

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



# SCIENCE WITHOUT BORDERS

Transactions  
of the International Academy of Science  
H&E

Volume 6  
2020-2021



Innsbruck



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

# **SCIENCE WITHOUT BORDERS**

**Transactions  
of the International Academy of Science  
H&E**

**Volume 6  
2020/2021**

Dedicated to the 20th anniversary of the Azerbaijan Section  
of the International Academy of Sciences

**Innsbruck – 2022**



## EDITORIAL BOARD

### Co-chairs

**Academician, Prof. Dr.  
Walter Kofler,  
President of ICSD/IAS H&E  
(Innsbruck, Austria)**

**Academician, Prof. Dr.  
Elchin Khalilov,  
President of ICSD/IAS-AS  
H&E (Baku, Azerbaijan)**

### MEMBERS OF EDITORIAL BOARD:

*Akad. Prof. Dr. R. Steinacker (meteorology), Austria; Acad. Prof. Dr. K. Hecht (medicine), Germany; Acad. Prof. Dr. G. Tellnes (medicine), Norway; Acad. Prof. Dr. Z. Samedzade (economy), Azerbaijan; Prof. Dr. M. Bayraktutan (geophysics), Turkey; Prof. Dr. L. Wang (seismology), China; Acad. Prof. Dr. A. Abbasov (Physics), Azerbaijan; Acad. Prof. Dr. V. Starostenko (geophysics), Ukraine; Acad. Prof. Dr. P. Mamedov (geophysics), Azerbaijan; Acad. Prof. Dr. R. Lobato (journalism), Brazil; Acad. Prof. Dr. O. Glazachev (medicine), Russia; Acad. Prof. Dr. E. Hajizade (Economic Sciences), Azerbaijan; Acad. Prof. Dr. G. Fumarola (ecology), Italy; Acad. Prof. Dr. M. Veliyeva (pharmaceuticals), Azerbaijan; Acad. Prof. Dr. M. Gigolashvili (astrophysics), Georgia; Acad. Prof. Dr. F. Ibrahimli (Medicine), Azerbaijan; Acad. Prof. Dr. P. Keshavan (biology), India*

**Science Without Borders. Transactions of the International Academy of Science H&E. 2020/2021. Vol. 6, Innsbruck, SWB, 2022, 536 p.**

In the book are published the transactions of full members and corresponding members of the International Council For Scientific Development/International Academy of Science H&E, and the articles, presented by Academicians of ICSD/IAS H&E. The content of the book is multidisciplinary and covers the main spheres of modern natural technical and humanitarian sciences.

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.

© **International Academy of Science H&E**

ISSN 2070-0334

ISBN 978-9952-451-07-8



**Innsbruck – 2022**

## CONTENTS

**FOREWORD**.....9

### MULTIDISCIPLINARY RESEARCHES

*W.W. Kofler, I.W. Kofler*  
HEALTH ORIENTED RECREATION IN MARINE  
ECOSYSTEMS- ENDANGERED BY PREVENTABLE  
CONSEQUENCES OF INTERNATIONAL  
SHIPPING.....10

### MEDICINE AND BIOLOGY

*W.W. Kofler, O.S. Glazachev, H.Lyshol, G.Tellnes*  
IS FIGHTING AGAINST COVID-19 ENOUGH? .....13

*Gunnar Tellnes, Kari Batt-Rawden, Werner Christie*  
PUBLIC MENTAL HEALTH PROMOTION  
- ASPECTS OF NATURE-CULTURE-HEALTH  
INTERPLAY FOR COMMUNITY CARE AND  
ENVIRONMENT.....21

*I.B. Novoselov, A.G. Roninson*  
FEATURES OF DEVELOPMENT OF EXPERIMENTAL  
PNEUMONIA AGAINST ADMINISTERING NATURAL  
ZEOLITES.....32

*M.N. Veliyeva, R.İ. Ibragimov, S.A. Atakishizade, P.M. Veliyev*  
INVESTIGATION PHARMACOLOGICAL PROPERTIES  
REMEDY FOR CLARIFICATION HUMAN ORGANISM  
FROM TOXINS .....46

*A. Hasanova, N. Sultanova, S. Sultanova*  
DIFFERENTIAL STAINING OF SISTER CHROMATIDS IN HUMAN  
METAPHASE CHROMOSOMES.....61

<b><i>A.T. Hasanova, N.H. Sultanova</i></b> RARE CASE OF THE CLINICAL COMBINATION OF TWO NOSOLOGICAL FORMS OF CHROMOSOMAL PATHOLOGY .....	71
<b><i>M.N. Veliyeva , Y.C. Mammadov, R.M. Heydarova, F.İ. Ibrahimli, P.M. Veliyev, F.J. Madatli, S.M. Babayeva</i></b> OF LICORICE MEDICATIONS IN THE TREATMENT COVID-19.....	78
<b><i>S.A. Atakishizade</i></b> INNOVATIVE DEVELOPMENT OF PHARMACEUTICAL SECTOR IN AZERBAIJAN.....	88
<b><i>A.E. Mammadova, M.N. Veliyeva</i></b> DEVELOPMENT AND CREATION OF SOME COSMETIC PRODUCTS BASED ON GLYCYRRHETINIC ACID, STUDY OF THEIR TECHNOLOGICAL PROPERTIES AND DETERMINATION OF EFFECTIVENESS IN CERTAIN DERMATOLOGICAL PATHOLOGIES.....	101
<b><i>M.N. Veliyeva, F.I. Madatli, P.M. Veliyev, Z.M.Omarova, N.T.Bayramov</i></b> "LICORICE ROOT" PREPARATIONS PERSPECTIVES IN CASE OF COVID -19 INFECTION DISEASE TREATMENT .....	109
<b><i>R.İ. Ibragimov</i></b> CHANGES IN BEHAVIORAL REACTIONS UNDER INFLUENCE OF HEAVY METAL SALTS IN EXPERIMENTAL ATHEROSCLEROSIS.....	119
<b><i>A.A. Mammadova</i></b> PEDIATRIC PERIODONTITIS TREATMENT WITH USING OF HERBAL ANTI-INFLAMMATORY MEANS.....	130

***N.A. Alakbarova***

THE HISTORY OF PSYCHOLINGUISTICS  
AND ITS ROLE IN AZERBAIJAN

LINGUISTICS.....134

## **PHYSICAL-MATHEMATICAL SCIENCES**

***F.G. Gabibov, L.A. Aliyeva***

REGULARITIES OF RELATIVE CHANGES IN THE  
VOLUME OF SUBSIDENCE SOIL OVER TIME  
AT DIFFERENT VALUES OF VERTICAL AND  
HORIZONTAL PRESSURES IN THE CONDITIONS  
OF THREE-AXIS TESTS.....

143

***F.G. Gabibov, E.M.Shokbarov, L.F.Gabibova***

SEISMIC PROTECTION OF UNDERGROUND DAMS  
BY USING RECYCLED WASTE.....

155

## **AGRICULTURAL SCIENCES**

***C.M. Talai, E.N. Khalilov, A.A. Zamanov, T.I. Allahverdiyev, I.Q. Ibrahimova,  
Q.M. Hasanova***

EFFECT OF MAGNETIZED WATER USING THE  
MAGMATRIX APPARATUS ON YIELD  
AND QUALITY WHEAT INDICATORS.....

162

***E. Allahverdiyev, E. Khalilov, A. Ibrahimov***

RESULTS OF TESTS OF THE INFLUENCE OF  
IRRIGATION OF MAGNETIZED WATER USING  
THE "MAGMATRIX AGRO" TECHNOLOGY TO  
VEGETABLE GROWTH.....

182

## **EARTH SCIENCE, ECOLOGY**

- E.N. Khalilov, F.E. Khalilov, T.Ş. Khalilova***  
ON THE POSSIBILITY OF ENHANCING THE  
ADSORPTION CAPACITY OF NATURAL  
ZEOLITE BY MEANS OF MAGNETIC WATER  
TREATMENT.....190
- Milena Cukavac, Strachimir Cht. Mavrodiiev,  
Lazo Pekevski, Spomenko J. Mihajlovic***  
MONITORING OF EARTHQUAKES, GEOMAGNETIC  
FIELD AND ATMOSPHERE PARAMETER IN FP7  
BLACKSEAHAZNET PROJECT.....195
- N.Ş. Huseynov, M.F. Suleymanov***  
CHANGE OF TEMPERATURE REGIME IN THE  
REGION OF GANJA-GAZAKH AND ANALYSIS  
OF INFLUENCE TO FLIGHTS.....200
- E.N. Khalilov, A.E. Khalilov, F.E. Khalilov***  
USING MAGVORTEX TECHNOLOGY IN THE  
CIRCULAR ECONOMY TO REDUCE CO<sub>2</sub>  
EMISSIONS.....207
- E.N. Khalilov, F.E. Khalilov***  
PRACTICAL EXPERIENCE AND PROSPECTS OF  
APPLICATION OF NATURAL ZEOLITE FOR  
DEEP WATER PURIFICATION.....214
- E.N. Khalilov***  
RISKS OF THE FOURTH INDUSTRIAL  
REVOLUTION AND POSSIBLE WAYS TO  
MITIGATE THEM.....228
- Shohreh Hassanpour, Mehmet Salih Bayraktutan***  
APPLICATION OF THE MAGNETIC METHOD  
TO EXPLORATION OF THE POTASSIC ZONE  
IN THE HAFTCHESHMEH PORPHYRY COPPER  
DEPOSIT (NW IRAN).....257

## HUMANITARIAN SCIENCES

*N.H. Aliyev*

THE POLITICAL AND LEGAL SUBSTANCE AND  
RAMIFICATIONS OF THE TURKMANCHAY  
TREATY FOR THE SOUTH CAUCASUS.....271

*T.Sh. Khalilova*

SWIMMING OF PITEY (PIFEY).  
MYTH OR REALITY.....282

*T.Sh. Khalilova*

CONCEPTS OF THE BORDER OF EUROPE  
AND ASIA IN ANTIQUE.....297

*K. Makili-Aliyev*

WEAPONIZATION OF SARSANG RESERVOIR IN  
THE NAGORNO-KARABAKH CONFLICT.....325

*A.S. Mammadov*

TOUR HEYERDAL AND AZERBAIJAN.....343

## ECONOMIC SCIENCES

*Z.A. Samedzade*

AZERBAIJAN'S VICTORY IN THE 44 DAY WAR  
CHANGED THE COURSE OF HISTORY IN THE  
KARABAKH CONFLICT.....349

*E.M. Hajizadeh*

ENERGY SECURITY AND PROBLEMS OF  
SUSTAINABLE ENERGY EFFICIENCY  
SUPPLY.....367



## **ARCHITECTURE AND CONSTRUCTION**

***N.Y. Mammadov***

FEATURES OF DEVELOPMENT OF THE NEW  
CITIES IN THE REPUBLIC OF AZERBAIJAN.....378

***N.Y. Mammadov***

ISSUES AND METHODS OF IMPROVEMENT,  
UPDATING OF NEW CITIES OF THE REPUBLIC  
OF AZERBAIJAN.....394

## **OIL INDUSTRY AND KHEMICAL**

***A.A. Quvalov***

ARTIFICIAL LIMESTONE STONE BASED ON  
CARBONATE ROCKSWASTES.....405

***L.N. Khalilova***

STUDY OF SEDIMENTATION ENVIRONMENT  
OF PRODUCTIVE SERIES DEPOSITS IN  
DARVIN BANK AREA.....413

## **CONCEPTUAL ISSUES**

***Kofler Walter, Oleg Glazachev***

A GUIDE THROUGH THE COVID-19  
JUNGLE.....423

## **FOREWORD**

The sixth volume of the multidisciplinary book “Science without borders. Transactions of the International Academy of Science, H&E, 2020/2021”, has 37 scientific articles.

In the book are represented the articles of famous scientists from Austria, Azerbaijan, Turkey, Russia, Germany, Australia, Bulgaria, Iran, Norway, Macedonia, Sweden, Serbia.

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 eight parts: multidisciplinary researches; medicine and biology; physical-mathematical sciences; agricultural sciences; earth sciences and ecology; humanitarian sciences; architecture and construction; oil industry and chemical sciences.

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, recommended by Academicians of IAS H&E.

### ***Editorial Board***

**MULTIDISCIPLINARY RESEARCHES  
HEALTH ORIENTED RECREATION IN MARINE ECOSYSTEMS-  
ENDANGERED BY PREVENTABLE CONSEQUENCES OF  
INTERNATIONAL SHIPPING**

**<sup>1</sup>W.W. Kofler, <sup>2</sup>I.W. Kofler**

*International Academy of Science H&E*

*<sup>1</sup>Austria, Russia, Innsbruck, Moscow,*

*<sup>2</sup>Australia, Brisbane*

*e-mail: walter.kofler@ias-he.com*

Every person needs recreation: We have to distinguish between bodily, psycho-mental and social needs for recreation (Kofler W. 1980). The demand on psycho-mental and social recreation has increased in the civilized world as a result of psychosocial stress, multitasking, monotony, heteronomy etc. Recreational activities in nature provide a fulfillment to wide range of different needs and stimuli to help promote health development (Kofler W. 2009).

Diving and especially snorkeling are activities with high value especially for psychosocial recreation, but to balance also commonly not used bodily functions according to totally free decisions - without any order of a boss!. Therefore, the quality and stability of a marine ecosystems should also be considered from a health care aspect - especially in areas with significant tourism e.g. in the Mediterranean, the Great Barrier Reef, New Caledonia or other parts of the South Sea. The stability of marine ecosystems is determined by many factors including manmade ones. We should focus on mitigating the preventable ones. A major factor is the artificial shift within ecosystems as a result of the introduction of IAS being transport around the world on hull the large vessels. The time spent by various vessels stationary at ports or at anchor in various locations around the world provides sufficient opportunity for a large variety of species to potentially colonize their hulls. As a result, International shipping actually links all the different oceans, from an IAS point of view.

Hence species originating from different ecosystems could potentially colonize the same hull. In turn they can then be transported over many thousand miles. As a result of improvements in marine paints that are widely used by now clusters of growth will start to break off along the journey which in turn might end up seeding these species in new ecosystems if conditions are favorable. Therefore, it would be preferable to clean the hull before this stage of colonization has been reached. There are legal regulations to prevent such a risk within the national territories of the sea. New Zealand has an effective regulation: So only ships are accepted in a harbor of New Zealand with a confirmation of a successfully cleaning of the hull. Therefore they have to be cleaned outside of

New Zealand - independently of the applied technique. But ships should be cleaned all 6 - 12 Month to keep prevent any larger growth, soft or hard to form. A conventional technique for cleaning would be mechanically using brush carts or similar techniques that require some level of scraping of the hull itself. This can be done in a dry-dock very costly and time consuming; or within the ocean using divers. In the second scenario the biota will end up in the water column. Therefore, the places for diver-based cleaning need to be selected very carefully to respect the prevailing currents and weather patterns. These cleans are time consuming and like all commercial dive operations pose a certain risk to the dive crews involved.

A third solution is offered now with a **new technique** (Kofler I. 2019). It is based on a computer guided automatic cleaning system. It fixes itself thanks to suction to the hull and cleans it with high pressure sea water (50 - 450 bar 80l/min) (HallWiper 2019). It cleans up to 1500sqm/hour. This technique does not damage the anti-fouling paint coating. The re-growing of organic material is generally 2 - 3 times slower with this technology as opposed to divers or other mechanical means of cleaning resulting in cleaner ships between dockings. The removed fouling is collected in an onboard filtration system with mesh sizes as fine as 10 my and can be deposited on land without any ecological harm. A special camera system with CMOS sensor in 1280 x 800 resolution allows to document the situation before and after the hull cleaning e.g. for the presentation to the port authorities.

The economic benefits of a clean hull are remarkable: Schulz from the Department of Naval Architecture and Ocean Engineering of the United States Naval Academy reported an additional power required up to 76% more then with a hydrodynamically smooth hull (Schultz 2007). Therefore it should be in the interest of the shipping companies to clean their ship hull regularly but not only with respect to the cost but also because of their responsibility for health and a comprehensive sustainable environment.

Additional power requirements either results in slower travel speeds or increased fuel consumption to reach standard cursing speeds. Additional fuel causes additional CO<sub>2</sub>- emission. Just one example: An average vessel which is currently cleaned by K ROV is 208 m LOA. From unconfirmed industry sources bulk or container vessels in that size range burn up to 80 tons of MDOs (Marine Diesel Oils) per day steaming. Assuming that a conservative 10% reduction in fuel consumption would be achieved post clean then you would save 6 - 8 tons /day. Rounded down that would be about 18 - 24 tons of CO<sub>2</sub>'.

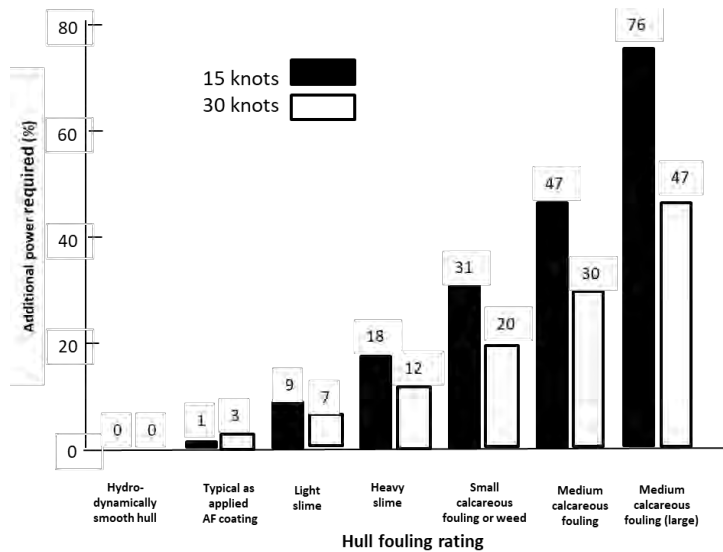


Figure 1: Economic benefits of a clean hull, Data taken from Schultz MP, Department of Naval Architecture and Ocean Engineering, U S Naval Academy / Naval Ships' Technical Manual Chapter 081 Waterborne Underwater Hull Cleaning of Navy Ships

An average car on Australian roads is considered to produce around 2,4 tons of CO<sub>2</sub> per annum (Basis: ABS Survey of Motor Use 20 June 2018; and greenvehicle.gov.au 2019)

## References

1. Hull Wiper (2019) Component & filter specifications, website...Hull Wiper@hullwiper.co, Accessed 15 June 2019
2. Kofler I. (2019) Hull Wiper - The Future of Hull Cleaning, Presentation for Marine Pest Sectoral Committee Partners Day 17 in Port Stephens
3. Kofler W. (1980) Ansatz für ein sozialmedizinisches Konzept der Erholungsraumplanung: Aufgabenbereiche - objektive Erholungsbedürfnisse - potentielle Erholungseignung einer Landschaft, United Nations World ed. E9-E13
4. Kofler W. (2009), Better critical decisions finding about environmental problems thanks emotional link to nature as a youngster? Proceedings, Ecological problems of the Global World, Herold Russian Section Int. Academy of Sciences Health and Ecology, ISBN 1819-5773, 22 – 26, Moscow, 2009
5. Schultz MP/ (2007) Effects of coating roughness and biofouling on ship resistance and powering', Biofouling, 23:5, 331 - 34.

# MEDICINE AND BIOLOGY

## IS FIGHTING AGAINST COVID-19 ENOUGH?

<sup>1</sup>Walter Kofler, <sup>2</sup>Oleg S. Glazachev, <sup>3</sup>Heidi Lyshol  
& <sup>4,5</sup>Gunnar Tellnes

<sup>1</sup>Medical University of Innsbruck, Austria,

<sup>2</sup>I.M. Sechenov Moscow State Medical University (Sechenov University), Russia,

<sup>3</sup>Department of Health and Inequality, Norwegian Institute of Public Health, Norway,

<sup>4</sup>Department of Community Medicine and Global Health, University of Oslo, Norway,

<sup>5</sup>School of Health Sciences, Kristiania University College, Norway

### Abstract

Tools of empirical epidemiology have been and are indispensable to focus political power on blocking the spreading of coronavirus disease 2019 (COVID-19) by stopping transmission. The present paper is a comment on e. gibney's article 'Whose coronavirus strategy worked best?' (Nature 2020; 581:15–6). The strategy for phase 2 should be more complex and interdisciplinary than described in the paper in Nature, especially in the period before a vaccine and specific treatments are available. The focus on reducing the mortality of COVID-19 will have side effects, including excess mortality from other causes. A part of this excess mortality will be based on the reduction of health-care offers as a consequence of the pandemic, and on structural limitations of the health-care system. A special challenge is to understand the relationship between death from and death with COVID-19, and therefore the relevance of severe acute respiratory syndrome coronavirus 2 infection in people with pre-existing burdens, for example coronary heart disease, cancer or older age. There is a need to extend the recently used tools to all available instruments, including physiological principles of prevention and promotion. The way to integrate global solidarity into the strategies of the different countries is critical not only for global health but also for the peace and long-term success for each individual country. The consequences of efforts against COVID-19 and the impact on reduced air pollution and climate change are also important to analyse from a global health perspective.

**Keywords:** COVID-19, public health, infectious diseases, community medicine, health promotion and prevention, NaCuHeal, Nature-Culture-Health

### Introduction

The current situation with coronavirus disease 2019 (COVID-19) is restricted by relevant but insufficient tools. This was demonstrated in a paradigmatic way by

the paper ‘Whose coronavirus strategy worked best? Scientists hunt most effective policies’. This excellent paper gives us information about forward-looking international studies on the basis of experimental epidemiology to ‘find ways to identify the measures that best predict infection rates’ and to ‘be able to forecast how adding and removing interventions would change the number of infections on SARS-CoV-2 over time’ [1]. We need such tools. However, the reader can get the impression that it is the responsibility of the scientists to ‘hunt the most effective policies’ and that the complexity of the situation can be handled just with the tools of experimental epidemiology and can be summarised by the position: ‘Without vaccine or effective treatment, stopping transmission remains the only defence against COVID-19’. Is such a strategy really sufficient, even in phase 2 – a situation in which the reproduction (R) rate is permanently  $<1$ , the number of new infected persons is much lower than the number of cured persons, contact tracing is sufficient and there are plenty of empty intensive care unit (ICU) beds for COVID-19 patients? In addition, is this sufficient to handle this epidemic that is also a pandemic? Are we adequately prepared to deal with the next pandemic – hopefully without a lockdown?

### **The responsibility of politicians, medical experts and other personnel**

The relationship between political decision makers and medical experts is clear: the politicians have to fix the strategy, usually based on unclear prerequisites and unknown future consequences nevertheless, they have to decide *now*. They are also responsible for the measures taken. The responsibility of the experts in infectious diseases and public health is to give information based on scientific principles. The scientific information may be expressed mathematically. The position of the medical doctors (MDs), such as general practitioners, public health physicians, epidemiologists and specialists in infectious disease, is more complex. Health depends on many factors, which may belong to many other scientific disciplines than medicine – from physics to socioeconomics up to now, these disciplines have not been compatible on a causal level. The results are often based on averages. The medical expert has to balance all these aspects with the focus on comprehensive proposals of curative, preventive and health-promoting efforts. The MDs need to cooperate with experts from different scientific disciplines, and they have to integrate multi-causality and multi-intentionality to keep in mind many different needs, demands and risks at the same time. MDs have to adjust the proposals according to the progress of the prior measures.

Therefore, aspects which are less relevant in phase 1 of an epidemic may gain relevance in phase 2. *Unintended side effects should be monitored: the*

*example of excess mortality* excess mortality has not been sufficiently studied. Banerjee et al. recently published an alarming population based cohort study on excess 1-year mortality associated with the COVID-19 pandemic [2] using data from the Office for national Statistics of England and Wales [3]. The Office for national Statistics reported 6000 excess deaths registered in the 2 weeks from 28 March to 3 April 2020, of which about 2500 deaths did not have COVID-19 recorded on the death certificates. We know that severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has a higher  $R_0$  and a higher case fatality rate than the 1918–1919 pandemic of Spanish Influenza, which caused about 50 million deaths [4]. The excess mortality of these other 2500 deaths requires our attention: the curves for ‘total mortality’ and ‘influenza and pneumonia’ in weeks 1–12 of 2020 and the 5-year-averages are totally unremarkable – in contrast to the data for weeks 13 and 14. Banerjee et al. add the excess deaths from the COVID-19 pandemic in those *affected* (indirectly, not infected) by reduced access to health services, the physical, psychological and social effects of distancing and economic changes to those *infected* (direct effects) [2].

### **The need for better registration of causes of death and distribution of medical resources**

It makes sense to distinguish between two groups of ‘affected deaths’. The first group comprises excess deaths without SARS-CoV-2 infection, caused by the reasons listed above. The improved strategy has to include improved distribution of ICU beds, personal protective equipment, hospital personnel and so on. The second group consists of excess deaths with SARS-CoV-2, but with another diagnosis on the death certificates. These cases call for a deeper analysis of the pathophysiological processes.

### **The added burden of COVID-19**

Health is a process in which the organism can balance the different demands to homeostasis. Death is the consequence when the demands to the organism cannot be adequately balanced. Therefore, survival and, finally, healing are based on two prerequisites:

- (a) sufficient available energetical, structural and morphological resources and
- (b) the sufficient organisation of these resources [5].

This lack of balance can cause a feeling of unwellness or pain, but it need not do so: COVID-19 patients with extraordinarily low blood oxygen levels have reported feeling comfortable [6]. We should not over estimate the subjective feeling as adequate stimulus to visit a physician, who could diagnose an aberration. The person could live decades with a known or unknown



pathophysiological deviation because of adequate potential to balance it. We know this from atherosclerosis for example. These pathophysiological processes explain why a comorbidity with atherosclerosis is linked with a high risk of dying of COVID-19. The related principle may be used to explain the excess mortality of different types of natural and man-made disasters, after Chernobyl, Bhopal, Seveso, heat waves, earthquakes and so on [7]. This also explains the formerly unexplained deviation of the mortality distribution of the victims of Hiroshima and Nagasaki [8].

### **A systematic analysis of the underlying factors**

A comprehensive analysis is missing. Useful proposals have been made by Harvey Fineberg [9] and others. Additional examples will be discussed here.

#### ***Modification of the characteristics of SARS-CoV-2: seasonality?***

There may be a slight seasonal effect, like in influenza epidemics, which leads us to expect a reduction in infections and the danger of second and third waves later nevertheless, our recent knowledge does not give real hope that SARS-CoV-2 will disappear like Middle Eastern Respiratory Syndrome (MeRS). Even with the disappearance of SARS-CoV-2, we should take into consideration that there are many possible candidates that could mutate to a similar virus. Any future strategy should use the given window of opportunity for better preparedness in our health-care systems and communities. This is needed independently of the hope for a vaccine or treatment [10].

#### ***Comprehensive understanding of preventive, health-promoting and curative options***

We present just a few examples from a wide field of options:

*Interrupting the chain of infection:* Direct contact with the virus is not enough to cause symptoms. The rate of people with positive tests but without symptoms confirms the assumption that processes must take place before symptoms occur. The fact that people without symptoms can infect others is another argument to consider tools to interrupt the process after immediate contact with the virus and its 'implementation' into the host body. The ongoing research, for example with n-Chlorotaurine antiseptic, should be followed with keen interest [11, 12]. *Health promotion: the example of intermittent hypoxia/hyperoxia training:* The ability to use oxygen in the air and to transport it to the needed organs/tissues decreases in the elderly, and this decrease is also a consequence of common diseases (e.g. coronary heart disease (CHD)). Intermittent hypoxia training or hypoxia-hyperoxia conditioning technologies are tools to improve oxygen uptake with positive effects on, for example, CHD [13] and Alzheimer's disease [14]. A critical factor for the coping capacity of patients

with SARS-CoV-2 is the amount of available oxygen. Hypoxic–hyperoxic training may serve to improve life in people predisposed to respiratory infections, with a high risk of developing chronic non-infectious diseases, as well as for the rehabilitation of patients after COVID-19, but also as a preventive tool. The nature-Culture-Health model (NaCuHeal) is another example of health promotion, which has been shown to improve health, quality of life and function [15].

### **COVID-19: a pandemic – not just anepidemic**

Each country has special conditions and therefore needs its own special strategy. The success of each country also depends on the success of all the other countries which suffer from the pandemic. The way in which this is handled is critical, not just for the global success of finally eliminating SARS-CoV-2. It also influences the freedom to travel and to exchange goods in the globalised economy, and strongly influences local and global health because of the consequences on morbidity and mortality as effects of unemployment and so on. In the recent situation, we are in danger of focus-sing on short-term wins, as was common in the 19th and large parts of the 20th century. The use of international agreements and treaties was comparable with the principles of game theory: reciprocation, only as long as the individual win can be maximised! At the end of the 20th century and the beginning of the 21st century, clever politicians have recognized that the long-term win for each country is higher if the agreements can be accepted and controlled independently from the actual and short-term win. It would in the end be more economical to support poor countries, even in the form of gifts: the costs to repair stability and regain predictability would be much higher than the costs to balance given in equalities. The long-term consequences of efforts against COVID-19 and the positive impact of the ongoing pandemic on reduced air pollution and climate change are also important to analyse from a global health perspective. Global health and the interplay between nature, culture and health (naCuHeal) may decide the future of the global economy and the fate of human beings on our planet [16]. There is an untapped potential for improving public health by employing health-promoting nature and cultural activities in the local community [17–19]. The goal is an increased ability to cope, productivity and prosperity to *all* people, that is, not only the affluent members of society, but also the ones who are in danger of becoming permanently incapable of working. The next level of the argument would be to respect the neglected, maybe suppressed conclusions of Darwin: he proposed that the natural progress from the purely biological understanding of other species would be understanding them as moral creatures [20]. The evolutionary process would

logically cause the extension of sympathy not just to ‘the men of all nations and races . . . but to the humblest living creature’. Therefore, the way we handle the recent pandemic can give us the tools to improve not only the level of health, but also the guidance for socio-eco-logical and cultural-based peace and sustainable development [21]. The importance of health promotion and contact with nature are also underlined by the World Health Organization that recently published a set of prescriptions for a healthy and green recovery from COVID-19, of which the first prescription is to ‘protect and preserve the source of human health: nature’ [22].

### **The need for a holistic perspective on pandemics, climate change and global public health**

The recent lock down has been influenced by the lack of preventive activities in consequence of the experiences with SARS and MeRS. We have known that the next pandemic would come – sooner or later. We may be able to develop a specific vaccine and treatment against SARS-CoV-2. This would not be sufficient to prevent the next lockdown. We know from history how important general improvements in health are (e.g. the decrease in the mortality rate of tuberculosis even without a vaccine and without a specific drug). Such processes take time. Therefore, we have to start now and not only with tools based on classic physiology and contact tracing. Phase 3 is needed. The necessary structure must be integrated into other strategies to deal sufficiently with the known challenges, for example global warming, climate change, the mass death of bees and so on.

### **Conclusion**

The present situation without a vaccine and specific treatments should stimulate a systematic focus on saving lives using curative, preventive and health promoting tools. The available knowledge should be used for additional research for a better understanding of the combined effects between different diseases, but also between the interactions of biological, physical, emotional, cognitive and intellectual challenges. The way to integrate global solidarity into the strategies of the different countries is critical not only for global health but also for the peace and long-term success of each individual country. The consequences of efforts against COVID-19 and the impact on reduced air pollution and climate change are also important to analyse from a global health perspective. There is an urgent need to extend the activities from phase 1 – coping with the acute pandemic – and phase 2 – to be prepared for a second wave of COVID19 and to develop a specific vaccine and treatment – to phase 3 – to be prepared for the

next pandemic, which must also be balanced with other expected fundamental risks to our existence. Therefore, there is a need to extend the recently used tools to all available instruments, including physiological principles of prevention and promotion.

### **Declaration of conflicting interests**

The authors declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

### **Funding**

The authors received no financial support for the research, authorship and/or publication of this article.

### **References**

1. Gibney E. Whose coronavirus strategy worked best? Scientists hunt most effective policies. *Nature* 2020; 581:15–6.
2. Banerjee A., Pasa L., Harris S., et al. Estimating excess 1-year mortality associated with the COVID-19 pandemic according to underlying conditions and age: a population-based cohort study. *Lancet* 2020; 395: 1715–25.
3. Office of National Statistics, Death registered weekly in England and Wales: provisional: week ending 3 April 2020, (accessed 7 September 2020). <https://www.ons.gov.uk/people-population-and-community/births-deaths-and-marriages/deaths/datasets/weekly-provisional-figures-on-deaths-registered-in-england-and-wales>
4. Layne S.P., Hyman J.M., Morens D.M., et al. New coronavirus outbreak: framing questions for pandemic prevention. *Sci Transl Med* 2020; 12: eabb1469.
5. Dussault A.C. and Gagné-Julien A.M. Health, homeostasis, and the situation-specificity of normality. *Theor Med Bioeth* 2015; 36:61–81.
6. Couzin-Frankel J. The mystery of the pandemic's 'happy hypoxia'. *Science* 2020; 368:455–6.
7. Kofler W. Health effects of environmental disasters and the need of a more complex model of man. In: Steinberger Y (ed) *Preservation of our world in the wake of change*. Jerusalem: I See QS VI A/B, 1996, pp.275–82.
8. Kofler W., Lercher P. and Puritscher M. The need for sufficiently taking into account unspecific effects in the understanding of health risk: Part 1: unexplained phenomena; Part 2: epistemological limitations and offers for solution; Part 3: Proof of the proposed solution by an experimentum crucis. IuAPPA and Korean Society for Atmospheric Environment, Seoul (on CD-ROM), 2001. f 0245 a-c.
9. Fineberg H. Ten weeks to crush the curve. *New Engl J Med*. 2020; 82: 37.
10. Neher R.A., Dyrda R., Druelle V., et al. Potential impact of seasonal forcing on a SARS-CoV-2 pandemic. *Swiss Med Wkly* 2020; 150:112.

11. Gottardi W. and nagl M. n-chlorotaurine, a natural antiseptic with outstanding tolerability. *J Antimicrob Chemother*2010; 65:3.
12. Arnitz R., Stein M., Bauer P., et al. Tolerability of inhaledn-chlorotaurine in humans: a double-blind randomized phase I clinical study. *Ther Adv Respir Dis* 2018; 12:1753466618778955.
13. Glazachev O., Kopylov P., Susta D., et al. Adaptations following an intermittent hypoxia-hyperoxia training in coronary artery disease patients: a controlled study. *Clin Cardiol*2017; 40: 370–6.
14. Bayer u, Likar R, Pinter g, et al. Intermittent hypoxic–hyperoxic training on cognitive performance in geriatricpatients Alzheimer’s and dementia. *Alzheimers Dement (NY)*2017; 3:114–22.
15. Batt-Rawden K.B .and Tellnes G. nature – Culture – Health activities as a method of rehabilitation: an evaluation of participants’ health, quality of life and function. *Int J Reha-bil Res* 2005; 28:175–80.
16. Tellnes G. How can nature and culture promote health? *Scand J Public Health* 2009; 37:559–61.
17. Tellnes G. President’s column: health promotion in the local community. *Eur J Public Health* 2005; 15:331–3.
18. Tellnes G., Batt-Rawden K.B. and Christie W.H. nature-Cul-ture-Health promotion as community building. *Herald IAS.RS* 2018;1:15–20.
19. Tellnes G., Batt-Rawden K.B. and Christie W.H. Public men-tal health promotion, epigenetics and naCuHeal – activities.*Herald IAS.RS* 2019;1:66–73.
20. Darwin C. *The descent of man, and selection in relation to sex.*2 nd ed., 12th thousand, revised and augmented. london:John Murray, 1877.
21. Kofler W., Glazachev O. and Tellnes G. evolution and thepromotion of health, wellbeing and peace (instead of preface). *Herald IAS.RS* 2020; 1:1-1.
22. World Health Organization. nature is our greatest sourceof health and well-being. WHO celebrates World environment Day 2020, for nature and for people, <https://www.who.int/news-room/feature-stories/detail/world-environment-day-2020> (accessed 7 September 2020).

## **PUBLIC MENTAL HEALTH PROMOTION - ASPECTS OF NATURE-CULTURE-HEALTH INTERPLAY FOR COMMUNITY CARE AND ENVIRONMENT**

<sup>1</sup>**Gunnar Tellnes, University of Oslo,**

<sup>2</sup>**Kari Batt-Rawden, NTNU,**

<sup>3</sup>**Werner Christie, NTNU**

<sup>1,2,3</sup>*International Academy of Science H&E (Norway)*

### **Introduction**

*The purpose of this paper* is to focus on the salutogenic (Antonovsky, 1996; Griffiths, 2009) approach to mental health promotion through nature and culture activities and its impact on health and wellbeing, and its significance for current and future policy. A brief overview of major literature from nature and culture research is included, as well as a brief section on the aspects of social connectedness and social capital. By focusing on the “Nature-Culture-Health interplay”, experiences from the Nature-Culture-Health (NaCuHeal) Centre in Asker, Norway is presented along with the conceptual model (fig 1).

### **Public Mental Health Promotion and current global challenges**

The term Public Mental Health was first introduced at the EUPHA conferences in Graz 2005 and Montreux in 2006. This was initiated by the EUPHA president professor Gunnar Tellnes who established a new “Section of Public Mental Health” (Tellnes, 2005) ([www.eupha.org](http://www.eupha.org)). Public Mental Health is a term created to underline the need to emphasize the neglected element of mental health in public health practice. It includes promotion, prevention, effective treatment, care and recovery (All-Party Parliamentary Group on Arts Health and Wellbeing, 2017). Mental disorders are one of the top public health challenges in the WHO European Region, affecting about 25% of the population every year. In all countries, mental health problems are much more prevalent among those who are most deprived. The WHO European Region therefore faces diverse challenges affecting both the (mental) well-being of the population and the provision and quality of care for people with mental health problems (WHO, 2013–2020). Depression has a substantial impact on quality of life. Older people with depression by definition report lack of energy, loss of enjoyment and worse general function, and depression may often be a cause or consequence of social isolation and loneliness. Depressed people with chronic somatic disorders are

likely to experience a particularly high symptom burden and a substantial decline in function (Forsman et al., 2011). Primary or secondary prevention of depression may have an important impact on population-level disability (WHO, 2013-2020). Understanding from developmental psychology and lifestyle medicine as well as a macroscopic perspective that considers individual, family, school, and community might be helpful (Jung-Ah Min et al., 2013).

Recent research confirms that longevity and a healthy life is strongly influenced by belonging to closely knit communities or groups, that can give you a sense of meaning and of mastering in collective activities like nature and culture experiences. Increasingly more emphasis has been put on nature and cultural activities for maintaining health and quality of life (Hansen et al., 2015; Cuypers et al. 2012; Tellnes 2017), and may be linked to the building of social capital in local communities (Campbell and Gillies, (2001).

Rapid processes of change in the community represent a challenge to public health policy (Tellnes, 1996, 2003, 2005a, 2009; Tellnes et al., 2018; Batt-Rawden and Tellnes, 2010). Health promotion is carried out by and with people, which improves both the ability of individuals to take action, and the capacity of groups, organisations or communities to influence the determinants of health (WHO, 1997). “Settings for health” represent the organizational base of the infrastructure required for health promotion. 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 (Fietje and Stein, 2015). Perhaps it is timely to bring forth to a further extent the unique qualities of nature (Fugelli, 2010) and the value of art (Clift et al., 2009). Public health research and practice should focus not only on factors causing disease and injuries (pathogenesis), but also on factors promoting health (salutogenesis) in the perspective of health promotion and prevention in different settings.

### **The Epigenetics Revolution**

Health Promotion in the Light of new Epigenetic Research, Environment and lifestyle may have impact on our genes both today and in the future, and recent epigenetic research indicates that our genes may be turned on and off as consequence of the way we are living (Carey, 2012).

After the Human Genome Project (HUGO 2001) there was huge optimism among many experts and pharmaceutical companies about the potential identification of disease determining genes. These would be used to develop new drug treatments for any disease with a genetic origin. Later it has become evident

that this is an unrealistic and simplified optimism. It turns out that most genetic risk factors for common diseases have a very low penetration, often less than 10%.

This implies that for most of the diseases dominating the global burden of diseases, including psychiatric disorders have other reasons than heritable or acquired genetic traits drive and are decisive the pathological processes. Newer evidence (Encode 2012; Human Microbiome project (2012) indicate that the relationship between our environment and the regulation of our genes have crucial impact on our metabolism both in health and disease. The environmental impact on the regulation of our genes through so-called epigenetic mechanisms are mediated by physical, chemical, microbial, behavioral and social factors impacting the regulation of our gene expression. This implies two important paradigm shifts in our understanding of health and disease.

The first is that complex environmental factors and influences directly affect our metabolism, and the phato physiological processes for a majority of complex public health diseases and challenges. That implies that generic public health preventive strategies for such diseases, directed towards environment, behavior and social conditions can be equally or more effective and efficient than individual prevention and cure. Secondly, it turns out that epigenetic regulation of genes, both pathogenic and salutogenic, can be inherited over a few generations before being “Washed out” of the germ-line. This implies that the same mechanisms that can reregulate epigenetic factors towards salutogenic effects, possibly can have impact over several generations (Carey 2012; Jablonca et al. 2014). In sum, this indicates the importance of public health strategies focusing on improving behavior, natural and built environments and culture.

### **Nature and culture – roads to wellbeing and social connectedness**

The role of access to green spots and nature for humans well-being has been grossly underestimated (Kaplan, 1995; Stigsdotter et al., 2010). The fact that most basic cultural attributes have been modified from, and developed, from evolutionary responses, researches further argues against a strict separation between natural and cultural affinities for nature (Mayer and Frantz, 2004). This is of great importance when it comes to community building that promotes health. With increasing urbanization, people have less access to nature in their daily life. In general, people in the Western societies spend most of their time in indoor settings. Integrating features of natural contents into the built environment can give people access to nature, to a greater degree. The debates in health promotion have also considered stress (Lindstrøm and Eriksson, 2015) and the links between social isolation and mental health (Putnam, 2000). This author has



previously addressed these issues through his discussion of ‘social capital’. He has called for arts and cultural activities to build capital through participation, not simply consumption or ‘appreciation’. Moreover, social capital is often a valuable by-product of cultural activities whose main purpose is purely artistic” (Putnam, 2000:411) and may be achieved through musical participation, which carries opportunities for aesthetic self-realization and self-experience. Social capital, a vital factor contributing to health, has to do with how well we are socially connected and integrated in the community (Esser, 2008). According to Gillies (1997), health promoters need to be involved in helping to “repair the social fabric of society by building social capital” (Gillies, 1997:15). Social capital refers to social cohesion and the cumulative experience of relationships with both those known to us and those who are strangers, including relationships characterized by mutual trust, acceptance, approval and respect. People are social beings and the quality of social interaction is vital to both personal and communal well-being.

### **Assessment of policy and guidelines options and implications**

In reference to the WHO report (2013-2020), mental health policies need to combine structural reform of services with a focus on quality, ensuring the delivery of safe, effective and acceptable treatments by a competent workforce. Current public mental health challenges ought to focus on interdisciplinary networks in collaboration with voluntary organizations in order to enhance health promoting settings at work, in hospitals, in schools and in local communities (Tellnes 2005; WHO, 2013-2020). To this end, the World Health Organization (WHO) requires partnerships for health and social development between the different sectors at all levels of the community.

Meaningful social activities, tailored to the older individual's abilities, preferences and needs should be considered when aiming to improve mental health among older people (Forsman et al., 2011). Increasing and strengthening the networks of relationships, will have an impact on mental wellbeing. This can be done through targeted interventions in local communities to build social relationships amongst isolated and vulnerable groups. Nature and culture activities that promote empowerment, self-efficacy and social connectedness may be developed, initiated and implemented in communities to sustain and maintain a healthy environment. Community care services need to strengthening hope and creating opportunities for people with mental health problems (Goldie et al., 2016). Creative arts initiatives can be an effective way of meeting the growing calls for a shift of emphasis in mental health services, enhancing the significance of relationships and social support in the context of the well-being agenda. An adequate grasp of mutuality and social relationships is also important

in addressing recent policy initiatives around loneliness (Sturgeon, 2006). Increase in public awareness of both mental health might be needed to increase the acceptance of mental health care for promotion and prevention of illnesses. Education for earlier recognition of problems and appropriate help-seeking would be important issues. Community-based interventions including education and enhancing social capital might contribute to mental health promotion. In order to persuade other sectors to adopt policies and programmes conducive to mental health promotion, the health sector needs to be able to communicate with them in their own language and to see the policies and programmes from their perspective. This applies whether engaging in policy development at the national level, encouraging non-governmental organizations to initiate programmes or engaging with service user groups. In addition, the mental health outcomes of programmes not primarily aimed at mental health promotion need to be evaluated. In sum, this indicates the importance of public health strategies focusing on improving behavior, natural and built environments and culture. Public mental health promotion therefore should be among our prime strategies to enhance the general health of the public towards greater well-being for all. This will also be in line with the concept of “Value Based Health Care” where the investment in policies and procedures in health care is evaluated against the end result in wellbeing for the patients and for society (Porter, 2010, 2013). Both our new understanding of biological realities and the complex relationships between nature, culture and health implies that more emphasis on a systems perspective on health is appropriate to sufficiently understand and successfully implement public health policies, including Mental Health policies (Mobus and Kalton, 2015).

### **Actionable Recommendations**

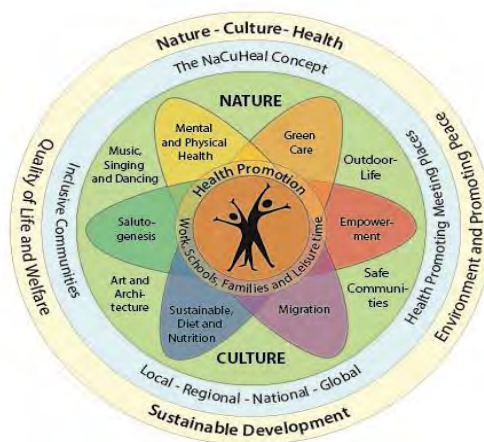
#### **Nature-Culture-Health (NaCuHeal) in Asker, a community intervention**

Hanlon et al., (2011) has described the “fifth wave” in public health as a phase that seeks to engage public health with the full complexity of the subjective, lived experience. At the WHO Regional Office for Europe, this shift is embodied in the publication of the European Health Policy framework, Health 2020, which aims to “significantly improve the health and wellbeing of populations” (Fietje and Stein, 2015:601). In this paper we would like to draw attention to a Centre for Nature-Culture-Health (NaCuHeal) in Asker, a suburb west of Oslo which was to create a common arena and forum for salutogenetic thinking and creativity (Tellnes, 1996, 2003, 2005).

Since 1994 there have been several practices and initiatives at the Centre where individuals from the community with various illnesses and diseases have

been assisted and stimulated to increase their self-efficacy, sense of coherence and empowerment. The Centres' focus on identity and ontological security (Giddens, 1991) to achieve a strong sense of belonging through participating in different nature-culture health activities, indicates ways to use, establish or re-establish their own talents and capacities for work. It is thus vital to maintain function and inclination to work in order to improve environment, quality of life and health among people in the local communities (Tellnes 1996; 2017).

The Nature-Culture-Health-centre in Asker, Norway [www.nakuheal.no] is one of the official partners of public health networks at the national level as well as municipality level. Criteria for success would be to develop a strong trust and valid cooperation and collaboration with public agencies, voluntary organizations, private businesses and pioneers to establish health-promoting settings (Batt-Rawden et al., 2017). The different activities to be experienced by the individuals at the NaCuHeal Centre are physical activity, art, nature walks, dance, music, hiking, gardening and contact with pets. These activities can strengthen the social capital (Putnam, 2000; Esser, 2008) and functional ability of the participants or population included (Batt-Rawden and Tellnes, 2005), especially with the focus on activities like choral singing, music, art and walking (see fig.1). As such, these activities are useful 'bridge-building methods' for communication and exchange of information, ideas and practical help (Gillies, 1997).



**Fig.1. Nature Culture Health – activities (NaCuHeal) promotes health in local, regional, national and global settings (Tellnes, 2017).**

**The purposes of the Nature-Culture-Health activities are:**

- To increase participant's empowerment and strengthen their own health and quality of life;

- Establishing solid social networks that are encouraging, motivating and stimulating;
- Exploring ways of coping in day-to-day activities by motivating work ability and function;
- Promoting social equity in health among people;

### **Potential practical effects of NaCuHeal-activities and theory**

Three factors can be described as criteria for success: The NaCuHeal centre is *an inclusive* place where everybody can develop their personalities, coping strategies, rethink and reassess their life situation at their own pace and rhythm. There is *pluralism* in group activities suitable for most people which contributes to developing relationships and meaning. There is also *pluralism* in the participants' *educational background, age, life situation and coping strategies* (Batt-Rawden & Tellnes, 2005; Tellnes et al. 2018). Through such creative activities, one may give each individual a sense of coherence (Antonovsky, 1996; Langeland et al., 2007; Langeland and Wahl, 2009) and agency (DeNora, 2014) and for many persons long-term certified sick, this has been a method for return-to-work and rehabilitation (Batt-Rawden and Tellnes 2005, 2011, 2012). Quite often, it may be necessary to practice and participate in NaCuHeal-activities for later to achieve a more successful, useful and active everyday life. Participation in nature-culture activities like local music making, walking in nature or hiking is also significant "routes" to sociability as it draws people back into the wider community according to Cohen (2009). It seems especially important for people with long-term sickness absence to gradually expand their sociability to prepare themselves to return to their workplace.

### **Final comments and recommendations**

Health Promotion and salutogenesis may have a positive impact on the regulation of our genes, and thereby on our physiology, health and wellbeing. Nature-Culture activities are methods that are proven to be useful to prevent both mental and somatic health problems in the future, and would be worth implementing more widely than they are today (Batt-Rawden and Tellnes, 2005, 2010; Tellnes 2009, Tellnes et al., 2018). Group support, such as discussions and exchanges of experiences among the participants, has previously been applied in psychosocial interventions (Birk et al., 2004). Additionally, social support groups designed to strengthen social networks may decrease loneliness among older adults as well as helping to increase social contacts and social activities of older people (Schoevers, 2000). Also in line with the innovative concept 'mutual recovery' which focus on shared creative practices' with their peers, other professionals and non-professionals, and individuals with mental health

difficulties, it promotes mental health among those involved and engaged (Crawford, 2018). This concept corresponds with vital elements and the underlying mechanisms at the Nature-Culture-Health Centre in Asker, Norway. Synthetic research methods are suggested to be applied in order to evaluate community approaches to *public mental health*. According to Cuyper et al., (2012) longitudinal designs and tracking studies of short-, medium- and long term health effects are needed to assess the sustainability of culture effects and across the life-span. Future policy of public mental health should give priority to health promoting nature and culture activities in local communities.

### **The reason for this is, as suggested:**

- Environment and lifestyle may have impact on the expression of our genes both today and in the future, and therefore both directly and indirectly on our health and wellbeing.
- With a broader understanding of the complex relationships within the biological as well as cultural systems we are exposed to, we can apply more holistic and effective approaches to public mental health policies and practices. It is our hope that WHO, EUPHA, EU and similar organizations will emphasize salutogenic nature and culture activities as a method of *public mental health promotion* and intervention in the local community as well as other settings.

### **References**

1. All-Party Parliamentary Group on Arts Health and Wellbeing, 2017, Inquiry Report. Creative Health: The Arts for Health and Wellbeing. Creative Commons, Mountain View, USA. [www.artshealthandwellbeing.org.uk](http://www.artshealthandwellbeing.org.uk)
2. Antonovsky, A. , 1996. The salutogenic model as a theory to guide health promotion. Health Promotion International 11-18.
3. Batt-Rawden, K.B. & Tellnes, G., 2005, Nature-Culture-Health Activities as a method of rehabilitation; An evaluation of participants' health, quality of life and function. Int J of Rehab Research 28, 175-180.
4. Batt-Rawden, KB., & Tellnes, G., 2010, The benefits of an holistic and salutogenic approach to rehabilitation and recreation. In: Kofler W. Editor. Ecology and forests for public health. Innsbruck: Science without borders. Transactions of the International Academy of Science H&E. Innsbruck, SWB, 2010. International Council for Scientific Development: pp.103-111, ISBN 978-9952-451-10-8.
5. Batt-Rawden, K.B. & Tellnes, G., 2011. How music may promote healthy behaviors. Scand J Public Health 39, 113-120.
6. Batt-Rawden, K.B. & Tellnes, G., 2012. Social factors of sickness absences and ways of coping: a qualitative study of men and women with mental and musculoskeletal diagnoses. Int J Mental Health Promotion 14, 83-95.

7. Batt-Rawden, K.B., Bjørk E., and Waaler, D., 2017. Human factors in implementation and adoption of innovations in health care services: A longitudinal case study on the introduction of new technology. *The Innovation Journal: The Public Sector Innovation Journal*, Volume 22, 3, 2017, article 3.
8. Birk, T., Hickl, S., Wahl, H-W., Miller, D., Ka¨mmerer, A., Holz, F. et al., 2004. Development and pilot evaluation of a psychosocial intervention program for patients with age-related macular degeneration. *The Gerontologist*, 44, 836– 843.
9. Campbell, C. and Gillies, P., 2001. Conceptualizing ‘social capital’ for health promotion in small local communities: a micro-qualitative study. *Journal of Community & Applied Social Psychology*. Volume 11, Issue 5, September/October 2001 Pages 329–346.
10. Carey N., 2012. *The epigenetics revolution: how modern biology is rewriting our understanding of genetics, disease, and inheritance*. New York: Columbia University Press.
11. Clift, S., Hancox, G., Staricoff, R. and Whitmore, C. 2009. *A systematic mapping and review of non-clinical research on singing and health*. Sidney De Haan Research Centre for Arts and Health, Canterbury: Canterbury Christ Church University.
12. Cohen, G., 2009. New theories and research findings on the positive influence of music and art on health with ageing. *Arts and health* 1: 48-63.
13. Crawford, P., Susan H., Wilson, M., Williamon, A., Manning, N., Brown, B., and Lewis, L., 2018. *Creative Practice as Mutual Recovery Research Programme Final Report*.
14. Cuyppers K., Krokstad S., Holmen T.L., Skjei Knudtsen M., Bygren LO, Holmen J. Patterns of receptive and creative cultural activities and their association with perceived health, anxiety, depression and satisfaction with life among adults: the HUNT study, Norway. *J Epidemiol Community Health*. 2012 Aug; 66 (8): 698-703.
15. DeNora T., 2014. *Music Asylums: Wellbeing Through Music in Everyday Life*. Routledge.
16. Esser, H., 2008. The two meanings of social capital. In D. Castiglione, J. W., Van Deth. and W. Guglielmo. (Eds.). *The handbook of social capital* 22-49. Oxford. Oxford University Press.
17. Fietje, N., and Stein, C., 2015. Culture and Health. *LANCET*, Volume 385, No.9968 6736 (15) X 6127-7, p.601., <http://www.thelancet.com/journals/lancet/issue/vol385no9968/PIIS0140>
18. Forsman, A., Nordmyr, J., and Wahlbeck, K., 2011, Psychosocial interventions for the promotion of mental health and the prevention of depression among older adults. *Health Promotion International*, Volume 26, Issue suppl\_1, 1 December 2011, Pages i85–i107, <https://doi.org/10.1093/heapro/dar074>
19. Fugelli, P., 2010. Nature and Health – A Love Story. In: Kofler W. Editor. *Ecology and forests for public health*. Innsbruck: Science without borders. Transactions of the International Academy of Science H&E. Innsbruck, SWB, 2010. International Council for Scientific Development: pp 67-75. ISBN 978-9952-451-10-8.
20. Giddens, A., 1991. *Modernity and Self-Identity*. Polity Press. Cambridge.

21. Gillies, Pam. 1997, Social capital: recognizing the value of society. *Healthlines*. Vol 45, pp. 15-16.
22. Goldie, I., Elliott, I., Regan, M., Bernal, L., and Makurah, L., 2016, *Mental health and prevention: Taking local action*. London: Mental Health Foundation.
23. Griffiths C.A., 2009. 'Sense of coherence and mental rehabilitation'. *Clin Rehabil.* Volume: 23 issue: 1, p: 72-78.  
<https://journals.sagepub.com/doi/10.1177/0269215508095360>
24. Hanlon, P., Carlisle, S., Hannah, M., Reilly, D., and Lyon, A., 2011,. Making the case for a "fifth wave" in public health. *Public Health* 2011; 125: 30–36.
25. Hansen, E., Sund, E. and Krokstad, S., 2015. Cultural activity participation and associations with self-perceived health, life-satisfaction and mental health: The Young HUNT Study, Norway: *BMC Public Health*, 15, 544.
26. Jablonka, E., Lamb, M.J. & Zeligowski, A. 2014. *Evolution in four dimensions. Genetic, epigenetic, behavioral, and symbolic variation in the history of life*. Cambridge, MA: MIT Press.
27. Jung-Ah Min, Chang-Uk Lee, and Chul Lee, 2013. Mental Health Promotion and Illness Prevention: A Challenge for Psychiatrists. *Psychiatry Investig.* 2013 Dec; 10,4: 307–316. doi: [10.4306/pi.2013.10.4.307]
28. Kaplan, S., 1995. The restorative benefits of nature: toward an integrative framework. *Journal of Environmental Psychology*, 15, 169 - 182.
29. Langeland, E. & Wahl, A.K., 2009, The impact of social support on mental health service users' sense of coherence: A longitudinal panel survey. *Int J of Nursing Studies* 46, 830-837.
30. Langeland, E., Wahl, A.K., Kristoffersen, K. and Hanestad B.R., 2007. Promoting coping: Salutogenesis among people with mental health problems. *Issues in Mental Health Nursing* 28, 275-295.
31. Lindstrøm, B., and Eriksson, E., 2015, *Haikerens guide til salutogenese. [Hitchhikers guide to salutogenesis]* Gyldendal Akademisk.
32. Mayer, F. S., & Frantz, C. M. 2004. The Connectedness to Nature Scale: A measure of individuals' feeling in community with nature. *Journal of Environmental Psychology*, 24, 504-515.
33. Mobus, G.E., and Kalton, M.C., 2015. *Principles of Systems Science*. Springer, New York.
34. Porter, M.E. 2010. What is value in Health care? *N Engl J Med* 2010, Dec 363:26 2477-2481.
35. Porter, M.E., and Lee, T.H. 2013. The strategy that will fix health care. *Harvard Business Review*.
36. Putnam, R.D., 2000, *Bowling Alone. The Collapse and Revival of American Community*. Simon and Schuster. New York.
37. Schoevers, R.A., Beekman A.T.F., Deeg, D.J.H, Geerlings, M.I., Jonker, C., and van Tilburg, W. 2000, Risk factors for depression in later life; results of a prospective community based study (AMSTEL). *Journal of Affective Disorders*; 59(2):127-137.

38. Stigsdotter, U.K., Ekholm, O., Schipperijn, J., Toftager, M., Kamper-Jørgensen, F., and Randrup, T. B. 2010. Health promoting outdoor environments - Associations between green space, and health, health-related quality of life and stress based on a Danish national representative survey. *Scandinavian Journal of Public Health*, 38(4), 411-417.
39. Sturgeon, S. 2006, Promoting mental health as an essential aspect of health promotion.
40. Health Promotion International, Volume 21, Issue suppl\_1, Pages 36–41, <https://doi.org/10.1093/heapro/dal049>
41. The ENCODE Project Consortium. 2012. An integrated encyclopedia of DNA elements in the human genome. *Nature*, 489, 7414, 57–74.
42. The Human Microbiome Project Consortium. 2012. Structure, function and diversity of the healthy human microbiome. *Nature*, 486, 7402, 207–214.
43. Tellnes, G. 1996, Integration of Nature-Culture-Health as a method of prevention and rehabilitation. In UNESCO's Report from the International Conference on Culture and Health, Oslo, Sept 1995. Oslo: The Norwegian National Committee of the World Decade for Cultural Development, 1996.
44. Tellnes, G. 2003, Public health and the way forward.. In: Kirch W (ed). *Public Health in Europe*. Berlin, Heidelberg, New York: Springer-Verlag.
45. Tellnes, G. 2005, Health Promotion in the local communities. (President's column). *Eur J Public Health*, 2005; 15 (3): 331. <http://eurpub.oxfordjournals.org/content/15/3/331> DOI: <http://dx.doi.org/10.1093/eurpub/cki147>
46. Tellnes, G. 2009, How can nature and culture promote health? *Scand J Public Health*; 37: 559-561. Editorial.
47. Tellnes, G. 2010, The Nature – Culture – Health Concept. In: Kofler W. Editor. *Ecology and forests for public health*. Innsbruck: Science without borders. Transactions of the International Academy of Science H&E. Innsbruck, SWB, 2010. International Council for Scientific Development: pp 62-67. ISBN 978-9952-451-10-8.
48. Tellnes, G. 2017, (ed.). *Health Promoting Cooperation – Nature and Culture as Public Health (Helsefremmende samhandling – Natur og kultur som folkehelse)*. Bergen: Fagbokforlaget., In Norwegian.
49. Tellnes, G., Batt-Rawden, K.B., and Christie, W. H. 2018 Tellnes, G., Batt-Rawden, KB and Christie, W., 2018. Nature Culture Health Promotion as Community building. *Journal “Herald of the International Academy of Science. N1. Russian Section”*, HIAS.RS. <http://www.heraldrsias.ru/>. *Herald of the International Academy of Science. Russian Section*”.vol. 1 (1).
50. WHO. 1997. Jakarta Declaration on Leading Health Promotion into the 21st Century. [http://www.who.int/health\\_promotion/conferences/previous/jakarta/declaration/en/](http://www.who.int/health_promotion/conferences/previous/jakarta/declaration/en/)
51. WHO. The European Mental Health Action Plan, 2013–2020. [http://www.euro.who.int/\\_\\_data/assets/pdf\\_file/0020/280604/WHO-Europe-Mental-Health-Acion-Plan-2013-2020.pdf](http://www.euro.who.int/__data/assets/pdf_file/0020/280604/WHO-Europe-Mental-Health-Acion-Plan-2013-2020.pdf)



## **FEATURES OF DEVELOPMENT OF EXPERIMENTAL PNEUMONIA AGAINST ADMINISTERING NATURAL ZEOLITES**

**I.B. Novoselov, A.G. Roninson**

*Association of Experts "Siberian Federal Center  
for Health Nutrition", Novosibirsk, Russia*

At present, pneumonia is one of the most common diseases both in our country and throughout the world. Losses resulting from disability days caused by pneumonia are 2-3 times greater than those caused by other diseases, including accidents and injuries. The number of cases of atypical pneumonia (Luchshev V.I. et al., 2003), as well as pneumonia with a protracted and complicated course and lethal outcome, is increasing (Sidorova L.D., Logvinenko A.S., 1998, 2000; Chuchalin A.G., 1998; Nonikov V.E., 2000; Bartbett J. G. et al., 1998; Celis R. et al., 1998). The problem has not only medical and social, but also economic implications, since the spread of pneumonia is not limited to humans only (Ackermann M.R., Brogden K. A., 2000).

The use of antibacterial therapy in cases of pneumonia has led to the resistance of its pathogens to a number of drugs, in particular, antibiotics (Struchunsky L. S. et al., 2002; Amsden G. V., Amankawa K., 2001). In addition, the active use of such agents may cause dysfunction of the immune system (Vorobyev L.P., Busarova G.A., 1997), which worsens the condition of patients, since an impaired immune reactivity of the body to a large extent determines the generalization of inflammatory processes and predetermines the severity of the disease and an increased mortality. Viral infections (COVID 19, etc.) or other diseases, as well as stressful effects, i.e. factors contributing to the development of secondary immunodeficiency, lead to an increased frequency of pneumonia, which, in turn, enhances disorders in the immune system due to the dysregulation of immune processes, thereby exacerbating both immunodeficiency and the severity of pneumonia (Kosovsky G. Yu., Slavianskaya T.A., 2003; McCullers J. A., Rehg J.E., 2002). It is known that the inflammation process can be treated more effectively depending on the duration of the inflammatory infiltrate resorption and the development of regenerative processes. However, while affecting individual links in the metabolism of damaged cells, it is impossible to ensure the full-scale regulation and stimulation of the reparative process. This makes it appropriate to search for new effective and pathogenetically substantiated non-drug methods for the rehabilitation of complex effects. Recent studies have shown that zeolites (sorbents with ion-exchange properties) (Blagitko E.M. et al., 1997) have anti-inflammatory and immunomodulatory

effects (Mayanskaya N.N., Novoselov Ya.B., 2000). It was shown that they are able to clear the body from most toxic products of both exogenous (contamination with highly toxic salts of heavy metals and radionuclides) and endogenous origin (toxic metabolites, tissue decomposition products in various pathological conditions) (Mayanskaya NN, Novoselov Ya. B., 2000). During inflammation, many of such endogenous toxic products are accumulated in the lungs. The reasons include tissue breakdown, secretion of various biologically active substances from mast cells, leukocytes and macrophages (Poch B. et al., 1996), as well as the accumulation of lipid peroxidation products (Sies H., 1991). To a large extent, this predetermined the choice of natural zeolites (sorbents with ion-exchange properties) in this study.

The urgency of the problem, inconsistency of information on the dynamics of inflammation criteria in the lungs and blood during the development of experimental pneumonia, and lack of data on the possibility of its correction using sorbents with ion-exchange properties served as a basis for formulating the goals and objectives of this research.

**Objective:** to study the nature of the experimental pneumonia in rats; to describe features of the functional state of phagocytic cells when using a sorbent with ion-exchange properties.

### Scientific novelty

It has been established that, when using standardized natural zeolite (a sorbent with ion-exchange properties) against the background of experimental pneumonia, the alternative-exudative processes, and later proliferative processes in the lungs occur faster by an average of 7-10 days, as compared to animals with experimental pneumonia that did not receive lithotherapy. On the 7th day of the early stage of the process decline, the lesions in this group differed from the ongoing process in animals with experimental pneumonia that did not receive sorbent, as evidenced by a decreased number of neutrophils, an increased number of macrophages, and the development of a thin layer of new granulation tissue. For the first time, the use of a standardized natural zeolite (a sorbent with ion-exchange properties) was found to normalize oxygen-

dependent and oxygen-independent biocide in experimental pneumonia: on the 20th day of the process development, the stimulation index of blood neutrophils and the content of cationic proteins were restored to the control level against the background of an increased level of high- and medium-active neutrophils. The administration of a sorbent with ion-exchange properties was shown to normalize an increased content of LPO products (diketones, diene

conjugates and MDA) in blood and lung tissues of rats with experimental pneumonia by the 7th day, which correlates with an increased activity of antioxidant protection factors - catalase and GSH content in the blood serum.

It was found that animals with experimental pneumonia that received standardized natural zeolite, had reliable, positive dynamics of changes in the activity indicators of lysosomal enzymes. In general, the use of standardized natural zeolite (a sorbent with ion-exchange properties) reduces the severity of the destructive component of the inflammatory reaction and prevents its protracted course and generalization, and favorably affects the course of experimental pneumonia.

### **Material and methods of research**

**Object of the study.** The study used 70 male Wistar rats weighing 180 - 220 g, which were obtained from the NGMA vivarium. The experiment was conducted in the autumn-winter period. Before the experiments, rats were adapted to the conditions and diet of the vivarium for at least two weeks. The animals were on a standard laboratory ration with a light regime: 12 hours - day, 12 hours - night, with free access to water. The experiments with rats were carried out from 9.00 to 12.00. For experimental modeling of pneumonia in the lungs, rats were sprayed with Sephadex G-100 through trachea under light ether anesthesia. The procedure was performed through the trachea of the animals using a special probe. The development of pneumonia in the lungs was confirmed by histological studies. Experimental animals were divided into groups (10 rats each), depending on the slaughter timing from the moment of the EP onset in the lungs - the EP group. After the reproduction of the EP, some animals (EP + L group) received lithotherapy by administering a standardized zeolite based on natural clinoptilolites provided by Nov Research and Production Company, Russia. The substance in the form of a suspension in an aqueous solution (1:1), 100 mg/kg body weight was administered intragastrically through a probe, once a day, starting from the first day of the experiment (the first administration was 3 hours before using Sephadex G-100). Three series of experiments were conducted: on the 1st, 7th and 20th day after the development of inflammation in the lungs of rats. The control material was the material taken from intact animals of the relevant age, which were kept on the general diet of the vivarium.

### **Research results and discussion**

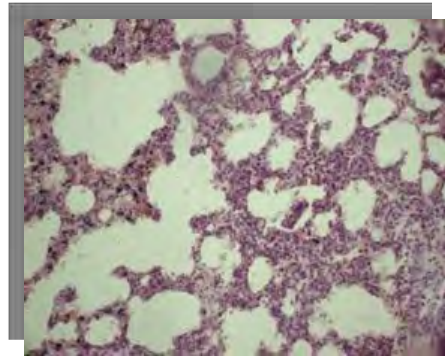
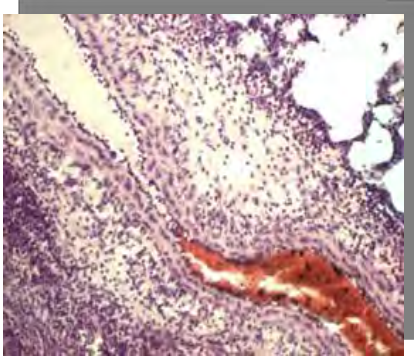
After modeling pneumonia in the lungs, experimental animals showed significant changes in behavior after 1 day: lethargy, a significant decrease in

appetite and motor activity. The development of pneumonia in the process of EP modeling was confirmed by histological studies at all stages of research.

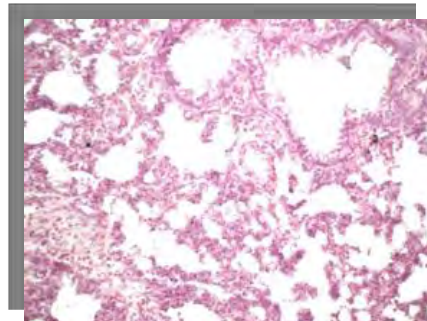
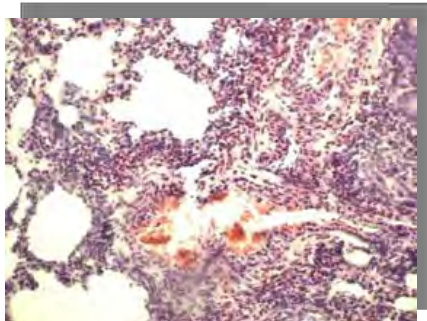
*Experimental pneumonia*

*Experimental pneumonia + lithotherapy*

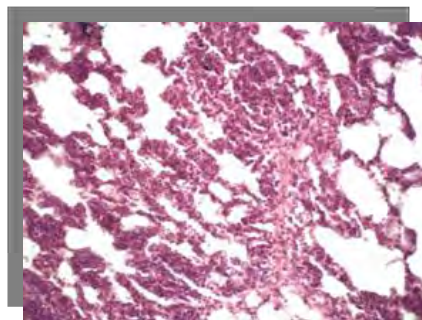
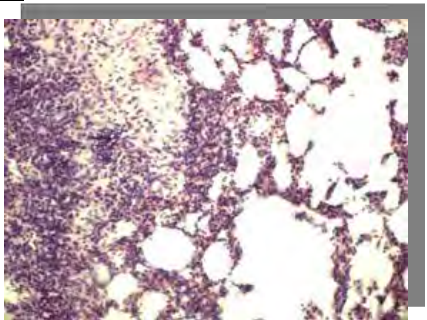
Day 1



Day 7



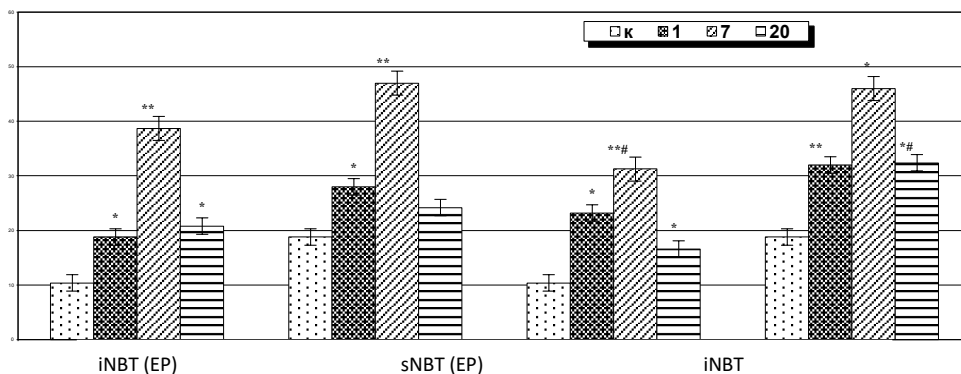
Day 20



Note: Staining with hematoxylin and eosin

**In the EP + L group, there was a positive trend in cleansing the bronchopulmonary apparatus of inflammatory elements, necrotic masses,**

**and in** the maturation of granulation tissue. So, on the 7th day of the early stage of remission, the lesion foci in the EP + L group differed from the ongoing process in the EP group by a decrease in the number of neutrophils and an increase in the number of macrophages. Cleansing of the destruction sites with the development of a thin layer of new granulation tissue was noted, while in the EP group, there were signs of inflammation of the vessel walls, areas of diapedetic hemorrhage and immaturity of the granulation tissue even on the 20th day. The data obtained indicate that, under conditions of using sorbents with ion-exchange properties, the alternative-exudative processes, and later proliferative processes occur faster by an average of 7-10 days. It is known that the activity of inflammatory processes, as well as the prediction of its development, can be predetermined to a certain extent by the response of phagocytes to a stimulus, and by the reserves of this response. In this regard, the participation of neutrophilic leukocytes in the process of inflammation was determined by the NBT test, which, as is known, characterizes the oxygen-dependent biocidity of polymorphic-nuclear blood leukocytes (Mayansky D.N. et al., 1985; Mayansky D.N., 1991; Yakovlev V.A. et al., 1992). In rats with EP, an increase in the score of the spontaneous NBT test was observed on all days of the study, with a maximum attained on day 7, when it increased by 3.7 times, as compared to intact rats. By day 20, the increase was less pronounced.



**Fig.1. Score of the NBT test at different periods of the course of experimental pneumonia in rats (EP, EP + L groups) (M + m).**

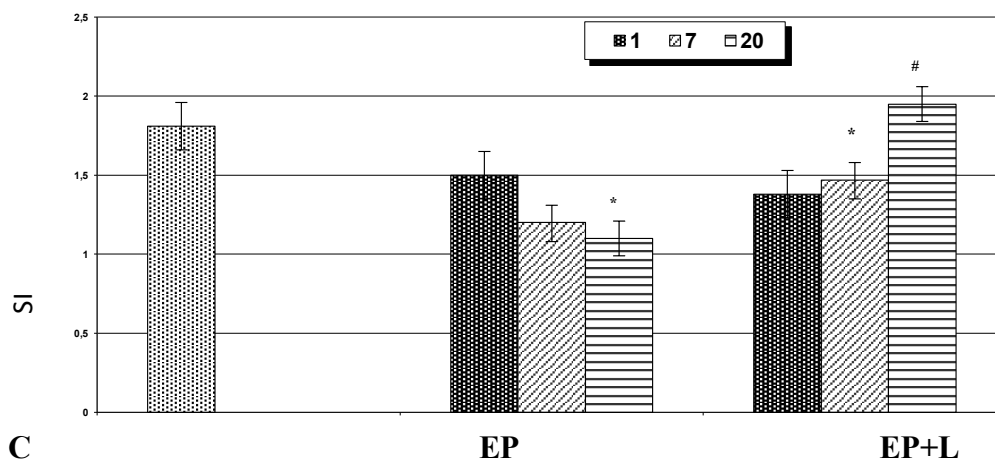
**Note:** \* - significant differences compared to control rats -  $p < 0.05$ , \*\* -  $p < 0.001$ ; # - significant differences compared to EP: # -  $p < 0.001$

When stimulating neutrophils with zymosan, the NBT test score was higher than that of the spontaneous NBT test. However, while an increase was 80.7% in control rats (comparison of the induced NBT-test and spontaneous NBT-test), rats with EP showed a much lower increase, especially on the 20th

day (on the 1st day - 48.9%, on the 7th day - 21.4%, and on the 20th day - only 16.0%) (Fig. 1).

As a result, there was a significant decrease in SI on the 20th day ( $1.1 \pm 0.11$  versus  $1.8 \pm 0.21$  in control rats,  $p < 0.05$ ) (Fig. 2). These data indicate a pronounced decrease in the biocidal reserve of neutrophils in rats with EP by the 20th day of the experiment.

When the sorbent with ion-exchange properties was administered to rats with EP, an increase in the spontaneous NBT-test score was also observed at all periods of the study, and stimulation with zymosan caused its further increase. It was especially pronounced on the 20th day, when the induced NBT-test score was 95.2% higher than that of the spontaneous NBT-test in the group of rats that did not receive zeolite. If we compare this indicator with intact animals, it increased by 1.7 times (by 72.3%), and 1.3 times (33.9%), as compared to rats with pneumonia that did not receive zeolite. SI in animals of this group was close to that of control animals. Moreover, it was significantly higher than in rats with pneumonia that did not receive zeolite ( $1.95 \pm 0.10$ , as compared to  $1.1 \pm 0.11$ ,  $p < 0.01$ ) (Fig. 2).



**C**  
**Fig.2. The dynamics of changes in the stimulation index (SI) at different periods of the course of experimental pneumonia in rats (EP, EP + L groups) (M + m).**  
**Note: \* - significant differences compared to control rats -  $p < 0.05$ ; # - significant differences compared to EP: # -  $p < 0.001$**

Thus, against the background of using a sorbent with ion-exchange properties in rats with EP, the biocide reserve of neutrophils did not decrease by the 20th day, and its value did not differ from control animals. It should be noted that an increase in SI indicates an increase in the phagocytic function of neutrophils and macrophages, which, like tissue macrophages, play a key role in the immune response by cooperating with T and B lymphocytes, and by

eliminating antigens and immune complexes (Mayansky A.N., Mayansky D.N., 1989; Freidlin I.S., Totolyan A.A., 1998).

Therefore, it is no coincidence that an increase in SI was noted during the convalescence of patients with acute pneumonia. In other words, it is a favorable prognostic sign (Yakovlev V.A. et al., 1992).

Cationic proteins take part in the development of inflammation and are indicators of nonspecific resistance of the body (Pigarevsky V.E., 1978; Yakushin S.S., 1989). Some researchers point to the possibility of an “avalanche” release of cationic proteins from leukocyte granules. Under their influence, the permeability of cell membranes increases, as well as the release of a number of biologically active substances by cells (Pigarevsky V.E., 1978).

The determination of cationic proteins in the blood, which characterize oxygen-independent biocide, showed that their content in animals with EP decreases on the 1st and 7th days of the process development. Moreover, the number of neutrophils with high activity was significantly lower at all stages of the study.

In animals with pneumonia that received standardized zeolite (selective ion exchanger and sorbent), the cationic protein content that decreased during EP was normalized at all stages of the study, the amount of highly active neutrophils was significantly higher than in animals of the experimental group not receiving sorbent.

In the redistribution of cells with low and medium activity, patterns are also observed that differ from those found in animals with EP that did not receive the sorbent.

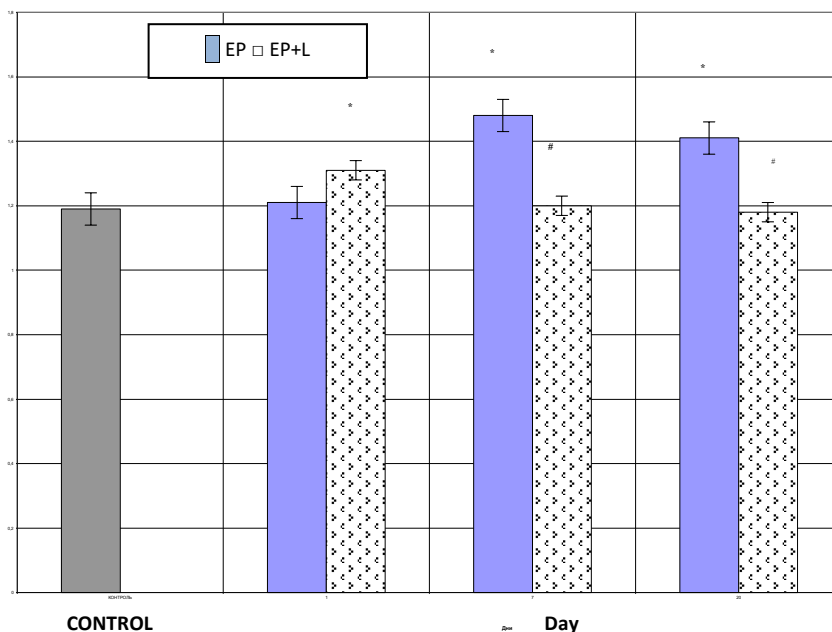
So, in this group, the proportion of SAA increased, while that of IAA decreased. The obtained dynamics of changes in the content of cationic proteins, the proportion of EAA, SAA and IAA can be explained by an increase in the protective functions of neutrophils.

Probably, such level of cationic proteins in pneumonia is consistent with the clinical pattern of the disease, namely, with a significant improvement in the condition followed by recovery.

Thus, while EP rats that did not receive a standardized natural zeolite showed low functional activity of neutrophils with a reduced biocidal reserve (hypoergic variant of the development of the disease), the addition of a standardized zeolite to the diet showed a normalizing effect both on oxygen-dependent and oxygen-independent metabolism of neutrophils, which can be regarded as a positive prognostic effect.

The experimental results regarding the sensitivity of neutrophils to the action of MK-886 leukotriene synthesis inhibitor showed that with an initially low level of the spontaneous lysosomal-cation test against the background of

using a sorbent with ion-exchange properties, this parameter tends to normalize by the 20th day. This correlates with the restoration of the inhibition index (II) to the control values on the 20th day, thus demonstrating the restoration of the neutrophils sensitivity to the action of MK-886 leukotriene synthesis inhibitor.



**Fig.3. The content of diene conjugates (DCs) in the blood serum of animals with experimental pneumonia who received or did not receive a sorbent with ion-exchange properties (EP, EP + L groups) (M + m).**

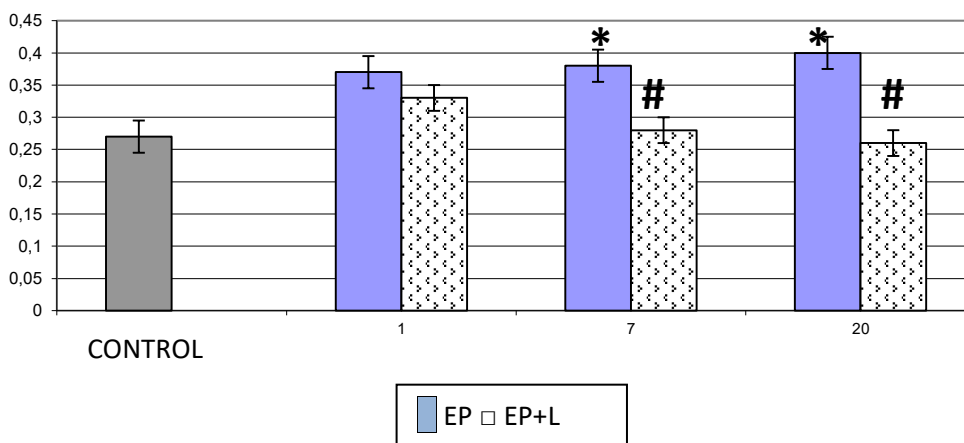
**Note:** \* - significant differences compared to control rats -  $p < 0.05$ , # - significant differences compared to EP: # -  $p < 0.001$ . The content of DC was expressed in units of optical density per ml.

It is known that the intensification of LPO, which leads to the destabilization of cell membranes, is an integral part of pneumonia pathogenesis. The dependence of the activation of LPO processes on the local leukocyte reaction in the lungs was shown (Cohen A.V., Rossi M., 1983), which, apparently, varies under the conditions of our experiments on modeling pneumonia, as evidenced by changes in the functional activity of neutrophils in blood.

