and formed with large yields as a result of high temperature interaction reaction of hydrocarbons in excess of chlorine in reactor with "boiling" layer of finely dispersed catalyst (activated coal, pumice, perlit and so on) /28/.

In accordance with theory of repulsion of valence electrons /14/ molecule of tetrachloromethane like molecule of methane has a point symmetry and therefore tetrahedral disposition of chlorine atoms is maintained.

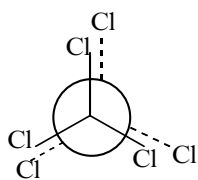


In molecule of  $\text{CCl}_4$  although there are 4 dipole moments of C-Cl bond but they are equal on value and directed to the various sides /11/.

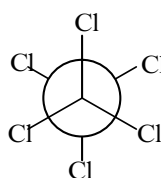


According to X-ray structural data molecule of  $\text{CCl}_4$  in crystalline form has not point symmetry /19/.

The height of barrier of internal rotation for molecule of hexachloroethane is in 5 times larger than for molecule of ethane (17,3 kcal/mol against 3 kcal/mol). Therefore in  $\text{CCl}_3\text{-CCl}_3$  a length of C-Cl bond (0,176 nm) and C-C bond (0,1564 nm) are not the same. Thus molecule of hexachloroethane has not a correct tetrahedral form as it is observed in ethane. The value of angle of Cl-C-Cl has somewhat larger value than  $109^\circ 28'$ . Therefore valence angle of Cl-C-Cl due to repulsion of chlorine atoms must be less in covered conformation than in squinted one /9/.



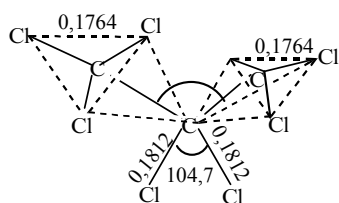
Covered form



Squinted form

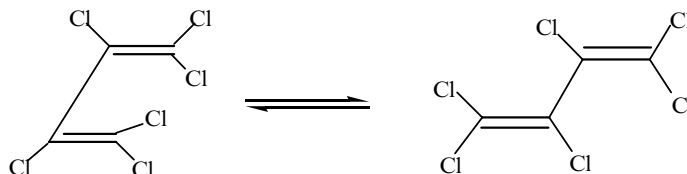
Thus molecule of hexachloroethane unlike the molecule of ethane may be considered as anankomer system, i.e. existence of its molecule in the only stable gosh-conformation form – due to deceleration of rotation around C-C bond.

According to data of gas electronography the considerable deviation of valence angles from tetrahedral is detected for molecule of octachloropropane. According to Stolvic data /33,35/ molecule of octachloropropane has an anankomer chess disposition of chlorine atoms as a result of deceleration rotation around both C-C bonds.

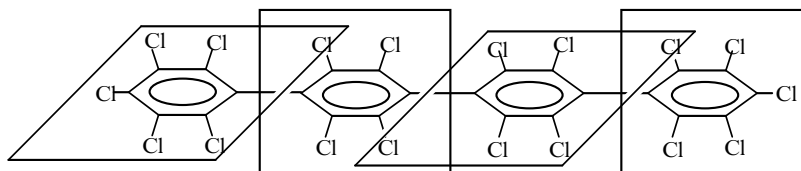


The very large elongation of C-C bond in comparison with propane has been found for molecule of hexachloropropane /23/.

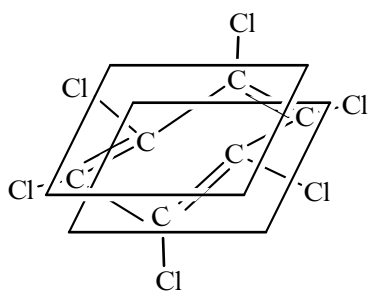
Due to large steric repulsing interaction of two chlorine atoms in 1,4-position of molecule of hexachlorobutadiene, its cisoid conformation becomes energetically disadvantageous and molecule preferably exists in coplanar-transsoid conformation.



The characteristic samples of anakomerity of conformation of chlorocarbon structure of molecules are perchlorophenylenes in which the planes of per-chlorophenyl rings have the interperpendicular or disposition near to this /3/.



It has been established that even molecule of hexachlorobenzene in which exists only insignificant spatial interaction, is deformed, chlorine atoms are alternated under and over- middle plane of carbon ring as a result of which planar form of six-membered aromatic ring acquires form close to chair-conformation /3/.