This coincides with the results of the morphological study. The data obtained demonstrate that, under conditions of using sorbents with ion-exchange properties, the alternative-exudative processes, and further proliferative processes with recovery proceed faster. In the same group, a more rapid decay



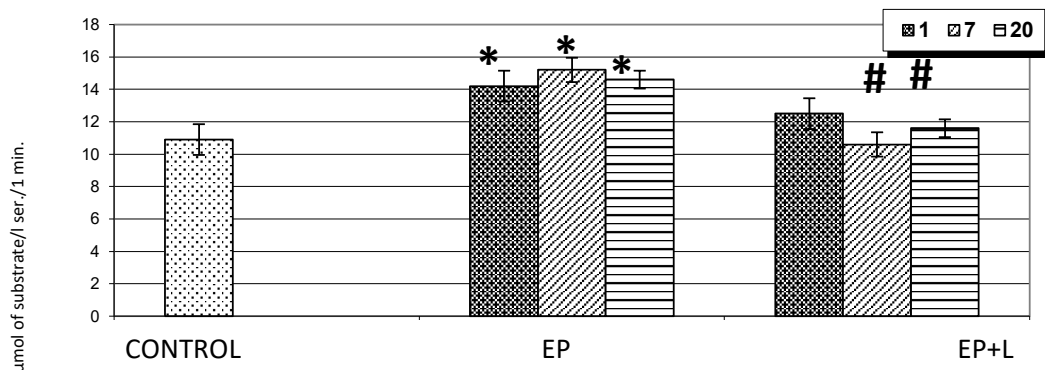
of lesions with an increase in the number of macrophages was observed, which correlates with an earlier and more pronounced beginning of reparative processes in the EP + L group. Determination of DC and diketones in the blood showed that their content in the blood serum exceeds that of intact rats on the 7th and 20th days (Figs. 3, 4).



**Fig.4. The content of diketones in the blood serum of animals with experimental pneumonia who received or did not receive a sorbent with ion-exchange properties (EP, EP + L groups) (M + m).**

**Note:** \* - significant differences compared to control rats -  $p < 0.05$ ; # - significant differences compared to EP: # -  $p < 0.01$ . The content of diketones was expressed in units of optical density per ml.

At the same time, a sorbent with ion-exchange properties did not provide for an increase in the content of these indicators. They were determined significantly lower than in rats with EP. In the lungs, the content of MDA in case of pneumonia was high on the 1st day, then it decreased gradually and returned to normal on the 20th day of the study. As regards blood serum, the content of MDA at all stages of the EP study was higher than in intact animals (Fig. 5). When using a selective sorbent in animals with EP, no increase in MDA levels was noted either in the lungs or in the blood. The content of MDA was at the level of control animals for almost all days of the study. Moreover, on the 1st day of the experiment, the level of MDA in the lungs was almost 2 times lower, and on the 7th day, the level of MDA in the blood was 1.4 times lower, on the 20th - 1.3 times lower than in rats with pneumonia that did not receive zeolite (Fig. 5).

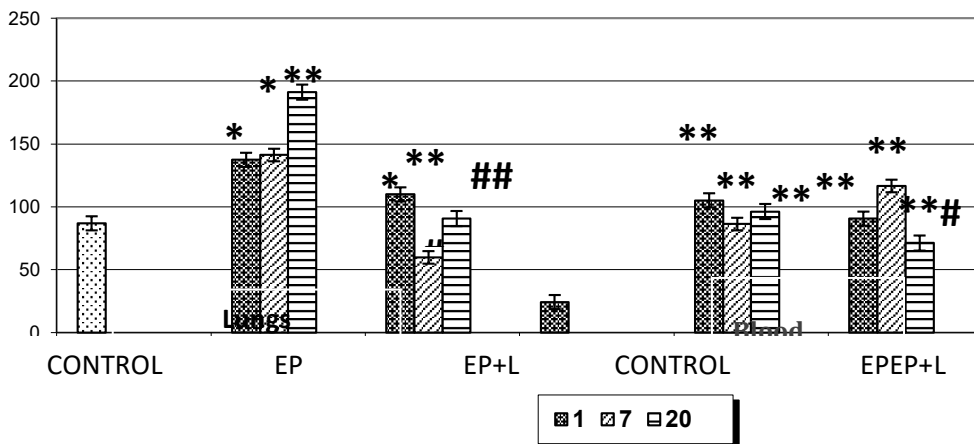


**Fig.5. Dynamics of malondialdehyde (MDA) content in the blood serum of animals with experimental pneumonia (EP, EP + L groups) (M + m).**

**Note:** \* - significant differences compared to control rats: \* -  $p < 0.001$ ; # - significant differences compared to EP: # -  $p < 0.001$

Thus, in case of EP, there is a unidirectional change in the content of LPO - an increase in DC, diketones and MDA in the blood, an increase of MDA in the lungs, which is not observed when administering a sorbent with ion exchange properties against the background of the EP development. Under pathological conditions that occur during EP, significant and prolonged activation of LPO is apparently accompanied by changes in the natural antioxidant system. In addition, a difference in the level of catalase between the EP and EP + L groups was found throughout the study. It was shown that administering a sorbent against the background of the EP development caused an increase in catalase activity in the hemolysate of erythrocytes, as compared to rats with EP that did not receive enterodonorosorbent. This effect manifested itself on the 7th and 20th days of the experiment. Moreover, by the 20th day, catalase activity decreased by 20.5% in the EP group versus the level of the 7th day, which indicates a sharp decompensation of oxidative stress against the background of high levels of lipid peroxidation. On the contrary, in the EP + L group, there was not only a significant increase in the level of antioxidants at all periods of the experiment, but also inhibition of LPO processes, especially on the 7th and 20th day. This effect may be another favorable prognostic factor, as evidenced by the data of a number of authors (Baltiyskaya N.V. et al., 1990; Provotorov V.M., Zizemskaya E.V., 1992). When the cell goes into a state of functional tension, the lysosomal vacuolar apparatus of the cell rapidly becomes active. We found that in case of EP, the activity of such lysosomal enzyme as acid phosphatase increases significantly in the lungs and blood serum of EP rats compared to intact animals, and the level of another lysosomal enzyme - cathepsin D - which was determined

during the study, has a clear tendency to a decrease. This fact indicates a decreased biocidal activity of neutrophils in the lungs (Fig. 6, 7).

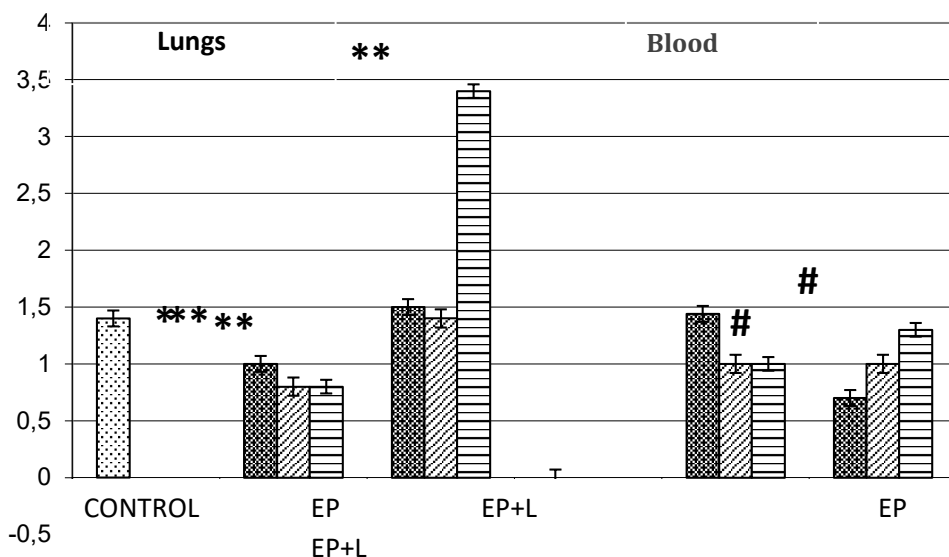


**Fig.6. The specific activity of acid phosphatase in homogenates of lung tissue and blood serum in animals with experimental pneumonia on the 1st, 7th and 20th day (EP, EP + L groups) (M + m).**

Note: \* - significant differences compared to control rats: \* -  $p < 0.01$ ; \*\* -  $p < 0.001$ ; # - significant differences compared to EP: # -  $p < 0.05$ ; ## -  $p < 0.001$ . The specific activity of acid phosphatase in the lungs was determined in  $\mu\text{mol/g}$  protein in 1 min. In blood - in  $\mu\text{mol/l}$  in 1 min.

Although the development of EP is accompanied by an increase in acid phosphatase activity in the lung tissues relative to the control already on the 1st day, the most significant increase in their activity was found on the 20th day. Against the background of administering a sorbent with ion-exchange properties in rats with EP, the reverse dynamics was observed, which is associated with the normalization of this indicator already on the 7th day. A significant increase in enzyme activity was also found in blood serum in both groups at all stages of the EP development, which may be associated with their entry into the blood from damaged lung cells. However, in animals treated with zeolite, as compared to rats that did not receive it, the activity of acid phosphatase decreased by 26.1% on the 20th day of the study (Fig. 6), which can be regarded as the activation of the recovery processes.

The dynamics of changes in the activity of cathepsin D in the lungs of the EP and EP + L groups was also different (Fig. 7).



**Fig.7. The specific activity of cathepsin D in homogenates of lung tissue and blood serum in animals with experimental pneumonia on the 1st, 7th and 20th day (EP, EP + L groups) (M + m).**

**Note:** \* - significant differences compared to control rats: \* -  $p < 0.01$ ; \*\* -  $p < 0.001$ ; # - significant differences compared to EP: # -  $p < 0.05$ . The specific activity of cathepsin D in the lungs was determined in  $\mu\text{mol/g}$  protein in 1 min. In blood - in  $\mu\text{mol/l}$  in 1 min.

A significant decrease in the cathepsin D activity in the lungs of EP rats was observed, as compared to intact animals. Conversely, against the background of administering a sorbent with ion-exchange properties, the activity of cathepsin D did not decrease, but increased. By the 20th day, its significant increase was noted (by 4.2 times), compared to rats from the EP group.

Summarizing the data obtained, it can be stated that the administration of a sorbent with ion-exchange properties contributes to the normalization of most of the indicators changed during EP, namely, the functional activity of neutrophils, macrophages, LPO products in the tissues of the lungs and blood, as well as the activity of lysosomal enzymes in the lungs.

At the same time, while most of the parameters were normalized by the 20th day of the inflammation development, some (for example, acid phosphatase in the blood) do not reach the control level, although they tend to approach control values.

It is possible that the corrective effect of the sorbent with ion-exchange properties appears in relation to them at a later date, especially since a moderately increased activity of lysosomal enzymes is necessary for the regeneration process to take place.

Considering the data obtained on the complex effect of the sorbent with ion-exchange properties as a means of correcting the indicators that changed during pneumonia, it can be considered pathogenetically justified and appropriate to use it in addition to traditional methods for curing pneumonia.

## Conclusions

1. Modeling pneumonia in rats led to the development of exudative-destructive inflammation, the signs of which persisted at all stages of the study (20 days). At the same time, with the administration of a standardized zeolite (a sorbent with ion-exchange properties), pronounced positive dynamics were noted, as a result of which the alternative-exudative processes, and later proliferative processes in pneumonia occurred faster by an average of 7-10 days.
2. On the 20th day, the administration of natural zeolite against the background of experimental pneumonia led to the restoration to the control level of both the neutrophil stimulation index estimated in the spontaneous and induced HBT test, and the cationic protein content against the background of an increased level of high and medium active neutrophils, which indicates the normalization of oxygen-dependent and oxygen-independent biocide.
3. In contrast to the long-lasting elevated content of lipid peroxidation products (diketones, diene conjugates and MDA) in the blood and lung tissues of rats with experimental pneumonia, the administration of sorbents with ion-exchange properties normalized these parameters by the 7th day of the study, which correlated with an increased activity of antioxidant protection factors - catalase and GSH content in the blood serum.
4. In case of experimental pneumonia, the activity of acid phosphatase increased significantly in the tissues of the lungs and blood serum at all periods of the study, as compared to intact animals. On the contrary, the administration of a sorbent with ion-exchange properties led to a quick normalization of this indicator, which was noted in the lungs already on the 7th day of the experiment.
5. With the development of experimental pneumonia in lung tissues and blood serum of rats, a significant decrease in cathepsin D activity was detected at all observation periods. However, with the administration of a sorbent with ion-

exchange properties, the activity of cathepsin D increased. Its significant increase was noted by the 20th day of the study.

6. The use of sorbents with ion-exchange properties was accompanied by normalization of the biocidal activity of neutrophils, increased reserves of their functional activity, restoration of the activity of the lysosomal-vacuolar system, which favorably affected the course of experimental pneumonia, prevented its prolonged course and generalization of inflammatory processes.

## **INVESTIGATION PHARMACOLOGICAL PROPERTIES REMEDY FOR CLARIFICATION HUMAN ORGANISM FROM TOXINS**

**M.N. Veliyeva, R.İ. İbragimov, S.A. Atakishizade,  
P.M. Veliyev**

*Azerbaijan Medical University Department of Pharmaceutical Technology and  
Pharmacy Organization Baku Azerbaijan  
e-mail:mahbubav\_amu@rambler.ru*

### **Introduction**

Firstly, have been given an information in scientific article related with elaboration of natural enterosorbent, was being obtained from the waste of medicinal plants of the flora of the Republic of Azerbaijan for the subsequent studding of these therapeutic possibilities. It is shown, that the enterosorbent can be used for treatment of acute intestinal infections in pediatric practice and adults, liver diseases, also for persons suffering by chronic intoxication due to work in ecologically polluted and harmful industries, including oil, or living in ecologically unfavorable environments. The pathology of the liver and digestive tract is a socio-economic and clinical-epidemiological problem of public health in all countries of the world, including the Republic of Azerbaijan. An important place is occupied by the studding of exotoxins effect that is xenobiotics influence for the health of the population and elaboration of effective methods of protection. In all over the world, including in our country, has been applying the new types of chemical and biological means for controlling plant pests and weeds. Chemical plant protection products such as herbicides, pesticides, fungicides, acaricides, insecticides, defoliant, disinfectants are widely used in agriculture, in everyday life, and naturally the population is forced to directly or indirectly contact with them, which increases the likelihood of acute and chronic poisoning organism in an environment with a high toxic loadings. An adverse microclimatic condition is the extreme effects of oil and its components, which is significant for oil industry workers in Azerbaijan (4).

The accumulation of endogenous toxic substances in the body and the associated homeostasis disturbances are called by endotoxycosis. Endotoxycosis develops as a result of anatomy of the natural function of the biological detoxification system and manifests itself in the form of complications of various diseases. The systems of endogenous intoxication are layered on the clinical manifestations of the main disease and develop almost in any infectious disease. Patients feel nausea, weakness, losing of weight and restless. Endotoxycosis is a complex multicomponent process at which there is an accumulation of a pool the middle molecular connections having various biological activity as a result of

pathological protein degradation due to increased proteolysis and other destructive influences of the amino acids necessary directed to the emergency supply of an organism with a certain set in extreme states for providing hormone and fermentation, regeneration of proteins, blood formation and other physiological functions. When these middle-molecular compounds form, a kind of "vicious circle" is formed, the increasing in concentration in the blood and the consumption of these substances entails their further production of a pathological nature. Therefore the main objective of detoxication actions consider the haemocorrection directed to decrease in concentration in blood of the most biologically active connections of middle-molecular connections or their neutralization (6).

At endogenous intoxication the main attention is paid to treatment of the main disease of the syndrome which has caused development (poisoning, burns, hepato-intestinal poisonings, a nephropathy, pancreatitis), however, the methods of detoxication therapy always take an important place in a complex of treatment (1).

The **purpose** of the present article was representation of remedy on the basis of industrial wastes of herbs and justification of its application in practice of gastrointestinal and hepatic poisonings.

### **Materials and methods**

The object of the research was the enterosorbent elaborated by us at the Department of Pharmaceutical Technology and Management of the Azerbaijan Medical University in Baku, the Republic of Azerbaijan, which was obtained on the basis of industrial waste of medicinal plants: roots and roots of licorice naked, hips, grape seeds, oat bran, burdock roots: 3:2:1:1:2, (Eurasian patent 201600043), conditionally called "AseTex". Clinical examination has been conducted at the Pediatric Department of Infectious Diseases of the Azerbaijan Medical University. Under observation were 201 children aged from 1-16 years with middle forms of acute intestinal infection of different ethology group I (basic) of-30 children; The II-nd group (comparisons) - 30 children. The main patients with a middle form of OCD of various etiology with damage of digestive tract as gastritis, enteritis, a gastroenteritis, the enterocolitis, the total number-151. The following group 62 patients aged from 18-70 years, with diagnoses of acute viral hepatitis of various forms: A, B and C. All patients were in condition of moderate severity. Verification of the diagnosis was carried out by detection of specific serological markers of viral hepatitis. In some cases were used also virologic PTsR-diagnostics. As remedy had been used the capsules elaborated by us enterosorbit in dosage of 1,0 (grams) and tablets 0,1 gram described early (1-



3), the dosage and course treatment changed depending on a disease and the course of the treatment.

The obtained data have been subjected to statistical processing by method of variation statistics with usage of Student criterion.

### **Results**

On the basis of Pediatric Infectious Diseases department of the Azerbaijani Medical University under the management of Professor N.G. Guseynova the test of clinical efficiency by oral consumption enterosorbent of "Azdetoks" in case of acute intestinal infections in children has been carried out. The observation was conducted for 201 children aged from a year up to 14 years. The research was conducted in 2 stages: at the first stage, the effectiveness of the use of "Azdetox" in complex therapy with furazolidone was investigated, and at the second stage the effectiveness of the use of "Azdetox" as a monotherapy was investigated. In the group of patients who received "AseTetox" as monotherapy, patients with acute intestinal infections predominated according to the type of enteritis or gastroenteritis, while in groups receiving as ethyotropic therapy furazolidone or furazolidone in combination with "Azdetox" - the main group consisted of patients with OCI involvement in the pathological process of the lower gastrointestinal tract (by type of enterocolitis, colitis, or gastroenterocolitis). Etiological diagnosis (salmonellosis, shigellosis, etc.) was deciphered in 33.7% of children, 66.3% of children were diagnosed with KINE. "Azdetox" is an effective drug for treating acute intestinal infections in children of early ages. Absence of side effects, shortening of the duration of the main symptoms of OCI against the background of reception of "Azdetox" allowed recommend for using in combination with diet and rehydration therapy without antibacterial drugs, especially in OCI of viral etiology.

Further under supervision there were 25 children, patients with noninvasive OCI, mostly unspecified etiology. Age of investigated patients is from 5 to 14 years. The comparison group consisted of 20 children who received activated absorbent carbon. Sorbents were given strictly on an empty stomach. The duration of enterosorption was determined by the dynamics of diarrhea syndrome, the rate of normalization of the stool. Clinical efficacy of the drug was determined by the timing of relief of intoxication, disappearance of abdominal pain feeling and stool normalization. The results are presented in Table 1.

**Table 1****Dynamic of action duration**

<b>Cupping Symptoms:</b>	<b>Study group "Azdetox"</b>	<b>Comparison group (activated charcoal)</b>
Intoxication	2.05 days	2.25 days
Abdominal pain	2 days	3days
Diarrheal syndrome	3.55 days	4.7 days

The tolerance of "Azdetoks" was good, side effects weren't. Whereas in group of comparison at 10% of children vomiting after intake of absorbent carbon was noted that has demanded change of a sorbent. The effectiveness of preparation "Azdetoks" in comparison with activated carbon proved to be significantly higher, which, together with a good tolerance of the drug "Azdetoks", allows him to recommend it as a sorbent in patients with a diagnosis of acute intestinal infections. In research has been included 52 children aged from 6 months up to 7 years. The diagnosis of salmonellosis was states in 5 children, shigellosis - 11 children, rotavirus infection - 20 children, KINE - 16 children. In most cases, children were arrived in an average condition. In the main group, children in addition to conventional therapy received «Azdetox». In cases of bacterial infection in combination with an antibacterial therapy, in cases of a viral gastroenteritis in combination with complex immunoglobulin medicine (CIM) as an ion therapy. (6). Dosages of "Azdetox": children to a semi-goal - 1/4 таб.; 0,5 - 1 year - 1/2 таб.; 1 - 3 years - 1/2-1 таб.; 3-7 years - 1 tablet. The preparation was administrated 3 times a day in 1-1,5 hours before or after the meal and other medicines. When carrying out the correlation analysis, a reliable positive correlation of the destination with an increase in the disappearance rate of pathological impurities (mucus and blood) from the stool and the terms of the normalization of the coprogram ( $p < 0.05$ ;  $R=0.52-0.59$ ) was noted. The clinical effect was manifested in the form of a reduction in the number of stools, reduction of abdominal pain, disappearance of pathological impurities in the stool in most children on the 3-5 day of treatment. Toxic and allergic reactions or other side-effects during the investigation were not noted.

"Azdetox" is recommended for the treatment of acute intestinal infections in children and adults both as a form of monotherapy and in complex treatment approach. Necessary condition of increase in therapeutic efficiency of enterosorbents is their appointment as was possible in earlier terms of the disease. The usage of "Azdetoks", from the first hours of emergence of clinical picture

symptomatically considerably improves an outcome of a disease and reduces terms of pathological process, especially at children of early age. In the OCD trial, 46 children aged 0-14 years with moderate forms of OCD related with various etiologies. I group (main) - 24 people participated in a research on OKA: group II (comparisons) - 22 people.

### **Criteria of inclusion**

Children of 0-14 years patients with the middle form of OCD related with various etiology with damage of digestive tract as gastritis, enteritis, a gastroenteritis, the enterocolitis, the gastroenterocolitis; absence in the anamnesis at the time of the research of reception of other enterosorbents.

Patients entered to a hospital mainly in the first 2-3 days from the appearance of the disease. At most of the patients observed (90%) an "invasive" type of diarrhea. Etiological diagnosis was deciphered in 64% of patients, including Shigellosis Zone and Flexner in 9 (18%), salmonellosis in 7 (14%), Escherichia - in 4 (8%), rotavirus infection in 5 (10%), intestinal infection caused by UPM-in 7 (14%) of patients.

### **Dosage administration:**

«Azdetox», was administered in the form of tablets 1-1.5 hours before meals in the following dosages:

12 months - 1/3 tablets	3 times a day,
1-3 years - 1 tablet	3 times a day;
3-7 years - 1 tablet	4 times a day;
12 years - 2 tablets	4 times a day.

From the moment of admission to a hospital, all patients received standard therapy (diet, oral rehydration, enzymes), of which 22 children (comparison group) received antibiotics as ethiotropic therapy (gentamycin, furazolidone, enterofuril), while 24 children in the main group received combination of antibiotic + "Azdetox". Other drugs with etiotropic effect (probiotics, immunomodulators) were not administrated for the patients.

The course of treatment depended upon the normalization of the frequency and nature of the stool and averaged 5-7 days. The results are presented in Table 2.

**Table 2**

**Evaluation effectiveness of the therapy**

Symptoms	Group- of patients	Number of patients (%) with symptoms disappeared treatment initiation to:					
		The 1-st day	The second day	The third day	The fourth day	The fifth day	The 7-8 day
Infectious toxicosis	Primary	3(13,3%)	13(56,7%)	19(90%)	22(96.7%)	24(100%)	-
	Control	-	4 (20%)	11(50%)	17(85%)	22(100%)	-
Fever	Primary	11(46,7%)	20 (80%)	21 (96%)	24(100%)	-	-
	Control	5 (25%)	11 (50%)	14(70%)	20(90%)	22(100%)	-
Vomiting	Primary	11(58%)	16(84,2%)	18(94,7%)	19(100%)	-	-
	Control	4 (33,3%)	9 (75%)	10(83,3%)	12(100%)	-	-
Abdominal pain	Primary	3(13,3%)	13(53,3%)	20 (80%)	21(93,3%)	24(100%)	-
	Control	3(15%)	7 (35%)	15 (75%)	18(90%)	19(95%)	100%
Diarrhea	Primary	2 (6,7%)	9 (30%)	13(56,7%)	21(93,3%)	24(100%)	
	Control	-	-	3(15%)	5 (25%)	9 (45%)	75%

As can be seen from the presented information, the symptoms of infectious toxicosis are already stopped on day 2 in 56.7%, and on day 3 in almost all patients (90%) of the main group. Normalization of body temperature in the first two days of the disease occurred in 80% of children. At the same time, in the comparison group, the relief of symptoms of toxicosis in these terms occurred only in 50% of patients.

Despite the fact that 70% of patients in this group normalized their body temperature, the children's state of health remained impaired, the appetite was reduced (40%), sluggishness (30%), irritability (25%), poor sleep (35%).

The relief of gastrointestinal symptoms were observed when included in the complex therapy of patients with «Azdetox» was also faster, compared with children receiving traditional therapy. Vomiting in the majority of patients (84.2%) of the main group was stopped in the first two days of the disease, while in 25% of the children of the control group it lasted up to 3 days. Especially distinct were the differences in the compared groups in the analysis of the dynamics of relief of diarrheal syndrome.

Normalization of the frequency and nature of the stool on the 3-rd day of treatment took place in more than half of the patients (56.7%), and by the fifth day - in all 100% of patients receiving "Azdetox" the end of the course of treatment (day7) at 96.7% of convalescents came full recovery with bacteriological sanitation, normalization of analysis of peripheral blood.

Only in 2 patients reduced appetite remained, the meteorism took place; the coprology research noted of excrements a significant amount of neutral fat, not digested muscle fibers were found. In the group of patients receiving traditional antibiotic therapy, the normalization of stools in the first 3 days occurred only in 15% of children, by the 5th day - less than half of the patients (45%). Even on the 7-8th day of the disease in 25% of the patients in the control group, the stool remained unstable, not digested, and contained impurities of mucus, free water.

At these patients such functional disorders of a GIT as painful feelings in a stomach without certain localization, a loss of appetite, violation of an emotional tone, lack of an increase of body weight were remained. In addition to clinical symptoms, other signs of the transferred infection also occurred in the patients of this group: violation of the rates of weight gain (25%), polyhypovitaminosis (20%) and anemia (10%). During the process of control microscopy of feces, mucus was detected in 30% (6 patients), in 15% (3 patients) - single white blood cells.

Attention was paid to the discovery of a significant amount of digested fiber (60%) and not digested muscle fibers (50%), neutral fat (75%), which indirectly indicated functional deviations from the stomach and pancreas. In the group of patients receiving traditional antibiotic therapy, the normalization of stools in the first 3 days occurred only in 15% of patients, by the 5th day - less than half of the patients (45%). Even on the 7-8th day of the disease in 25% of the patients in the control group, the stool remained unstable, not digested, and contained impurities of mucus, free water.

These patients retained functional abnormalities of the gastrointestinal tract, such as pain feeling in abdomen without definite localization, a decreasing of an appetite, a disturbance in the emotional tone, and a lack of weight gain. In a control bacteriological study in 3 children (15%) of the control group, repeated excising of pathogens from feces were noted. The results are shown in Table 3.

During statistical processing of average duration of clinical symptoms in compared groups of patients it is established that when using in complex therapy of middle forms of OCD of an enterosorbent of "AZDETOX", the average duration of symptoms of infectious toxicosis, slackness, a loss of appetite, fever duration in comparison with the patients receiving only antibiotics is authentically reduced. At the same time, there was no significant difference in the average duration of abdominal pain feeling in the compared groups. The duration of the acute period of the disease with the use of sorption therapy "AZDETOX", decreased from  $6.0 \pm 0.34$  to  $3.2 \pm 0.21$  days.

**Table 3**

**The average duration of clinical symptoms of OCI in children, depending on the therapy**

Clinical symptoms	Patient groups and mean duration of symptoms (days)		
	The main group (n = 30 people)	Control group (n = 20 people)	P
Infectious Toxicosis	2,38±0,22	3,43±0,16	<0,05
Lethargy	1,96±0,12	2,75±0,09	<0,05
Reduced appetite	2,2±0,24	3,28±0,24	<0,05
Fever	1,87±0,19	2,75±0,21	<0,05
Pain in the abdomen	2,7±0,20	2,85±0,22	-
Diarrhea	3,2±0,21	6,0±0,34	<0,05

During carrying out the correlation analysis, a reliable positive correlation of the destination with an increase in the disappearance rate of pathological impurities (mucus and blood) from the stool and the terms of the normalization of the coprogram ( $p < 0.05$ ;  $R=0.52-0.59$ ) was found. The clinical effect was manifested in the form of a reduction in the number of stools, reduction of abdominal pain feeling, disappearance of pathological impurities in the stool in most children on the 3-5 day of treatment. Toxic and allergic reactions or other side-effects during the investigation were not noted. «Azdetox» is recommended for the treatment of acute intestinal infections in children and adults both in the form of monotherapy and in complex treatment. A prerequisite for improving the therapeutic effectiveness of enterosorbents is their use as early as possible in the disease. The usage of «Azdetox» from the first hours of appearance of clinical symptoms significantly improves the outcome of disease treatment and shortens the duration of the pathological process, especially in young children. On the basis of the Department of Infectious Diseases of the Azerbaijan Medical University, the results of the clinical usage of preparation «Azdetox» in patients with acute viral hepatitis were further investigated. 62 patients aged from 18 to 60 years were under observation. 22 - Diagnosed with CAA. 20 - HBV, 20 - HCV. All patients were in a state of middle form. The diagnosis was verified by the detection of specific serological markers of viral hepatitis. In a number of cases, additional virological PCR diagnostics was also used. In addition to the standard basic therapy, 22 patients received the drug «Azdetox» at a dose of 1.0 to 2 capsules 3 times a day for 21 days, or in a shorter period (all patients with hepatitis A, a significant proportion of patients with hepatitis B and C) in the case of recourse to major clinical manifestations. 20 patients received only basic

treatment without the use of the preparation «Azdetox» and were included in a comparison group. Groups of patients are randomized by a simple blindly method. Basic therapy of viral hepatitis suggested compliance with the regime of bed wards, compliance with diet number 5a-5, the use of pathogenetic drugs - infusion of detoxification solutions (colloid and polyionic crystalloid), the appointment of multivitamins and other preparations. Clinical efficiency related with administration of the preparation «Azdetox» was evaluated according to the duration of the main clinical syndromes: intoxication; cholestasis; mesenchyme-inflammatory and dyspeptic syndromes. Also objective laboratory biochemical indicators were used: bilirubin, alkaline phosphatase, AlAt, AcAt; GGTP, prothrombin index. At the patients with hepatitis A receiving the preparation of «Azdetox» observed smaller duration of symptoms of intoxication in comparison with the patients who weren't receiving. The duration of appearance of symptoms of cholestasis with reception of "Azdetox" patients of control group had also, in comparison with control group ( $p < 0,06$ ), except for acholia duration a feces where indicators in the studied groups of reliable distinctions had been observed. Though duration of hepatomegaly and discomfort feelings in a liver in the form was less at patients of accepting "Azdetox» in comparison with patients of control group, data of average values weren't reliable. During statistical calculation process of the average duration of clinical symptoms in compared groups of patients were decreased when using complex treatment of middle forms of OCD refer to administration of enterosorbent «AZDETOX» such as: toxicosis, lethargy, loss of appetite, duration of fever, compared with patients receiving only antibiotics. At the same time, there was no significant difference in the average duration of abdominal pain feeling in the compared groups. The duration of the acute period of the disease with the use of sorption therapy "Azdetox", decreased from  $6.0 \pm 0.34$  to  $3.2 \pm 0.21$  days. When carrying out the correlation analysis, a reliable positive correlation of the destination with an increase in the disappearance rate of pathological impurities (mucus and blood) from the stool and the terms of the normalization of the coprogram ( $p < 0.05$ ;  $R = 0.52-0.59$ ) was observed. The clinical effect was manifested in the form of a reduction in the number of stools, reduction of abdominal pain feeling, disappearance of pathological impurities in the stool in most children on the 3-5 day of treatment.

Toxic and allergic reactions or other side-effects during the study were not noted. «Azdetox» is recommended for the treatment of acute intestinal infections in children and adults both in the form of monotherapy and in complex treatment.

**Table4****The duration of the main clinical syndromes in patients with hepatitis A against the background of the usage the preparation of "Aztex"**

<i>Syndromes</i>	<i>Symptoms</i>	<i>Duration (in days)</i>		<i>P</i>
		"Aztetox" (N = 22)	the control (N = 20)	
Intoxication syndrome	Nausea, anorexia	2,44±0,67	4,82±1.46	<0,05
	Weakness	4,97±2,39	6,31±2.7	>0,05
	Subfebrile condition	2,23±0,65	6,71±1.99	>0,05
	Tachycardia	4,53±2,76	7,13±4.73	>0,05
Cholestatic syndrom	yellowish of sclera andthe skin	13,22±2,26	21,13±1.52	<0,05
	Dark urine	7,89±2,15	17,19±3,31	<0,05
	Acholic feces	4,96±5,18	7,83±5.83	>0,05
	Skin itch	5,1±1,32	11,12±2.21	>0,05
Mesenchymal inflammatory	The mesenchymal Inflammatory hepatomegaly	13,0±4,08	17,11±3.29	<0,05
	Heaviness in righsubcostal area	9,16±3,82	13,11±5,33	>0,05
Dyspeptic syndrome	Stool retention	2,88±0,95	7,93±2,19	<0,05
	meteorism	2,88±1,67	12,23±2.99	>0,05

A prerequisite for improving the therapeutic effectiveness of enterosorbents is their use as early as possible in the disease. The use of «Aztetox», from the first hours of appearance clinical symptoms significantly improves the outcome of the disease and shortens the duration of the pathological process, especially in children with early age. On the basis of the Department of Infectious Diseases of the Azerbaijan Medical University, the results of the clinical use of the drug «Aztetox» in patients with acute viral hepatitis were further investigated. 62 patients aged from 18 to 60 years were under observation. 22 - Diagnosed with CAA. 20 - HBV, 20 - HCV.

Il patients were in a state of moderate severity. The diagnosis was verified by the detection of specific serological markers of viral hepatitis. In a number of cases, additional virological PCR diagnostics was also used. In addition to the



standard basic therapy, 22 patients received the preparation «Azdetox» in dosage of 1.0 to 2 capsules 3 times in a day for 21 days, or in a shorter period (all patients with hepatitis A, a significant proportion of patients with hepatitis B and C) in the case of recourse to major clinical manifestations. 20 patients received only basic treatment without the use of the drug «Azdetox» and were included in comparison group.

**Table 5**  
**The average duration of clinical symptoms of OCI in children, depending upon the therapy**

Clinical symptoms	Patient groups and mean duration of symptoms (days)		
	The main group (n = 30 patients)	Control group (n = 20 patients)	P
Infectious Toxicosis	2.38 ± 0.22	3.43 ± 0.16	<0.05
Lethargy	1.96 ± 0.12	2.75 ± 0.09	<0.05
Reduced appetite	2.2 ± 0, 24	3.28 ± 0.24	<0.05
Fever	1.87 ± 0.19	2.75 ± 0.21	<0.05
Abdominal pain feeling	2.7 ± 0.20	2.85 ± 0.22	<0.05
Diarrhea	3.2 ± 0.21	6.0 ± 0.34	<0.05

Groups of patients are randomized by a simple blindly method. Basic therapy of viral hepatitis suggested compliance with the regime of bed wards, compliance with diet number 5a-5, the use of pathogenetic drugs - infusion of detoxification solutions (colloid and polyionic crystalloid), the appointment of multivitamins and other preparations. Clinical efficacy of preparation «Azdetox» was evaluated according to the duration of the main clinical syndromes: intoxication; cholestasis; mesenchymal-inflammatory and dyspeptic syndromes. Also objective laboratory biochemical indicators were used: bilirubin, alkaline phosphatase, ALT, AST, GGTP, prothrombin index.

**Table 6**  
**The duration of the main clinical syndromes in patients with hepatitis A against the background of the use of the drug " Azdetox "**

«Azdetox»	Syndromes Symptoms Duration (in days)		
	The main group (N = 22)	Comparison group (N = 20)	
Intoxication, Nausea, Anorexia	2.44 ± 0.67	4.82 ± 1.46	p<0.05
Weakness	4.97 ± 2.39	6.31 ± 2.7	p<0.05

Sub febriletemperature	2.23 ± 0.65	6.71 ± 1.99	p<0.05
Tachycardia	4.53 ± 2.76	7.13 ± 4.73	p<0.05
Yellowish	13.22 ± 2.26	21.13 ± 1.52	p<0.05
Darkness of urine	7.89 ± 2.15	17.19 ± 3.31	p<0.05
Acholia feces	4.96 ± 5.18	7.83 ± 5.83	p>0.05
Skin itch	5.1 ± 1.32	11.12 ± 2.21	p> 0.05

The mesenchymal-inflammatory hepatomegaly  $13.0 \pm 4.08$   $17.11 \pm 3.29$   $<0.05$  group. At laboratory researches of patients with hepatitis B against the background of application of enterosorbent «Azdetox» the reliable information was received which is presented in Table 7.

In patients receiving the preparation "Azdetox" the level of bilirubin and ALT on the 9 th -12th day of treatment was significantly lower ( $p <0.05$ ), compared with patients receiving only basic therapy; there were no significant differences in the levels of AST and AF in the patients of the study groups; indices of prothrombin index in patients taking "Azdetox", significantly increased ( $p <0.03$ ) to 7-10 days of treatment, in contrast to patients who received only basic therapy.

The length of stay of the patient on the bed with Azdetox was  $15.5 \pm 1.0$  and was significantly lower, compared with that in patients who received only baseline therapy of  $27.47 \pm 1.33$  ( $p <0.01$ ).

**Table 7.**

**Laboratory information in patients with hepatitis B with treatment administration of «Azdetox» and control group**

Indicators	"Azdetox " (n= 20)			Control (n=20)			
	1-3 days	9-12 days	18-21days	1-3 days	9-12 days	18-21 days	27-30 days
Bilirubin	116,12±13,62	55,66±10,0	35,58±4,0	135,33±10,0	84,62±9,88	43,33±9,0	32,44±4,3
ALT	2551±380	656±133	278±82	2212±217	1080±108	461±113	282±31
AST	1444±222	348±86	89±32	996±142	461±53	149±56	121±18
AF	328±19	312±43	219±25	286±39	246±59	216±29	217±11
PTI	87±2,14	89,2±3,78	85,58±2,9	83±2,4	82±2,39	93±3,81	88±5,5
K-day	19,5±2,0			31,85±2,23			

The investigation process of the duration of the main clinical syndromes with the usage of «Azdetox» called for the following symptoms with the appropriate duration, refer to the table. Analysis of the symptoms of intoxication syndromes, cholestasis, mesenchymal inflammation in patients with acute hepatitis C showed no significant influence of «Azdetox» on their duration. Nevertheless, «Azdetox» allowed flatulence and stool retention in patients of the experimental group in significantly shorter periods, compared with the comparison group ( $p < 0,03$ ), the results in Table 8.

There were no significant differences in the levels of the above-mentioned parameters in the patients of the study groups at the appropriate time, although against the background of the Azdetox administration, the levels of ALT in the serum of patients on the 7-10 days of treatment were lower.

The indices of prothrombin index in patients taking "Azdetox" significantly increased ( $p < 0.05$ ) to 7-10 days of treatment and were significantly higher, compared to patients receiving only basic therapy ( $p < 0.05$ ). There were no significant differences in the duration of the bed-day in patients with the study groups of acute hepatitis C. In accordance with the results obtained, "Azdetox" may be recommended as one of the preparation of choice for therapy in the light and medium-heavy course of acute viral hepatitis.

**Table 8**

**Laboratory findings in patients with hepatitis C with treatment administration of "Azdetox" and the control group**

Indicators	«Azdetox» (A = 20)		Control group (A = 20)			
	1 - 3 days	7-10 days	16-19 days	1 - 3 days	7- 10 days	16-19 days
Bilirubin	105.5± 15,65	49,26±11,45	45.65±7,8	121,66±22,2	40±7,92	34,2±5,39
ALT	1590±289	291±103	244±31	1899±245	565±108	188±32
AST	949±219	190±70	61±13	1042±114	192±56	61±10
AF	353±50	200±17	187±19	377±33	275±17	188±19
PTI	71.78±2,8	88,9±4,75	98,4±0,9	89,54±5,66	96,4±1,9	9,6±4,27
K-day	14,17± 1,26		16,17±1,88			

**Discussion**

1) The natural enterosorbent based on industrial wastes of plant raw materials of roots and rhizomes of licorice naked, rose hips, grape seeds, oat cuts, burdock roots in the ratio: 3: 2: 1: 1: 2 in the form of powder in encapsulated

form of 1.0 (gram) and tablets of 0.1 grams conditionally named "Azdetox" on which normative documentation was approved.

2) Studying of clinical efficiency of oral enterosorbent in acute intestinal infections in children is highly effective, has a rapid and pronounced detoxification and antidiarrheal clinical effect, and significantly reduces the duration of the acute period of the disease, in comparison with the traditional OCD therapy with furazolidone. The detoxication clinical effect of "Azdetox" increases with the increase in the daily dose of the drug and does not depend on the motility of the lesion of the gastrointestinal tract in children with AID. The method of enterosorption with the use of "Azdetox" can be used in clinical practice as a monotherapy for mild forms and in combination with furazolidone with moderate forms of OCD in children. In case of moderate forms of acute infection, "Azdetox" can be used separately as monotherapy.

3) It has been revealed that the drug "Azdetox" has high clinical efficacy in treating patients with manifest forms of acute hepatitis A and B, which is characterized by a significant reduction in the duration of manifestations of the main clinical syndromes in these infections - intoxication, cholestatic, mesenchymal-inflammatory, dyspeptic of the given preparation and authentically earlier normalization of biochemical indices characterizing cholestatic, cytolytic syndromes and protein-synthetic function of the liver. In acute hepatitis C, "Azdetox" does not adversely affect biochemical indicators, while it reduces the duration of such manifestations of dyspeptic syndrome as flatulence and stool retention. In combination with traditional pathogenetic therapy for acute hepatitis A, B, the appointment of "Azdetox" in a dose of 2 tablets 3 times a day for 8-10 days for hepatitis A and 15-17 days for acute hepatitis B has an adequate positive effect.

"Azdetox" does not have side effects in patients with acute hepatitis A, B, C and requires an expansion of indications for prescribing for these diseases.

## References

1. Atakishizade S.A., Velieva M.N., Veliyev P.M. The use of a means to purify the body of toxicants based on herbal remedies. //The Eurasian patent 201600043 of 25.06. 2018.
2. Atakishizade S.A., Velieva M.N. Development of capsule technology based on waste medicinal plants // Development, research and marketing of new pharmaceutical products, Proceedings, Issue 71, Pyatigorsk 2016, 96-97 p.
3. Atakishizade S.A., Velieva M.N., Veliyev P.M. A study of comparative enterosorption properties of antidote agents based on medicinal plant meals. //

- "Topical issues of modern pharmaceutical technology". Materials of the all - Russian scientific and practical conference with international participation, dedicated to the memory of the outstanding scientist, Honored Scientist of the RSFSR, Doctor of Pharmaceutical Sciences, Professor I.A. Muraviev. Pyatigorsk, 2016, 9-12 p.
4. Atakishizade S.A. Remedy for clarification of organism from toxins. //Scientific materials were being devoted for 120 years of birthday anniversary of Əziz Əliyev. Bakı 2017, 392 p.
  5. State Pharmacopoeia of the USSR-issue 2: General methods of analysis. Medicinal plant raw materials/M3 of the USSR.-11th ed., Addition-M.: Medicine, 1990-400 p.
  6. Luzhnikov E.A. Kostomarova L.G. Acute poisoning: A guide for doctors // M.: Medicine 1989- 432 p.

## **DIFFERENTIAL STAINING OF SISTER CHROMATIDS IN HUMAN METAPHASE CHROMOSOMES**

**A. Hasanova, N. Sultanova, S. Sultanova**

*Azerbaijan Medical University, Baku*

*aytakin\_hasanova@mail.ru, nailasultanova069@gmail.ru*

( Presented by Academician, Prof. Dr. Mahbuba Veliyeva )

The aim of this study was to determine the frequency and distribution of sister chromatid exchanges (SCEs) in the individual chromosomes of human karyotype. Chromosomes were studied in (i) healthy subjects, (ii) subjects with rearrangements of X chromosome, (iii) in lymphoblastoid cell lines isolated from the peripheral blood of patients with acute leukaemias. 5-bromo- 2-deoxyuridine (BUdR) was added for 48, 72 and 96 hours, respectively, in a concentration of 30 µg per ml. The slides were stained according to the technique of Perry and Wolff (1974).

The average number of SCEs was 9,2 with no statistically significant differences between the individual groups. Out of the total number of SCEs 20% was found in the centromeric region with no difference between the cells in the 2nd and 3rd divisions. The observed distribution of breakpoints was approximately proportional to the relative length of individual chromosomes with a higher number in long chromosomes and a lower number in the small ones. Non-random distribution of SCEs was only found in the B group of chromosomes of lymphoblastoid cell lines, which showed an excess compared with the SCEs of both the controls and the expected frequency based on the relative length of chromosomes.

Neither in the late replicating i(Xq) nor in the early replicating Xq did the number of SCEs significantly exceed the expected value. Differential staining of sister chromatids consists in introducing some base analogs to label the newly replicating DNA. The originally used tritiated thymidine (Taylor, 1958) was replaced with 5-bromo-2-deoxyuridine (BUdR), which alter incorporation into the double helix considerably decreases the chromatin affinity to some stains (Latt, 1973). These include acridine and 33,258 Hoechst and, moreover, Giemsa, which helps to observe sister chromatid exchanges (SCEs) on permanently stained preparations more easily.

### **Evidence so far available can be summarized as follows:**

1. The mean number of SCEs in human cells cultivated in vitro ranges from 6 to 12 (Kim, 1974) with BUdR concentrations of 6—50 µg/ml media with no dependence on the age or sex of subjects examined.

2. The number of SCEs is to some degree dependent on the BUdR concentration in the cultivation media: at concentrations above 160 µg/ml there occurs a steep rise in the number of exchanges. Similarly the photolysis of BUdR substituted DNA significantly raises the number of SCEs (Perry and Wolff, 1974),

3. The number of exchanges showed a manifold increase hither to found only in Bloom's syndrome where as in Fanconi's anaemia, xeroderma pigmentosum or ataxia teleangiectasia the findings were the same as in healthy subjects. Further an increase in SCEs was recorded as an after-effect of cancerogens in vitro on human lymphocytes and fibroblasts (Perry and Evans, 1975; Beek and Obe, 1975) and in vivo in experimental animals (Perry and Wolff, 1974).

In the present study both the average number of exchanges and the distribution of breakpoints will be considered in short-term peripheral blood cultures from healthy subjects with karyotypes 46, XX and 46, XY, patients with structural rearrangements of X chromosome, and in three lymphoblastoid cell lines derived from patients with acute leukaemia.

### **Material and methods**

The evaluation of the number and distribution of SCEs was performed in

1. Seventy-five mitoses with karyotype 46, X, i(Xq) derived from 4 patients. In one of these subjects a double centromere in the i(Xq) was identified by means of C banding.
2. Twenty mitoses of one patient with reciprocal translocation 46, XX, t(X,4) (Xqter→Xq22: :4p16→4qter). Autoradiography proved that both the deleted X and the B4 chromosome with translocation were early replicating.
3. Fifty-six mitoses obtained from three lymphoblastoid cell lines, derived from the peripheral blood of patients suffering from acute leukaemias. These were classified as dedifferentiated (Epstein-Barr virus positive), lymphatic and myeloid (both EBV-negative).
4. One hundred and seventy mitoses from the control group consisting of 3 males with karyotype 46, XY and 4 females with 46, XX karyotype. The mean age of controls was 29.5 years.

The peripheral blood leukocytes were cultivated for 48, 72 and 96 hours in EPL or Parker medium (Usol, Prague), enriched by 20% calf serum, with PHA (Wellcome) and protected by streptomycin and penicillin. Bromodeoxyuridine

(Sigma) was added in a concentration of 30 µg/ml since the beginning of cultivation. The tubes were protected from light to avoid photolysis. Colcemid (Ciba) in a concentration of 10 µg/ml was added two hours before harvesting.

The cells were hypotonized by 0.075 M KCl and methanol: acetic acid (3:1) were used for fixation.

The lymphoblastoid cell lines were grown as permanent suspension cultures from peripheral blood. They were established and subcultured in RPMI 1,640 medium enriched by 20% fetal calf serum, protected by streptomycin and penicillin, without PHA. BUdR was added in a concentration of 30 µg/ml for 48 or 72 hours following 48 hours of subcultivation. The examination of SCEs was carried out in the 15th, 3rd, and 38th, and in the 16th passages in three individual lines. The harvesting of chromosomes was the same as with the above-mentioned short-term peripheral blood cultures.

Chromosomal preparations were stained according to the FPG staining technique of Perry and Wolff (1974). Intact mitoses with harlequin chromosomes were photographed and SCEs evaluated first directly under the microscope, then from enlarged negatives or karyotypes.

Exchanges occurring in short arms, long arms and in centromeric regions were counted separately. The number of SCEs was examined independently by two experienced observers and expressed as the number of breakpoints. Statistical evaluation was performed by means of *t* test and  $\chi^2$  test.

## Results

The difference in the number of SCEs found per cell in 50 mitoses of control subjects when evaluated from photomicrographs or karyotypes is small but significant ( $p < 0.01$ ). Therefore the data described have been obtained from karyotypes only.

Table I compares the mean number of SCEs between individual groups of subjects examined. The mean value of 9.5 SCEs per mitosis found in the control group was in no way significantly different from mean values of the other groups, i.e. those consisting of pathological karyotypes and lymphoblastoid cell lines ( $p > 0.05$ ).



**Table 1**

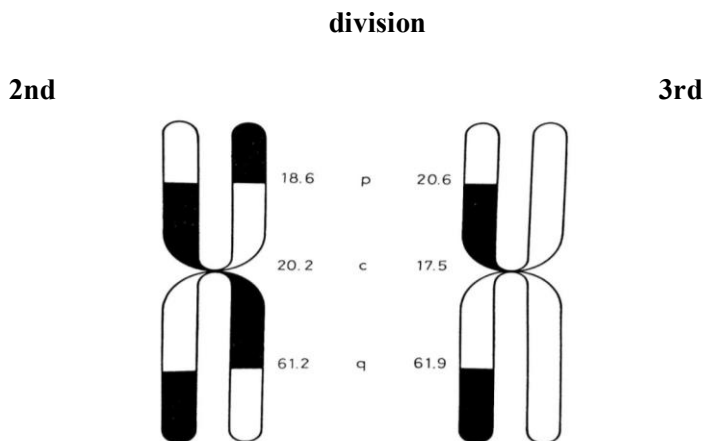
**Mean number of SCEs per mitosis, standart deviation ( $\pm$ S.D.) and number of SCEs chromosome in individual group of subjects in cell after the 2<sup>nd</sup> division in BUdR**

46,XX, i (Xq)	8.8	5.6	0.19
46,XX,t(X,4)	9.4	3.7	0.20
Controls(46,XX and 46,XY)	9.5	4.6	0.21
Lymphoblastoid lines	9.6	4.8	0.21
Mean	9.2		

High frequency of SCEs (20%) was found in the centromeric region of chromosomes after the 2nd and 3rd divisions in BUdR medium, as shown in Fig. 1.

Distribution of SCE, % The distribution of SCEs both observed and expected on the basis of the relative length of chromosomal groups in the karyotype with results of  $\chi^2$ test is shown in Table II. The changes were similar in all observed groups. The only exception were B group chromosomes of the lymphoblastoid ceil lines, where the number of breakpoints increased significantly ( $p < 0.01$ ).

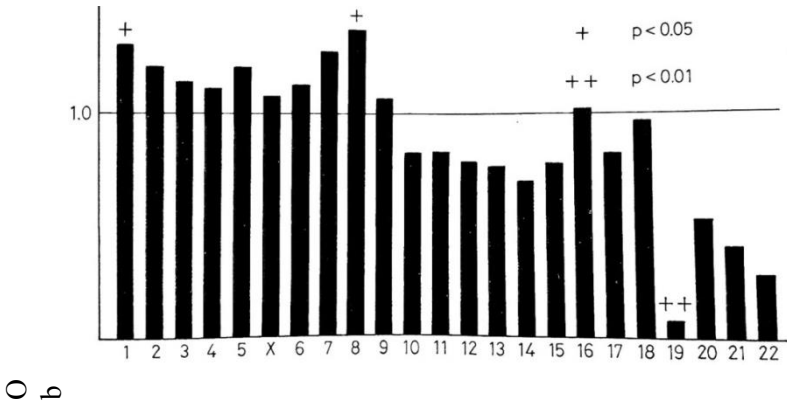
In this particular chromosomal group the breakpoints leading to exchanges were distributed proportionally along the whole length of all chromosomes. Significant difference was found not only as against the expected number of SCEs but also as against the control group. The increased number of breakpoints on the long chromosomes was naturally matched by their decrease in small chromosomes.



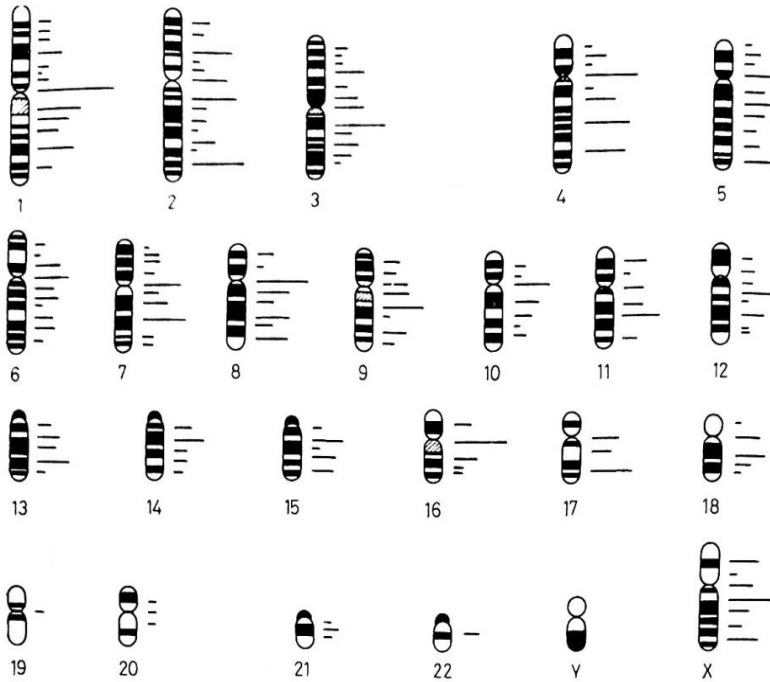
**Fig.1. Percentage of SCEs in short arms, centromeric regions and long arms after the 2nd and 3rd divisions in medium with BUdR.**

Distribution of breakpoints in individual chromosomes in the human karyotype is shown in Fig.2. This graph demonstrates the difference between the expected and observed values in chromosomes A1, C8 and F19, i.e, an excess on chromosomes A1 and C8 and a deficit on F19.

2nd division, control subjects

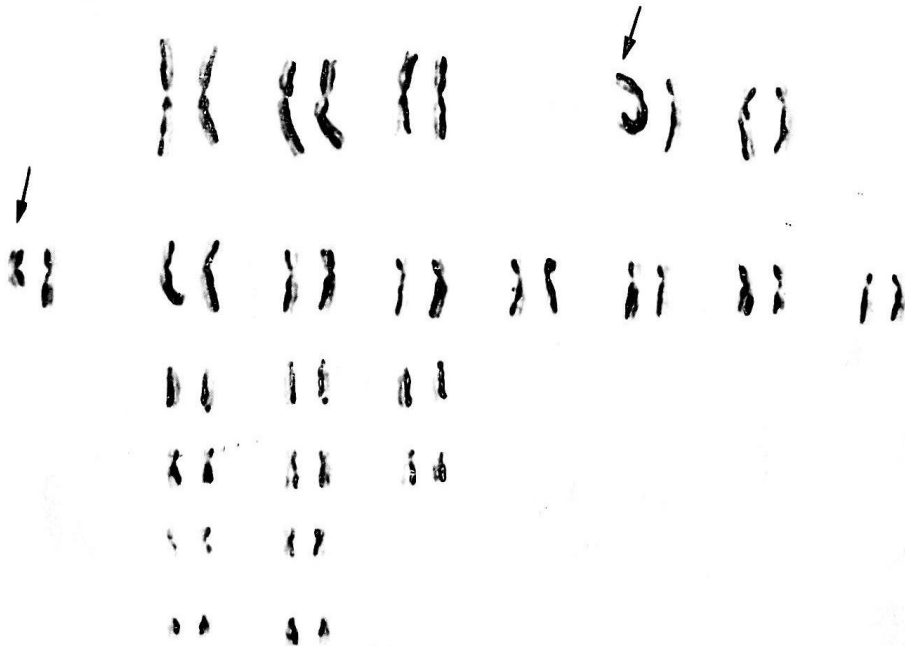


**Fig.2. Distribution of SCEs in individual chromosomes. 1=expected value based on the length of chromosomal pair. Crosses mark the significance level ( $\chi^2$ test).**



**Fig.3. Distribution of SCEs along individual chromosomes.**

Fig. 3 shows the location of exchanges in the individual chromosomes. As we preferred to evaluate the non-banded chromosomes (G-banding considerably interferes with the accuracy of SCE calculation), the regions of breakpoints are only roughly delineated. Even so it is clear that some regions are more often involved in SCEs than others. This is the case especially with regions 1q1, 3q2, 4q2, 8c and 16c. SCEs seem to be preferentially located on G-negative bands, as mentioned also by Morad, Jonasson and Lindsten (1973). Our results are illustrated in Fig. 5 showing a mitosis 46, X, i (Xq) after two divisions in BUdR medium, Fig. 4 demonstrating the karyotype of a cell with 46, XX, t (X,4) translocation, and Fig. 6, in which a G-banded mitosis after two divisions in BUdR can be seen.



**Fig.4. The karyotype 46, XX, t(X,4) (Xqter→Xq22::4p16→4qter) after two divisions in BUdR medium.**



**Fig.5. Mitosis 46, X, i (Xq) after two divisions in BUdR medium, the arrow pointing to X isochromosome with one exchange.**



**Fig.6. G-banded mitosis with harlequin chromosomes. The mitosis makes the exact determination of SCEs impossible despite the excellent quality of the mitosis as such.**

## **Discussion**

Perry and Evans (1975) assumed that the exact number of SCEs can be assessed under the microscope even by a relatively less experienced observer. This only holds for manifold increases such as seen, for example, after high doses of mutagens or in Bloom's syndrome. If, however, an accurate frequency and distribution of breakpoints is to be calculated the karyotype seems to be the only solution. This was demonstrated by comparison of the number of SCEs found in

50 mitoses, examined under the microscope, in enlarged negatives and karyotypes. The differences between the results obtained were small, but significant. All the groups of subjects studied showed only statistically non-significant differences in the mean number of SCEs, similarly to the values cited by other authors for healthy individuals and identical culture conditions.

**TABLE II**  
**Distribution of SCEs in different subjects in relation to relative length of chromosomal groups**

Group	46,XX,t(Xq)			46,XX,t(Xp-4p+)			Lymphoblastoid lines			Controls		
	E	O	$\chi^2$	E	O	$\chi^2$	E	O	$\chi^2$	E	O	$\chi^2$
A	124.0	163	12.26**	41.7	42	0.0	118.9	161	14.91**	332.4	399	13.34**
B	67.0	88	1.21	16.5	18	0.14	63.4	106	28.62**	177.2	203	3.76
t(B,X)	-	-	-	7.2	9	0.45	-	-	-	-	-	-
t(Xq)	17.0	24	2.88	-	-	-	-	-	-	-	-	-
C+X	198.0	216	1.64	66.8	82	3.46	204.1	180	2.85	570.7	640	8.42*
D	58.0	51	0.84	19.2	18	0.08	55.1	55	0.0	154.0	129	4.06
Xq-	-	-	-	3.0	5	1.33	-	-	-	-	-	-
E	48.0	32	5.33	17.0	10	2.88	48.9	24	12.68**	136.7	98	10.96**
F	25.0	4	17.64**	9.3	3	4.27	26.6	8	13.01**	74.4	20	39.78**
G+Y	19.0	8	6.37	7.0	1	5.14	19.8	3	14.25**	56.1	13	33.11**
Total	556.0	556	0.0	187.7	188	0.0	536.8	537	0.0	1501.9	1502	0.0

E=expected value (based on the relative length of the chromosomal group)

O=observed value

$\chi^2$ - $\chi^2$  test. Asterisks mark the statistical significance level: \*\*p<0.0001

\*p<0.01

This error is eliminated in mitoses after the third division in BUdR medium chiefly due to the fact that the chromosomes are lightly stained with regard to both strands which are substituted by DNA after dividing three times in BUdR medium. The highly increased number of SCEs in B group chromosomes in lympho- blastoid cell lines is a puzzling phenomenon. A structurally altered chromosome of B group (4q+) was only found in one of these cell lines (acute dedifferentiated leukaemia). The original hypothesis that the structurally altered chromosomes of these cell lines are more susceptible to exchanges was not proved in the course of further investigations. As a matter of fact the remaining two lines with an increased number of SCEs in B group consisted of morphologically normal B group chromosomes. Interestingly, the cell line established from dedifferentiated acute leukaemia in which the presence of EB-virus was proved by immunofluorescence showed no increase in the frequency of exchanges. It was found that in the Chinese hamster the inactivated X carried more aberrations than the active one. Natarajan and Klasterska (1975) found more frequent SCEs in both X chromosomes than in the autosomes of *Microtus agrestis*. Since they found it difficult to identify the late replicating X chromosome they could not evaluate the role of inactivation in promoting SCEs. Nevertheless, they supposed that the higher frequency of SCEs in the normal X chromosome might be due to its preferential inactivation. However, in a subject with reciprocal X-autosomal translocation, neither the late replicating X chromosome (represented by isochromosome for long arms of X) nor the early replicating X showed statistically significant differences from the expected value. Karyotypes are used when assessing SCEs in centromeric regions. Some authors claim that it is almost impossible to differentiate between true SCEs and twisted chromatid; indeed those dealing with the problem arrived at widely differing results. Korenbetg and Rykovsski (1988) quote 5% incidence after the 2nd as well as after the 3rd division. On the other hand, Burkholder (1993) observed 20% of all exchanges in centromeric regions in kangaroo rat, then Craig and Bickmore (1994) found around 20% of SCEs in centromeric regions in human lymphocytes. Our own observations in 7,820 chromosomes yielded 19% exchanges in centromeric regions. The value remained unchanged after the second and after the third division, thus confirming the accuracy of the observation. The more frequent occurrence of SCEs in highly repetitive centromeric regions reported by Sumner (1994) suggests the possibility that SCEs are the results of recombination between homologous sequences of DNA. When observing the distribution of SCEs in individual chromosomes of healthy subjects we found chromosomes A1 and C8 to be preferentially involved. Therefore we tried to establish the relationship between the localization of breakpoints leading to SCEs and the localization of chromosomal or chromatid breaks, either

spontaneous (Sumner, de la Torre and Stuppia, 1993), or induced by mutagens. The failure to find a coincidence for the two phenomena might suggest that the underlying mechanisms are different.

### References

1. Ayme S., Mattei J.F., Mattei M. G., Aurran Y. and Giraud F., 1976, Non-random distribution of chromosome breaks in cultured lymphocytes of normal subjects. *Hum. Genet.*, 31, 161-175
2. Beek B. and Obe G., 1975, The Human Leucocyte Test System. VI. Use of sister chromatid exchanges as possible indicators for mutagenic activities. *Humangenetik*, 20, 127-134.
3. Burkholder G.D., 199, The basis of chromosome banding. *Appl Cytogenet.*, 19, 181-186.
4. Craig J.M. Bickmore W.A., 1994, The distribution of CpG islands in mammalian chromosomes. *Nature Genetics*, 7, 376-382.
5. Kim M.A., 1974, Chromatidaustausch und Heterochromatin veränderungen menschlicher Chromosomen nach BUdR-Markierung. *Humangenetik*, 25, 179-188.
6. Korenbetg J.R. Rykovski M.C., 1988, Human genome organisation. Alu lines and the molecular structure of metaphase chromosome bands. *Cell*, 53, 391-400.
7. Latt S.A., 1973, Microfluorometric detection of deoxyribonucleic acid replication in human metaphase chromosomes. *Proc. nat. Acad. Sci. Wash.*, 70; 3395-3399.
8. Morad M., Jonasson J. and Lindsten J., 1973, Distribution of Mitomycin C induced breaks on human chromosomes. *Hereditas Lund*, 74, 273-282.
9. Natarajan A.T. and Klasterka, I., 1975, Heterochromatin and sister chromatid exchanges of *Microtus agrestis*. *Hereditas Lund* 150-154.
10. Perry P. and Wolff S., 1974, A new Giemsa method for the differential staining of sister chromatids. *Nature*, 251, 156-158.
11. Perry P. and Evans H.J., 1975: Geological detection of mutagen-carcinogen exposure by sister chromatid exchanges *Nature*, 258, 121-125.
12. Schroeder M.T., 1975, Sister chromatid exchanges and chromatid interchanges in Bloom's syndrome. *Humangenetik*, 30, 317-323
13. Taylor J.H., 1958, Sister chromatid exchanges in tritium labelled chromosomes. *Genetics*, 43, 515-529.
14. Sumner A.T., de la Torre J., Stuppia I., 1993, The distribution of genes on chromosomes: A cytological approach. *J Mol Evol*, 37, 117-122.
15. Sumner A.T., 1994. Functional aspects of the longitudinal differentiation of chromosomes. *Eur J Histochem*, 38, 91-109.

## **RARE CASE OF THE CLINICAL COMBINATION OF TWO NOSOLOGICAL FORMS OF CHROMOSOMAL PATHOLOGY**

**A.T. Hasanova, N.H. Sultanova**

*Azerbaijan Medical University  
aytakin\_hasanova@mail.ru, nailasultanova069@gmail.ru*

( Presented by Academician, Prof. Dr. Mahbuba Veliyeva )

### **Abstract**

The text presents a rare case of the clinical combination of two nosological forms of chromosomal pathology in a patient. Down syndrome is characterized by multiple congenital malformations, including changes in the brain and facial skull, and developmental disorders of the musculoskeletal and cardiovascular systems. Congenital developmental abnormalities are also possible with trisomy on the X chromosome. The case of combined chromosomal pathology in a child A. indicates the importance of monitoring of the fetus conditions in the first and second trimesters of pregnancy for the timely detection of fetal malformations and, if necessary, invasive prenatal diagnosis of chromosomal pathology in a specified period to the further decision on prolongation or interruption of a pregnancy with an abnormal fetus.

**Keywords:** *Down syndrome, trisomy X, malformations, chromosomal syndromes.*

### **Introduction**

Aneuploidy is the second most important category of chromosome mutations relating to abnormal chromosome number. Trisomy 21 and numerical sex chromosome anomalies are common chromosomal disorders, with a birth incidence of 1:700 to 1:2,500 respectively [9. p.24-32.].

The chances of two chromosomal anomalies occurring in a single conceptus are a rare event and the reported incidence varies from 0.21% to 2.8% in spontaneous miscarriages subjected to cytogenetic study [6. p.73-77].

Nonetheless, the incidences might be more than the expected occurrence, if multiplied by the individual frequencies of each aneuploidy [7. p. 351-39]. However, the underlying mechanism involved in the formation of double aneuploidy (DA) is not well understood. Parental origin is studied only in a small number of cases and both non disjunctions occurring in a single parent is an extremely rare event. Because of the rarity and for an addition to the existing literature, we present a case of double aneuploidy in a clinically suspected case



of Down syndrome. Chromosomal pathology makes a significant contribution to perinatal morbidity and mortality. Only few options of numerical chromosome abnormalities in children are compatible with postnatal development and lead to chromosomal diseases.

The big interest of the clinical case description of combined chromosomal pathologies - Down syndrome and trisomy on the X chromosome in patient A is attractable.

### **Case report**

A proband is a girl, which was born from the first pregnancy of a 17-year-old mother who was not registered for a pregnancy up to 28 weeks. During registering of a pregnant woman, water deficiency, chronic fetoplacental insufficiency, chronic fetal hypoxia, proteinuria, and trichomoniasis were found. An ultrasound study, first conducted at 32–33 weeks, revealed a syndrome of delayed fetal development, valgus deformity of both legs, pyeloectasia, megaureter, impaired uteroplacental blood flow. At 36 weeks planned operative delivery was carried out, the girl's weight at birth was 1,360, height - 39 cm, head circumference - 29 cm, breast circumference - 24 cm. The state at birth was heavy, crepitating wheezes were detected in the lungs. After one and half hours after the birth because of an increase in respiratory failure patient A. was transferred to the artificial respiration.

On clinical examination of a child were being observed craniofacial dysmorphism (hydrocephalic form of the skull, hypertelorism of the eyes, low-lying deformed auricles, gothic palate), problems of development of the musculoskeletal system (bilateral club foot), and limitation of the hip joints, reduction soft tissue turgor. The skin is icteric, the subcutaneous fat layer is underdeveloped. From the 11th day of life, patient A. had a rough systolic murmur at the second-third intercostal space with irradiation to the back, sonorous, rhythmic heart sounds Fig. 1. In the lungs, breathing was detectable in all fields, the borders of the heart were enlarged, crepitating rales were heard. On the 28th day of life, according to echocardiography, there is a negative trend with an increase of left heart compartments. Refer to ECG test at the same age, sinus rhythm, severe tachycardia, hypertrophy of the right atrium were detected, and data for ischemia, a violation of repolarization along the anterior, septal and lower walls of the heart, were also being observed. Specified diagnosis of the girl: congenital heart disease, ventricular septal defect, open arterial duct, aneurysm of interatrial septum is obviously.

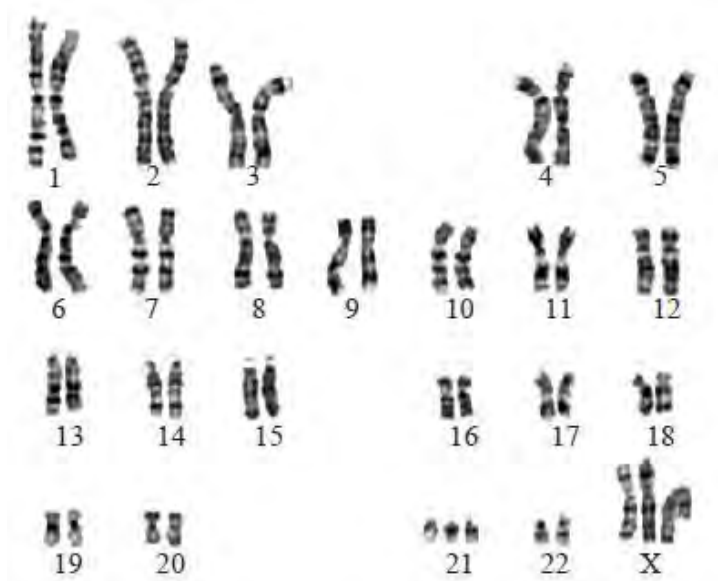


**Fig.1. Clinical features of the proband**

At 1 month, in patient A., an ultrasound examination of the urinary system revealed border pyeloectasia on the left, and no ecopathology was detected in the abdominal organs. As a multispiral computed tomography of the chest was carried out, a sharp expansion of the cardiac shadow, bronchopulmonary dysplasia was detected. According to the results of the multispiral computed tomography of the brain, we diagnosed hypoxic-ischemic brain lesion, borderline internal hydrocephalus, moderate external hydrocephalus, a congenital anomaly of the cerebellar vermis development - Dandy-Walker malformation.

The cytogenetic conclusion obtained by standard karyotyping with differential staining of chromosomes is 48, XXX, +21, which corresponds to the presence of two additional chromosomes — the X chromosome and the autosome 21. Thus, the proband simultaneously diagnoses two nosological forms of chromosomal pathology - Down syndrome and trisomy on the X chromosome Fig.2.

With an increase in cardiac decompensation, there appeared insufficiency of blood circulation of the II B grade, high pulmonary hypertension, as well as severe bilateral pneumonia and respiratory failure of the III grade. At 1 month 14 days, patient A. had a cardiac arrest, resuscitation did not reverse the condition. According to the literature, 60% of children with Down syndrome die before the age of 3 months, only 10% live to a year, while the main cause of death is cardiac impairment and respiratory arrest.



**Fig.2. Karyotype showing both trisomy X and trisomy 21**

### Discussion

According to literary sources, Down syndrome is characterized by multiple congenital malformations, including changes in the brain and facial skull, malformations of the musculoskeletal, cardiovascular systems, that are obviously. When trisomy on the X chromosome is also possible manifestation of congenital developmental abnormalities. The literature describes cases of a combination of two chromosomal abnormalities in one patient. In the case of the patient A., the main developmental abnormalities are associated with more severe malformations characteristic of Down syndrome.

The patient with a karyotype 48, XXX, +21, who had an intrauterine growth retardation, a change in the shape and size of the skull, an inter-ventricular septum defect, a pulmonary stenosis and a clubfoot of the left leg, that was being described by *H. Pachajoa* [2013]. Thus the phenotype of the patient, as well as in the case of patient A., was determined by the developmental anomalies most often described in Down syndrome.

Double trisomies are rarely seen among live births as most of the cases are inevitably lethal [6. p.73-77]. Trisomy- 21 and triple- X in the same individual has been reported earlier [Balwan et al. 2008; Devlin and Morrison 2004; Guzel et al. 2009; Kovaleva and Mutton 2005] and phenotypic features of classical Down syndrome were only seen. However, strabismus, periorbital swelling, scanty eyebrows and microganthia observed in the present case have not been observed in earlier reports. Molecular research though carried out in a small

number has shown that they are either derived from a single parent or have different parental origin [6. p.73-77.].

In the present study, molecular characterization has shown maternal origin of double aneuploidy with origin of trisomy 21 at meiosis- II and trisomy X at meiosis-I. Though the origin of meiotic error is not known precisely, several factors like age [*Diego-Alvarez et al. 2006; Li et al. 2005; Baird and Sadovnick 1988*], nutritional (B12/Folate deficiency with hyperhomocystenemia) and /or polymorphism in the gene regulating B12/Folate pathways have shown to be associated with an increased risk of meiotic error [*James et al. 1999; Sheth and Sheth 2003*]. However, in the present case, the age factor is ruled out as maternal age was 26 years at the time of the child's birth. Further study for the common polymorphism in MTHFR gene (677CT or TT) was also normal with low vitamin B-12 in father and normal B-12 status in the mother. Since both non-dysjunction occurred in mother, low vitamin B12 in the father is unlikely to have any role in the present case. This again shows that the cause of meiotic error was either due to abnormal function, due to mutation or regulatory anomaly of unknown genes involved in the meiotic error or genetic predisposition in some families for the double aneuploidy [4. p.958-966]. Prognosis for patients with trisomic miscarriage is favorable. However, the risk of trisomic pregnancies with advanced maternal age is higher [18. p. 465–483.].

Also, patients with an euploid miscarriage have a poor prognosis. This suggests that an alternative cause of miscarriage may exist, such as variants in proteins affecting DNA methylation or meiotic segregation [15.p.1245–1254.], gonadal mosaicism for a chromosome abnormality or balanced translocations [17. p.367–373]. In the present case, pregnancy loss in first trimester was difficult to ascertain as no information about the fetal loss was available, and recurrence risk would be difficult to ascertain to the family in presence of normal chromosomal status in both parents. It is likely that some other mechanism of independent non-disjunction might be playing a role in such cases and further studies are needed to elucidate the molecular events for double aneuploidy. Nonetheless, it would be appropriate to advise the family for prenatal diagnosis in subsequent pregnancies.

The case of combined chromosomal pathology in a child A. indicates the importance of monitoring of the fetus conditions in the first and second trimesters of pregnancy for the timely detection of fetal malformations and, if necessary, invasive prenatal diagnosis of chromosomal pathology in a specified period to the further decision on prolongation or interruption of a pregnancy with an abnormal fetus.

## References

1. Bochkova V.P., Ginter E.K., Puzyrev V.P. - Hereditary diseases. National leadership / ed. M. : GEOTAR-Media, 2012. - 936 p.
2. Baird P.A., Sadovnick A.D. 1988. Maternal age-specific rates for Down syndrome: Changes over time. *Am J MedGenet*, 29(4): p.917-927.
3. Balwan W.K., Kumar P., Raina T.R., Gupta S. 2008. Double trisomy with 48, XXX+21 karyotype in a Down's syndrome child from Jammu and Kashmir. *Ind J Genet*, 87(3): p.257-259.
4. Diego-Alvarez D., Ramos-Corrales C., Garcia-Hoyos M., Bustamante-Aragones. et al. 2006. Double trisomy in spontaneous miscarriages: Cytogenetic and molecular approach. *Human Reproduction*, 21(4): p.958-966.
5. Devlin L., Morrison P.J. 2004. Accuracy of the clinical diagnosis of Down's syndrome. *Ulster Med J*, 73(1): p.4-12.
6. Guzel A.I., Demirhan O., Pazarbasi A., Ozgunen F.T. et al. 2009. Detection of parental origin and cell stage errors of a double non-disjunction in a fetus by QF-PCR. *GenetTest Mol Biomarkers*, 13(1): p.73-77.
7. Hook E.B. 1992. Chromosome abnormalities: Prevalence risk and recurrence. In: D.J.H. Brock, C.H Rodeck, M.A. Ferguson-Smith (Eds.): *Prenatal Diagnosis and Screening*. Edinburgh: Churchill-Livingston, p. 351-39.
8. James S.J., Pogribna M., Pogribny I.P., Melynk S. et al. 1999. Abnormal folate metabolism and mutation in the MTHFR gene may be maternal risk factors for Down syndrome. *Am J Clin Nutr*, 70: p.495-550.
9. Kovaleva N.V., Mutton D.E. 2005. Epidemiology of double aneuploidies involving chromosome 21 and the sex chromosomes. *Am J Med Genet A*, 134A(1): p.24-32.
10. Kozlova S.I., Demikova N.S. *Inherited syndromes and medical genetic counseling*. -M. : KMK, 2007. - 448 p.
11. Li QY, Tsukishiro S., Nakagawa C., Tanemura M. et al. 2005. Parental origin and cell stage of non-disjunction of double trisomy in spontaneous abortion. *CongenitAnom (Kyoto)*, 45: p. 21-25.
12. Lorda-Sanchez I., Diego-Alvarez D., Ayuso C., de Alba MR et al. 2005. Trisomy 2 due to a 3:1 segregation in an abortion studied by QF-PCR and CGH. *Prenat Diagn*, 25: p. 934-938.
13. Old J.M., Ludlam C.A. 1991. Antenatal diagnosis. *Baillieres Clin Hematology*, 4: p. 391-428.
14. Pachajoa H. Double aneuploidy (trisomy X, trisomy 18) in a newborn with trisomy 18 phenotype// *Arch Argent Pediatr*. - 2013. - No. 111 (4). - p. 101-104.
15. Robinson W.P., McFadden D.E., Stephenson M.D. 2001. The origin of abnormalities in recurrent aneuploidy/ polyploidy. *Am J Hum Genet*, 69: p. 1245-1254.
16. Sheth J.J., Sheth F.J. 2003. Gene polymorphism and folate metabolism: A maternal risk factor for Down syndrome. *Ind Pediatr*, 40(2): p. 115-123.

17. Sugiura-Ogasawara M., Ozaki Y., Sato T., Suzumori N. et al. 2004. Poor prognosis of recurrent aborters with either maternal or paternal reciprocal translocations. *FertilSteril*, 81: p. 367–373.
18. Warburton D., Kline J., Stein Z., Hutzler M. et al. 1987. Does the karyotype of a spontaneous abortion predict the karyotype of a subsequent abortion? Evidence from 273 women with two karyotyped spontaneous abortions. *Am J Hum Genet*, 41: p. 465–483.
19. Yuzhakova A.G. A rare case of Down syndrome with X-chromosome disomy / [et al.] // *Medical genetics*. - 2015. - № 4. - p. 49–50.

## ON THE USE OF LICORICE MEDICATIONS IN THE TREATMENT TO TREAT COVID-19

<sup>1</sup> M.N. Veliyeva, <sup>2</sup> Y.C. Mammadov, <sup>3</sup> R.M. Heydarova, <sup>4</sup> F.İ. Ibrahimli, <sup>5</sup> P.M. Veliyev, <sup>6</sup> F.İ. Medetli, <sup>7</sup> S.M. Babayeva

<sup>1</sup>*Dr. Pharm. Sci., Prof., Academician of IAS AS H&E, vice-president of IAS AS H&E, Chief of Pharm. Techn. & Management Department, Azerbaijan Medical University, mahbubav\_amu@rambler.ru,*

<sup>2</sup>*M.D., the Scientific Head of the laboratory "Research of natural lymphotropic drugs" at the Pathological Physiology Department of the Azerbaijan Medical University, corresponding member of the Azerbaijan Academy of Sciences, yagubmemmed@mail.ru,*

<sup>3</sup>*PhD in Biology, the Department of Soil Geography, General Director of "Biyon Production" Industrial Park, Chairman of SEBA Azerbaijan-Korean Cultural Exchange Association, chairman\_seba@yahoo.com, heydarova13@mail.ru,*

<sup>4</sup>*M.D., Prof., Head of department of the Scientific Research Center of the Azerbaijan Medical University, ifikriya@mail.ru*

<sup>5</sup>*PhD in Med., Chief of the Medical Service of the Ministry of Emergency Situations of Azerbaijan, Colonel, velperviz@yahoo.com,*

<sup>6</sup>*PhD, Assoc.Prof. of Pharm. Techn. & Management Department, dean of Pharm. Faculty, Azerbaijan Medical University, madfarah3003@gmail.com,*

<sup>7</sup>*PhD, Azerbaijan Medical University, Farmakology Department, Baku, svetlanapharma@gmail.com,*

### Abstract

Licorice is a national treasure of Azerbaijan, since the species growing in our country are distinguished by a high content of glycyrrhizic acid (up to 24%), which makes them indispensable in the fight against viral infections. The COVID-19 pandemic shocked the whole world, claiming hundreds of thousands lives, since traditional medicines used in the fight against it, amid which antibiotics accounted for a large percentage, were ineffective. Later it turned out that the use of antibiotics led to a deterioration in the patients' condition and an increase in mortality in the population. All the errors of medicine have been the result of a narrow approach to the problem and a lack of recognition by some doctors and researchers of the value of herbal medicines. As a result of the preferential use in the early stages of the pandemic development exclusively drugs of chemical origin, it was practically impossible to save those who fell ill in the first outbreak of the disease, especially when complications occurred; and here folk medicine comes to the rescue. Medicines developed by Azerbaijani scientists based on licorice, a natural raw material with lymphotropic and antiviral action, prevent the virus from binding to the host cell membrane, inhibit the replication of the virus that has

already entered the body, thus preventing the development and spread of the disease. The research proposed by our laboratories in this area has helped save the lives of thousands of people. The goal of this work is to disclose the importance and usefulness of licorice based medicinal syrups in the treatment of the Covid-19 infection.

**Key words:** *COVID-19 pandemic, Glycyrrhiza glabra, glycyrrhizic acid, limphotropic effect.*

## Introduction

Despite the use of many drugs to treat COVID-19 infection since the early onset of the coronavirus, the scientists are still searching for effective treatments and prophylaxis of COVID-19 infection. Currently, the researchers are conducting clinical trials of three groups of drugs; these include antiviral drugs, immunomodulators and respiratory drugs. Antiviral drugs prevent the virus from entering or multiplying inside the lung cells, the second group of drugs is designed for the immune system response, and the third group includes drugs that allow the lungs to supply enough oxygen to the blood.

Since the specific treatment is not available, different methods are used to prevent the infection spread. In some countries, chloroquine, hydroxychlorine and mefloquine are among the drugs used against coronavirus. In Azerbaijan, which mostly uses the recommendations of the WHO, arbidol, koletrax, kaletra are used.

Amid effective antiviral tools, *Bald Licorice - Glycyrrhiza glabra F. (L.)* and its main useful component, glycyrrhizic acid become the subject of discussion in scientific articles of certain countries (China, Korea, Iran, Germany, Japan, Turkmenistan, Turkmenistan, Azerbaijan, etc.).

*Bald licorice - Glycyrrhiza glabra* is one of the first medicinal plants used by the World Health Organization [1]. Its usefulness has been known for over 5000 years. Licorice is also a natural national treasure of Azerbaijan. According to various scientists, it contains more than 200 beneficial biologically active substances. Drugs derived from this medicinal plant are used in medicine and pharmacy by 14 pharmacotherapeutic groups and have such beneficial effects as antiseptic, lymphotrop, immunomodulatory, anti-inflammatory, antiviral, antibacterial, antisclerotic, antiallergic, antitussive, antidiabetic, expectorant, diuretic etc [2]. In addition, it is widely used in cosmetology, food and household industries [3]. Numerous scientific studies have shown that glycyrrhizin and glycyrrhizinic acid, the main ingredient of licorice root, is effective in the treatment of SARS (severe acute respiratory syndrome) [4], herpes, AIDS, hepatitis, influenza, encephalitis and pneumonia, as well as in infections caused by respiratory syncytial virus, arboviruses, and viruses of vesicular stomatitis



[5]. Since glycyrrhizic acid and glycyram are safe [6] and effective against SARS, scientists hope that these natural substances can become an important tool against COVID-19.