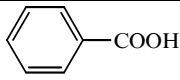
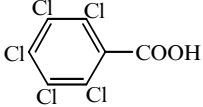
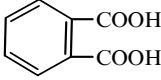
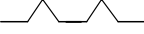
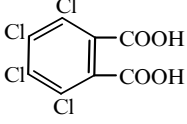



These and other peculiarities of chlorocarbons give on them specific properties. These properties are: increased /4/ or decreased /10/, thermal stability of molecules of chlorocarbons, halogenophilic reaction /39/, inverted diene synthesis /27/, reaction chlorinolysis /3/, increased acidity (Table 2) of perchlorocarboxylic acids /29-

31/ and perchlorophenols, increase of intramolecular hydrogen bond, reinforce of nucleophilic substitution owing to steric tension of molecule /3/, decrease of activity of unsaturated bonds as a result of screening by chlorine atoms, exceptional inertness and high stability /5/ of perchlorotriphenyl radicals /6/ in which central carbon atom has been surrounded by three perchlorobenzene nuclei and so on.

**Value  $pK_{\alpha}$  of carboxylic and chlorocarboxylic acids /35-37/.**

**Table 2.**

A c i d s	$pK_{\alpha}$
$CH_3COOH$	4,76
$CH_2Cl-COOH$	2,86
$CHCl_2-COOH$	1,29
$CCl_3-COOH$	0,65
	4,21
	-
	$pK_1 = 2,95, pK_2 = 5,41,$ $\Delta pK = 2,46$ 
	$pK_1 = 4,40, pK_2 = 5,22,$ $\Delta pK = 0,82$ 

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## SYNTHESIS AND PROPERTIES OF PROPARGYL β-HALOGENETHERS

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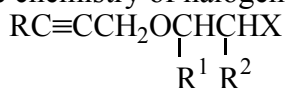
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The interest to considered grade of compounds is stipulate of that as compared with saturated analogues, combination in the molecule halogens atom and double bond permits priori to predict expansion of their synthetic and applied possibilities<sup>1-3</sup>.

Taking into consideration accumulated own material, we attempted to systematize state chemistry of halogen ethers, described by general formula

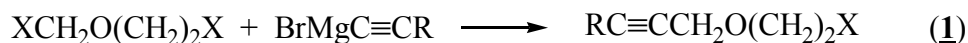


R, R<sup>1</sup>, R<sup>2</sup> = H, Alk, Ar

R<sup>1</sup> и R<sup>2</sup> = -(CH<sub>2</sub>)<sub>4</sub>-

X=Cl, Br, I

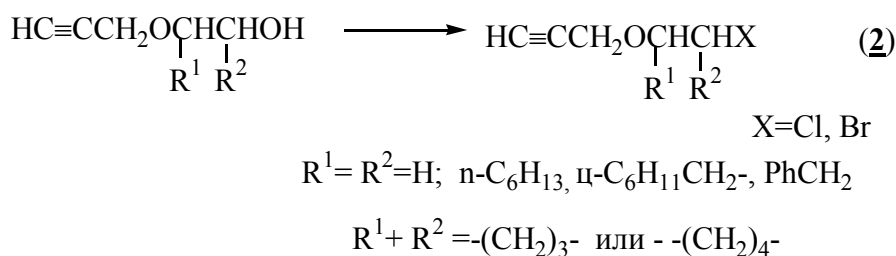
Probably the most «old» way of synthesis of β-chloro(bromo)ethers of propynol and its C<sub>sp</sub>-alkylsubstituted homologs is contained in processing of corresponding α-halogen methyl-β-halogenethyl ethers by Iocoitch reactive from acetylene or from its monosubstituted



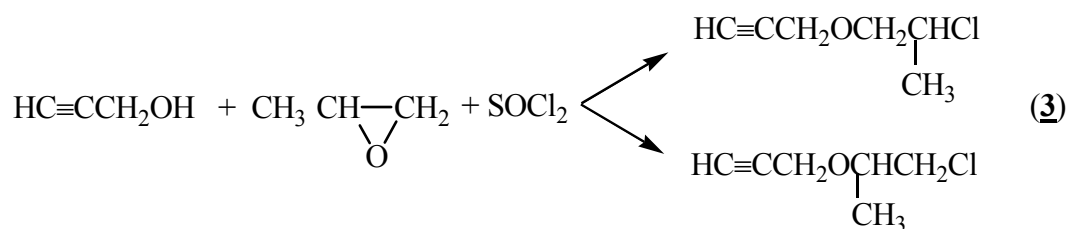
X=Cl, Br; R=H, Alk, Ar

**Observance of equimolar correlation of reagents practically provides the reaction (1) proceeding with participation more reactionable α-ether atom of halogen of initial dihalogen ether.**

The synthesis of  $\beta$ -chloro(bromo)ethyl propargyl ether may be carried<sup>1-3</sup> out by substituted halogenation of monopropargyl ethers of 1,2-diol under the influence halogens of phosphorus or sulphur (thionylchloride, tribromide or pentachlorous phosphorus) in aprotic solvents

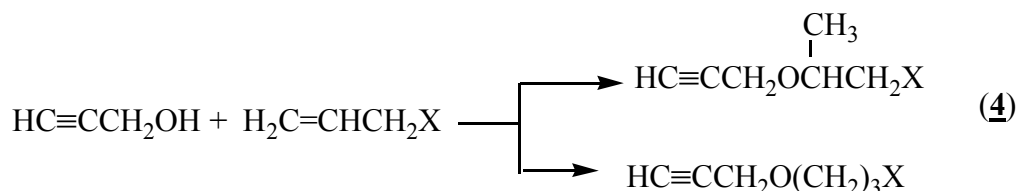


In this aspect it should be considered also chemism of three component catalytic ( $\text{BF}_3$ ) reaction with participation of propynol, methyl-oxirane and thionyl<sup>4</sup> chloride, resulting to isomer propargyl  $\beta$ -chloroethers



The last, it is obvious, are the result of substitution of hydroxyl by halogen in intermediately forming products of disclosing of three component epoxycycle by propynol, i.e. corresponding isomer monopropargyl ethers of propylene glycol.

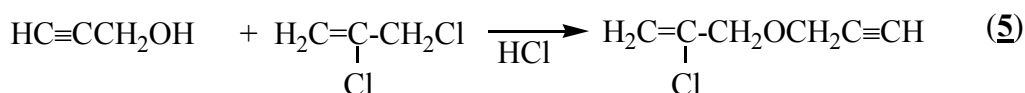
The efforts to get the individual  $\beta$ -halogen ethers by means of combination to allylhalogen (in the presence of p-toluene sulphonic acid) were futile: with decrease of atomic number of halogen, the growth fraction of isomer, forming by addition to double bond in spite of Markovnikov rule, i.e. corresponding  $\gamma$ -halogen ether is observed



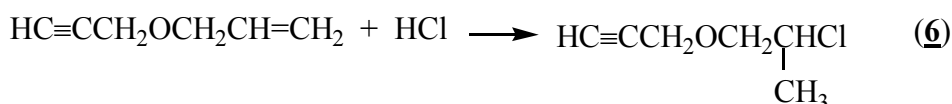
In this conditions the addition of propynol to metallychloride proceeds regioselectively<sup>5</sup> and leads to formation of individual propargyl ether of dimethylchloromethylcarbnol.

The heterogeneous catalysts can also promote the additive process of interaction of propynol with substrates, containing C=C bond. So reaction with 2-bromocyclohexene in the presence of phosphorus-molybdenum acid<sup>6</sup> leads to  $\beta$ -bromocyclohexyl propargyl ether with high yield.

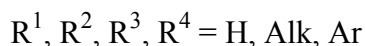
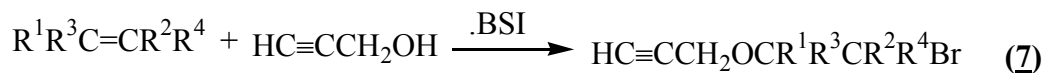
Using more high mobility of halogen, connected with tetragonal atom carbon (as compared with C<sub>sp</sub>-hybridization) it is possible to realize synthesis of propargyl ether of 2-chloro-2-propen-1-ol by condensation of propynol with 2,3-dichloro-1-propen in condition of interphase catalysis