Licorice roots comprise triterpenoid 4–20% of saponins (mostly glycyrrhizin), a mixture of 18 $\beta$ -glycyrrhizic acid salts. Glycyrrhizic acid, the main triterpene-derived pharmacologically active substance from licorice in Azerbaijani *Glycyrrhiza glabra* content is even up to 24% [7]. In Japan and China, Glycyrrhizic acid is used as a hepatoprotective drug in chronic hepatitis. From January 2014, glycyrrhizic acid in the content of the licorice extract is approved by the FDA as a food sweetener [8]. Unlike other worldspread species, licorice spread in Azerbaijan is the richest in glycyrrhizic acid. The Azerbaijani licorice derived drugs have a wide range of pharmacological and biological activity: lymphotrop, anti-hemo-lymphocoagulating, antiviral, antioxidant, antidote, anticonvulsant, antiallergic, hepatoprotective, neuroprotective, immunomodulatory, anti-inflammatory, etc. According to Cinatl J., who published the results of the antiviral potential assessment for ribavirin, 6-azauridine, pyrazofurine, mycophenolic acid and glycyrrhizin against SARS, glycyrrhizin was found to be more active in inhibiting viral replication than all other compounds [9]. It should be noted, that COVID-19 is very similar to SARS appeared in 2003, and in this regard it is also termed SARS-CoV-2. Both viruses cause infection by invasion the human alveolar epithelial cells, and their genomes are 79.5% compatible [10]. It was found, that glycyrrhizin also inhibits the adhesion of the virus to the host cell membrane and its penetration into the cell [11], i.e. glycyrrhizin prevents the first stages of the virus action. It is not ruled out, that glycyrrhizin is able to stop the replication of COVID-19 and other coronaviruses, and is a powerful tool against them. Based on in-depth scientific analysis and the results of many phytotechnological and pharmacotherapeutic studies, one may conclude that the use of licorice in viral and bacterial infections is promising, even necessary [12]. It is acknown that antiviral drugs are widely used in the treatment of viruses: SARS; MERS - Middle East Respiratory Syndrome; HIV - human immunodeficiency; Ebola disease fever; malaria and a number of other viral diseases - their prophylaxis and complex treatment protocols include licorice preparations, including licorice juice and glycyram. The scientists around the world are currently offering natural remedies instead of the SARS-COV-2 coronavirus vaccine, scientists in some countries prefer non-traditional pharmaceutical products. Chinese scientists have extensively used a combination of homeopathic remedies and herbs in the treatment of COVID-19, including licorice (*Glycyrriza glabra* L.); *Platycodon root- (radix platycodonis)*; *Japanese Honeysuckle- (Lonicera japonicae)*; In addition to the drugs produced and widely used in China, amid chinese medicine tools used

against COVID infection were also mentioned the *Eupatorium fortunei*. The Ministry of Science and Technology of China allowed to prescribe against coronavirus plant-derived drugs that are less harmful. According to local media, those who received both synthetic & plant-derived drugs recover faster than prescribed only synthetic drugs. Beijing Chief Physician Van Ronby emphasised the high therapeutic effect of “*Qindfei Paidu*”, a drug based on licorice root and other medicinal plants. According to a study Gomaa A. and Abdel-Wadood Y., 2021, the main component of licorice root, glycyrrhizic acid, has positive effect on people infected with the coronavirus. Studies published in scientific journals have shown that the main active ingredient in licorice root, glycyrrhizic acid, effectively inhibits SARS virus clinically dangerous isolates replication [4], while other studies have shown that it inhibits adhesion of certain proteins of the pathogenic virus to host cell. It should be noted that some specialists prefer non-traditional folk remedies. Chinese scientists, the first and leading experts in this field, consider phytotherapy important in the fight against coronavirus. They pay special attention to the prevention of COVID-19 platycodon root (*Radix Platycodonis*), Japanese Honeysuckle (*Lonicera japonica*), bald licorice (*Glycyrrhiza glabra*) and *Eupatorium fortunei*. Although many authors generally consider such herbal remedies to be promising in the treatment of coronavirus, more extensive research is needed to confirm the effectiveness of these drugs.

- The researchers from Beijing University and the Chinese Military Medical Academy found that one of the components of licorice root in the treatment of COVID-19 helps the body fight the virus by imitating interferon.

- The President of Madagascar Medicine Academy presented herbal preparation "COVID ORGANICS" for the prevention and treatment of COVID-19. In protocol, they mixed chloroquine and azithromycin with plant-derived from medicine emphasising the use of medicinal plants.

- Iran, one of the most affected by the COVID-19 epidemic countries, has officially announced testing two herbal sprays to treat respiratory illnesses such as coronavirus.

- The President of Turkmenistan, Mr. Gurbanguly Berdymukhamedov claimed that licorice could cure coronavirus and instructed the Ministry of Health scientifically study to apply widely bald licorice - *Glycyrrhiza glabra* against COVID-19.

- German scientists have proved the effectiveness of liquid licorice root extract and glycyrrhizic acid in the treatment of SARS-COV-2.

The glycyrrhizic acid based Spanish drug “Viusid Glycyrrhizic”, as well as about 20 other antiviral remedies are used in the treatment of various diseases. Scientists of the Azerbaijan Medical University have been conducting research on licorice, a natural resource of our country, for more than 30 years. The various

industrial licorice syrups made in Azerbaijan according to our data in numerous research laboratories. The licorice-based drugs are termed differently in various countries: “Biyān” - in Azerbaijani; "Liquiriciae" – in Latin; “Glycyrrhiza” – in Greek; “Licorice” – in English; “Sussholr” – in German; Liquiricae – in French; Lucretius – at Ukraine; Lokritsiya – in Bulgarian; “Yatxu-matxu” – in Indian; “Gan-tcao” – in Chinese; Gamco – in Korean; “Maduka” – in Mongolian; "Dzir-tribili" – in Georgian etc.

The beneficial properties of licorice root have been known since ancient times. Thousands years ago, Tibetan physicians, the genius Ibn Sina (Avisenna), treated many diseases with the licorice root. Licorice root is still widely used in both folk medicine and traditional medicine. Licorice root is used in the treatment of cough, pneumonia, cardiovascular system, anemia, reduces blood clotting, helps with digestive system, liver, treats cold, urinary tract diseases, stress and depression, strengthens the immune system, helps in infections and poisons, fights against viruses, germs, and fungi. Such drugs also exhibit anti-inflammatory, sedative and various other positive effects. In COVID-19 pandemic, the antitussive effect of licorice is of special interest: licorice is the only plant with a wonderful effect for both dry and wet coughs.

In 1929-1934, licorice reserves in Azerbaijan amounted to 11.86 t / ha. The supply and processing of licorice root declined sharply During the First World War and the Civil War. In 1922, with the establishment of the Licorice Joint Stock Company, the licorice industry began to recover. Studies conducted later have shown that the area where licorice is distributed has decreased 5 times, total licorice stocks have decreased 4 times, and inspections over the next 30 years have further reduced it. In Azerbaijan, the first supply of licorice root for industry was carried out by American and British companies in the 1980s. A plant for processing licorice root was built at the Ujar railway station, and also licorice has been regularly exported to the Israel. The content of glycyrrhizic acid of vegetate in Azerbaijan 8 species licorice (*Glycyrrhiza glabra L*) with an antiviral effect is 24%; this is higher than in the other species (33) distributed in the world. Along with glycyrrhizic acid, licorice contains saponins, flavonoids, steroids, essential oils, vitamins, organic acids, trace elements, resins, phytoserols, lipids, pectins, carbohydrates, etc. - it is very rich in nutrients. Modern methods have made it possible to obtain more than 200 biologically active substances from licorice, and the most useful of these substances is glycyrrhizic acid. Glycyrrhizic acid has become the main object of research in various fields of medicine due to its wide range of biological activity. Based on the Ilham Aliyev’s presidential decree №2 / 483 from May 15, 2012 addressed to Azeri scientists, the bald licorice, the national plant wealth of Azerbaijan, has been selected as the main object of research; after, the useful substances and pharmaceutical products have

been brought to light from it. According to the direct instructions of President Ilham Aliyev, licorice preparations start to be produced in the industry "Licorice Industry Park", and its safe medicinal syrup products are currently used as an effective drugs.

We note that extensive scientific research was conducted under the leadership of Professor Yagub Javad oglu Mammadov, the scientific head of the laboratory "Research of natural lymphotropic drugs" established at the Department of Pathological Physiology of the Azerbaijan Medical University in 1990-1995. Scientific research in the laboratory was carried out in three directions. In the "Pharmacology and Pharmacy" department conducted preliminary screening of 326 medicinal plants from the flora of Azerbaijan and their impact on blood and lymph clotting; the anticoagulant and fibrinolytic effect of 110 was confirmed. After experiments, pharmaceutical products were created on the basis of pharmacologically active substances from 46 promising medicinal plants. We have presented a list of these substances as promising drugs that affect the blood and lymph clotting. Based on phyto-pharmacological studies, the lymphotropic activity of 12 highly effective Azerbaijan medicinal plants including licorice were first discovered in world medicine and proposed for use in the pharmaceutical industry. In Azerbaijan, individual preparations from licorice are currently in use: glycyrrhizic acid and glyciram; dry and solid extracts of licorice containing complex licorice substances. Licorice root syrup impact on lymph has been studied in detail, and its very effective lymphotrop effect has been confirmed and applied in medicine. This contributions into world medicine was made by Azerbaijani scientists and all these medicines are certified. They are approved by the Control-Analytical Laboratory in the "Pharmacy" Institution of the Republic of Azerbaijan Ministry of Health; their composition and purity meet the standards. These drugs were tested separately abroad, and it was confirmed that their composition corresponds to the required by Pharmacopoeia. Their clinical researches were conducted in 4 leading hospitals and clinics of the Republic of Azerbaijan: in the United Children's Hospital named after G.Garayev; Republican Children's Hospital; Children's Clinical Hospital; At the Melikov United City Hospital.

Under the guidance of well-known scientists of Azerbaijan Medical University Pediatric Departments' located in these hospitals: academician Adila Namazova; Eyubova A.E.; Prof. Hajiyev A.A., 12 dissertations (3 doctoral and 9 PhD) have been completed. The scientific research conducted under the supervision on 9086 patients, the results were controlled and signed by the heads of these departments and chief physicians of hospitals, and 4 important documents were approved by the Azerbaijan Republic Minister of Health. Thus

in our country, the above-mentioned effects of drugs have been thoroughly approved, tested and confirmed in accordance with the Pharmacopoeia.

Significance of the of licorice plant preparations is mainly based on their lymphotrop, immunotrop activities and ability to reduce blood and lymph clotting. These features of licorice finds its reflection in Veliyeva Mahbuba Nabi gizi's doctoral dissertation defended in 1998 titled "Antihemo-, lymphocoagulation and lymphastimulant herbal medications from the flora of Azerbaijan" & prepared at the Department of Pathological Physiology under the guidance of Professor Yagub Cavad oglu Mammadov, the Corresponding Member of the Azerbaijan Academy of Sciences. The medicinal properties of licorice are also discussed in Aliyev Mamed Haji oglu's doctoral dissertation titled "Lymphatic coagulation and the tissue lympho dreinage disorders in the pathogenesis of post-reanimation encephalopathy, as well as their correction" (2006). The medicinal properties of licorice presented in the works carried out for the PhD degree in three dissertations listed below as well. Babayeva Svetlana Mamed gizi's dissertation titled "Lymphotropic phytotherapy in complex treatment of post-reanimation impairment" (2000), Talishinskaya Malahat Bakhtiyar gizi's dissertation titled "Correction of immune and hemo-, lymphacoagulation disorders in the post-resuscitation period" (2003), and prepared by Aliyeva Aida Jabbar gizi PhD work titled "Disorders of the lympho drainage, immune system along with peroxidation of lipids in acute pneumonia and their correction ways" (2003).

The healing effect of licorice is reflected in the work of the Pediatrics Department dissertant Valiyev Parviz Mustafa oglu, who defended his dissertation in 1996. In 2009, Mirzazadeh Elmar Soltanali oglu defended his dissertation on "Application of licorice in the complex treatment of herpetic stomatitis in children" at the Pediatric Dentistry Department of Azerbaijan Medical University. He proved antiviral and immune system strengthening effect of licorice. In 1998 based of this work, Mahbuba Nabi gizi Veliyeva defended her doctoral dissertation on "Antihemo-, lymphocoagulative and lymphastimulant herbal medicines derived from the flora of Azerbaijan" and earned the title of professor. Since 1997, Professor M.N. Veliyeva has been leading the Department of Pharmaceutical Technology and Management of Azerbaijan Medical University. Under the leadership of Professor M.N. Veliyeva, 3 doctoral dissertations on pharmacy are being prepared, 24 PhD dissertations on pharmaceutical sciences, 50 master's dissertations have been defended. 565 scientific works were published, including 65 patents, 22 rationalization proposals, 7 monographs, 17 textbooks and manuals, 7 methodical instructions, 14 teaching aids, 28 technical conditions, 7 articles for pharmacopoeia. Professor M.N.Veliyeva is the first inventor scientist in

Azerbaijan pharmacy. She participated in the Women's Exhibition, and Competition for the International Patents for the Assessment of the Innovative Development. As the author of the most Inventions and Patents from Azerbaijan, she deservedly represented our country at this exhibition and delivered to our country 2 gold, 1 silver, 2 bronze medals and a honored Special Prize established by these organizations. These awards and prizes were given for 1 patent, 36 medicinal syrups applied to the "Biyon Industrial Park" and are currently produced. On October 28, 2019, President Ilham Aliyev inaugurated this Industrial Complex. Such a magnificent industrial complex has been established in our country for the first time, and it is gratifying that our state supports and appreciates these innovations. Because the products are 100% herbal, there are no side effects. "Licorice Production Park" has been established on 1,539 hectares of land in Agdash region under "Licorice Products LLC". Planting supplies 1539 ha of licorice, 11 ha is taken by following Industrial complexes. The "Licorice Plant Supply"; "Licorice Plant Processing"; "Plant Extracts and Plant Medicinal Syrups" has been launched to produce drugs that meet modern requirements.

It is gratifying that therapeutic syrups produced at "Biyon Industrial Park", such as "Biyon Syrup", liquorice "Immunovit" Syrup; Licorice "Broncho" syrup, licorice "Gripson" syrup proved itself in the Covid-19 pandemic. Many patients recovered in Covid-19 pandemic by taking only these drugs. In addition, the following therapeutic syrups helped to eliminate the complications of COVID-19: Licorice "Sed"; liquorice "Hem"; Licorice Syrup, Licorice "Cardio".

### **Conclusions**

1) Since 1990, as soon as Azerbaijan gained its independence, scientists of the Azerbaijan Medical University Departments have conducted in-depth scientific research on 12 promising medicinal plants of the Azerbaijan flora including licorice.

2) The properties of licorice drugs disclosed by our researchers: lymph cleansing, antiviral, reducing clotting and enhancing the activity of the immune system have been proven in the treatment of bronchial diseases.

3) Therapeutic syrups produced in the "Biyon Industrial Park" of Azerbaijan: "Biyon syrup"; Licorice "Immunovit"; "Biyon Broncho"; Licorice "Gripson"; "Biyon Sed"; Licorice "Hem"; Licorice "Cardio" have proved effect in Covid - 19 pandemic.

The Republic of Azerbaijan is developing as a building an independent, democratic, modern, legal, civil country. Started on 27.09.20 and ended on 08.11.20 the Second National Patriotic War has been written in golden letters into the history of the world. Those who fell in this war cleared the way for the

free development and achievement of the intended purposes. We became a new, Integrated, National, Free, Independent Republic of Azerbaijan. Therefore, we express our gratitude to our President Ilham Aliyev and sincerely congratulate him and all people contributed on the above-mentioned scientific achievements.

### References

1. Mahbuba Veliyeva The Licorice of the Medicine, Baku-2012, 225 p.
2. Zhang QH, Huang HZ, Qiu M, Wu ZF, Xin ZC, Cai XF, Shang Q, Lin JZ, Zhang DK, Han L. Traditional Uses, Pharmacological Effects, and Molecular Mechanisms of Licorice in Potential Therapy of COVID-19. *Front Pharmacol.* 2021 Nov 26;12:719758. doi: 10.3389/fphar.2021.719758. PMID: 34899289; PMCID: PMC8661450.
3. Huan, C., Xu, Y., Zhang, W., Guo, T., Pan, H., & Gao, S. (2021). Research Progress on the Antiviral Activity of Glycyrrhizin and its Derivatives in Licorice. *Frontiers in pharmacology*, 12, 680674. <https://doi.org/10.3389/fphar.2021.680674>
4. National Center for Biotechnology Information (2022). PubChem Compound Summary for CID 14982, Glycyrrhizic acid. Retrieved March 25, 2022 from <https://pubchem.ncbi.nlm.nih.gov/compound/Glycyrrhizic-acid>. <https://pubchem.ncbi.nlm.nih.gov/compound/Glycyrrhizic-acid>
5. Bailly Ch., and Gérard V. “Glycyrrhizin: An alternative drug for the treatment of COVID-19 infection and the associated respiratory syndrome?” *Pharmacology & therapeutics* vol. 214 (2020): 107618. doi:10.1016/j.pharmthera.2020.107618
6. Huan Changchao, Xu Yao, Zhang Wei, Guo Tingting, Pan Haochun, Gao Song. Research Progress on the Antiviral Activity of Glycyrrhizin and its Derivatives in Licorice. *Frontiers in Pharmacology*, 2021, 12, <https://www.frontiersin.org/article/10.3389/fphar.2021.680674>, DOI:10.3389/fphar.2021.680674
7. Xuqin Du, Lipeng Shi, Wenfu Cao, Biao Zuo, Aimin Zhou. Add-on effect of Chinese herbal medicine in the treatment of mild to moderate COVID-19: A systematic review and meta-analysis. *PLOS ONE*, August 2021. Doi:10.1371/journal.pone.0256429, Pubmed ID: 34415962
8. Gomaa A.A., Abdel-Wadood Y.A. The potential of glycyrrhizin and licorice extract in combating COVID-19 and associated conditions. *Phytomedicine Plus*, 2021, 1(3): 100043, <https://doi.org/10.1016/j.phyplu.2021.100043>.
9. Li, J.; Xu, D.; Wang, L.; Zhang, M.; Zhang, G.; Li, E.; He, S. Glycyrrhizic Acid Inhibits SARS-CoV-2 Infection by Blocking Spike Protein-Mediated Cell Attachment. *Molecules* 2021, 26, 6090. <https://doi.org/10.3390/molecules26206090>
10. Zhu J., Deng Y., Wang X., Li X., Zhang N., Liu Z., Zhang B., Qin Ch., Xie Z. An artificial intelligence system reveals liquiritin inhibits SARS-CoV-2 by mimicking type I interferon. *bioRxiv* 2020.05.02.074021; doi: <https://doi.org/10.1101/2020.05.02.074021>

11. Nie C, Trimpert J, Moon S, Haag R, Gilmore K, Kaufer BB, Seeberger PH. In vitro efficacy of Artemisia extracts against SARS-CoV-2. *Virology*. 2021 Sep 8;18(1):182. doi: 10.1186/s12985-021-01651-8. PMID: 34496903; PMCID: PMC8424155.
12. Hoseini-Tavassol Z, Ejtahed HS, Soroush AR, Sajjadpour Z, Hasani-Ranjbar S, Larijani B. Natural Derived Nasal Spray; A Proposed Approach for COVID-19 Disease Control. *Infect Disord Drug Targets*. 2021;21(8):e160921191568. doi: 10.2174/1871526521666210218201113. PMID: 33602078.



## INNOVATIVE DEVELOPMENT OF PHARMACEUTICAL SECTOR IN AZERBAIJAN

**S.A. Atakishizade**

*Azerbaijan Medical University, Department of Pharmaceutical Technology and  
Pharmacy Organization, s.atakishizade@gmail.com*

( Presented by Academician, Prof. Dr. Mahbuba Veliyeva )

### **Abstract**

The restoration of the state independence of the Republic of Azerbaijan, fundamental changes in the structure of a market economy, the establishment of democracy and a legal state is also required important reforms in the health, pharmaceutical and education systems.

**Key words:** *innovative, pharmaceutical, education.*

Reforms in economy and health area, acceptance at the state level privatization program, constitutional guarantee of free enterprise made opportunity for private pharmacies development. On the other hand, “Medical products” low accepted by Azerbaijan Republic and other orders in that area. Azerbaijan Pharmaceutical institutions operating in the Azerbaijan Republic (pharmacies, bases, depot) and the professionals also have their own business principles out of this law.

In the territory of our republic to supply for high demand for medicines, producing by technologies which are meeting the world standards, storage, forming international export and pharmaceutical activities are regulated with pharmaceutical law. It should be noted that, key point of improving pharmaceutical service for country are reforms of pharmacy networks.

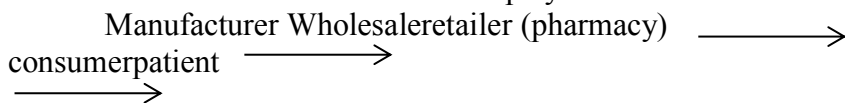
The World Health Organization carries out comprehensive and important work in this area. So, still in 1986 by the World Assembly in the field of medicines developed by the Health Organization category approved. WHO standardized pharmacist and his role is two consultations which held in Delhi in 1988 and Tokyo in 1993. In 1992, the International Pharmaceutical Federation was a public and hospital for pharmacy services pharmacies have developed standards called 'Reliable Pharmaceutical Practice'. Those standards were followed by a review of the relevant WHO staff in 1993 was sent to give. WHO recommended part of the EAP.

It should be noted that the western pharmaceutical market is a classic schema is as follows:

Manufacturer                      Doctor              Patient              Pharmacist.  
   →                      →                      →

In this case, the cost of the drug in lieu of the patient is paid by the insurance company and the doctor wrote the prescription. As a result of the production companies in the West mainly focused on doctors.

These pharmaceutical companies in the Independent States classification scheme is a bit different and can be displayed as follows:



**There are two reasons for this type of scheme:**

- a) First, it gives the pharmacist confidence in him and, therefore, greater authority in choosing the appropriate medication.
- b) Secondly, in traditional pharmacies, in the outpatient clinics high role of informational work on new drugs.

When market relations were formed in the country in the early 90's the state monopoly on the operation of pharmacy networks was abolished and pharmacies received free legal status. This is also an economic issue for them.

This led to increased interest in earning high profits. Accordingly, for each recipient, all possible services active to improve and improve the skills of pharmacy staff stimulated the struggle. Nowadays, as a rule, new drugs and their analog information information activities again in place of pharmacies they do. For this reason, pharmacy workers are on the drug market they are even more interested in advancing because their personal financial situation is the same the cost depends on the speed of their turnover and the revenue from the store. Exactly this in terms of implementation of the EAP principles provided by WHO the holding is of great importance for our republic, which is, in essence, the most important with the part relating to the interaction between doctors and pharmacy staff connected.

Proper implementation of the EAP is a training provided by pharmacists their level, experience, and ability to accommodate them directly depends on the management of the new specialist in management. Take a look at past years. It is clear that higher pharmaceutical education in Azerbaijan has been more than 70 years available. As it is known, in 1938 the former USSR is Turkish Azerbaijan State Institute of Pharmacy was established among the Republics and the Azerbaijan State Medical Institute in connection with the war in 1941 has become a pharmaceutical faculty. Over the past years, more than 4,000 higher education pharmacists have been trained at the faculty for our and other countries. Curricula and subjects from the time of higher pharmacy education, their subjects The program has been changed several times, with 4 years, 4.5

years and 5 years of teaching. After our Republic gained independence, it also had a variety of international. Membership in the higher education system and health care in the country reforms in pharmaceutical education, international standards created conditions for approaching.

Work in this direction was adopted in 1996, "Pharmaceutical activity of the Republic of Azerbaijan. Compliance with the multilevel education system approved by the New Education Act. in 1998, the first Pharmacists in the Faculty and in 2000 Initially, the first Ph.D. It should be noted that generally in the last 10-15 years, international organizations: World Health Organization (WHO), UNESCO, International Federation of Pharmaceuticals (Federation International Pharmaceutical) focusing on pharmaceutical education in accordance with the requirements of modern times increased. This is an international organization organized by these organizations at different levels gatherings (Vancouver 1997, New Orleans 1998, San Salvador, El Salvador 2000). Availability of a market economy in many countries of the world and so on medication in the health care system in transition has led to drastic changes in the profession. In this regard, pharmaceuticals. The changes in education and the unification of education in the training of pharmaceutical specialists have also been on the agenda. It is no coincidence that a special document by the World Health Organization and the World Bank is entitled "Quality practice of pharmaceutical education "(Good Pharmacy Education Practice-GPEP) prepared. This document lists 7 areas as mandatory for the pharmacist shown (pharmacist "7 stars" -the seven stars pharmacist). In 1998 At the First World Congress on Pharmaceutical Education in New Orleans (WHO - FIP orld Congress on Pharmacy Edication New Orleans, April 1998) this document has been approved. The meeting, as well as everyone's likes and self uninterrupted, gradual, gradual and post-graduation decided to study. In recent years, reforms in pharmaceutical education have emerged in the pharmaceutical profession This is because of changes. Thus, the number of medicines each day and the interstate turnover is getting easier. Pharmacy in the preparation of medicines ready-to-use drugs that are limited in their role and are produced by most enterprises have become commercial outlets. The classic pharmaceutical profession issues of rational use of drugs, such as changing factors, increasing requirements and control over their quality, on a global scale.

The presence of counterfeit drugs and other cases can. According to the Law of the Republic of Azerbaijan on Education, adopted in 2009, the basic principles of state policy and the regulation of educational activities are defined in accordance with the Constitution of the Republic of Azerbaijan. These also play a key role in the adoption of relevant laws and regulations on different

stages of education. Education in the Republic of Azerbaijan has a continuous nature, and is a strategically important area of activity reflecting the interests of citizens, society and the state. Education in the Republic of Azerbaijan is based on international conventions, based on human rights and other international treaties in which Azerbaijan is involved, and is developing on the basis of national, moral and universal values, integrated into the world education system.

The following forms of education are used in the Republic of Azerbaijan: formal, informal. The organization of formal education is established by the relevant executive body. The following forms of education are used in the Republic of Azerbaijan: visual, apocalyptic, distant; freely (externally). Home education and personal education may be organized according to the education system established in the Republic of Azerbaijan. If necessary, other forms of education may be used, with the use of modern educational technologies in the manner prescribed by the relevant executive authority. The following educational institutions operate in the Republic of Azerbaijan: state, municipal, private. Public education institutions in the Republic of Azerbaijan do not aim for direct income. The following stages and stages of education are defined in the Republic of Azerbaijan: preschool education; general education; elementary education, general secondary education; complete secondary education; primary special education; secondary special education; high education. Primary vocational education is carried out in accordance with educational programs. Persons enrolled in primary vocational education on the basis of general secondary education have the right to complete secondary education. Training of highly qualified specialists and scientific and pedagogical specialists is carried out in a high level, taking into account the needs of society and the market. There are 3 levels of training of specialists and scientific and pedagogical specialists in higher educational institutions of the Republic of Azerbaijan: undergraduate (except medical education); magistracy (except medical education), doctoral studies. On the basis of a full and specialized undergraduate education at the level of education, highly qualified specialists are trained in different educational programs. Persons who have completed their undergraduate education are considered to be highly educated. Undergraduate graduates receive a bachelor's degree in higher education. Graduates' work encompasses all areas of activity, except for research and scientific and pedagogical activities. The content and rules of the organization of education in the undergraduate are taught by the relevant executive authorities. The magistracy provides for a more in-depth study of any field, depending on the specialization of education for research or professional purposes, and provides the right to engage in professional, research and scientific-pedagogical activities. The content and rules of the organization of education in the magistracy and awarding of the "master's degree" are

appropriated by the relevant executive bodies. The magistracy can be created in higher educational institutions with sufficient specialist potential, material and technical base and educational infrastructure.

Medical education programs and state educational standards are subdivided into basic education and residency education, and graduates receive high-level doctoral and doctor-specialist degrees. The content and rules of the organization of education in the residency are established by the relevant executive authorities. The doctoral program provides the preparation of scientific and scientific-pedagogical specialists, as well as the development of specialties and degrees. Doctoral studies are conducted in higher education institutions and scientific organizations (administration of military educational institutions) and end with awarding the appropriate academic degrees. Degrees are awarded in accordance with the laws of the dissertation councils operating in universities and research institutions. The following scientific degrees are established in the Republic of Azerbaijan: with the indication of the doctor of philosophy; indicating doctor of sciences. Specialists of higher educational institutions are given scientific names in accordance with relevant rules for their scientific and pedagogical achievements. The following scientific names are defined in the Republic of Azerbaijan: associate professor, professor. The rules and conditions for awarding the degree of associate professor and professor are determined by the relevant executive bodies. The higher educational institution in the Republic of Azerbaijan has the right to name the honorary professor (docent). The rules and conditions for awarding an honorary professor (associate professor) degree are determined by the relevant executive authorities.

Additional education in the Republic of Azerbaijan covers the following areas: professional development; retraining of specialists; training and improvement of specialists; secondary and secondary special education; increasing rates; education of wise persons. The content and rules of supplemental education are developed by the relevant executive authorities in accordance with a special education program, taking into account the limitations of health. Additional education is provided in the institutions of vocational education, training institutions and other institutions that organize training and professional development courses, as well as in the structures of training and professional development. They are allowed to operate in this area. Persons trained in any area of supplemental education under relevant education programs are issued a special document by the relevant executive authorities on the established rules. Scientific researches in the education system are carried out in educational management, higher education institutions and scientific-research structures (research institutes, centers, chairs, laboratories, etc.) operating in their respective subdivisions or divisions.

Research work carried out in the education system is fundamental and applied. Scientific research in the field of education is carried out at the expense of period budget, grants, funds of various funds, non-budget organizations, as well as funds received on the basis of orders. Scientific researches are innovative and include new educational technologies in the study of the history of education, improvement of the educational organization and its management, reconstruction and development of the educational process with the use of modern methods. Scientific researches are innovative and are devoted to the study of the history of education, improvement of the educational organization and its management, reconstruction and development of the educational process with the use of modern methods and application of new educational technologies and pedagogical innovations in other areas.

Demand for pharmaceutical education in the Republic of Azerbaijan has been strongly developed due to the independence of our country and transition to market economy, development of entrepreneurial activity in pharmaceuticals.

One of the key objectives of the country's education system is the integration of national education into international systems, including the European system of specialization. Integration of Azerbaijan into the European Union and joining the Bologna Declaration on the Common European Environment for Higher Education in 2004 required the introduction of innovative policies to the higher education system of pharmaceutical specialists in the country. In this case, the basic provisions of the Bologna process will be applicable. Earlier, in 1998, new state educational standards were introduced by dividing a number of educational programs into two-level systems: undergraduate and graduate. These are now being successfully implemented in the national higher education institutions of the country. New educational standards require a modern specialist to be able to create and work in accordance with the legislation of the Republic of Azerbaijan and the state standards in the field of education. The main component of modern education programs, which form the basis of reforms in higher education, is a competent approach to the establishment of the education system. One of the main issues is its focus on the training of specialists.

In this regard, students must not only gain knowledge and skills, but also be able to translate these knowledge and skills into practical knowledge and skills, be knowledgeable and psychologically relevant to a specific group of subjects and processes necessary for the specialist's pharmaceutical activity. must be prepared.

Traditionally, a graduate student's qualifications as a specialist in national education are determined by the combination of knowledge, skills and abilities. In connection with Azerbaijan's entry into the European educational

environment, these concepts are replaced by the notion of "satirical". The concept of "competence" is intended to act appropriately in the subjective context and in the pursuit of significant results. Professional knowledge is at the core of competence.

Graduate of pharmacy faculty as an expert is understood as the quality criterion of knowledge reflecting the specialist's readiness for professional activities and the level of his / her integration into professional and personal development. Therefore, the main task of innovation in pharmaceutical education is to provide competence in professional education, which will allow a specialist with a high level of professionalism to compete in the labor market and develop an effective specialist in the world standards.

In view of the above, the educational standards at the Faculty of Pharmacy of the Azerbaijan Medical University have been developed for the 050806 - Bachelor and 060801 - Pharmacy standards approved by the Ministry of Education of the Republic of Azerbaijan. For this purpose, the issue of presenting key points in the history and activities of the Pharmaceutical Technology and Management Department at the Azerbaijan Medical University has been put forward. In the early twentieth century, there was no specialist in secondary and higher pharmacy education in Azerbaijan. The pharmacy was managed by non-national experts. After our country joined the Soviet Union in 1920 and Azerbaijan became known as the Soviet Socialist Republic, radical changes in education, including pharmacy, began. First of all, pharmacy training in the form of monthly and three-year courses began. Later, in 1925, the School of Pharmacy was established, which was then reorganized as a Pharmacy Technical School.

In 1937, the Council of Medicine at the Republican Public Health Commissariat approved the establishment of the Institute of Pharmacy. In 1938 the Institute of Pharmacy was established. He was led by Doctor of Medicine, Professor Aziz Mammadkarim oglu Aliyev. The first important departments, including specialized chairs were established at the Institute. Azerbyacn Medical University was established on May 9, 1930 on the basis of the medical faculty of Baku University (now Baku State University). In 1937, on the basis of several departments separated from the Medical University, the Azerbaijan Pharmaceutical Institute was established. The Institute of Pharmacy has prepared the first graduates with higher pharmaceutical education. However, with the outbreak of the Great Patriotic War, scientists, including alumni, will be deployed to the Red Army. Due to the weak material and technical base and lack of specialists, the activities of the Azerbaijan Pharmaceutical Institute had to be stopped. In 1942, the Institute of Pharmacy was abolished, on the basis of which

the Faculty of Pharmacy was established at the Azerbaijan State Medical Institute.

Since the establishment, development and modernization of the Faculty of Pharmacy at the Medical Institute and later the Medical University, it has undergone numerous reforms and government programs. In order to improve the quality of graduates' training, there has been an increase in the demand for training of scientific specialists and raising the level of knowledge of the faculty. He was transferred to a 5-year training period and released specialists in the field of "pharmacist". Prior to 1970, forms of correspondence and visual education were introduced. Enrollment to the faculty increased from 25 students to 150 students (teaching in Russian and Azerbaijani languages). Enrollment to the faculty has been reduced on a regular basis, and currently 100 students are enrolled. Training is conducted in Azerbaijani, Russian and English languages.

In our country, key provisions, principles and methodologies for the management of pharmaceutical specialists have been successfully applied in relation to the selection, recruitment, evaluation of business ability, professional orientation, adaptation and motivation of conflict management in the pharmaceutical organization. At the same time, it is important to keep in mind the modern features and subtleties that are closely intertwined in the practice of pharmacists' practice management, so that they are closely linked to the current trends and regularities in the medical processes and drugs circulation. At present the basic training of pharmacists in the Republic of Azerbaijan is carried out through higher and secondary specialized pharmaceutical schools. Therefore, the question of reorganization of pharmaceutical education should be considered as a matter of general preparation of pharmaceutical specialists. The pharmaceutical market needs professionals with new economic thinking, knowledge of clinical pharmacology, pharmacological economics, and medicines. In this regard, the adoption of new generation education standards requires coordinated changes in higher and secondary specialized schools. Consolidation of secondary and higher pharmaceutical education should be considered as a prerequisite for pharmaceutical education reform. It has been established that the development of personality in the pharmaceutical industry involves the use of multiple social impact mechanisms. The introduction of these mechanisms in various fields of activity is intended to form a system of professional qualifications, and it goes through several stages: initial, preparatory, adaptation, specialization and decline in professional activity.

The legal status of the pharmaceutical organization, on the one hand, and the sale of non-prescription drugs in shops, post offices and specialized terminals, despite the fact that the pharmacy organizations are commercial organizations, provides a basis for discussion. These issues should be considered



as innovative developments in pharmaceutical business development and management of specialists in pharmaceutical organizations. It has been discovered that work stress can lead to emotional retardation of specialists, including staff at pharmacy organizations. A pharmacy worker in a modern pharmacy organization is undergoing more burdens than pharmacists of the 80s and 90s. In this regard, there is an urgent need for employees of pharmacy organizations to study the problem of stress and occupational safety prevention. Training programs for pharmaceutical specialists and personal research in pharmaceutical management have been developed based on the study of the state of pharmaceutical specialists and the existing methodological approaches to the existing models. Analyzing the training system, it was determined that the training of highly qualified specialists is carried out by the Faculty of Pharmacy of the Azerbaijan Medical University and the Azerbaijan State Agrarian University. Secondary pharmacy education is provided to specialists of Medical College No.1 and No.2 in Baku. With the use of a psychological package to assess the professional training of pharmacists, it has been identified in the process of university and college preparation that changes in the social environment of development, rhythm and activity, and changes in the values of youth development. The pharmacy faculty of universities and medical colleges have content differences in the vocational training of students in the field of pharmacy. Students receive pharmacy education or make their own choices under the influence of their parents and relatives. However, overall educational performance in terms of production relationships, successes and failures is influenced by the learning environment. Students on creativity and value scale have made the right choice by locking themselves in with people who specialize in activities. Students of Medical College Pharmacy faculties have been found to have low levels of essentials for pharmacists: irregular self-regulation, stubbornness, self-control, communication, and internment in the system of personal relations. This will not allow him to succeed in entrepreneurship and scientific activities.

Students from the Faculty of Pharmacy at the Azerbaijan Medical University have higher levels of subjective control over both emotionally and emotionally. They are more creative, and their activities are focused on achieving results. Students of the pharmaceutical faculty of the Azerbaijan State Agrarian University have the opportunity to realize themselves in business and pedagogical activities. In the field of social researches it is found that 5747 pharmacists are engaged in pharmaceutical activity in Azerbaijan, 52% of them have higher education and 48% have secondary education. In rural areas, secondary special education is predominant, with 65%. Social studies conducted by pharmacists have allowed them to formulate their average statistical

results. Urban pharmacies and private drugstores are mainly employed by the graduates of the Azerbaijan Medical University and the Pharmacy Faculty of Medical College No.1 and No.2. These are mostly young women, with an average age of 35 years. When examining the conditions for the formation of professional skills throughout their careers, there was an information gap between pharmacists. Pharmacy managers need additional knowledge in management, marketing, legal and economic fundamentals. Sellers must master additional drug formulas and clinical pharmacology programs. The structure of specialists working in the department of reception and production was analyzed. It has been established that appetizers for the preparation of medicines are practically nonexistent, aimed at the implementation of practically ready medicinal forms in Azerbaijan.

When the experts were asked about the preservation and further development of extemporaneous drugs, it became clear that the role of pharmacists in extemporaneous production of drugs had not developed in the country. An analysis of the stressogenic factors affecting the work of the specialists has revealed that the “occupational dysfunction” is 83% higher in the drug supply specialists and 56% in other specialists. Survey of high school students revealed that in only 23% of cases, they are ready for the realities of their specialties and are aware of its stressogenicity. This proves that students need to develop programs to develop stress-resistant qualities. For professionals, it is necessary to take preventive measures to prevent professional downturns. It is known that the distribution of teaching subjects in the Council of Europe and general education programs in clusters has similar features and features that are characteristic of the modern Republic of Azerbaijan. Graduates of the pharmaceutical faculty of the Azerbaijan Medical University are formed on the basis of their professional activities, taking into account national characteristics. Azerbaijani pharmacists work in various areas of health and pharmaceutical sector. They fulfill their European responsibilities, but there are differences in the graduates' competence, especially in productive activities.

Positive results were obtained when students' knowledge and skills were analyzed through tests. However, the improvement of their specific knowledge and skills is insufficient, which requires this issue to be considered as a separate issue in terms of maturity of education standards and their adaptation to the knowledge and skills set out in the basic curriculum structure. Innovation activities in the higher pharmaceutical education system in Azerbaijan have been pursuing a number of areas recently: correction of curricula to improve the forms, methods and means of education; improving the current and final control system.

The implementation of the tasks entails interactive learning that stimulates the student's educational activities. Thus, it has been established that recent training of pharmacists in Azerbaijan is shaped according to the requirements of state, sectoral documents and regulations, including the establishment of a system of training and education of pharmacists in the form of in-house training, licensed schools in private and practical activities.

Social inquiries of pharmacy managers revealed that Azerbaijan's practice of specialist management depends on national mentality and does not accept duplication of foreign experience. In addition, the introduction of automation in the production of medicines, the application of international experience should be carried out in accordance with the specifics of the pharmaceutical market in accordance with the current legislation. At the same time, there is a need for pharmacists to apply innovations. At the same time, it is established that the pharmacy specialist does not fully understand its role and role in the healthcare system. They do not understand their need to improve the health of the population, the commercial interests of the patient, and the need for the social functions of pharmacies. Students of Public Pharmacy Organizations, Azerbaijan Medical University, Azerbaijan State Agrarian University, Medical College No.1 and No.2 have been trained to apply and develop their knowledge on the development and protection of health. It has been established that public-sector pharmacists are not yet influenced by these processes, as they should concentrate their efforts on all aspects of pharmaceutical activity and to correct educational and professional standards. The analysis of the information on the role of public pharmaceutical organizations in the training of pharmacists has revealed the need for advanced training of pharmacists, which is to assimilate new qualifications that pharmacists can only obtain in practical activities.

An innovative model of the system of professional training of pharmaceutical specialists in the Republic of Azerbaijan has been developed by summarizing the experience and knowledge of foreign and domestic specialists. In this case two sub-systems are separated. The first is the management sub-system of professional training which combines 3 institutional components - Azerbaijan Medical University, Azerbaijan State Agrarian University, Medical College No.1 and No.2. The second semester is a managed system, which is a contingent of students: students, pharmaceutical professionals. This will ensure that the country has the right specialist training for pharmaceutical education.

## References

1. Atakişizadə S.A. Azərbaycanın əczaçılıq bazarında innovasion idarəetmə. Jurnal: Sağlamlıq, Elmi - praktik jurnal, №4, 2017, 133-136 s.
2. Vəliyeva M.N., Atakişizadə S.A. Milli elmdə innovasion siyasətin formalaşmasına dair // Azərbaycan təbabətinin müasir nailiyyətləri, rüblük elmi-praktik jurnal, №1, 2017, 260-261 c.
3. Vəliyeva M.N., Atakişizadə S.A. və s. Milli əczaçılıq sektorunun səmərəli inkişafına dair. AMEA - nın müxbir üzvü, əməkdar elm xadimi, iqtisad elmləri doktoru, professor, Aqıl Əlirza oğlu Əliyevin anadan olmasının 90 illiyinə həsr edilmiş elmi-praktik konfransın materialları. Bakı 2016, 216-219s.
4. Атакишизаде С.А., Велиева М.Н.. Инновационное развитие фармацевтического образования в Азербайджане. European Journal of Biomedical and Life Sciences, Austria, Vienna, 2016 №4, 49-53с.
5. Атакишизаде С.А. Государственное регулирование фармацевтической деятельности в Азербайджанской Республике // Сборник материалы V Межрегиональной научно-практической конференции с международным участием. Владикавказ, 2015, с. 253-259.
6. Атакишизаде С.А. Стратегия фармацевтической этики в инновационной научно практической деятельности фармацевтов. Западный Университет Научный Вестник, журнал, Баку, 2015, №1, 92-97с.
7. Атакишизаде С.А. Организация лекарственного обеспечения населения республики. Современная фармация: «Проблемы и перспективы развития» Материалы V Межрегиональный научно-практической конференции с международным участием. Владикавказ, 2015, 295-299 с.
8. Атакишизаде С.А. Стратегия фармацевтической этики в инновационной научно практической деятельности фармацевтов//Биомедицина, Ежеквартальный научный журнал, №2, 2017, 90-93 с.
9. Атакишизаде С.А., Велиева М.Н. Разработка методических подходов к инновационной деятельности аптечных предприятий в Азербайджане. Современная фармация: «Проблемы и перспективы развития» Материалы V Межрегиональный научно-практической конференции с международным участием. Владикавказ, 2015, 299-302 с.
10. Атакишизаде С.А., Велиева М.Н., Велиев П.М. Изучение сравнительных энтеросорбционных свойств антидотного средства на основе шротов лекарственных растений. «Актуальные вопросы современной фармацевтической технологии». Материалы всероссийский научно-практической конференции с международным участием, посвященной памяти выдающегося ученого, заслуженного деятеля науки РСФСР, доктора фармацевтических наук, профессора И.А.Муравьева, Пятигорск, 2016, 9-12 с.
11. Атакишизаде С.А. Перспективы развития фармацевтического образования в Азербайджане // AstanaMedicalJournal, 2017, №4 (94), 263-269 p.

12. Велиева М.Н., Атакишизаде С.А., Магеррамов В.А., Магеррамова С. Маркетинговые исследования по лекарственному обеспечению в Азербайджанской Республике // European Journal of Biomedical and Life Sciences Austria, Vienna 2017 №1, 95-98 p.
13. Багирова В.Л. Концепция фармацевтической помощи. Фармацевтическая этика и деонтология / В.Л. Багирова // Солвей-фарма Электронный ресурс. Режим доступа: <http://www.solvay-pharma.ru/articles/article.aspx?id=4465&tid=135>. - Загл. с экрана.
14. Байденко В.И. Болонский процесс: середина пути./Под науч. ред. д-ра пед. Наук, проф. Байденко В.И. - М.: Исследовательский центр проблем качества подготовки специалистов, 2005-379 с.
15. Водопьянова Н.Е Синдром выгорания: диагностика и профилактика / Н.Е. Водопьянова. - СПб.: Питер, 2013. - 336 с.

## **DEVELOPMENT AND CREATION OF SOME COSMETIC PRODUCTS BASED ON GLYCYRRHETINIC ACID, STUDY OF THEIR TECHNOLOGICAL PROPERTIES AND DETERMINATION OF EFFECTIVENESS IN CERTAIN DERMATOLOGICAL PATHOLOGIES**

**A.E. Mammadova, M.N.Veliyeva**

*Azerbaijan Medical University, Department of Pharmaceutical Technology and Management, afsana.mammadova.75@mail.ru*

Acute environmental pollution, inadequate rest, poor quality of nutrition, increased stress and other factors lead to disruption of the endoecological balance, metabolism and hormonal regulation in the human body. These disorders cause various diseases in the human body, including skin. In recent years, antioxidant, detoxicant, immunostimulating biologically active substances that regulate metabolism, and hormonal regulators are widely used to prevent the formation and development of wrinkles and various skin defects. In the preparation of such funds are widely used biologically active substances of plant origin. The two-phase extraction method is used in the development of many cosmetic products [1]. As a result of initial searches, it was decided that a phytocomposition consisting of licorice roots, green tea leaves and sage grass and containing a large number of flavonoids, triterpene compounds, phytoestrogens, essential oils, etc. can be used to correct facial skin defects. Preliminary screening showed that the phytocomposition consisting of licorice roots, green tea leaves, and sage grass in a ratio of 7:3:5 showed higher antioxidant activity in «in vitro» experiments [2]. The preparation of a cosmetic emulsion cream (base) from a phytocomposition was carried out by the method of two-phase extraction. A mixture of water with olive oil (4:6) was used as an optimal solvent. The two-phase extraction method has the following advantages: on the one hand, the correct choice of solvent combination is determined depending on the nature of the product being prepared, and on the other hand, there is a precondition for the direct preparation of the intended product. Thin layer chromatography was used to determine biologically active substances, in particular saponins and flavonoids, extracted using the two-phase extraction method in aqueous and oily phases. For chromatographic determination of the quality of saponins and flavonoids in the aqueous and oily phases, their partial purification was first carried out. For a qualitative determination of saponins and flavonoids in an aqueous filtrate, «SILUFOL» plates and various solvent systems were used: n-butanol-ethanol-water (5:3:2) (I), n-butanol-acetic acid-water (6:1:1). 3) (II), n-

butanol-acetic acid-water (4:1:5) (III). To determine the areas in which saponins are located on the plates, a 25% solution of tungsten phosphoric acid in a 95% solution of ethanol was used as a clarifying reagent. As a result of chromatographic studies, it was found that the aqueous extract contains two main triterpene glycosides (I-II). Rf of these substances are presented in table 1 [3].

**Table 1.****The results of chromatographic studies**

Identified substances	Solvent System (Rf)		
	n-butanol-ethanol-water (5:3:2)	n-butanol-acetic acid-water (6:1:3)	n-butanol-acetic acid-water (4:1:5)
<i>water phase</i>			
Triterpene glycoside I	0,40	0,21	0,14
Triterpene glycoside II	0,95	0,84	0,84
Flavonoid I	-	0,2	-
Flavonoid II	-	0,37	-
Flavonoid III	-	0,51	-
Flavonoid IV	-	0,75	-
Flavonoid V	-	0,95	-
<i>fat phase</i>			
Flavonoid	-	0,86	-

A qualitative determination of flavonoids in the aqueous filtrate was carried out, spots on the chromatographic plates were detected with a 10% solution of ammonia in a closed cell at room temperature. During this time, the dark yellow and yellow spots inherent in the flavonoids formed under the influence of ammonia, and it was found that the best separation of flavonoids on chromatographic plates occurs in the solution system II. As a result, 5 flavonoids were identified, which are presented in the table. In the fat phase, one flavonoid spot was identified (Rf - 0.86). Thus, thin-layer chromatographic studies showed that there are two triterpene glycosides and five flavonoids in the aqueous phase, and one flavonoid in the oil phase [3].

After these studies, the method of two-phase extraction from the phytocomposition was used to directly obtain an emulsion cream of the type water / oil (base). In further studies, some technological properties of the emulsion – cream were studied, namely: mechanical pollution and aggregative stability. No mechanical impurities were found in the filtration [4].

It is known that the study of the rheological properties of ointments, and more precisely, plasticity, elasticity, structural adhesion, thixotropy and other characteristics, plays a key role in characterizing their most important biotechnological properties. To this end, colloidal and thermal stability, as well

as structural and mechanical properties of the proposed therapeutic - cosmetic product were studied. The obtained results confirm that the studied cream has colloidal stability. A study was made of the thermal stability of the proposed emulsion cream. As a result, it was found that in the emulsion cream, depending on the temperature, the process of delamination is not observed. The pH of a cosmetic product, the main ingredient of which is glycyrrhetic acid, is determined on the basis of the methodology for ointments and creams proposed by the United States Pharmacopeia [5]. Physico-chemical characteristics of the recommended cosmetic cream are shown in the table 2.

**Table 2.**

**Physico-chemical characteristics of the medicinal and cosmetic products based on glycyrrhetic acid**

<b>Color</b>	<b>Smell</b>	<b>Homogeneity</b>	<b>pH</b>	<b>Colloidal stability (visually)</b>	<b>Thermobility (visually)</b>
Yellow-green	It has a special odor	homogenous	5,35	constant	constant

The rheological properties of the treatment - cosmetic emulsion cream were determined using the viscometric method on the apparatus "Reotest-2". The rheological properties of the agent were studied at room temperature and at 34 °C (human skin temperature). Based on the results obtained, curves of the dependence of the displacement velocity on the bias voltage are constructed.

Rheograms of the proposed cream showed that with an increase in deformation, adhesion drops sharply. This dependence indicates the structure of the system. The flow of the system does not begin immediately, but only after a certain voltage, necessary for the destruction of structural elements. The proposed tool has sufficient thixotropy. This is evidenced by the large area of the ascending and descending bends of the flow guides. The thixotropic properties of the drug make it well-absorbed by the skin and convenient for packaging [6].

The antioxidant and antiradical activity of the proposed cosmetic emulsion cream has also been identified. The antioxidant activity of the drug is primarily associated with inhibition of the active form of oxygen. According to the results of the analysis of inhibitors (indicator I50), the antioxidant activity of the aqueous phase and quercetin of the cosmetic product based on glycyrrhetic acid is close to each other [2].

A study of the proposed cosmetic creams and their main components in the aqueous and oily phases during experimentally created thermal and chemical



burns revealed their healing effect, and the wound healing process was histologically examined [7].

Based on the “Guidelines for conducting toxicological studies of cosmetic ingredients in animal experiments” (V.P. Fisenko, 2006), the presented cosmetic cream based on extracts of licorice root, sage and green tea and its two modifications (water and oil phases) were tested for healing with experimentally reproduced thermal and chemical burns. At the same time, the skin-irritating effect and the possible allergic reaction of the tested cream on the mucous membranes of the eye and nose were determined by application of a diluted mother solution [7]. The following experimental burns were modeled on rabbits of the «Chinchilla» breed, divided into 3 groups, in series, under local procaine anesthesia:

Groups:

1. Thermal (temperature over 150 °C) - 4 rabbits;
2. Chemical (35% hydrochloric acid) - 2 rabbits;
3. Chemical (50% sodium hydroxide solution) - 2 rabbits;

It should be noted that the chemical burn under the action of sodium hydroxide was more pronounced than under the influence of hydrochloric acid.

When comparing the effects of the lipophilic and hydrophilic fraction of the cream, it should be noted that wound healing occurred faster against the background of the lipophilic fraction, but under the influence of the hydrophilic variant, the appearance of a hairline was observed earlier.

The reaction to local lubrication of the test cream from the mucous membrane of the eye and nose was satisfactory, i.e. there was no irritation, allergic reaction, swelling, discharge from the nose; The conjunctiva of the eye and cornea remained transparent. Thus, an experimental study of the effect of medical-cosmetic cream based on licorice root, sage and green tea extracts on reproduced burn and chemical damage to rabbit skin revealed a wound healing effect of the drug when applied again to the wound surface. When analyzing the effect of the tested ointment, it was found that a thermal burn is better treatable, but a chemical burn can be cured longer, especially when exposed to alkali [7].

A histological study of the effect of therapeutic and cosmetic products based on glycyrrhizic acid for use in experimentally reproducing thermal and chemical burns was carried out at the Department of Histology, Embryology, Cytology at Azerbaijan Medical University, as well as at the Center for Microscopic Pathology at the «Ömür» Medical Clinic [7]. Biopsies were taken from experimental (simulated) thermal and chemical burns in domestic rabbits from the center of the wound (in the area of damage), in the intermediate zones and 0.3x0.3x0.3 cm from the border with relatively healthy tissues, provided that the samples were not crushed.

The results of a histological study of the effect of therapeutic cosmetics based on glycyrrhizic acid on experimental burns showed that the following occurs:

- stimulation of the epidermis both from the center and from the periphery of the burn wound;
- reduction of the epidermis;
- the absence of severe fibrosis and pseudo-keloid type changes in the dermis;
- more effective regeneration of the skin glands;
- intensification of hair follicles, sacs and rods;
- reducing the time of histological normalization of the microcirculation network;
- more effective restoration of histochemical properties (visual quantity and distribution) of vital glucosaminoglycans necessary for skin structures;
- elimination for earlier periods of dehydration, blisters with protein-glucosaminoglycan-liquid contents (bullous) relatively evenly distributed around the entire perimeter of the wound [7].

Microbiological studies on the antibacterial, antifungal effect of the cosmetic emulsion cream based on glycyrrhizic acid were carried out at the Department of Microbiology of the Azerbaijan Medical University. To conduct research on the antibacterial and antifungal effects, 95%, 80%, 60%, 40% and 20% alcohol extracts from the recommended phytocomposition were presented.

As a result, the antibacterial and antifungal effect of aqueous and alcoholic extracts (95%, 80%, 60%, 40%, 20%) from the phytocomposition consisting of bare licorice root, sage grass and green tea leaves (7:3:5) was not found It was [4].

A study was made of the clinical effects of various modifications of the proposed emulsion creams based on glycyrrhizic acid in some dermatological pathologies. Emulsion creams were presented in 5 different compositions for the initial study. The ingredients of the prepared emulsion creams are divided into 5 types, taking into account the base and the addition of various plant components: calendula, sea buckthorn, pumpkin, oil extract from freshly sprouted wheat seeds and a combination of all these ingredients. The composition of emulsion creams is presented in table 3.

The study was conducted on 20 patients with pemphigus and 20 with psoriasis, who contacted the Republican Dermatovenerologic Dispensary in 2012. Psoriasis patients consisted of 12 men and 8 women aged 37-70 years. All patients were diagnosed with moderate vulgar psoriasis with pronounced reddish round papules and rounded irregular plaques with sharp red bulges on the skin of the scalp, body and limbs.

The severity and prevalence index of psoriasis (PASI - Psoriasis Area and Severity Index) was 12-16. At the same time, the dermatological quality of life index in these patients (DLQI - Dermatology Life Quality Index) was determined in the range of 22-28 [8]. Pemphigus patients consisted of 18 women and 2 men aged 35-65 years. 17 patients had pemphigus vulgaris and 3 patients had vegetative pemphigus. All patients with psoriasis and pemphigus underwent traditional systemic therapy [8].

The regression of clinical manifestations in both groups began on the 5-10th day of treatment with a parallel effect, but with different and definite nuances. It should be noted that it was not possible to achieve a therapeutic effect when using «Clean line» herbal medicine, cream taken for comparison, which contains echinacea, licorice and chamomile. In similar clinical studies, it was found that, unlike the «Clean line»herbal medicine,cream, the foundation, which is an integral part of emulsion creams, has a therapeutic effect. But compared with the therapeutic effect of the aforementioned emulsion creams, the effect of the base manifested itself more slowly [8].

Recommended cosmetic creams based on glycyrrhizic acid, used for psoriasis vulgaris, pemphigus vulgaris and vegetative, are not inferior to traditional medicines in their regenerative, reparative and keratolytic effects. Thus, the proposed cream can take its rightful place in the series of drugs with topical action for the treatment of vulgar psoriasis, vulgar and vegetative pemphigus. The fact that cosmetic creams based on glycyrrhizic acid (including the base) have a smoothing effect on the skin can be used in medical cosmetology for people over 35 years old, in programs for rejuvenation [8].

**Table 3.****Recommended composition**

<b>№</b>	<b>Modification of emulsion cream</b>	<b>Basic emulsion cream composition *</b>	<b>Additional components</b>
1	Calendula	Licorice..... 7 q Sage ..... 3 q Green tea ..... 5 q Emulsifier T2 .... 20 q Extractant ..... 40% ethyl alcohol and olive oil (2: 3) - 200 parts	Calendula oil ..... 10 ml Glycyrrhizic acid 0.1 g ** Vitamin E ..... 1 ml ** Almond oil ..... 20 ml ** Base ..... 60 sq. ** Beeswax ..... 5 g ** Propylene glycol ..... 5 ml ** Nipagin ..... 50 mg **

2	Sea buckthorn	/-----/	Sea buckthorn oil..... 10 ml
3	Pumpkin	/-----/	Pumpkin oil..... 10 ml
4	Wheat	/-----/	Wheat oil..... 10 ml
5	Combination	/-----/	Calendula oil..... 2,5 ml Sea buckthorn oil.....2,5 ml Pumpkin oil..... 2,5 ml Wheat oil..... 2,5 ml

Note: \* the base is the main unchanged part of the prepared emulsion cream and is identical in all modifications;

\*\* - marked components are the same in all versions.

On the basis of the phytochemical composition, cosmetic emulsion cream (Emulsion-cream "Glytesa") was proposed and the corresponding technological schedule was developed. The Pharmacopoeia Article was developed for the cosmetic cream "Glitesa" and approved by the Expert Council on Pharmacology and Pharmacopoeia of the Ministry of Health of the Republic of Azerbaijan[9]. On the part of the Eurasian Patent Organization (EAPO), the base cream received Europatent (EAPO, Medical-Cosmetic Emulsion Cream, No. 025031, 11/30/2016, pp. 1-4) [10].

### References

1. Məmmədova Ə.E., Vəliyeva M.N. Biyan əsasında olan kosmetik vasitələr // Azərbaycan Əczaçılıq və Farmakoterapiya Jurnalı. Bakı, 2009, №1, s. 89-92.
2. Мамедова А.Э., Кулиев М.Р., Велиева М.Н. «In vitro» изучение антиоксидантной и антирадикальной активности лечебно-косметологического крема на основе глицерризиновой кислоты // Научные ведомости Белгородского государственного университета, Белгород, 2012, № 10, с.144-147.
3. Məmmədova Ə.E., Tağıyev S.Ə.İ kifazalı ekstraksiya üsulundan istifadə etməklə bitkimənşəli su/yağ tipli emulsiya-kreminalın matexnologiyasının öyrənilməsi // Azərbaycan Əczaçılıq və Farmakoterapiya Jurnalı. Bakı, 2011, №1, s.19-22.
4. Мамедова А.Э. Исследования в области создания некоторых лечебно-косметологических средств на основе глицерризиновой кислоты // «Проблемы фармацевтической науки и практики», Материалы IV Межрегиональной Научно-Практической конференции с международным участием. Владикавказ, 30-31 мая 2014, с.113-116.
5. Məmmədova Ə.E. Qlisirizin turşusu əsasında müalicəvi-kosmetoloji vasitənin standartlaşdırılması // Azərbaycan Əczaçılıq və Farmakoterapiya Jurnalı. Bakı, 2012, №1, s.29-32.

6. Məmmədova Ə.E. Qlissirizinturşusu əsasında müalicəvi-kosmetoloji emulsiya-kremvə onun göstəriciləri // Azərbaycan Əczaçılıq və Farmakoterapiya Jurnalı. Bakı, 2011, №2, s.45-47.
7. Məmmədova Ə.E., Axundov R.A., Vəliyeva M.N. Qlissirizin turşusu əsasında hazırlanmış müalicəvi-kosmetoloji vasitənin eksperimental yaraya təsirinin öyrənilməsi / Faydalı bitkilərin istifadəsinin aktual problemləri mövzusunda Beynəlxalq elmi konfransın materialları, Bakı, 2011, s. 312-315.
8. Məmmədova Ə.E., Fərəcov Z.H., Vəliyeva M.N., Əmirova İ.A., Yaqubova L.R. Bəzi dermatoloji patologiyaların müalicəsində qlissirizinturşusu əsasında müalicəvi-kosmetoloji vasitələrin tətbiqi // Azərbaycan Tibb Jurnalı. Bakı, 2012, №3, s. 48-52.
9. Məmmədova Ə.E., Vəliyeva M.N. Emulsion-krem “Qlitesa” Farmakopeya məqaləsi, Bakı, 2013, 7 s.
10. Мамедова А.Э., Велиева М.Н. Евразийский Патент 201300491 Лечебно-косметический эмульсионный крем. Бюллетень Евразийского Патентного Ведомства. 2014, №9, с.26-26.

## "LICORICE ROOT" PREPARATIONS PERSPECTIVES IN CASE OF COVID -19 INFECTION DISEASE TREATMENT

**M.N. Veliyeva, F.I. Madatli, P.M. Veliyev, Z.M.Omarova, N.T.Bayramov**

*Azerbaijan Medical University,  
E-mail: mahbubav\_amu@rambler.ru,  
velperviz@yahoo.com, biochemistrydep.amu@gmail.com*

### **Abstract**

In presented scientific article an effectiveness experience of phyto-therapeutic and clinic-laboratory basically scientific facts have been provided for 30 years which can be elaborated in cases of treatment and prophylaxis of various infection diseases and COVID-19. The results of scientific investigations were being proved by different state documents and various scientific articles. That is wonderful, firstly in innovation of the World medicine since of 1993 year till now, the richness of the Republic of Azerbaijan "Glycyrrhiza Glabra L.(F.) - licorice root" especially lymphotropic properties had been studied by Azerbaijan Scientifics'. Having been used the same useful properties of "Licorice root" in various forms of different preparations had been elaborated type of treatment of several diseases such as: oncologic, viral, HIV and so. The same properties of Licorice preparations can be recommended in usage in case of Covid-19.

**Key words:** *COVID-19; licorice root; lymphotropic properties; phyto-therapy.*

### **Actuality**

At present wide spreading of pandemic Covid-19 in over the World had created the big problems for populations of many countries. Different kind of vaccines already were being prepared by scientists of the World. Besides of, Covid-19 prophylaxis and treatment several preparations especially by herbal origin have been used also.

It's known, refer to different informational sources, antiviral and antibacterial preparations widely had been used in case of treatment of viral infections.

It's clear, that in case of different types of viruses (grip) SARS- acute respiratory syndrome; MERS-middle east respiratory syndrome; HIV-human deficit syndrome; In case of Ebola hyperthermia situation; malaria and in cases of other viral diseases licorice root preparations refer to protocol are being used for treatment and prophylaxis in cases of viral diseases.

The Chinese scientists used traditionally homeopathic preparations and herbal preparations in case of treatment of Covid-19 also: "*Glycyrrhiza Glabra*", *Radix Platycodonis*; *Radix Lonisera*; *Herba Eupatorium fortunei*.

It had been proposed different newly herbal preparations for the treatment of viral infections by Chinese scientists of different Universities.

The same ideas are also being accepted in Korea, Japan, Russia, Germany and Spain.

The president of Madagascar has proposed the preparation "organics" for treatment of Covid-19, which contains glycyrrhizin acid. The president of Turkmenistan has proposed using the "Licorice root" in case of Covid-19 treatment and prophylaxis. Iranian scientists had already proposed the usage of 2 herbs (one of them is Licorice) in forms of spray for treatment of Covid-19 and H<sub>1</sub>N<sub>1</sub> infection diseases.

Germans scientists proposed the dry extract of Licorice and glycyrrhizin acid for treatment of Covid-19, and the same type of treatment proposed in case of SARS-COV-2 in vitro.

**Results and discussions:** Glycyrrhizaglabra L.- Çılpaq Biyan, «Licorice root», adimaduram, akarmanis, asloosoos, aslussos, athimaduram, athimaduramu, athimathuram, bekh-e-mahak, boisdoux, cha emthet, estamee, gancao, glycyrrhiza, herbe aux tanneurs, hsi-pan-ya-kan-tsoo, irk al hiel, irk al hilou, irksos, jakyakgamcho-tang, jashtimadhu, jethimadh, jethimadha, kanpo, kanzo, kan-ts'ao, kumcho, Lakritzenwurzel, licorice, licorice root, liquiritiae radix, liquorice, liquorice root, madhuyashti, madhuyashtirasayama, mulathee, muleti, mulhatti, neekhiyu, Persian licorice, racine de reglisse, racinedouce, reglisse, reglisse officinalis, rhizomaglycyrrhizae, Russian licorice, Russian liquorice, Russisches Süsshholz, si-pei, sinkiang licorice, Spanish licorice, Spanish liquorice, Spanisches Süsshholz, Süsshholzwurzel, sweet root, sweetwood, ud al sus, velmi, walmee, welmii, xi-bei, yashti, yashtimadhu, yashtimadhukam, yashtomadhu Licorice root preparations in the world for these useful properties and effectiveness in human body in case of treatment and have the first place. The nature of Azerbaijan is rich and various. Along with surprising herbal flora and the fauna is diverse in addition with mineral rare objects. Therefore, usage of domestic natural resources as medicinal raw materials for elaboration and creation of pharmaceutical production is important and relevant purpose in pharmacy and medicine.

Among the representatives of appointed flora, using by the persons as remedies is difficult to find, perhaps, a plant with such ancient, documentary recorded history being possessed by Licorice.

Licorice or liquorice – "Glycyrrhiza" is a natural officinal and technical plant. It was known for Sumer's, Indians, Egyptians and being used as traditional

medicine in ancient Chinese, Tibetan and Arabic medicine for a long time. In the Republic of Azerbaijan 7 kinds of licorices grow, the most distribution was being gained by a licorice smooth or sweet.

The sweet licorice of the Republic of Azerbaijan gained the global recognition among all known species of licorices; refer to high content of the main valuable component of glycyrrhizin acid till 25%. Above 9000 patents had been accepted for useful properties of "Licorice root" in the fields of medicine, pharmaceuticals and cosmetology. At present refer to experience of medicine above 500 forms of preparations and biologically active substances have been distributing in over the world till now.

It had been obtained several therapeutic agents from lower and upper part of Licorice root: anti-inflammatory, antibacterial, antiviral, antifungal, wound reparation, spasmolitik, antiallergic, diuretic, antitoxic, antisclerotic, anticoagulant, lymphotropic (the same property had been discovered by Azeri scientists), can be used in cases of oncologic diseases and dissolving of lymphatic senses.

Scientists of many countries of the world had already proved anti-inflammatory properties of licorice preparations, including glycyrrhizin acid and its derivatives, it is revealed that glycyrrhizin acid and it enforce the influence of exogenous hormones of adrenal glands, inhibits oxidizing phosphorylation and biosynthesis of the sulfated mucopolysaccharides, creates lower an activity of a fosfolinaza A2, increases an activity of a glutaminiransfera. It is shown, that glycyrrhizic acid inhibits activity of a fosfolinaza A2 in cellular membranes. Glycyrrhizic acid and its derivatives, like nonsteroid resolvents influence a cascade of arakhidonic acid, inhibiting biosynthesis of prostaglandins.

Taking into account phased out before, we have paid an attention for development of a number of medicinal and parapharmaceutical means on the basis of licorice related with anti-inflammatory activities; which were being certified in a form of patents: "the obtaining method of means from the herbal raw materials which are possessed by anti-inflammatory activity".

This information allows making an opportunity to discuss, that the studied medicinal forms of licorice are safe and have a stimulating effect on both the lymph and the immune system. Identified lymphogenous or lymph-stimulating with a small anticoagulant effect, as well as immunotropic effects characterize the licorice naked as a source of valuable drugs with lymphotropic activity.

We are very happy nation because of "Licorice root" is our national richness. Having been used modern technology above 200 pharmacology active substances had been discovered from Licorice root. The most important of them is glycyrrhizin acid.



In many countries glycyrrhizin acid was being used in treatment process of patients as antiviral and in cases of immunodeficit conditions. As a result of many scientific publications 25 Euro-Asian patents had been obtained by us in this direction of science. We wish to discuss about several of them.

One of Euro-Asian patent (N 019559) was being obtained by us as an antiviral preparation from lower and upper part of "Licorice root" together with other additionally herbal parts as: *Tribulusterrestris*, *Herbahyperici*, *herba Viola Tricolor*. That also should be noted that, the same herbal parts can be obtained as a solid extract and then, different curative preparation forms such as: sprays, nose drives, crèmes and meaning for gagger which can be widely used in cases of acute viral diseases.

Another of Euro-Asian patent (N 020017) was being obtained by us as an antiinflammatory preparation from herbal raw materials can be obtained 35 syrups. This patent (N 020017) had been nominated for "**Special Prize**" and golden medal in Korea in case of event of "*11-th Korean International Academy for Women Inventors and Exhibition*".

The national Licorice manufacture production and production process of 35 syrups was organized refer to that patent (N 020017).

The same as: "Biyane syrup", Biyan"Qripson" and "Biyanebroncho" have an antiviral activity; at present these are at the process of market distribution in our country and being attracted an attention of the population. "Biyane syrup" possesses by antiviral, antibacterial, anti-inflammatory, against coughing and immunomodulator activities. Appointed activities can be used in pediatric practice and also in case of adults treatment process.

In preparation of Biyan "Qripson" are being included: *Licorice extract*, *Thyme extract*, *Elecampane extract*, *Dog-rose extract*, *Lime extract* and a *Lemon extract*. That complex herbal extract creates special pharmacotherapeutic effect which can be used in cases of treatment and prophylaxis of acute and chronic viral respiratory diseases and Covid-19 with positive dynamics.

With happy sense of organizers we can state that the preparations are in process of market distribution in pharmacies. This preparation is effective and the good result had been achieved yet.

In preparation of "Biyanebroncho" are being included: *Licorice extract*, *Marshall extract*, *Anise extract*, *Elecampane extract*, *Lemon tincture* as a complex parts. That syrup can be used in cases of pneumonia, antiviral, antibacterial and as immunomodulator effective mean. Appointed above herbal syrups are natural without side-effects and are not harmful. In the market process of the Republic of Azerbaijan that herbal preparations are respective.

Firstly, on the bases of Licorice- *Licorice extract*, *Colefiower extract*, *Dog-rose extract*, *Milk triste extract*, *Clover extract*, *Hawthorn* and *Walnuts*

tincture was being created by immunostimulating, antiviral, antibacterial activities anti-inflammatory preparation "Biyannimmunovit". That curative syrup can be administered in cases of many diseases with immunosuppression condition and has good effectiveness in pediatric and adult practice in the treatment process.

Additionally, had been elaborated "Biyannhem" some herbal part are being included: *Licorice extract, Dog-rose extract, Bereris vulgaris extract, Gingo-biloba extract, Lemon tincture and Yugalndes tincture* which also create general strengthening, hematopoietic and tonic activity and can be used in treatment process of patients and had already been resulted as a good syrup.

With the purpose of treatment and prophylaxis of parodontitis had been elaborated special herbal complex with curative activity Euro-Asian patent (N036115) presented in form of oil extract: *Licorice root, Folia Salvia Oficinalis, Flores Calendulae, herbae Thymus Vulgaris and Chitozan*. The phytopreparation is widely being used in patients with thalassemya and acute infected patients with viral infections. Creates positive clinical effect in cases of application in the oral cavity. Separately being used for gagger solution of that herbal part.

It had been elaborated eco-friendly rational method of preparation of silver nanoparticles with usage of water licorice extract and the rhizome of licorice by us. Obtained nanoparticles of AgNPs were being tested in the practice of stomatology Being revealed of antiviral and antibiotic activities and was presented in Euro-Asian patent (N 00019426). That means is eco-friendly and effective.

Being patented antibacterial gel for treatment of acne Euro-Asian patent (N 002608) has an antiviral and antibiotic activities on a basis of licorice and AgClN with obtaining of nanoparticles 12 nm with diameter of 8 nm.

Being patented several series of cremeson a bases of licorice in Euro-Asian patent (N 2019501), in the composition of nanoparticles AgCl with water Licorice extract have an antiviral, anti-oxidative and bleaching activities.

Separately being elaborated active biological supplement which has an anti-infection, absorbable, regenerative, analgesic, anti-allergenic, and reparative properties on a basis of Licorice by Euro-Asian patent (N 033517). That should be noted that above mentioned type of preparations have been already implementing in the process of production till now.

Since 19-th century, the sweet licorice of the Republic of Azerbaijan has been exporting for many countries of the world. In fact the new licorice industry has been organized by other way in Independent, Democratic and Civil Republic of Azerbaijan.

So, since 2005 year on the basis of deep scientifically based researches had been organized the open joint stock company with production of preparations

of licorice - "Biyān Products" MMC which is located in Agdash district of the country. "Biyān Products" MMC has 1000 hectares of a newly created licorice plantations and constructed plant with an area of 11 hectares. As a matter of fact that licorice industry takes the second place in the world after the American of the licorice industry "Licorice". The year raw materials of a licorice are gain grown up 3-years are being processed in the plant with receiving a reasonable root, dense extract, also preparations and medically biologically active additives in the form of syrups. That plant has been working refer to exclusively newly developed standards and legal certificates. The special documents are the international patents and special certificates were being obtained from the Ministry of Health of the Republic of Azerbaijan: license for production, hygienic certifications, specifications, production schedules. The newly created licorice industry has a purpose for expansion of pharmaceutical, food, industry for color production, tobacco-growing, cosmetology production of construction materials, fertilizers of chemical household means and fodder products.

The purpose of establishing the enterprise is to bring to the world market processed licorice root and 100% plant-derived, biologically active food supplements made from licorice using modern technologies. The 11-hectare Biyan Industrial Park includes a licorice supply and processing plant, a plant extract and syrup plant and other ancillary facilities.

It was reported that the plant is capable of processing 2,300 kilograms of licorice root per hour. The plant is equipped with modern equipment manufactured by the Turkish company Bigtem.

Licorice root is selected both mechanically and manually, cleaned, washed, cut into different shapes and sizes, dried and packaged. The plant extract and syrup plant operating under the Biyan Industrial Park produces biologically active food additives. Produced products are made on the basis of scientific patents. One of these patents won a special award and a gold medal at the International Forum of Women Inventors in 2019 in the Republic of Korea. Therapeutic syrups produced have anti-cough, anti-inflammatory, anti-influenza and anti-flu effects, expectorant, increase immunity, hemoglobin, calm the nervous system. The main advantages of the products are 100% plant origin, ecological purity of raw materials, the absence of chemicals - preservatives, flavors and dyes. The annual production capacity of the line is 350,000 units. Throughout the production process, product samples are tested in a laboratory equipped with modern equipment. Both chopped licorice root and licorice syrups are in great demand in both domestic and foreign markets. The first samples of the product were sent to Iran. In the future, the products will be exported to the United States, Korea, India, Egypt and European countries. The Licorice

Industrial Park plans to export 7,500 tons of licorice root and 100,000 licorice juices a year under the "Made in Azerbaijan" brand.

This park will add new names to products manufactured under the Azerbaijani brand. The purpose of the establishment of the enterprise is, using modern technologies, to bring to the world markets biologically active additives of 100% vegetable origin, made from processed licorice root and licorice. The licorice industrial park with a total area of 11 hectares includes a licorice procurement and processing plant, a plant for the production of extracts and syrups and other auxiliary buildings.

The plant of extracts and syrups, operating at the Solodkovo Industrial Park, produces biologically active food additives of plant origin. Products are manufactured on the basis of scientific patents. One of these patents received a special award and a gold medal at the 2019 International Forum of Women Inventors in the Republic of Korea. The produced syrups treat coughs, inflammations, flu and runny nose, have anti-inflammatory effects, strengthen the immune system, and calm the nerves. The main advantages of the products are that they are 100 percent plant-based, made from environmentally friendly raw materials and do not contain chemicals - preservatives, sweeteners and colors. The annual production capacity of the line is 350 thousand pieces. Throughout the entire production process, product samples are tested in a laboratory equipped with the most modern equipment. In the domestic and foreign markets there is a great demand for both crushed licorice root and herbal syrups containing licorice. The first product samples were sent to Iran. In the future, it is planned to export products to the USA, Korea, India, Egypt and European countries. It is planned to export 7,500 tons of licorice root and 100 thousand pieces of licorice syrups under the Made in Azerbaijan brand in the Licorice Industrial Park.

## Referenses

1. Rare Hercht, Khalilov Elchin Nusrat, Ilse Triebnig, Rhalilova Tamila Shirin, Valiyeva Mahbuba Nabi, Sadikova Farhanda Emir, Solovey Yelena. COVID-19: A Global Problem For Modern Civilization // Transaction of the International Academi of Science, Science Without Borders, vol.5, special Edition, 2020.
2. L.Van de Sand, M. Bormann, M.Aet, L. Shipper, C.S.Heilinglah, D.Todt, U.Dittmer, C.Eesner, O.Witske, A.Krawczyk. Glycyrrhizin effective etyneutralires SARS. Cov-2 in vitro by inhibiting the virae main protcase bio Rxiv/10.1101/2020.12.18.423104: 2020.12.18 123104 v.1, fuel, pdf.
3. N.Pandion and Soundhary Chidanbaran. Antimicrobial cytotoxicity and anticanser activity of silver nanoparticles from Glycyrrhiza glabra.

- <https://ijpsr.com/bft-article/antimicrobial-cytotoxicity-and-anticancer-activity-of-silver-nanoparticles-from-glycyrrhiza-labra/niew-fulltext>.
4. O.A.Ruban, M.V.Khalovka, I.V. Kovalevska, D.S.Pulyaev. Argumentation the method of introducing active ingredients into the Ointment "glitatsid"//Jurnal «Вестник фармации» №3 (65) 2014.
  5. Biyan Products, <https://biyan.az/about-us>
  6. Воронин Н. Арбидол, хвойник, солодка. Чем лечили китайский коронавирус? <https://www.bbc.com/russian/features-51708954>
  7. Корень солодки - лекарство от 1001 болезни. <https://haqqin.az/news/185521>
  8. M.N.Veliyeva, N.M.Huseynov, P.M.Veliyev. The Lymphostimulaton preparations – Glycygram. World Congress of Pharmacy 96. 1996, p.53, Jerusalem, Israel.
  9. M.N.Велиева Лимфотропные средства из солодки голой, флоры Азербайджана. статья. Современные Достижения Азербайджанской медицины. Г. Баку, 1998, с.90 – 93.
  10. M.N.Veliyeva The hemolym hocoaquating and lymphostimulating Herbs from the flora of Azerbaijan. Jurnal “Pharmakeftiki”. Athens.1998 vol 11.№ 3, p. 84-90.
  11. M.N.Велиева Солодка и ее применение в медицине. Монография, г. Баку, «Тебиб», 1995, 168 с.
  12. Велиева М.Н., Велиев П.М. Разработка фармацевтических и парафармацевтических средств на основе солодки голой // Доклады Академии Наук Азербайджанской Республики, Баку, 2012, с. 97-102.
  13. Велиев П.М. Эффективность применения иммуностропных препаратов солодки голой в комплексном лечении некоторых болезней у детей. Автореферат дисс. канд. мед.наук, Москва, 1996, 20с.
  14. M.N.Велиева Лекарственные и парафармацевтические средства на основе солодки. статья. “Известия” Биологические медицинские науки НАНА, г. Баку, 2012, с. 130-137.
  15. M.N.Vəliyeva. Biyan və onun təbabətdə tətbiqi. Bakı, 2012, 265 s.
  16. П.М.Велиев. Эффективность применения иммуностропных препаратов солодки голой в комплексном лечении некоторых заболеваний у детей. Диссертация.канд.мед.наук., 1997, 196с.
  17. M.N.Vəliyeva, Y.C.Məmmədov, R.Ə.Nacılı.Qlisiramın alınma üsulu Patent p960014.
  18. M.İ.Livanov, Y.C.Məmmədov, M.N.Vəliyeva, P.M.Vəliyev. Timomeqaliya xəstəliyinin müalicə üsulu. Patent p960049.
  19. M.N.Vəliyeva, P.M.Vəliyev. Biyan şərbəti. Patent a20070250.
  20. M.N.Vəliyeva. Dərman şərbəti. Patent a20070252.
  21. M.N.Vəliyeva, Ü.M.Məcidova, E.N.Xəlilov. Ağ ciyər və tənəffis yollarının qeyri- spesifik xəstəliklərində dərman bitkiləri əsasında vasitə. Patent: İ 2010 0089.
  22. M.N.Vəliyeva, T.Ş. Xəlilova. İmmunostimullaşdırıcı və sətəlcəm əleyhinə vasitə. Patent İ. 20100112.

23. Р.М.Гейдарова, М.Н.Велиева. Средство для лечения гинекологических заболеваний. Евразийский Патент № 022793.
24. Р.М.Гейдарова, М.Н.Велиева, А.Я.Евдаев, П.М.Велиев. Средство, обладающее противогеморройным действием. Евразийский Патент №024167.
25. А.Э.Мамедова, М.Н.Велиева. «Лечебно-косметологический эмульсионный крем» Евразийский Патент №025061.
26. Р.М.Гейдарова, М.Н.Велиева, П.М.Велиев. Средства для профилактики и лечения инфекционно-воспалительных заболеваний горла/глотки и ротовой полости на основе лекарственных растений. Евразийский Патент №027691.
27. М.Н.Велиева, П.М.Велиев. Способ получения средства из растительного сырья, обладающего противовоспалительной активностью. Евразийский Патент №028017.
28. М.Н.Велиева, Р.М.Гейдарова, П.М.Велиев, С.Е.Мусаева, Ф.И.Мадатли. Средство для профилактики и лечения мочеполовой системы у мужчин на основе лекарственных растений. Евразийский Патент 2001600339/26.
29. М.Н.Велиева, Р.М.Гейдарова, П.М.Велиев, Г.З.Азимова, Г.Г.Гасанов. Средство против выпадения волос на основе лекарственных растений. Евразийский Патент 201400801/26.
30. М.Н.Велиева, Б.Б.Кязимов. Гомеопатическая композиция, обладающая имфотропным действием. Евразийский Патент N033144.
31. М.Н.Велиева, С.Э.Мусаева. Суппозитории для лечения эрозии шейки матки. Евразийский Патент 201500967/28.
32. М.Н.Велиева, Р.М.Гейдарова, П.М.Велиев, С.А.Атакицизаде, Г.Г.Гасанов. Применение средства для очищения организма от токсикантов. Евразийский Патент 030852.
33. М.Н.Велиева, В.Б.Баширов. Биологически активная добавка, обладающие анти-инфекционным, рассасывающим, регенерирующим, обезболивающим, антиаллергическим и восстанавливающим действием. Евразийский Патент 033517.
34. Р.В.Шадлинская, М.Н.Велиева, Р.М.Гейдарова. Средство для лечения и профилактики заболеваний пародонта и слизистой ротовой полости. Евразийский Патент №036150.
35. М.Н.Велиева, Е.З.Абдуллаев, Н.Г.Мамедова. Антивирусное средство для лечения и профилактики носоглотки при ОРВИ. Евразийский Патент №019559.
36. М.Н.Велиева, Д.Д.Саилова, А.А.Мамедова. Лечебно-профилактическая композиция по уходу за зубами и полостью рта. Евразийский Патент №019426.
37. М.Н.Велиева, С.Д.Мехралиева. Антибактериальная гель на основе коллоидного серебра и солодки. Евразийский Патент № 019086.
38. Veliyeva M.N.1, Veliyev P.M.2, Mehraliyeva S.Ja.1, Amiraliyeva T.A.1, Zeynalova G.R.1, Gafarova D.S.Elaboration Of Pharmaceutical Means With

- Anti-Inflammatory Activity On The Basis Of Natural Raw Materials Of The Republic Of Azerbaijan-Sciences Of Europe, 2019, 35, P.39-43
39. Магеррамова Севиндж Гаджибала Гызы, Гасымова Гюльнара Нисан Гызы, Меджидова Улькар Мирза-Ага Гызы, Велиев Первиз Мустафа Оглы-Новое Средство Для Очистки Желудочно-Кишечного Тракта На Растительной Основе-Вестник Науки и Образования-2019,N7,P.91-94
40. Luciana D., Ghamamno A.A., Osmanov H.M. Nanotechnology challenges: the contribution to a new medicine // 2nd Baku International Medical Congress. November 6-7, 2015, p.4.