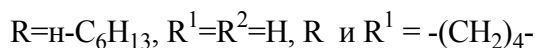
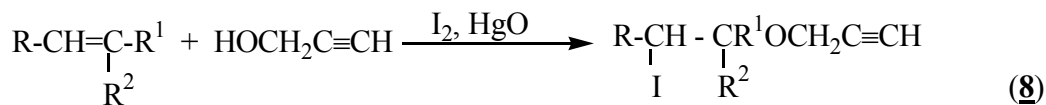
To effective methods of synthesis of propargyl ethers of 2-halogenpropanol undoubtedly the process of chemoselective electrofil addition of halogene hydride to double bond of allyl propargyl ether should be mentioned. The reality of method is confirmed experimentally on the example of hydrochloration of the last in C<sub>6</sub>-hydrocarbon solvent with result of getting  $\beta$ -chloropropargyl ether<sup>8</sup>



The general and reliable method of propargyl  $\beta$ -bromoethers is the affect of N-bromosuccinimide (BSI) on binary mixture of olefin and propynol<sup>9-11</sup>



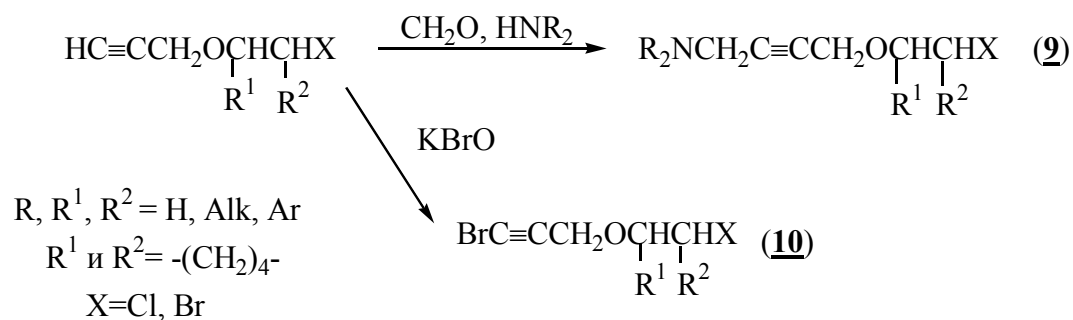
Substitution of BSI to molecular iodine and the catalyst of the process by mercury oxide provides getting of propargyl  $\beta$ -iodoethers<sup>12-14</sup>



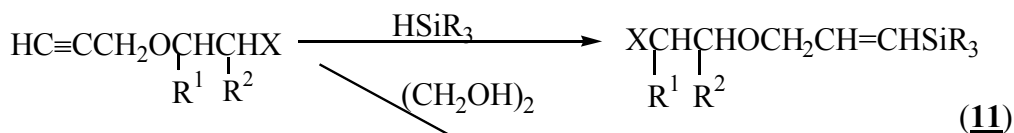
In this conditions iodoalkoxydation of styrene results with formation of mixture of  $\beta$ -iodoethers<sup>12</sup> isomer.

The chemical properties of propargyl  $\beta$ -halogen ethers are considered in the following order: conversion with participation of active centers of ethynyl groups, exchange processes with participation of halogen atoms, the rest reactions.

Substitution of terminal acetylene hydrogen's atom of  $\beta$ -halogen ethers is the result either of influence over hypobromite potassium or under condition of Mannikch reaction under influence of aminomethyling «pair»-paraformaldehyde-secondary amine: in this case the corresponding  $\text{C}_{\text{sp}}$ -substituted derivatives<sup>5,6</sup> are formed



The combination of hydrosilanes to triple bond  $\beta$ -chloroethers (or their bromine analogue), catalyzed by platinum compounds proceeds mainly according to Farmer rule and leads to silicon containing unsaturated ethers; cycloaddition of ethylene glycol in the presence of mercury oxide and boron trifluoride etherate let possibility to pass to substituted 1,3-dioxolanes<sup>5,6</sup>

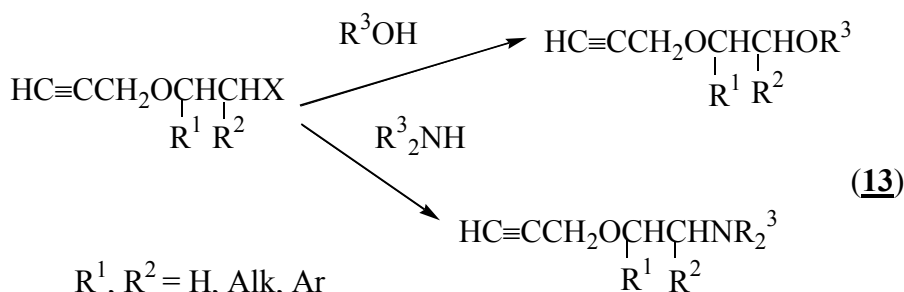


R, R<sup>1</sup>, R<sup>2</sup> = H, Alk, Ar

R<sup>1</sup> и R<sup>2</sup> = -(CH<sub>2</sub>)<sub>4</sub>-

X=Cl, Br

Substitution of halogen atom under action of different nucleophile reagents (spirits, amines) allow to get full alkylpropargyl ethers of vicinal diols and also the acetylene amine ethers<sup>5,6,12</sup>



R<sup>1</sup>, R<sup>2</sup> = H, Alk, Ar

R<sup>3</sup>=Alk

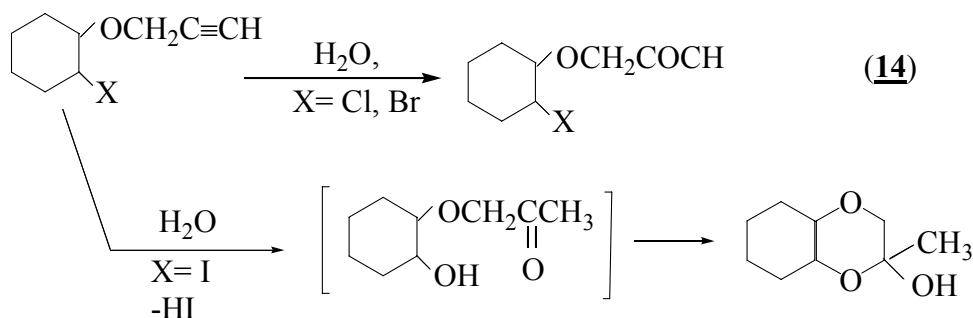
R<sup>1</sup> и R<sup>2</sup> = -(CH<sub>2</sub>)<sub>4</sub>-

X=Cl, Br, I

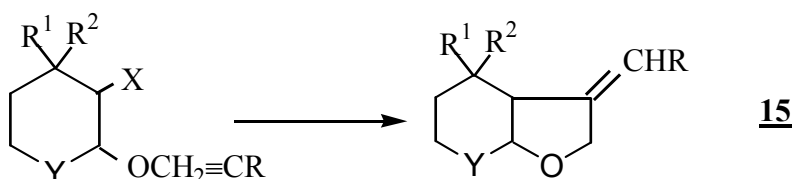
The lightness substitution of halogen in this case with increases its atomic number increase.

This conformity discovers reflection in condition of catalytic hydration (Kucherov reaction); chloro-<sup>5</sup> and bromoethers<sup>15</sup> convert into expecting halogen ethers of oxyacetone\*, as just as the iodoethers suffer intermolecular cyclohydration forming cyclic hemi acetyls

- This compounds are the convenient initial substances for synthesis of substituted derivatives of 1,4-dioxyne<sup>16-18</sup>



By variation the nature of using catalyst turn out well to regulate the direction of intermolecular ring formation of propargyl  $\beta$ -halogenethers<sup>20,21</sup> by getting different substituted tetrahydrofurans



From practically useful properties of propargyl  $\beta$ -halogen ethers let's mark their ability to break metal corrosion in acid medium. The most effective inhibitors corrosion of steel in that are the iodoethers of aromatic series<sup>22-26</sup>, the protective effect of which increase with increase of aggressive mediums temperature.

It is suggest to use the series of propargyl  $\beta$ -halogen ethers as a antimicrobe additions to lubricants and fuels<sup>27-33</sup> and also as active ingredient of glue compositions<sup>34</sup>.

Use the  $\alpha$ -organil- $\beta$ -bromoethylpropargyl ethers  $HC=CCH_2OCHRCH_2Br$  ( $R=Ph, CH_2Cl$ ) for getting of modified phenol-formaldehyde oligomers with following sodification of the last, allowed to realize making stable to thermo-oxidative break-down of new three-dimensional reticular polymers<sup>35</sup>.

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## **EFFICIENCY OF IMPULSE NEUTRON-NEUTRON LOG APPLICATION FOR CONTROL OVER OIL FIELDS DEVELOPMENT**

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One of the major tasks of oil-field geophysics consists in correct interpretation of downhole data considering geological, reservoir and physical-chemical characteristics of oil in productive layers.