## CHANGES IN BEHAVIORAL REACTIONS UNDER INFLUENCE OF HEAVY METAL SALTS IN EXPERIMENTAL ATHEROSCLEROSIS

**R.İ. Ibragimov**

*Azerbaijan Medical University, Baku, Azerbaijan  
iri-71@mail.ru*

(Presented by Academician Mahbuba Valiyeva)

### Abstract

The aim of the research was to study the effect of chronic exposure heavy metals salts ( cadmium sulfate, nickel nitrate and cobalt nitrate ) on the indicators of behavioral reactions in experimental atherosclerosis.

The experiments were performed on 140 white outbred male rats weighing 200-250 g. The model of atherosclerosis was created according to I.V.Savitsky et al. (2016): mercazolil-25 mg/kg of body weight, methylprednisolone - 0.17 mg/kg of animal weight and 15% aqueous solution of ethyl alcohol in free access instead of water against the background of an atherogenic diet for 2 weeks. The state of lipid metabolism was assessed by the level of total cholesterol, high-density lipoproteins, low-density lipoproteins in blood serum on a BOECO apparatus (Germany) using standard reagent kits.

The animals were chronically exposed to heavy metal salts through drinking water for 60 days (cadmium sulfate - 1 mg/kg, nickel nitrate - 2 mg/kg and cobalt nitrate - 2 mg/kg). Changes in the behavioral reactions of experimental animals were carried out in the "Suok-test," which allows us to analyze the state of anxiety, motor and vestibular disorders, as well as anxiety-induced motor disorders. The results of studies after exposure experimental animals with salts of heavy metals against the background of atherosclerotic changes showed a significant aggravation of behavioral disorders that took place after modeling atherosclerosis. According to the severity of pathological changes, the pattern was as follows in descending order: cadmium sulfate → nickel nitrate → cobalt nitrate. The obtained data also indicate that cobalt, which is a necessary trace element for the body with prolonged exposure, also has a toxic effect. The destructive effect of heavy metals on the central nervous system of experimental animals during the development of atherosclerotic processes is chronic and it is necessary to develop appropriate methods of prevention and treatment.

**Key words:** *heavy metals, atherosclerosis, behavioral reactions, lipid metabolism*

### Introduction

Human exposure to toxic heavy metals is a global challenge.. Environmental pollution in recent years has increased many times, and in



some places has reached a level that is toxic to living things. One of the most potent and widespread chemical contaminants is heavy metal pollution. Until recently, it was thought that heavy metal poisoning mainly affects professionals, but now it has become apparent that this applies not only to people who work with "chemicals," but also to the entire population. High concentrations of heavy metals as a result of bioaccumulation are found in all natural environments: atmosphere, water, soil, plants. Ultimately, heavy metals enter the human body through the food chain and lead to serious health risks [1, 5, 6].

A review of recent literature shows that exposure to heavy metals is an important and underestimated risk factor associated with the development of atherosclerosis and its consequences [3, 4, 5, 9].

In addition, in recent years there has been an increase in the number of patients with neurotoxicosis among the population. The urgency of the problem of damage to the nervous system due to exposure to chemical factors remains high. The results of recent studies indicate the important role of heavy metals in the etiology of modern neurological epidemics - Alzheimer's disease, Parkinson's disease, etc. [1, 2, 7, 8].

It is also known that the study of the state of higher nervous activity through behavioral reactions is a clear indicator of the state of the body as a whole, and also allows you to assess the impact of heavy metals on the body. Based on the foregoing, the aim of the research was to study the effect of chronic exposure to heavy metal salts (cadmium sulfate, nickel nitrate, and cobalt nitrate) on behavioral responses in experimental atherosclerosis.

## **Materials and methods**

The experiments were performed on 140 outbred white male rats weighing 200–250 g, which kept under standard vivarium conditions. The experiments were conducted in strict compliance with the requirements of the European Convention (Strasbourg, 1986) for the maintenance, feeding and care of experimental animals, as well as their withdrawal from the experiment.

The studies were performed in 4 groups of 10 rats in each group. Group I was the control (healthy male rats - they ate their usual diet). The model of atherosclerosis was created according to I.V. Savitsky et al (2016) [10] who, when developing the model, were based on the polyetiological theory of the development of the disease. Modeling was performed on outbred male rats who received the antithyroid drug Mercazolil at a dosage of 25 mg/kg of body weight, an immunosuppressive drug Methylprednisolone, at a dosage of 0.17 mg/kg of animal weight, and a 15% aqueous solution of ethyl alcohol in free access

instead of water *ad libitum* along with atherogenic diet for 2 weeks. Atherosclerotic changes were assessed after 2 weeks by the level of total cholesterol (TC), high density lipoproteins (HDL), low density lipoproteins (LDL) in serum on a BOECO apparatus (Germany) using standard reagent kits.

After modeling atherosclerosis, animals in the experimental series were chronically exposed to heavy metals salts through drinking water for 60 days. Water-soluble salts of heavy metals were used as toxicants: cadmium sulfate (1 mg/kg), nickel nitrate (2 mg/kg) and cobalt nitrate (2 mg/kg). The heavy metal mother liquor was calculated according to the equation  $A = (X \cdot B) \cdot C$ , where X is the coefficient = 6.77; B is the average weight of the rat; C-average daily water intake by animals) and added to drinking water drinking bowls. The rats in the control group received an equivalent volume of regular drinking water.

Changes in the behavioral reactions of experimental animals were carried out in the "Suok-test," which allows us to analyze the state of anxiety, motor and vestibular disorders, as well as anxiety-induced motor disorders. The studies were carried out on the 30th and 60th days of exposure.

Statistical analysis of the obtained numerical values was performed using the standard MS Excel 2005 software package. The value of the statistical significance level was assumed to be at least  $p \leq 0.05$ .

## Results and discussion

The study of lipid metabolism indicators in the dynamics of exposure with salts of heavy metals after modeling atherosclerosis showed the following changes (Tab. 1, Fig.1).

The content of total cholesterol and LDL in blood serum compared with the initial level after modeling of atherosclerosis increased on average by 21% and 36%, respectively. The HDL level decreased by 19% ( $p < 0.05$ ).

After 30 days the start of exposure against the background of a model of atherosclerosis, the level of total cholesterol and LDL cholesterol under the influence of cadmium sulfate increased by an average of 35% ( $p < 0.05$ ) and 59% ( $p < 0.01$ ), nickel nitrate by 30% ( $p < 0.05$ ) and 46% ( $p < 0.01$ ) and cobalt nitrate by 25% ( $p < 0.05$ ) and 41% ( $p < 0.01$ ), respectively. The HDL level decreased on the 30th day of the study, respectively after exposure cadmium sulfate by an average of 34% ( $p < 0.05$ ), nickel nitrate by 25% ( $p < 0.05$ ) and 15% ( $p < 0.05$ ) and cobalt nitrate.

After 60 days of exposure, total cholesterol and LDL levels under the influence of cadmium sulfate were increased by 79% ( $p < 0.05$ ) and 74% ( $p < 0.01$ ), nickel nitrate by 59% ( $p < 0.05$ ) and 60% ( $p < 0.01$ ) and cobalt nitrate by 38% ( $p < 0.05$ ) and 56% ( $p < 0.01$ ), respectively, compared with baseline

data. The level of HDL cholesterol after 60 days of the exposure decreased under the influence of cadmium sulfate by 47% ( $p < 0.05$ ), nickel nitrate by 36% ( $p < 0.05$ ) and cobalt nitrate by 29% ( $p < 0.05$ ) compared to the original data.

The results of the study of behavioral reactions showed that in all periods of the study after exposure to heavy metal salt against a background of atherosclerotic processes, a damaging effect on the brain of experimental animals was recorded, expressed in disorders of behavioral reactions (Tab. 2, Fig.2). After modeling of atherosclerosis in experimental animals, anxiety and poor coordination of movements were noted in comparison with the control group. The number of stops made by rats was on average 16% ( $p < 0.05$ ) more than the indices of control individuals, and the time of stops increased by 8%.

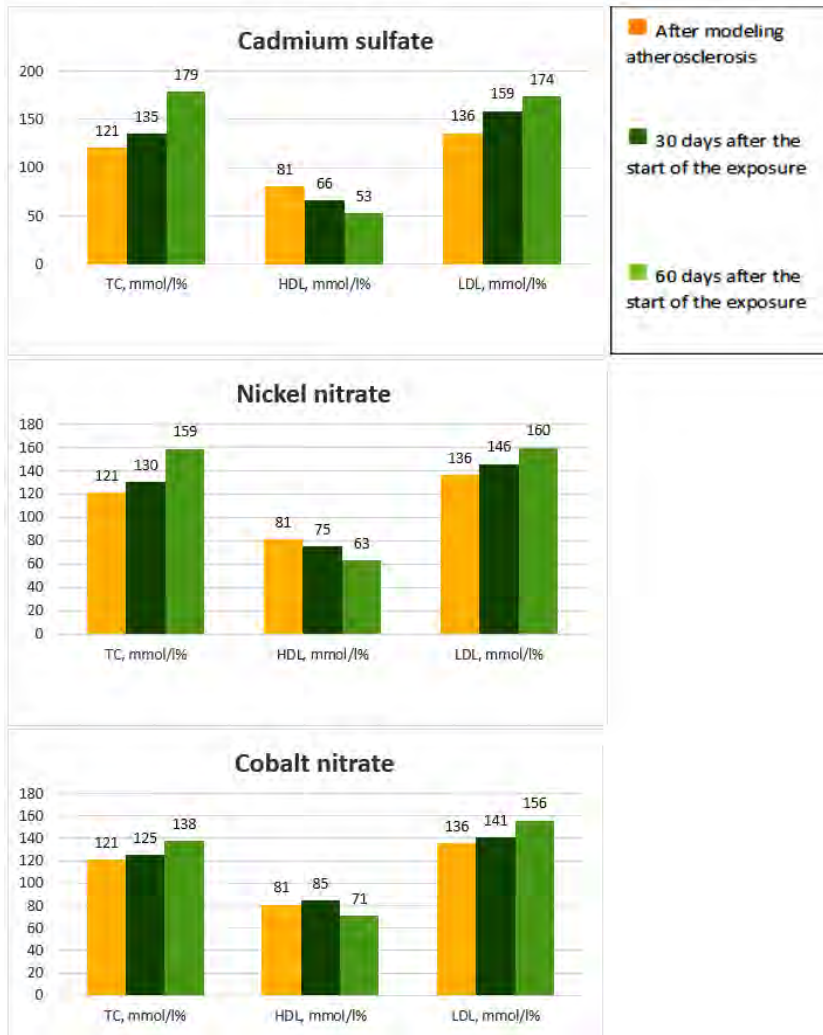
**Table 1. Indicators of lipid metabolism in the blood serum of rats with chronic exposure with salts of heavy metals against the background of experimental atherosclerosis ( $M \pm m$ ,  $n=10$ )**

Indicators	Terms of research			
	Before modeling atherosclerosis	After modeling atherosclerosis	30 days after the start of the exposure	60 days after the start of the exposure
<b>Cadmium sulfate</b>				
TC, $\mu\text{mol/l}$	2,42 $\pm$ 0,15	2,94 $\pm$ 0,09*	3,35 $\pm$ 0,19*	4,32 $\pm$ 0,19*
HDL, $\mu\text{mol/l}$	1,28 $\pm$ 0,09	1,04 $\pm$ 0,07*	0,84 $\pm$ 0,10*	0,69 $\pm$ 0,12*
LDL, $\mu\text{mol/l}$	1,13 $\pm$ 0,06	1,54 $\pm$ 0,04*	1,76 $\pm$ 0,10**	1,96 $\pm$ 0,10**
<b>Nickel nitrate</b>				
TC, $\mu\text{mol/l}$	2,42 $\pm$ 0,15	2,94 $\pm$ 0,09*	3,15 $\pm$ 0,19*	3,85 $\pm$ 0,11*
HDL, $\mu\text{mol/l}$	1,28 $\pm$ 0,09	1,14 $\pm$ 0,07*	0,96 $\pm$ 0,2*	0,81 $\pm$ 0,3*
LDL, $\mu\text{mol/l}$	1,13 $\pm$ 0,06	1,54 $\pm$ 0,04*	1,65 $\pm$ 0,10**	1,81 $\pm$ 0,15**
<b>Cobalt nitrate</b>				
TC, $\mu\text{mol/l}$	2,42 $\pm$ 0,15	2,94 $\pm$ 0,09*	3,03 $\pm$ 0,19*	3,35 $\pm$ 0,19*
HDL, $\mu\text{mol/l}$	1,28 $\pm$ 0,09	1,14 $\pm$ 0,07*	1,09 $\pm$ 0,10*	0,91 $\pm$ 0,2* 71
LDL, $\mu\text{mol/l}$	1,13 $\pm$ 0,06	1,54 $\pm$ 0,04*	1,6 $\pm$ 0,10**	1,76 $\pm$ 0,12**

Notes: \* -  $p < 0.05$ , \*\* -  $p < 0.01$ , \*\*\* -  $p < 0.001$  (compared with baseline)

In parallel, there was a decrease in horizontal motor activity by an average of 20% ( $p < 0.05$ ) and also the number of grooming acts - by an average of 10%, but these changes were not statistically significant. Also, in comparison with the control, there was a decrease in exploratory activity.

Therefore, vertical activity, in the form of a standing, statistically significantly decreased on average by 24% ( $p < 0.05$ ).



**Fig. 1. Indicators of lipid metabolism in the blood serum of rats with chronic exposure with salts of heavy metals against the background of experimental atherosclerosis.**

The number of peeking down and the number of bowel movements slightly increased in comparison with the control group. The number of transitions to the center increased by 16% ( $p < 0.05$ ). On the 30th and 60th days of the study in the animals of the experimental group that received cadmium sulfate there was a significant increase in the number of stops, on average, 2.2 times ( $p < 0.01$ ) and 3 times ( $p < 0.001$ ), respectively. At the same time, an increase in the duration of the stopping time was recorded by almost 2.3 times ( $p < 0.001$ ) and more than 4 times ( $p < 0.001$ ) compared with control animals in the indicated study periods after the start of the inoculation. Horizontal activity also decreased almost 2 times ( $p < 0.01$ ) on the 30th day and by 62% ( $p < 0.001$ ) on the 60th day of the study.

The number of groomings in the noted periods decreased on average by 45% ( $p < 0.01$ ) and 39% ( $p < 0.01$ ), respectively, compared with the data of intact animals. Vertical activity and the number of downward glances during these periods of the study decreased, respectively, by an average of 56% ( $p < 0.001$ ) and 68%, ( $p < 0.05$ ) on the 30th day of the study and by 36% ( $p < 0.001$ ) and 58% ( $p < 0.001$ ), respectively, on the 60th day compared with the data of the control group. Transitions to the center and defecation decreased statistically significantly by 40% ( $p < 0.05$ ) and 56% ( $p < 0.05$ ) and 37% ( $p < 0.05$ ) and 48% ( $p < 0.05$ ), respectively, after 30 and 60 days after the start of exposure.

Disorders of motor and exploratory activity in experimental animals were exposed nickel nitrate were as follows. Thus, the number of stops on the 30th and 60th days after exposure was 1.7 times ( $p < 0.001$ ) and 1.8 times ( $p < 0.001$ ) more than in control animals, respectively. In these terms of the study, the stopping time also increased more than 2 times ( $p < 0.001$ ) and 3.8 times ( $p < 0.001$ ).

The horizontal activity decreased statistically significantly, respectively, by 43% ( $p < 0.01$ ) and 54% ( $p < 0.001$ ) on the 30th and 60th days after the start of exposure. The number of grooming acts decreased by 40% ( $p < 0.01$ ) and 60% ( $p < 0.001$ ), respectively.

**Table 2. Changes in the indicators of behavioral reactions in the "SUOK-test" in rats, exposed to cadmium sulfate, nickel nitrate and cobalt nitrate (M±m, n=10)**

Indicators	Terms of research			
	Before modeling atherosclerosis	After modeling atherosclerosis	30 days after the start of the exposure	60 days after the start of the exposure
<b>Cadmium sulfate</b>				
<u>The number of stops</u>	6,2±0,5	7,2±0,3*	14,2±0,5**	18,5±0,8***
The time of stops	28,2±0,4	30,4±0,41	65,2±0,43**	121,1 ±0,54***
Horizontal motor activity	26,4±1,31	21,0±1,21*	13,0±0,7**	10,1±0,8***
Number of grooming acts	5,1±0,18	4,6±0,2	2,8±0,12**	2,1±0,3***
Vertical activity	2,5±0,36	1,9±0,21*	1,1±0,2***	0,8±0,1***
The number of peeking down	12,5 ±0,56	13,2 ±0,6	8,0±0,31**	5,2 ±0,4**
The number of transitions to the center	2,5 ±0,46	2,1±0,6*	1,5±0,31**	1,1±0,25**
Number of <u>defecation</u>	1,75±0,27	1,82±0,12	1,1±0,26*	0,9±0,2*
<b>Nickel nitrate</b>				
<u>The number of stops</u>	6,2±0,5	7,2±0,3*	10,2±0,6**	11,5±0,5**
The time of stops	28,2±0,4	30,4±0,41*	57,2±0,4**	107,5 ±0,9**
Horizontal motor activity	26,4±1,31	21,0±1,21*	15,0±1,1**	12,0±0,17***
Number of grooming acts	5,1±0,18	4,6±0,2	3,1±0,12**	2,1±0,3***
Vertical activity	2,5±0,36	1,9±0,21*	1,4±0,2***	0,9±0,1***
The number of peeking down	12,5 ±0,56	13,2 ±0,6*	10,0±0,42*	6,2 ±0,41**
The number of transitions to the center	2,5 ±0,46	2,1±0,6*	1,8±0,31*	1,5±0,5**
Number of <u>defecation</u>	1,75±0,27	1,82±0,12	1,2±0,11*	1,1±0,2**

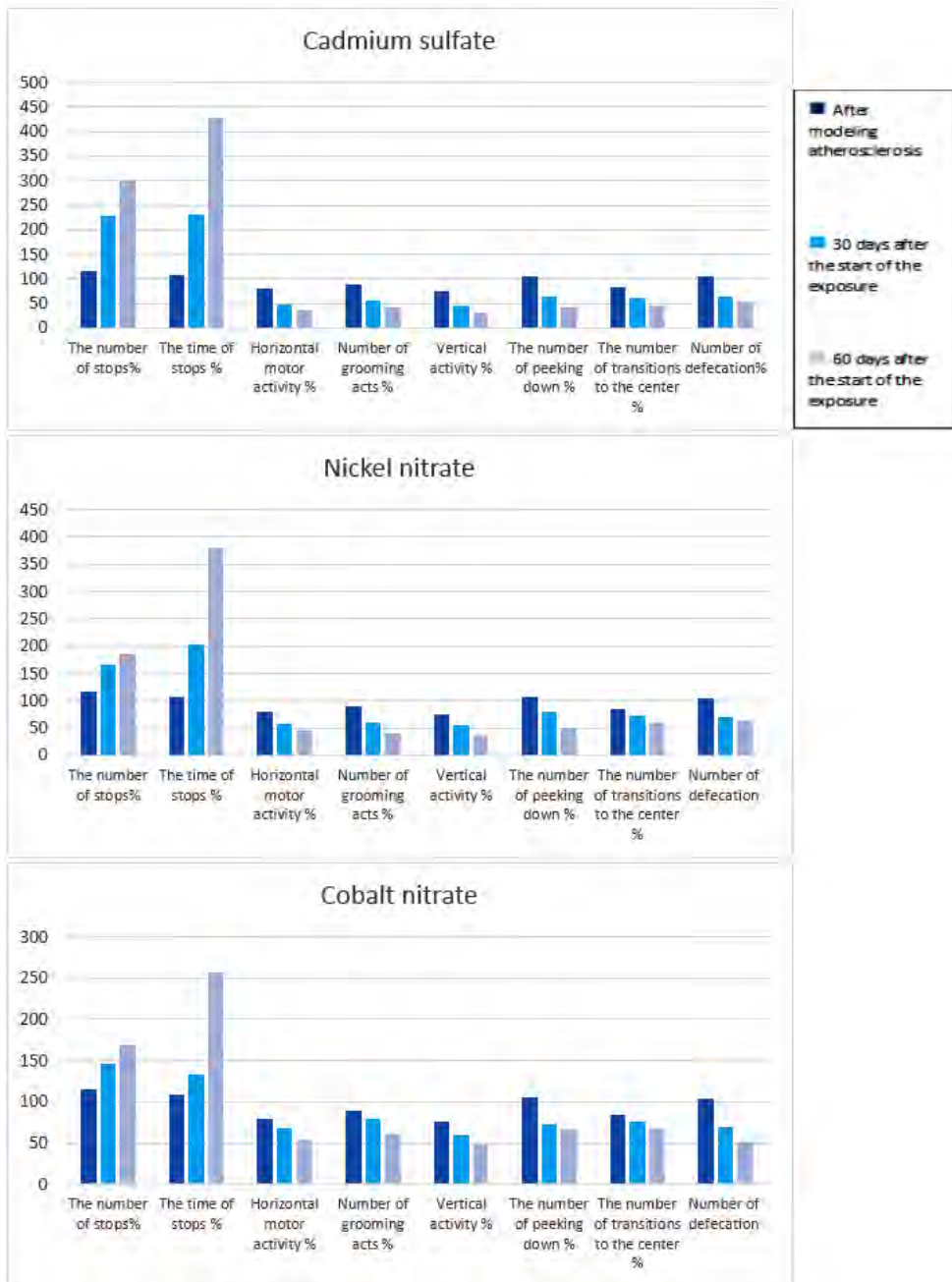
<u>Cobalt nitrate</u>				
<u>The number of stops</u>	6,2±0,5	7,2±0,3*	9,2±0,5**	10,5±0,4**
The time of stops	28,2±0,4	30,4±0,41*	37,5±0,42*	72,5 ±0,54**
Horizontal motor activity	26,4±1,31	21,0±1,21*	18,0±0,3**	14,0±0,5***
Number of grooming acts	5,1±0,18	4,6±0,2	4,1±0,12*	3,1±0,4**
Vertical activity	2,5±0,36	1,9±0,21*	1,50±0,2***	1,2±0,1***
The number of peeking down	12,5 ±0,56	13,2 ±0,6*	9,1±0,26*	8,2 ±0,4**
The number of transitions to the center	2,5 ±0,46	2,1±0,6*	1,91±0,3*	1,7±0,33**
Number of <u>defecation</u>	1,75±0,27	1,82±0,12	1,2±0,26*	0,9±0,21**

Notes: \* -  $p < 0.05$ , \*\* -  $p < 0.01$ , \*\*\* -  $p < 0.001$  (compared with baseline)

The research activity of the experimental animals after chronic exposure nickel nitrate also significantly decreased. There was a statistically significant decrease in vertical activity, respectively, by 44 % ( $p < 0.001$ ) and 54 % ( $p < 0.01$ ) on 30th and 60th days of the study. The number of looking down also decreased by almost 2 times ( $p < 0.001$ ), respectively on the 60th days after exposure by 64% ( $p < 0.01$ ) and 50% ( $p < 0.01$ ). Transitions to the center and acts of defecation decreased by an average of 40% ( $p < 0.01$ ) on the 60th day of the study compared with the initial data.

The nature of changes in the indicators of motor and research activity of experimental animals were exposed cobalt nitrate were as follows. The number of stops on the 30th and 60th days after the start of the exposure increased by an average of 1.5% ( $p < 0.05$ ) and 1.7 times ( $p < 0.001$ ) in comparison with the indicator of control rats. At the same time, the stopping time increased 1.3 times ( $p < 0.05$ ) and more than 2.5 times, respectively on the 30th and 60th days after the start of the exposure. Horizontal locomotor activity in the indicated periods decreased on average by 32% ( $p < 0.05$ ) and 47% ( $p < 0.001$ ), respectively, compared with the initial data.

**Fig.2. Changes in the indicators of behavioral reactions in the "SUOK-test" in rats, exposed to cadmium sulfate, nickel nitrate and cobalt nitrate.**



The number of grooming acts also decreased by an average of 20 % ( $p < 0.05$ ) and 40% ( $p < 0.01$ ), respectively, over the indicated study periods Vertical



activity significantly decreased on average by 40% (  $p < 0.05$  ) and 52% (  $p < 0.001$  ), respectively on the 30th and 60th days after the start of the exposure. The number of pecking down in comparison with the control group decreased by 27% (  $p < 0.05$  ) and 32% (  $p < 0.01$  ) after 30 and 60 days. The number of transitions to the center decreased by 24% (  $p < 0.05$  ) and 32% (  $p < 0.01$  ), respectively on the 30th and 60th days after the start of the exposure. The number of defecations decreased by 30% (  $p < 0.05$  ) and 42% (  $p < 0.01$  ), respectively, during the indicated study periods compared to those of the control group.

### **Conclusions**

Thus, the data obtained during the experiment showed that after modeling of atherosclerosis there were disorders of behavioral reactions: an increase in the level of anxiety and a decrease in both motor and exploratory activity. This was evidenced by an increase in both the number and duration of stops, a decrease in horizontal and vertical motor activity, the amount of grooming, looking down and defecation.

The results of studies after exposure experimental animals with salts of heavy metals (cadmium sulfate, nickel nitrate and cobalt nitrate) against the background of atherosclerotic changes showed a significant aggravation of behavioral disorders that took place after modeling atherosclerosis. The severity of the changes was of a temporary nature, and the most dramatic changes in the indicators of the atherosclerotic process and behavioral reactions were noted by the 60th day of the study.

According to the severity of pathological changes, the pattern was as follows in descending order: cadmium sulfate → nickel nitrate → cobalt nitrate. The data obtained also indicate that cobalt, which is a necessary trace element for the body with prolonged exposure, also has a toxic effect.

The data obtained indicate that the destructive effect of heavy metals on the central nervous system of experimental animals during the development of atherosclerotic processes is chronic and it is necessary to develop appropriate methods of prevention and treatment.

### **References**

1. Andrade V.M., Aschner V.M., Marreilha A.P. (2017) Neurotoxicity of Metal Mixtures //Adv. Neurobiol., 18:227-265.
2. Claude W.M. (2017) Occupational Metal Exposure and Parkinsonism //Adv. Neurobiol., 18: 143- 158.

3. Fagerberg B., Barregard, L., Sallsten G. et al. (2015) Cadmium exposure and atherosclerotic carotid plaques—results from the Malmo diet and Cancer study //Environ. Res., 136: 67–74.
4. Fatenkov O.V, Simerzin V.V., Panisheva Y.A. et al. (2019) Innovative treatments for patients with subclinical carotid atherosclerosis. Bulletin of Medical Institute “REAVIZ”: //Rehabilitation, Physician and Health, 2 (38):129-137.
5. Jayant Patwa, Swaran Jeet Singh Flora (2020) Heavy Metal-Induced Cerebral Small Vessel Disease: Insights into Molecular Mechanisms and Possible Reversal Strategies //Int J. Mol. Sci. 21(11):3862
6. Karri V., Kumar V., Ramos D., Oliveira E., Schumacher M. (2018) Comparative In Vitro Toxicity Evaluation of Heavy Metals (Lead, Cadmium, Arsenic, and Methylmercury) on HT-22 Hippocampal Cell Line //Biol. Trace Elem., Res., 184(1):226-239
7. Karri V., Schuhmacher M., Kumar V. (2016) Heavy metals (Pb, Cd, As and MeHg) as risk factors for cognitive dysfunction: A general review of metal mixture mechanism in brain //Environ. Toxicol. Pharmacol., 48:203-213.
8. Schofield K. (2017) The Metal Neurotoxins: An Important Role in Current Human Neural Epidemics? // Int. J. Environ. Res. Public Health, 5; 14 (12). 1412-1511.
9. Sumin A.N., Medvedeva Yu.D., Shcheglova A.V., Barbarash L.S. (2020) Predictors of unfavorable outcomes in patients with peripheral atherosclerosis //Russian Journal of Cardiology and Cardiovascular Surgery; 13(1):41-47.
10. Савицкий И. В., Слюсарь А. А., Мясковская И. В. (2016) Мультифакторное моделирование атеросклероза на крысах //Журнал образования, здоровья и спорта. 6.

## **PEDIATRIC PERIODONTITIS TREATMENT WITH USING OF HERBAL ANTI-INFLAMMATORY MEANS**

**A.A. Mammadova**

*Associate Department Pediatric Stomatology of  
Azerbaijan Medical University*

(Presented by Academician, Prof. Dr. Mahbuba Valiyeva)

Scientific-based information on the study of the problem of prevention and treatment of pediatric periodontitis provided in scientific article.

Great attention paid for the development of a medicinal vegetable agent for the prevention of pediatric periodontitis. Separately, scientific results on complex treatment of pediatric periodontitis were being given: applications of non-steroidal anti-inflammatory agents in the practice of treatment of pediatric periodontitis were being justified. The numbers of 40 school children were being separated with diagnosis of chronic periodontitis of various severities and observed. Detailed clinical and laboratory studies have shown that in the course of therapeutic and preventive measures usage of anti-inflammatory drugs significantly restores the functional activity of local immune factors. They were found to improve the trophic of periodontal tissues, contribute to the elimination of gum bleeding and inflammation, and to the investigator, contribute to the positive result treatment. Infectious diseases are one of the most pressing problems of modern clinical medicine. Herpes simplex virus infection caused by the herpes simplex virus is found in all countries and in different geographical climates. It is known that acute herpetic stomatitis is the main cause of pediatric infectious pathology. In every child with acute herpetic stomatitis, the disease develops into a chronic relapse after a certain period of time. In addition, the formation of a chronic form of the disease has more unfavorable consequences, and these consequences have not only clinical, but also social and epidemiological value.

The chronic course of the disease and the tendency to relapse are the body's inability to fully withstand the immune response to the antigenic structure of the virus. A number of effective anti-herpes chemicals have been developed that quickly eliminate the acute manifestation of herpes infection. However, the prevention of the risk of recurrence of the disease is not specific to these drugs.

In this regard, currently one of the priority areas in the treatment of herpes infections in the patient's oral cavity is combined with immunocorrective therapy and antiviral therapy. If we look at the history of medicine, we see that. The use of herbal medicines in the treatment of various pathologies plays a key role. Out of the large arsenal of medicines, about 40% of herbal medicines are used in medical practice. Sweet licorice is one of the most promising herbal medicines with a wide technological program in its production. The healing power of sweet licorice is well known. Licorice root has been used since ancient times. Ancient medical books contain information about this medicinal plant. For many years, scientists from different countries.

**Table 1.**

**Activity level of lysozyme in saliva (%)**

	Control group	I group contractgroup		II—basic grapple	
		From treatment	From treatment	From treatment before	From treatment then
M	60,5	47,6	53,2	-47,7	56,9
min	52,0	44,0	52,0	44,0	1
max	62,0	52,0	62,0	52,0	62,0
P<	-	0,001	-	0,001	-
P <sub>1</sub> <	-	-	0,001	-	0,001
P <sub>2</sub> <	-	-	-	-	0,001

**Table 2.**

**Amount of IgG in saliva (g / l)**

	Control group	I group contractgroup		II—basic grapple	
		From treatment	From treatment then	From treatment	From treatment then
M	0,320	47,6	53,2	47,7	56,9
min	0,310	44,0	52,0	44,0	52,0
max	0,350	52,0	62,0	52,0	62,0
P<	-	0,001	-	0,001	-
P <sub>1</sub> <	-	-	0,001	-	0,001
p <sub>2</sub> <	-	-	-	-	∞

**Table 3.**

**Amount of IgA in saliva (g / l)**

	Control group	I group contractgroup		II—basic grapple	
		From treatment	From treatment	From treatment before	From treatment then
M	0,210	0,434	0,363	0,432	0,225
min	0,200	0,410	0,340	0,410	0,210
max	0,240	0,450	0,390	0,450	0,240
P<	-	0,001	-	0,001	-
P <sub>1</sub> <	-	-	0,001	-	0,001
p <sub>2</sub> <	-	-	-	-	0,001

Extractive substances derived from licorice root (glycyrrhizin, glycyrrhizic acid and its derivatives) have become the object of in-depth chemical and pharmacological research. It is registered as a pharmacological plant in different countries of the world. This medicinal plant has anti-inflammatory activity, bacteriostatic effect, analgesic effect. It also has an immunomodulatory effect.

In our study, the drug licorice "Gliciram" was used.

### The purpose of the study.

Study of the effectiveness of the use of the drug "Gliciram" in the complex treatment of CKD in children.

### Research materials and methods.

We treated and examined 40 patients with moderate KHS, aged 1-5 years. Two research groups (20 people in each group) were established to determine the effectiveness of the use of the drug "Gliciram" in the complex treatment of CKD in children. Group I children (comparison group) were treated locally according to the traditional scheme.

**Table 4.**

#### Amount of IgA in saliva (g / l)

	Control group	I group	II—basic	Control	I group
		From treatment	From treatment then		From treatment before
M	0,280	0,520	0,433	0,499	0,336
min	0,260	0,500	0,353	0,455	0,280
max	0,300	0,550	0,460	0,540	0,350
p	-	0,001	-	0,001	-
p <sub>1</sub> <	-	-	0,001	-	0,001
p <sub>2</sub> <	-	-	-	-	0,001

the accuracy of the difference in the p-control group

p<sub>1</sub> -the accuracy of the difference in pre- and post-treatment readings

Accuracy of difference in p<sub>2</sub>-I group

In group II (children of the main group) in the background of treatment with the consent of the pediatrician, the drug "Gliciram" was prescribed in an age-appropriate dose for two weeks. Indicators of local immunity before and after treatment were determined in all patients: the level of lysozyme activity in saliva, the amount of immunoglobulin G, A (IgG, IgA) in serum and secretory immunoglobulin A (IgA) in the mixture of saliva. A control group was established to conduct a comparative analysis of the survey results, and the group included practically healthy children aged 1-5 years

(going to kindergarten). Immunological studies to determine the activity of lysozyme in the oral fluid mixture in children with CKD showed that this indicator was low before treatment in both groups. (Table) 47.6% in group I ( $p < 0.001$ ), 47.7% in the group ( $p < 0.001$ ). After treatment, the activity of lysozyme in the saliva mixture in sick children increased. However, the degree of normalization of this indicator depended on the chosen method. Comparative analysis of the results of groups I and II shows that lysozyme activity levels are higher in the group. In group I - 53.2% ( $p < 0.001$ ), in group I - 56.9% ( $p < 0.001$ ). (Table 2) -0.556 g / l ( $p < 0.001$ ) in group I, -0.55 lq / l ( $p < 0.001$ ) in group II After treatment, a decrease in this indicator was observed. Thus, in group I it fell to 0.465 g / l ( $p < 0.001$ ), and in group II to 0.340 g / l ( $p < 0.001$ ). At the same time, the result was closer to normal in group II.

A similar situation applies to IgA in the saliva of sick children. (Table 3) If before treatment this indicator is equal to 0.434 g / l ( $p < 0.001$ ) in group I and 0.432 g / l ( $p < 0.001$ ) in group II if so, it was observed to be close to normal after treatment. In group I it was 0.363 g / l ( $p < 0.001$ ), and in group II it was 0.225 g / l ( $p < 0.001$ ). The difference between IgA after treatment in the first parent study groups is an indicator of statistical accuracy. When determining the dynamic changes of IgA in the oral fluid mixture during complex treatment of children with CKD, it was found that in both groups this indicator was high before treatment, (Table 4) in group I -0,520 g / l ( $p < 0.001$ ), and in group II it was 0.499 g / l ( $p < 0.001$ ). After treatment, there is a return to normal. Thus, in group I it is -0.433 g / l ( $p < 0.001$ ), and in group I it is equal to 0.336c ( $p < 0.001$ ). The difference between the values of group I and II indicators shows statistical accuracy. Analyzing the dynamics of the oral mucosa in sick children, it should be noted that as a result of treatment, the state of local immunity of the oral mucosa changes to normal. The more effective the treatment, the more the virus instantly stops the infection, quickly affects the pathological process, causes regeneration in the damaged areas, and as a result, the protective factors are actively renewed. However, the data from the study show that the drug "Gliciram" is effective in the use of the mother in children with complex treatment of CKD, as it improves the rate of seven deaths, eliminates the local and general symptoms of the disease.

## THE HISTORY OF PSYCHOLINGUISTICS AND ITS ROLE IN AZERBAIJAN LINGUISTICS

**N.A. Alakbarova**

*Azerbaijan National Science Academy,  
Institute of Linguistics named after I.Nasimi, Baku, Azerbaijan  
ladynarmina@gmail.com*

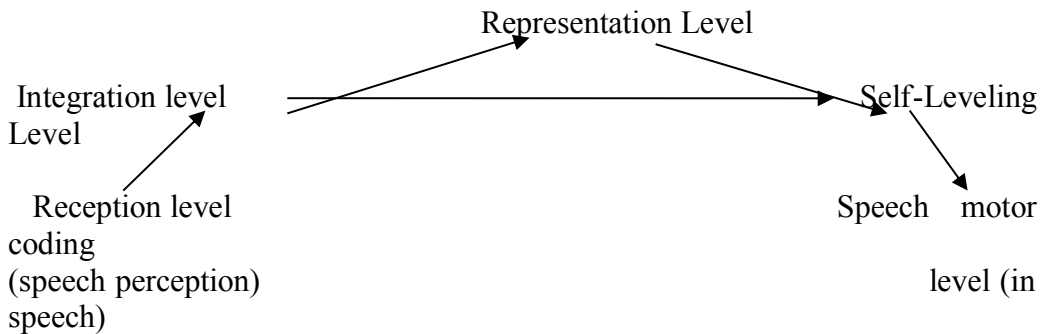
The term "psycholinguistics" was first proposed by the American psychologist N. Pronko in 1946. Psycholinguistics was created as an independent field in 1953 as a result of an inter-university seminar organized by the Committee on Linguistics and Psychology at Indiana Council for Social Research. The seminar was organized by two well-known American psychologists, Charles Osgood and John Carroll, as well as linguist, ethnographer and literary critic Thomas Sibek.

The term "psycholinguistics" entered science in the USA in 1954, when the same collective work was published in the USA under the editorship of C. Ascud and T. A. Sibeoka. This book summarizes the main theoretical principles adopted during the seminar, as well as the main areas of experimental research based on these principles (3, p. 37). However, ideas close to the problems of psycholinguistics began to arise and develop before that. It can be assumed that a psycholinguistic approach to the study of language and speech existed before a number of American scientists introduced the term "psycholinguistics" into science.

The history of the creation and development of psycholinguistic science is quite clearly represented in the works of A.A. Leontiev (123.139). Based on an in-depth analysis of this issue A.A. Leontyev identified several successive stages in the development of psycholinguistics as a science. Representatives of the first generation psycholinguistics C. Osgood, C. Carroll, T. Sibeyok, F. Lonsbury and others. is considered. The most prominent representatives of the second generation are K. Miller, N. Chomsky (Chamsky) and D. Slobin. As the representatives of the third generation of psycholinguistics are called, or, as famous American psychologists and psycholinguists call it, the "new psycholinguistics" was formed in the mid-70s. In the USA this is connected with the name with J. Bruner and J. Verchin; in France with the name of Jacques Meler, George Noise, Daniel Dubois, and in Norway this is connected with the name of the talented psycholinguist R. Rommetev.

The essence of the psychological concept of K. Oskud can be defined as follows. Speech is a system of direct or indirect human response to speech and

non-speech stimuli. Speech stimuli partially induce the same behavior as the connection between speech and non-speech stimuli as the corresponding speech stimuli. The schematic diagram of C. Osquda's speech behavior is as follows: (8):



According to A. A. Leontiev, the main feature of the first generation psycholinguistics is its reactive nature. In general, it is assembled in a modernized version of the bio-biological scheme “stimulus-response”. His orientation is purely psychological, based on a certain interpretation of behavioral processes, and in this case, speech behavior. Although the psycholinguistics of the first generation is not a theory of speech effects or actions, it is a theory of delivery of speech into the environment, and the theory of speech is similar to an instrument for balancing the internal psychological balance or “human environment” (3, p. 37).

Prominent representatives of second-generation psycholinguistics (which emerged in the late 1950s) are the prominent American linguists, Chomsky, and psychologist George Hermitage Miller.

N. Chomsky developed the concept of a language model of transformation. According to A. A. Leontiev, the “transformational approach” in linguistics was first proposed by the teacher of N. Chomsky Z. Harris. N. Chomsky’s service consists in the fact that he implemented this approach in the form of a general theory of grammar, a complete model of the language function in speech communication. It contains specially transformed rules and operations that show the syntactic structure of the sentence as a whole. N. Chomsky singles out a group of simple syntactic structures that he calls “nuclear” (for example, Peter reads a book). If we apply a “passive” operation to such a nuclear structure, Peter reads the book. If we add the operation of refusal to this, we say: Peter does not read the book. A question may also be asked: Does Peter read a book? Two, three or even four transformations can be used at the same time (is it not a book that Peter has read?) (4, p. 29).



For most American and English-speaking psycholinguists, ethnographic knowledge of language is usually a richer linguistic theory in the United States — the generative grammar of N. Chomsky's different variants. Accordingly, American psycholinguistics focuses on trying to figure out how many psychological hypotheses based on Chomsky's ideas are consistent with observed behavior. From this position, some authors look at the child's speech, others consider the role of language in social interaction and the relationship between the third language and cognitive processes.

Chomsky notes that language has a genetic predisposition to language development (children begin to pronounce their first words at 12 months; at 18 months they can see sudden spontaneous grammar in children), and the process of learning a language is completely different from learning to cycle or chess. Chomsky sees these processes as separate and intellectually separate from the intellect, and most importantly, these processes are universal. In the past, it was believed that a word should be expressed first. Until the nineteenth century, mental abilities were explored through an intimate gaze and direct practical thinking. In particular, logic was determined by the laws of thinking. N. Chomsky, who followed J. G. Herder, called him "independent" in the face of intellectual warnings. Language also sees the realization of this advantage and characterizes linguistics as a field of psychology.

The main difference between the second generation of psycholinguistics was the interpretation of language acquisition. According to representatives of the school of N. Chomsky, mastery of the language is not the acquisition of individual speech elements (words, etc.), but the assimilation of the system of rules for the formation of perceptions. However, second-generation psycholinguistics, as Leontiev notes, is actually a psychological process that leads to the realization of linguistic structures in speech. The systematization of speech behavior or human activity is excluded directly from the consistency of the language; Conscious human activity of a person imposes only certain restrictions on the implementation of linguistic structures.

One of the most important provisions of second-generation psycholinguistics is the idea of universal derived rules for language operations. These rules, firstly, clearly do not exist in the linguistic material, and secondly, the child is free to master and master both his native language and any foreign language. Thus, the process of mastering the language approaches the interaction of these derivatives or acquired language material skills, that is, the actualization of these derivative rules in the ontogenesis of speech.

The works of English scholars Judith Green, John Morton, John Marshall and other researchers are of particular importance in second-generation psycholinguistics. In the works of these scientists, the subject of research is text, as well as text; At the same time, the emphasis is on the study of linguistic understanding in relation to the "psychological significance" of the sentence and the logical structure.

According to A.A. Leontiev, a typical representative of the third generation of psycholinguistics is the French psycholinguist George Noised. One of the main points of the psycholinguistic concept of K. Nuus was the development of "autonomous psycholinguistics." It was intended to eliminate its autonomy from language models, as well as to eliminate the "isomorphism" of the language and psychological structures.

According to Joseph, certain psycholinguistic operations are also cognitive and communicative in nature. They gain practical skills in communication, interaction and speech. C.Nuaze and his colleague J.Meler consider psycholinguistics ("linguistic psychology") an integral part of cognitive psychology. (6, p. 20)

Third-generation psycholinguistics critically criticizes N. Chomsky's concept of the role of universal derivatives of linguistic structures in the formation of a person's linguistic abilities. As D. Dubua notes: "Language should be considered not only as a formal object common to all people, but also as a social and historically defined object (9, p. 25-26). In the 70s of the last century R. Rommetevet sharply criticized the psycholinguistics of the second generation. Because he believed that second-generation psycholinguistics would perceive their views in a vacuum, and he repeatedly stated that psycholinguistics should first investigate "... considerations that enter into the communicative environment" (4, p. 72).

According to A. A. Leontiev, third-generation psycholinguists eliminated the school of isolation of N. Chomsky. The psycholinguistics of the third generation was able to overcome not only atomism, but also the psycholinguistic individualism of previous generations. The principle of "reactivity" of speech behavior for this generation was also completely unacceptable.

Part of the third generation of psycholinguistics was sent to the psychological school of L.S. Vygotsky. Among them was the famous foreign psycholinguist J. Verch. K. Vercha is considered "the most outstanding specialist in the West in Vygotsky" and an active promoter of his scientific views.

A.A. Leontyev calls the German philosopher and linguist Wilhelm von Humboldt the forerunner of psycholinguistics, because this is his “idea of speech and language as a link between sociology” (5, p. 26).

As early as the nineteenth century, Humboldt wrote that language plays an important role in the “worldview”, that is, in the formation of objective information from the external environment. A similar approach can be found in the works of the 19th century Russian philologist A. A. Potot, as well as in his teaching on the “internal form” of a word.

In the psycholinguistic approach to the phenomenon of language, the Russian tradition is based on I. A. Baudouin de Courtenay (1845-1929), the Russian and Polish linguist who founded the Kazan Linguistic School. It was Baudouin who spoke of language as a "psychosocial being" and proposed the inclusion of linguistics in the "psychosocial" sciences.

Students of Baudouin V. A., Bogorodsky and L. V. Shcherba used experimental methods to regularly study speech activity. Of course, Shcherba did not speak of psycholinguistics, since the term A. Leontiev’s monograph in 1967 began to intensify in Russian linguistics. Nevertheless, it was in Sherba’s famous article “Three Aspects of Linguistic Phenomena and Experiments in Linguistics” that the main ideas of modern psycholinguistics were already present: focusing on the study of real processes of speech and hearing; understanding of living spoken language as a special system and, finally, a special place in the Serbian psycholinguistic experiment.

The development of psycholinguistics in Soviet Russia began in the mid-60s. First of all, the work was carried out at the Institute of Linguistics of the USSR Academy of Sciences (Moscow), as well as in other institutes of the country.

Every two to three years, All-Union Symposia on Psycholinguistics were held. Soviet psycholinguistics relied on the materialistic school of L. Vygotsky (the first concept of activity) and the linguistic heritage of L.V. Sherbakh and his school, especially on his active grammar.

The Moscow school of psycholinguistics, which considers psycholinguistics as one of the derivatives of the psychological theory of activity developed by A. N. Leontyev, has long called psycholinguistics "the theory of speech activity" and in parallel uses the term "psycholinguistics".

Since the late 1970s, the problem area of psycholinguistics has developed under the influence of both processes in linguistics, and with the time of the sciences related to both linguistics and psycholinguistics.

French psycholinguistics is usually considered the followers of the Swiss psychologist Jean-Piaget. Therefore, the main area of interest is the role of

language in the formation of the child's speech and the development of intellectual and cognitive processes.

On the subject of language learning, J. Piaget showed that there is no instinct for imitation based on theories of empowerment and conditionality. The child must also learn to imitate. For this, the child gradually develops its own perception as it develops. For example, at the beginning the idea of volume depends solely on the shape of the objects. The child says that the elastic plastic cube is "smaller" when crushed (7, p. 21)

Despite the fact that psycholinguistics is so popular, Azerbaijan has few specialists in the field of psycholinguistics. Professor Gulmira Sadieva-Guruoglu is the founder of psycholinguistics in our country. She currently lives and works in Turkey. Sadieva is a specialist in some areas of neurolinguistics and psycholinguistics. Answering the questions of the psychologist and expert of the Echo newspaper S. Bagirov: "I think that with the development of science, technology and society, interest in psycholinguistics and new directions in this science will increase. As for the psycholinguistic school in Turkey, which is stronger than Azerbaijan, I would like to say that it is too early to talk about it. There or there is no such school." (thirteen)

G. Sadieva's research on neurosurgery can be attributed to bioavailability and cognitive psycholinguistics by some of its signs. Sadieva is currently managing two projects. One is with the psychiatry department "Speech Analysis for Patients with Schizophrenia," and the other with the Faculty of Medicine, such as the neurological department for analyzing the speech of patients with Alzheimer's. His plan also includes work with the radiological department of the medical faculty. The study of the semantic perception and pronunciation of bilingual and multilingual people, that is, the fact that the hemisphere is perceived and pronounced through the brain (right or left hemisphere), is one of the works of G. Sadieva. She believes that semantic perception, bilingual and multilingual pronunciation depend on a number of components, such as age, location, language learning, language knowledge and other subtleties of mastering and learning the language. (thirteen)

Of the linguists who chose to study psycholinguistics in Azerbaijani linguistics, I would even say that the most widely researched researcher in the field of psycholinguistics is Mayil Askerov. The book of Mayil Askerov "Linguistic Psychology or Psychology of Language" was published in 2011. In this book, M. Askerov examines the linguistic, functional-semantic, linguistic and psychological aspects of linguistic, speech and word-form relations in relation to the cognitive process, the emergence of a new linguistic structure and the need for occult speech, which is the driving force of language development.

The lexical, lexical and grammatical and grammatical forms of the text are analyzed on the basis of materials from the Azerbaijani and Turkish languages.

In his book "Linguopsychology or Psychology of Language" M. Askerov notes that "here we consciously open the question of whether the image of the mind is a material being or a divine spirit. Since our goal is not to reveal the nature or material nature of intellectual images that allow us to realize the processes of reflection and reflection." (See paragraph 2.3).

The author laid the psychological foundation for this new dimension, called linguopsychology: "The theory of the psychological activity of L. Vygotsky is based on the S + O + F act, as defined by academician I. M. Sechenov makes a diagram "(see paragraph 3.1). After reading the book, it becomes clear that M. Askerov managed to create such an original scheme using the views of L. Vykotsky and I. M. Sechenov. In this book, M. Askerov analyzes the processes of thinking and the psychological aspects of speech and language in speech, thought processes and language interactions.

The monograph of M. Askerov "Theory of Linguistic Psychological Unity" is also one of the most valuable scientific works on psycholinguistics. The study of human speech, linguistic and linguistic units in the process of action and communication is the main subject of the monograph of M. Askerov. This monograph is devoted to the theory of language and its psychological problems. A number of psycholinguistic theories were criticized at the beginning of the monograph, and then an attempt was made to establish a theoretical basis for a new psycholinguistic direction.

As Askerov, theories of biohelvism and neobiochemistry are not accepted, which fuel the discourse in the form of "stimulating reactions" and justify the inadmissibility of the theory of psychological activity. In his opinion, ideas such as "speech is a unit of thoughtful speech" or "cannot express ideas without language" are completely wrong. The author writes, trying to prove these statements incorrectly: "In this situation we are faced with a strange choice. Either we must admit that we do not understand and do not understand non-verbal objects, namely objects, existence, state and movements, that is, we have no idea that there is no word combination in the brain, or we must recognize that there is no word in our brain words, but no words. we are unable to think and think of any concept "12, p. 59). The author believes that a person is not able to fully comprehend the real world. Reality is gradually assimilated on the basis of its own units and at the moment of contact with them. Even reality units cannot be fully understood by man. Each feature that relates to a unit of reality is called an "element of reality" in the study. It is also argued that the perception of reality, as well as its units, is carried out by "assimilation of the elements of reality." That

is, according to the author, the “minimal unit of perception” that a person understands is precisely the “element of reality” (12, p. 169).

In recent years, neurolinguistics, psycholinguistics and linguistics have become more active in Azerbaijani linguistics. Ayten Gadzhieva, Leyla Khanbutaeva, Heydar Eminli, Kamal Abdullaev, Faig Veyselli and many others tried to reveal the psycholinguistic aspects of their research, even if this is the surface of psycholinguistics.

K. Abdullaev’s book “Journey to Linguistics” contains both the principles of neobiesterism and cognitive psycholinguistics, and the problem of internal speech and its transformation into speech is explained on the basis of the theory of speech activity (10, p. 5). The introduction of F. Veyselli to discourse analysis, as well as the “Cognitive Perspectives of Discourse Analysis” by A. Mammadov and M. Mammadov are subject to neo-culture and cognitive psycholinguistics. Although the article by A. Gadzhieva on the analysis of the psycholinguistic aspect of the metacognitive dictionary of the early Turkic period was written on the basis of cognitive psycholinguistics, it also affects the theory of neo-hysterism and speech activity (10, p. 5).

The help of psycholinguistics in the study of language in Azerbaijani linguistics can be seen in the issues raised by a number of linguists and researchers in their scientific work. Studies show that psycholinguistics psychologically studies the studied language problems. In other words, psycholinguistics studies language or speech in the following areas:

- description of speech information based on the mechanisms of speech formation and perception

- the study of the functions of speech activity in society

- Study of the relationship between speech information and the characteristics of the participants in the speech (conversion of the speaker’s intentions into information, their intervention in events)

- analysis of the development of speech in connection with the development of personality

Psycholinguistics is primarily a field of linguistics that explores speech as a psychological phenomenon. Psycholinguistics is considered the inner world of speaking and listening, writing and reading. Therefore, he does not study “dead” languages.

Psycholinguistics has arisen in connection with the importance of a theoretical understanding of a number of practical issues related to linguistics. There is not enough linguistic knowledge when analyzing a text, not a speaker. For example, when teaching a native language, especially a foreign language; in the field of speech therapy and speech therapy for preschool children; problems of speech exposure (mainly in the promotion and work of the media); forensic psychology and forensics. In addition, for example, psycholinguistics is required

to recognize people by their speech functions, solve problems of machine translation and gain access to a computer for talking information.

Thus, psycholinguistics is closely related to general linguistics. In addition, he constantly interacts with sociolinguistics, ethno-linguistics and applied linguistics.

### References:

1. Брунер Дж. Онтогенез речевых актов // Психолингвистика. – М. 1984.
2. Выготский Л. С. Избранные психологические исследования. – М., 1956.
3. Леонтьев А.А. Основы психолингвистики. – Изд. 3-е. – М.: СПб., 2003.
4. Леонтьев А.А. Психолингвистика // Тенденции развития психологической науки. – М., 1989.
5. Леонтьев А.А. Психолингвистические единицы и порождение речевого высказывания. – М., 1969
6. Миллер Дж. Психолингвисты // Теория речевой деятельности (Проблемы психолингвистики). – М., 1968.
7. Пиаже Ж.П. Речь и мышление ребенка. – М./Л., 1932.
8. Osgood C.E. Psycholinguistics // Psychology: a Study of a Science/ S. Koch (Ed.). V. 6. – New York, 1963.
9. Dubois D. Theories linguistiques, modeles informatiques, experimentation psycholinguistique – Paris, 1975.
10. Əsgərov M. Psixolinqvistika ilə bağlı yeni nəzəriyyə. AMEA Nəsimi adına Dilçilik İnstitutu. Türkologiya. Beynəlxalq elmi jurnal. Bakı, 2013, №2, s.4-13
11. Əsgərov M. Linqvopsixologiya və ya dilin psixologiyası. Bakı, 2011.
12. Əsgərov M. Linqvo-psixoloji vəhdət nəzəriyyəsi. Bakı, 2015.
13. С.Багирова. Гюльмира Садиева-Куруоглу: "Говорить об искусственном интеллекте как о нависшей угрозе пока рано". 19.07.2016. <http://echo.az/article.php?aid=103068>
14. Выготский Л. С. Избранные психологические исследования. – М., 1956.
15. Леонтьев А.А. Основы психолингвистики. – Изд. 3-е. – М.: СПб., 2003.

## PHYSICAL-MATHEMATICAL SCIENCES

### REGULARITIES OF RELATIVE CHANGES IN THE VOLUME OF SUBSIDENCE SOIL OVER TIME AT DIFFERENT VALUES OF VERTICAL AND HORIZONTAL PRESSURES IN THE CONDITIONS OF THREE-AXIS TESTS

**F.G. Gabibov, L.A. Aliyeva**

*Azerbaijan University Of Architecture And Civil  
Engineering*

#### **Abstract**

Carried out studies of the stress-strain state of loess subsidence of soils of the city of Mingechaur (Azerbaijan) in the context of triaxial tests. The studies were carried out on a stabilometer, in which the change in volume deformations was determined using a volumeter. Graphs of changes in the volume of soil samples over time with different changes in the intensity of stress and lateral pressure were constructed. The increase in volume deformations occurs when the vertical and horizontal stresses are equal. When vertical stresses exceed horizontal stresses, there is a decrease in volumetric deformations and destruction of soil samples.

**Key words:** *volumetric deformations; destruction of soil samples; stress-strain state.*

Few works are devoted to the study of the stress-strain state of subsidence soils under the conditions of three-axis tests. These works include the works of A.I. Pilyugin [1, 2] and previously published articles by the authors [3-6].

The present studies, as well as the previous ones, were carried out on loess-like subsidence soils (type II in subsidence) of Mingechaur (Azerbaijan), the physical and mechanical characteristics of which are given in the previous work of the authors [3].

The studies were carried out on a stabilometer (fig. 1 and 2) in which the changes in volumetric deformations were determined using a volumometer.

The volumometer is equipped with an independent stabilometer AT No. 8/65, the design of the main parts of which (fig.1), compared to the standard design, is equipped with a spring dynamometer 19, a clock type indicator 20 with an accuracy of 0.01 mm, an air compressor 21, polyethylene hoses 23, a volumetric glass of the volumometer 24 and a reducer.



The principle of operation of the volumometer is as follows.

The compressed air from the compressor 21 is pressurized into the air collector 11, in the lower part of which there is a working fluid (water), which under pressure through the valves B3-5 and B3-2 begins to fill the compression chamber 2 through the base valve 8. A valve 15 is designed to displace air from the compression chamber. At the same time, through B3-2, the water level in the volumetric glass 24 begins to rise. The valve B3-1 is designed for the outlet of the air displaced from the volumometer.

When the liquid level rises, the volumometer may overflow. In this case, with the help of the valve B3-3, the liquid is drained through the valve B3-4. When the water level is set in the middle of the measuring glass, the valve B3-5 is blocked, thereby transferring the system from the filling mode to the measurement mode.

The transfer of horizontal (lateral) stress to the sample 16 is carried out by means of hydrostatic pressure of the liquid (water).

The axial load  $P$  is transferred to the sample 16 by the upper die 14 using the rod 3 through a lever device. The axial deformation of the sample is determined by the clock type indicator 25.

Volumetric deformations are measured with a volumometer.

The general technique of the experiments was as follows. Pressure was applied to the sample: first lateral and then vertical. At these constant pressures, the soil was deformed. The values of these deformations were recorded. After stabilizing the deformation of the dry soil, the tap 12 was opened and the soil from the tank 6 began to be moistened with water. The moment of the beginning of humidification was fixed. The total deformation of the moistened soil consisted of deformations of the dry and deformations of the moistened sample.

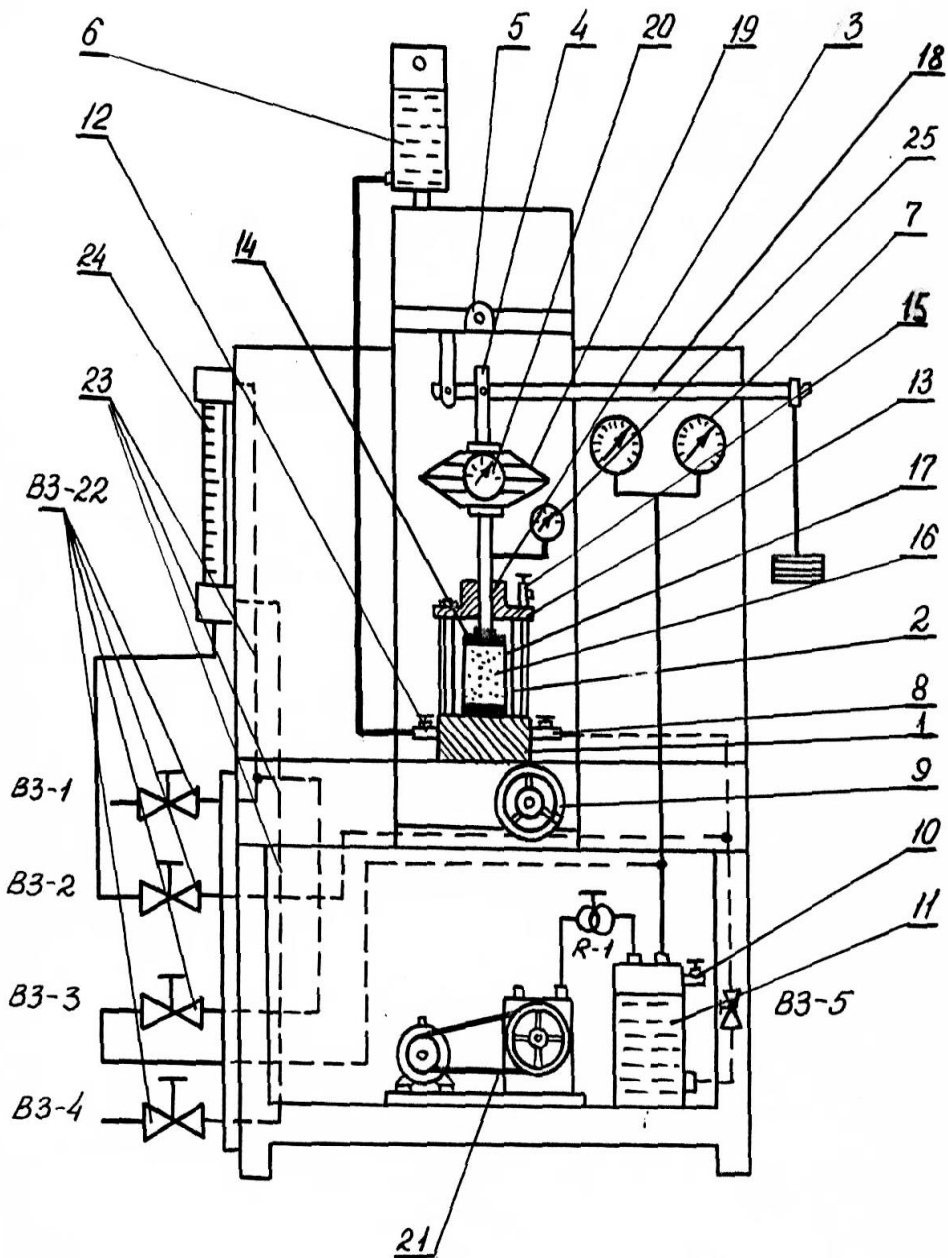
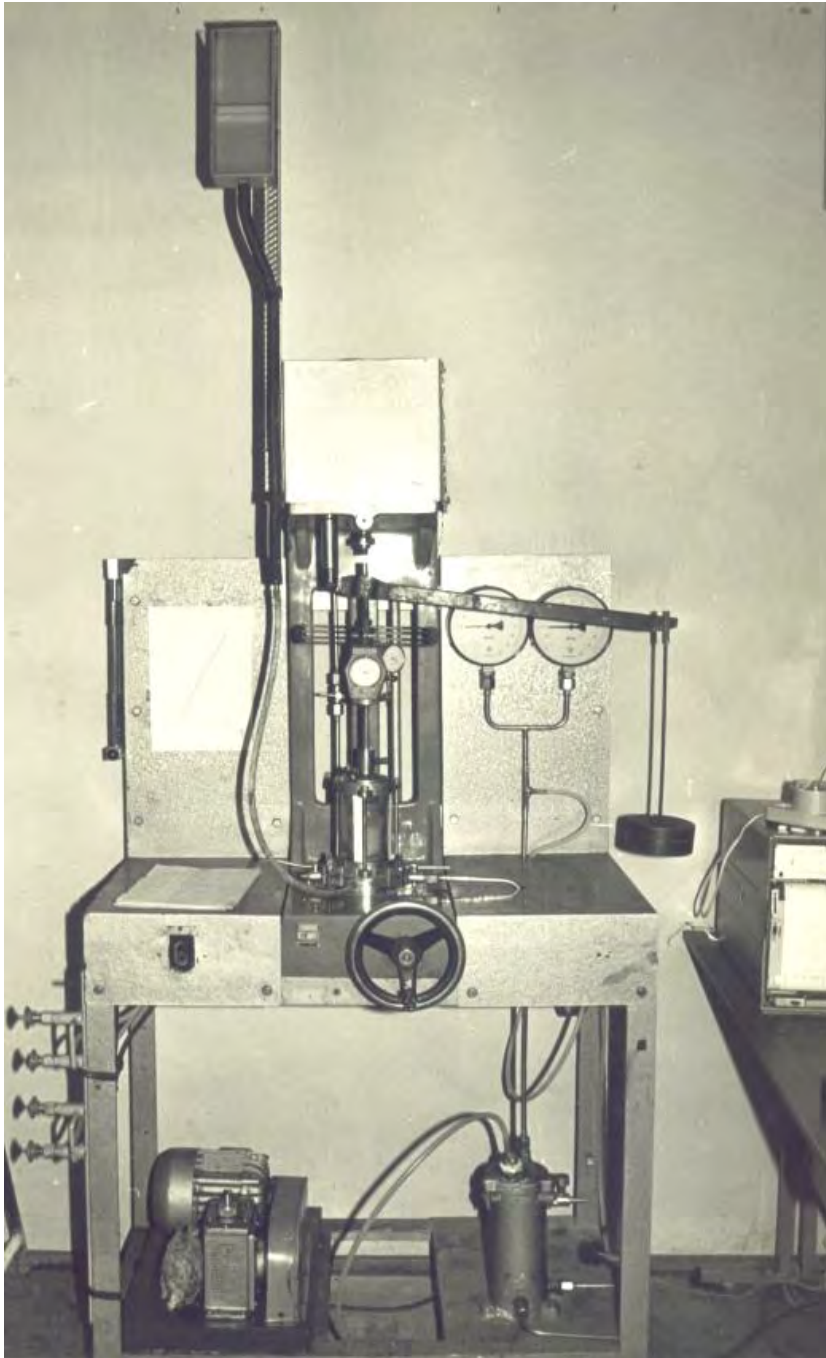


Fig.1. Structural diagram of the stabilometer with volumetr



**Fig.2. Photo image of the stabilometer**

The experiments were carried out before stabilization of deformation or before destruction of the soil sample. The sample 16, enclosed in a rubber sheath, is covered with a glass cover and attached by means of hinged bolts to the base 1. Through the hole in the neck of the cap 13, a pressure piston 14 is installed, in the upper part of which there is a dynamometer 19 with an indicator of the clock type 20.

By means of the lever 18 lowered the pressure bolt 4 together with the dynamometer 19 and the indicator 20 making sure that the indicator reading was equal to 0.

In the initial state of the valve volumeter are in the following position: B3-1, B3-3closed; B3-2,B 3-5open.

Turn off the compressor 21 and fill the compression chamber 2 with the working fluid, while opening the valve 15 to exit the air displaced by the working fluid.

At the same time, after B3-2, raise the level of the working fluid in the volumetric glass of the volumeter. When the working fluid reaches the level of the red mark, the valve B3-2 is closed, thus the filling mode of the volumeter is considered complete. Close the valves B3-4 and B3-5. Create in the compression chamber 2 comprehensive horizontal pressure according to the working program  $P=0,1; 0,2; 0,3$  MPa.

After stabilizing the deformation of the soil sample 16 open the valve B3-3, transferring the system to the measurement mode.

The all-round horizontal pressure in the chamber 2 is fixed by the pressure gauge 7.

After stabilization of the total horizontal pressure  $P$  at each value vertical pressures are applied to the sample:

$$\sigma = \frac{N}{F} = 0,05; 0,1; 0,15; 0,2; 0,25; 0,3 \text{ MPa}$$

For each specific value of the vertical and all-round horizontal pressures applied to the sample in the dry state, it is necessary to wait for the deformation to stabilize. After that, through the valve 12, we feed water from the tank 6 for soaking the soil sample 16.

Without changing the value of the vertical load, we observe the indicator readings after 5; 10; 15; 30 minutes; 1; 2; 3 hours, etc. after the water supply on the first day and after 3 hours on the second and following days. The measurements are carried out till the stabilization of the absolute deformation or to failure of the sample.

Measurement of volumetric changes of the soil sample is made on the volumetric glass, measured in millimeters.

To characterize the stress-strain state of the soil, it is convenient to use a certain ratio of stress and strain components, which would not change when the coordinate axes of the section under consideration are rotated. Such generalized quantities, which are invariants with respect to the coordinates are:

$$\sigma_{av} = \frac{\sigma_x + \sigma_y + \sigma_z}{3} = \frac{\sigma_1 + \sigma_2 + \sigma_3}{3} ; \quad (1)$$

the average linear strain

$$\varepsilon_{av} = \frac{\varepsilon_x + \varepsilon_y + \varepsilon_z}{3} = \frac{\varepsilon_1 + \varepsilon_2 + \varepsilon_3}{3} = \frac{\varepsilon_v}{3} \quad (2)$$

the stress intensity

$$\sigma_i = \frac{1}{\sqrt{2}} \sqrt{(\sigma_1 - \sigma_2)^2 + (\sigma_2 - \sigma_3)^2 + (\sigma_3 - \sigma_1)^2} ; \quad (3)$$

the intensity of deformation subsidence

$$\varepsilon_i = \frac{\sqrt{2}}{2(1 + \mu)} \sqrt{(\varepsilon_{sl_1} - \varepsilon_{sl_2})^2 + (\varepsilon_{sl_2} - \varepsilon_{sl_3})^2 + (\varepsilon_{sl_3} - \varepsilon_{sl_1})^2} . \quad (4)$$

The generalized values  $\sigma_{cp}$ ,  $u$ ,  $\varepsilon_{cp}$  characterize the change in the volume of the soil sample during planting,  $\sigma_i$  and  $\varepsilon_i$  - the change in its shape.

Deformation properties of soils are described by stresses and strains:

$$\varepsilon_i = \varphi(\sigma_i); \quad (5)$$

$$\sigma_{av} = \varphi(\varepsilon_{av}). \quad (6)$$

With axisymmetric triaxial compression  $\sigma_1 = \sigma_z$ ,  $\sigma_2 = \sigma_3 = \sigma_r$ , which takes place in our studies  $\sigma_z > \sigma_r$ ;  $\varepsilon_1 = \varepsilon_z$ ;  $\varepsilon_2 = \varepsilon_3 = -\varepsilon_r = -\mu\varepsilon_z$ , and we will have

$$\sigma_{av} = \frac{\sigma_z + 2\sigma_r}{3}; \quad (7)$$

$$\varepsilon_{av} = \frac{\varepsilon_z + 2\varepsilon_r}{3}; \quad (8)$$

$$\sigma_i = \sigma_z - \sigma_r; \quad (9)$$

$$\varepsilon_{sl_i} = \frac{1}{1 + \mu} (\varepsilon_{sl_z} + \varepsilon_{sl_r}). \quad (10)$$

The stresses in the sample and its deformations are defined by the following expressions:

$$\sigma_z = \sigma_i = P + \frac{N}{F}, \quad (11)$$

$$\sigma_z = \sigma_2 = \sigma_3 = P, \quad (12)$$

$$\varepsilon_z = \varepsilon_1 = \frac{\Delta h}{h}, \quad (13)$$

$$\varepsilon_r = \varepsilon_3 = \varepsilon_2 = -\frac{\Delta d}{d}. \quad (14)$$

Generalized characteristics of the stress-strain state of the sample, taking into account (11)–(14), will take the form of axisymmetric loading:

$$\sigma_{av} = \frac{\sigma_1 + 2\sigma_3}{3} = \frac{N}{3F} + P, \quad (15)$$

$$\varepsilon_{av} = \frac{\varepsilon_1 + 2\varepsilon_3}{3} = \frac{1}{3} \left( \frac{\Delta h}{h} - \frac{2\Delta d}{d} \right), \quad (16)$$

$$\sigma_i = |\sigma_1 - \sigma_3| = \frac{N}{F}, \quad (17)$$

$$\varepsilon_{sl} = \frac{l}{l + \mu} |\sigma_1 - \sigma_3| = \frac{l}{l + \mu} \left( \frac{\Delta h}{h} - \frac{\Delta d}{d} \right). \quad (18)$$

According to the conducted experiments, fig. 3 - 5 show graphs of changes in the relative volume of samples of the studied soil over time at different values of stress intensity and lateral (horizontal) pressure.

Analysis of the graphs shows that for all cases of soil stress, there is an increase in the values of relative deformations over time. However, as can be seen from the graphs, the relationship of bulk soil deformations with stress intensity and lateral pressure has some features.

So, for example, as follows from fig.3, at horizontal pressures

$$\sigma_r = 0,1 \text{ MPa},$$

the relative volume deformations increase to the values of the stress intensity equal to

$$\sigma_i = 0,1 \text{ MPa}$$

Then with the increase in stress intensity is a gradual decrease in the relative volumetric deformation of the soil.

Analyzing the graphs of fig. 4,  
it can be seen that at horizontal pressures

$$\sigma_r = 0,02 \text{ MPa} ,$$

the increase in the relative volume deformations of the soil is observed up to the values of the stress intensity equal to

$$\sigma_i = 0,02 \text{ MPa} .$$

Starting from this value, the relative volume deformations decrease.

A similar pattern is also observed for values of horizontal (lateral) pressure  $\sigma_r = 0,03 \text{ MPa}$  (fig. 5).

The relative volume deformations increase up to the intensity

$$\sigma_i = 0,03 \text{ MPa value} .$$

Thus, according to experimentally established dependencies, the increase in relative volume deformations occurs at values of the stress intensity

$$\sigma_i = \sigma_r .$$

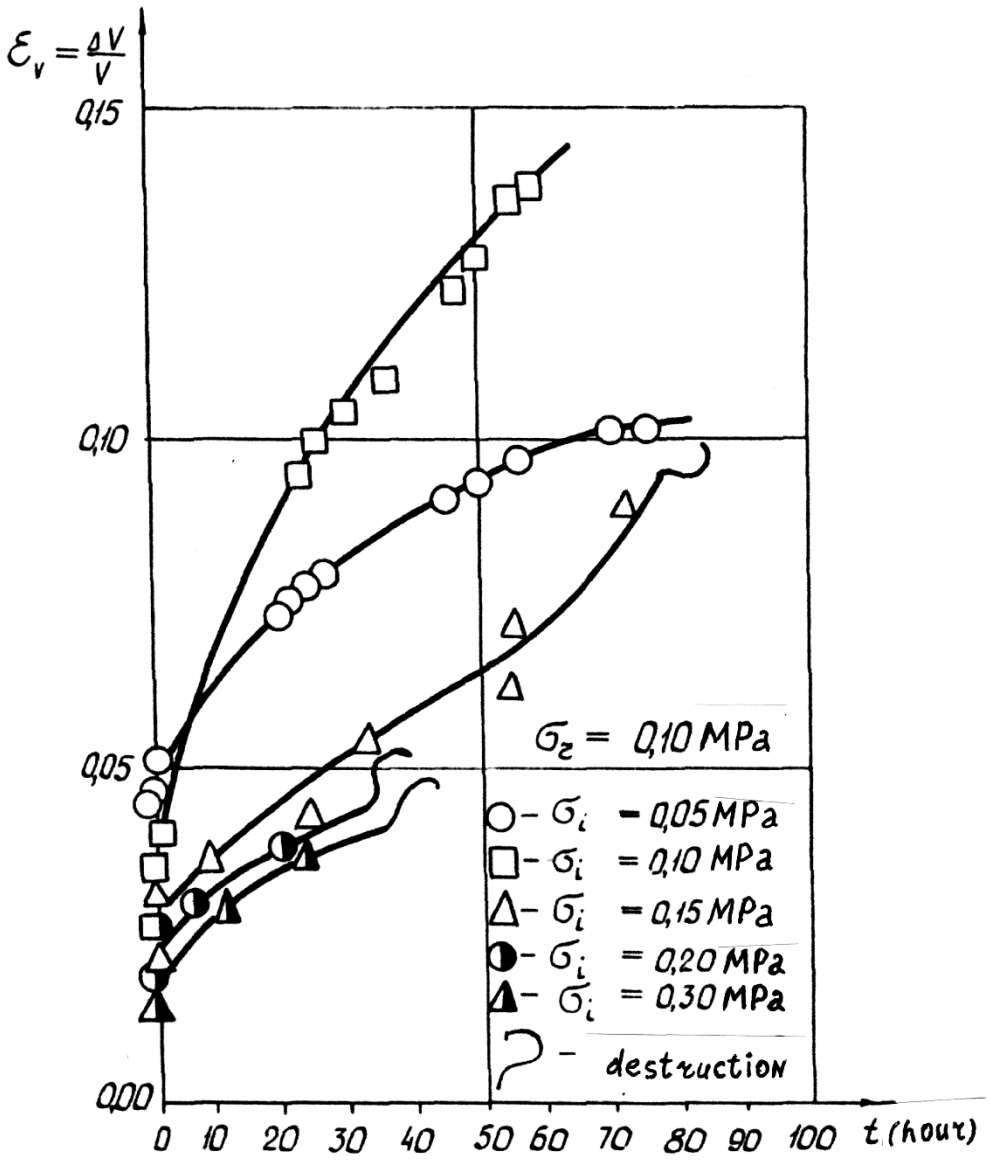


Fig.3. Graphs of the relative volume strain dependence in time at  $\sigma_r = 0,2 \text{ MPa}$



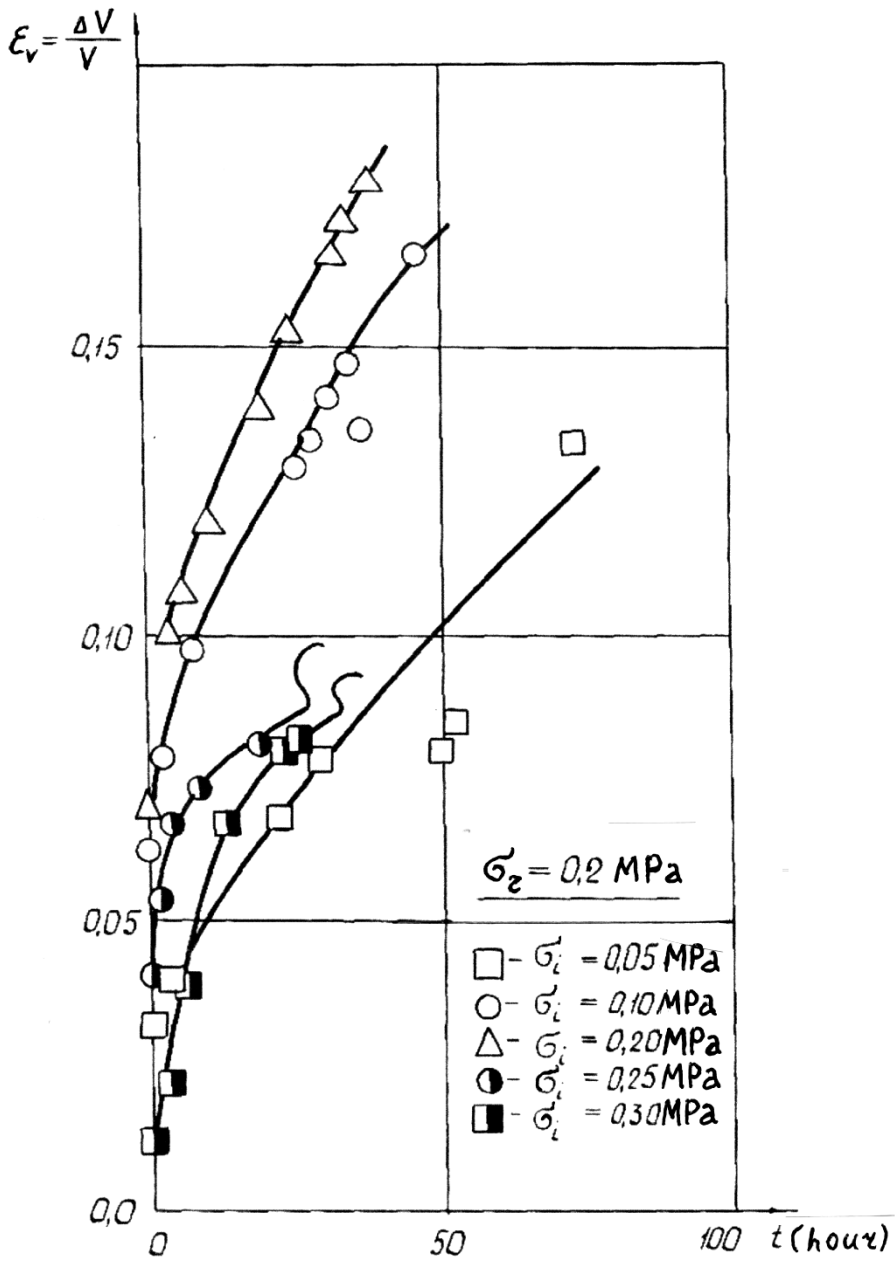


Fig.4. Graphs of the relative volume strain dependence in time at  $\sigma_r = 0,2 \text{ MPa}$

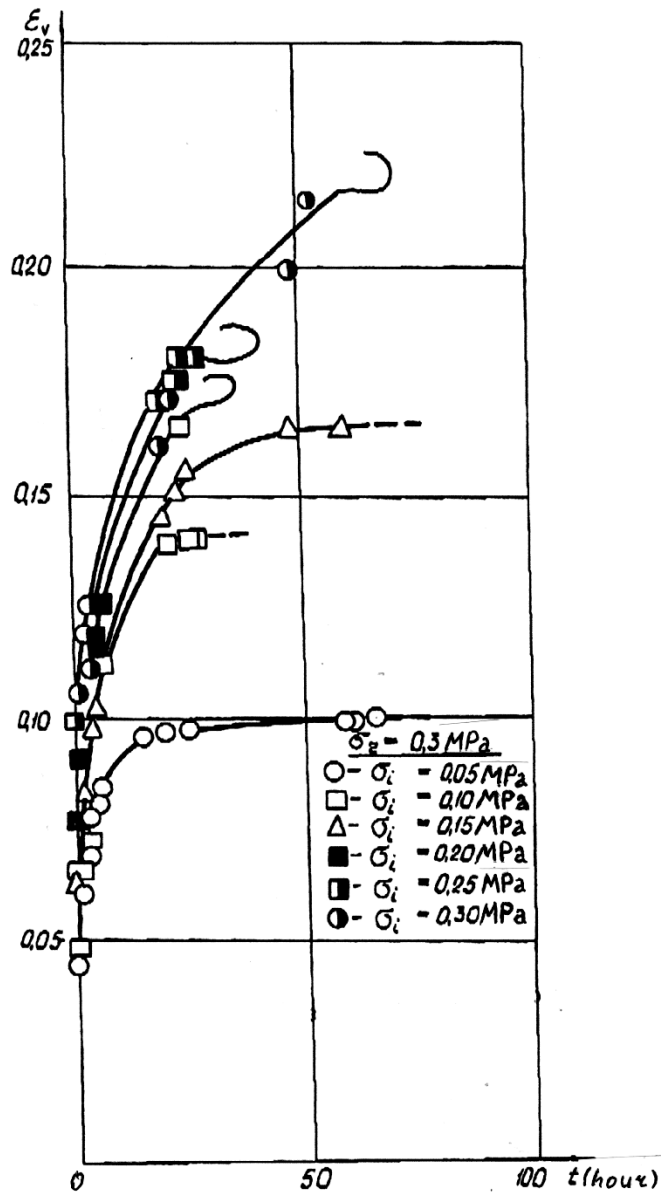


Fig. 5. Graphs of the relative volume strain dependence in time at  $\sigma_r = 0,3 \text{ MPa}$

At values

$$\sigma_i > \sigma_r,$$

a decrease in the relative volume deformations of the subsidence soil is observed. In addition, it should also be noted that, according to experimental data, the destruction of soil samples usually occurs at stress intensities

$$\sigma_i > \sigma_r.$$

### References

1. Pilyugin A.I. On lateral pressure during subsidence of loess soils. "Base, foundations and soil mechanics", № 1, Moscow, 1961.
2. Pilyugin A.I. Determination of the estimated value of the expected subsidence of loess soil based on the results of a three-axis test. Scientific reports of VODGEO "Hydrogeology", Moscow, 1962.
3. Alieva L.A., Gabibov F.G. Regularities of changes in the intensity of subsidence soil deformations over time at different values of stress intensity and lateral pressures in three-axis tests. "Theoretical and applied mechanics", №. 1, Baku, 2009, pp. 96-101.
4. Alieva L.A., Gabibov F.G. Study of the regularities of changes in the average relative deformation of subsidence soil depending on the normal stress at different values of lateral pressure in three-axis tests. "Ecology and water management", №. 5, Baku, 2008, pp. 87-91.
5. Alieva L.A., Gabibov F.G. Investigation of the regularities of changes in the average deformations of subsidence soils over time at different values of the average normal and lateral compacting pressures during three-axis tests. "Budivelni designs", Issue 71, Book 1, Kiev, NIISK, 2008, pp. 251-259.
6. Alieva L.A., Gabibov F.G. Investigation of the dependence of subsidence soil deformations on the intensity of stresses during three-axis tests. "Ecology and water management", №. 3, Baku, 2009, pp. 69-73.