Application of hydrodynamic and geophysical techniques at final stages of hydrocarbon fields development is crucially important because complex conditions demand correct evaluation of some parameters of layers and, as a result, regulation of production process.

Among these parameters the most important are initial and current distribution of oil, gas and water across section, current oil-gas saturation coefficients, oil displacement evaluation, injection of water and other agents into the bed and technical state of well. We must note that in mature fields, where drilling of new wells was stopped, geophysical data are acquired from cased wells.

Today one of the widely used geophysical technique is Impulse-Neutron Log (INL). Application of various modifications of this technique and relevant equipment has started since 1962 /5,8/. No doubt, use of INL, data interpretation and equipment have been significantly improved since then.

There are mainly two types of INL. The first is Impulse-Neutron Log (INL-T), which uses meanlife of thermal neutrons and the second one carbon-oxygen Impulse-Neutron Log (INL C/O). Of these only Impulse Neutron-Neutron Log is widely applied in Azerbaijan and around the globe. Despite that geologic setting of oil fields and reservoir characteristics of productive layers, physical-chemical features of oily water in some fields in Azerbaijan are not favourable for INNL application, several techniques have been developed for evaluation of current oil saturation. However, due to technical and financial shortages the studies were not performed at a proper level and required trends

have not been correctly chosen. As it was mentioned earlier, one of the widely used down hole techniques is INNL which featured by relatively smaller number of measured parameters.

Studies evidenced that major parameters of INNL, which are thermal Neutrons meanlife- $\tau$  and diffusion coefficient in layer water, NaCl in particular, boron, shaliness, porosity coefficient ( $k_p$ ), etc. Since lithologic composition (chemical characteristics) and shaliness of layer water depend on maturity of the field, the increase of INNL efficiency is quite a complex task.

The authors /1/ have displayed that if NaCl content is less than 100 q/l then the Neutrons meanlife - $\tau$  has values close to that in oil and water. In this case the data interpretation fails to give correct picture of oil-saturated intervals.

For rocks with less than 20% porosity and salinity 100 q/l and for rocks with less than 10-15% porosity and 200q/l salinity the neutron technique provides good results /5/.

According to /4/, neutrons meanlife, depending on lithology and fluid content of rocks with high chloride content, simplifies methods for oil saturation evaluation. Drop of chlorine percentage in water makes oil saturation evaluation more difficult.

If  $\tau_{or}$  values are close to those in oil and water the INNL data interpretation will probably fail to give correct results.

**Shows values of neutrons meanlife versus water salinity in oil-gas fields /4/:**

Table 1

Salt	Chemical indication	Specific weight, q/sm <sup>3</sup>	$\tau_{or}$ , m/sec
Calcium chlorine	CaCl <sub>2</sub>	2,15	0,005
Magnesium chlorine	MqCl <sub>2</sub>	2,32	0,004
Sodium chlorine	NaCl <sub>2</sub>	2,15	0,006
Potassium chlorine	KCl	1,99	0,007
Sodium sulphate	NaSO <sub>4</sub>	2,70	0,26
Sodium carbonate	Na <sub>2</sub> CO <sub>3</sub>	2,50	0,31

Neutrons meanlife depends also on rock lithology. For example, the  $\tau_{or}$  value in graphites higher than that in sands. On the contrary, in case of high boron content the  $\tau_{or}$  values are lower.

Coefficient of neutrons diffusion D vary depending on rock lithology and, in general, used for evaluation of porosity.

Thermal neutrons meanlife ranges between 133-255 m/stc depending on fluid type and in naften type of oil  $\tau_{or} \approx 187$  m/sec.

Table 2 displays neutrons meanlife values  $\tau_{or}$  for cases when rocks made up from quartz sands.

**$\tau_{or}$  values versus oil-saturation and porosity**

Table 2

Oil saturation,%	$\tau_{or}$ m/sec		Porosity %	
	40	30	20	10
100	40	30	20	10
80	0,37	0,44	0,55	0,73
70	0,25	0,30	0,40	0,58
60	0,18	0,26	0,36	0,53
20	0,12	0,16	0,22	0,37
10	0,11	0,14	0,20	0,34
0	0,10	0,14	0,19	0,32

Below we give factors which impede evaluation of oil and water saturation of rocks while INNLL application:

1. inhomogeneity of rocks in the studied layers
  2. penetration of outer fluids into the layer through casing and displacement of layer fluid
  3. Drop of water salinity as a result of water injection into and around the outlined area
1. It must be noted that proper interpretation of INNLL diagrams depends on fluid saturation, as well as on lithologic composition.

Thus, in case of high chloride content in clays the percentage of chloride in high density rocks is low. This impedes correct evaluation of oil-water saturation of rocks by INNL use, if there are no other geophysical techniques.

**Integrated interpretation of INNL data together with data gathered by SP (Spontaneous Polarization), GL (Gamma Log) and micro-sonde allows to delineate layers of small thickness.**

2. One of the negative factors is penetration of fresh water through the casing into water bed.

In this case, in the area surrounding the borehole, which is characterized by longer lifespan of neutrons the dense accumulation of neutrons is observed, impeding identification of water bed.

It should be noted that identification of fresh water penetration in new wells, and oil-water saturated the layer is possible by electric log. Oil delineation is possible by radiometry technique only if there is harsh water. That is because thermal neutrons lifespan are different for oil and water and this eases the interpretation of data.

3. Accuracy of oil and water beds delineation decreases after water injection into layer. In this case INNL provides better results in comparison with NNL (Neutron-Neutron Log) and NGL (Neutron-Gamma Log).

As a result of borehole measurements, simulation and evaluation it was displayed that neutrons lifespan is over than 200 mk/sec if chloride content in bed water is <50g/l.

Since INNL data significantly depends on physical-chemical characteristics of oil and water, these characteristics must be considered for each case.

In oil fields across Azerbaijan and abroad there are a lot of water layers with NaCl content, without chloride. Under these circumstances the accurate evaluation of oil in reservoir beds by use of geophysical techniques is still a problem.

The task is more complicated if layers are inhomogeneous, shaly-sands of various thickness and reservoir properties. In these types of layers even at initial stages of development it is quite difficult to identify type of fluid saturated the layer. In oil fields in Azerbaijan the water content of layers distinguishes from that in other regions. This is due to a large number of production wells, presence of shaly reservoir properties. That is why, water content of beds within a single well is not the same.

In particular, layer water has a high salinity in some portion of section. Oil-field studies showed that area of INNL effect covers 0,5m radius area around the borehole. This area is also depression zone, which characterises by complexities generated while production. Pressure and temperature here are lower than in other portions of layer and due to high probability of sedimentation of

heavy components of oil the permeability is lower (in water saturated portions). This area is also known as mud injection area /2/.

Any agent (fluid), injected into the layer and area surrounding the borehole, penetrates through this area into the layer and provides layer water flow to the area surrounding the well.

That is why, for evaluation of perforated intervals with low water salinity it is proposed to increase NaCl content artificially in area surrounding the well prior INNL use (within INNL effect area-within 0,5m radius) /6/.

To fulfill the task, at first, INNL is applied. Then, injection of water with 100-150g/l NaCl is sufficient. Repeatedly, INNL is applied and then comparative analysis of both cases allows to evaluate type of fluid in the layer.

Due to relative simplicity of proposed technique, which is also cost effective, the technique is currently tested in oil fields in Azerbaijan. In beds with thin interlayers as a result of long-term production and unequal pressure distribution the hydrodynamic relation is generated and fluid (oil-water) moves from non-perforated intervals into those perforated /3/. This leads to oil saturation decrease in non-perforated portion and flooding of that area is observed.

Hydrodynamic relations are mostly traced in depression area, i.e. in the area surrounding borehole. The area is also featured by temperature drop and sedimentation of heavy components of oil and water. Practically, the area is characterized by pressure and temperature values favorable for sedimentation of parafin, pitch, asphalten.

The depression area surrounding borehole covers 0,5-1,0m and is recommended for impact in order to increase productivity /2/.

Taking into account that INNL covers area not larger than 0,5m radius, the data acquired in oil beds with heavy hydrocarbons (parafin, asphalten, hydron, ets) do not allow to evaluate oil and water saturation accurately.

For the past years INNL application in aim to evaluate current oil saturation in fields across Azerdaijjan has not been efficient. Layers evaluated as oil-bearing turn to be water layers or produce water sooner than expected. The false picture of oil saturation is created due to peneration of heavy components of oil into porous area surrounding borehole and sedimentation onto rock surface.