## SEISMIC PROTECTION OF UNDERGROUND DAMS BY USING RECYCLED WASTE

<sup>1</sup>F.G. Gabibov, <sup>2</sup>E.M.Shokbarov, <sup>3</sup>L.F.Gabibova

<sup>1</sup>*Azerbaijan Research Institute of Construction and Architecture, Baku, Azerbaijan, farchad@yandex.ru*

<sup>2</sup>*Kazakh Scientific Research Institute of Construction and Architecture, Almaty, Kazakhstan, eshokbarov@kazniisa.kz*

<sup>3</sup>*"HALLI BURTON" company, Houston, USA, leyli17@yahoo.com*

### Abstract

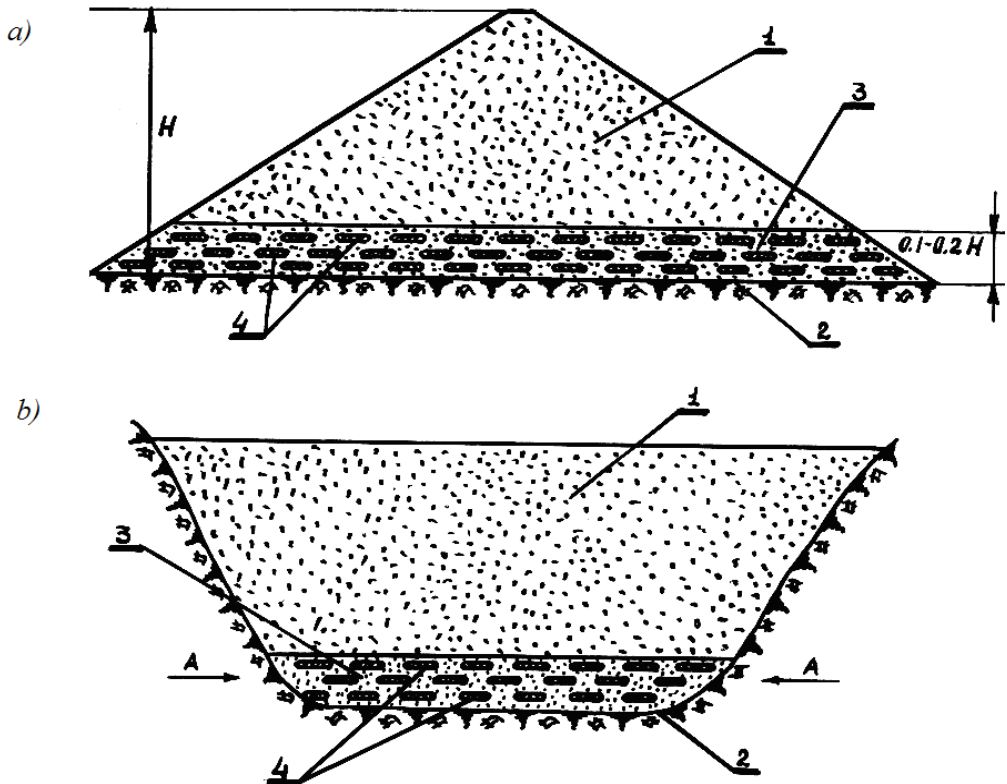
Designs of ground dams with a seismic isolation layer located between the dam body and its ground base have been developed. The seismic insulation layer is formed using recycled metal-cord tires filled with qumbrin. A new construction of a seismic-resistant ground dam with reinforcing elements is also described. The reinforcing elements are made of concrete blocks formed in two recycled tires of different sizes installed on top of each other, which are filled with concrete.

**Key words:** *ground dams; seismic isolation layer; reinforcing elements.*

Ground dams are currently the main type of retaining structures designed and constructed in areas of high systematic activity. Therefore, the task of ensuring their system stability is particularly urgent, and for its successful solution, it is necessary to use all the tools available to engineers. One of the constructive measures to improve the seismic resistance of group dams is a solution based on the use of the principle of seismic isolation. In this case, a horizontal layer or several layers of soil are arranged in the body of the structure (in its lower part), the dynamic characteristics of which differ significantly from those of the main soil of the dam. This design solution is characterized by an active principle of operation - it is able to regulate (in the direction of reduction) the level of seismic load on the structure without increasing the cost of the dam [1].

The principles of operation of this design solution-seismic isolation, the essence of which is to place between the structure (dam) and the source of seismic vibrations (base) of the soil layer dynamic stiffness, which is significantly (not less than 1.5-2.0 times) different from that of the ground body of the dam. Under certain conditions, in the absence of local soils with the required dynamic stiffness characteristics for the insulating layer, the latter is formed from imported soil, which is very expensive. The authors have developed new designs of earthquake-resistant ground dams.

Earthquake-resistant ground dam, built in wide openings (fig.1) consists of an upper main part 1 of the dam located between the main part of the dam body and base 2 seismic isolation layer 3 is formed by installing in it inclusions of the same type disposed of metal-cord tires 4, the cavity of which is filled with gumbrin 5 [2].



**Fig. 1. Earthquake-resistant ground dam, built in wide sections: a) cross section; b) longitudinal section.**

The dam is constructed as follows. At the beginning, the Foundation of 2 dams is prepared, then the seismic isolation layer of 3 dams is constructed, for example, from the conditioned soil of local quarries, consisting of a mixture of sand and gravel. In the seismic isolation layer 3 of 0.1 to 0.2 the height of the project embankment dam installed included in the form of recycled steel 4 tires from heavy trucks, such as BelAZ, with an external diameter of 3 m and a width of the tread part 0.8 m, the cavity of which is filled with gumbrin 5. Gumbrin is a waste treatment technology of industrial oils.

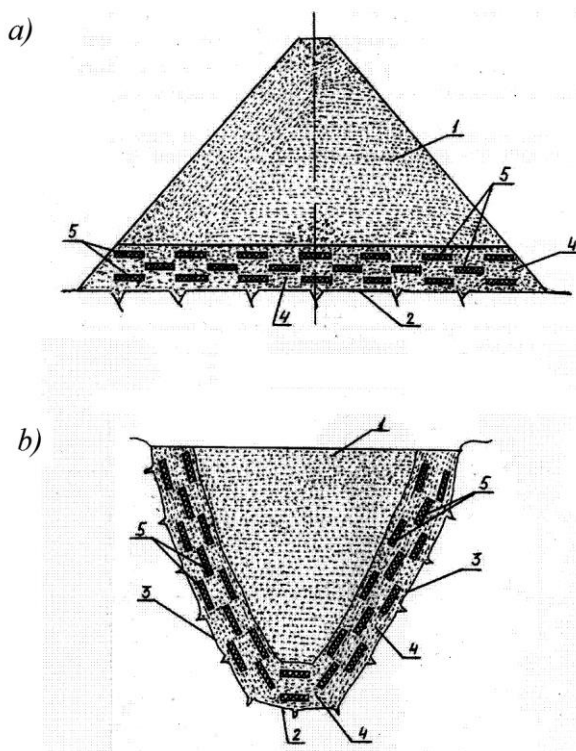
This waste is obtained from bentonite clay, which is used for cleaning technical oils. This waste accumulates in large quantities in the landfills of oil refineries.

Tires 4 are laid horizontally in a staggered order with an equal step. After stacking tires one of a number of the cavity is filled with the seal gumbrin 5.

Then, in a separate row, the space between the tires is filled with air-conditioned local soil with a seal. Above the specified layer, a layer of conditioned local soil, no more than 0.8 m thick, is filled in. After this, the tires 4 are again laid on the resulting compacted ground surface, which are filled with gumbrin 5 and the spaces between the tires are filled with conditioned local soil with a seal. Moreover, the tires in the vertical plane should be staggered. Then the self-insulating layer is laid in the above sequence. In our case, three rows of tires filled with gumbrin are placed in the seismic isolation layer in the vertical plane.

The dynamic stiffness of the resulting seismic isolation layer is at least 70% lower than the dynamic stiffness of the local conditioned soil used for laying the upper main part of the soil dam. In addition, reinforced rubber shells of inclusions of the seismic isolation layer give it additional damping properties. For earthquake-proof earth dams constructed in narrow sections proposed another constructive solution (fig.2).

The dam consists of the main part 1, dam body and located around the contact of the dam with base 2 and sides 3 target seismic isolation layer 4 which is formed by installing the layer of inclusions in the form of recycled metal-cord tires 5, the cavity of which is filled with gumbrin [3].



**Fig. 2. Earthquake-resistant ground dam, built in narrow sections: a) cross section;  
b) longitudinal section.**

The use of these new structures allows us to achieve increased dampness and diffraction due to the unique technical properties of waste (tires and gumbrin). Soil reinforcement is one of the structural measures used on dams of small and medium height to increase their seismic resistance.

The presence of rebar in the ground gives it a kind of grip, turns an incoherent soil into a coherent one. By supplying rebar in the zone of tensile dynamic stresses, a significant increase in the strength of the soil dam is achieved in the event of an earthquake [4, 5].

For the first time, the use of recycled metal-cord tires from heavy-duty vehicles for reinforcing the support prisms of group dams was proposed by F. G. Gabibov and others [6].

F. Schlosser and A. Vidal (France, 1969) introduced two conditions that determine the behavior of the armo-soil-as a single array: - friction  $\tau$  along the contour of the reinforcement and the ground must satisfy the Coulomb condition, that is

$$\tau = \frac{1}{2B} \frac{dE}{dx} < K\sigma \quad (1)$$

- the tensile stress in a complex armature must be less than the tensile strength  $R$ , that is

$$F / S < R \quad (2)$$

where  $F$  is the tensile strength of the rebar;  $\sigma$  -ground pressure on the valve;  $K$  - coefficient of friction of the reinforcement on the ground;  $B$  - the minimum width of the complex strip of rebar;  $S$  -average cross-sectional area of complex fittings.

The authors developed a new design of a seismic-resistant group dam (fig.3) with reinforcing elements using recycled metal-cord tires [7, 8].

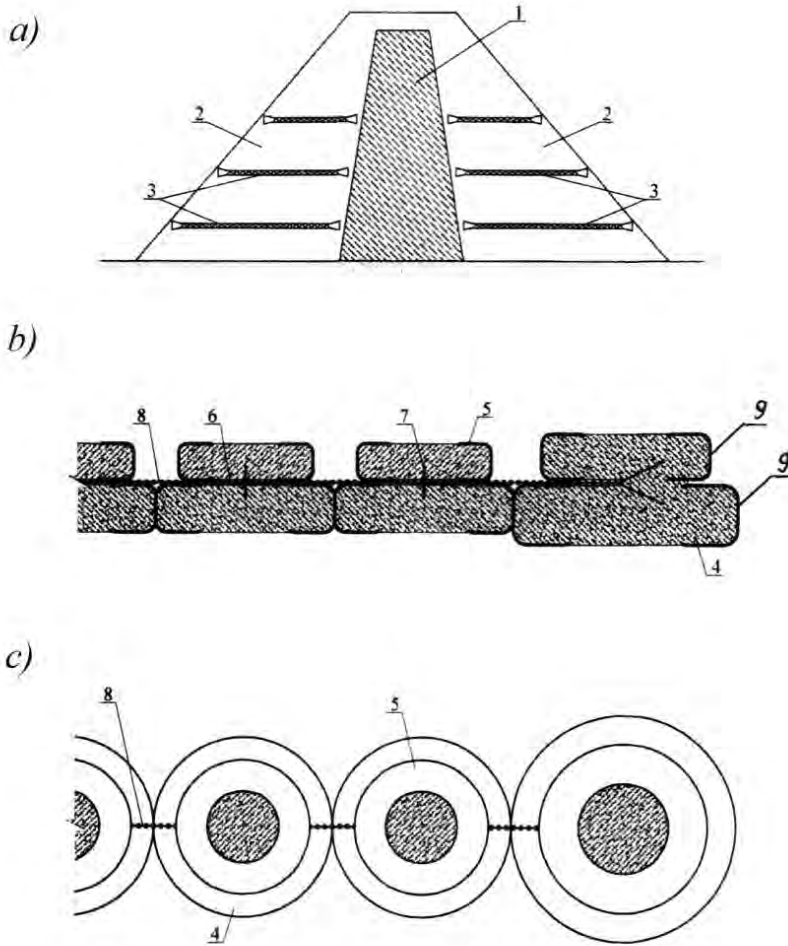
The dam includes a core 1, side prisms 2 and reinforcing elements 3.the Reinforcing element consists of concrete blocks made of two paired concrete disks. In this case, the disks of larger diameter 4 are located below the disks of smaller diameter 5.

Channels 6 are formed in concrete blocks and metal parts 7 are placed. smooth steel rods 8 pass through channels 6, rigidly attached to metal parts.

Channels 6 are formed by covering the surface of the struts with a composition that excludes the coupling of the struts with the concrete blocks. Concrete disks 4 and 5 are formed using recycled metal-cord tires 9, which serve as a permanent formwork in the manufacture of disks 4 and 5.

As shown by field observations soil of the dam during construction are experiencing significant deformation of the extension. At the same time, horizontal displacements of points located in slopes exceed vertical deformations by 25-30%. However, there are almost no horizontal deformations near core 1. But precipitation reaches the highest values due to high vertical stresses from the proper weight of prisms 2 and the transfer of part of the weight of the core 1 to them during its consolidation.





**Fig. 3. Earthquake-resistant ground dam with reinforcing elements: a) a cross section of the dam; b) a fragment of the reinforcing element (longitudinal section); c) fragment of the reinforcing element, top view.**

During the construction of the dam, as well as during seismic impacts on it during operation, reactive friction forces are formed in the reinforcing elements directed towards the core 1. Thus, preliminary stresses will be created that compress the side prisms of the dam and prevent the formation of internal sliding surfaces.

Rubber-reinforced coating (tires) 3 concrete blocks allows you to create a natural layer of waterproofing of the concrete blocks themselves and due to the damping properties of reinforced rubber to achieve a noticeable increase in the seismic isolation of the dam.

### References

1. Natarius Y.I. Increasing the seismic resistance of dams from ground materials. Moscow: Energoatomizdat, 1984, 88 p.
2. Gabibov F.G., Gabibova L.F. and others. Earthquake-resistant ground dam, built in wide openings. Patent of the Russian Federation for invention №. 2556896, 2015.
3. Gabibov F.G., Gabibova L.F. and others. Earthquake-resistant dam, built in narrow sections. Patent of the Russian Federation for invention №. 2558280, 2015.
4. Jones K.D. Structures made of reinforced soil. Moscow: Stroizdat, 1989, 280 p.
5. Lyather V.M., Ivashchenko I.N. Seismic stability of ground dams. Moscow: Nauka, 1986, 280 p.
6. Gabibov F.G. et al. Earthquake-resistant ground dam. Patent of the Republic of Azerbaijan for inventions №. i 20130038, 2013.
7. Shokbarov E.M., Gabibov F.G., Gabibova L.F. Method of manufacturing concrete blocks of reinforcing elements of the dam from local materials. Patent of the Republic of Kazakhstan for invention №. 33961, 2019.
8. Shokbarov E.M., Gabibov F.G., Gabibova L.F. Dam from local materials. Patent of the Republic of Kazakhstan for invention №. 33971, 2019.

## AGRICULTURAL SCIENCES

### EFFECT OF MAGNETIZED WATER USING THE MAGMATRIX APPARATUS ON YIELD AND QUALITY WHEAT INDICATORS

<sup>1</sup> C.M.Talai, <sup>2</sup> E.N.Khalilov, <sup>1</sup> A.A.Zamanov, <sup>1</sup> T.I.Allahverdiyev,  
<sup>1</sup> I.Q.Ibrahimova, <sup>1</sup> Q.M.Hasanova

<sup>1</sup>Ministry of Agriculture of Azerbaijan, Agricultural Research Institute,  
talai\_akinchi@mail.ru

<sup>2</sup>Azerbaijan Section of the International Academy of Science H&E,  
prof.khalilov@ias-as.org

#### Abstract

Laboratory and field studies of the effect of magnetized water were carried out using the MAGMATRIX SMA apparatus on the yield and quality indicators of wheat. The results of the experiments revealed an increase in the green mass and root system of the germinated wheat grains when irrigated with magnetized water, both without using the soil and the seeds planted in the soil layer. In both cases, when using the MAGMATRIX SMA apparatus in laboratory conditions, a significant increase in the green mass and root system of germinated wheat grains is observed on the 14th day of irrigation with magnetized (experimental planting) water compared to irrigation with ordinary (control planting) water, more than 300%. Field experimental studies were carried out at the Absheron Experimental Base of the Scientific Research Institute of Agriculture of the Ministry of Agriculture of Azerbaijan. As a result of the experiment in the field, the positive effect of magnetized water on the Gobustan soft wheat variety during the research year, its growth size, quantitative and qualitative indicators were determined. Under the influence of magnetized water, the growth sizes of plants compared with plants grown on ordinary water were 1.65-6.59% higher, the size of the ear, the number and weight of grains in the ear were 12.4-15% higher, and the grain yield was higher 9 g/m<sup>2</sup> or 3.6%, quality and technological indicators of grain are higher by 1.62-8.74%.

**Key words:** magnetized water, soft wheat, plant height, productivity, structural elements of an ear, yield index, quality, bread volume.

#### Introduction

One of the main urgent problems facing the agriculture of Azerbaijan is considered to be water shortage, low fertility and soil salinity in most of the territory of Azerbaijan, which makes them unsuitable for agricultural needs. Against the backdrop of climate change, this problem shows itself most significantly. The total volume of world water reserves is 1390 million km<sup>3</sup>, of which 1340 million km<sup>3</sup> is accounted for by the oceans. Fresh water reserves

make up less than 3% of the total water volume. Of these, only 0.3% can be used from a technical point of view. Currently, more than 40% of the world's population suffers from a shortage of fresh water. Therefore, in the 21st century, the issue of shortage of fresh water is considered as a global problem of our time. This crisis situation in meeting the freshwater needs of the population and agriculture has arisen, first of all, due to climate change, a decrease in water resources due to pollution of the freshwater ecosystem, in addition, accelerated urbanization and the occurrence of changes in land use [1].

Agricultural production, land and water resources, as a system ensuring the food security of the world population, are under threat. In the future, these restrictions may be accelerated due to the use of short-term technologies in agriculture, social and economic pressure, as well as changes in climatic conditions. According to experts, in 2050 the world population will reach 9 billion and, as a result, the world's demand for food products will increase by 70%, and in developed countries an increase of approximately 100% is expected. Over the past 50 years, sown area has increased by 12%. Over the same period, the area of irrigated land increased by 2 times. Currently, 11% of land and 70% of fresh water in the world is allocated to agriculture for the production of plant products. In agriculture, by 2050, the area of irrigated land will increase by 6% and reach 318 million hectares [2].

In developing countries, irrigated land makes up 1/5 of all agricultural land, while at the same time it provides almost half (47%) of plant products, including 60% of grain. Relatively developed countries account for less than 1/5 part (17%) of the land allotted for irrigation areas for grain, 2/5 part (38%) of grain production. From this point of view, considered a strategic plant for the country, the sown area of wheat has changed over the past 5 years in the range of 539.7-679.1 thousand hectares. Up to 60% of Azerbaijan's wheat crops are irrigated. More productive use of irrigation water is required in order to obtain higher yields from wheat fields in our country [3].

In the process of growing agricultural plants, one of the main responsibilities is, especially in a dry climate, providing them with quality irrigation water. Water is considered the main substance necessary for all physiological processes. Water absorption takes place in various structures of plant cells at the nano level. Water unites all cells and tissues of the body into a single whole, participates in the creation and adjustment of membrane structures. It, being a solvent, is involved in many biochemical processes, its molecules are involved in oxidation. Water acts as a donor of electrons and protons in photosynthesis of the restoration of biosynthesis [4]. Therefore, scientists around the world are trying to develop and test new technologies aimed at improving the quality characteristics of water. One of such technologies is the MAGMATRIX magnetic water treatment technology developed by Professor Elchin Khalilov,

which we tested in laboratory and field conditions using the example of the Gobustan soft wheat variety.

### **Existing experience in applying magnetic irrigation water treatment to increase yield and grain quality**

A number of researchers have studied the effects of magnetic irrigation water treatment on plant growth. Studies were conducted in greenhouses. In the experiments, sunflower, corn and soybeans were planted in pots. The control group of plants was watered with tap water, and the experimental group of plants - with magnetized water once a day. On the twelfth day, after the start of the experiment, it was found that when irrigated with magnetic water, the height of the sunflower increased by 21%, the height of soybeans by 40% and the thickness of the corn stalk increased by 26% compared with the control group of plants watered with tap water / 5 /.

N.A. Volkonsky in his studies showed that irrigation with magnetized water of rice plantings in Kazakhstan and the Kuban allowed to increase rice yield by 18% and reduce water consumption by 15% compared to control rice plantings irrigated with ordinary natural water /6/.

From 1974 to 1980, experiments were carried out in the Saratov region with spring wheat. In the control and experimental plots with an area of 84 hectares each, using Frigate sprinklers, the fields were irrigated with ordinary water and magnetized water in the experimental plot. As a result of the experiments, an increase in the yield of wheat irrigated by magnetized water was found to be about 20% / 7, 8 /.

The calculation of economic efficiency from irrigation of spring wheat with magnetized water, only for the Volga region, gives an economic effect of 2.5 million rubles (more than \$ 4 million) per year / 9 /.

N.V. Yakovlev and K.I. Kolobekov found that irrigation with magnetized water promotes the development of a more powerful assimilation apparatus, the accumulation of a large photosynthetic potential, and dry underground biomass. Reducing the alkalinity of the soil contributes to the conversion of nitrogen, phosphorus and potassium into a more digestible form by plants. The content of these elements in plant samples irrigated with magnetized water was 10-15% higher than that of the control / 8 /.

Interesting research results on irrigation of winter wheat crops with magnetized water were obtained in the Andijan region of the Republic of Uzbekistan. Due to the magnetic treatment of irrigation water, field germination of seeds, compared to control, increased by 0.5 ... 4.3%, plant safety by 0.9 ... 4.3%, the number of plants to harvest by 3.6 ... 18.0 pcs/m<sup>2</sup>, productive stems by 32 ... 54 pcs/m<sup>2</sup>, spike length 1.2 ... 1.5 cm, the number of spikelets per spike 2 ... 3 pcs., The number of grains 0.5 ... 1.3 pcs., the mass of grain from one ear in

the variants with vegetative irrigation with magnetized water per 0.1 g, 1000 grains in the same variants 0.2 ... 0.7 g. As a result, the yield increase averaged 1.8 ... 5.7 kg/ha. The best results were achieved with treated water at least one vegetative irrigation / 10 /.

Another important factor is a significant decrease in calcium and magnesium bicarbonates in water, which makes the water softer and more favorable for irrigation use. After irrigation with magnetized water, the content of mobile forms of phosphate in the soils increases, and the nitrification ability in the upper horizons increases. Rinsing with a magnetized water of a two-meter monolithic soil layer showed that magnetized water leaches % 18 – 32% more salts than usual. More than 70% of the salts are washed out in the first washing cycles, while the magnetization efficiency is maintained during the mineralization of water at 7-8g / l / 9 /.

### **Experimental laboratory studies of the germination of wheat grains irrigated with magnetized water**

The laboratory experiment described in this paper is the 11th experiment with the same methodology and conditions. The previous 10 experiments conducted from February 5, 2018 to December 21, 2018 allowed us to obtain statistically identical results and were also carefully documented. Thus, the description and results of this experiment given in this conclusion can be considered statistically reliable and objective.

**The purpose of the experiment:** To check the effectiveness of the magnetic activation of water treated with the standard eco-Lid-Bio magnetic activator (ELB, Ukrainian production) and a new type of activator **MAGMATRIX SMA** (MM, Azerbaijani production) on the qualitative and quantitative characteristics of germination of wheat grains compared to irrigation with ordinary water.

#### **Experimental technique**

- The experiment was carried out using the same variety of wheat grains. Wheat grains were distributed in three plates, while plates on an electronic scale were previously weighed with an accuracy of 1 g. Grains weighing 40 grams were placed on each plate.

- Every day, at the same time (at 12:00), plates with grains were weighed before irrigation, and before weighing, all three plates were photographed together with a SONY high-resolution digital camera.
- There sult sofall weighings were enter edin the table.
- The experiment was conducted for 14 days.
- On day 14 (September 27, 2018) at 12:00, sprouted whe at samples were taken from the plates. All samples were cut green mass and weighed, there sultsareplacedin Table 1.
- The root system of all samples was weighed separately and the result sarelistedin Table 1.
- All three samples of cut green mass and root system were photographed.
- Compiled graphs of the dynamics of changes in the weight of germinating wheat throughout the entire period of the experiment;
- Comparative charts were made of the weight of the green mass of the sprouted wheat, the weight of the root system and the total weight of the green mass and the root system.
- Measurements were made of changes in pH, water hardness, concentration of oxygen dissolved in water, and surface tension of water.

### **The results of an experiment to study the germination of wheat grains irrigated with magnetized water without using a soil layer**

At the initial stage of the experiment, studies were carried out on changes in a number of properties of tap water as a result of magnetic treatment using a MAGMARTIX SMA apparatus. Studies have shown that after passing water through the MAGMARTIX SMA apparatus, within three hours there is a decrease in water of calcium and magnesium bicarbonate salts and, in general, water hardness by 23%, while the concentration of pure calcium and magnesium has not changed. The measurements were carried out by water evaporation.

It should be noted that standard hardness meters, based on the determination of the specific resistance of water, do not allow an objective assessment of the hardness of water, since, as a result of magnetic treatment of water, the content of ions, in particular hydrogen protons and oxygen concentration increases in water, which leads to an increase its electrical conductivity and reduced resistance.

At the same time, crystals of calcium and magnesium are formed in water, mainly during boiling, in the form of loose suspended flakes, which are easily destroyed by weak mechanical action.

The amount of oxygen bubbles contained in water two hours after the magnetic treatment of water increased by 250%. The pH of the water remained virtually unchanged (before magnetic treatment, the pH was 6.7, and after magnetic treatment, 6.3). The viscosity of water as a result of magnetic treatment decreased by 5-8%.

The results of weighing the green mass and root system of sprouted wheat on day 14 of irrigation are shown in Table 1.

**Table 1.**

<b>Name parameter</b>	<b>Plain water (control)</b>	<b>Magnetized water standard activator</b>	<b>Magnetized water apparatus Magmatrix</b>
Green mass weight	10	48	63
Root system weight	66	146	207
Total weight	76	194	270

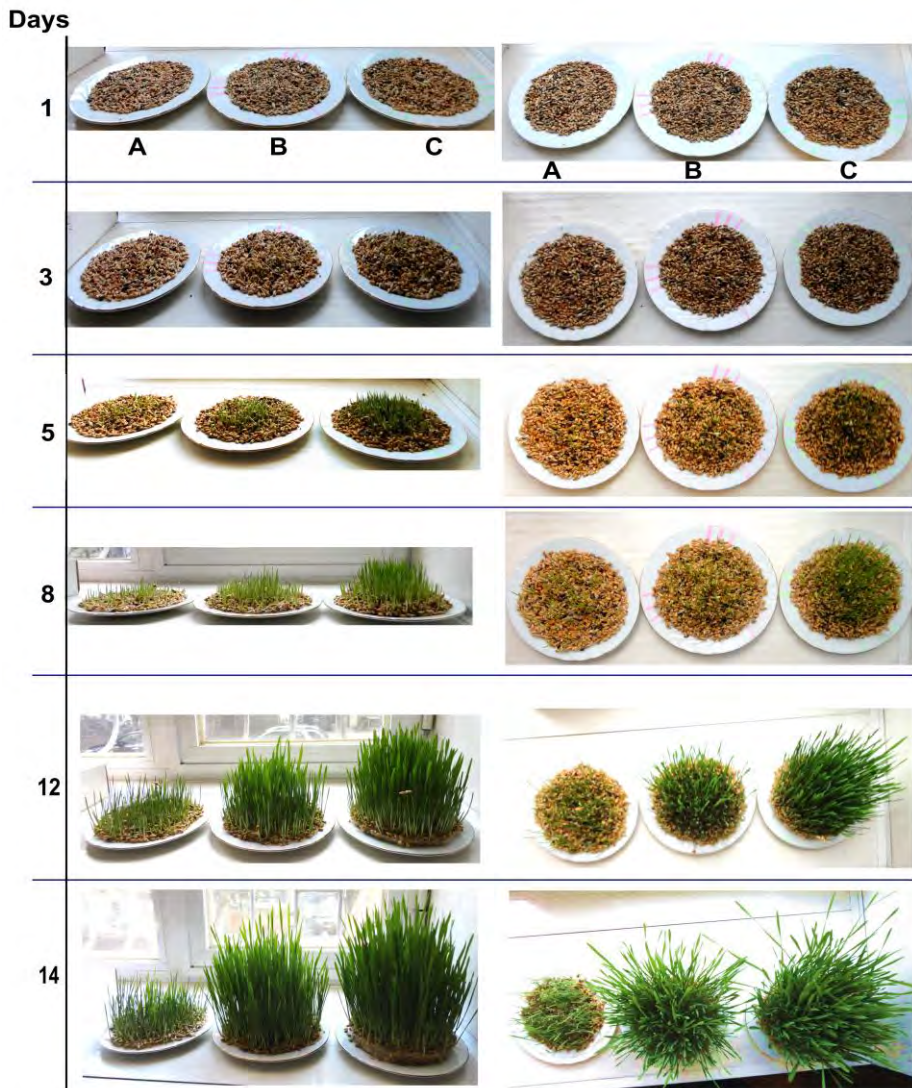
In the process of research, all three samples were photographed and a photo catalog was compiled as shown in Fig. 1. Samples of wheat grains are placed in plates: A (watered with ordinary tap water - control), B - watered with water activated with ELB, C - watered with water activated with MAGMATRIX. From top to bottom are six rows of photographs that correspond to the following days of the experiment: 1, 3, 5, 8, 12, 14.

During the experiment, it was noted that starting from the third day, the grain in the first plate began to emit a slight unpleasant odor, mold elements were noticed. From the grain placed on plates 2 and 3, the smell was not felt and mold was not observed until the 10th day of the experiment. Throughout the experiment, the unpleasant smell of decay intensified from wheat grains placed in plate A, accompanied by a significant increase in mold and yellow mucus. Starting from the 10th day, a faint rot and a small amount of mold were felt from the grain placed on plate B. At the same time, there was no smell from the grain in the plate C, mold was also not detected. External visual analysis and weighing results showed that the germination of grains in plate A lagged significantly behind the germination of grains in plates B and C.

Visual analysis showed that the sprouted wheat in plate A was quite rare with thin and weak stems. The wheat in plate B was significantly thicker and its stalks were significantly denser, and the green mass was larger. The root system of wheat in plate B was significantly more developed and the green mass was about twice as high in comparison with plate A. The root system of green wheat



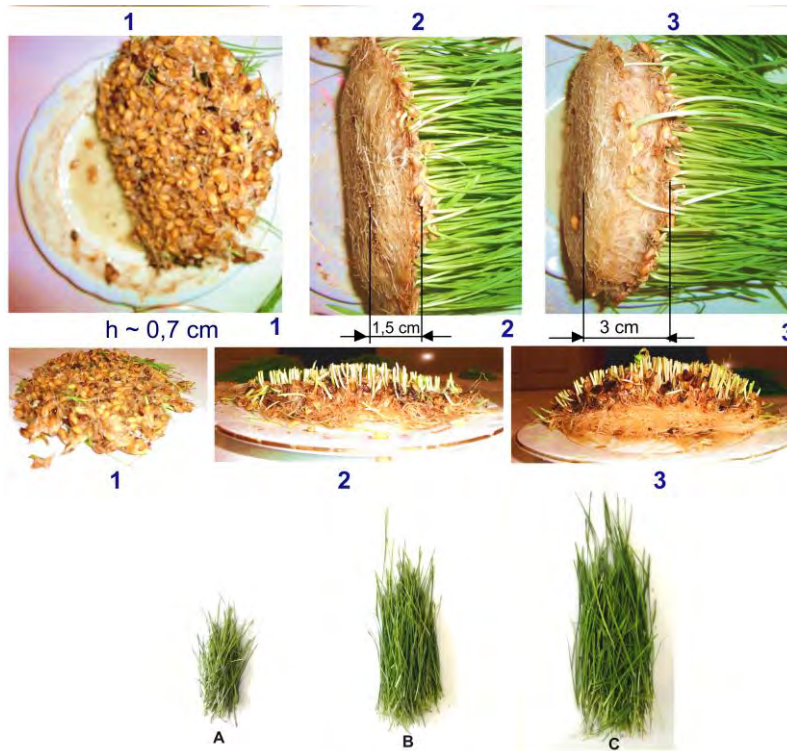
in plate C was significantly more developed compared to the root systems in plates a and b, and the green mass differed in thicker, higher and stronger stems compared to that in plates a and B.



**Fig. 1. The results of the experiment on irrigation of wheat grains with ordinary water - A, water magnetized with the ELB - B apparatus and water magnetized with MAGMATRIX.**

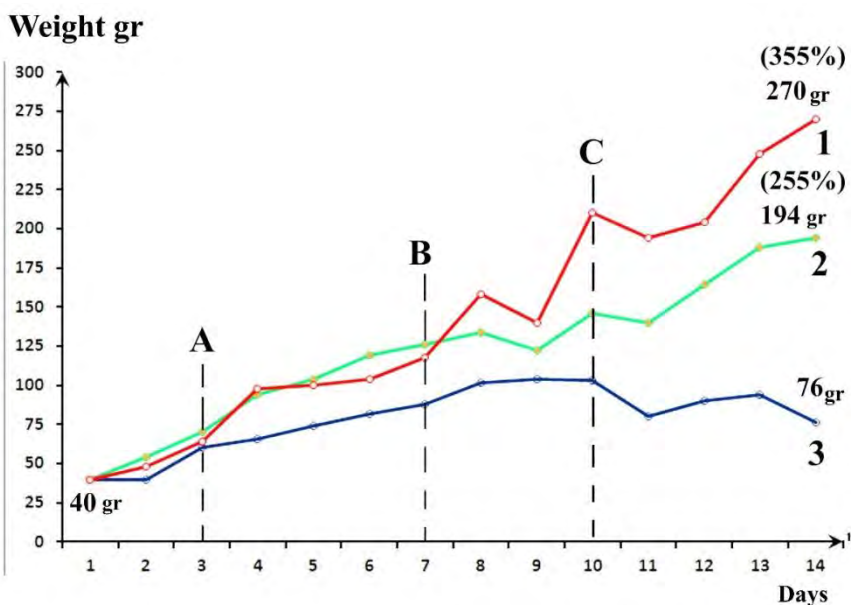
Fig. 2. the lower parts of the stems and root systems of wheat samples A, B, C are shown. A significant difference in the density and strength of the stems

and root systems of the samples can be noted. The root system of sample C is much more developed and thicker than the root systems of samples A and B. As can be seen from Fig. 2, the thickness of the root system of sample B is 1.5 cm and more than twice that of sample A, and the thickness of the root system of sample C is 3 cm and twice that of sample B.



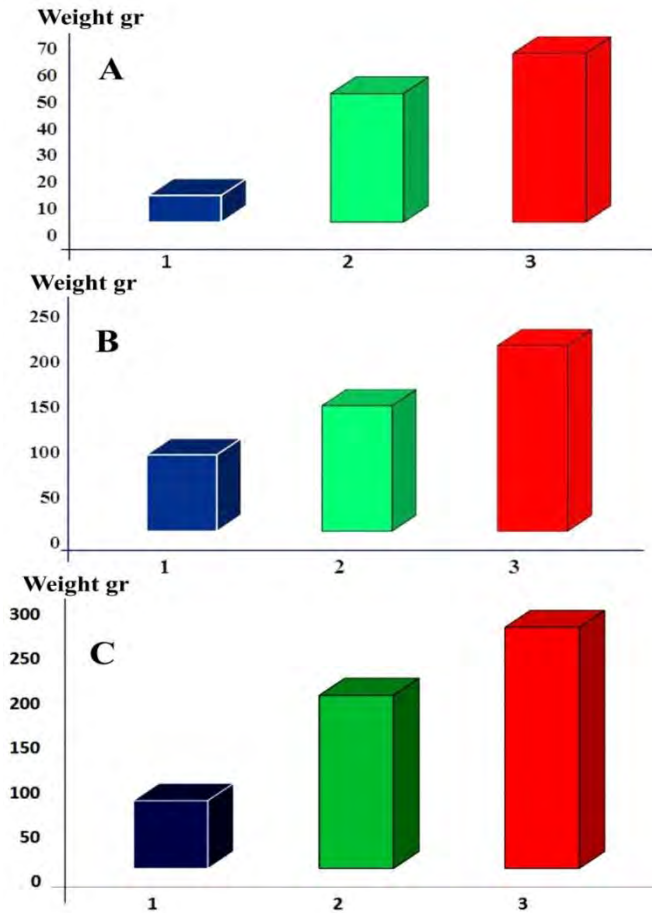
**Fig. 2. Comparison of quantitative indicators of the root system and the green mass of sprouted wheat being watered: 1- plain water; 2 - water magnetized by the ELB apparatus and 3 - magnetized by the MAGMATRIX apparatus.**

The weight gain of the root system of sample B compared with the weight of sample A is 221%, and the weight of sample C is 314% higher than that of sample A, and 42% higher than that of sample B. The increase in the total weight of the green mass and the root system of sample B compared to sample A is 255%. The increase in the total weight of sample C compared to sample A is 355%, and compared to sample B is 40%. An analysis of the growth dynamics of the weight of sprouted wheat shows an interesting pattern, which can be divided into three main stages - I, II and III. As can be seen from the graphs in Fig. 3, until the 3rd day of the experiment, the weight of all three samples increased almost identically. However, after the third day, in stage I, the weight gain of the sprouted wheat in samples B and C was ahead of the weight gain of sample A.



**Fig.3. Dynamics of weight growth of sprouted wheat (green mass + root system):**  
**1 - when watering with water activated by a MAGMATRIX magnetic activator; 2**  
**- when watering with water activated with a standard magnetic activator; 3 -**  
**when watering with ordinary tap water.**

Moreover, the growth dynamics of the weight of samples B and C was almost the same. However, starting from the 7th day, in stage II, the dynamics changed sharply: the increase in the weight of sample C began to outstrip the growth in the weight of sample B. Moreover, the increase in the weight of sample B was still ahead of the weight of sample A. In stage III, starting from 10 day, the difference in weight growth between samples B and C increased sharply, while the weight of sample A from that moment began to decrease. Fig. 4. diagrams are shown showing the weight of the root systems and green masses of all three samples - A, B and C as a result of the experiment.

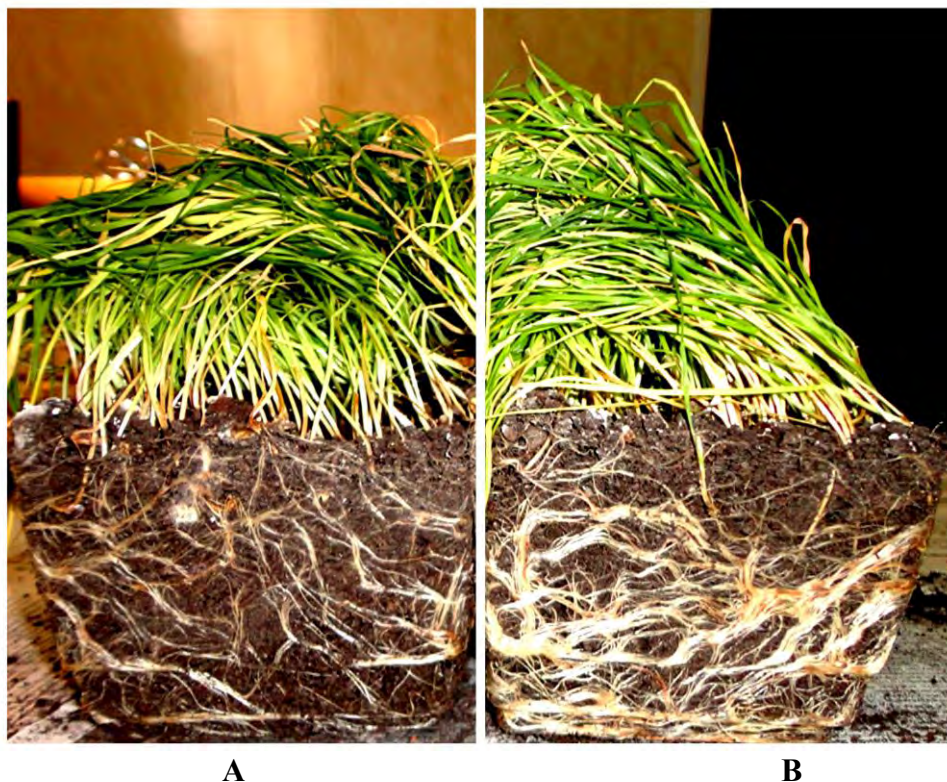


**Fig. 4. Charts showing the weight of root systems and green masses: A - Weight of green mass; B - Weight of the root system; C - The total weight of green mass + root system. 1 - when watering with ordinary tap water; 2 - when watering with water activated with a standard magnetic activator; 3 - when watering with water activated by a MAGMATRIX magnetic activator.**

On the 14th day, the weight of sample A significantly decreased, the weight growth of sample B slowed down, and the weight growth of sample C, on the contrary, increased.

**The results of an experiment to study the development of the root system of wheat grains irrigated with magnetized water using a soil layer**

At the next stage, we conducted an experiment on irrigation with ordinary and magnetized water using a MAGMATRIX apparatus of wheat grains in pots with fertilized compost soil. On day 14 of watering, sample A watered with plain water and sample B watered with magnetized water were removed from the pots.



**Fig. 5. Root systems of sprouted wheat planted in pots with soil layer on the 14th day of watering. A - irrigated tap water; B - irrigated magnetized water.**

As can be seen in the photo, Fig. 5, the root system of sprouted wheat grains on the 14th day of irrigation watered with magnetized water is significantly more developed and has a larger mass compared to the root system of wheat grains watered with tap water. The difference in weight of the root systems is 62%. In order to have an active development of the vegetative mass, a plant needs to have a well-developed and branched root system. The root system not only supplies the plant with water and nutrients. The formation of complex organic substances from mineral compounds of nitrogen and phosphorus, as well as a number of other chemical transformations, take place in the roots. The

importance of the root system for plant growth and their quality indicators was pointed out by many authors /11-13/. In addition, a well-developed root system of plants effectively restores, improves and preserves the soil structure, making it more fertile, rich in biomass, trace elements, a significant amount of proteins, carbohydrates and other compounds necessary for plant growth. In the photograph (Fig. 5), it can be clearly distinguished that in the lower part the root system, watered with magnetized water, is much more developed. Therefore, in vivo, the roots of a prototype wheat will penetrate deeper horizons. It should be emphasized the important role of wheat roots penetrating to a great depth. In areas where soil moisture is insufficient, deeply located roots most effectively supply a wheat plant with water from lower horizons. Due to this, in arid and hot regions, irrigation of wheat with magnetized water will increase its vitality and productivity.

### **The results of field studies of the effect of magnetized water on yield and quality indicators of wheat growth**

The aim of the research is to study the effect of magnetized water on growth indicators, yield, spike structural elements and quality indicators of grains. For this purpose, field experiments were set up at the Absheron Experimental Base of the Scientific Research Institute of Agriculture on an area of 50 m<sup>2</sup> in 3 repetitions and 2 versions Fig.6. The climate of Absheron, being mainly moderately hot and dry, has favorable conditions. Absheron is a region of Azerbaijan with low precipitation (200-400mm/year) and strong winds. On the Absheron Peninsula, mainly the gray-brown type of land with alkaline properties, with carbonates in it, is widespread, the amount of humus in the plowing layer is small and amounts to 1.27-1.32%. As an object of research, the used Gobustan variety of soft wheat was grown under irrigation with magnetized and non-magnetized (ordinary water) waters. Watering plants with magnetized water was started in the first decade of April 2019. Magnetic treatment of water was carried out using the apparatus MAGMATRIX SMA /14/.



**Fig.6. An experimental plot for planting wheat irrigated with magnetized water.**

Watering was started from the phase of plant entry into the tube and continued during the growing season of the formation and filling of grains. During this growing season, watering was carried out 4 times. Based on the calculation of the irrigation water norm per hectare of  $700 \text{ m}^3$ ,  $3.5 \text{ m}^3$  of water was supplied to an experimental field of  $50 \text{ m}^2$ . In total,  $14 \text{ m}^3$  of water was supplied to the experimental field. In both variants, plants were grown in the optimal regime of mineral nutrition (N90, P90, K90).

In experiments, we studied the dynamics of growth indicators at different stages of the organogenesis of the vegetative period of the soft wheat variety Gobustan.

The effect of magnetized water on the growth characteristics of the plant was traced from the phase of wheat exit into the tube to the phase of wax ripeness of grain. Plants of their constant growth sizes reach the beginning of the phase of wax ripeness of grain. It was determined that the growth sizes of plants changed depending on growing conditions.

**Table 2.**

**The effect of magnetized water on the growth indicators of the common wheat variety Gobustan in various periods of ontogenesis, sm (Absheron, 2019)**

TEST Option	Dates / phases of development						
	04.04 exit to a tube	04.23 exit to a tube	04.30 end of the exit to the tube	07.05 heading	10.05 bloom	21.05 milk ripeness of grain	10.06 wax ripeness of grain
<b>Magnetized water</b>	67,3	67,9	92,3	99,5	101	108,4	111,8
<b>Common water</b>	65,1	66,8	89,2	95,8	98,3	101,7	106,3
<b>Difference sm</b>	<b>2,2</b>	<b>1,1</b>	<b>3,1</b>	<b>3,7</b>	<b>2,7</b>	<b>6,7</b>	<b>5,5</b>
<b>Difference%</b>	<b>3,40</b>	<b>1,65</b>	<b>3,47</b>	<b>3,86</b>	<b>2,75</b>	<b>6,59</b>	<b>4,92</b>

That is, during these vegetation periods, plants were grown under irrigation with magnetized water and had growth sizes of 67.3-111.8 cm, and plants irrigated with ordinary water had a product growth of 65.1-106.3 cm. In the year of study, a high coefficient of variation (4.92-6.59%) was achieved in the vegetation phases of milk ripeness and wax ripeness. In ontogenesis, the growth sizes of plants grown with magnetized water were 1.1-5.5 cm or 1.65-6.59% higher than plants grown with ordinary water. The main difference in plant growth was manifested at the end of the reproductive phase of the growing season, during the phase of milk and wax ripeness. Magnetized water had a positive effect on the growth size of plants and the difference between the options was 1.6-6.7 cm (table 1). Growing conditions also affected the yield of plants and the structural elements of the ear. Depending on the growing conditions, there was a difference in the size of the ear, the number and weight of grains. That is, in plants grown on magnetized water the number of grains in one spike averaged 51.5 pieces, and their weight was 2.14 grams, while in plants grown on ordinary water, these figures were 45.8 pieces, respectively and 1.86 grams. As can be seen, in the plants grown on magnetized water, the size of the spike and household indicators were larger than the plants grown on ordinary water, and this difference varied between 2.65-15%. This difference in the structural elements of the spike ultimately affected the yield indicators (table 3).



**Table 3.**  
**The effect of magnetized water on yields and structural elements of the ear of the Gobustan soft wheat variety (Absheron, 2019)**

Test Options	Spike width, sm.	Spike Length sm.	Spike Mass gr.	The number of grains in the spike, pcs.	of grains in the spike, gr.	Harvesting grain gr/m <sup>2</sup>
<b>Magnetized water</b>	1,55	9,79	2,76	51,5	2,14	553
<b>Common water</b>	1,51	9,48	2,45	45,8	1,86	534
<b>Diference,%</b>	2,65	3,30	12,6	12,4	15,0	3,60

The natural mass of 1000 grains characterizing the physical properties of the grains did not have a particular difference. This difference compared with plants grown in ordinary water varied within 0.71-0.76%. In plants grown on magnetized water, the number of harvested trunks was 427.3 units/m<sup>2</sup>, and in another embodiment was 418.4 units/m<sup>2</sup>. The growing conditions for the Gobustan soft wheat variety also affected business performance.

From this point of view, in plants grown on magnetized water, the sheaf weight per unit area was 1452 g/m<sup>2</sup>, grain productivity 553 g/m<sup>2</sup>, and in plants grown on ordinary water these figures are respectively 23 g/m<sup>2</sup> or 1.61% less and 19 g/m<sup>2</sup> or 3.6%.

The yield of plants grown on magnetized water was higher; this had a positive effect on their yield index. The yield index calculated as the ratio of grain yield to the total mass of the sheaf in plants grown on magnetized water was 0.38, and in another embodiment 0.37. This means that in plants grown on magnetized water, the share of yield in the total biomass is 38%. According to the crop index, the difference was 2.7% (Table 4).

**Table 4.**  
**The effect of magnetized water on the economic indicators of the “Gobustan” soft wheat variety (Absheron, 2019)**

Test Options	Sheaf weight gr/m <sup>2</sup>	Harvesting gr/m <sup>2</sup>	The number of shoots pcs / m <sup>2</sup>	Crop index
<b>Magnetized water</b>	1452	553	427,3	0,38
<b>Common water</b>	1429	534	418,4	0,37
<b>Diference,%</b>	<b>1,61</b>	<b>3,60</b>	<b>2,13</b>	<b>2,7</b>

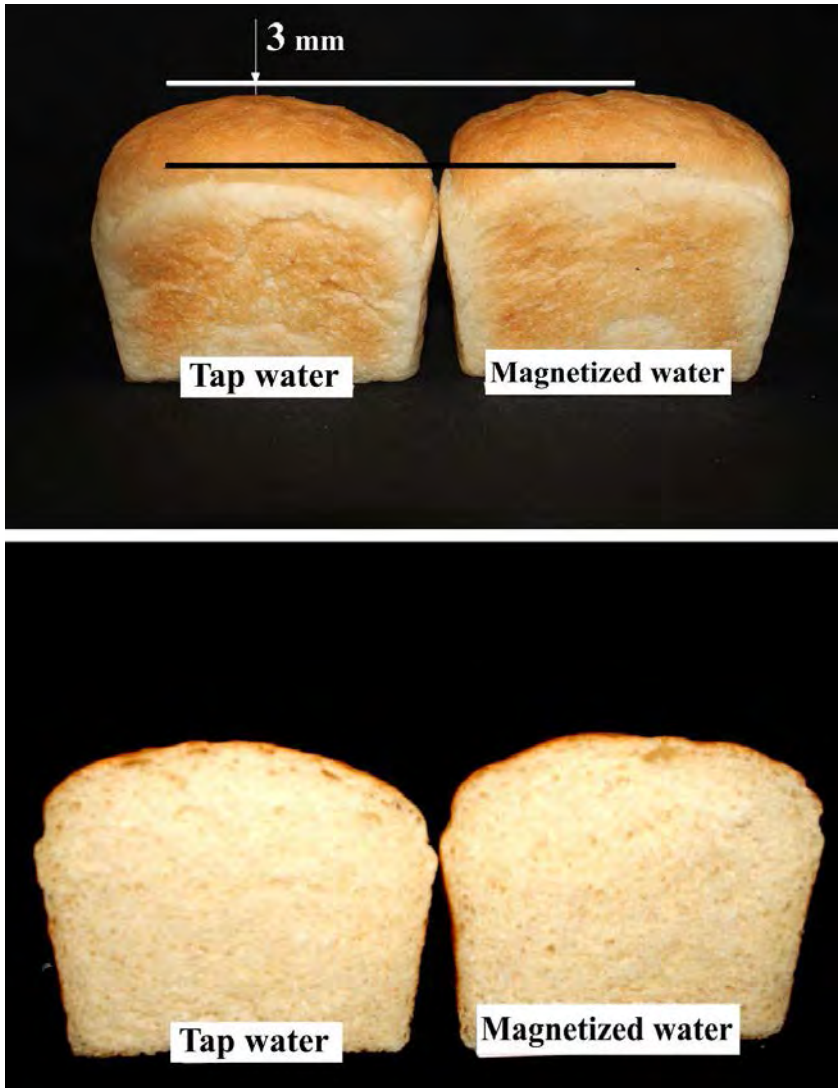
Magnetized water had a positive effect on the quality indicators of the Gobustan soft wheat variety. That is, in plants grown on magnetized water, the vitreousness, which is the physical property of grain, was 49.8%, the amount of protein was 11.2%, the amount of gluten was 25.1%, and the quality unit for gluten of NIR was 88.8.

**Table 5.**  
**Qualitative and technological indicators of the “Gobustan” soft wheat variety grown on magnetized water (Absheron, 2019)**

Test Options	Weight 1000 grains gr.	Glassy ness %	Gluten %	IDK	Protein %	Grain nature g/l	Bread volume sm <sup>3</sup>	The quality of bread in balls
Magnetized water	42.5	49.8	25.1	88.8	11.2	798	590	4.8
Common water	42.2	43.2	24.7	91.9	10.3	792	547	4.6

This shows that the difference in quality indicators for plants grown in ordinary water is not large, with the exception of vitreous.

At the same time, magnetized water had a positive effect on the quality of gluten. In both cases, the quality of gluten in grown plants meets the requirements of the 3rd class of the State Standard. Bread made from flour grown on magnetized water meets the standards and its volume is 590 cm<sup>3</sup>. The difference in bread volume was 7.86% Fig.7.



**Fig.7. This photo shows the difference in the size of bread baked from wheat flour, watered with plain water and magnetized water.**

Thus, the positive effect of magnetized water on the Gobustan soft wheat variety, its growth size, quantitative and qualitative indicators was determined during the research year. Under the influence of magnetized water, the growth sizes of plants compared with plants grown on ordinary water were 1.65-6.59% higher, the size of the spike, the number and weight of grains in the spike were 12.4-15% higher, and the grain yield was higher 9 g/m<sup>2</sup> or 3.6%, quality and technological indicators of grain are higher by 1.62-8.74%.

## Equipment used

During the experiment, devices for magnetic water treatment were used: the standard Eco-Lid-Bio (ELB) apparatus manufactured in Ukraine and invented by prof. E.N.Khalilov apparatus MAGMATRIX SMA /14/. Both devices are based on the use of powerful permanent neodymium magnets. Meanwhile, in the design of the ELB, magnets are used located on the outer surface of the housing inside which water passes, and in the MAGMATRIX SMA apparatus water passes through a magnetic matrix, while water passes through a system of magnets. The physical principle of MAGMATRIX is patented and consists in the fact that to increase the efficiency and reduce the size and weight of the device for magnetic activation of water, the system of permanent magnets is made in the form of a three-dimensional matrix. Magnetic granules are collected in a matrix with the greatest possible tight packing. The three-dimensional matrix has a three-dimensional spiral structure along a passing stream of water, which causes a swirl of water. In addition, the magnetic matrix provides the maximum and uniform magnetic energy density in the entire volume of the working chamber of the MAGMATRIX magnetic water activator, unlike all existing analogues. Induction of the magnetic field of the magnetic matrix at any point in its volume is 5000 Gauss.

Thus, in this device, the liquid is simultaneously exposed to four types of exposure, contributing to its most effective magnetic activation and structuring: alternating magnetic field with maximum induction of exposure to water; vortex flow (Schauburger effect); high turbulence, which ensures good miscibility of all fluid layers; infrasound exposure, destroying water clusters.

Due to the fact that the water passing through the pores of the magnetic matrix adheres to the surface of the magnets as much as possible, the magnitude of the induction of the magnetic field directly affecting the water, on average, is more than 100 times higher than the similar indicator of all magnetic water activators existing today.



**Fig. 8. Magnetic water treatment devices MAGMATRIX.**

## References

1. Wikipedia, ru.m.wikipedia.org
2. Management of systems at risk, FAO, 2012, 310, art.
3. www.earthscan.co.uk. Water for food, water for life: A Comprehensive Assessment of water Management in Agriculture. London: Earthscan, and Colombo: International Water Management Institute, 2007, 5 6p.
4. Yulchiev B. Magnetic water and wheat productivity. Scientific and technical progress: agriculture and crop production, p. 37-38
5. Dardymov IB, Brekhman II, Krylov A.V. in the book: "Questions of hematology, radiobiology and biological effects of magnetic fields." Tomsk, Tomsk University, 1965, p. 325-328.
6. Volkonsky N.A. "Hydrotechnics and land reclamation." 1973, No. 9.
7. Yakovlev K.P., Kolobenkov K.I., Polyakov N.I. Steppe open spaces, 1977, No. 10, p. 38-39.
8. Yakovlev K.P., Kolobenkov K.I. Magnetic treatment of water systems. Abstracts of the All-Union Meeting. M., NIITEKHIM, 1981, p.142.
9. Klassen V.I. Magnetization of water systems. Moscow, Chemistry, 1982, p.270.
10. Yulchiev B. Achievements of science and technology of the agro-industrial complex. No. 7, 2011, p. 37-38
11. Zinchenko S.I., Bezmenko A.A., Schukin I.M., Taleva D.A., Development of the root system of grain crops in agroecosystems on gray forest soil. Achievements of science and technology of the agro-industrial complex, No. 4, 2013, p. 20-21.
12. Krasilnikov P.K. The methodology of the field study of the underground parts of plants. - L., 1983. 127-132.
13. Ustimenko A.S., Danilchuk P.V., Gvozdikovskaya A.T. Root systems and productivity of agricultural plants: ed. N.G. Gorodnogo. Kiev. - 1975.368 s.
14. MAGMATRIX SMA. Device for magnetic activation of water. Specifications TŞ AZ 1305917371.001-2019. Effective December 3, 2019. Certificate of conformity
15. No. AZ031 ASI 01/35/00856.19

## **RESULTS OF TESTS OF THE INFLUENCE OF IRRIGATION OF MAGNETIZED WATER USING THE "MAGMATRIX AGRO" TECHNOLOGY TO VEGETABLE GROWTH**

**<sup>1</sup> E.Allahverdiyev, <sup>2</sup> E.Khalilov, <sup>1</sup>A.Ibrahimov**

*<sup>1</sup>Scientific Research Institute of Vegetable Growing  
of Ministry of Agriculture of Azerbaijan.*

*<sup>2</sup>International Academy of Science H&E – AS  
e-mail: prof.khalilov@ias-as.org*

### **Introduction**

In recent decades, in many countries of the world, including the USA, China, Russia, India, Japan, Germany, etc., excellent results have been obtained on the use of magnetically treated irrigation water in agriculture.

It should be emphasized that the magnetic treatment of water is understood as the effect on the water flowing through special devices by a powerful constant or alternating magnetic field. After magnetic treatment of water, while maintaining the chemical composition, its structure changes, which is reflected in its physical and chemical properties, that is, ordinary water becomes much more chemically and biologically active.

The uniqueness of the results of using magnetized irrigation water is that /1,2/:

- the yield of various plant species increases from 50% to 200%, depending on the type of plant;
- consumption of irrigation water is reduced by 30-50%;
- the consumption of fertilizers is reduced by 60-80%;
- the vegetative period decreases by 7-15 days;
- the amount of seed is more than halved;
- the storage life of yields of various plants is more than doubled;
- the soil is disinfected from fungi and a number of pathogenic bacteria, microorganisms and parasites.
- Desalination of saline soils occurs.

It has been established that in the process of magnetization, structuring and softening of water occurs, the calcium and magnesium bicarbonates contained in the water change their crystal structure and precipitate in the form of a fine powder, the surface tension is significantly reduced and the fluidity of water improves / 3 /. It was also found that instead of solid crystals of calcite, loose crystals of aragonite are formed.

For Azerbaijan, such an important property as desalinization of saline soils is acquiring special relevance. In addition, the possibility of using it for the magnetization of water, salt (sea) water for irrigation is especially relevant.

### **1. Review of global experience in the use of magnetic processing of Irrigation water in agriculture**

In the USSR, the first results of studies on increasing plant productivity by irrigation with magnetized water were published by I.V. Darnyodov, I.I. Brekhman and A.V. Krylov in 1965. The studies were carried out by the Research Institute of Biologically Active Substances of the Siberian Branch of the USSR Academy of Sciences. These researchers came to the conclusion that irrigation with magnetized water has a beneficial effect on the growth and development of sunflower (by 21%), corn (by 26%) and soybeans (by 40%) /4/.

Experiments carried out using magnetized water in a greenhouse showed an increase in the size of onions and carrots by 22%, underground peas by 37% and aboveground by 14%, tomatoes by 18%. An 18% increase in tomato mass was also recorded /5/.

Studies of the Kuban Agricultural Institute showed that when irrigating rice with magnetized water, the increase in yield was 18%, and the decrease in the used irrigation water was 15% /6/.

In part, N.P. Yakovlev and K.I. Kolobenkov (1981) tried to answer the question of the mechanism of the effect of water magnetization on the growth of spring wheat. In particular, they found that irrigation with magnetized water contributes to the development of a more powerful assimilation apparatus, the accumulation of a large photosynthetic potential, dry underground mass. "Reducing the alkalinity of the soil helps to convert ozone, phosphorus and potassium into a more assimilable form for plants. The content of these elements in wheat samples watered with magnetized water turned out to be 10-15% higher than in the controlled ones /7/.

### **2. The use of magnetized irrigation water with high salt content and in saline soils**

Studies carried out in Azerbaijan by S.M. Mamedov (Azerbaijan Scientific Research Institute of Agrotechnics and Melioration) made it possible to establish a significant increase in the yield of a number of vegetable and forage crops when irrigated with magnetized salt water. The scientist magnetized highly mineralized water of the Caspian Sea, which he used to irrigate plants. Table 1. Shows the results of the experiments carried out by S.M. Mamedov /2/.



The researches of S.M. Mamedov are extremely important for the conditions of Azerbaijan, where large areas of saline soils and underground waters on the coast of the Caspian Sea contain a high concentration of sea salt. As you know, salt water cannot be used for watering for two main reasons. Firstly, salt is deposited in plants, which delays the intercellular circulation of water. Secondly, salts are deposited in the capillaries of the soil, making it impermeable.

**Table 1.**  
**Results of experiments of S.M. Mamedov to increase the productivity of plants, watered with ordinary and magnetized water in centners / ha.**

<b>Culture</b>	<b>Plainwater</b>	<b>Magnetizedwater</b>
Tomatoes	110,7	160,1
Eggplant	77,4	161,4
Corn	96,7	127,3
Sorghum (greenmass)	122,7	146,5

Meanwhile, in France in 1960, patent No. 1206631 (Class A019) was issued, in which it is proposed to water plants with hard water, including sea water, after the water has been magnetized. The test results of the present invention, carried out on high-calcareous soils with hard saline water rich in calcium, magnesium sulfates and sodium chloride, after its magnetization, were successful / 2 /. Studies conducted in Azerbaijan by Sh.M. Aliev and D.M. Agalarov, based on irrigation of agricultural crops with magnetized Caspian water with mineralization of 14 g/l, showed a significant increase in the yield of sorghum (by 45%) and corn (by 30%) / 8 /.

### **3. The mechanism of reducing soil salinity using magnetic water**

After irrigation with magnetized water, the content of mobile forms of phosphate increases in the soils, and the nitrification capacity in the upper horizons increases. Washing a two-meter monolithic soil layer with magnetized water showed that magnetized water washes out 18 - 32% more salts than ordinary water. More than 70% of the salts are washed out in the first washing cycles, while the efficiency of magnetization is preserved even with water salinity at 7-8 g / l, 2, 9/.

### **4. Results of similar experiments carried out in the USSR**

In 1975-1976, experiments were carried out to magnetize irrigation water at the Kubansky state farm in the Krasnodar Territory. River water was processed

simultaneously by six devices for water magnetization. Two completely identical plots were allocated - experimental (5.5 ha) and control (6.1 ha). In 1975, the yield of peas and sheep in the experimental plot was 21 higher than in the control. The sugar beet yield in the experimental plot was 14% higher than in the control plot. It was also noted on the experimental site a simultaneous decrease in the amount of irrigation water by 11-18% and the removal of salts from the active soil layer up to 23%.

In the last two decades, the most significant contribution to the development of technologies for the magnetization of water was made by Professor Yu.P. Tkachenko, since 1987, has carried out large-scale research in the field of application of magnetic water treatment in agriculture, industry and other areas. Tkachenko's research was carried out within the framework of joint international programs in many countries of the world: Turkey, Indonesia, Iran, Egypt, Australia, Saudi Arabia, Pakistan, Iraq, Qatar, Sudan, etc. Research results Yu.P. Tkachenko allowed the introduction of technologies for the magnetization of water for use in agriculture in Russia and a number of countries of the world /1/. The Fractal Water website (USA, 2018, <https://www.fractalwater.com/catalog/super-imploder>) provides very impressive results of many years of experience in using magnetized water for irrigating plants, which we present below:

- Save up to 20% in water consumption. Soft and bioactive water penetrates the soil more easily, spreads over a wider area of the soil, helps the soil to retain moisture, stimulates soil nutrients and enhances root and plant growth, reducing irrigation requirements by 20%.
- Saving 10-50% when using chemicals reduces the need for fertilizers, insecticides, pesticides, herbicides and fungicides, making the materials more soluble.
- Saving 10% energy. Smaller scale build-up of salts in the pipe, better flow due to lower friction losses, reduction of pumping costs by 12%, energy savings and increased profits.
- Increase in productivity from 10 to 30%.

### **5. Results of testing equipment "MAGMATRIX AGRO"**

Tests of the equipment "MAGMATRIX AGRO" manufactured on the basis of an application for an international Eurasian patent "Device for magnetic activation of liquids" (EAPO №201900186/31, author Prof. E.N. Khalilova, 28.10.2019) was carried out on the basis of the Research Institute vegetable growing of the Ministry of Agriculture of Azerbaijan.



**Fig. 1. The apparatus "MAGMATRIX AGRO" installed in the greenhouse of the Scientific Research Institute of Vegetable Growing of the Ministry of Agriculture of Azerbaijan (village Mehtiabad, 2019).**



**Fig. 2. Growing vegetables when irrigated with magnetized water in a greenhouse of the Scientific Research Institute of Vegetable Growing of the Ministry of Agriculture of Azerbaijan (village Mehtiabad, 2019).**

One of the main factors in obtaining high yields of fruit and vegetable crops is the use of the correct irrigation system. In this regard, it is very important to study the composition of the irrigation water in the greenhouse.

In this regard, the effect of a magnetic activator "MAGMATRIX AGRO" used for irrigation of plants planted in a closed area on the productivity of plants during the growing season was studied. The experiment was carried out in three variants, the plants were planted in 5-nested green house pots. In vegetation experiments, plants of the same species were given the same amount of water. The experiment was carried out according to the following scheme. In practice, during irrigation, indicators of the quality of irrigation water for each option, height, age and dry weight of plants were recorded. The experiment was carried out according to the following scheme.

1. Control option (ordinary irrigation water was used, pH 7-7.5, Ec 2.8).
2. Option of irrigation water using nitric acid to adjust pH and Ec. (pH 6-6.5, Ec 2.4).
3. Option of irrigation water using a magnetic activator. (pH 5.5-6.5, Ec 2.2).

As can be seen from Table 1, in the experiments carried out, the height, branching, leaf opening and flowering of plants were approximately equal in the variant of nitric acid used to control water quality with a magnetic activator used for irrigating plants. Meanwhile, we see that the height of the stem when using magnetic water was about 15-17% higher compared to watering with ordinary water but using nitric acid. Also, the pH and Ec values of water in the variants were 5.5-6.5 and 2.2-2.4, respectively. However, since the cost of nitric acid used to regulate water quality is more expensive, the use of magnetic activators for irrigation is considered to be more economically and environmentally efficient.

**Table.1.**  
**Results of phenological observations in experiments carried out under different irrigation conditions during the mass flowering of tomato plants**

		Practice options											
№	Of the plant name	Control option (Used in irrigation ordinary water)				Irrigation water using a magnetic activator				Irrigation water using nitric acid to regulate pH and Ec			
		Styling height, cm	Branch mass	Leaf mass	Mass of flowers	Styling height, cm	Branch mass	Leaf mass	Mass of flowers	Styling height, cm	Branch mass	Leaf mass	Çiçeklən məsi
1	Tomatoes	45,0-55,0	average	average	weak	70,0-90,0	strong	high	very high	60,0-75,0	strong	high	high

## References

1. Tkachenko Yu.P. Magnetic technologies in agriculture. 2015.<https://www.proza.ru/2016/09/26/1066>
2. Klassen I.V. Magnetization of water systems. Ed. 2nd supplemented. M., Chemistry, 1982, p. 265-282.
3. Klassen V.I. RJ VINITI. Chemistry. 1975, ref. 14, I359, Deponir. manuscript, VNIITEKhim, Cherkassy, No. 472-75 dep.
4. Dardymov I.V., Brekhman I.I., Krylov A.V. In the book: Questions of hematology, radiobiology and biological effects of magnetic fields. Tomsk, Tomsk University, 1965, pp. 325-328.
5. Lisin V.V., Molchanova L.N. In the book: Materials of the XI Final Conference of the Semipalatinsk Medical Institute, Book Publishing House, 1967, p. 37-38.
6. Volkonsky N.A. Hydraulic engineering and land reclamation. 1973, no. 9.
7. Yakovlev N.P., Kolobenkov K.I. Magnetic treatment of water systems. Abstracts. Dokl. IV All-Union. Meeting, M, NIITEKHIM, 1981, p. 166.
8. Aliev Sh. M. and Agalarov D. M. Magnetic treatment of water systems. Abstracts. Dokl. IV All-Union. Meeting., M, NIITEKHIM, 1981, p.87yu
9. Gusenkov E.N., Kochetkov S.G. Hydraulic engineering and melioration, 1971, No. 1, p.62

## EARTH SCIENCES, ECOLOGY

### ON THE POSSIBILITY OF ENHANCING THE ADSORPTION CAPACITY OF NATURAL ZEOLITE BY MEANS OF MAGNETIC WATER TREATMENT

**E.N.Khalilov, F.E.Khalilov, T.Ş.Khalilova, A.E.Khalilov**

*Azerbaijan Section of the International Academy of Sciences H&E*

*prof.khalilov@yahoo.com*

#### **Abstract**

The results of experimental studies of the authors of this work made it possible to conclude that the adsorption properties of natural zeolite-clinoptilolite of the Aydag deposit of Azerbaijan are enhanced in the process of filtering contaminated water, previously treated with an alternating magnetic field using a MagVortex apparatus. The increase in the adsorption properties of natural zeolite-clinoptilolite ranges from 9% to 21%, depending on the adsorbed elements. The continuation of these studies will improve the efficiency of filters using natural zeolite for drinking and waste water treatment.

**Key words:** *natural zeolite-clinoptilolite; adsorption; adsorbent; magnetization of water; magnetic water activator MagVortex.*

#### **1. Review of existing scientific works**

Conducted in the early 70s of the last century, scientific research by a number of authors made it possible to discover the effect of increasing the adsorption capacity of some natural minerals and substances when a magnetized aqueous solution is passed through them, compared to a non-magnetized one. One of the reasons for the increase in the adsorption properties of porous substances, the authors /1/ consider a decrease in the surface tension of an aqueous solution by 10% -13% as a result of exposure to a magnetic field.

An increase in the adsorption of surface-active substances (surfactants) at the interface between liquid and gas was discovered by V.I. Minenko. A salt of a quaternary ammonium base was added to the water solution, and the process of adsorption by various adsorbents was compared before and after the magnetic treatment of the aqueous solution. These results are also in good agreement with the results of studies of the effect of magnetic treatment of sodium hexadecyl sulfate solution at the liquid-gas interface /2/. Magnetic treatment of sodium hexadecyl sulfate solution made it possible to increase the adsorption properties of the adsorbent.

A change in the degree of surfactant adsorption on the surface of magnetized distilled water is also accompanied by a change in monomolecular adsorption layers. Direct measurements have shown that the monomolecular layer of palmitic acid on the surface of the magnetized distillate has a significantly lower surface pressure compared to the non-magnetized distillate /3/. Interesting research results were obtained by a group of scientists presented in /4/. Using the radiometric method, they found that the magnetic treatment of an aqueous solution of sodium oleate contributes to a significant increase in the degree of fixation of this reagent on the surface of particles of phosphorite, dolomite, and quartz. At the same time, the maximum degree of adsorption is observed at a certain magnetic field strength /4/. The work /5/ also provides a brief overview of the most important results of studies by different authors on the effect of magnetic treatment of aqueous solutions on the adsorption properties of various adsorbents.

Very interesting results were obtained during the magnetic treatment of not aqueous solutions, but directly of the adsorbent itself /6/. Magnetic treatment of silicon with a constant magnetic field in combination with vacuum treatment made it possible to fix an increase in its adsorption capacity by 2–4 times. At the same time, silicon samples were exposed to a constant magnetic field for several days (up to 7 days), after which their adsorption properties were repeatedly measured. It was determined that the adsorption properties of silicon samples are gradually restored to the previous level (to the level prior to exposure to a magnetic field), while the total relaxation period is about 150 days. The work /7/ considers the effect of pre-treatment by a pulsed magnetic field of nanoporous aluminosilicate sorbents of various structures on the adsorption of formaldehyde vapors. The effect of a pulsed magnetic field on the sorbent surface morphology and the intensification of sorption activity was determined. It was found that at  $B = 0.011$  T, adsorption on the montmorillonite sample is activated, and with an increase in the magnetic induction force from 0.011 to 0.12 T, an increase in adsorption on samples containing clinoptilolite is noted. The combined effect of a pulsed magnetic field ( $B = 0.011$  T) and heat treatment enhances the absorption of formaldehyde by all sorbents under study. The maximum activation under the action of a pulsed field is noted at 48 hours of sorbent exposure after treatment. The relaxation of the studied systems is the same and is equal to 72 hours at different strengths of magnetic induction.

## **2. Methodology of the conducted experimental studies**

The authors carried out studies of the effect of magnetization of water from Lake Boyukshor, located in the industrial zone of oil and petrochemical enterprises in Azerbaijan. The water of Lake Boyukshor is heavily polluted with



industrial waste and contains various toxic chemical elements, heavy metals and radionuclides.

The experimental research methodology included:

1. Water sampling from Lake Boyukshor;
2. Analysis of a water sample and determination of the content of chemical elements in it.
3. The water sample was divided into two parts;
4. The first part of water was passed through a MagVortex magnetic water activator with two magnetic matrices to obtain magnetized water;
5. After that, the first part of the water (magnetized water) was passed through crushed natural zeolite-clinoptilolite with a particle size of 0.2-0.5 mm, from the Aydag deposit of Azerbaijan.
6. The second part of the water (non-magnetized water) was passed through a similar crushed natural zeolite-clinoptilolite with a particle size of 0.2-0.5 mm, from the Aydag deposit of Azerbaijan.
7. After passing the first and second parts of water through the crushed natural zeolite-clinoptilolite, each of the parts of the water was analyzed separately for the content of various polluting chemical elements in it.

### **3. Results**

The analysis of the first and second parts of the water sample was carried out at the International Scientific and Technical Complex Intergeo-Tethys. The results of comparing the analysis of the elemental composition of the first and second parts of water after passing through the natural zeolite-clinoptilolite are shown in Table 1.

As can be seen from Table 1, the first part of the water sample, which was magnetized using a MagVortex apparatus containing two magnetic matrices, after passing through the natural zeolite-clinoptilolite, began to contain a lower concentration of pollutants compared to the second part of the water (not magnetized), which was also passed through natural zeolite-clinoptilolite.

**Table 1.**

Trace elements	Initial content in water mg / l	After cleaning with natural zeolite, content in water mg / l		Increasing the adsorption capacity of natural zeolite during the passage of magnetic water
		Magnetized water	Not magnetized water	%
Mercury	1,35	0,57	0,85	20,5
Chromium	94,0	15,5	30,7	16,1
Cobalt	0,98	0,27	0,36	9.1
Zinc	230	37,1	59,3	9.7
Selenium	1,9	0,46	0,69	12
Strontium	1095	340,0	432,4	9
Tellurium	2,12	0,65	1,178	15
Barium	222,1	87,5	133,2	20
Cesium	4,83	1,31	2,12	17
Iron	770,1	171,3	238.9	9
Manganese	74,3	44,3	59,9	21

That is, the adsorption properties of natural zeolite-clinoptilolite increase when magnetized water is filtered through it, compared to non-magnetized water. Moreover, it should be noted that different pollutants have different degrees of adsorption increase after magnetic water treatment, which is also shown as a percentage in Table 1.

#### 4. Conclusions

As a result of experimental studies of the effect of magnetic treatment of polluted water using the MagVortex apparatus on the adsorption capacity of natural zeolite, the following was established:

1. Magnetic activation of water increases the adsorption properties of natural adsorbents, in particular, natural zeolite-clinoptilolite compared to non-magnetized water;
2. Depending on the elemental composition of the pollutant, the percentage of increase in the adsorption properties of natural zeolite changes from 9% to 21%;

3. The results obtained make it possible to recommend the preliminary magnetization of the purified water before it passes through the filtering natural adsorbent, in particular, the natural zeolite-clinoptilolite.

### References

1. Minenko V.I. Magnetic treatment of water-dispersed systems. Kyiv, Technique, 1970, 160 p.
2. Issues of theory and practice of magnetic treatment of water and water systems. Collection of works of the second All-Union Conference. Moscow, Tsvemetinformatsia, 1971, 316 p.
3. Gabrielli C., Ficalbi A., Geof., e. meteorol., 1965, v.14, No. 5-6.
4. Klassen V.I., Orel M.A., et al. Proceedings of the Universities, Nonferrous Metallurgy, Ordzhonikidze, 1968, No. 1, p. 6-9.
5. Klassen V.I. Magnetization of water systems. Moscow, Chemistry, 1982, pp. 56-60.
6. Makara V.A., Vasiliev M.A., Steblenko L.P. and others. Changes in the impurity composition and microhardness of near-surface layers of silicon crystals caused by the action of a magnetic field. Physics and technology of semiconductors. Volume 42, Issue. 9, M., 2008, pp. 1061-1064.
7. Belchinskaya L. I., Khodosova N. A., Bitshtskaya L. A. Adsorption of formaldehyde on mineral nanoporous sorbents treated with a pulsed magnetic field. Physical chemistry of the surface and protection of materials, M., 2009, volume 45, no. 2, p. 218-221

## MONITORING OF EARTHQUAKES, GEOMAGNETIC FIELD AND ATMOSPHERE PARAMETER IN FP7 BLACKSEAHAZNET PROJECT

<sup>1</sup>M. Cukavac, <sup>2</sup>S. Mavrodiiev, <sup>3</sup>L. Pekevski,  
<sup>1</sup>J. M. Spomenko

<sup>1</sup> Republic geodetic authority, Belgrade, Serbia

<sup>2</sup> Institute for Nuclear Research and Nuclear Energy, Bulgarian Academy of Sciences, Sofia, Bulgaria, e-mail: mavrodi@inrne.bas.bg

<sup>3</sup> Seismological Observatory, Faculty of Natural Sciences and Mathematics, Skopje, Macedonia

### Abstract

Short-term evaluations of regional seismic activity are based on time correlation between the local and regional geomagnetic quakes and the incoming minimum/maximum of tidal gravitational potential, where the geomagnetic quake is defined as a jump of the day mean value of the geomagnetic field standard deviation. The probability time window for a forthcoming earthquake is approximately  $\pm 1$  day for the tidal minimum and  $\pm 2$  days for the tidal maximum. The statistic evidence of the geomagnetic precursor reliability is based on distributions of time differences between the occurred and the predicted earthquakes for the period 2002–2005 for the Sofia region and for the period 2004–2005 for the Skopje region. This leads to the Gaussian behaviour with the increasing of the statistics. The predicted earthquake is identified by the maximum of the function proportional to the density of the radiated earthquake energy in the monitoring point.

**Key words:** density of radiated earthquake energy, earthquake, geomagnetic quake, precursor, tidal extreme, tide difference

### Introduction

The European FP7 Project entitled "Complex Research of Earthquake's forecasting Possibilities, Seismicity and Climate Change Correlations" began in 2011, bringing together researchers from Bulgaria, Macedonia, Ukraine, Georgia, Slovenia, Greece, Turkey, Armenia and other countries. The purpose of the project, Black Sea HazNet, is a development of long-term research cooperation through coordinated joint program for exchange of data, know-how and scientists. Without creating an adequate physical model of the Earth existence and its gravitational and electromagnetic interactions, which ensure a long-time stability of the Sun system and its planets, there is no reliable way to solve the earthquake prediction problem. The earthquake-related part of the model has to be infinitely repeated in the "theory–experiment–theory" process, using *nonlinear inverse problem* methods in looking for correlations between the

fields in dynamically changing space and time scales. Each approximate model supported by some experimental evidence should be included in the analysis (Thanassoulas et al., 2001; Eftaxias et al., 2001, 2002; Duma, 2006). The adequate physical understanding of the correlations among electromagnetic precursors, tidal extremes and a forthcoming earthquake is related to the progress of an adequate Earth magnetism theory, as well as to the quantum mechanical understanding of the processes in the earthquake source volume before and during the earthquake. The achievements of tidal potential modeling of the Earth surface, including ocean and atmosphere tidal influences, multi-component correlation analysis and nonlinear inverse problem methods in fluid dynamics and electrodynamics are crucial for every step of constructing mathematical/physical models. Some progress in establishing the geomagnetic field variations as regional earthquakes' precursors was presented in several papers (Mavrodiev, Thanassoulas, 2001; Mavrodiev, 2003a, b, c, 2004; Mavrodiev, Pekevski, 2008; Mavrodiev, Pekevski, Jimseladze, 2008). The approach is based on understanding the complex origin of earthquake processes. The role of the geomagnetic variations as earthquake precursors can be explained by the hypothesis that the strain accumulation and displacements in the crust during the earthquake preparation cause medium's density change, within which a chemical phase shift and a corresponding electrical charge shift appear.

The parameters of the forthcoming earthquake epicentre could be estimated from at least three measuring points of the geomagnetic vector. This is done by applying the inverse problem methods for locating of the volume where the phase shift arrived within a certain time window.