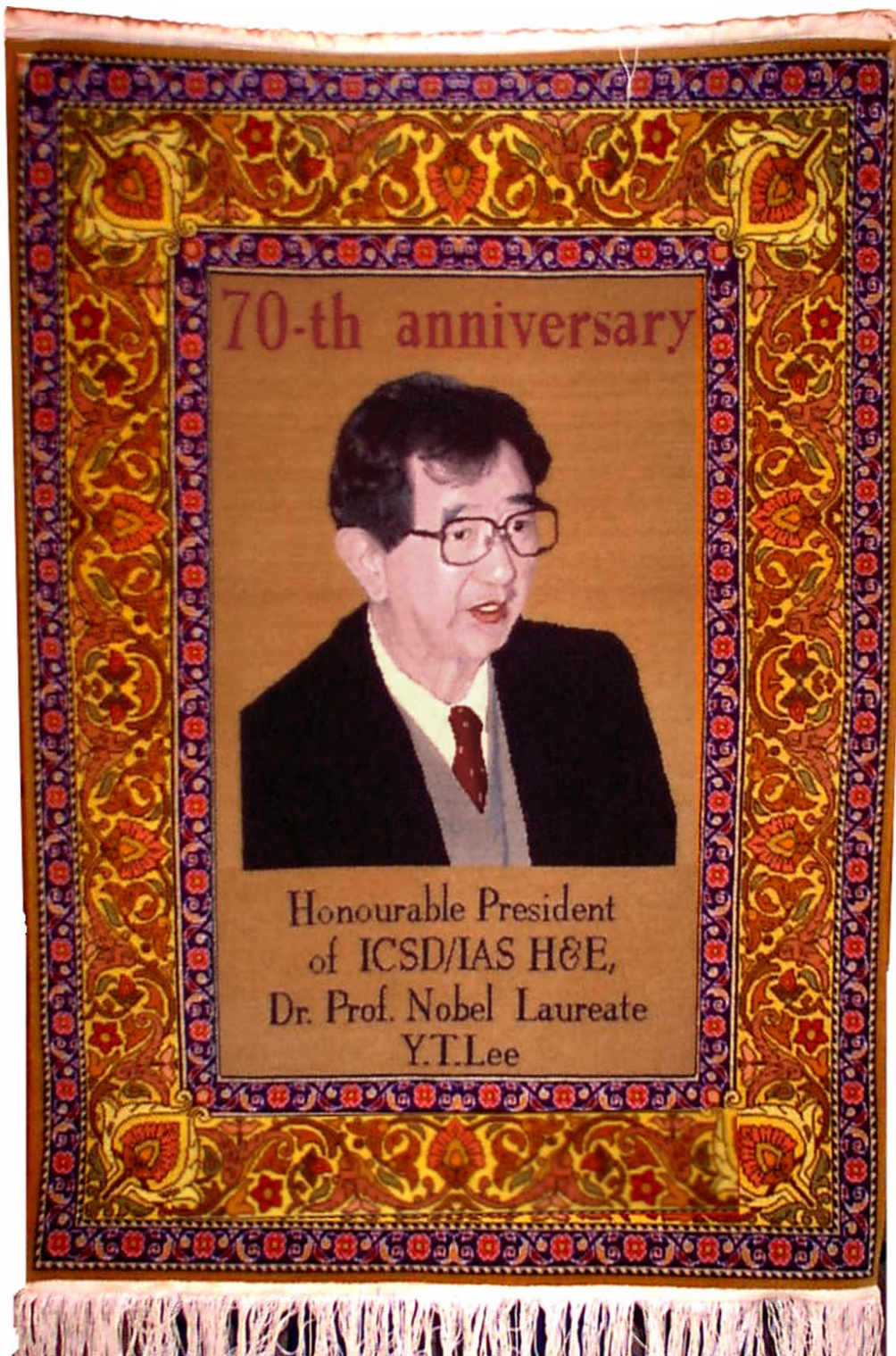
In order to increase INNL efficiency the new technology has been proposed for use in sections with oil containing heavy components and at final stages development /7/.

This tecnology is applied prior use of INNL in perforated areas and areas selected for perforation applyinge [isted thermal and chemical techniques /2/.

After the technology is used in area surrounding the borehole and heavy components of oil removed from that area the use of INNL provides proper evaluation of current oil satutation.

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