## Methods

In the paper (Mavrodiev, 2004) the geomagnetic quake was defined as a jump of the day mean value of the signal function *Sig*:

$$Sig = \sum_{m=1, M} \sigma_{Hm} / M, \quad \delta Sig = \sum_{m=1, M} \delta \sigma_{Hm} / M.$$

Here  $\sigma_{Hm}$  is the standard deviation of geomagnetic field component  $Hm$ , and  $\delta \sigma_{Hm}$  is the corresponding error. The predicted regional seismic activity is identified by the maximum of the function proportional to the density of the earthquake radiated energy in the monitoring point. The analytical size of this function is

$$S_{ChM} = 10^M / (D + Depth + Distance^2),$$

where the distances are in kilometres,  $D = 40$  km is the fit parameter and  $M$  is the earthquake magnitude. Thus, if we have a jump of the signal function  $Sig$ , and its error  $\delta Sig$  is such that it satisfies numerically the condition

$$Sig_{Today} - Sig_{Yesterday} > 0.1 Sig_{Yesterday}$$

in the next tidal extremum time the function  $S_{ChM}$  will have a local maximum value. The earthquake for which the function  $S_{ChM}$  has a maximum can be interpreted as a predicted one.

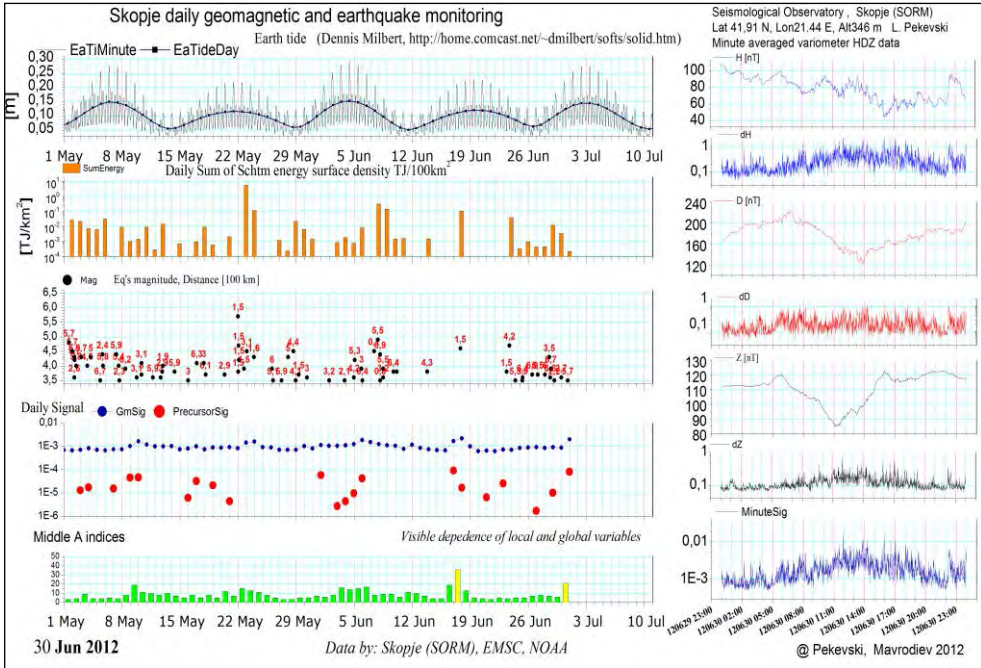
### Data

Earthquakes data reported in NEIC earthquake catalogues for the wider Balkan region and the time differences between the tidal extremes and all occurred regional earthquakes (magnitudes  $M > 3.5$ ) were analyzed. The data include epicentral distances up to 800 km from Sofia, Skopje and Belgrade. Geomagnetic field variations from Geomagnetic observatories in Panaguriste, Bulgaria (PAN) and Grocka, Serbia (GCK), and from Seismological observatory Skopje, Makedonia were included in analysis.

### Analysis and results

Monitoring data for Skopje, Belgrade Sofia and the results of there analysis, illustrate that the geomagnetic quake is a regionally reliable regional seismic activity precursor. Analysis consist of: the number of signals preceding the incoming tidal extreme data, information for the tidal minimum or maximum, the time of the tidal extreme, the parameters of the occurred earthquake (time, epicentre's coordinates, hypocentral depth, magnitude, epicentral distance from the monitoring point [in 100 km]), the value of function  $S_{ChM}$  [J/km<sup>2</sup>], the difference between the time of tidal extreme and the time of the occurred earthquake (in days).

The presented earthquakes have magnitudes  $M > 3.5$  and with energy "densities"  $S_{ChM}$  greater than 200. Fig.1. presents the Skopje data (up to down) – the daily behaviour of geomagnetic vector components, the daily and hourly behaviour of the tidal potential, earthquake energy density  $S_{ChM}$ , magnitude, epicentral distance from Skopje and the function  $Sig$ .



**Fig.1. The reliability of the time window prediction for the incoming earthquake, may-june 2012, Skopje**

### Conclusion

The data are presented as they are published in the “Every day monitoring” directory of the website “Earthquake prediction using reliable regional seismic activity precursors – <http://theo.inrne.bas.bg/~mavrodi/>” for the period may-june 2012. The correlations between the local geomagnetic quake and the incoming earthquakes, which occur within the time-window defined from the extremes of the Earth tidal gravitational potential ( $\pm 1$  day for the tidal minimum and  $\pm 2$  days for the tidal maximum) are statistically tested. The distribution of the time differences between the predicted and occurred events becomes Gaussian with the increasing of the statistics. The solving of distance sensibility problem can be performed on the basis of at least three stationary and one mobile device for vector geomagnetic field measuring, which should fulfil the Intermagnet standards, but with at least 10 samples per second. The data acquisition system has to include the almost real-time frequency analysis for establishing the characteristics of the geomagnetic quake.

## References

1. Duma G., (2006): Modeling the impact of telluric currents on earthquake activity, EGU06-A-01730; NH4.01-1TH5P-0571, Vienna.
2. Eftaxias K., Kapiris, P., Polygiannakis, J., Bogris, N., Kopanas, J., Antonopoulos, G., Peratzakis, A., and Hadjicontis, V., (2001): Signature of pending earthquake from electro-magnetic anomalies, *Geophysical Research Letters* 28(17):3321–3324.
3. Eftaxias K., Kapiris, P., Dologlou, E. Kopanas, J., Bogris, N., Antonopoulos, G., Peratzakis, A., and Hadjicontis, V., (2002): EM anomalies before the Kozani earthquake: A study of their behaviour through laboratory experiments, *Geophysical Research Letters* 29(.8) 10.1029/ 2001 GL013786.
4. Mavrodiev, S.Cht., and Thanassoulas C., (2001): Possible correlation between electromagnetic earth fields and future earthquakes, *INRNE–BAS*, Seminar proceedings, 23–27 July 2001, Sofia, Bulgaria, ISBN 954-9820-05-X, 2001
5. Mavrodiev, S.Cht., (2003): The electromagnetic fields under, on and over Earth surface as “when, where and how” earthquake precursor, European Geophysical Society, *Geophysical Research Abstracts*, Vol.5, 04049.
6. Mavrodiev, S.Cht., (2004): On the Reliability of the Geomagnetic Quake Approach as Short Time Earthquake’s Precursor for Sofia Region, *Natural Hazards and Earth System Science*, 4:433– 447.
7. Mavrodiev, S. Cht., and Pekevski, L., (2008): Complex Regional Network for Earthquake Researching and Imminent Prediction, *Electromagnetic phenomena related to earthquakes and volcanoes*. Editor: Birbal Singh. Publ., Narosa Pub. House, New Delhi, pp. 135–146.
8. Mavrodiev, S., Pekevski, L., and Jimseladze, T., (2008): Geomagnetic-Quake as Imminent Reliable Earthquake's Precursor: Starring Point for Future Complex Regional Network, *Electromagnetic phenomena related to earthquakes and volcanoes*. Editor: Birbal Singh. Publ., Narosa Pub. House, New Delhi, pp. 116–134.
9. Thanassoulas, C., Tsatsaragos, J., and Klentos, V., (2001): Determination of the most probable time of occurrence of a large earthquake., *Open File Report A*. 4338, IGME, Athens, Greece.



## CHANGE OF TEMPERATURE REGIME IN THE REGION OF GANJA-GAZAKH AND ANALYSIS OF INFLUENCE TO FLIGHTS

<sup>1</sup> N.Ş. Huseynov, <sup>2</sup> M.F. Suleymanov

<sup>1</sup>Head of the Chair “Aviation Meteorology” National Aviation Academy  
nazimmet@mail.ru

<sup>2</sup>National Aviation Academy, mahmud-suleymanov@mail.ru  
(Presented by Academician Rza Mahmudov)

### Abstract

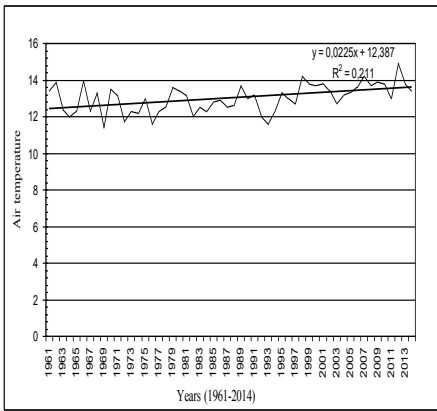
In this article regularity (variability) of air temperature in Ganja-Gazakh region and its impact on aviation flights was analyzed on the basis of the relevant temperature data and norm values for a period 1961-2014 from meteorological stations at Agstafa, Dashkasan, Shamkir, Gadabay, Ganja and Goygol-resort.

**Key words:** Take off running distance, take-off speed, average air temperature, statistical analysis, Ganja-Gazakh.

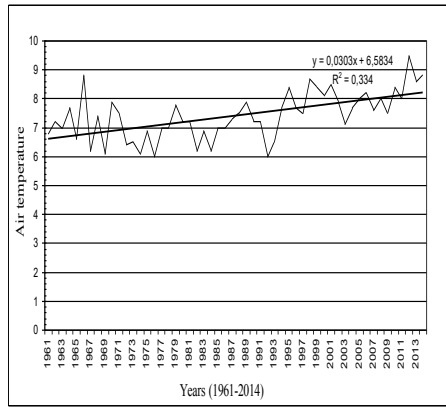
During descent and climbing stages of aircrafts, their speed and take off distance depend on the physical characteristics of the atmosphere, especially on the air temperature. Increasing the temperature of the air requires increased speed at the departure of aircrafts. Change of take-off speed causes the aircraft to change the running and the take-off distance. More favorable conditions for speeding up the aircraft are observed mainly in low-temperature levels in the tropopause and low stratosphere. The air temperature diminishes when the air temperature changes, which results in a decrease in engine power, increase the speed of the engine, and, respectively, increase running distance. So increasing of the temperature by 10<sup>0</sup>C causes the take off distance to be increased by 7-13% [3]. Calculations show that the change in air temperature by 30<sup>0</sup>C (e.g. from winter to summer or vice versa) results in an hourly fuel consumption of up to 5-6%, lowering of air to 5<sup>0</sup>C, maximizing the maximum speed by 1%. At a standard elevation of 11 km, the maximum velocity of the boom increases as compared to the zero level due to the decrease in temperature in the standard atmosphere [2]. The maximum speed decreases with increasing temperature. The maximum vertical speeds of the aircraft primarily depends on the engine's current thrust. Temperature mode also affects the engine's force, as it affects the maximum vertical speed. The temperature incrementing above the standard temperature leads to a decreasing of maximum vertical speed. The standard vertical speed of the aircraft shrinks by 10-20% when relative air temperature increases by about 10<sup>0</sup>C relative to the standard atmosphere [3].

Accordingly, civilian airline flights are operated at optimum speeds of high altitudes. From this point of view, the study of the observed temperature

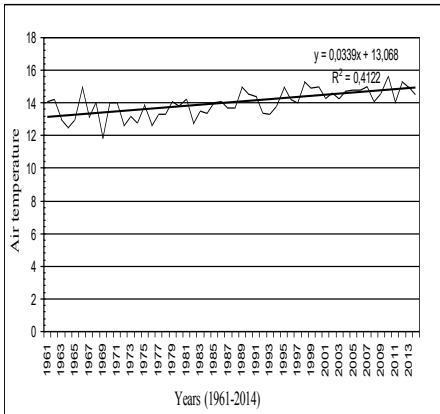
regime is becoming even more urgent, given that international flights are being explored. The time-spatial distribution of the temperature indices of the area is mainly carried out in time intervals, such as the seasons, months, and days of the year, in large, medium or small areas. It is more appropriate to analyze the space templates characteristics of the temperature indices at constant date intervals, and intervals were selected for the calendar months and year as the time interval to evaluate the time-space variability of the thermal regime of the investigated area. For this purpose, the analysis of the long-term dynamics of temperature indices for the years using the daily evaluation of observations on the temperature of 1961-2014 in Agstafa, Dashkasan, Shamkir, Gadabay, Ganja and Goygol-resort meteorological stations located in the study area was analyzed [1].



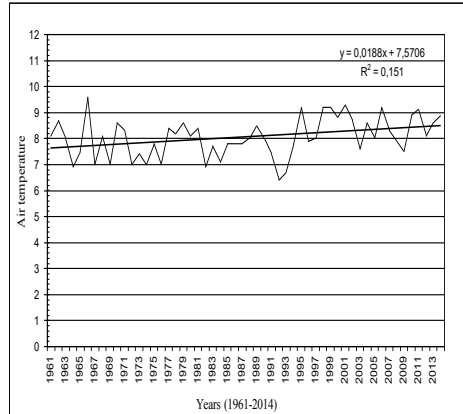
**Fig. 1. A long-term of average annual air temperature ( $^{\circ}\text{C}$ ) for the period 1961-2014 in Agstafa Meteorological Station**



**Fig. 2. A long-term of average annual air temperature ( $^{\circ}\text{C}$ ) for the period 1961-2014 in Dashkasan Meteorological Station**

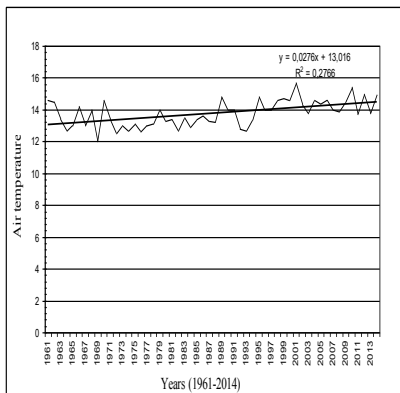


**Fig. 3. A long-term of average**



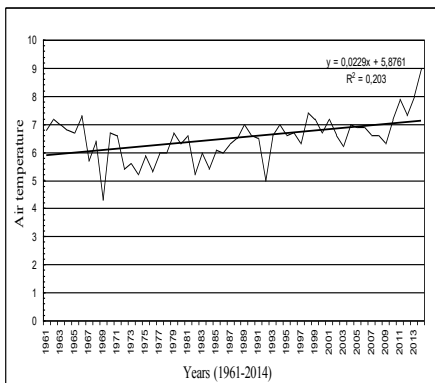
**Fig. 4. A long-term of average**

**annual air temperature (°C) for the period 1961-2014 in Shamkir Meteorological Station**



**Fig. 5. A long-term of average annual air temperature (°C) for the period 1961-2014 in Ganja Meteorological Station**

**annual air temperature (°C) for the period 1961-2014 in Gadabay Meteorological Station**



**Fig. 6. A long-term of average annual air temperature (°C) for the period 1961-2014 in Goygol-resort Meteorological Station**

Fig. 1.2.3.4.5 shows the variations and trends of air temperature fluctuations for 1961-2014 on 6th. From the trends in the graphs, it is clear that in the area where the research is being conducted, each year, average annual temperature increases are observed. Increasing the temperature of the area both on months and in seasons leads to an increase in fuel consumption on aviation flights.

**Table 1.**

**Comparative Analysis of Air Temperature Indicators for the period 1961-1990 (Norm Rates) and 1991-2014 (°C) temperature of 1991-2014**

Stations	Years		Difference
	1961-1990 (norma)	1991-2014	
Agstafa	12.7	13.4	0.7
Dashkesan	7.0	7.9	0.9
Shamkir	13.6	14.5	0.9
Gadabay	7.8	8.3	0.5
Ganja	13.4	14.3	0.9
Goygol-resort	6.2	6.9	0.7

Another important challenge to modern climate studies is to determine the average annual or normative values of climate values, including air temperature. The solution to this problem is therefore crucial because of the climate change trends in the dynamics of the meteorological sequences, and there are serious difficulties in choosing the optimal variant of the average estimation period. Thus, the calculated average or normal evaluation should remain statistically stable beyond the limits of the chosen period. It is impossible to predict such relative stability for any calculation period.

Taking these into consideration, the average statistical period for the 1961-1990 period, as recommended by the World Meteorological Organization, is also used in our country as well as in many countries. Using this method, it is possible to make comparative analysis of climate change results for different regions of the world. When compared with the norm (1961-1990), a substantial increase was observed in the study of the average. When compared to Table 1, the highest increase in the average air temperature was observed at Dashkesen, Shamkir, Ganja stations  $0.9^{\circ}\text{C}$ , Aghstafa,  $0.7^{\circ}\text{C}$  at Goygol-resort, and at least at Gedebey station  $0.5^{\circ}\text{C}$ . Increasing the average air temperature in the area is shown for months as well. In the research, anomalies were also examined for months, in addition to the average annual temperature in terms of the norm. According to Table 2, there are no abnormalities on the territory but only in Agstafa and Gedebey stations in some months. However, anomaly is observed in each of the hydrometeorological stations.

Thus, in December in Agstafa and in January and February in Gadabay anomaly is equal to zero. Except for November and December in Gadabay, the amount of anomaly was positive in the study area [1]. Given the effect of the maximum and minimum quantities of the temperature on aviation flights, each one has been analyzed individually [5].

The high amount of air temperature can cause a sharp decrease in density, which in turn increases the running distance on the runway. But in minimum evaluation it can lead to increase of ice build-up events and reduce braking effect on the runway [3].

The average monthly temperature of the maximum air temperature is calculated as the average monthly temperature of the day's maximum temperature. The minimum monthly temperature of the air is calculated as the average monthly values of the minimum temperature of each day.

**Table 2.**

**Anomalies of the average monthly air temperature (1961-1990) according to long-term in 1991-2014 (°C)**

Stations	Months												Annual
	01	02	03	04	05	06	07	08	09	10	11	12	
Agstafa	0.9	1.1	1.1	0.4	0.1	0.9	0.4	0.9	0.6	1.4	0.1	0	0.7
Dashkesan	1.1	0.7	1.4	0.7	0.8	1.3	0.6	1.1	0.5	1.5	0.1	0.8	0.9
Shamkir	1.0	0.8	1.5	0.8	0.7	1.3	0.9	1.7	1.0	1.7	0.2	0.3	0.9
Gadabay	0	0	0.9	0	0.3	0.9	0.2	1.6	1.0	1.5	-0.3	-0.1	0.5
Ganja	1.4	1.0	1.0	0.1	0.2	1.3	0.9	1.6	1.0	1.7	0.7	0.2	0.9
Goygol-resort	0.8	0.8	1.5	1.0	0.5	0.9	0.4	1.3	0.6	0.7	0.1	0.2	0.7

Accordingly, the maximum absolute maximum temperature on the area in July is about Agstafa 41°C, Dashkasan 34°C, Shamkir 39°C, Gadabay 35°C, Ganja 41°C and Goygol-30°C. Absolute minimum temperatures were observed in Agstafa -26°C, Dashkasan -24°C, Shamkir -17°C, Gadabay -25°C, Ganja -18°C in January and -24°C in Goygol-resort in January [5].

The seasonal changes in air temperature indications for the study area are clearly shown in Table 3. It is clear from the table that global warming has also influenced to season changes. The results of the statistical analyzes show that the average air temperature is higher than norm, in each stations of studied region. Anomalies of the average air temperature in the winter months were observed in the winter season at 0.9°C in Ganja, 1.0°C in Goygol-resort, 1.2°C in Shamkir in the summer, and 0.9°C in Dashkesen, Shamkir and Ganja hydrometeorological stations in the autumn. In general, the winter is 0.6°C in the winter, 0.7°C in summer, 1.0°C in summer, and 0.8°C in the fall [4].

As you can see, the high amount of anomaly coincides with the summer season. These temperature changes will naturally not be neglected on aviation flights. This trend will lead to increase of fuel consumption and increase the running distance on the runway.

Therefore, construction of new airports in the area to be explored in the future should be carried out in more adequate areas. Specifically, the length of the runways should be taken into account.

This is the result of the average air temperature for a period 1991-2014 compared to the norm (1961-1990). Aghstafa 0.7°C, Dashkesan 0.9°C, Shamkir 0.9°C, Gadabay 0.5°C, Ganja 0.9°C and Goygol-Meteorological Station 0.7°C.

The mean values of the average air temperature for the seasons in comparison with the norm (1961-1990) for a period 1991-2014 are as follows.

Winter anomaly in Agstafa 0.6<sup>0</sup>C, Dashkasan 0.8<sup>0</sup>C, Shamkir 0.7 <sup>0</sup>C, Gadabay 0.0<sup>0</sup>C, Ganja 0.9 <sup>0</sup>C, Goygol-resort 0.6<sup>0</sup>C.

Anomaly in the spring months Agstafa 0.5<sup>0</sup>C, Dashkasan 0.9<sup>0</sup>C, Shamkir 0.9 <sup>0</sup>C, Gedabey 0.4<sup>0</sup>C, Ganja 0.4 <sup>0</sup>C, Goygol-resort 1.0<sup>0</sup>C.

Anomaly in summer months Agstafa 0.8<sup>0</sup>C, Dashkesen 1.1<sup>0</sup>C, Shamkir 1.2 <sup>0</sup>C, Gedabey 0.9<sup>0</sup>C, Ganja 1.2 <sup>0</sup>C, Goygol-resort 0.8<sup>0</sup>C.

Autumn anomaly Agstafa 0.7<sup>0</sup>C, Dashkesan 0.7<sup>0</sup>C, Shamkir 1.0 <sup>0</sup>C, Gedabey 0.7<sup>0</sup>C, Ganja 1.2 <sup>0</sup>C, Goygol-resort 0.4<sup>0</sup>C.

The absolute maximum air temperature was observed in July in Agstafa 41<sup>0</sup>C, Dashkesan 34<sup>0</sup>C, Shamkir 39<sup>0</sup>C, Gadabay 35<sup>0</sup>C, Ganja 41<sup>0</sup>C and Goygol-resort 30<sup>0</sup>C.

The absolute minimum air temperature was observed in January in Achatafa -26<sup>0</sup>C, Dashkasan -24<sup>0</sup>C, Shamkir -17<sup>0</sup>C, Gadabay-25<sup>0</sup>C, Ganja -18<sup>0</sup>C and Goygol-resort -24<sup>0</sup>C.

Calculations on the study area indicate that the change in air temperature by 30<sup>0</sup>C (winter-to-winter or vice versa) causes an hourly fuel consumption to 5-6%, and take-off running distance to 7-13%.

**Table 3.**

**Distribution of seasonal temperature norms for the period of 1961-1990 and 1991-2014 (<sup>0</sup>C)**

Hydrometeorological stations	Years and differences	Winter	Summer	Spring	Autumn	Annual
Agstafa	1961-1990	1.9	11.9	23.5	13.5	12.7
	1991-2014	2.5	12.4	24.3	14.2	13.4
	Anomaly	+0.6	+0.5	+0.8	+0.7	+0.7
Dashkesan	1961-1990	-1.5	5.6	15.7	8.2	7.0
	1991-2014	-0.7	6.5	16.8	8.9	7.9
	Anomaly	+0.8	+0.9	+1.1	+0.7	+0.9
Shamkir	1961-1990	3.1	12.6	24.1	14.4	13.6
	1991-2014	3.8	13.5	25.3	15.4	14.5
	Anomaly	+0.7	+0.9	+1.2	+1.0	+0.9

Gadabay	1961-1990	-1.0	6.8	16.6	9.0	7.8
	1991-2014	-1.0	7.2	17.5	9.7	8.3
	Anomaly	0	+0.4	+0.9	+0.7	+0.5
Ganja	1961-1990	3.0	12.4	23.9	14.0	13.4
	1991-2014	3.9	12.8	25.1	15.2	14.3
	Anomaly	+0.9	+0.4	+1.2	+1.2	+0.9
Goygol-resort	1961-1990	-2.6	5.0	14.8	7.4	6.2
	1991-2014	-2.0	6.0	15.6	7.8	6.9
	Anomaly	+0.6	1.0	+0.8	+0.4	+0.7

### References

1. A.M.Paşayev, V.Z.Sultanov, N.Ş.Hüseynov, R.N.Nəbiyev. Gəncə aeroportunun iqlim xarakteristikası. Bakı, 2003, 110 s.
2. Quliyev H.İ., Hüseynov N.Ş. “Aviasiya meteorologiyası” fənni üzrə qısa mühazirələr kursu. Bakı, 2004, 80 s.
3. H.İ. Quliyev., Aviasiya meteorologiyası. Bakı, 2013, MAA, 362 s.
4. R.N. Mahmudov, Müasir iqlim dəyişmələri və təhlükəli hidrometeoroloji hadisələr, Bakı, 2018, MAA, 231 s.
5. Hüseynov N.Ş., Məlikov B.M., Hacıyev A.X., Məmmədova H.V. “Azərbaycan Respublikasının Beynəlxalq Aeroportlarında temperatur rejiminin təhlili” Bakı-2013. Milli Aviasiya Akademiyasının Elmi Əsərləri, №2.
6. Prof. Dr. Elchin Khalilov. <https://www.ekhalilov.org/about-us.html>

## **USING MAGVORTEX TECHNOLOGY IN THE CIRCULAR ECONOMY TO REDUCE CO<sub>2</sub> EMISSIONS**

**E.N.Khalilov, A.E.Khalilov, F.E.Khalilov**

*International Academy of Sciences H & E-AS  
prof.khalilov@ias-as.org*

### **Introduction**

As you know, global warming occurs due to the increasing volume of CO<sub>2</sub> emissions. According to the UN, cited in the Global Emissions Gap Report, a record 55.3 gigatons of greenhouse gases were released into the atmosphere in 2018. In 2017, this figure was 53.5 gigatons /1/. With such emissions of carbon dioxide, it should be assumed that by the end of this century, the temperature on Earth will rise by 3.2 degrees, which will lead to devastating consequences for the planet.

The 197 states that signed the Paris Climate Protection Agreement in 2015 have pledged to fight global warming. Their goal is to prevent the average temperature from rising by 2 degrees Celsius by the end of the century. The permissible limit for the increase of 1.5 degrees has also been agreed, but even it will be very difficult to comply, according to the Global Emissions Gap Report published on November 26, prepared by experts of the United Nations Environment Program (UNEP) /1/.

“Our inability a few years ago to tackle climate change decisively meant that we now need to reduce greenhouse gas emissions by more than 7 percent a year - if we cut emissions evenly over the next decade,” said Inger Andersen, Executive Director of the UN Environment Program at the presentation of the report. In other words, starting from 2030, the amount of CO<sub>2</sub> emitted into the atmosphere should be reduced annually worldwide by 15 gigatons.

### **The main anthropogenic factors affecting global climate change**

According to UNEP, the bulk of CO<sub>2</sub> emissions into the atmosphere comes from the energy, transport and construction sectors.

The transportation sector is one of the largest contributors to greenhouse gas emissions in the world. Emissions from heavy-duty vehicles and light-duty vehicles are expected to contribute to the largest share of carbon dioxide emissions from this sector, totaling 38 percent and 36 percent, respectively /2/. Thus, one of the main sources of CO<sub>2</sub> emissions into the atmosphere is transport, and its share is currently at least 25% of the total emissions.



The UNEP report identifies five key points that should significantly affect the reduction of CO<sub>2</sub> in the future: the are phasing out coal and investing in renewable energy, switching vehicles to alternative fuels, decarbonizing industrial production and improving energy efficiency, providing electricity to 3.5 billion people.deprived of it at the moment /1/.

Let us consider in more detail the problem of CO<sub>2</sub> emissions from transport.

### **The global fuel transport crisis**

The number of cars, buses and trucks is increasing every day, as is the number of cars that are being scrapped. A recent study by WardsAuto shows the exact number of cars should be close to 1.4 billion (2019). Currently, about 100 million new cars are produced annually in the world. Of course, not all of them will be on sale, but estimates say that by 2035 more than 1.8 billion cars will be used in the world, and in 2100 - 8 billion /3/.

Every year, the increase in car production significantly outstrips the increase in market demand, which leads to a decrease in production and job losses in the automotive sector. This is not a one-time accident and not some kind of delusion. This is a long-term sustainable trend that will only get stronger.

Currently, the main reason for the decline in the number of new car buyers is that the average American and European household has shown stable or declining income for almost two decades. These people were excluded from the new car market. So they buy and use used cars. And they have a lot of great options, especially with certified vehicles that are in very good condition and have a warranty.

The unstable and deteriorating economic situation in the world since 2020, caused by the COVID-19 pandemic and a sharp drop in oil prices, has led to a strong exacerbation of the economic crisis around the world, a huge increase in unemployment and a significant decrease in per capita income. Therefore, in the very near future, car sharing services and the purchase of used cars will withdraw even more customers from the new car market. In fact, this has already begun and in the near future this trend will only intensify.

A few years ago, Barclay's published an alarming study called Disruptive Mobility, which predicted that US car sales would fall 40% by 2040. It predicts that General Motors will have to cut 68% of its North American manufacturing facilities and Ford will close 58%. The total US car fleet is predicted to fall from more than 250 million today to less than 100 million /4/.

And it's not just Barclay. A few months ago, another study by RethinkX called Transport Disruption and the Crash of Internal Combustion Machines and the Oil Industry predicts that by 2030 the number of cars in the United States will

drop to 44 million, car production will fall 70% and car dealerships will cease existence /4/.

Thus, in the coming years, the majority of the world's population will be content with the used car market and this will lead to a strong development of the market for old car repair services. Automotive corporations will have to rebuild their capacity to produce spare parts for older cars in order to maintain their business to some extent.

Thus, life itself led humanity to the choice of a model of economic development developed by the famous scientist, Prof., Dr. Walter R. Stahel - the Founder and Director of the Product-Life Institute Geneva, former Director of the risk management program at The Geneva Association /5/.

### **Circular economy of Prof. Dr. Walter R. Stahel**

World renowned scientist Prof. Dr. Walter R. Stahel - co-founded the Product Life Institute in Geneva, Switzerland, a consultancy devoted to developing sustainable strategies and policies, receiving recognition for his prize winning paper 'The Product Life Factor' in 1982.

The development of the ideas of Walter R. Stahel and some other theorists led to the creation of new principles of economic development, now known as the "circular economy". In a circular economy, industry is reusing and extending the life of goods as a strategy to prevent waste, create jobs in regions, and improve resource efficiency. This is done to decouple wealth from resource consumption, that is, to dematerialize the industrial economy. The "circular economy" was adopted by the state coal industry in China as a guiding philosophy /6/.

In the 1990s, Stachel extended this vision to the sale of services as goods and as the most effective "circular economy" strategy. He described this approach in his 2006 book "The Performance Economy", with a second extended edition in 2010 containing 300 examples and case studies /7/.

In 2017, reports by Anders Weikman and Christian Sandberg on the macroeconomic impact of a circular economy and efficiency economics showed for seven European countries that national CO<sub>2</sub> emissions could be reduced by 66% and new jobs created by the transition to a circular economy /8/. In November 2018, the U.S. Energy Transitions Commission agreed that "hard-to-reach" sectors could be converted to carbon neutral by 2050, at a cost of less than 0.5% of global GDP. They found that the reduction of CO<sub>2</sub> emissions by up to 40% is due to a more cyclical economy, 15–20% - energy efficiency, 40–45% - decarbonized sources /9/.

In September 2019, the Ellen MacArthur Foundation published its document *Completing the Picture - How the Circular Economy Fights Climate*

Change. The document shows a clear connection between the circular economy and how it can help governments and businesses achieve their climate goals and provide broader social benefits. It says renewable energy systems will solve 55% of climate change problems. The remaining 45% should be addressed by converting to a circular economy in the way we use products /10/.

### **Application of "MagVortex" technology in the "circular economy"**

Developed by "Magmatrix Systems" (Azerbaijan) within the framework of Program of the International Academy of Sciences "Health and Ecology" - AS technology "MagVortex" is designed to save hydrocarbon fuel and reduce CO<sub>2</sub> into the atmosphere in internal combustion engines. This technology is applicable to all types of transport (road, sea and air, using internal combustion engines), Fig. 1. The author of the technology is Prof. Dr. Elchin Khalilov /11/.



**Fig. 1. Various types of transport with internal combustion engines.**

The tests were carried out on the basis of the order of the Cabinet of Ministers of the Republic of Azerbaijan in a number of state-owned enterprises at diesel power plants, as well as by the International Academy of Sciences H&E together with the Intergeo-Tethys company on used and new cars. The test results showed that the MagVortex technology (MAGMATRIX FUELL) reduces fuel consumption (gasoline and diesel fuel) on cars with internal combustion engines, as well as diesel and gasoline power plants and, as a result, reduces CO<sub>2</sub> emissions into the atmosphere.

During the tests, an actual reduction in fuel consumption from 10% to 35% was obtained, and a decrease in CO<sub>2</sub> emissions into the atmosphere from 15% to 30%.

The most important conclusion from the tests is that the maximum fuel economy (30% or more) and the maximum reduction in CO<sub>2</sub> emissions (35% or more) into the atmosphere were recorded on the oldest models of used trucks and cars, and the savings effect increases proportionally the service life of the used car. It is noteworthy that during the testing process, other widely advertised devices for saving fuel, produced in different countries based on the use of permanent magnets, were also tested, but unfortunately, they did not allow to obtain any noticeable fuel savings and reduce CO<sub>2</sub> emissions. What is MagVortex technology? These devices are based on the use of a special system of permanent very powerful neodymium magnets, which create a vortex flow and some other physical effects when the fuel passes through them. This technology is currently at the stage of international patenting and it differs from all known technologies in its physical principle of action. The “MagVortex” apparatus significantly improves the quality and energy parameters of the fuel. In 2020, on the basis of instructions from the Azerbaijani government to various interested ministries and departments, state tests of the MagVortex technology (MAGMATRIX FUELL) were carried out, which allowed to obtain positive results. The MagVortex apparatus is installed after the fuel filter on the fuel hose leaving the fuel tank. The fuel leaving the fuel tank, after passing through the fuel filter, enters the “MagVortex” apparatus, after which it is supplied to the engine fuel system. So, this technology is most effective on used cars with a long service life, of which there are more than 1 billion worldwide. Its installation on a car is very simple, as shown in Fig. 2. On new cars, the technology allows fuel savings of 8-12% and CO<sub>2</sub> emissions reduction by 10-15%. It is noteworthy that along with significant fuel savings and a decrease in CO<sub>2</sub> emissions into the atmosphere, the use of the MagVortex device made it possible to increase the engine power by 5-7%, as well as reduce engine noise and vibration and increase the stability of its operation, which is especially pronounced on old cars models with a long service life. The UNEP report identified five main points that should significantly affect the reduction of CO<sub>2</sub> in the future: they are phasing out coal and investments in renewable energy, switching vehicles to alternative fuels, decarbonizing industrial production and improving energy efficiency /1/.

It is impossible to completely stop the emission of carbon dioxide into the atmosphere without a complete transition to alternative energy sources, the authors of the report believe. But so far, none of the countries that intend to become "climate neutral" by 2050 have set themselves such a goal. Instead, coal, gas and oil production is growing worldwide, reaching a record high in 2018, rising to 37 gigatons. According to the report, to achieve the intended goal of

reducing carbon dioxide emissions by 2050, energy production around the world must be 85% from renewable sources.



**Fig. 2. Left, the MagVortex apparatus mounted on the fuel hose car VAZ-2106 made in Russia in 1995.**

### **"Circular economy" during the transition from hydrocarbon fuel for "green technologies"**

"On the one hand, we are talking about big ambitions, and on the other, about how to quickly achieve the goal to reduce greenhouse gas emissions. First of all, the energy and transport sectors play a decisive role in this," says John Christensen /1/. The process of switching to alternative energy sources has already begun, and one of the successful examples of this is the continuous improvement of Tesla electric vehicles and similar electric vehicles produced in various countries. For example, in China, the production of electric vehicles is strongly stimulated by the state, and large financial and tax incentives are provided to companies producing electric vehicles. Electric vehicle companies in China are also encouraging buyers to buy them in every possible way, for example, by providing a lifetime warranty when buying an electric vehicle. Buyers of electric vehicles are provided with lucrative loans and some free maintenance services for electric vehicles, and free chargers are provided. Meanwhile, the transition period from the use of internal combustion engines in transport, energy and special equipment will require a long period of time, and,

as follows from the UNEP report, this may take at least 30 years. In solving this problem, it is necessary to provide for transition technologies that can qualitatively extend the life of old cars, sea and air transport, power plants using liquid fuel, as well as construction and military equipment, etc. That is, it is necessary to apply technologies that will reduce fuel consumption and CO<sub>2</sub> emissions into the atmosphere, while simultaneously improving the technical characteristics of internal combustion engines (increasing power and reducing engine noise, increasing other operational characteristics). Application of “MagVortex” technology will allow to extend the life of old cars and other equipment using internal combustion engines, while increasing their operational characteristics, first of all, saving fuel and reducing CO<sub>2</sub> emissions into the atmosphere.

### References

1. EmissionsGapReport 2019/UNEP, <https://www.unenvironment.org/resources/emissions-gap-report-2019>
2. Statista. <https://www.statista.com/statistics/748621/distribution-of-worldwide-co2-emissions-from-transportation-sector-by-sub-sector/#:~:text=The%20transportation%20sector%20is%20one,percent%20and%2036%20percent%2C%20respectively.>
3. DRIVETRIBE. How many cars in the world? [https://drivetribe.com/p/how-many-cars-are-there-in-the-dqbpAzrATLOOSgDfRrgkQ?iid=PboHkMImTV2mE\\_D53KsSww](https://drivetribe.com/p/how-many-cars-are-there-in-the-dqbpAzrATLOOSgDfRrgkQ?iid=PboHkMImTV2mE_D53KsSww)
4. <https://www.wardsauto.com/ideaxchange/planning-peak-auto>
5. Walter R. Stahel. [https://en.wikipedia.org/wiki/Walter\\_R.\\_Stahel](https://en.wikipedia.org/wiki/Walter_R._Stahel)
6. China coal market gets international outlook By Wang Qian (China Daily) Updated: 2010-11-17. [http://www.chinadaily.com.cn/bizchina/2010-11/17/content\\_11565512.htm](http://www.chinadaily.com.cn/bizchina/2010-11/17/content_11565512.htm)
7. Walter R. Stahel. The Performance Economy. 2nd Edition. 2010. PALGRAVE MACMILLAN. 349 p.
8. The Circular Economy and Benefits for Society Jobs and Climate Clear Winners in an Economy Based on Renewable Energy and Resource Efficiency. <https://clubofrome.org/wp-content/uploads/2020/03/The-Circular-Economy-and-Benefits-for-Society.pdf>
9. <https://www.energy-transitions.org/publications/mission-possible/>
10. Completing the picture how the circular economy tackles climate change ellenmacarthur foundation (2019). [https://www.ellenmacarthurfoundation.org/assets/downloads/Completing\\_The\\_Picture\\_How\\_The\\_Circular\\_Economy\\_Tackles\\_Climate\\_Change\\_V3\\_26\\_September.pdf](https://www.ellenmacarthurfoundation.org/assets/downloads/Completing_The_Picture_How_The_Circular_Economy_Tackles_Climate_Change_V3_26_September.pdf)
11. Prof. Dr. Elchin Khalilov. <https://www.ekhalilov.org/about-us.html>

## **PRACTICAL EXPERIENCE AND PROSPECTS OF APPLICATION OF NATURAL ZEOLITE FOR DEEP WATER PURIFICATION**

**E.N.Khalilov, F.E.Khalilov**

*“AZERZEOLITE” Scientific and Industrial Association,  
International Academy of Science AS,  
Baku, Azerbaijan e-mail: prof.khalilov@ias-as*

### **Abstract**

Research on the use of natural zeolite for deep purification of drinking water was started in Azerbaijan under the leadership of Prof. Dr. Elchin Khalilov in 1993. In Azerbaijan, filters for deep water purification based on the use of natural zeolite were successfully tested at the treatment facilities of the Jeyranbatan reservoir. After deep purification with the help of natural zeolite, drinking water was supplied to the capital of Azerbaijan, Baku. Along with large-scale wastewater treatment plants for filtering drinking water, led by Prof. Dr. E. Khalilov also developed and successfully tested mobile filters based on a truck. In addition, personal filters for deep purification of drinking water have been developed and patented. All of these models of filters based on natural zeolites allow water to be purified from radioactive contamination, organofluorine and chlorine-containing substances, heavy metals, compounds containing arsenic and other highly toxic substances. One of the main achievements is water purification with the help of natural zeolite from many types of pathogenic bacteria, viruses and fungi. Laboratory research conducted under the guidance of Prof. Elchin Khalilov to purify the water of Lake Boyuk-Shor from cyanobacteria showed that natural zeolite activated by the magnetic resonance method effectively contributes to a significant decrease in the population of cyanobacteria in water.

***Key words:** natural zeolite; deep water purification; treatment facilities; cyanobacteria; magnetic resonance method.*

### **Introduction**

Research on the use of natural zeolites for deep water purification was carried out under the guidance of prof. Elchin Khalilov from 1993 to the present. The main goal of research is the creation of new effective and versatile technologies for deep water purification.

Deep water purification means water purification in two main directions:

1. Purification of water from toxic and harmful chemical compounds: radioactive elements; heavy metals; dioxins and furans; arsenic chemical compounds; organochlorine and other hazardous chemical pollutants.
2. Purification of water from pathogenic microorganisms (viruses, bacteria, fungi, spores, etc.)

The intensive development of various types of industry in the modern industrial world is inextricably linked with the formation of various chemical and biological wastes, which become the cause of soil and natural water pollution. Atmospheric precipitation promotes active dissolution, capture and penetration of chemical and biological pollutants into groundwater. The problem of chemical and biological pollution of groundwater exists in all industrial zones, in the territories of large cities and settlements, as well as in areas of agricultural land where chemical fertilizers are used. Research conducted under the guidance of prof. Elchin Khalilov made it possible to obtain very good results in the use of natural zeolites, both for deep purification of water from chemical contaminants and for purifying water from biological contaminants - pathogenic bacteria, viruses and fungi that cause severe infectious diseases and pathologies. In the program of these studies, headed by Prof. Elchin Khalilov attracted leading scientists and specialists in the field of mineralogy, chemistry, microbiology, virology, ecology and medicine. As a result of these studies, patents were obtained for filters for deep water purification and for the use of natural zeolite for adsorption from water, both toxic chemical compounds and biological - pathogenic bacteria and viruses that cause various serious diseases in humans: poliomyelitis, tuberculosis, papilloma virus, avian influenza virus H<sub>5</sub>N<sub>1</sub> and other microorganisms in water. Under the guidance of Prof. E. Khalilov developed stationary industrial zeolite filters, mobile filters for drinking water purification and personal filters for drinking water purification of various modifications based on natural zeolite. Laboratory studies carried out in the study of water contaminated with cyanobacteria of Lake Boyuk-Shor, located on the Absheron Peninsula of Azerbaijan, showed that activated natural zeolite can also be effectively used in the process of water purification from cyanobacteria.

### **1. Stationary filters for deep water purification**

In the book of prof. E. Khalilova / 1 /, on pp. 149-151, the results of the introduction of filters based on natural zeolite of the Aydag deposit of Azerbaijan, which are being developed by the Association "AZERTZEOLIT", are presented. The zeolite filter was installed at the water treatment plant of the third stage of the Jeyranbatan main water pipeline, through which water flows to the capital of Azerbaijan - the city of Baku. The results of a comparison of the effectiveness of using natural zeolite and quartz sand for filtration are shown in Table 1.



**Results of comparison of the efficiency of application of natural zeolite  
and quartz sand for water filtration**

**Table 1.**

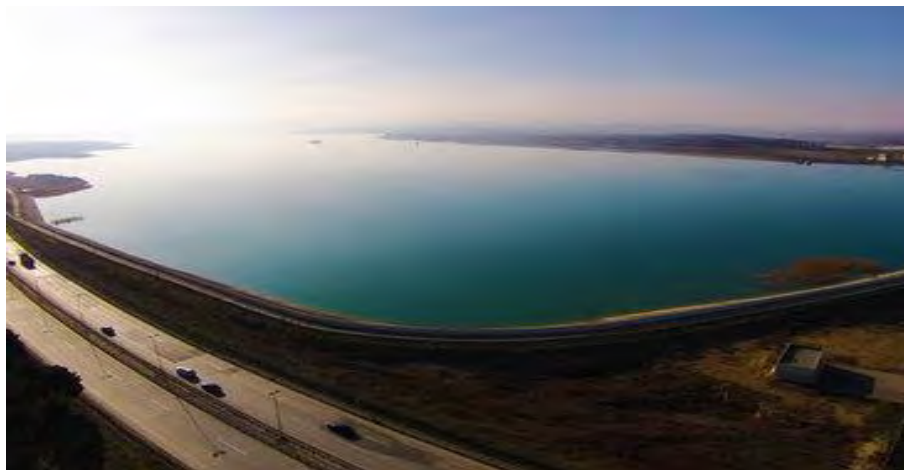
(from the book: E.N.Khalilov, R.A.Bagirov. Natural zeolites, their properties,  
production and application. Baku-Berlin, Elm, 202, p.150)

№	Parameter name	Unit of measurement	Filter loading	
			Quartz sand	Zeolite
1	Performance	m <sup>3</sup> / hour	8640	10800
2	Performance of one filter	m <sup>3</sup> / hour	720	900
3	Number of filters	PC.	12	12
4	Single filter area	m <sup>2</sup>	91,5	91,5
5	Duration of work of the station during the day	hour	24	24
6	Estimated filtration rate in normal mode	m/ hour	8	10,0
7	Estimated filtration rate at forced mode	m/ hour	9	10,9
8	Flushing intensity	l / s · m <sup>2</sup>	15	15
9	Duration of flushing	Min.	7-8	6
10	Water consumption for one wash	m <sup>3</sup>	580-600	500
11	Filtration cycle duration	hour	24	24
12	Capacity for retaining mechanical dirt on zeolite filters	kg / m <sup>2</sup>	3	6-8

In addition to mechanical cleaning, natural zeolite has a high adsorption capacity in relation to many radionuclides, heavy metals, toxic chemical compounds and trace elements contained in groundwater, especially in industrial zones. This problem is also observed in the industrial zones of China. It should be borne in mind that the Jeyranbatan reservoir of Azerbaijan is located in close proximity to the city of Sumgait, which is the center of the chemical and petrochemical industry of Azerbaijan. A large number of chemical, petrochemical and metallurgical enterprises are located here, which are the cause of severe pollution of the atmosphere, ground and surface waters, including water in the Jeyranbatan reservoir.

**The use of zeolite filters at the water treatment plant of the Jeyranbatan water supply system made it possible to increase the filter capacity by 25%, save water for flushing one filter - more than 54,000 m<sup>3</sup> per year, and increase the productivity of the water treatment unit by 1,576,800 m<sup>3</sup> per year.**

The use of natural zeolite in the water treatment facilities of the Jeyranbatan reservoir made it possible to significantly increase the efficiency of water purification entering the city water supply system of Baku city, in comparison with standard filters.



**Fig. 1. Jeyranbatan reservoir providing water to the city of Baku.**

The results of these comparisons are given in the book by Prof. E.Khalilov / 1 /, in table 2.

**Comparison of water purification of jeyranbatan water pipeline when using standard filter loading and natural zeolite**

**Table 2.**

(from the book: E. N. Khalilov, R. A. Bagirov. Natural zeolites, their properties, production and application. Baku-Berlin, Elm, 2002, p. 156)

Trace elements	Initial content in water mg / l	After cleaning, content in water mg / l	
		Zeolite	Quartz sand
Mercury	0,82	0,34	0,8
Chromium	44,0	11,08	26,8
Cobalt	0,69	0,24	0,52
Zinc	130	43,5	35,6
Selenium	1,5	0,53	0,78
Strontium	890	310,0	789,0
Tellurium	1,79	0,98	1,72
Barium	172,3	137,0	161,1
Cesium	4,09	1,9	3,96
Iron	670,1	161,3	232,4
Manganese	44,1	44,1	44,1

Studies have shown that crushed natural zeolite also has a much higher efficiency in water purification from mechanical and colloidal particles and impurities in water compared to quartz sand, granodiorite and other minerals. Multi-stage zeolite filters have been developed and tested. Each cascade contained crushed zeolite with various granule sizes and layer heights. Many necessary parameters were determined: the number of stages with a filtering zeolite charge, the optimal size of granules in each cascade, the volume of the zeolite charge depending on the volume of passing water, the effective service life of the zeolite charge depending on the degree of water pollution, etc. In particular, tests were carried out to clean the Kura River of Azerbaijan, while the water from the river was continuously cleaned for 535 hours (23 days). In the book of prof. Elchin Khalilov, photographs of filter media made of natural zeolite at various stages of water purification made using an electron microscope are given, which allows us to judge the process of water purification and adsorption. One of the most pressing problems of groundwater pollution is the increased content of ammonium ions. The main anthropogenic sources of ammonium input into groundwater are:

- domestic waste water (up to 10 g per inhabitant per day);
- industrial waste water (especially from food, chemical, timber-chemical industries);
- surface runoff from the territory of settlements;
- surface runoff from farmland when using ammonium fertilizers;
- sewage from livestock farms;

Conducted under the guidance of prof. E. Khalilov's studies published in his book /1/ (pp. 303-313) showed that natural zeolite is a highly effective filtering element for the adsorption of ammonium ions in order to purify ground and surface waters /17/. The efficiency of purification of ammonium ions from wastewater using natural zeolite was 87.3%. The properties of natural zeolite have been significantly enhanced by modifying the natural zeolite. These works were carried out at the International Scientific and Technical Complex "Intergeo-Tethys".

The results of these studies made it possible to develop and approve Technical Conditions (national standards of Azerbaijan) on the use of natural zeolites for the purification of drinking and waste water, to develop and patent new types of filters for water purification based on natural zeolite, to lay a theoretical and experimental basis for creating various modifications of filters (from large-scale filters for urban main water lines to mobile and personal filters for purifying drinking water). Based on the results of all these studies, the corresponding test reports were approved.

## **2. Mobile filters for purification of drinking water**

Prof. Elchin Khalilov also developed and successfully implemented mobile filters for purifying drinking water directly from natural water sources - springs, open reservoirs, artesian waters, etc. These filters are installed on the basis of trucks and can be used in remote hard-to-reach areas: by geologists, rescuers, the military, etc. in areas of natural disasters, emergency situations and other areas with a high risk of water pollution by chemical and biological substances. This filter allows to purify ground water and water from open reservoirs from chemical and biological contaminants to the level of drinking water standard.

## **3. Personal filters for deep purification of drinking water based on natural zeolite**

Personal filters for deep purification of drinking water from chemical and biological contaminants were developed by prof. Elchin Khalilov in collaboration with a group of scientists. Filters are intended for the use of drinking water purification from natural and artificial water sources and are intended for geologists, tourists, climbers, military men, rescuers, etc., Fig. 2.

These filters use natural zeolite of different fractions, including modified zeolite saturated with iodine, silver and other substances that improve the quality of water purification and biological disinfection.



**Fig.2. Personal filters for deep purification of drinking water based on natural zeolite.**

## **4. Worldwide priority research.**

### **4.1. Biological water purification using natural zeolite**

To research which has a world priority, primarily include the results of studies on the use of natural zeolites for the disinfection of water from pathogenic

bacteria, viruses, fungi and other microorganisms posing a great danger to humans and the animal world. Research conducted under the guidance of prof. E.Khalilov showed that natural zeolites crushed to granules of a certain size make it possible to purify water from dangerous biological contaminants 85% -90% more efficiently than quartz sand, granodiorite, gravel and expanded clay. The results of recent studies on the use of natural zeolite for chemical and biological water purification were described in the last works of prof. E. Khalilov / 2-7 /. Were also tested filters based on natural zeolites for the effectiveness of water purification from bacteria, viruses and microorganisms, which were carried out in organizations headed by prof. Elchin Khalilov and a number of medical institutions in Azerbaijan by order of the Scientific and Production Association "AZERTZEOLIT". One of the latest research by Prof. Elchin Khalilov are devoted to studies of the effectiveness of the use of nano zeolite for chemical and biological water purification, which have shown the promise of this technology.

### Results of microbiological water purification using natural zeolites

<b>Microbiological contamination type</b>	<b>The name of the contaminant microorganism adsorbed by natural zeolite from water based on evidence</b>			
<b>Bacteria</b>	Mycobacterium tuberculosis	Streptococcus, staphylococcus	E. coli; St.aureus	Ps.aeruginosa
<b>Viruses</b>	Poliomyelitis viruses	H5N1	Enteroviruses	Papillomaviruses
<b>Fungi</b>	Ulocladium, Penicillium, Alternaria, Aspergillus, Chaetomium, Phoma,	Aspergillus fumigatus	Candida albicans, C. guilliermondii, C. tropicalis, C. pseudotropicalis, C. krusei, C. parakrusei	blastomycosis, sporotrichosis, chromomycosis, coccidioidosis, histoplasmosis, rhinosporidiosis, aspergillosis

The results of these studies were described in detail in works / 1-7, 11, 22, 23 /. Thus, conducted by Prof. Khalilov's research for during more than 27 years in the field of using natural zeolites for deep water purification made it possible to develop and implement on an industrial scale in Azerbaijan new effective technologies for filtering water for a wide range of tasks - from large-scale industrial filters for urban water treatment plants to mobile and personal deep water filters purification of drinking water.

The results of these studies have been published in national and international scientific journals and books /1/, as well as presented at international conferences. For these technologies prof. Elchin Khalilov also received patents.

#### **4.2. The problem of blue-green algae in natural water bodies of Azerbaijan and some results of its solution with the help of natural Zeolite**

A large number of natural lakes are located on the Absheron Peninsula of Azerbaijan. Basically, these are relict lakes formed over a long period of time and are of great importance for the ecosystem of the peninsula.

Of the Apsheron lakes, the following are polluted: Lake Yasamal, very polluted lakes are Boyukshor, Masazir, Kurdakhani, Khojahasan, Bul-Bula, Girmizigol, Fig.3.



**Fig.3. Polluted lakes of the Absheron Peninsula in the zone of old oil-producing territories.**

One of the largest natural reservoirs of the Absheron Peninsula is Boyuk-Shor Lake, which covers 1200 hectares and, unfortunately, is the most polluted of all. If 100 years ago the area of Lake Boyuk-Shor was 10 square meters. km at a depth of one meter, now the lake has increased to 14 sq. km at a depth of 10 meters.

At least the first meter of bottom sediments was so saturated with fuel oil and household and chemical pollution that it lost its balneological qualities. The continued discharge of household waste into the lake has led to the emergence of

another problem that is rapidly increasing in scale - the pollution of Lake Boyuk-Shor with blue-green algae (cyanobacteria).

#### **4.3.Existing methods of cleaning water bodies from cyanobacteria (blue-green algae)**

*There are several different methods of controlling the development of cyanobacteria:*

- Method based on dimming, i.e. on limiting or stopping the flow of light to the surface of the water, where cyanobacteria are concentrated. This method can be based on covering large areas with special opaque films or spraying special substances on the surface of the water to reduce the flux of light.
- A method based on the introduction of hydrogen peroxide into the water, which, when it gets into the water, breaks down into water and oxygen - harmless substances. Meanwhile, an excess of the dose of hydrogen peroxide can adversely affect the development and existence of some species of microfauna and flora in the water basin;
- Mechanical cleaning by means of mechanical collection of blue-green algae from the water surface or mechanical filtration;
- The biochemical method consists in the use of drugs or chemicals to kill algae, for example, by dissolving antibiotics or antiseptics in water. This method can have a negative impact on the existence of other microflora and aquatic fauna.
- Biological method 1. The biological method is based on the consumption of gastropods, as well as some fish, such as ancistrus, algae;
- Biological method 2. Development in the reservoir of special bacteria (for example, chlorella), which compete with the blue-green algae for nutrition, and absorb the food base which the blue-green algae used to feed on. It is due to the sharp reduction in "food" that the amount of blue-green algae is noticeably reduced.
- The use of filters with ultraviolet lamps, which suppress the development of cyanobacteria and destroy them;
- Geophysical method - exposure of cyanobacteria to ultrasonic waves, which suppress their development. This method is not fully tested and can be harmful to marine life;
- Biophysical method 1, based on the use of special compositions that are sprayed on the surface of the reservoir in the area of the presence of cyanobacteria. This method is based on the creation of a special powder with superhydrophobic properties. The powder consists of copper sulfate

and a binding agent - a water repellent. The powder is sprayed over the blue-green algae and remains on the water surface for a long time. After application of the composition, algae cells collect in colonies on the surface of the water and precipitate over time. Considering the technology of creating a coating, it can be stated that this method is quite expensive and not always effective.

- Biophysical method 2. Researchers from the Nanjing Institute of Geography and Limnology at the Chinese Academy of Sciences have created a new composite substance that causes algae to quickly descend from the surface of the water to the bottom. This process does not generate harmful compounds and contributes to the efficient assimilation of nutrients contained in algae in the natural ecosystem of the reservoir. The new method is preferable because it is cost effective and environmentally friendly. It is expected to be widely used in the fight against eutrophication of lakes.

According to the latest China Water Resources Bulletin, eutrophic lakes make up over 70 percent of China's 121 large lakes that are associated with algal blooms. The bulletin says that this problem has become especially urgent in recent years in the aquatic environment.

#### **4.4. New technology for purification of reservoirs from blue-green algae "ZEOMAG"**

Physicochemical method "ZEOMAG" was developed by prof. Elchin Khalilov and is based on the use of natural zeolite activated by the magnetic resonance method to combat cyanobacteria. This method is environmentally friendly, highly efficient and cheap, since it allows the use of specially activated low-grade zeolite for these purposes. The method was successfully tested in laboratory conditions and received very good results. Conducted by the Research and Production Association AZERZEOLIT from 2008 to 2020 under the leadership of Prof. Elchina Khalilova scientific research laboratory work has made it possible to create a fundamentally new concept of using natural zeolite to combat blue-green algae. Was studied the efficiency of purification using natural zeolite activated by the magnetic resonance method of prototypes of cyanobacteria taken from Lake Boyuk-Shor contaminated with household and chemical waste, located on the Absheron peninsula near the capital of Azerbaijan - the city of Baku, Fig.4. and Fig.5. The results obtained using this method have confirmed its effectiveness. To purify water from cyanobacteria, the natural zeolite of the Aydag field of the Republic of Azerbaijan was used. Based on the research results obtained, several applications for obtaining international patents



were issued, which are currently at the patenting stage. Using the developed by prof. E.N.Khalilov and F.E.Khalilov of technologies "MAGMATRIX simultaneously with natural zeolite in the process of water purification from cyanobacteria made it possible to reduce the content of cyanobacteria in the experimental water sample by 70% already at the first stage. The use of natural zeolite activated by the magnetic resonance method to combat the spread of blue-green algae has no analogues in the world. This technology is named by the authors "ZEOMAG".

This technology made it possible to increase the adsorption capacity of natural zeolite by at least 20% - 25%.

### Conclusion

Thus, the experience of using natural zeolite-clinoptiylolite from the Aydag deposit of Azerbaijan has shown its high efficiency in the process of deep water purification from radionuclides, heavy metals, dioxins and furans and other toxic compounds. On the basis of the research carried out, devices and methods for filtering drinking and waste water have been developed and applied. In particular, natural zeolite was used to purify the drinking water of the Jeyranbatan reservoir. In addition, mobile and customized solutions have been developed and tested. Personal filters for deep purification of drinking water from chemical and biological contaminants were developed, tested and introduced in some state structures of Azerbaijan. It is necessary to emphasize the world priority of research by a group of scientists led by prof. Elchin Khalilov, associated with the use of natural zeolite-clinoptilolite for biological purification of water from pathogenic bacteria and viruses that cause severe infectious diseases in humans.



**Fig.4. A new problem of Boyuk-Shor lake is cyanobacteria.**



**Fig.5. Cyanobacteria release toxic compounds, which leads to a decrease in the biodiversity of Boyuk-Shor Lake and its surrounding areas.**

The next interesting conclusion is the confirmation of the effectiveness of the use of natural zeolite activated by the magnetic resonance method for cleaning water bodies from blue-green algae. Laboratory studies carried out in the study of water contaminated with cyanobacteria of Lake Boyuk-Shor, located on the Absheron Peninsula of Azerbaijan, showed that activated natural zeolite can also be effectively used in the process of water purification from cyanobacteria.

### References

1. Khalilov E.N., Bagirov R.A. Natural zeolites, their properties, production and use. Baku-Berlin, 2002, Elm, 350 p.
2. Khalilov E.N. Application of natural zeolite for deep water purification: application experience and development prospects. Science Without Borders. Ecology and Environmental Protection. Volume 6, 2020, Austria, Innsbruck.
3. E.N. Khalilov, F.E. Sadykhova, Kh.T. Gahramanova "AZEOMED": zeolite sorbent of viral-bacterial flora. Natural zeolite in medicine. IAS-H&E, SWB, Bourgas, 2010, pp.36-45
4. E.N. Khalilov, T.Sh. Khalilova, F.E. Sadykhova. Selective adsorption of bacterial flora on "AZEOMED". Natural zeolite in medicine. IAS-H&E, SWB, Bulgaria, Bourgas, 2010, pp.46-50

5. F.E. Sadykhova, Kh.T. Gahramanova, E.N. Khalilov To adsorption of malignant cell population on modified zeolites. Natural zeolite in medicine. IAS-H&E, SWB, Bourgas, 2010, pp.50-62
6. E.N. Khalilov and etc. Kinetic regularities of crystallization of zeolite-filled high-strength polyethylene. "Chemical Problems" Journal, №2, Baku, 2009, pp.350-353
7. Veliev P.M., Khalilov E.N. Development of a natural multicomponent medical composition with immunostimulant and antioxidant effects (glycyrrhetic acid, chitosan, zeolite, an amber acid). SCIENCE WITHOUT BORDERS. Transactions of the International Academy of Science H & E. Vol.3. 2007/2008, SWB, Innsbruck, 2008, pp.43-58, ISBN 978-9952-451-01-6 ISSN 2070-0334
8. E.N. Khalilov and etc. Obtaining a mixed natural zeolite-based mineral fertilizer of prolonged action. Azerbaijan Chemical Journal, №8, 2007
9. Kh.T. Gahramanova, N.T. Gahramanov, E.N. Khalilov. Properties of zeolite-containing polyolefins. Azerbaijan Chemical Journal. №3, 2007, pp.156-159
10. E.N. Khalilov and etc. Physical-chemical study of modified zeolite. Chemical problems, №4, 2006, pp.650-652
11. E.N. Khalilov, F.E. Sadykhova, Kh.T. Gahramanova. To adsorption of malignant cell population on modified zeolites. Azerbaijan Journal of Oncology and Hematology, №2, 2005, p.93-95
12. E.N. Khalilov, N.T. Gahramanov, Kh.T. Gahramanova. Study of effect of natural zeolite on physical-mechanical properties of polyolefins. VI Baku International Mamedaliyev Conference on oil and chemistry dedicated to 100<sup>th</sup> birthday of Academician Y.G.Mamedaliyev, 27-30 September 2005, Baku
13. E.N. Khalilov and etc. Study of ammonium ion adsorption by natural and modified zeolite-clinoptilolite. Speeches and presentations II International Symposium "Ecological and technological problems in emergency situations" October 8-10, 2002, Baku, pp.82-88
14. E. Khalilov, R. Bagirov, A. Guvalov. Application of Aydag deposit zeolite for waste water purification. International Practical Conference, Baku, 17-18 September, 2001, RN "Novruz-94", pp.553-556
15. Khalilov E.N. Using natural zeolite of the Azerbaijan Aydag deposit in solving the region's radiation and chemical safety problems. I International Symposium, 20-22 November, Baku, 2000
16. E.N. Khalilov Development prospects of zeolite industry in Azerbaijan. Int. Conference Materials, v.1, Baku, 28-30 October 1999 , pp. 3-11
17. E.N. Khalilov and etc. Adsorption of ammonia and formic acid on natural zeolite and its cation-exchanging forms. Int. Conference Materials, v.1, Production and application of natural zeolites, Baku, 28-30 October 1999
18. E. Khalilov, R. Bagirov. Mineralogical composition and technological properties of original AND modified forms of natural zeolites. Materials of the conference: "Production and application of natural zeolites", 28-30 October 1999, pp.3-11, "Seda" publishing house, 1999, Volume 2, pp.3-40

19. E.N. Khalilov, T.A. Khalilov, S.A. Eminov, T.S. Guliyeva. The role of natural zeolite in the improvement of physical-chemical properties of light soils. Materials of the conference: "Production and application of natural zeolites", 28-30 October 1999, pp.3-11, "Seda" publishing house, 1999, Volume 2, pp.40-48
20. E.N. Khalilov, R.A. Bagirov, T.S. Farhadov. Using promoted ferric sulfate of natural zeolite in the process of production of a series as a protective layer on GPZ. Materials of the conference: "Production and application of natural zeolites", 28-30 October 1999, pp.3-11, "Seda" publishing house, 1999, Volume 2, pp.83-92
21. E.Khalilov, R.Bagirov, A.Salamov. About experimental-design works on enrichment and modification of natural zeolites of Azerbaijan. Abstracts of the International Symposium on Natural Zeolites. Natural zeolites – 97, Gurjaani, Georgia, 24-26 September, 1997, pp.28-29
22. Chernova E.N., Russkikh Ia.V., Zhakovskaya Z.A. *Fizicheskie i khimicheskie metodyvozdeistviya na tsianobakterial'noe "tsvetenie" vodoemov. Obzor* [Physical and chemical methods for control of cyanobacterial blooms in water bodies: a review]. *Regional'naya ekologiya* [Regional Ecology], 2018, no. 3(53), pp. 39–61. (in Russian). DOI 10.30694/1026-5600-2018-3-39-61
23. Polyak Y.M., Sukharevich V.I.. Toxic cyanobacteria: their occurrence, regulation of toxin production and control. ResearchGate.№ 11-12, November-December, 2017, p.125–139.
24. China develops harmless treatment method of blue algae. <https://smartwatermagazine.com/news/chinese-academy-sciences/china-develops-harmless-treatment-method-blue-algae>
25. Zhurkovich I.K., Kovrov N.G., Lugovkina N.V., Milman B.L.Caution, microcystins! Analytics, Volume 8 No. 5 (42) 2018. [https://www.j-analytics.ru/files/article\\_pdf/7/article\\_7096\\_167.pdf](https://www.j-analytics.ru/files/article_pdf/7/article_7096_167.pdf)

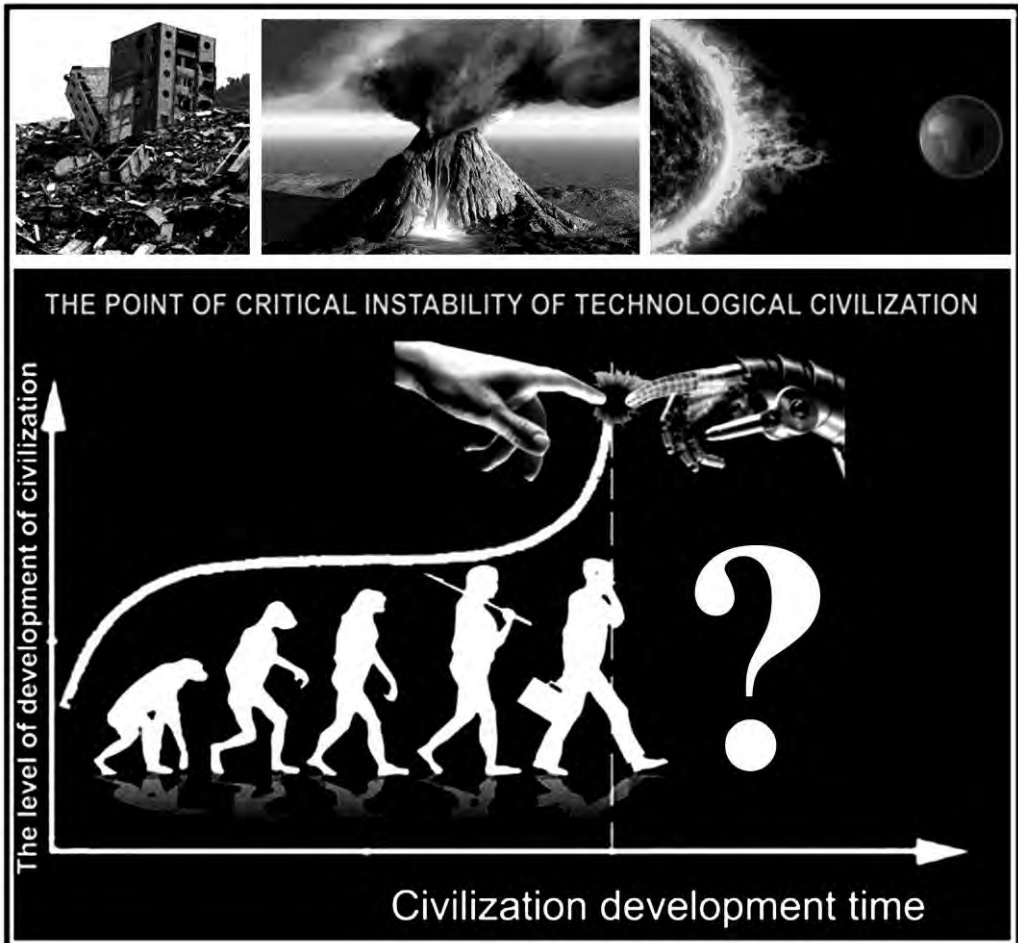
#### Patents:

1. Khalilov E.N. and other. Method of enterosorption. Azerbaijan patent No.a20090255, 26.11.09
2. Khalilov E.N. and other. Method for concentrating viral flora from slightly polluted waters. Azerbaijan patent No. i20060040, 19.04.2006
3. Khalilov E.N. and other. Method of fixing calcium hydro- and dihydrogen phosphates on the surface of a zeolite. Azerbaijan patent No. i20050097, 06.07.2005
4. Khalilov E.N. and other. Filter for water purification. Azerbaijan patent No.i20050151, 20.10.2005
5. Zarev Vladimir Vasilievich. Composition for cleaning water bodies from cyanobacteria and green algae. Russian Patent No. 2742169.
6. Zarev Vladimir Vasilievich. Composition for cleaning water bodies from cyanobacteria and green algae, Russian Patent No. 2737729.

## RISKS OF THE FOURTH INDUSTRIAL REVOLUTION AND POSSIBLE WAYS TO MITIGATE THEM

**E.N.Khalilov**

*International Academy of Sciences H&E-AS*  
*prof.khalilov@ias-as.org*



**Image by Prof. Dr. Elchin Khalilov, 2020**

## Abstract

This work shows that modern civilization has come to the brink when further technological development not only does not increase its safety in the face of growing natural disasters and global geophysical and space (space weather) factors, but, on the contrary, creates new large-scale threats and risks for its further existence humanity.

The increasing dependence of people in many areas of their activity on high technologies has created a new reality in which large-scale natural disasters can lead to a global disruption in the work of information, energy and other technological systems, which will lead to unpredictable consequences for humanity. The decrease in the strength of the Earth's magnetic field, on average, by 10%, significantly weakened the protection of our planet from cosmic electromagnetic and corpuscular radiation. We state that the modern technological society is not ready for global natural challenges. We propose to use "parachute technology" to mitigate the catastrophic consequences of global natural disasters, primarily associated with powerful flares on the Sun with coronal ejections towards the Earth.

**Key words:** *critical instability, singularity, natural disasters, technological civilization, the fourth industrial revolution, Carrington event, supervolcano, solar storm, "parachute technology", circular economy.*

## Introduction

Over the past decades, many scientists have been trying to predict the development trends of modern technological civilization. One of the directions of the forecast is associated with the so-called concept of "singularity", according to which the development of artificial intelligence at a certain moment can reach the level of "intellectual explosion", when artificial intelligence surpasses human intelligence and begins to improve itself. The process of self-improvement of artificial intelligence will begin to grow uncontrollably, which will ultimately lead to the creation of a "superintelligence" that surpasses the intelligence of all mankind. Thus, the "superintelligence" will be able to destroy or enslave humanity. The concept of technological singularity and the term "singularity" itself were popularized by the American science fiction writer Vernor Vinge in his 1993 article "The Coming Technological Singularity" /1/. I think that if in 1993 the concept of "singularity" was perceived as fiction, today many IT representatives will seriously think about it before calling this concept "fantastic".

A completely different perspective of the development of a technological civilization is considered by G.A. Lemarchand in his work /2/. It presents an empirical study of the long-term evolution of several social indicators (for example, population growth, statistics of deadly conflicts, the spread of

democratic systems, etc.). Guillermo A. Lemarchand suggests that the human species emerges, develops and dies out with similar evolutionary patterns. In his view, long-term indicators demonstrate a kind of macro-transition in their long-term behavior, which he defined as "technological adolescence". This age of our civilization is characterized by human pollution of the environment, destruction and disharmony with nature. According to the author of the hypothesis, our humanity needs to move from the "technological adolescence" to the "technological mature era", in which we learn to live in harmony with representatives of our species and the environment, as well as learn how to effectively manage the growth of our power over nature on different scales /2/.

Klaus Schwab writes in his work "the fourth industrial revolution": "The development and implementation of the latest technologies are associated with uncertainty and mean that we do not yet have an idea of how the transformations caused by this industrial revolution will develop in the future. The very fact of their complexity and interdependence across all sectors implies the responsibility of all participants in the global communities - governments, business, academia and the public - for working closely with each other to better understand emerging trends ". /3/

Speaking in terms of possible risks, Klaus Schwab notes that "the nature of the changes taking place is so fundamental that world history has not yet known such an era - a time of both great opportunities and potential dangers /3/.

We would like to consider one of such dangers emanating from nature itself. So, in our opinion, the technological development of mankind has reached the point that we called "the point of critical instability of the technological civilization".

As Professor Klaus Schwab notes, today we can state that humanity is almost completely dependent on IT and HiTech, which cover almost all areas of our life. We cannot imagine our life without communication using instant messengers, on social networks, without the Internet, online conferences, bank transfers, online payments for purchases in stores, restaurants and in the vast majority of different service sectors. Our life at the computer and on the Internet is at least 50% of our time, and in some cases more than 70%. Moreover, many technological and production processes are switching to autonomous control systems with elements of artificial intelligence with minimal human participation. Thus, our life is gradually moving into virtual space. On the other hand, satellite communication and navigation systems, video control systems, unmanned vehicles, flying vehicles, robots performing various functions and much more have made our life almost completely dependent on high technologies. The next generation after us will become absolutely dependent on IT and HiTech. On the one hand, it seems excellent when various gadgets,

computers, smartphones and robots make our life much easier. Thinking about this, I would like to ask a few questions to myself and the readers:

- How stable and protected are all these systems from external influences and unforeseen factors?
- Can a situation arise when the technological world around us will be destroyed by a global natural process in an instant and we will be left alone with nature?
- If this does happen, will modern humanity be able to survive?
- Where and in what form will life be preserved?
- How real is the threat of destruction of the "technological world" and our "virtual reality"?
- What real events can threaten the modern "technological civilization"?

*I will try to answer some of these questions and want to start with specific examples from our lives that we have already experienced.*

## **1. Examples of Natural Threats to a Technological Civilization**

### **1.1. Carrington event of 1859**

One of the earliest and most striking examples of the threat of the influence of natural factors on the technological development of civilization is the Carrington event /4/, which is a powerful geomagnetic storm on September 1–2, 1859 during the 10th solar cycle (1855–1867). The solar coronal mass ejection affected the Earth's magnetosphere and caused the largest geomagnetic storm in human history. A related "flash of white light" in the solar photosphere was observed and recorded by British astronomers Richard Carrington and Richard Hodgson. The storm caused strong auroras and damaged telegraph systems.

In many countries of the world, telegraphs were disabled, some of them ignited. Many of them became unusable for 8 hours or more and had noticeable economic consequences /4/. This event was of a planetary scale. In many regions of the world, people have observed bright flares and stripes in the sky, shines of various colors, and in some regions there were strong electrostatic discharges in the sky. Most people from different countries assumed that this might be a giant fire beyond the horizon.

Lot of inhabitants of the Earth testified that they observed aurora borealis, unprecedented in scale and beauty. Many newspaper editorial offices that used telegraph systems to receive and transmit information were unable to timely cover events on the pages of their newspapers, which prevented the public from receiving necessary information about current events for several days to two



weeks while the telegraph lines and devices were restored. Cases of injuries of personnel serving telegraph devices were recorded as a result of a strong electric shock, which was induced by a geomagnetic storm in the winding of the telegraph transformer /4/.



**Fig.1. 1859 Aurora Storm-painting by Frederick Edwin Church in 1865 «Northern Lights».**

<https://www.messagetoeagle.com/solar-storm-known-as-the-carrington-event-took-place-on-august-28-1859/>

The calculation of economic losses from the solar flare in 1859, which is given in /4/, includes damage to 125,000 miles of telegraph cables, more than 50% of all telegraph devices in the world, damage to newspapers and telegraph operators as a result of downtime, moral damage to the population of the planet due to fear and panic that has arisen as a result of giant glow, discharges, lightning and other light and atmospheric electrical effects. Many people perceived this event as a biblical prediction about the end of the world or an impending global catastrophe, which led to strong emotional experiences /4/.

## **1.2 The influence of the solar storm of 1989 on the energy system of the Canadian province of Quebec**

NASA working paper, Severe Space Weather - Understanding the Social and Economic Impact, published in 2009, investigated the impact of space storms on US power systems, GPS-based air navigation systems, telecommunications

satellites and predicted the impact solar storms during the next peak in 2011-2012. /5/

The negative effects of increased solar activity included:

1. Failure of the satellite navigation system GPS and short-wave receivers due to increased radio absorption in the D-layer of the earth's ionosphere and even the loss of satellites (as was the case with the Soviet Salyut-6 and Japanese ASKO) due to an increase in their friction in the upper atmosphere during solar flares.

2. Induction of strong electric currents in long overhead power lines, cables and power transformers, especially ultra-high voltage (from 330 to 1150 kV AC), in communication lines under the influence of coronal mass ejections.

3. The negative impact of proton showers on radio electronic equipment, astronauts, pilots and aircraft passengers.

Of the listed facilities, the most important are power supply systems, since their failure for a long time poses the greatest technological threat to the daily life of mankind. This is evidenced by a number of accidents in electric power systems.

For example, in 1989, a small solar storm damaged EHV power transformers and plunged the Canadian province of Quebec into darkness for 9 hours. At the Salem NPP in the US state of New Jersey, at the same time, a powerful EHV power transformer /5/ failed. The working paper, Extreme Space Weather Events - Understanding the Social and Economic Impacts, states: "The modern technological society is characterized by a complex web of dependencies and interdependencies between its critical infrastructures.



**Fig. 2. The coronal ejection has led to the induction of strong**

### **electric currents in high voltage power lines.**

A complete picture of the socioeconomic impact of severe space weather should include both direct, sectoral effects (such as power outages and damage to spacecraft) and the side effects of technology failures caused by space weather on dependent infrastructures and services”.

#### ***Impact of space weather on the industry***

The power generation, spacecraft and aviation industries are major industries that can be adversely affected by harsh space weather. The impact of space weather can also be felt by a growing number of Global Positioning System (GPS) users, for example in the oil and gas industry, which uses GPS positioning data to support offshore drilling operations.

#### ***Power engineering***

During intense geomagnetic storms, the auroral oval moves to lower, densely populated latitudes, where rapidly changing ionospheric currents associated with the aurora can create DC currents in the power grid. Such geomagnetically induced currents (GICs) can overload the grid, causing severe voltage regulation problems and possibly widespread power outages. Moreover, GICs can cause intense internal heating in EHV transformers, exposing them to the risk of failure or even irreversible damage ”. /5/

### **1.3 The 2010 eruption of the Eyjafjallajökull volcano**

Let me give you one example from recent history: the 2010 eruptions of the Eyjafjallajökull volcano were volcanic events in Iceland that, although relatively small for volcanic eruptions, caused huge disruptions in air traffic across western and northern Europe in an initial period of six days of April, 2010. Local destruction continued in May 2010. The eruption was officially declared over in October 2010, when the snow on the glacier had not yet melted. From 14 to 20 April, ash from the volcanic eruption covered large areas of northern Europe. About 20 countries have closed their airspace to the movement of commercial jet aircraft, affecting about 10 million travelers /6/.



**Fig.3. Eyjafjallajökull volcano eruption 2010**

[https://yandex.ru/images/search?from=tabbar&text=Eyjafjallajökull%20volcano%20eruption%202010&p=7&pos=302&rpt=simage&img\\_url=https%3A%2F%2Fsun9-43.userapi.com%2FXpPxxd4UZxkhAL8PJhA1cI4aPUHf\\_S0O2-XBrA%2FIUjF0BADapM.jpg](https://yandex.ru/images/search?from=tabbar&text=Eyjafjallajökull%20volcano%20eruption%202010&p=7&pos=302&rpt=simage&img_url=https%3A%2F%2Fsun9-43.userapi.com%2FXpPxxd4UZxkhAL8PJhA1cI4aPUHf_S0O2-XBrA%2FIUjF0BADapM.jpg)

#### **1.4 COVID-19 Pandemic, 2020**

The coronavirus pandemic has accelerated the transition of mankind to an absolute dependence on IT. During the COVID-19 pandemic, most non-manufacturing companies have transferred their employees to online work and in the future, from 30% to 70% of all company workers will continue to work online. This means their dependence on the stability of the Internet and other communications.



Universities, schools and other educational institutions will also gradually switch to online learning, which makes them absolutely dependent on the stability of communication systems. The usual personal communication of people will gradually be replaced by communication on social networks, as well as on the basis of online meetings and conferences. Thus, humanity is gradually becoming completely dependent on IT. How dangerous is it, in terms of the risk of damage caused by natural factors?

## **2.Current dynamics of geological and space risk factors**

The report of the International Committee GEOCHANGE provides an in-depth analysis of the dynamics of the vast majority of natural disasters over the past century. Today it is already clear that 90% of what was predicted in this report in 2010 in the dynamics of natural disasters has already happened /6/.

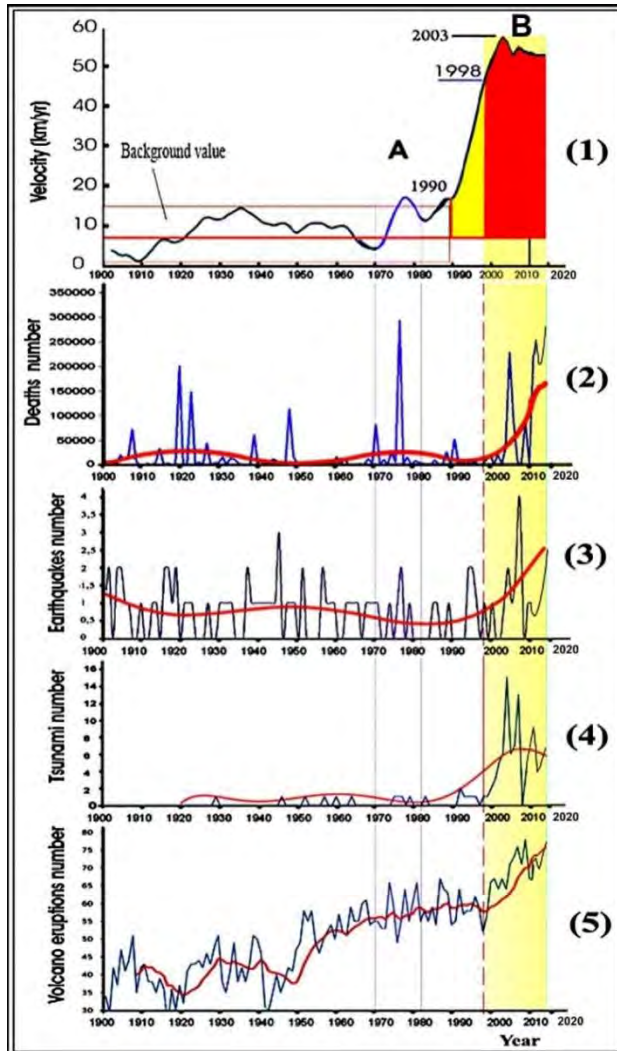
It is known that the endogenous activity of the Earth in the form of earthquakes and volcanic eruptions is simply an external manifestation of the internal energy of our planet, most of which comes from its core and adjacent layers. Today, science has yet to obtain accurate and final information about the mechanisms for the release of the Earth's internal energy, which causes convection in the mantle and, as a result, the movement of lithospheric plates.

Meanwhile, it is known for certain that the Earth's magnetic field is formed by processes occurring in the inner and outer core of our planet.

One of the most striking indicators of energy processes in the Earth's core is the speed of movement of its geomagnetic poles. There are various theoretical models to explain the drift of the geomagnetic poles. However, regardless of the model under consideration, it is obvious that a significant "jump" in the speed of the Geomagnetic North Pole indicates an increase in energy at the level of the Earth's core and surrounding layers. The jump in the speed of the North Magnetic Pole by more than 500% can be associated with significant changes in energy processes in its inner and outer core. In this case, the release of the Earth's internal energy should lead to an increase in the endogenous activity of the planet in the form of strong earthquakes and volcanic eruptions /6,7/. On the other hand, a sharp change in the speed of movement of the Earth's magnetic North Pole should also have an impact on global climate change. It is known that the Earth's magnetic field affects the movement of plasma, electric currents and general electrical properties of the upper region of the ionosphere. In addition, the Earth's geomagnetic field captures high-energy charged particles and has a significant effect on magnetospheric processes /8/. The fivefold acceleration of the drift of the North Magnetic Pole and the opening of the cusp angles change the energy potential of the ionosphere and upper atmosphere, which may affect the redistribution of cyclones and anticyclones. This idea requires further careful

study and is put forward in order to show a possible physical mechanism for the redistribution of the Earth's geomagnetic field, which affects global climatic processes. Numerous studies by various authors (Campbell, 2003; Newitt, et al., 2002; Barton, 2002; Alldrige 1987; Kuznetsov, 1990, 1997) were devoted to the development of a mathematical model describing the formation of the Earth's magnetic field. As V.V.Kuznetsov points out in his works, the drift of magnetic poles (its direction and speed) is one of the most important characteristics of geomagnetism. Meanwhile, many questions can be answered by studying the possible correlation between changes in the speed of the Earth's magnetic N Pole and the dynamics of the number of strong earthquakes, volcanic eruptions and tsunamis /6/. Fig.4. shows a comparison of graphs of changes in the drift velocity of the North Magnetic Pole, the number of strong earthquakes, tsunamis and volcanic eruptions in the period from 1900 to 2020. Comparative analysis identifies two characteristic cycles, labeled A and B, of increased statistical values for the parameters of each graph. Cycle A covers the period from 1970 to 1983, and cycle B from 1998 to the present. Within cycle A, an acceleration of the drift of the North Magnetic Pole is observed from about 8 to 18 km per year. During the same time period, there has been a sharp increase in the number of people killed in major earthquakes, along with an increase in the number of major earthquakes, catastrophic tsunamis and volcanic eruptions. Despite the fact that the most noticeable increase is observed in the number of large earthquakes, earthquake victims and volcanic eruptions, the presence of an increased activity cycle for large tsunamis is also clearly visible for this period. Take the second and most pronounced a sharp increase in all statistical indicators cycle in all statistics, cycle B. This cycle covers the period from 1998 to the present. During this period, there was a surge in all statistical indicators of the considered catastrophes. For example, the increase in the drift speed of the North Magnetic Pole by 1998 approached its maximum, that is, about 50 km per year /6, 7/. The graphs clearly show that 1998 is a turning point for all statistical indicators of considered natural disasters, was marked by a sharp increase in the number of strong earthquakes and earthquake casualties, as well as in the number of large tsunamis and volcanic eruptions. It is noteworthy that the statistical indicators for this period grew exponentially, and now all statistical indicators are in the stage of steadily continuing growth. Thus, analyzing the graph in Fig. 4. we can be convinced that the situation of an increase in the number and intensity of natural disasters and the drift rate of the North Magnetic Pole after the report of the International Committee GEOCHANGE 2010 /6, 7/ and today in 2020 continues to remain at the same high level and higher. This indicates an increased risk of the impact of natural disasters and geophysical factors on the sustainability of the operation and development of IT, the energy sector and space systems for various purposes. The eruption of large volcanoes, such as Krakatoa, can lead to the

release of a huge mass of volcanic ash into the stratosphere, which will create serious problems in the operation of satellite communications systems, air transport and launching space rockets. An example of such an event is the eruption of the Krakatoa volcano, which began in May 1883 and ended with a series of powerful explosions on August 26 and 27, 1883, as a result of which most of the island of Krakatoa was destroyed. 19 km<sup>3</sup> of ash were thrown out in a huge explosion; a column of incandescent gases, debris and dust rose to a height of more than 80 km /6, 8, 9/.



**Fig.4. Comparison of graphs for change of North Magnetic Pole's drift rate and parameters reflecting dynamics of natural disasters between 1900 and 2020 (by E. N. Khalilov, 2020)**

- (1) – *graph for drift rate of Earth's North Magnetic Pole;*
- (2) – *graph for number of dead during large earthquakes;*
- (3) – *graph for dynamics of large ( $M > 8$ ) earthquake numbers;*
- (4) – *graph for dynamics of catastrophic tsunami numbers;*
- (5) – *graph for dynamics of volcanic eruption numbers.*

Meanwhile, the most dangerous event in the history of the Earth is the eruption of supervolcanoes. There are about 20 supervolcanoes known to science on Earth. On average, eruptions occur once every 100,000 years. One of the largest volcanoes of our time is the Yellowstone Caldera, which is often called the Yellowstone Supervolcano /6, 8, 10, 11/. Caldera is located in the northwestern corner of Wyoming USA, which is home to most of the national park. The caldera is approximately 55 km by 72 km. The first of three giant eruptions from the Yellowstone supervolcano occurred 2.1 million years ago and formed the Island Park caldera and the Huckleberry Ridge tuff deposits. Then from the explosions the mountain ranges disintegrated, the emissions rose to a height of 50 km - to the upper boundary of the stratosphere; volcanic ash covered more than a quarter of North America. A cataclysm of this magnitude can be compared with the eruption of the supervolcano Toba about 75 thousand years ago, when about 2800 km<sup>3</sup> of magma was ejected (during the first eruption of Yellowstone, the volume of emission was 2500 km<sup>3</sup>).

The second eruption of the supervolcano occurred 1.3 million years ago; then the volume of emissions of the awakened Yellowstone was 280 cubic kilometers. As a result, the large Henris Fork caldera was formed.

The third eruption took place 640 thousand years ago; it was twice as weak as the first time. As a result of the eruption, the top of the volcano collapsed, forming a caldera - a huge circular depression with a circumference of 150 km. In addition, the eruption formed the Lava Creek tuff deposits /10, 11/.

The probability of a giant eruption of Yellowstone Supervolcano in the modern period is estimated by scientists as 0.00014% per year /11/. This calculation is based on two time intervals between three known giant eruptions. As a specialist in the study of the cyclical nature of volcanic eruptions and earthquakes, I cannot agree with this statement. The distance between the maximums of the cycles can vary and it depends on other more global cycles of the Earth's geodynamics and space cycles. It would be naive to think that cyclicity has a simple sinusoidal function. In real geological processes, cyclicity is modulated by cycles of different orders. There is a complex relationship and mutual influence of the cycles of seismic and volcanic activity.





**Fig.5. The Yellowstone Caldera.**

<https://www.sb.by/articles/nasa-izverzhenie-vulkana-yellowstoun-unichtozhit-chelovechestvo.html>

There is a certain hierarchy of cycles from hundreds of millions of years to several years, and sometimes even several months. The ultimate cyclicity of any geodynamic process is the result of the superposition of all existing cycles. In this case, different cycles are branded under the influence of different factors, for example, 22-year and 11-year cycles of solar activity, endogenous cyclicity of energy pulsations in the Earth's core and in layer D, which is responsible for the dynamics of convective flows in the mantle /8, 12-16/.

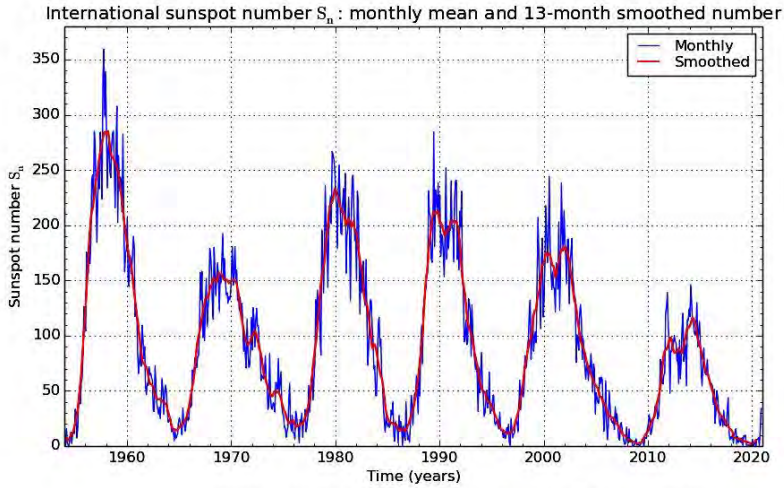
Some cycles of global volcanic and seismic activity with periods of hundreds of millions of years are formed under the influence of cosmic processes - the position of the solar system in the Galaxy. For example, a geological cycle of about 250 million years equal to a galactic year (a complete revolution of the solar system around the center of our galaxy) characterizes the largest of the mass extinctions (the so-called "Great Extinction"), when 90% of the then existing biodiversity was destroyed. This event took place about 250 million years ago /8, 16/. The known geological cycle of 33 - 38 million years, which reflects the beginning of the modern ice age, is the half-period of the complete cycle of the solar system crossing the median line of the Galactic equator. The last mass extinction, which took place about 66 - 70 million years ago, reflects the complete cycle of the solar system crossing the median line of the Galactic equator. Geological science explains the catastrophic event that occurred about 66 million

years ago by the fall of a space object about 10 km in diameter to the Earth. Geologists believe that this event led to the formation of the Chicxulub crater and contributed to the extinction of the Cretaceous and Paleogene periods, which caused the extinction of most dinosaurs. At the same time, the position of the Solar System relative to the plane of the galactic equator may have a statistical relationship with the number of falling space objects on the Earth's surface /8, 16-19/. By the way, at present, the solar system is very close to the point of intersection of the median line of the equatorial plane of the equator. Even considering the trend of change in the number and energy of volcanoes and earthquakes from 1900 to the present in Fig.4. we are witnessing the transition of a straight-line growth trend to an exponential one since 1998. Thus, geodynamic processes can accelerate and the eruption of the Yellowstone supervolcano can occur at any time as a result of a small shock - a trigger mechanism. NASA has developed a very risky plan to "save humanity from the eruption of the Yellowstone supervolcano". This plan provides for cooling the magma by pumping water, but this may cause an eruption, not prevent it, volcanologists warn /20,21/. NASA claims that the implementation of this plan will help eliminate the constantly threatening eruption of the Yellowstone supervolcano, which threatens the United States and the entire world. The plan provides for the creation of several boreholes in the caldera of the volcano in the so-called lava dome and through them to start pumping high-pressure water into the magma stratum, thereby provoking the release of heat from the magma stratum and relieving the pressure accumulated there.

### **3. Space weather is the greatest natural hazard to our technological civilization**

There is one very strange addiction. If up to a certain point in the technological development of civilization, this development helped people to better resist natural disasters, then since the late 1990s everything has changed. When IT made a leap and moved to a qualitatively new level of development, the stability and security of the further development of civilization began to decline in relation to countering natural disasters. One of the main parameters of the physics of the Earth - the intensity of its magnetic field (magnetosphere) has decreased by 10% over the past few decades, and the drift speed of the north magnetic pole has increased by 500% or more. The Earth's magnetosphere protects our planet, its biosphere from hard cosmic radiation, wave and corpuscular radiation, destructive for all living things. But the magnetosphere protects not only biological life, but also high-tech equipment - IT, satellite

communications and navigation systems, on which most of the high-tech civilization is based.

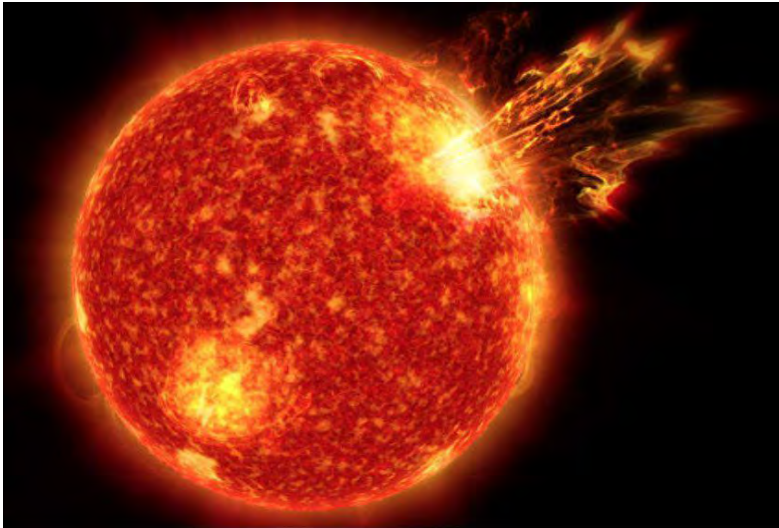


SILSO graphics (<http://sidc.be/silso>) Royal Observatory of Belgium 2020 December 1

**Fig.6. 19-24 cyclesofsolaractivity.**

Solar flares pose a real threat to technological civilization. The largest number of the most powerful flares usually occur in the middle of 11-year solar cycles, Fig. 6. One of the most recent powerful solar flares occurred on November 29, 2020, Fig. 7. The rate of coronary ejection was approximately 1100 kilometers per second. According to the NASA GOES-16 space satellite, the outbreak was assigned a score of M4.44 out of five possible /22/. The last flare of such and greater strength on the Sun was recorded in the fall of 2017. According to the Laboratory of X-ray Astronomy of the Sun, there were more flares in the first decade of November than in the whole year /22/.

“There is a significant possibility that the real power of the flare was even higher, since the center of the explosion was on the opposite side of the Sun, invisible from Earth. More precisely, it was located behind the left edge of the solar disk. The area of the solar surface, where the flare occurred, is thus not visible from the Earth ” - says the report of the Laboratory of X-ray Astronomy of the Sun of the Physics Institute of the Russian Academy of Sciences (FIRAS) /22/. So it was most likely that the outbreak was actually more powerful and belonged to the upper class X.



**Fig. 7. A powerful coronal mass ejection that occurred during flash time on November 29, 2020. Credit: NASA, SDO / In-Space /22/.**

Humanity is lucky that such an arrangement of the solar flare area excludes the possibility of a strong influence of this event on the Earth. The main manifestations of activity (charged particles and plasma clouds), which inevitably form in events of such strength, have passed hundreds of millions of kilometers from the Earth. If the coronal mass ejection were towards the Earth, humanity would already face colossal technological problems today.

Space satellites and manned space stations can be damaged by solar storms. The work /5/ provides an excellent example of this: “The effect of space weather on spacecraft operations is illustrated by the outage in January 1994 of two Canadian telecommunications satellites in geostationary orbit. On January 20, 1994, Telesat's Anik E1 was disabled for about 7 hours as a result of damage to its control electronics by the discharge of electric charge deposited in the interior of the spacecraft by penetrating highenergy electrons.

The outage occurred during an energetic electron storm that had begun a week earlier as a high-speed solar wind stream swept past Earth. During the E1 outage, the Canadian press was unable to deliver news to 100 newspapers and 450 radio stations. In addition, telephone service to 40 communities was interrupted. Shortly after E1 was restored to service, its sister satellite, Anik E2, went off the air, resulting in the loss of television and data services to more than 1,600 remote communities. Backup systems were also damaged, making the \$ 290 million satellite useless. Approximately 100,000 home satellite dish owners were required to re-point their dishes manually to E1 and other satellites. It took Telesat operators 6 months to restore Anik E2 to service. The E2 failure is

estimated to have cost Telesat \$ 50 million to \$ 70 million (U.S. dollars) in recovery costs and lost business. The principal cause of space-weather-related spacecraft anomalies and failures is radiation" /5/.

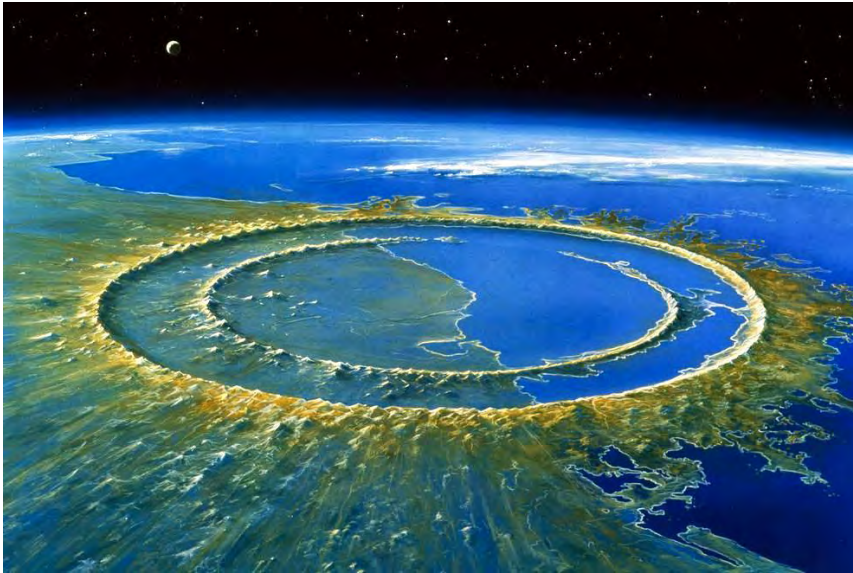
#### **4. Asteroid hazard to technological civilization**

We do not exclude other space hazards, which can lead to global damage to IT and high technologies on a planetary scale. These factors include the fall of large asteroids to the Earth, which have repeatedly occurred in the geological history of our planet. Despite the fact that the statistical probability of these cosmic threats is significantly lower compared to the coronal ejection from the Sun towards the Earth, we should not exclude them.

Entering the atmosphere of a comet or a large meteorite can cause violent disturbances in the ionosphere and induce huge currents, which will also be one of the damaging factors of the modern technological infrastructure of mankind. In addition, a powerful explosion when a large cosmic body enters the atmosphere can also lead to the emergence of a strong electromagnetic pulse, shock wave, infrasonic waves and other damaging factors. When a large space body strikes the Earth's surface, powerful seismic waves also arise, which lead to catastrophic earthquakes, and when falling into the ocean or a large body of water, giant tsunamis can occur.

##### **4.1. Chicxulub crater after asteroid impact 66,5 million years ago**

Chicxulub crater is an ancient impact crater with a diameter of about 180 km and an initial depth of 17-20 km, located on the Yucatan Peninsula, and is included in the list of the largest craters on Earth. It is assumed that the crater was formed about 66.5 million years ago at the end of the Cretaceous as a result of the impact of an asteroid about 10 km in diameter. The impact energy is estimated at  $5 \cdot 10^{23}$  joules or 100 teratons in TNT equivalent. For comparison, the largest thermonuclear device had a power of about 0.00005 teraton, which is 2 million times less) /23/. As we have already noted above, one of the most significant catastrophes in the history of the Earth is the fall of a space object about 10 km in diameter about 66 million years ago, which led to the death of almost all life on Earth /8/. Fig. 8. shows an artistic image of the crater Chicxulub from the fall of a giant meteorite on the Earth 66 million years ago /23/.



**Fig. 8. Artist's reconstruction of Chicxulub crater soon after impact, 66 million years ago. DETLEV VAN RAVENSWAAY/SCIENCE SOURCE**  
<https://www.sciencemag.org/news/2016/11/updated-drilling-dinosaur-killing-impact-crater-explains-buried-circular-hills>

Quite often, we perceive the possibility of a repetition of similar cosmic catastrophes on Earth, which took place in the geological past of the planet, as unrealistic. In fact, this is not the case, the life of the planet in the geological past and at the present time occurs according to the same laws of cosmology, geology and the statistical probability of a cosmic event.

These events do not depend in any way on the existence of human civilization and our perception. To confirm my words, I want to cite just two facts of the fall of large cosmic bodies to the Earth at the beginning of the last century and in the last decade.

#### **4.2. The fall of the Tunguska meteorite in Siberia (Russia) June 30, 1908**

As an example, I would like to cite the fall to Earth on June 30, 1908, of a large meteorite in Siberia in the region of the Podkamennaya Tunguska River, which was named the Tunguska meteorite /24-28/. The shock wave from the explosion of the Tunguska meteorite was recorded by instruments in England. In the area of the disaster, the forest was fallen over an area of about 2150 square km. This area is comparable to modern Hong Kong. Within a radius of 15 km. from the epicenter of the explosion, the trees were burned by the high temperature /24, 25/.



**Fig.9. Place of the fall of the Tunguska meteorite /26/.**

When the Tunguska meteorite exploded near the Earth's surface, 10-15 megatons of energy were released. Fig. 9 presents a Place of the fall of the Tunguska meteorite /26, 27/. The work /26/ provides unique evidence of the first moment of the fall of the Tunguska meteorite, a description of this event by local residents, police, government officials. The first scientific researcher of the Tunguska phenomenon was the Russian researcher Leonid Alekseevich Kulik. Leonid Kulik organized and led the first scientific expedition to the place where the Tunguska meteorite fell. The work /26/ describes in detail the results of the first scientific expedition to study the place of the fall of the Tunguska meteorite, provides unique photographs and naturalistic descriptions of the area and some unusual consequences of this amazing event. By a happy coincidence, the fall of the Tunguska meteorite occurred in the uninhabited territory of Siberia in Russia. The fall of such a meteorite in a densely populated region could lead to huge casualties and colossal destruction.

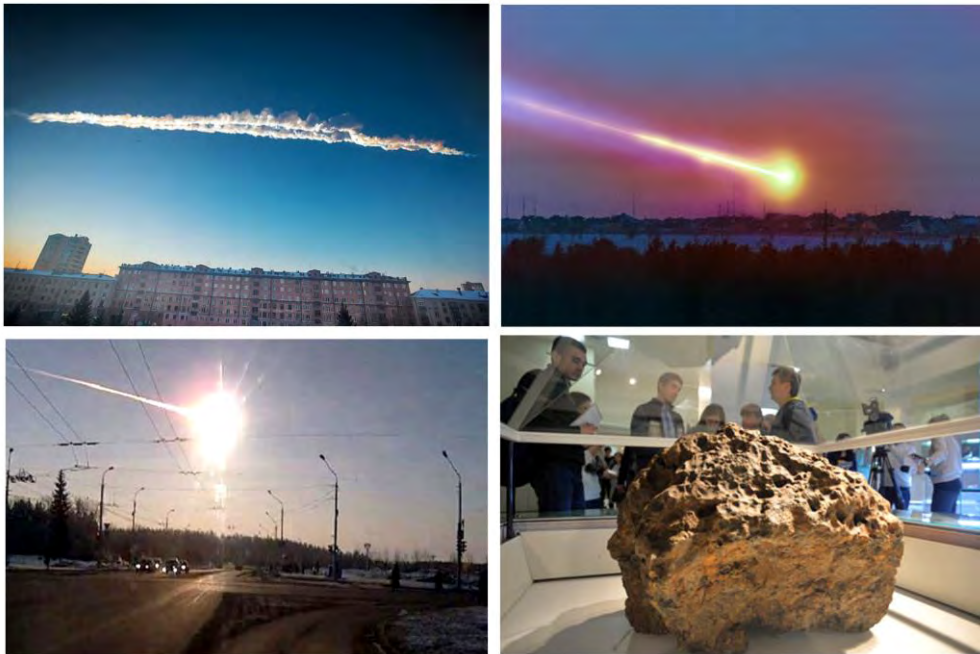
### **4.3.Chelyabinsk meteorite, February 15, 2013**

The fall of the Chelyabinsk meteorite February 15, 2013 was accompanied by its destruction with the propagation of a series of shock waves over the territory of the Chelyabinsk region and part of neighboring regions of Russia, as well as Kazakhstan, which led to certain destruction in Chelyabinsk (several fragile buildings were destroyed, many buildings were slightly damaged) and injuries among the population (about 2 thousands). The power of the explosion that occurred at the moment the meteorite entered the dense layers of the atmosphere over the Chelyabinsk region, according to NASA estimates, was

from 300 to 500 kilotons, which is approximately twenty times the power of the atomic bomb dropped on Hiroshima /29, 30/. Many fragments were found in the Chelyabinsk region. The largest of the fragments, with a total weight of 654 kg, were recovered on October 16, 2013 from the bottom of Lake Chebarkul (Chelyabinsk region). The largest fragment is kept in the State Historical Museum of the South Urals. The asteroid had an approximate size of 18 metres and a mass of about 9,100 metric tons before it entered the denser parts of Earth's atmosphere and started to ablate. At an altitude of about 23.3 km (14.5 miles) the body exploded in an air burst. Scientific studies carried out in recent decades show that the probability of a collision of relatively large natural objects with the Earth is not so low and can threaten humanity. Such natural space objects are small bodies of the Solar system - asteroids and comets, as well as rather large fragments. These natural objects that pose a potential threat to the Earth are called dangerous celestial bodies.

#### 4.4. Asteroid impact avoidance

Is it possible to create a system for protecting our civilization from the threat of destruction or large-scale damage as a result of the fall of large space objects to the Earth?



**Fig.10. On February 15, 2013, a large meteorite fell into Lake Chebarkul near the city of Chelyabinsk, Russian Federation. The photo on the bottom right shows a**



**large meteorite fragment weighing 473 kg placed in the Chelyabinsk Museum of Local Lore. /31/<https://lenta.ru/news/2015/01/26/meteorite/>**

A number of large research centers in different countries, including the USA, China, Russia, Japan, etc., have been seriously working on the problem of creating a "Planetary protection against the fall of large space objects" over the past decades. This task includes three main aspects:

1. Early detection of a space object, potentially dangerous to the Earth.
2. Mathematical modeling of the trajectory of this object and determination of the moment and time of its closest approach to the Earth and statistical assessment of the probability of the object falling to the Earth. Within the framework of this task, the issue of assessing the possible damage to humanity from the fall of a celestial body to Earth is also considered.
3. In the event that a real danger of a space object for humanity is identified, scientists are developing various types of technological approaches to prevent the fall of dangerous celestial objects on Earth.

Near-Earth object tracking programs include Near Earth Asteroid Tracking (NEAT), Lowell Observatory Near Earth Object Search (LONEOS), Kampo Imperatore Near Earth Observatory (CINEOS), Japan Space Guard Association, and /32/ Asiago-DLR / Asteroid Survey.

The European Union is supporting another project, NEO Shield, which analyzes realistic options for preventing asteroid collisions with Earth. Their goal is to provide test mission designs for realistic concepts of mitigating the effects of space bodies falling to Earth /33/.

Spaceguard is the name of these loosely linked programs, some of which receive funding from NASA to fulfill the US Congress decision to detect 90% of near-Earth asteroids larger than 1 km in diameter by 2008 /34 /.

The B612 Foundation is a United States-based, private, non-profit foundation dedicated to protecting the Earth from asteroid strikes. It is led mainly by scientists, former astronauts and engineers from the Institute for Advanced Study, Southwest Research Institute, Stanford University, NASA and the space industry. There are various methods of changing the course of a space object /37/. They can be distinguished by different types and principles of impact, such as deflection or fragmentation, energy source (kinetic, electromagnetic, gravitational, solar/thermal or nuclear) and approach strategies /38, 39/. NASA's 2007 analysis of alternative deflection methods showed that non-nuclear kinetic impactors are the most mature approach and can be used in some deflection / mitigation scenarios, especially for hazardous space objects that consist of one small solid body /40/. The European Space Agency (ESA) is studying the preliminary design of two space missions for ~ 2020, called AIDA (formerly Don

Quijote), and if launched, they will be the first mission to deliberately deflect asteroids. Another alternative to explosive deflection is the slow movement of the asteroid over time. A small but constant thrust is accumulated to significantly deflect an object off its course. Edward T. Lu and Stanley G. Love have proposed using a massive unmanned spacecraft hovering over an asteroid to gravitationally bring the asteroid into safe orbit. Although both objects are gravitationally attracted to each other, the spacecraft can counteract the force acting on the asteroid, for example with a low-thrust ion drive, so as a result of this, the asteroid is accelerated towards the spacecraft and thus deviates slightly from its orbit. At the end of 2007, it was estimated that there are about 20,000 potentially dangerous objects capable of crossing the Earth's orbit, and large enough (140 meters or more) to cause concern /41/.

### **5. Modeling possible technical and social consequences powerful solar storm in a modern metropolis in 2030-2040**

In a few years, humanity will reach the point of critical instability of technological civilization. And then, given the continuing decrease in the magnetic field strength of the magnetosphere, a relatively strong solar flare could put our civilization on the brink of complete destruction. Given the exponential growth of IT and HiTech, we will try to simulate the possible development of the situation in the event of a powerful solar flare with a coronal ejection towards the Earth in the period from 2030 to 2040.

In many developed countries of the world during this period of time, unmanned vehicles will be widely used: taxis, trains, drones, etc. Drones with artificial intelligence will be widely used in the service industry, they will replace postmen, pizza carriers and couriers delivering various goods. Many mining companies will use unmanned heavy-duty vehicles in their quarries to transport ore, rocks, and minerals. Already, a number of large mining companies have begun testing such unmanned vehicles and they have received good results using 5G technology. The number of office workers will be reduced to a minimum, 80% of office staff will work online /42, 43/. Metro and trains will be operated by autopilots. Education in schools and universities will completely go online. All banking operations will be carried out online using smartphones and new types of individual devices that read a person's mental commands. Such devices are already being widely developed, including by Elon Musk's companies. Many manufacturing enterprises will use mainly automated control systems with elements of artificial intelligence.

Large-scale volcanic eruptions, earthquakes, typhoons, floods and other natural disasters can lead to large casualties and destruction in large areas and for a certain time disrupt the life of entire states and even continents. In this case,

humanity can mobilize the technological and financial resources of the international community and after a certain time restore the technical, economic and social infrastructure and vital activity of the regions affected by global natural disasters. Meanwhile, in our opinion, the only global risk factor for the entire planet is a possible powerful solar flare with a coronal ejection directly towards the Earth. Sooner or later, but this will happen and create a huge threat to the life and existence of modern civilization.

What can a powerful solar flare with a coronal ejection toward the Earth lead to?

A powerful magnetic storm will lead to the destruction of many satellites, the global communications infrastructure and satellite navigation system will be disrupted. The autopilot control systems will either be completely out of order, or their normal operation will be disrupted. This will lead to massive accidents of all types of vehicles driven by autopilots, disorientation and drone crashes. The work of airports dispatching services will be completely disrupted, aircraft in the air that receive distorted GPS signals or do not receive information about their position will be completely disoriented and massive plane crashes may occur. Any electronic devices, in most cases, will be disabled. The induction of currents of enormous power in transformers, substations, electric generators of various types, control units of power plants, high voltage lines will lead to their failure. The systems for transmitting and receiving radio signals, including antennas and GSM communication stations, will burn out. In addition, individual means of radio communication - smartphones, telephones, walkie-talkies, radio control systems, etc. will also burn out. It is now well known that sufficiently intense electromagnetic radiation in the frequency range from 200 MHz to 5 GHz can cause failure or damage to electronic systems /44-48/. It is in this frequency range that most radars, television broadcast stations, mobile communications, powerful microwave sources, etc. work. The electromagnetic spectrum of powerful electromagnetic radiation during a solar storm also covers the specified frequency range /49/, which poses a great threat to damage to all electronic and electrical systems on Earth and in near-Earth space.

Who and where will suffer the most and least in the event of a powerful solar flare and coronal ejection towards the Earth?

Developed countries with a high level of industrialization and a large-scale network of telecommunication systems, the use of IT and HiTech will suffer most from electromagnetic effects. Poor countries with underdeveloped industries and low IT and HiTech usage will be the least affected. These countries include: countries in Africa and Latin America, some countries in the Middle East and Southeast Asia. The use of old wired telephone systems, used cars of the old generation, mainly made before 1990, makes these countries less vulnerable in the event of a powerful solar flare towards the Earth.

## **6. "Circular economy" - "rescue parachute" for our technological civilization**

Klaus Schwab, founder and permanent president of the World Economic Forum in Davos, describes the scale of technological change as unprecedented in human history. Speaking about the colossal possibilities of the fourth industrial revolution, K. Schwab in his book / 3 / repeatedly notes the existence of uncertainty in the question of what consequences this revolution can lead to humanity in case of violation of the basic ethical and moral principles of its further development. His fears concern risks that humanity may not even be aware of. A separate class of such hazards is natural processes, which include global geophysical and space (space weather) factors.

Military aircraft provide protection for pilots in the event that disaster is imminent. Such protection is a catapult and a parachute, which save the pilot's life, even when the plane cannot be saved. Is there a "saving parachute" for humanity if a catastrophe is inevitable? We must unequivocally admit that such a "saving parachute" is not provided for our technological civilization.

Where is the exit?

This way out is suggested by the philosophy of "circular economy", which was developed in detail by the world famous scientist, Professor Walter R. Stahel /50-52/.

First of all, we are talking about extending the life of the product and preserving technology and industrial enterprises using simpler technologies with a relatively low level of use of electronic control systems, artificial intelligence and IT. First, one should not allow the emergence of an uncontrollable "chain reaction" of the technological development of mankind and try to more consciously and balanced approach to each subsequent step of the "technological leap", calculating its consequences. We must not forget that the discovery of nuclear energy once brought the world to the brink of physical destruction. Secondly, it is necessary to realize that a less technological civilization is more stable and protected in relation to external influences, primarily of a geological and cosmic nature.

I would like to cite, in support of my words, a specific example from my life and closest history: on November 25, 2000, a strong earthquake of 6.5 points occurred in our city of Baku (Republic of Azerbaijan) with a three million population. A year earlier, headed by me Institute for Forecasting and Studying of Earthquakes officially presented a mid-term forecast of an earthquake indicating the approximate time, place and strength of the earthquake, as well as the depth of its hypocenter.

All predicted parameters were confirmed by the subsequent earthquake with an accuracy of 89%. However, despite the advance warning, it was later

revealed that the mobile communications of the modern city of Baku with several mobile operators were completely paralyzed. It turned out that due to the large number of people calling each other, the cellular communication system was overloaded and did not recover for 5-6 hours. At the same time, the old telephone cable connection with analog telephone exchanges of the 70s worked perfectly /6/.

We propose to develop and approve an international program that allows to create in advance "parachute technology" (the term "parachute technology" in the context of protecting civilization was introduced by the author) for the preservation and sustainable development of our technological civilization in the event of a threat of coronal ejection of the Sun towards the Earth or in the case of another large-scale natural disaster. To give a margin of safety and vitality to the modern technological civilization, it is necessary, along with HiTech and IT, to simultaneously adapt to modern conditions and preserve as "parachute technologies" fairly simple technologies that are little affected by powerful electromagnetic pulses (EMP).

***We offer the following main criteria for the formation of "parachute technologies":***

1. Each country should have and keep in the future shielded from powerful EMP, cable communication systems, at least at the level of government communications and government structure.

2. A system of cable international communication between the heads of state and international organizations, for example, the UN and its main structures, the governing bodies of the European Union, the IAEA, etc., should be created, well-shielded from powerful EMPs.

3. Standard vehicles should be provided that run on hydrocarbon or hydrogen fuels with a minimum use of electronics.

4. Special warehouses with "simple measuring devices, personal protection systems, mechanical and semi-mechanical mechanisms (hoists, winches, etc.), machine tools and equipment, as well as enterprises using equipment with a minimum level of electronic control, should be provided.

5. All database storage systems, large servers and data centers, government and corporate IT management systems should be located in pre-prepared special rooms that have maximum protection against powerful EMP, as well as fully autonomous and protected power supplies from EMP.

In our opinion, along with IT and HiTech, not less than 30% of simple technologies with minimal use of complex electronics and enterprises using similar technologies should remain in all countries, due to the extension of their life. It will also be necessary to preserve the system for ensuring the functioning of these enterprises, the repair of their equipment, the supply of materials and

component parts. The above criteria also fit into the philosophy of "circular economy" /24/.

These "parachute technologies" and enterprises will be a kind of "backup option" for the technological civilization, in the event of a force majeure circumstance, which is the coronal ejection of solar matter towards the Earth. They will have to soften the blow to humanity's technological infrastructure. Thus, we propose to take logically justified proactive measures to protect humanity from a real threat of a natural nature emanating from the Sun - the most powerful source of energy coming to Earth.

The brief rationale and criteria for "parachute technology" described in this paper to mitigate the consequences of coronal ejection from the Sun towards the Earth requires careful study with the participation of scientists and international experts from various fields of science and industry.

We consider it necessary to develop international standards for the formation of a unified system of international coordination of the active preparation of mankind for the possible consequences of a powerful coronal ejection towards the Earth. This requires the creation of a special commission or expert group at the UN with the involvement of the European Union and other interested international structures.

## References

1. Vernor Vinge. Singularity. Department of Mathematical Sciences. San Diego State University. VISION-21 Symposium sponsored by NASA Lewis Research Center and the Ohio Aerospace Institute, March 30-31, 1993. A slightly changed version appeared in the Winter 1993 issue of Whole Earth Review.
2. Lemarchand G.A. (2006) The Life-Time of Technological Civilizations. In: Burdyuzha V. (eds) The Future of Life and the Future of our Civilization. Springer, Dordrecht. [https://doi.org/10.1007/978-1-4020-4968-2\\_51](https://doi.org/10.1007/978-1-4020-4968-2_51)
3. Klaus Schwab. The fourth industrial revolution, World Economic Forum, 2016, 184 pp.
4. James L. Green, Scott Boardsen, Sten Odenwald, John Humble, Katherine A. Pazamickas. Eyewitness Reports of the Great Auroral Storm of 1859. Submitted to Advances in Space Research August 5, 2005. <https://ntrs.nasa.gov/citations/20050210157>
5. Severe Space Weather Events - Understanding Societal and Economic Impacts: A Workshop Report - Extended Summary Committee on the Societal and Economic Impacts of Severe Space Weather Events: A Workshop, National Research Council. ISBN: 0-309-13812-4, 32 pages, (2009). <http://www.nap.edu/catalog/12643.html>
6. Khalilov E.N. First report of the Chairman of the International Committee GEOCHANGE on issues of Global Changes of the Geological Environment

- 30.06.2010. GEOCHANGE: Problems of Global Changes of the Geological Environment. Vol.1, London, 2010. p. 54-220.
7. Earth's Magnetic North is Shifting at an 'Unprecedented' Rate. <https://operationdisclosure1.blogspot.com/2019/12/earths-magnetic-north-is-shifting-at.html>
  8. Khain V.E., Khalilov E.N. Cycles in geodynamic processes: their possible nature. Moscow: Scientific World, 2009, 520 p.
  9. Mekhtiev Sh.F., Khalilov E.N. Rhythms of Earthly Catastrophes. Baku, Elm, 1988, 109 p.
  10. Bryan, Scott E., Peate, Ingrid U., Peate, David W., Self, Stephen, Jerram, Dougal A., Mawby, Michael R., Marsh, J.S. (Goonie), & Miller, Jodie A. (2010) The largest volcanic eruptions on Earth. *Earth-Science Reviews*, 102(3-4), pp. 207-229.
  11. Yellowstone caldera. [https://en.wikipedia.org/wiki/Yellowstone\\_Caldera](https://en.wikipedia.org/wiki/Yellowstone_Caldera)
  12. Mehdiyev Sh.F., Khalilov E.N. On the possibility of revealing the relationship between volcano eruptions and solar activity. *Volcanology and seismology*, No. 3, 1985, pp. 64-67.
  13. Khain V.E., Khalilov E.N. About possible influence of solar activity upon seismic and volcanic activities: long-term forecast. *Science Without Borders. Transactions of the International Academy of Science H&E. Vol.3., Innsbruck, 2007/2008*, pp.2017-256.
  14. Elchin Khalilov. Solar-terrestrial relations. *Journal: GEOCHANGE: Problems of Global Changes of the Geological Environment. Vol.1, London, 2010*, pp.139-150.
  15. Khain V.Y., Khalilov E.N. Regularity of Spatial-temporary Distribution of Volcano Eruptions. *Science Without Borders. IAS H&E., Innsbruck, V.1., 2003/2004*, pp.243-250.
  16. Khain V. Y., Khalilov E. N. Space-time regularities of seismic and volcanic activity. Burgas, SWB, 2008, 304 p.
  17. Mehdiyev Sh.F., Khalilov E.N. About the periodicity of volcanic activity. *Reports of the Azerbaijan Academy of Sciences. vol. XLIII, № 11, 1987*, p. 35-39.
  18. Mekhtiev Sh.F., Khain V.E., Ismail-Zade T.A., Khalilov E.N.. Spatiotemporal regularities of volcanic eruptions. *Reports of the USSR Academy of Sciences*, v. 289, № 6, 1986, pp. 1462-1464.
  19. Mekhtiev Sh.F., Khalilov E.N. Volcanoes and geodynamics. *Nature (Priroda)*, № 5, 1987, pp. 46-49.
  20. NASA Wants To Drill Into The Yellowstone Super Volcano To Save Humanity. <https://www.ladbible.com/technology/technology-nasa-wants-to-drill-into-yellowstone-super-volcano-to-save-humanity-20180127>
  21. The NASA risky plan to save humanity from the Yellowstone super-volcano. <https://earth-chronicles.com/natural-catastrophe/the-nasa-risky-plan-to-save-humanity-from-the-yellowstone-super-volcano.html>
  22. The Sun has the most powerful flare in the past three years. <https://in-space.ru/na-solntse-proizoshla-samaya-moshhnaya-vspyshka-za-poslednie-tri-goda/>

23. Eric Hand. Drilling of dinosaur-killing impact crater explains buried circular hills. *Science*. doi:10.1126/science.aaf5684
24. Additional Details on the Large Fireball Event over Russia on Feb. 15, 2013. [https://cneos.jpl.nasa.gov/news/fireball\\_130301.html](https://cneos.jpl.nasa.gov/news/fireball_130301.html)
25. Farinella P, Foschini L., Froeschl'e Ch., Gonczi R., Jopek T. J., Longo G. and Michel P. Probable asteroidal origin of the Tunguska Cosmic Body. *Astronomy & Astrophysics*. (A&A), 377, 1081–1097 (2001) DOI: 10.1051/0004-6361:20011054<https://www-th.bo.infn.it/tunguska/aah2886.pdf>
26. Lorien Wheeler F., Donovan L. Mathiasb. Probabilistic assessment of Tunguska-scale asteroid impacts. *Icarus*. Volume 327, 15 July 2019, Pages 83-96.
27. Tunguska meteorite. The secret of an alien from outer space. Moscow-Norilsk, Russian Geographical Society, 2018, 192 p.
28. Tunguska meteorite. <https://8h.ru/article/tunguskiy-vyval-meteorit>
29. Chelyabinsk meteorite. [https://en.wikipedia.org/wiki/Chelyabinsk\\_meteorite](https://en.wikipedia.org/wiki/Chelyabinsk_meteorite)
30. Chelyabinsk. Meteoritical Bulletin Database. The Meteoritical Society (18 March 2013). <https://www.lpi.usra.edu/meteor/metbull.php?code=57165>
31. Chelyabinsk meteorite. <https://lenta.ru/news/2015/01/26/meteorite/>
32. Pravec, P., A.W. Harris, P. Kusnirak, A. Galad, K. Hornoch (2012). Absolute magnitudes of asteroids and a revision of asteroid albedo estimates from WISE thermal observations. *Icarus* Volume 221, Issue 1, September–October 2012, Pages 365-387, ISSN 0019-1035, <http://dx.doi.org/10.1016/j.icarus.2012.07.026>.
33. NEO Search Program. [https://cneos.jpl.nasa.gov/about/search\\_program.html](https://cneos.jpl.nasa.gov/about/search_program.html)
34. Asteroid\_impact\_avoidance. [https://en.wikipedia.org/wiki/Asteroid\\_impact\\_avoidance](https://en.wikipedia.org/wiki/Asteroid_impact_avoidance)
35. Study to Determine the Feasibility of Extending the Search for NearEarth Objects to Smaller Limiting Diameters. Report of the Near-Earth Object Science Definition Team. August 22, 2003. <https://cneos.jpl.nasa.gov/doc/neoreport030825.pdf>
36. Canavan, G. H; Solem, J. C. (1992). "Interception of near-Earth objects". *Mercury*. **21** (3): 107–109. [https://www.researchgate.net/publication/253052410\\_Interception\\_of\\_near-earth\\_objects](https://www.researchgate.net/publication/253052410_Interception_of_near-earth_objects)
37. C. D. Hall and I. M. Ross, "Dynamics and Control Problems in the Deflection of Near-Earth Objects," *Advances in the Astronautical Sciences, Astrodynamics* 1997, Vol.97, Part I, 1997, pp.613–631.
38. Solem, J. C. (1993). Interception of comets and asteroids on collision course with earth. *Journal of Spacecraft and Rockets*. [https://digital.library.unt.edu/ark:/67531/metadc1090076/m2/1/high\\_res\\_d/5693171.pdf](https://digital.library.unt.edu/ark:/67531/metadc1090076/m2/1/high_res_d/5693171.pdf)
39. Solem, J. C.; Snell, C. (1994). "Terminal intercept for less than one orbital period warning Archived May 6, 2016, at the Wayback Machine", a chapter in *Hazards Due to Comets and Asteroids*, Geherels, T., ed. (University of Arizona Press, Tucson), pp. 1013–1034.



40. "NEO Survey and Deflection Analysis and Alternatives". Archived from the original on 2016-03-05. Retrieved 2015-11-20. Near-Earth Object Survey and Deflection Analysis of Alternatives Report to Congress March 2007.
41. Subcommittee Questions NASA's Plan for Detecting Hazardous Asteroids. *November 8, 2007.*  
<https://web.archive.org/web/20110506052124/http://democrats.science.house.gov/press/PRArticle.aspx?NewsID=2036>
42. The world of work from home: there is more to this new reality than meets the eye.  
<https://economictimes.indiatimes.com/prime/tag/future-of-work>
43. Thomas Hobbs. Stay home, be productive. <https://www.vontobel.com/en-ch/impact/stay-home-be-productive-19497/>
44. Vladimir Vasilevich Shurenkov, Vyacheslav Sergeevich Pershenkov. Electromagnetic pulse effects and damage mechanism on the semiconductor electronics. *FACTA UNIVERSITATIS. Series: Electronics and Energetics. Vol. 29, No 4, December 2016, pp. 621 - 629 DOI: 10.2298/FUEE1604621S*
45. C. Kopp and R. Pose, "The Impact of Electromagnetic Radiation Considerations on Computer System Architecture", Dept. of Computer Science, Monash University, Clayton, Victoria, Australia.
46. High Power Microwave Technology and Effects, University of Maryland Short Course Presented to MSIC Redstone Arsenal, Alabama August 8-12, 2005.
47. S.M. Hwang, J.I. Hong, and C.S. Huh, "Characterization of the susceptibility of integrated circuits with induction caused by high power microwaves", *Progress In Electromagnetics Research, PIER, vol. 81, pp. 61-72, 2008.*
48. X. Fei, C. Bing and L. Chenglong, "Damage efficiency research of PCB components under strong electromagnetic pulse" *Applied Mechanics and Materials, vol. 130-134, pp. 1383-1386, 2012.*
49. SolarEnergy Distribution. [https://geologycafe.com/oceans/images/insolation\\_curve.jpg](https://geologycafe.com/oceans/images/insolation_curve.jpg)
50. The Circular Economy – a user's guide. Walter R. Stahel (2019) with a foreword by Dame Ellen MacArthur. Routledge, Abingdon
51. Walter R. Stahel. *The Performance Economy. 2nd Edition. 2010. PALGRAVE MACMILLAN. 349 p.*
52. The Circular Economy and Benefits for Society Jobs and Climate Clear Winners in an Economy Based on Renewable Energy and Resource Efficiency  
<https://clubofrome.org/wp-content/uploads/2020/03/The-Circular-Economy-and-Benefits-for-Society.pdf>

## APPLICATION OF THE MAGNETIC METHOD TO EXPLORATION OF THE POTASSIC ZONE IN THE HAFTCHESHMEH PORPHYRY COPPER DEPOSIT (NW IRAN)

<sup>1</sup>Shohreh Hassanpour, <sup>2</sup>Mehmet Salih Bayraktutan

<sup>1</sup>Department of geology, Payame Noor University, Iran  
hassanpour@pnu.ac.ir

<sup>2</sup>Depart. Geotech, Fac. Engineering Igdır Univ. Turkey  
mehmet.salih.bayraktutan@igdir.edu.tr

### Abstract

Because of a good potassic alteration outcrops in the Haftcheshmeh ore deposit, we decided to detect borders of this alteration zone by a ground magnetic method (Hassanpour et al. 2009). Simulation and modeling of acquired data was carried out using Geometrics & Geosoft software. Qualitative and quantitative results of geophysical surveys have been presented in the form of total field intensity, second derivative, upward continuation & pole reduction maps. Comparison of magnetic results together with bore hole logging results show a good relationship between, as an exploration guide in the project.

Ground magnetic survey on have been worked on Masjeddaghi, Haftcheshmeh ( Eastern- Azarbayjan ) and Nowchun (near Sarcheshmeh mine in SE Iran) ore deposits. Simulation and modeling of acquired data was carried out using Geometrics & Geosoft softwares. Qualitative and quantitative results of geophysical surveys have presented in the form of total field intensity, second derivative, upward continuation & pole reduction maps. Comparison of magnetic results together with borehole logging show a good relationship that obtain a good pattern to a field geologist to assign and guide an exploration project. According to this pattern, all drill holes in Haftcheshmeh porphyry system were designed.

**Key words:** *Magnetometry, Potassic zone, Haftcheshmeh porphyry, NW Iran*

### 1. Introduction

At all map scales, the foremost role of the geophysicist mineral exploration is to provide geologic information in three dimensions, particularly in terrains concealed by younger rock systems. At large scales (deposit and district-size studies), high-resolution magnetic and gravity data are often used to define structures directions in related to mineralization (e.g., strike-slip faults—Isles et al, 1989; Henley and Adams, 1992; Mckinlay et al., 1997; Whiting, 1986). On the other hand, at smaller scales, geophysical data can help elucidate the regional geologic framework, mainly by defining major compositional boundaries or structural zones that may be favorable environs for mineralization

(e.g., Gunn et al., 1997a, b; Jaques et al., 1997; Leclair et al., 1997; Moore et al., 1998).

Here we investigate the utility of magnetic data to understand the distribution of concentrating on porphyry systems. Because, magnetization commonly differ across alteration boundaries, the interpretation of magnetic data in three dimensions is important to further our understanding of geology and alteration information in the system. For copper exploration, the magnetic survey is of particular importance, because it may map areas of structural complexity, hematization outcrops in the area, that we have proposed to explore as potassic alteration zone by magnetic geophysics exploration method. All acquired data helped us to design precise drilling points as well (Fig 2). It should be mentioned that for drilling plan, an exploration geologist must pay especial attention to geochemistry and geophysical data all together. We could get the best result especially in potassic zone of some porphyry systems in northwest and southeastern part of Iran in Arasbaran and Kerman porphyry systems (Hassanpour et al., 2009).

### **1.1. Haftcheshmeh**

The Haftcheshmeh Cu-Mo porphyry deposit is located in the Arasbaran porphyry belt (in NW Iran). This ore deposit is a typical porphyry Cu-Mo porphyry system in terms of its all mineralization, alteration and association with granodioritic intrusion and predominance of quartz vein hosted copper mineralization. The Haftcheshmeh, has been explored by drill holes in 2009 and, is a world class giant porphyry system, at about 0.5 percent Cu and 180 ppm Mo at 180 Mt ore. It occurs into gabbrodiorite and a felsic granodiorite which influenced in Cretaceous limestones and hornfelses. Skarn type metasomatic alteration and mineralization occurred along the contact between upper Cretaceous impure carbonates in the south and west of the deposit. The Haftcheshmeh intrusion is intersected by different dykes ranging in composition from granodiorite to monzonite, Gabbrodiorite and Diorite (Fig 1). There are very interesting potassic outcrops and mineralization into gabbrodiorite and granodiorite bodies (NICICO, 2008).

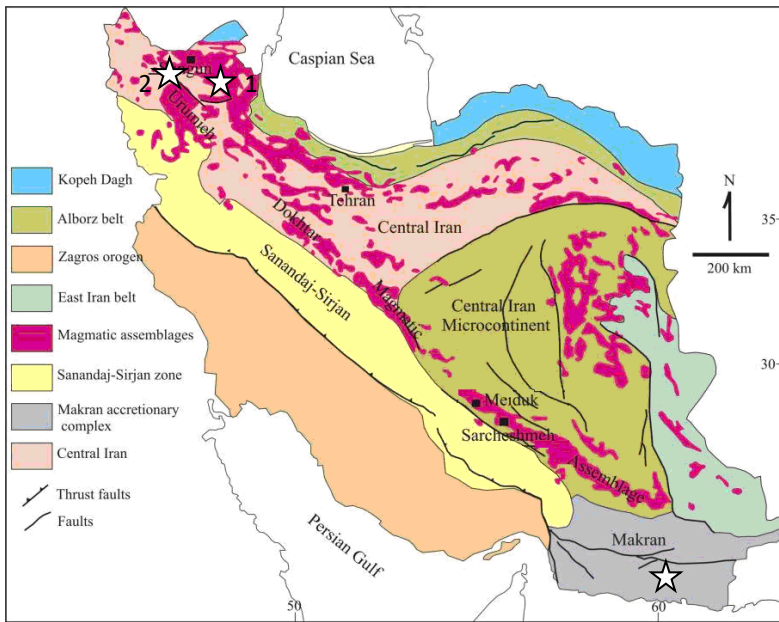
### **1.2. Masjeddaghi**

Masjeddaghi deposit is located on the northwestern part of Iran, 35 Km from east of the Djolfa town. This prospect has been studied since 2000 by GSI and by NICICO recently. Mineralization is occurred in two epithermal and porphyry forms in andesite to trachyandesite and dioritic subvolcanic rocks with Paleocene ( Hassanpour and Alirezaei ) age rocks. These rock set with area of 500 km<sup>2</sup> contains argillic, phyllic, propylitic, and potassic alterations zones. Magnetic method has been applied for investigation of copper mineralization and

geological features such contact, fault, and probable alteration especially potassic zone in the region for the first time in this research. The results used as an exploration pattern in all NICICO prospects from 2006 (NICICO, 2008).

### 1.3. Nowchun

The Nowchun copper ore deposit is situated on the southeastern slope of Kuh-e-Manzar about four km in southwest of the Sarchashmeh copper open pit mine and 10 km in northeast of the Pariz town. The Eocene andesite and tuffs are the oldest rocks in this region, and formed alternations of stratified flows and tuff horizons in variable thickness. They have been subjected to intensive folding and faulting, and have been altered by contact metamorphic and hydrothermal processes (NICICO, 2008).



**Fig. 1. Studied porphyry systems locations on Iran geology map**

- ☆ Porphyry systems
- 1, 2, 3 Haftcheshmeh, Masjeddaghi

## 2. Method

### 2.1. Field procedure

In this method, to obtain database in the field, it is necessary to choose two base points for total field variation measurements, one inside and one another will be outside the surveyed area. In this case, two set of the magnetometer will

be used. One of them is located in the base (outside) to take measurements every five minutes. A second magnetometer will be moving in the area to produce data quality; each station should be reread three readings and divide them by three. Finally, after dataset correction as drift correction, Ref correction and diurnal corrections, a total field intensity map will be proceed. A number of advanced techniques for data enhancement or filtering as employed in ground survey data will be discussed here as following: vertical derivative, upward and downward continuation, reduction to the pole, most of which are applied to two dimensional data.

## 2.2. Total field intensity instrument

Proton magnetometer G-856 has been used in all of porphyry copper prospect area. The precession frequency, typically 2000 Hz, is measured by modern digital counters as the absolute value of the total magnetic field intensity with accuracy of 1 gamma, and in special case 0.1 gamma, in the earth's field of approximately 50,000 gammas.



**Fig. 2. G856 Magnetometer**  
**1.3. Total field intensity map**

The geomagnetic survey in recording of data is done through a 100 m by 20 m griding network and after averaging between three separate records per each point. Whenever, variation between two successive points was greater than 50 nT, there was an additional record between the two points. After the common correction processes, such as drift correction, ref. correction and diurnal correction, the total magnetic field map is plotted by Oasis Montaj software, with 25 nT contour interval. Magnetic field intensity in each point is proportional to the magnetic field and remnant magnetization of rocks on that point. Remnant magnetization of rocks is a property related to the amount of iron bearing minerals in rock content, and is different in rocks. So, the rocks containing this

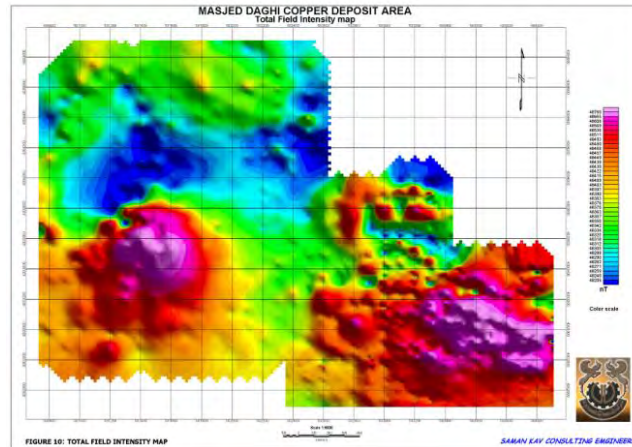
kind of minerals reveal a greater total magnetic field anomaly. As a matter of fact, there are usually more magnetized minerals in intrusive rocks than sedimentary rocks. Therefore, measurement of total geomagnetic field variation over ground surface, in addition to show magnetic mineral anomalies, and also will reveal layer contacts and probable faulting systems (NICICO, 2008).

### **3. Discussion and Results**

#### **3.1. Masjeddaghi Copper ore Deposit:**

By working with a well-known applicable program; IGRF, the background value of the masjeddaghi area is proposed 48373 nT. The maximum and minimum total fields measured in the area were 49974 nT and 47047 nT respectively. Magnetic anomalies are recorded in the south and the southeastern part of the total magnetic field intensity map (Fig.3). Recorded anomaly in the southern part of the prospect (at the location of zone) which is surrounding Arpachay River can be related to potassic zone which shows high intensity. The southeastern part of the prospect is also so important due to high intensity anomaly which is recorded and detected alterations. High intensities are generally recorded on andesite unit which contain magnetite minerals. As a result of all boreholes information, Porphyry mineralization which has limited outcrop around Arpachay river is an elliptical mass with  $500 \times 400 \times 600$  (L×D×h). Based on estimations its reserve is 300 Mt with about 0.35 copper assay, and 150 ppm gold (based on report of geological survey, 2005 and NICICO 2009).

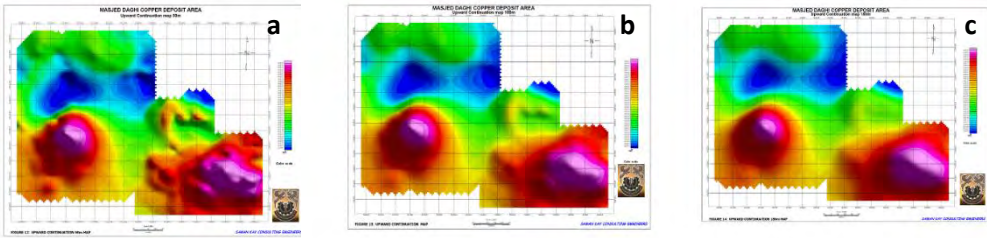
Investigation of the total magnetic field intensity map demonstrates that magnetic anomalies are connected with an elliptical body with  $500\text{m} \times 400\text{m}$  (L×D) and this issue confirms in geological reports, too. As it has shown on magnetic field intensity map, phyllic and argillic alterations have lower magnetic field intensity and are demonstrated with yellow to green colors (Fig, 3). Finally, studied area is composed of two absolutely different in the case of magnetic field intensity. High intensities are related to alteration and occurred at the location of copper mineralization, and medium intensities connected with phyllic and argillic alterations are recorded around the mineralization. Then by application of several filters such as derivative, upward, pole reduction on raw data, their virtual identity may be revealed. For determination of depth, slope and thickness, the two sections of AB and A'B' are chosen and studied. Location of magnetic field intensity measurement stations, their UTM coordinates, location of AB and A'B' sections, the main fault location, and etc. are presented in the compiled map.



**Fig. 3. Total field intensity map of Masjeddaghi porphyry**

### 3.1.1. Upward Continuation Maps

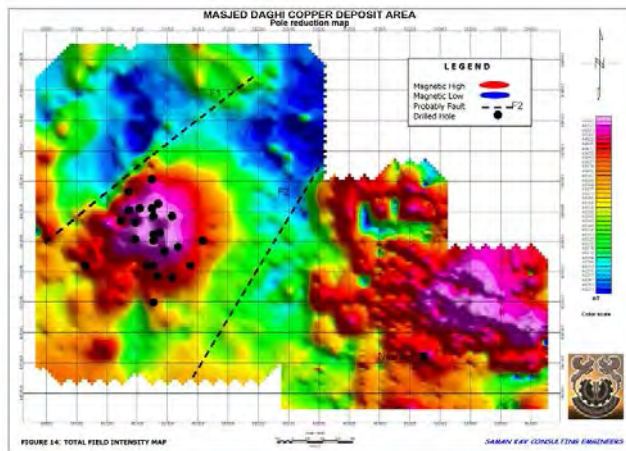
Upward continuation of raw magnetic data in the Masjeddaghi copper prospect area at three altitude level of 50 , 100 and 150 m, is done by the Oasis Montaj software, and the results are shown on the figures of 4a ,4b ,4c. In this way, unlike first derivative, the effect of surface weakened anomalies and deeper anomalies (with higher wave length) are tended to be shown significantly. As we consider in figure (4a) Upward Continuation in 50 m altitude, made contour line smoother with respect to the total field intensity map. This can indicate the anomalies have deep origin and also are transversal and longitudinal distributed and they are continuous respect to the surface masses. This effect is more visible on maps of 4b and 4c, at 100 and 150 m respectively. We can see smoothness of contour lines with more details on the map of number 4b, and especially on the map of number 4c. Study of these map help us to continue with the processes controlling deep magnetic anomalies. At all three maps, we can see, elongation of magnetic bodies is coincident with the direction of alteration, (i.e. northwest – southeast). So, it can be concluded that two different anomalies are appear in these maps. Indicating that anomaly 1 (southwestern) is shallower than anomaly 2 (southeastern). However, due to erosion level in Arpachay River, anomaly1, lead to outcrop of diorite porphyry intrusion, while anomaly 2 is buried in sediments. Anomalies due to surface masses and noises that are existing in the total intensity map are eliminated in these maps (Fig., 4a, b, c).



**Fig.4 (a, b, c): Upward Continuation Map in Masjeddaghi ore deposit.**

### 3.1.2. Pole-Reduction Map

As it is explained before, in order to interpret the total magnetic intensity map, it should be utilize some filters on the data. Using the software, we have produced a pole reduction map from total magnetic intensity map (Fig. 5). Anomalous features in total magnetic intensity map also exist in pole reduction map, but comparison between pole reduction map and total magnetic intensity map reveal that anomalies are shifted during pole reduction process and also became more regular, so that it demonstrated anomalous variations more precisely. It also reveals that magnetic dipoles are also in their actual direction. It's an important factor in correlation between geologic features and resulting magnetic anomalies (Fig. 5). This profile is proposed perpendicular to the strike of the main structures of the area with A coordinates of  $x=581400$  and  $y=4303200$  and B coordinates of  $x=581400$  and  $y=4304400$ . Numerical modeling by geometrics shows the anomalous bodies is towards north with 400 m width (Fig, 6a). The thicknesses of alluvial formations are estimated 7m in geophysical study.



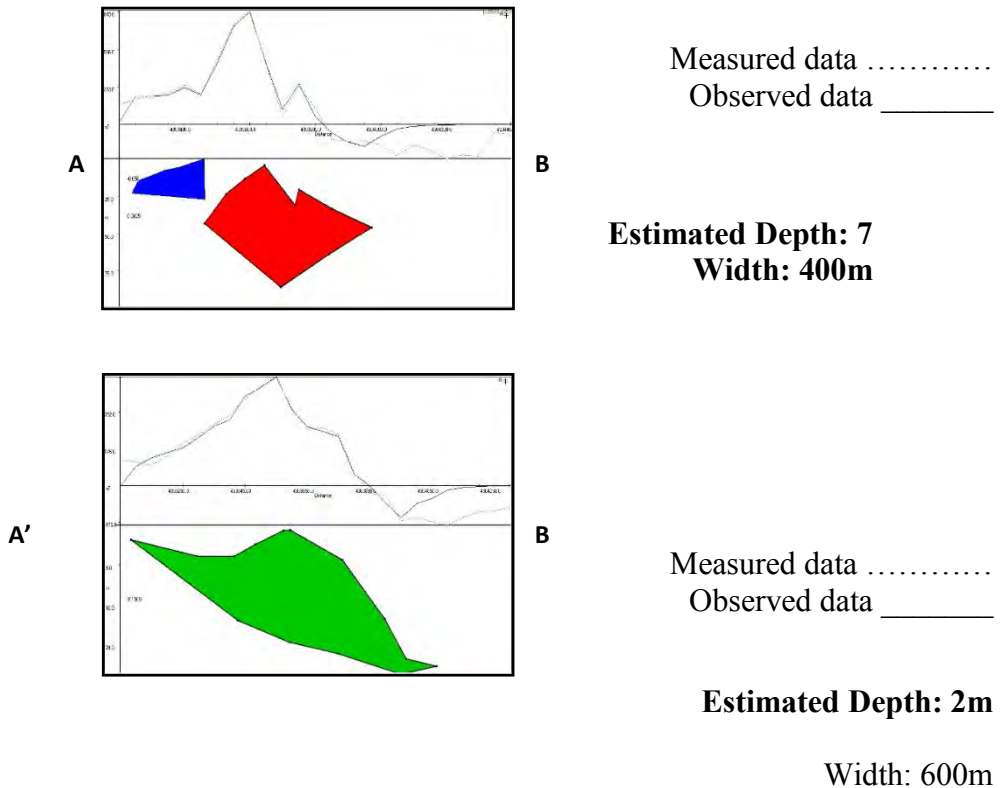
**Fig. 5. Pole reduction Map, Drill holes are illustrated on the ore zone.**



This profile is proposed perpendicular to the strike of the main structures of the area with A coordinates of  $x=581600$  and  $y=4303050$  and B coordinates of  $x=581600$  and  $y=4304250$ . Numerical modeling by Mag2dc shows the anomalous bodies is towards north with 600 m width. The thicknesses of alluvial formations are estimated 2 m (Fig, 6b) (NICICO, 2009).

### 3.2. Masjeddaghi

Masjeddaghi deposit is located on the northwestern of Iran, 35 Km from east of the Jolfa town. This prospect has been studied since 2000. Mineralization was occurred in two epithermal and porphyry forms in andesite to trachyandesite and Dioritic subvolcanic rock with about Miocene host rocks. These rock set with area of 8 m<sup>2</sup> contains argillic, phillitic, Propylitic, and Potassic alterations zones. Magnetic method has been applied for investigation of copper mineralization and geological features such contact, fault, and probable alteration zone.



**Fig.6a - Numerical modeling of magnetic anomaly on AB section**  
**Fig. 6b. - Numerical modeling of magnetic anomaly on A'B' section**

Results of primary raw data interpretations and studies on processed geophysics data of Masjeddaghi site can be summarized as below:

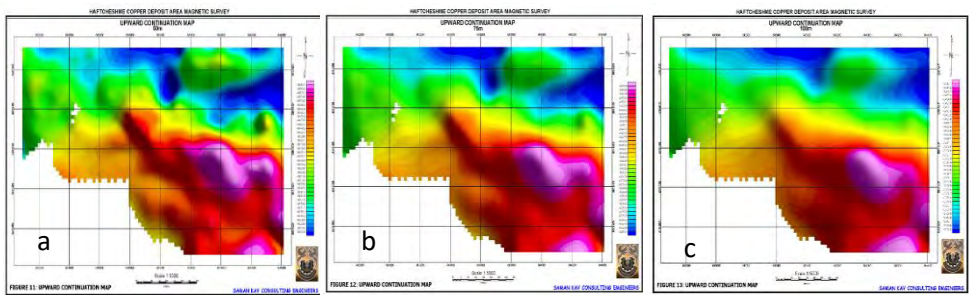
1. Zone boundaries are the cause of the magnetic anomalies, which probably, related to magnetite components of andesite to trachyandesite igneous masses that are studied completely.
2. Background threshold amount of studied area which is obtained by using universally creditable IGRF program is equal to 38373nT. Maximum and minimum amount of total magnetic field in studied area is 49974nT and 47047nT correspondingly.
3. High magnetic intensities amounts are related to potassic alteration zones, and medium amounts are recorded around in phyllic and argillic alteration zones (NICICO, 2008).
4. Oasis Montaj software was used for preparing total magnetic field intensity map, upward map, reduction to pole-reduction maps.
5. Upward maps at various depths confirm the importance of recorded anomalies in the southern part of the prospect.
6. Modeling of magnetic anomaly was carried out on the AB and A'B' sections, location of them were posted on the total magnetic field intensity map and sections were prepared by means of Geometrics software. Anomalous mass has northern dip direction and its approximate thickness in the western and the eastern profile is 500m and 700 m respectively. Depth of alluvium formations is about 7m and 2m in the western part of the AB and A'B' sections, correspondingly.
7. Presence of F1 and F2 faults were recognized, by north eastern-southwestern strike of the magnetic counters (Fig.5) (NICICO, 2008).

### **3.3. Haftcheshmeh**

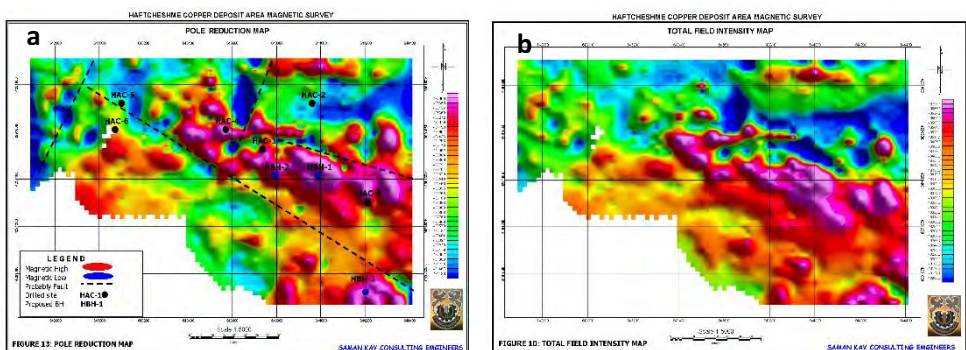
Haftcheshme copper deposit is located on the northwestern of Iran, 8 Km from northwest of Sungun copper open pit mine. The area has been covered with exploration studies since 2006. Mineralization has occurred in Gabbroic and Granodioritic rocks with porphyritic textures and Miocene age. All kind of alterations that have seen in porphyry type deposit are seen in this ore deposit with 4 km square extent. Used magnetic survey method for detecting alteration zone and various geological aspects such as: contacts, faults and etc., applied magnetics survey in a 1.7 square km area with 50\*20 meter grid size, and after probable desirable results, it is predicted farther explorations.

Results of primary raw data interpretations and studies on processed geophysics data of Haftcheshmeh copper deposit can be summarized as below:

1. The anomalous magnetic features are related to the Granodioritic and Gabbroic intrusive Miocene dated bodies, which their distributions are very well found.
2. The background level of the region is obtained by IGRF software equal by 48664 nT. The maximum total field measured is 49250 nT and the minimum is 47290 nT.
3. From mineralization point of view, the most preferable areas seem to be located in the central and southeast of the region.
4. Application of Oasis Montaj, has led to producing first derivative, upward continuation and reduction to pole maps.
5. An upward continuation map shows subsurface anomalies over southeastern part of the region have deep origin and also are transversal and longitudinal distributed and they are continuous respect to the surface masses (Fig, 7 a, b, c).
6. According to the interpreted magnetic features on the maps, the fault F1, has NW- SE strike and the mineralization is occurred along this faulted zone in a NW- SE direction (Fig 8a) (NICICO, 2008).



**Fig. 7(a, b, c) : Upward Continuation Map in Haftcheshmeh ore deposit**



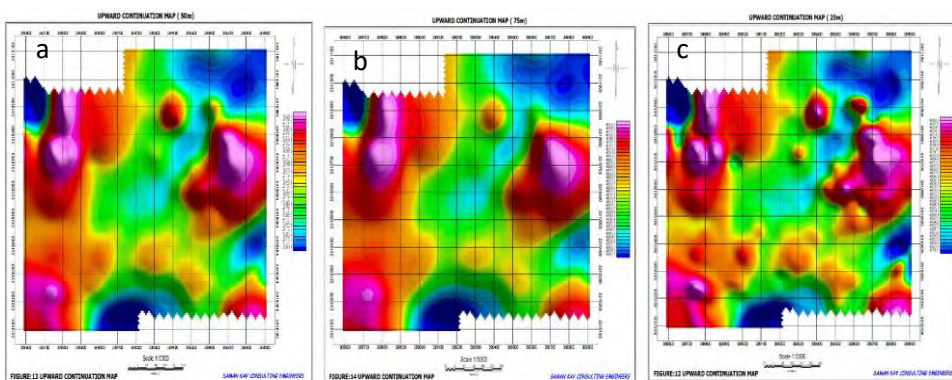
**Fig. 8: a. Pole Reduction map, primary drill holes are illustrated on the ore zone. B, Total field intensity map of the Haftcheshmeh porphyry**

### 3.4 Nowchun

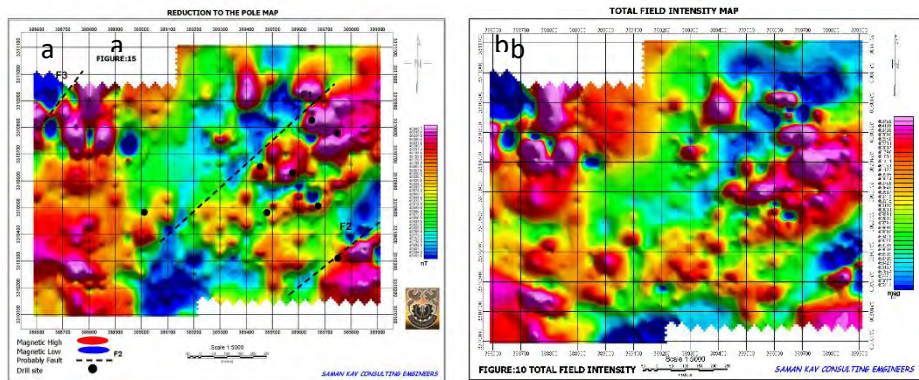
The Nowchun copper mineral deposit is situated on the southeastern slope of Kuh-e-Manzar about 4 km southwest of Sarchashmeh copper open pit mine and 10 km northeast of Pariz town. The Eocene andesite and tuffs are the oldest rocks, and form alternations of stratified flows and tuff horizons of variable thickness. They have been subjected to intensive folding and faulting, and have been altered by contact – metamorphic and hydrothermal processes. The hornfelses are developed over a wide area, and show gradual transitions with the surrounding, unaltered andesites.

Results of primary raw data interpretations and studies on processed geophysics data of Nowchun copper deposit can be summarized as below:

1. The anomalous magnetic features are related to the Micro-granodioritic intrusive Oligocene dated bodies, which their distributions are very well found.
2. The background level of the region is obtained by IGRF software equal by 45935nT. The maximum total field measured is 47700nT and the minimum is 44700nT.
3. The north eastern and north western part shows high magnetic anomalies. A high anomaly zone over the Potassic alteration probably shows the existence of magnetite.
4. Application of Oasis Montaj, has led to producing first derivative, upward continuation and pole reduction maps and analytic signal estimations (Fig, 10a).
6. An upward continuation map shows subsurface anomalies over southeastern part of the region have deep origin and also are transversal and longitudinal distributed and they are continuous respect to the surface masses (Fig, 9 a,b,c).
9. According to the interpreted magnetic features on the maps, the fault F1, has NE – SW strike and the mineralization is occurred along this faulted zone in a NE – SW direction (Fig, 10a) (NICICO, 2008).



**Fig. 9 (a, b, c) : Upward Continuation Map in Nowchun ore deposit**



**Fig. 10: a. Pole Reduction map, drill holes are illustrated on the ore zone, b. Nowchun Total field Intensity Map**

#### 4. Conclusions

The present investigations planned and carried out by exploration department of National Iranian Copper Industries Company (NICICO) for delineation of Potassic alteration zones and lead to useful and applicable results (especially by first author), so these results can be employed for exploration objectives, in first stage for exploration drilling planning and next for optimal gridding. This method may be applied for geophysical explorations of all porphyry systems and for all deposits contain magnetite minerals.

#### Summary

The Haftcheshmeh, Masjeddaghi and Nowchun are three porphyry systems that are located in Iran. Geology, mineralization and alterations are according to worldwide porphyry systems. Geophysical studies have been done on all three porphyry systems and had grateful resulted.

Results of primary raw data interpretations and studies on processed geophysics data on these copper systems can be summarized as below:

1. The anomalous magnetic features are related to the sub-volcanic intrusions, which their distributions are very well found.
2. The background level of the region is obtained by IGRF software are between 49250nT and 38373nT.
3. In all porphyry systems high anomaly zone have observed over the Potassic alteration probably shows the existence of magnetite.
4. According to the interpreted magnetic features on the maps, all faults and the mineralization are distinguished properly.
5. The potassic zone pattern can be used as an exploration key in all porphyry systems researches.

## Acknowledgement

For a variety of reasons we are grateful to the management of National Iranian Copper Industry, exploration department, whose has paid for all expenses in this regard. The authors' gratitude is further expressed to Prof. Dr. Elchin Khalilov for reviewing earlier versions of the manuscript and making critical comments and valuable suggestions.

## References

1. Gunn P.J., Milligan P., Mackey. T., Liu S., Murray A., Maidment D. and Haren R., 1997b, Geological Mapping using the national airborne and gravity datasets: An example focussing on Broken Hill: *Journal of Australian Geology and Geophysics*, v. 17, p. 127–136.
2. GSI (2004), Geological studies and map providing of the Masjeddaghi district in 1:5000 scale, unpublished
3. GSI (2004), Litho-geochemical studies of the Masjeddaghi district, unpublished
4. Hassanpour Sh., Rasa I., Heidari M., Oskoui R., (2008), Application of the magnetic method to exploration of potassic zone related the masjeddaghi copper deposit, 12th. Iran geological society, Ahwaz, Iran
5. Hassanpour Sh., Rasa I., Heidari M., (2009), Application of geophysic methods to exploration of the porphyry bodies in NW and SE of Iran, in press Hassanpour Sh, Rasa I, Heidari M, (2009), Metallogeny of Cu& Au deposits in Arasbaran zone, Phd thesis, unpublished data
6. Henley R.W., and Adams D.P.M., 1992, Strike-slip reactivation as a control on epithermal: Vein-style gold mineralization: *Geology*, v. 20, p.443–446.
7. Isles D.J., Harman P.G., and Gunneen J.P., 1989, The contributions of high resolution aeromagnetics to Archean gold exploration in the region, Western Australia: *Economic Geology monograph* 6, p. 389–397.
8. Jaques A.L., Wellman P., Whitaker A., and Wyborn D. 1997, High-resolution geophysics in modern geological mapping: *Journal of Australian Geology and Geophysics*. v. 17, p. 159– 186.
9. NICICO, (by Kavoshgaran Ltd. Co.) (2007), Litho-geochemical explorations on the Haftcheshmeh district in scale 1:5000, unpublished data.
10. NICICO, (by Kan Iran Ltd. Co.), (2007), Litho-geochemical explorations on the Nowchun district in scale 1:5000, unpublished data.
11. Leclair A.D., Lucas S.B., Broome H.J., Viljoen D.W., and Weber W. 1997, Regional mapping of Precambrian basement beneath Phanerozoic cover in southeastern Trans-Hudson Orogen, Manitoba and Saskatchewan: *Canadian Journal of Earth Sciences*, v. 34, p. 618–634.
12. Mckinlay F.T., Williams A.C., Kong J., and Scott-Smith B.H., 1997, An integrated exploration case history for diamonds, Hardy Lake project, NWT, *in*

- Gubins, A.G., ed., Geophysics and geochemistry at the millenium: Proceedings Mineral Exploration, GEO F/X, p. 1029–1038.
13. Moore D.H., Vander Berg A.H.M., William C.E., and Magart A.P.M., 1998, Paleozoic geology and resources of Victoria: Journal of Australian Geology and Geophysics, v. 13, p. 107– 122.
  14. NICICO report, (1988), Iran copper ore deposit lists, volume 1 of Exploration 97, Fourth Decental International Congress.
  15. NICICO, (Saman Kav Ltd. Co.), (2008), Report on geophysical study on the the Masjeddaghi copper deposit, eastern Azarbaijan, unpublished data.
  16. Tethyan copper company Ltd., Reko diq exploration and discovery, Pakistan presentation, Net source
  17. Whiting, T.H., 1986, Aeromagnetics as an aid to geological mapping: A case history from the Arunta inlier, Northern Territory: Australian Journal of Earth Sciences, v. 33, p. 271–286.
  18. NICICO, (Zarnab Ltd. Co.), (2008), Geological studies and map providing of the Haftcheshmeh district in 1:5000 scale, unpublished.
  19. NICICO, (Kan Iran Ltd. Co.), (2008), Geological studies and map providing of the Nowchun district in 1:5000 scale, unpublished.

## HUMANITARIAN SCIENCES

### THE POLITICAL AND LEGAL SUBSTANCE AND RAMIFICATIONS OF THE TURKMANCHAY TREATY FOR THE SOUTH CAUCASUS

**N. H. Aliyev**

*Department of International Relations and Foreign  
Policy of the Academy of Public Administration  
under the President of the Republic of Azerbaijan  
namikamall@gmail.com*

#### **Background of the Turkmanchay Peace Treaty**

A second Russian-Iranian war broke out in 1826. The Azerbaijani state of the Gajars (Iran) was intent on retrieving the northern Azerbaijani lands that had been annexed by Russia.

In July 1826, Abbas Mirza's troops (the son and heir of Fatkh-Ali, shakh of the Gajar) set out to Garabagh and Ganja. On this quest, Abbas Mirza was joined by HussainGulu-khan Bakuvi (of Baku), Ughurlu-khan (the son of Javad-khan of Ganja, who had been murdered by the Russians), and Mustafa-khan of Shamakhi.

The troops soon laid siege to Shusha. Abbas Mirza's army had virtually taken over Garabagh by then. However, the Gajar army made a fatal mistake laying siege to Shusha. It gave the Russians the necessary time to regroup and unite their forces. HussainGulu-khan made several attempts at taking Baku, however even a reinforcement troop dispatched by AbbasMirzawas of no avail. The Russians held on to Baku steadfastly.

In the meantime, the steady progress of Mustafa-khan of Shamakhi's army along Shirvan culminated in its liberation by August 1826. Soon thereafter the Russian troops were driven out of Guba and Sheki, and eventually had to flee Lenkaran as well.

Meanwhile, part of the Iranian army was making its way towards Tbilisi, which, however, was a remarkably fortified stronghold. On their way to Tbilisi the Iranian army came upon General Madatov's troops (a Russian General of Armenian descent. Following the conquest of the Garabagh Khanate he claimed to have descended from Garabagh Meliks (while it is well known that the Meliks were Albanians, not Armenians), whose lands had once been conquered by Turks (Azerbaijani), and even asked the Emperor to grant him stewardship of the Garabagh Meliks' domains)outside Shamkir. While at first the Iranian army outnumbered the Russians, it had to retreat as soon as the Russians were joined by Georgian troops, and shortly thereafter suffered defeat. Not a long while after



that Abbas Mirza's army was defeated near Ganja. The other khans, that had thereto made successful progression, were also soon defeated.

Using the momentum, the Russian troops launched a powerful offensive on Irevan. The ensuing siege was unsuccessful though. This prompted the Russians to lift the siege, and attack Nakhchivan, which they took without combat. Abbas Mirza wanted to defend the strategic fortress of Abbas-Abad, however, outnumbered and outweaponed, that town also failed to fend off the Russians and soon fell.

The Russian armies resumed their siege of Irevan. Although few in number, the Armenians living in Irevan, as was their way, betrayed their fellow citizens. The khan had no intention of surrendering, and the fortress promised to hold. Irevan had all chances of putting up a good fight and slowing down the Russian army's progressing incursion. But the Armenians opened the town's northern gateway, letting the Russians in. For this success, I.F. Paskevitch, the Russian Commander-in-Chief, was bestowed by Tsar Nikolay the First the privilege of adding the word «Irevansky» (meaning, of Irevan) to his title.

In October 1827, the Russian armies started an incursion to the Southern Azerbaijan. They were met with little to no resistance as they took Marand and Khoy, and managed to ultimately overcome the brave defensive of Tabriz, sacking the city. The Russians also violated the terms of armistice during the negotiations by taking over Urmia and Ardebil [See 10].

The Gajar's Iran and Russia signed a treaty on February 10, 1828, in the village of Turkmanchay, some 50 km of Tabriz [1].

**The Turkmanchay Peace Treaty** was signed between Iran and Russia on February the 10<sup>th</sup> (25<sup>th</sup>), 1828 A.D., or Shaban the 5<sup>th</sup> of the year 1243 of the Flight [1]. On behalf of Russia, the Treaty was signed by General-Adjutant to His Royal Majesty the Emperor of Russia, Infantry General, Commander-in-Chief of the Special Caucasus Corps, the Civil Governor of Georgia, Astrakhan and Caucasian provinces, the Commander of the Caspian Navy **Ivan Paskevitch**, and the Full State Counsellor, the Chamberlain **Alexander Obreskov**; on behalf of Persia, the Treaty was signed by the Minister of Foreign Affairs **Mirza Abul Hassan-khan**, and ratified by the Naib-Sultan (Prince) **Abbas Mirza Gajar**.

The body of the Treaty comprised 16 articles, with 6 more appendices, that set forth the terms of war indemnity, temporary occupation and delineation of the new borders. In parallel to the Treaty, they also signed the Trade Pact, which enabled Russian merchants to trade freely across Iran, and stipulated a single five percent importation tax for Russian and Iranian merchandise. Pursuant to the Pact, in all court hearings and litigations that could arise in Iran among Russian subjects or between them and foreign subjects, the Russians would be subject to the jurisdiction of the Russian diplomatic emissaries; Iranian courts

would have purview over any litigation between Russian and Iranian subjects but interpreters from a Russian mission or consulate were to be provided at all times.

So, what were the consequences of this treaty for the region as a whole? First and foremost, it ended the bloody Russian-Iranian war of 1826-1828. Superseding the Gulistan Treaty of 1813, the new treaty, in its spirit and letter, was a testament to Russia's victory, which saw the Gajar conceding some of the Azerbaijani khanates. To wit, under the treaty Russia stood to take over the Nakhchivan and Irevan khanates, and practically legalize its conquest of the Baku, Guba-Derbend, Ganja, Javad, Garabagh (the Kurakchay Treaty of May 14, 1805), Nakhchivan, Lenkaran, Shirvan (Shamakhi), Sheki khanates, along with a handful of sultanates.

### **The handover of the Irevan and Nakhchivan khanates to the Russian Empire's domain**

Pursuant to Article III of the Treaty, «His Majesty, the Shakh of Persia, on his own behalf and on behalf of his heirs and successors, hereby yields to the Russian Empire, to possess and dispose in full propriety, the khanate of Irevan, as it is on this and yonder side of the river Araz, and the khanate of Nakhchivan. As a consequence of this concession, His Majesty the Shakh hereby undertakes to, not later than within six months starting from the signing of this Treaty, hand over to the Russian governorships all archives and records of public domain, which have a bearing upon the governance of both of the aforementioned khanates». And this is how Russia got to take over all archives and other records along with the territories, thereby eliminating our chances to access important historical evidence. It would appear that Azerbaijan, as the rightful successor, should work towards retrieving all archives of the Azerbaijani khanates handed over by Persia to Russia.

Delineation of the Azerbaijani khanates is stipulated under Article IV of the Treaty, namely: «with the consent of both august agreeing parties, the boundary between the two states shall be established as the following line: originating from the spot upon the boundary of the Ottoman lands, which is the closest, in a straight direction, to the summit of Agra Minor (mount Ararat in the Russian text), the line of the boundary shall course up to the summit of said mount; thenceforth it shall slope down to the upper course of the river Lower Karasu, which flows from the southern side of Agra Minor (mount Ararat in the Russian text); thereafter this boundary line shall continue up the stream of the river until its influx into the river Araz, near Sharur; henceforth it shall follow the river-bed of Araz until it reaches the fortress of Abbas-Abad; here, by the outermost bastions of the fortress, sitting on the right-hand bank of the river Araz, a circumference shall be laid of a half-agach's breadth, i.e., 3 ½ Russian versts, in all directions, and the expanse of the land within said circumference

shall belong exclusively to Russia, and shall be severed with utmost precision within two months from today. From the spot, where the aforementioned circumference from the eastern side aligns with the bank of the river Araz, the boundary line shall follow the river-bed until the Yeddi-Buluk ford; from thence, the Persian land shall stretch along the river-bed of Araz for 3 agachs, i.e., for 2 Russian versts; then the boundary shall traverse the Mughan steppe until the river Bolgaru, to a spot that lies 3 agachs, i.e., 21 versts below the convergence of two rivers, the Odinabazar and the Sarakamish. From thence the boundary shall follow along the left-hand bank of the river Bolgaru upstream until the convergence of the aforementioned rivers of Odinabazar and Sarakamish; thereafter, along the right-hand bank of the eastern river Odinabazar to its upper course, and from hence to the summits of the Jikoyir heights, wherefore all waters flowing down from these heights towards the Caspian Sea, shall be in the domain of Russia, and all waters flowing to the Persian side, shall be in the domain of Persia. Whereas hither the boundary between the both states is set forth by the mountain ridge, therefore it shall be established that their slopes towards the Caspian Sea shall be in the domain of Russia, whilst the opposite slopes shall be in the domain of Persia. From the ridge of the Jikoyir heights the boundary shall course up to the summit of the Kamarkuy along the mountains, which separate Talish from the county of Arshi. The mountain-tops, which separate the flow of waters in two parts, shall constitute hither the boundary line the same as it has been stated above with regard to the lands between the upper course of the Odinabazar and the Jikoyir heights. Thereafter the boundary line shall, with the strictest adherence to the aforementioned rule concerning the flow of waters, follow from the Kamarkuy summit along the mountain-ridge, which separates the counties of Zuvanta and Arshi, to the boundary of the county of Valkidzhy. Thus, the Zuvant county, save for the part thereof, which lies upon the opposite side from the aforementioned mountain-tops, shall be conceded to Russia. From the boundary of the Valkidzhy county the boundary line between both states shall, in strict and uninterrupted adherence to the aforementioned rule concerning the flow of waters, follow along upon the Kloputy summits and along the chief mountain-ridge, which course through the Valkidzhy county, to the northernmost headspring of the river Astara, and from thence along the bed of said river until it flows into the Caspian Sea, whereupon shall terminate the boundary line, which is meant to separate the Russian lands from those of Persia».

### **The war indemnity**

The Treaty compelled Iran to pay a sizeable war indemnity, in the amount of ten Kururs of Rainje Tamans, or twenty million Rubles in silver. The timeframe for the indemnity was set by Article II of Treaty's Appendix: three Kururs of Tamans were to be paid to the Russian representatives or their

delegates within the first eight days of the signing of the Treaty, two more within fifteen days, another tree on April the 1st (13th), 1828, or on the 26th of the next Ramadan, and the remaining two Kururs on January the 1<sup>st</sup> (13<sup>th</sup>), 1830, thereby completing the sum of ten Kururs of Tamans that Persia undertook to pay Russia.

Until Iran has paid the bulk (eight Kururs) of the sum due, the Russian troops would keep their hold of the Southern Azerbaijan provinces.

A quote from the Treaty to this effect: «...And should the aforementioned sum of eight Kururs of Tamans, God forbid, be not paid in full by the 15th (27th) of August of this year, or by the 15th of the month of Safar of 1244, it is and shall be understood, that in that case, the entire province by the name of Azerbaijan shall forever be separated from Persia and HRM the Emperor of Russia shall therefore enjoy the right to either have it as an inextricable part of his Empire, or otherwise establish therein independent and inherited khanates under his direct and exceptional patronage.

As regards the sums of money, which, pursuant to the aforementioned covenants, shall have been paid to Russia by then, it is understood that such sums of money shall remain irrevocably in her domain». In other words, Russia stood to take all of Azerbaijan if Iran failed to make the payments as they became due.

#### **Concerning the successor and heir to the throne of Iran**

Russia acknowledged the Prince Abbas Mirza Gajar as the rightful successor and heir to the throne of Iran, and undertook “upon his ascension to the throne, to recognize and treat him as the rightful lord of that state” (Article VII). This provision was an unconditional guarantee of peace in event of a lawful (in order of succession) change of the ruler of Persia.

#### **Free sea-faring in the Caspian Sea for Russian and Persian merchant ships**

Russian and Persian merchant ships were afforded an opportunity to freely navigate the Caspian Sea, with a mutual possibility of mooring in the ports of both states. The parties undertook to assist ships in event of wreckage. However, Russia was the only state that reserved the right to keep a navy in the Caspian, as it had gotten this privilege under the Gulistan and the Turkmanchay Treaties (Article VIII).

#### **Resumption of diplomatic and trade relations**

This is the topic that Articles IX, X and XI of the Treaty are concerned with. The Treaty also deals with the possibility of considering mutual debt obligations, exchange of consuls or trade agents, etc.

#### **De-facto seizure of the real estates of the Irevan and Nakhchivan khans**

Pursuant to the Treaty, «The august agreeing parties, for the benefit of their respective subjects, have mutually agreed to grant those of them, who

possess immovable properties on both sides of the river Araz, a three years' time, during which they shall be free to sell and trade such properties at will; but HRM the Emperor of Russia, as it concerns him, shall extricate from this gracious behest Hussain-khan, the former Sardar of Erivan, his brother Hassan-khan, and Karim-khan, the former lord of Nakhchivan» (Article XII). Thus, the aforementioned lords no longer could dispose of their immovable properties.

### **Amnesty**

Articles XIV and XV of the Treaty granted amnesty to the people of Azerbaijan, defectors, anyone who had any connection to the war. However, to finalize the relinquishment of the Garabagh, Nakhchivan and Irevan khanates, the Russians included a provision in the Treaty stating that«HRM the Emperor of Russia, on his behalf, shall promise that he would equally disallow Persian defectors to settle or reside in the Garabagh and Nakhchivan khanates, as well as in the part of the Erivan khanate, which lies on the right-hand bank of the river Araz. However, it is understood, that this condition has and shall have legal effect solely with respect to people, who had public titles or statesmanship, namely khans, beks and religious leader or mullahs, who, by the way of personal examples, persuasion and secretive connections, could exert a harmful influence upon their former compatriots, who had been under their governance or rule».

This provision essentially kept Muslim elites from returning and settling in the Garabagh, Irevan and Nakhchivan khanates, thereby effectively opening the khanates for easy re-settlement of Armenians.

Article XV, section one, goes on to say: «HRM the Shakh, driven by a beneficial and salvatory desire to restore peace in his state and ward his subjects against all that which could further augment the toils of war, which has been thus blissfully discontinued by this Treaty, shall grant full and utter forgiveness to all residents and officials of the province by the name of Azerbaijan. None of them, of whichever rank, may be subjected to persecution, nor excoriation or offense for their opinions, deeds and demeanor in the time of war or as long the temporary occupation of said province by the Russian troops lasts».

### **Re-settlement**

Provisions of the second part of Article XV were key for re-settling Armenians to the Garabagh and Irevan khanates. The shakh undertook to give «officials and residents a one year's time... for a free transition with their households from the Persian lands to the Russian lands, for exportation and sale of their movable properties of all manner, with no hindrance whatsoever on the part of the government and local administrations, nor any taxes or charges to be

levied upon the properties or belongings sold or exported by such persons. Regarding immovable properties, a five years' time shall be established to sell or otherwise dispose freely of such property. However, this exemption shall not apply to those, who, before the aforementioned one year's time expires, should commit any prosecutable transgression or offense».

Russia decided to use the loyal Armenians to make sure that Azerbaijan does not slip away. A case file of the diplomatic chancery under the Steward of the Transcaucasian province of the Russian Empire, dated June the 4<sup>th</sup>, 1824, concerning an Anton Grikurov, an Arzrum (Erzerum) merchant, who stated that Nestorian Armenians were willing to take actions against the Persians, contains a memo by the Tbilisi Military Governor that clearly says that Nestorian Armenians, who lived in Persia near Salmast, were prepared to become Russian subjects and conspire with Russia against Persia. The memo is so clear and unambiguous that it is unlikely to leave any room for speculation or rebuttal. The most striking part of the memo is the Armenian merchant wishing Russia success in conquering Azerbaijan, which is evident of the Armenians' age-old desire to take over and settle Azerbaijani lands.

In his address to the military governor, Grikurov the merchant writes: «...The letter, which is to be handed to the Patriarch, should be given to me, and this I shall take to him, travelling thereto with guides three, of which lot one is mine interpreter. I trust that they should succumb to the Russian persuasions quite speedily, **for they have confidence in the invincible force of the Russian host, and hope for the conquest of Azerbaijan**, near which they reside, and after which they should prosper under the scepter of the Russian Monarch» [11, p.38, 40].

The Armenian Catholicos Nerses Ashtraketsi drafted a resettlement plan, and asked the Russian Ambassador to Iran A.S. Griboyedov and General I. Paskevitch to remember to include the Armenian resettlement to Azerbaijani lands in the Treaty. Sure enough, Griboyedov, who, as the very Nerses claimed, was a «faithful protector of the Armenian people», and Paskevitch, did remember to include the resettlement in the Turkmanchay Treaty.

What Griboyedov and Paskevitch counted on was that Article XV of the Treaty would enable them to re-settle as many Armenians as possible from Iran to the Northern Azerbaijan; they were also confident that many Azerbaijanis would flee their lands as the local Russian-led governments had started to inflict major harassments against them. Thanks to this Article over 50 thousand Armenians from Iran alone were resettled to Azerbaijan.

I. Chopin, State Counsellor, and President of the Revenues and Government Properties Administration of the Armenian province that was established in 1828 in the wake of Russia's annexation of South Caucasus by merging the Azerbaijani khanates of Nakhchivan and Erivan, wrote a document

at the direction of Count Paskevitch of Erivan, wherein he reports that the Russian-Persian war of 1826-1828, and subsequently the Russian-Turkish war of 1828-1829 resulted in re-settlement of 23 568 and 21 639 Armenians respectively to the former Irevan khanate, and 10 652 and 27 Armenians respectively to the former Nakhchivan khanate. 1340 colonists were from Persia re-settled to the Ordubadcounty. Thus, the total tally of re-settlers from Persia amounted to 35 560, and 21 666 from Turkey, in turn, bringing the total count to 57 226 Armenians [See2, p. 637-642].

### **Official records evidence that it was Garabagh and Zangezur where the bulk of re-settlers settled**

In his book titled *A New Threat to the Russian Cause in Transcaucasia: A Future Sale of Mughan to Outlanders*, N.N.Shavrov wrote: «...From 1828 through 1830 we had resettled to Transcaucasia over 40 000 Persian and 84 000 Turkish Armenians, and installed them at the best government-owned lands of the Elisabethpol and Erivan governorates, where the Armenian populace had been but insignificant, as well as in the Tbilisi governorate, namely in the districts of Borchali, Akhalsikh and Akhalkalaki.

They were granted more than 200 000 dessiatinas (dessiatina is an archaic Russian measure of land, approx. 2.7 acres) of government lands; as well, more than 2 000 000 Rubles worth of privately-owned lands were acquired for them from the Muslims. The highland areas of the Elisabethpol governorate and the shores of the Geokchalake (currently Sevan – N.A.) are now settled by these Armenians. It is also noteworthy that the officially re-settled 124 000 Armenians were followed by a multitude of unofficial re-settlers, wherefore the total tally is significantly in excess of 200 000 people... Of the 1300 thousands of Armenians presently residing in Transcaucasia, more than 1 000 000 souls are not natives of the land, and were settled here by us» [3, p. 59-60].

### **Native “Armenians” are originally Albanians**

Kamala Imranli writes in her study: «As for the native «Armenians», they are considered as such only due to their religious denomination, but not their ethnic origins, which is Albanian... However, subsequently, as the Armenians demanded so, and the Russians yielded (for their own ulterior motives), the Albanians were subjected to Armenization, save for a small portion of them, who currently live in two districts of Azerbaijan on the left-hand bank of the Kura river. In spite of what they are perceived as by others, to us, the Garabagh «Armenians» are still Albanians, which is made evident by their intrinsic characteristics and features.

However, simply because of the name that had been forced upon them, they call themselves Armenians, and show no willingness to examine whether or not they indeed are, hence clearly demonstrating what a victim of a targeted national identity disruption policy is” [4, p. 8].

Possible ramifications of the re-settlement, the radical shifts in the ethnic make-up of the local populace were of concern not only for the natives but the saner Russian intelligentsia even in the 19<sup>th</sup> century. In particular, the prominent Russian diplomat and poet A.S.Griboyedov (who, as a matter of fact, had a direct involvement in the Turkmanchay Treaty that split Azerbaijan in two parts) wrote: «We also spoke with him (duke Argutinsky) at length of persuasions, which should be offered to the Muslims to compel them to accept their current predicament, which, mind you, will not persist, and to seek to expel from their minds any concerns and unease that the Armenians should forever possess the lands, wherein they have been allowed but a stay» [5, p. 341].

Armenian sources demonstrate that as a result of the resettlement of yet another 350 000 Armenians [See 6, p. 268] to Caucasus in 1914-1916, their numbers in the Erivan governorate (formerly the Irevan and Nakhchivan khanates) reached 669 871 [See 7, p. 219].

However, even after all these resettlements the Armenians did not have a majority in South Caucasus. In this respect, the correspondence between the foreign minister of Russia Sazonov and the vicar of Caucasus the Great Duke Nikolay Nikolayevich is quite noteworthy. In his letter dated June the 14<sup>th</sup>, 1916, the minister wrote to the Great Duke: «With regard to granting broad autonomy to Armenians, we should remember that in Great Armenia (the context also discussed eastern Turkey, the historic Cilician Armenia – N.A.), now conquered by Russia, the Armenians were never a majority”, and “under such circumstances, Armenian autonomy would lead to an unjust enslavement of a majority by a minority”...[See 8, p. 208-209].

The Great Duke Nikolay Nikolayevich replies on July the 3<sup>rd</sup>, 1916, that «It is my sincere belief that the Armenian issue is utterly non-existent within the bounds of the current Russian Empire, and even mentions thereof ought to be disallowed, for Armenian subjects of Russia in the domain (Caucasus – N.A.) are as equal Russian subjects as are Muslims, Georgians and Russians»[See the same doc. CXLIV, p. 211-212].

## Conclusions

- The Turkmanchay Peace Treaty signified a division of disparate Azerbaijani khanates between Russia and Iran. Iran got to keep the Ardebil, Garadagh, Maki, Maragha, Sarab, Tabriz, Urmiya, Khoy khanates.



- The Russian-Iranian wars of 1804-1813 and 1826-1828, and the ensuing Turkmanchay Treaty triggered a mass-scale resettlement of Armenians to South Caucasus, including Garabagh.
- The Treaty's provisions enabled a targeted Armenization of our ancestral lands to allow the Armenians to expropriate all historical and cultural monuments of the Ancient Caucasian Albania.
- Azerbaijani Muslims were tolerant and did not persecute those Albanians who refused to convert to Islam, thereby enabling the Albanians to preserve their culture and ways, escape ethnic mixing and gradual disappearance, unlike many other ancient nations. However, as the Armenians came along, the Albanians lost their official church, their temples, and had no choice but to join the Gregorian congregation: they were thus often mistaken for Armenians.
- The Turkmanchay Treaty's text purposefully distorts and falsifies the geographic names with an aim to eradicate them from our history.
- Nowhere does the Treaty ever mention the mythical «Eastern Armenia», which has never existed on any of the world maps, other than those concocted by Armenians scholars.

**Thus, the Irevan khanate of Azerbaijan became:**

in 1828, the Armenian province,

in 1849, the Erivan governorate of the Russian Empire's Caucasian domain,

in 1918, the Republic of Ararat,

in 1920, the Soviet Socialist Republic of Armenia, from 1991, the Republic of Armenia.

As a result, based on, and owing to the Turkmanchay Peace Treaty, the indigenous Azerbaijani lands of Geycha and Zangezur, first with the support of the Russian Empire, and subsequently the Soviet Union, were forcefully declared “Armenian”. NagornoGarabagh and the seven adjacent districts that combined make up 20% of Azerbaijan’s territory have been occupied for more than a quarter of a century by the armed forces of Armenia, which has been recognized as the aggressor.

We do not purport to have had an in-depth examination of the issues relating to the Turkmanchay Treaty. Our colleague, assistant professor Shalala Huseynova put it quite aptly that “this treaty needs to be viewed as a three-dimensional hologram, from different angles and vantage points” [9].

## References

1. Туркменчайский мирный договор между Россией и Персией от 10 февраля 1828 года. - <http://www.hist.msu.ru/ER/Text/FOREIGN/turkman.htm>
2. Шопен, И. Исторический памятник состояния Армянской Области в эпоху ее присоединения к Российской Империи. – СПб: Типография Имперской Академии Наук, 1852
3. Шавров, Н.Н. Новая угроза русскому делу в Закавказье: предстоящая распродажа Мугани инородцам. - СПб, 1911
4. Имранлы Кямаля. Создание армянского государства на Кавказе: Истоки и последствия: Монография. – Москва: Ладомир, 2006
5. Грибоедов А. С. Сочинения. В 2-х томах, т.2. - Москва, 1971
6. История армянского народа. – Ереван: Издательство Ереванского университета, 1980
7. Кавказский календарь на 1917 год. Типография Канцелярии Наместника Е.И. В. на Кавказе, 1916
8. Раздел Азиатской Турции (по секретным документам б. министерства иностранных дел, под редакцией Е.А. Адамова). – Москва: Издание Литиздата НКВД, 1924, док. СХЛ
9. Гусейнова, Шелала. В Туркманчае Персия и Россия делили независимые Азербайджанские ханства. – Эхо, 2013, 9 февраля; [http://www.rizvanhuseynov.com/2013/02/blog-post\\_9.html](http://www.rizvanhuseynov.com/2013/02/blog-post_9.html)
10. Туркменчайский договор (1828). Окончательный раздел Азербайджана. - <http://azerbaicanli.org/ru/page57.html>
11. Алиев, Намик. История еще одного армянского предательства. – Право и политология (Тбилиси), 2011, № 16, с.38-52

## SWIMMING OF PITEY (PIFEY). MYTH OR REALITY

**T.Sh. Khalilova**

*International Academy of Science AS H&E, Baku Azerbaijan  
t.khalilova2015@gmail.com*

In the ancient period, geographical discoveries made by the most inquiring and worthy sons of mankind broadened the horizons about the already known Oikumen and led to the development of theoretical thought and physical-geographical ideas about the Earth as a whole.

In the middle of the IV century BC. e. an event that seems impossible happened - the voyage of Pitey, the ancient Greek navigator, astronomer, mathematician, geographer from Massalia (Marseilles) across the Northern Ocean. However, the scientific significance and fame of this fact has survived for millennia, but could not be understood by contemporaries. Researchers suggest that "Pitey (Pythaeus) made his grand trip on behalf of the wealthy merchants of Massalia, who probably wished to obtain reliable information about the little-known countries of tin and amber and sent him as a proxy. After all, it cannot be assumed that ... significant costs associated with such an expedition were covered by Pytheus from their own means " [29, p. 180]. The merchants who sent Pitey on a voyage set concrete, trading tasks for him - to find islands where tin and amber are mined. The route of his journey was created on the basis of information that has been transmitted since the time of the Argonauts. "Archons want Pythaeus to find a way connecting the shores of the Hyperborean Ocean with Pontus Euxinsky, which, according to oral legends, Jason and his companions traveled to Argo many years ago" [9]. Pitey, having equipped two ships, intended to go out of the Mediterranean Sea to the Atlantic Ocean and turn north to go to Britain, then turn east to find the entrance to Tanais and "return to Massalia along Tanais" via Pont (Black Sea - author's note). "Will it reveal to us the secret of the road to Tanais and will it allow us to return to Massalia around the inhabited World"? [9]. The outline of such a route by Pietem was based on information about the possibility of communication along European rivers between the Black and Baltic Seas. This water basin was adopted by Timaeus from Tauromenia (a famous historian of the first half of the III century BC, describing the campaign of the Argonauts) over the North Ocean [6. p.18].

Pitey's report was not preserved, but came to us through other ancient authors, including Pliny the Elder, Strabo, and others. Having passed Gibraltar, Pitey turned north and reached Britain. He described in detail every day sailing along the shores of England and Scandinavia. "Britain is a huge island with coasts of over forty thousand stadia in length. In its northern part, closer to midnight,

days in the summer last twenty hours. It is from there that I should go to the Throne of the Sun ” [9]. He further notes on the Pune merchants: “However, they bring amber from Hyperborea”! The pilot explains that they are turning up to meet the vessels of the scans ” [9]. Those towards the Baltic Sea, as evidenced by the collected observations of Pitey on the northern shores of the Celtic and the Baltic. Diodorus of Sicily and Pliny, in his words, report on the “Scythian” shores and islands near Celtic in the North Ocean, where amber is gathered in large quantities by local residents ” [6].

A mystery for researchers remains the island of Thule, which Pitey reported, both about its nature, climate, and about people with a description of their homes and lifestyle; agriculture, up to the method of processing grain under a canopy. Modern researchers place the island of Thule in various places of the Northern Ocean. Pliny the Elder noted its location: “The most distant of all known lands is Tula, where during the winter solstice, when the Sun passes the sign of Cancer ... there are no nights, and during the day there is very little light. Some people think that this goes on for 6 consecutive months ... At a distance of one day of the sea route from Tula, there is supposedly a frozen sea (πεπυγγυια), which some call the Gulf of Kronius (Κρονιοσκολπος) "[11.XXXVII. 58.4, 104]. Messages of this order require critical consideration, because from the epic of the Scandins it is known that Icelanders, for example, divided the year into summer (day) and winter (night). [17. The mysterious route of Pifey. Ch. 2]. Scandinavians possessed fragmentary information about Jan Mayen, which they called Fulla. “To the north of Britain lie still other islands: Scandia, Dumna, Bergi and the greatest of all Berriquet, from which they usually sail to Tula” [22].

Since the direction to the island of Thule, Pitey received from the Scandinavians, and he sailed to Tanais, so Tula can be assumed in the southeast of Scandinavia. Petey notes that his task is to move further east: “... but we need to find another river, called Tuna or Duna, further towards sunrise; it sounds close to Tanais ” [9].

Modern scholars have noticed that in the real geography of the era of colonization, Greek sailors sailing to the northwest: “... more than once it seemed that they were sailing in the same direction as the sailors who turned to the northeast (and vice versa - author's note. ) This, most likely, should explain the presence of the same mythical and ethnic names, both in the north and in the east: the double localization of the islands of Eey, Scheria, Eritia, duplication of the tribal names of Iberians (in Spain and the Caucasus), Elim (in Sicily and in Asia Minor), Tyrrhenes (in Italy and in the Aegean Sea), etc. " [6. c.9].

First of all, in the stories about this island there are no characteristic features of the Far North:

- the phenomenon of aurora;
- no mention of icebergs;

- mentions of polar bears, deer are absent by any ancient author, including Pifey;
- describes the cultivation of wheat and the method of processing grain, in addition, the inhabitants of Tula allegedly extracted wild honey, which is not possible in the Arctic.

“Everything speaks for the fact that not only the Greeks themselves, but also their informants were not in the Arctic [17]. However, Petey argued that "he personally explored the entire northern part of Europe to the ends of the world" [18. p.104]. Where is this limit: in the north or in the southeast beyond the mouth of Tanais?

In the direction southeast of Scandinavia, in the west of the East European Plain (Russia), the Central Russian Upland is located at an altitude of 160 to 300 m above sea level. This place is located on the famous trade route “From the Varangians to the Greeks”. On a hill, there are such cities as: Tula, Belgorod, Kaluga, Orel, etc., and 60 kilometers south-east of Tula, there is the source of the Don River, at an altitude of 236 meters above sea level. After all, it was this river that Pitey sought to get into the Black Sea.

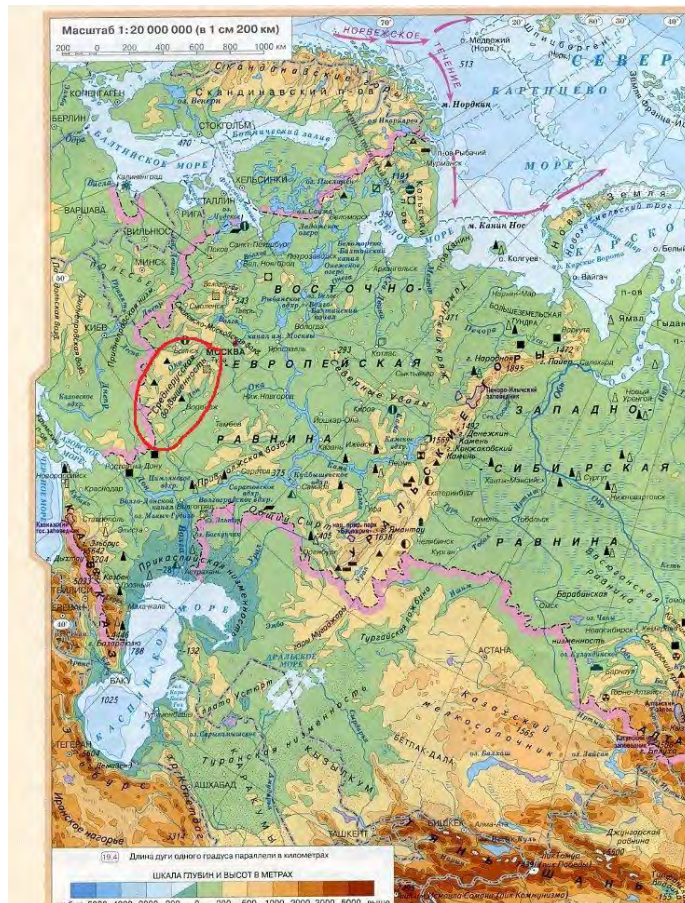
The city was founded near the Tula River. One of the earliest attempts to explain the origin of the toponym Tula was the hypothesis of Vladimir Dahl. In his dictionary, he explained the word “Tula” as follows: “Tula is a secretive, inaccessible place. Since the name of the Upa River is unconditionally Baltic (compare the lit. ùpè, upìs, up ,s, Latvian. Upe “river”), its tributary Tula can also be of Baltic origin, as evidenced by a number of parallels in Lithuanian toponymy: the Tule river, the Tulis swamp, the Tulyte field , Tulejos meadow, Tulia valley, etc. " [23]. After all, the Scandinavians called this island - the island of Thule.

It would seem that there is no connection, except for the name, the ancient island of Tula and the city of Tula on the Central Russian Upland within the East European Plain of Russia (Fig. 1).



**Fig. 1** [http://www.megatula.ru/page/karta\\_goroda\\_tuly/karta\\_tuly](http://www.megatula.ru/page/karta_goroda_tuly/karta_tuly)

On the map, the Central Russian Upland stands out as an island, against the background of a plain descending below sea level to the north (White Sea) and to the south (Caspian Lowland -27 m below sea level) 2. The Central Russian Upland in its northern parts and partially along the western and eastern slopes was covered with glacier. Deposits of glacial origin are found in these territories, their thickness varies up to 15 m. “A glacier, passing millennia ago across the plain, has formed many lakes on its territory. Under the thickness of the earth in the localization of the Russian Plain, artesian water reserves are stored in the amount of three underground basins of huge volumes and many located at a shallower depth. ” [24]. The climatic characteristics of the Central Russian Upland are marked by subarctic features. “The summer season corresponds to the polar day, the winter season to the polar night.” [25].



**Fig.2.** <https://znanija.com/task/32257100>

And, at present, the East European Plain is characterized by low volatility, which: “leads to swamping of vast areas [25]. The Central Russian Upland rose above the East European Plain (up to 300 m above sea level), while the plain itself was flooded with glacial water and in ancient times seemed to the Greeks an island located in the far north. Here, justification is given for almost Arctic cold weather, constant summer rains in this region - low evaporation and, as a result, large cloud cover that delays the melting of glaciers. This territory is located on the route of Pitey to Tanais (Don) and further to the islands with tin and amber. “It is high time to find the passage through Tanais (Don). The Phoenicians rise to the countries of Borea for amber, tin, gold and furs ” [9]. Borean countries associate Greek myths with the mountains of the Caucasus [10.p.913].

Back in the first half of the last century, the paleographer S.A. Kovalevsky, analyzing ancient written sources, in his work "The Face of the Caspian" claimed that about 3,500 years ago, the Caspian Sea was connected to the Sea of Azov along the Manych Strait. And furthermore, it reached further along the Volga channel in the north of the Baltic Sea. And this situation existed 2500 years ago. According to S.A. Kovalevsky, "the last time this connection of the Sea of Azov and the Caspian was interrupted only in the IV century BC. e., shortly before the campaigns of Alexander the Great ". [eight. p.46]. In the understanding of the ancients, this is, indeed, the ocean, having a connection with the World Ocean flowing around Oikumena.

The ancient Greek view of the Earth, which claimed that the Ocean River surrounded the populated part of Oikumena, is consistent with our assumption of fresh waters in northern Europe - as a result of melting glaciers. Scientists came to the conclusion that the range of the last great glaciation in Europe stretched north from the Sudeten and Carpathians and the territory located above the Sea of Azov (except for hills and mountains), was able to free itself from glacial captivity and populate people "... only in pre-boreal and boreal times (approximately 10,000–7,750 years ago) " [21. p.6-7]. This suggests flooding with fresh water, as a result of melting glaciers, the territory north of the Caspian Sea and the Sea of Azov at a time close enough to the ancient period. Hence the stunning imagery contained in ancient sources about the ocean - "River - Ocean". In his work "Description of the Populated Land" (translated by I. II. Tsvetkov, comments by L. A. Yelnitsky), Dionisy Perieget gives an explanation of the slow melting of glaciers and excessive cold in the region of the Ocean and the Caucasus - high humidity leads to thickening of clouds covering the sun and, as a consequence, the inability to warm this territory [10 p. 1425]. Fig. 3. 17th century map, where the Caspian Sea is depicted connecting with the water body in the north through the Volga, the Don and the Baltic Sea in the form of a belt ("balteus (balteum) - belt, band" - hence the name of the sea - Baltic - author's note) and, respectively, with the Atlantic Ocean. In the northeast, the Caspian Sea is connected to the eastern basin of northern rivers flooded with glacial water (East, Eoysky Ocean of ancient sources - author's note). The image of the Caspian Sea on this map corresponds to the description of ancient authors about the connection of the Caspian with the world Ocean. In the north and east, the Caspian Sea was associated with the Ocean (Scythian, Sarmatian, Arctic, Kronian, Eastern, etc.).





**Fig. 3. Première révolution de la Mer Caspienne. - Uppsala University Library**  
<https://mispronzaya.livejournal.com/389481.html>

The existence in the north of the sea or the Ocean, which has many names, reflecting the peoples located near them, was also assumed in the early Middle Ages. “Scholia 115. The East Sea, the Barbarian Sea, the Scythian or Baltic Sea are one and the same sea, which Martian and other ancient Romans called the Scythian or Meotian swamps (which indicates the relatively shallow depth of these water basins - approx. ), Getae deserts or the Scythian coast ” [2]. “And this sea, starting from the Western Ocean and lying between Denmark and Norway, extends to the east to an unknown distance” [2]. The frames of this water basin are laid from the Sea of Azov to the Atlantic Ocean in the west through the Baltic, like a belt. So this situation existed at a historically close time, being reflected in ancient sources. Einhard, or Einhard (c. 770–840 centuries), a Frankish historian, one of the representatives of the so-called Carolingian Renaissance, the author of *The Life of Charlemagne*, based on ancient authors, wrote: “10. A gulf extends from the West Ocean to the east. Locals call this bay the Baltic, because it stretches through the Scythian regions up to Greece for a long distance like a belt. It is also called the Barbarian Sea, or Scythian waters, because barbarian peoples live on its shores. The Western Ocean is what Roman writers call British. It washes Britain, which is now called England. It is huge in

the west, scary and dangerous” [2]. The connection between the Western (Atlantic) Ocean and the extreme eastern limits, like an echo from antiquity, was also reflected in *The Tale of Bygone Years*: “Lyakhi and Prussians, chud sit near the Varyazhsky Sea. Varangians are sitting on this sea: from here to the east - to the limits of the Sims, they are sitting along the same sea and to the west - to the land of English and Voloshsky ” [13]. Consequently, the location of the water area, under different names, in the north, from the ocean in the west (Atlantic) and further east from the Caspian Sea, took place, as almost all ancient authors constantly mention.

Judging by the records of the journey for amber and tin, Pythaeus, most likely, having rounded the northern part of Europe, reached the Sea of Azov and, possibly, the Caspian. “The wind from sunset with force carries us forward” [9]. The phrase shows - direction to the east, rather southeast.

However, he did not reach his goal - to enter the Black Sea via Tanais (Don) and Meotida (Sea of Azov). By the 4th century B.C. the connection between the Volga and the Don was interrupted. Apparently, the locals, through the channels and lakes "wide as sea arms", dragged their little vessels on their hands, but the ship of Pitey was difficult for this and he could not find a way to Tanais.

But, Pythaeus passed very close by. In the surviving notes, he wrote: “Who can be hippos - so I wrote down the name of people with horse legs? Or panotises, people with huge ears, guarding, it seems, the entrance to Tanais?

One hundred and twentieth day travel. Panotises and hippos exist. I understand why they are so called - these blond-haired and blue-eyed barbarians with upturned noses wear a long wrap. This is an integral piece of brown coarse-haired fabric in the form of a hood, cut in half from the neck to the very heels. They wrap their naked body in these wide strips of fabric without removing the hood, and it seems that they are served by two huge ears! The appearance of the barbarians causes ridicule of the berg. I understand them, but do not approve. They are also called "Horse Feet", I wrote down this name in Greek - hippos. I had to see in their huts shoes with a sole made of an elongated plank or mesh woven from thin birch twigs. The barbarians walk in this shoe in the snow, which covers the earth here for three quarters of a year.

These hippos-panotises, whose language is impossible to understand in any way, seem to belong to the Scythian tribes. The barbarians treated us with milk and cheese. The Hippemolgian people are Scythian because they milk the mares. (10. p. 1001 Eli Herodtan) ” [9].

It is interesting to note that the territory of Priazovye, Don has Arctic characteristics - the cold lasts "three quarters of a year." Geographical reference - tribes guard the entrance to Tanais and that these tribes are Scythian, similar to the description by ancient authors that the Scythians live in the north of the

famous Oikumena, beyond which the North Ocean. This ethnographic picture is described by Ptolemy, placing the tribes in the following sequence: “Gelons, hippopods (or hippies) and melanchleans; below them are agafirs (agatyrs), then aors (northwest of the Caspian Sea)” [1. p. 316.22.]. These fragments confirm our conclusion that the area above the mouth of the Don was flooded (a consequence of the melting of glaciers), therefore, according to the ideas of ancient authors, the border of the North Ocean was south, not far from the mouth of the Don (three days of sailing to the Baltic island).

Apparently, having found no way out to the Black Sea, Pitey, not far from the mouth of the Don, met the hippopot tribes - panotises and entered the North Caspian along the Volga channel. “At the distance of one day of the sea route from Tula there is a frozen sea called the Kronian Sea [22].

During one of the sites, the Greeks recognized the name of the sea they discovered. Pythaeus called it - the sea of Fear. What kind of sea is discovered by Pifey? “One hundred and thirteenth day of travel. Entered Mentonomon. He, I suspect, is Ba Altis of the Phoenicians. We go to A-baalo. A light wind blows from sunset, the sea is calm, its depth is barely fifteen fathoms outside the strait” [9].

Not far from the mouth of Tanais, Pitus enters the sea, which has a series of names. In particular, this sea was called the Ocean. Diodorus of Sicily, describing the location of the Scythians, notes: “they acquired a country in the mountains to the Caucasus in the lowlands of the coast of the Ocean and Lake of Meotia and other areas to the Tanais River” [27.2.43.1.2.]. Consequently, the territory between Tanais, Meotida, the Caucasus and "in the lowlands of the Ocean" is the Caspian lowland at the confluence of the Volga River. Consequently, the North Caspian with the mouth of the Volga was perceived as the Ocean. In accordance with the Ionian tradition, the Caspian was located on the border of the Northern and Eastern oceans. In Pliny's book Natural History, we read: “The path from the Caspian Sea and the Scythian Ocean turns to the Eoya, and the coastline now faces east. The first part of this coast from the Scythian cape is uninhabited due to snow; the nearest areas remain uncultivated due to the savagery of the tribes ” [11.VI.53]. The connection of the North Caspian Sea with the Cronian Ocean is indicated by the remark of Dionysius Perieget about the location of the “Caucasus reaching the Kronian Sea” [10.p.938]. Dionysius, examining the Caspian (Hyrcanic Sea), draws attention to the ocean, located from it in the north, calling it Kronian, Dead. “Both because of the cold in these countries; for the sea is freezing. It is called the Cronian Sea, as some say, because Cronus allegorically means cold, and the Dead because of the remoteness of the sun and its greater proximity to southern countries ” [10.p.552]. On the one hand this sea is cold, but on the other it is located in the south. Antique authors, in particular, Dionisy Perieget in his work “Description

of the Populated Land” (translated by I. II. Tsvetkov, comments by L.A. Yelnitsky), characterize the mountains of the Caucasus, where it denotes, in fact, the “Arctic” zone of Ciscaucasia and the Caucasus and the same characteristics of the description of the flora: "652-710. The peoples beyond Tanais (Don - approx. Aut.) And in the Caucasus ... leave their land free of cold winds, which, raging with terrible gusts, shake the earth and mountains covered with pine trees "[10. p.536]. Judging by the data of Pitey and ancient authors, he ended up in the Northern Caspian.

In the works of ancient authors another designation appears - the North Sea. "The North Sea is called the Gulf of Kronia" [10. p.552]. German considered the source of the message of Herodotus and Strabo the writings of Hekatey, moreover, he restored the message of Hekatey as follows: "the arms of Araks flow into the North Sea, and one sleeve into the Caspian Sea", see Herrmann. *Alte Geographie ...* S. 36-38 " [Pyankov p. 480]. Consequently, the North Sea is located north of the Hyrcanic Sea of ancient sources (basin of the South Caspian - approx. Author). This is evidenced by the confluence of the Volga (Ra, Eridan - approx. Author) into the North Sea.

"I don't believe in the existence of the river called Eridan among the barbarians, which flows into the North Sea (from there, according to the stories, amber is brought)", Herodotus honestly admits [9, III, 115]. If the North Sea covered the North Caspian, then Eridanus is the Volga (Ra is the name of the Volga on ancient maps, and Dan or Don called the river. Perhaps Radan, or Eridan - approx. Author). The first in ancient geography, Ptolemy (VII, 5, 4), on the map of Sarmatia, showed the river Ra (Volga), which flows into the Caspian Sea. "However, Meotida (the Sea of Azov) was still depicted too large and going far to the north with its shores" [4. p.125]. Consequently, Pitey from the Atlantic reached the Northern Caspian on his ship, where amber was located on the islands.

"85. According to some scholars, "Men Tunum" means "sea passage" in Old Norse. In this case, we could only talk about the straits between the Baltic and North Seas. However, Pliny mentions Mentonomon in connection with the journey of Pifey - the sea (not a strait!). This name does not lend itself to exact translation. Most agree that this word is more correct to read "Metuonis", it can be translated from Latin as "Sea of Fear" [9]. If we take into account that the Baltic Sea and the Caspian Sea connected the water area like a belt ("sea passage"), then the North Caspian with the flowing Volga fits the description of Metuonis.

"The German Guyon tribe (the Caspian region, the Caucasus region - one of the proto-Arians' habitats - author's note) lives on the shallows of the sea (the landscape corresponds to the North Caspian), called Metuonis ... Hence, one day sailing to the island of Abalus. Amber waves spring to this island in spring"[22].

Pseudo-Scymnus and Apollonius specify - an island near the mouth of Eridan (Volga) [16]. We assumed that Eridanus, which flows into the North Sea, is the Volga, which flows into the Caspian. Above, we examined the connection of the Caspian Sea with the North and Crony Sea. At least two questions arise:

- What kind of island is one day sailing from the mouth of the Eridan - Volga (and where was this mouth)?
- Where does amber come from on an island in the Caspian Sea? “The name of the North Ocean as the Kronian or the Dead is associated with ideas about the Blessed Islands within it, where Kronos reigned” [Scholia to the “Description of the Land” by Dionysius. 10. p. 1008]. Here are the origins of the name of the island - Tsar's Island. “One hundred and fourteenth day of travel. A-baalo. Tsar's island. From now on, I will call it Basil, so as not to cause trouble by the loud utterance of the magic Phoenician words. Rowers, like crazy, rush along the shaded pine trees, picking up full baskets of amber ”[9].

Information in ancient sources about the presence of amber in the Caspian Sea? Dionysius Perieget gives information about the Ciscaucasia and the Caspian: “At their mouths. Riphean mountains, Scythia. The Arctic Sea, i.e., the Cronian Ocean, the so-called Dead Sea. Amber will be born not only in Eridan, but also in Scythia, different from Celtic: the first is called, that is, having a pleasant shine. The poet says: “they collect a tear of golden amber” [10.p.316].

The connection of the Caucasus Mountains and the Ocean is discussed above. In the commentary on “Dionysius’s Landmarking, he noted:“ Now we need to understand the Caucasus as the northernmost part of the aforementioned Taurus, reaching the Kronian Sea; part of it is also the Riphean mountains described above ” [10.p.938]. Therefore, the Riphean mountains are also part of the Caucasus. The Northern, Cronian Ocean corresponds to the zone of the Northern Caspian, as according to the ancient authors “The Caucasus - at the end of the Ocean” [10.p.46], the Caucasus is the end of Oikumena, located near the ocean it is the basin of the Middle and Northern Caspian [19 p.65-69]. Here is how the Caucasus is described in the ancient scholars of Prometheus: “For the Caucasus is the end of the inhabited land. He came to the final part of the earth, for the Caucasus is the end of inhabited land ... (Pitey claimed that he had reached "the limits of the world") [18. p.104]. The Caspian Sea, in the works of ancient authors, appears before us mysterious and full of wealth “723. The Caspian Sea presents many other miracles to people, and it produces crystal stones and jasper  $\eta\epsilon\rho\acute{o}\epsilon\sigma\sigma\alpha\nu$ , that is, similar in color to fog, dark, terrible for empus and other ghosts. This stone, apparently, is considered to protect from troubles and averting

visions, which include Empus, one of the lower divine in from the retinue of Hecate ” [10.p.550].

In an essay to Diodorus, Bishop of Tire, about 12 stones that were on Aaron’s robes, amazing crystals of the Caspian Sea are described: “IV, 186 Dind .... Another variety that looks like ice, invented by fabulous legends as a cure for ghosts. It was discovered by Iberians (eastern Georgia - approx. Auth.) And shepherds of the Girkans (southwestern part of the Caspian - approx. Auth.), Who live near the Caspian land and lake. There is another jasper, called opal, similar to snow or sea foam, or if you mix blood with milk, as massagets usually drink ... ” [10. p.753].

Consequently, the Caspian Sea is rich in crystals. Most likely, amber was brought into the Caspian by the streams of the Eridan (Volga) River, connected with the water basin of the Baltic Sea, through the Don and the Sea of Azov. Amber has been stuck for thousands of years on the island, opposite the mouth of the Volga, in the days of sailing from the mouth of Eridan.

Dionysius Perieget notes in one geographical region: the island of Erithia, pastures of the bulls of Gerion, the Caucasus, Iberians on the islands of Gisperides, where tin is mined. "And behind the Sacred Cape, which is called the" peak "of Europe (the Caucasus - approx. Auth.), The rich descendants of the glorious Iberians (eastern Georgia - approx. Auth.) Inhabit the Hesperides - the place of extraction of tin" [7].

Is it not on these islands and not on this tin that Pitey rode? “I am cooling Venitaf’s commercial fervor because I want to bring amber and tin if I can’t find a way to Tanais (Don is the north-east of Oikumena and not the west in the Atlantic Ocean. Pitey was constantly sailing east of Britain)” [9].

The linking of the Phoenician “A-baalo” with the Greek “Basilia” (“Tsar's Island”) has echoes in the name of the Cronian Sea in honor of the father of Zeus Kron, who he made king on the Divine Islands. At the same time, there is a possibility that: “A-baalo” (in the name of Pitey Abalus) came from the Celtic word “avalla”, which means “apple”. In this regard, one can recall the English legend of King Arthur buried on the magical island of Avalun, or Avalon. And then there is no doubt that A-baalo, Abalus, Avalun - all this means the same "Apple Island". So in ancient times they called the Blessed Islands, where the golden apples of the Hesperides grew ”[9]. Prometheus, with the permission of Zeus, receives liberation from Hercules, who found himself in the mountains of the Caucasus on the way to his eleventh feat - the extraction of golden apples in the Hesperides garden. Hercules came to one of the islands of the Caspian Sea, where Kron was king, for gold apples. Pitey sailed for amber and tin here, by a circuit along the River - Ocean.

Elnitsy L.A., noted that in Gigin (Fab., 274) and Cassiodorus (Cassiod., III, 31) the discovery of tin (lead) is attributed to the semi-mythical Phrygian king

Midas: “Pliny's message can be interpreted in the sense that the voyages Asia Minor to the west behind the tin dates back to the era of Phrygian power. However, this legend could have in mind not Western, but some northeastern sources of this metal, which in the VIII-VII centuries. BC e. Phrygians traded” [6. p. 43-50 Greek colonization and Greco-Phoenician oceanic voyages]. The “northeastern sources” of tin were in the Caspian Sea. The Phoenicians knew the way through the Black Sea (Pontus) - the Sea of Azov (Meotidou) - Don (Tanais) - Volga (Eridan) - to the Caspian Sea (North, Kroni, Dead Sea) but kept in the strictest confidence. Among the Phoenicians, this sea even had its own name - Ashkenas - Northern” (Chapter 2. The mysterious route of Pitey) [17]. Therefore, the archons asked such questions to Pete when he tried to “talk about Tanais, about Scythian lakes, about the Caspian Sea: “What glory Massalia would have expected if amber could be transported through Pontus!” Have you really collected it right on the beach? “Is there any way to go around Oikumena from sunrise?” [9].

They could not forgive him that he did not find the way back through Pont, because by the fourth century. BC. the connection between the Volga and the Don was interrupted. A fragment of Strabo confirms our assumption that Pitey came from the Atlantic Sea to the Caspian Sea and intended to return through Pontus. “He does not understand that I hope to return to Massalia according to Tanais, and does not know how to read the map” [9]. Judging by the fleeting remark of Polybius that Pythaeus “adds that on his return from those places he visited the entire coastline of Europe from Gadir to Tanais” (18. p. 104). The phrase "upon returning from those places" indicates that on his return from the Caspian (Gadira - the kingdom of Hades in the Caspian region - approx. Author), he passed from Gadir to Tanais. This is the return journey, not the beginning of the journey. Therefore, historians have a question: And what did the Greeks need in Hades - the city of the Carthaginians? After all, these are enemies, rivals. Hence the assumption that he was captured. But, these fragments convince that he returned from the Caspian to Tanais, however, he did not find a passage from the Volga to the Don. Further, he could swim to Massalia the same way (the Carthaginians passed ships sailing into the Mediterranean Sea, and not from it).

Upon his return to Massalia, the navigator and scientist Pitey in his works: “On the Ocean” and “Description of the Earth”, brought to the descendants the observations obtained, valuable scientific astronomical information. Ethnographic messages regarding the lifestyle of the tribes of northern Europe confirm the research honesty of Pitey. Observations of Pitey, supported by the philosopher and geographer Dykearch, as well as the historian Timaeus [16], are preserved in ancient sources. An analysis of ancient sources with the involvement of mythological tradition, and taking into account the changing hydrological situation of the Baltic and Caspian seas, allowed us to trace the way of the

navigator, scientist Pitey from the Mediterranean to the Caspian along the coast of northern Europe. Pitey's voyage is a weighty argument confirming the ancient Greek theory of a continuous body of water in the north of Europe and Asia, connecting the Atlantic Ocean in the west with the Indian or Eastern (Eoia) ocean in the east.

### References

1. Antique geography. prof. M.S. Bodnarsky. State publishing house of geographical literature. Moscow - 1953.
2. Adam of Bremen Acts of the Archbishops of the Hamburg Church. Book IV Description of the Northern Islands. Eastern literature.
3. Herodotus. Per. Mishchenko F.S. Edition by A. G. Kuznetsov. Printing house of E. G. Potapov Moscow. 1888 <http://simposium.ru/ru/node/12981>
4. Ditmar A.B. Frontiers are ecumenical. The evolution of the ideas of ancient scientists about inhabited land and natural latitudinal zonality. M. Publishing House. Think. 1973.
5. Dionysius Perieget. Description Oykumeny. Per. Ilyushechkina E.V. Bulletin of Ancient History, No. 4/2005, No. 1, 2/2006
6. Elnitsky L.A. The knowledge of the ancients about the northern countries. M.; 1961.
7. Ilyushechkina E.V. The rhetorical topos about the "Scythian" north in Solin's compilation. Eastern Europe in antiquity and the Middle Ages. The Russian Academy of Sciences. Institute of General History, Moscow, April 17-20, 2018. Conference proceedings P.125 (013.p. 22-23).
8. Kondratov A.M. Atlantis Sea Tethys 1986
9. Lalleman Ferdinan Pifey from Massalia Book: Pifey - e-Reading [https://www.e-reading.club >downloadhtml](https://www.e-reading.club/downloadhtml)
10. Latyshev V.V. News of ancient Greek and Latin writers about Scythia and the Caucasus // Bulletin of Ancient History. - 1947. - Nos. 1-4; 1948. - Nos. 1-4; 1949. - Nos. 1-4. Source: [http://apsnyteka.narod2.ru/l/izvestiya\\_drevnih\\_pisatelei\\_o\\_skifii\\_i\\_kavkaze/index.html](http://apsnyteka.narod2.ru/l/izvestiya_drevnih_pisatelei_o_skifii_i_kavkaze/index.html)
11. Guy Pliny Secundus (Senior) Natural History. <http://ancientrome.ru/antlitr/plinius-secundus/index.htm>
12. Plutarch. Comparative biographies: In 3t. Ed. prepared by M.E. Grabar-Pasek and S.P. Markish-M. : Publishing House of the USSR Academy of Sciences, 1963.
13. The Tale of Bygone Years. Part 1, Per. D.S. <http://www.spsl.nsc.ru/history/descr/PWL/povest1.htm>
14. Pomponius Mela. On the position of the earth. Ancient geography. M., 1953.
15. Pyankov I. Century. Central Asia in the ancient geographical tradition M. 1997
16. Sklyarenko V. M. "Famous travelers. <https://www.litmir.me/br/?b=252139&p=2>
17. Snisarenko A. ... [geoman.ru >books> item1982](http://geoman.ru/books/item1982)



18. Strabo. Geography in 17 books of M.; Publishing House of Science. 1964: 1994 per. G.A. Stratanovsky under the general ed. prof. S.L. Utchenko.
19. Khalilova T.Sh. Representations of the Riphean mountains in ancient Greek and Indopersian literature. Bulletin M.A. Russian section. 2020.1.
20. Richard Hennig. Unknown lands. T. I-IV. M.: 1961 [kronk.spb.ru ›library› hennig-r](http://kronk.spb.ru/library/hennig-r)
21. Cherednichenko A.G. Indo-European Problem and Aegeid. Actual Problems of General History., Series History. Political science. Economy. Computer science. Scientific Bulletins 5 2011. No. 7 (102). Issue 18.
22. 100 Great Adventures - [fisechko.ru](http://fisechko.ru) - [fisechko.ru](http://fisechko.ru) knowledge base ›pricluh
23. Tula - [Wikipedia en.wikipedia.org ›wiki›](http://en.wikipedia.org/wiki/Tula)
24. Central Russian Upland. <https://www.google.com/search?q=>
25. <https://touristam.com/vostochno-evropeyskaya-ravnina.html>
26. [http://www.vostlit.info/Texts/rus/adam\\_br/frameadam\\_buch4.htm](http://www.vostlit.info/Texts/rus/adam_br/frameadam_buch4.htm)
27. <http://simposium.ru/en/node/9840> Diodorus of Sicily History Library

## CONCEPTS OF THE BORDER OF EUROPE AND ASIA IN ANTIQUE

**T.Sh. Khalilova**

*International Academy of Science AS H&E, Baku Azerbaijan  
t.khalilova2015@gmail.com*

Consider how ideas about the border between Europe and Asia changed in the antique period? What did the geographical concepts include: Meotida, the mouths and sources of Tanais, noted in the works of ancient authors? The geographic realities of ancient sources reflect the hydrographic changes during this period and mythical times, which allows them to be linked into a single canvas with historical events. What could serve as the border between Europe and Asia in the ancient period?

According to ancient Ionian ideas (XI-VII centuries BC), the inhabited land ("oikumene") was divided into two halves: the "country of the day" and the "country of night". They included understanding: first, East and South; the second is West and North. [2, p. 9]. By the 6th century BC. e., in connection with the development of trade and navigation, there is an increase in geographical knowledge. Navigators and merchants, embraced by both knowledge and the pursuit of profit, made up descriptions of the sea coasts (so-called "periplus") and individual countries ("periegeses"). Hecateus of Miletsky on the map (without a grid of coordinates) and in his work "Detouring the Earth" for the first time divided the oecumene into two parts of the world - Europe and Asia. He considered the Phasis (Phasis) river to be the border of Europe and Asia [11 p.36]. Aeschylus in the poem "Chained Prometheus" designated Phasis, the Cimmerian Isthmus and the Strait of Meotida as the border of Asia and Europe:

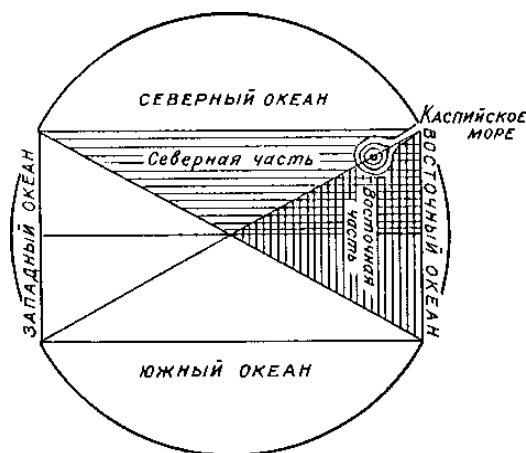
You will come later to Isthm Cimmerian,  
730 To the gates of the cramped sea. There, daring  
You must swim across the strait of Meotida.  
And the glorious memory in people will remain About this crossing.  
There will be a name for her - "Cow ford" - Bosphorus.

**You will throw the Plains of Europe, you will come to the Asian continent [36., p.256].** Later, the border was the mouth of the Tanais River. Probably, at some period, both versions took place, as Herodotus says about it (5., IV, 45). He proposed dividing the land into two parts - "to the north and south of natural reservoirs in the form of the seas: Mediterranean, Propontida (Marmara), Pontus (Black) and Caspian (IV, 39)" [11, p. 35]. Aristotle separates Europe from Asia by the river Tanais in his work "On the Universe": "261 ... Some believe that the limit of Asia is the space from Tanais to the mouth of the

Nile" [18.,175]. The historian Polybius (200-120 BC) takes the Tanais River across the border between Europe and Asia (26, book III, 38, 59; IV, 39). According to Strabo (65 BC - 21 AD), the land, consisting at that time of three parts of the world: Asia, Europe and Libya, was divided by borders between them along the rivers Tanais and Nile [31., book. II, ch. 5, p. 26; ch. 5, p. 28; book XI, ch. 7, p. 4, etc.]. Roman geographer of the 1st century A.D. e. Pomponius Mela, the author of the first geographical work in Latin "On the Position of the Earth", in a number of places in his work says that the border between Europe and Asia runs along the Meotida and the Tanais River. [2., p. 179, 181, 190]. The Roman encyclopedic scientist Pliny the Elder in his "Natural History" asserted that the border of Asia and Europe is the isthmus between Pontus and the Caspian Sea, the Cimmerian Bosphorus and Meotida [2, p. 246, 259, 260]". (20) [So,] on the edge of the Asian land stretches a high isthmus between the Caspian and Euxian seas (Caucasus): it was then that they began to consider it the border between Europe and Asia" [10]. Claudius Ptolemy (70-147) took the Tanais river, or rather, the meridian passing through the mouth of the river, abroad [2., p. 319]. Agatemer, son of Orton, who lived in the 3rd or 4th century. n. e., left a "Short Description of the Land", where he summarized knowledge about the border of the continents of Asia and Europe: according to the ancients, the Phasis river and the isthmus up to the Caspian Sea, and later - the Meotian lake and the Tanais river" [18., p.720].

Consider: How did the basins of Meotida, Phasis and Tanais rivers change? And also: What was taken for Meotida, Phasis, Tanais?

On the ancient Ionian map, Meotida (the Sea of Azov) was represented as an open basin connecting to the outer ocean. [14., p.53]. Researchers noted that at the beginning of the 1st millennium BC. Meotida, having a direct outlet to the ocean, "... was still depicted as too large (slightly smaller than Pontus) and extending far to the north with its shores" [12., p.125] As Herodotus called her, she was "the mother of Pontus" [18., p.538]. the nurse of Pontus: "116. from μάϊα nurse"[18., p..541]. What was the orohydrographic situation in this region? How has it changed over the millennia? At the beginning of the 1st millennium BC. Meotida (Sea of Azov) did not have clear shores and was connected to the Northern Ocean, and Tanais (Don) was not indicated on the map. At the same time, the Caspian Sea was considered to be located at the junction of the Arctic (Arctic) Ocean and the Eastern (Eois) Ocean and was connected with them by a strait (Honorius scheme, Fig. 1).



**Fig.1. Scheme of the "earthly circle" Honorius 1 [29., p.290]**

Modern researchers agree that ancient sources mention the connection between the Black and Caspian Seas through the modern Azov Sea, Don and Volga. [17, p. 46]. In the 1st millennium BC. these views are reflected in stories: about Io's journey in Aeschylus's poem "Chained Prometheus"; about the journey of the Argonauts; the adventures of Odysseus in Homer's poem; in the description of the route of Pitea (Pythea) to the tin and amber islands, to the mouth of the Tanais river, in the middle of the 4th century BC. e.

Geographical landmarks of the north-west of ancient Europe: the Caucasus, Meotids, we can see in the poem of Aeschylus "Chained Prometheus". Where Prometheus describes the route of the fugitive Io:

From here you are confused by sunrise  
Steer your step on unpaved virgin soil  
And you will come to the nomadic Scythians ...  
They live on the left hand of these places  
Khaliba's iron Fear them!  
They are fierce and unfriendly to guests.  
You will come to the river to Gromotukha ...  
Caucasus

720 You will see a terrible mountain. From her horns  
Snowy stream gushes. Jump the ridges,  
Neighboring the stars, and by noon a step  
We must go down. To the Amazons, the army,

Hostile to men, you will come [36., p.256].

From Elbrus (where he was chained between two peaks) - to the east, past the Khalibs (Vainakh tribes); without approaching the Scythians to climb to the tops of the mountains along the course of the "mad" river (Terek) to the stars and through the Darial Gorge to descend from the mountains to the south to the Amazons). According to Quintus Curtius Rufus: "24. As mentioned above, a tribe of Amazons bordered on Hyrcania ... They had a queen Talestris, who ruled all those living between the Caucasus and the Phasis River (ie, in Transcaucasia, where Prometheus pointed the way - author's note)" [15., book. VI, ch. 5, 24,25].

Plutarch in "Comparative Biographies" (Pompey XXXV., Ch. 35. 638) noted: "The Amazons live in that part of the Caucasus that extends to the Hyrcanian Sea." All fragments of Pliny's work "Natural History" mark the dwelling of the Amazons near two seas: "The Tribe of the Amazons; the latter lives up to the Caspian and Hyrcanian seas" (VI. XIV., 35). Consequently, the Amazons will show Io the way to the sea. But to which sea? To the Caspian or Hyrcanian Sea? Rather, the road between these two seas because Prometheus directed Io to the isthmus:

the way there will show in a friendly way.  
You will go to the Cimmerian isthmus,  
To the narrow gates of the sea, fearlessly  
Cross the gorge of the Meotian waters, [35].

To the sea with a close entrance. Prometheus gives a clear direction: to the east, leave the Khalibs on the left and, through the pass, to the south to the Amazons: "whose regions stretch as far as the Caspian Sea."

And the glorious memory in people will remain  
About this crossing. There will be a name for her -  
"Cow ford" - Bosphorus. You will throw Europe  
Plains, you will come to the Asian continent. [36., p. 257].

At first glance, everything is very clear: Meotida - the Sea of Azov and the Kerch Strait. The Encyclopedic Dictionary of Brockhaus and Euphron says: "The Greeks called the Cimmerian Bosphorus the strait that connected the Meotian Sea (Azov, palus Maeotis) with the Pontus, ie the Black Sea; now the Kerch Strait. Like Tanais (Don), K. Bosphorus served as the border between Europe and Asia and got its name from the Cimmerians. Strabo praises the beautiful harbors along the shores of the Kerch Strait" [16]. However, the Sea of Azov is to the north of the Greater Caucasus, and Prometheus directed it east, then cross the mountain pass to the south. Then what "Meotida swim across the strait" must

Io to get to Asia? Aeschylus, at first glance, created many mysteries in outlining the path of Io. Why would Io go from the Caucasus to the Sea of Azov, to the Cimmerian Bosphorus, and then cross the sea, heading east to be near the Nile, which is in Egypt? Geographical absurdity. Consider a number of facts: « The Kerch Strait received the name Bosphorus Cimmerian not from Io (in the form of a cow), but from Hercules, who swam across the strait on a bull with Geryon's cows much earlier. "Bosporus ("cow crossing"), so called so not because of Io's crossing here in the form of a cow, but in memory of Hercules' stay in Scythia with his cows" [24, p.129]. This means that she did not swim across the modern Kerch Strait. In addition, the phrase: "You will come later to the Isthm Cimmerian, To the narrow gates of the sea" or "To the narrow gates of the sea", does not correspond to the description of the Kerch Strait by ancient authors with beautiful harbors. There is no gorge and no narrow gates (fig. 2).



**Fig. 2. Crimean bridge across the Kerch Strait <https://www.google.com/search?q>  
The mouth of the Don cannot be crossed from west to east, only from north to south;**



**Fig. 3.** <http://world-river.ru/index/don/0-32>

3. Io did not go north, Prometheus directed her east from himself, then through the pass to the south and, further from the Amazons, to the east - to the sea. And only after its passage this crossing will be given the name Bosphorus. Therefore, this is a different Bosphorus, not the Kerch Strait.

Where did Io cross from Europe to Asia?

Io approached the western part of the Caspian Sea, in accordance with our route. The question arises: Having approached the western coast of the Caspian Sea, which strait should Io cross in order to be in Asia?

A fragment of Gaius Julius Solin (30., 4.16, 2) that: "between the one and the other continent lies a wide sea" cannot correspond to Tanais (Don). There is no "wide sea" between continents. In mythical times, this was the strait from the Middle to the South Caspian along the ancient channel of the paleo-Volga. The "wide sea" between the continents corresponds to the Hyrcanian Sea (South Caspian).

To the east of the Caucasus was the Absheron sill, separating the basins of the South and Middle Caspian. The strait ("Pluto Stream" - the ancient channel of the paleo-Volga) passed through the Absheron threshold (Cimmerian Isthmus, Acherusiyskaya steep), stretching to Turkmenistan. Then, it is quite logical that Prometheus could call this entire water basin, which included the Sea of Azov, the Don, Volga and Middle Caspian rivers - Meotian waters. The understanding

of Meotida as the Sea of Azov began to emerge by the end of the first millennium BC, when the connection between the Don and the Volga was severed.

You will go to the Cimmerian isthmus,  
To the narrow gates of the sea, fearlessly  
Cross the gorge of the Meotian waters, [35].

The phrase "To the narrow gates of the sea" corresponds to the passage of the strait from the Middle Caspian through the rocks of the Absheron threshold (gorge) into the sea (Hyrcanian Sea - South Caspian). "You will throw the Plains of Europe, you will come to the Asian continent." The Sea of Azov does not fit this description. According to Pliny: "In the middle of its bend, it joins the Maeotian lake. This strait, 2,500 paces wide, is called the Cimmerian Bosphorus" [2, p. 246]. The width of the strait was known to ancient authors and they did not call it a gorge. Aeschylus, through the mouth of Prometheus, called the modern Absheron threshold - the Cimmerian isthmus. The Absheron sill, like an isthmus, separated the Middle Caspian from the South Caspian. Ancient authors emphasized the habitation of the Cimmerians around the Ocean [18., p.48]. In the content of the eleventh cant (evening of the thirty-third day), in the poem of Homer, Odysseus tells his adventures: "The north wind brings the ship (the route of the route is north-south) to the shores of the Cimmerians, where the ocean stream is plunged into the sea" [8]. The Caspian Sea was considered to be connected by the strait with the ocean (the ancient channel of the Paleo-Volga - author's note). This situation developed in the Caspian Sea, where the North Caspian, merging with the Ocean, which flowed through the Middle Caspian (Caspian Sea - author's note) and the Absheron sill, flowed into the Hyrcanian Sea - the South Caspian basin "The ocean is plunged into the sea". This is the territory of nomadic tribes - Cimmerians. Therefore, Prometheus calls the strait across the Absheron threshold (east of the modern island Zhiloy - ed.) Cimmerian Bosphorus. In honor of the passage of his Io in the form of a cow and the presence of the Cimmerians there, in contrast to the Bosphorus of the Cimmerian (Kerch Strait) named after Hercules. "Pluto's stream", because the Caspian is on the border of the inhabited world, beyond which is the kingdom of Hades, Pluto. Thus, we were able to trace the path of Io from Elbrus in the Caucasus to the strait across the Absheron threshold.

I will reveal to you, Io, the wandering path,  
Write it down on the tablets of bitter memory  
Having passed the stream that cut the continents,  
Turn to the sunny, scorching east!  
Surf pass the seething seas! Sultry



Fields of Kisfena you will meet the Gorgonins,  
And three Forkids, gray-haired girls,  
Like swans. They have one eye  
And one tooth. The ray has not penetrated them yet  
Day sun and night month.  
And in the neighborhood there are three winged sisters  
They live. Gorgons, in their braids - snakes, in the heart - poison.  
Whoever looks into their eyes will cool down life!  
I'm telling you to warn you.  
Listen to the sad path of wandering!  
Fear the sharp-clawed vultures, Zeus  
Silent dogs! One-eyed troops  
Beware of the Arimasp horsemen,  
Have a golden-flowing nomad  
Pluto's Stream! At the end of the earth  
You will find a black people living  
At the sunny springs, where the Ethiopian river is.  
Guide your steps along the shore! From the Byblos Mountains p. 259  
There the Nile crashes down with waterfalls  
A fruiting and sweet wave.  
He will show the way to the triangular earth,  
To Ust-Nilya. There is a distant settlement  
You and the children, Io, lay yours. [36., p.260].

According to the author's version, Io crossed the strait ("You must cross the strait of Meotids", the ancient channel of the Paleo-Volga) through the Absheron threshold and ended up on the Asian continent - to the east of the sea. In addition, neither the Don nor the Kerch Strait with their calm movement (the characteristic of the Don fits - quiet) was never called a stream by the ancient authors. The epithet "noisy sea" does not correspond to the calm Sea of Azov, but it is quite typical for the stormy Caspian. Those. to be on the eastern coast of the Caspian Sea ( it was possible along the land Apsheron threshold ).

Having passed the stream that cut the continents,  
Turn to the sunny, scorching east!  
Surf pass the seething seas! Sultry  
Fields of Kisfena you will meet the Gorgonins,

To the east of the modern Don there could not have been "sultry fields of Kifseni", but to the east of the Caspian are the modern fields of sultry Turkmenistan. Therefore, to swim across the Meotian waters through the

Cimmerian Bosphorus means the direction - through the strait between the Middle and South Caspian, to the east, along the Apsheron threshold. And the concept of Meotian waters includes the basins of the modern Azov Sea, the Don, Volga and Middle Caspian rivers. The medieval map (Fig. 4) schematically depicts a single water basin of the Azov Sea, Don, Volga and Caspian Sea, which has access to both the Northern Ocean and the South.

Companions of Alexander, in particular Polyclitus of Larissa, a historian who wrote at the turn of the 4th - 3rd centuries BC. e., believed that Meotida (Sea of Azov) through a very narrow isthmus merges with the Caspian Sea "[29, p.36]. Polyclitus even gives evidence that this sea is a lake - [in it] there are snakes and the water is fresh, and that it does not [represent] another, separate from Meotida [the lake, deduces] from the fact that Tanais flows into it (31., XI, 7, 4) [18., p. 188]. His views on this issue were stated by Diodorus of Siculus (XVII, 75, 3) and Quintus Curtius Rufus (VI, 4, 18, 19) " eighteen.

In the Caspian Sea (Middle Caspian), the water is less salty than in other seas, and there are snakes of great length, and the fish differ in the color of their scales. Some call this sea the Caspian, others - the Hyrcanian, there are those who believe that the Meotian swamp flows into it and that the water in this sea is not as salty as in others, because it is softened by the water pouring into it from the swamps " [15., Book VI, Chapter IV, 18]. Expressing the opinion of his contemporaries, Aristobulus (IV-III centuries BC) said that Tanais begins in the Caucasus and flows into the Caspian Sea (Middle Caspian - ed.), Which is part of Meotida (fr. 25, fr. 54 ) [29., p.47].

Consequently, during this period of antiquity, the water basins of the Sea of Azov, Volga, Don and Middle Caspian Sea had already separated from a single system of "Meotian waters", but were interconnected.

According to the fragment of Hecateus Abder "On Hyperboreans", the "Parapanis River (fr. 14)" acts as "the eastern border of the Northern Ocean" [23, p. 117]. The Hyrcanian Sea was located at the junction of the North and East Oceans. In the first millennium BC. The "eastern border of the Northern Ocean" was the strait connecting the Hyrcanian Sea with the ocean, i.e. bed of the paleo-Volga. Consequently, the strait from the ocean to the Caspian at Hecateus Abder could be called the Parapanis River (to the west of it - the Northern Ocean). "The Northern Ocean, going west from the Parapanis River, " where it flows through Scythia, "Hecateus calls the Amalchian, or "Frozen "[23., p.117].



**Fig. 4. Première révolution de la Mer Caspienne. - Uppsala University Library. <https://mispronzaya.livejournal.com/389481.html>**

The hero of the work of Hecateus goes to the country of the Hyperboreans, and sails there, through the Cimmerian Bosphorus (fr. 8), namely, through the city of Cimmerida, located on this strait. Further, his path (already semi-fantastic) lay, probably, through the Sea of Azov and the lower reaches of the Tanais (Don), and then through the Kumo-Manych depression into the Caspian Sea (fr. 13) [ibid.].

These ideas could have formed only under a different scheme of the Caspian Sea basin. The Volga River merged with the Don and, called Tanais, flowed along the paleo-Volga into the Hyrkan Sea (the South Caspian basin). Taking into account the data of paleohydrography, S.N. came to the conclusion that: "in the VI century. BC e. (maybe even earlier) the Caspian Sea had a very low level (-58 m abs. plus or minus 10 m), at which the operation of the Azov - Caspian waterway through the Lower Don - Manychi - Lower Kuma is possible" [20. p. 137].

The fact of the periodicity of flooding of the Manych lowland in the north of the Caspian Sea was based on: "on real data on the Manych lowland, sometimes flooded with spring waters, which could give the impression of the

confluence of the Caspian and Meotida - a fact that should hardly be assumed by the known geographers of the era of Alexander the Great" [14., p.105].

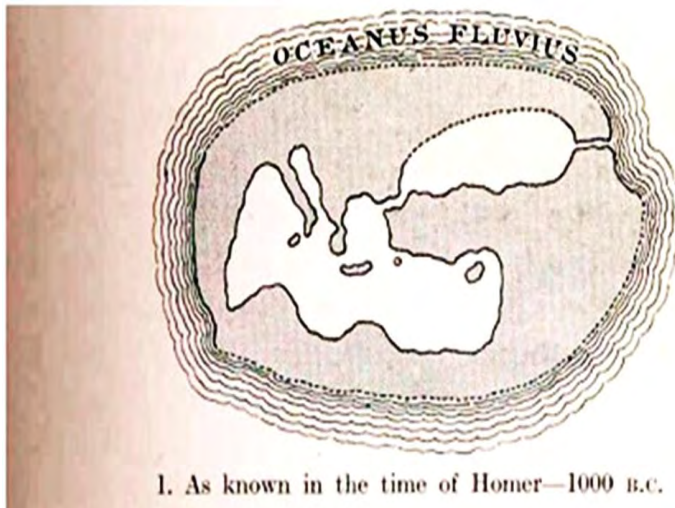
The change in the coastline was recorded much later by Pliny. "[The lands], lying opposite the Sarmatians, sometimes seem to be islands, and sometimes a single continent, because due to the change of the ebb and flow of the sea, the gaps between them are sometimes filled with water, sometimes exposed." [22., book III.6.55.]. And further: (book. VI, ch. 5, § 17) "Mithridates fled to them, during the reign of Emperor Claudius, and told that Thallians lived in their neighborhood, whose region in the east reaches the mouth of the Caspian Sea, and, that the mouth dries up during the low tide" [2., p.260]. The connection between the water basins of the Don and Volga rivers in the first millennium BC is interrupted.

The change in the water boundaries of Meotida over the millennia, from the basin open to the Northern Ocean, then connected with the Caspian through the Volga and Don and, finally, taking shape in the form of the modern Sea of Azov, was reflected in the works of ancient authors.

### **Phasis - the border of Europe and Asia**

Herodotus summed up the question of the boundaries of continents with a bit of humor: "I also cannot resolve why the earth, in essence one, was given three names after the names of women (Europe, Asia, Libya - author's note), and its borders were recognized (male names - author's note) Egyptian river Nile and Colchis Phasis (others call the border of the Meotian river Tanais and the Cimmerian ferries). I can't find out the names that made the distinction, and where did they get the names ..." [5., v. I. 45; 18., p.109].

By the beginning of the 1st millennium BC. Meotida had not yet completely separated from the Northern Ocean, which means that Tanais (modern Don) also did not have its own geographical landmarks. Phasis was adopted as the border between Europe and Asia, mentioned in many legends and having a peculiarity: "The water of Phasis does not rot and remains unspoiled even for more than ten years, unless it becomes even fresher" [18., p. 564]. Aeschylus in "The Liberated Prometheus" makes the Phasis river a border: "We came, Prometheus, to look at Your calamities and at these sufferings from fetters", "Where is the double border of the European land and Asia, the great Phasis" [18., 846].



**Fig. 5. Homer's times VIII century BC e.**

**Source:** <https://www.stepandstep.ru/istoriya/drevniye-karty/>

Reflecting ideas about the Phasis River, coming from mythical times, ancient authors connected it with the Ocean (Fig. 5). The Phasis River, being a harbor since the ancient period, was also, in the future, “the starting point of the Transcaucasian trade route, going from the sea along the navigable Phasis river to the Suram pass and further to the interior regions of the Caucasus” [37].

The Likhsy (Suramsky) ridge separates the Kura and Rioni basins. In the myths about the Argonauts, examples are given of the hydrographic situation in the Transcaucasus, which is completely different from the modern one. “IV, 131-135. RIVER LIK. The hissing of the dragon was also heard by those living very far from the Titan Eya in the Colchis land at the mouth of the Lik, which, deviating from the noisy river Araks, merges its sacred waves with Phasias; both of them, joining in one river, flow into the Caucasian Sea [18., p.274].



**Fig. 6.** <https://www.google.com/search?rlz=1C1GGRV> Kura and Rioni\_ (The Rioni river is highlighted in red, the Kura river in blue)

The Black Sea was referred to by ancient authors as Pontus Euxine. The Caucasus Sea can only be the Caspian Sea. Perhaps by the beginning of the 1st millennium BC the branch of the Fasis (Rioni) and Kura rivers were connected in the area of the Suram pass, through the basins of the rivers Kvirila, Dzirula and others. The Suram ridge has a second name - Likh (Lik). Probably Kura before the 1st millennium BC. merging with Phasis in the area of the Suram, Likh (Lik) ridge, in this territory it had a name - the Lik river. According to ancient Greek mythology, "It was up to Shorapani (river Kvirila, Imereti) that Jason and his friends, the Argonauts, reached during their journey through ancient Colchis" [37]. Probably, later, along the Kura River, they sailed to the Caspian Sea, which, according to ancient authors, was an ocean bay. In the map-scheme, the time of Homer of the VIII century BC. e. (Fig. 5) reflected the hydrographic scheme of Transcaucasia at the end of the II millennium BC.

In the antique period, the mouth of the Kura was upstream. The Hyrcanian Sea (South Caspian) in the west reached Mingechevir. "... in the III century. BC e. the mouth of the Kura was somewhere near Mingechaur, that is, the sea stood at the level of - \ - 101 - \ - 20 m abs". [21., p.133]. Probably, through the system of swamps and rivers, the Kura arm, having received the waters of the Araks, could reach the basin of the Middle Caspian, which is considered to be connected with the ocean. Hence the opinion of modern scientists about the message of Hecateus about the Araxes. Herrman reconstructed the message of Hecateus as follows: "the Araks branches flow into the northern sea, and one branch into the Caspian Sea" [29, p.480]. And Junge noted: "the Araks' arms flow into the Ocean, and one arm - into the Hyrcanian Sea" [29, p.480]. Those.

separation of the river branches is recorded. Moreover, one arm flows into the Hyrcanian Sea, and the other into the one located to the north.

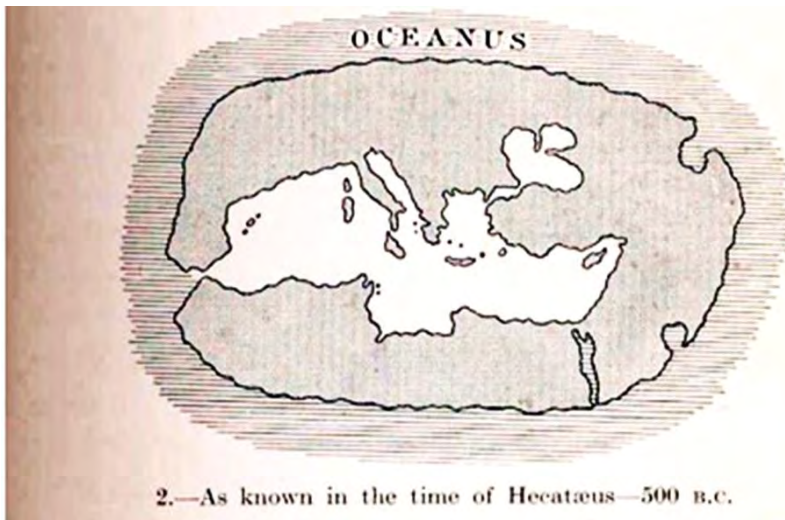
Consider a fragment of the "History" of Herodotus Book Four. Melpomene: "37. Asia is inhabited by the Persians up to the southern sea, called the Eriphrean Sea. Above the Persians to the north live the Medes, above the Medes of the Saspeira, above the Saspeira Colchians, extending to the northern sea, into which the River Fasis flows. These four peoples occupy the space from sea to sea "[5]. A sequential listing of tribes: Persians, Medes, Suspeyrs, Colchians, speaks of their residence in the territory of the Caucasus" ... the space from sea to sea", i.e. from the Caspian to the Black Sea.

- according to Apollonius of Rhodes, the Lik river, deviating from the noisy river Araks, merges with Phasis and flows into the Caucasus Sea.
- According to Herodotus, the Phasis River flows into the North Sea.

Geographical tradition of the 1st millennium BC brought the Phasis arm into the Ocean, i.e. north of the Hyrcanian Sea. The North Sea of ancient authors is the Middle Caspian basin. The Phasis branch - connecting with other rivers of Georgia - in the area of the Suram ridge it connected with the Kura, which deviates from the Araks (The Face of mythical times - ed.), - the Kura branch through a system of swamps flowed into the Middle Caspian ("Ocean", "North Sea" , "To another sea"). It is this Phasis, merging with the Kura, as a unified system of rivers of the Transcaucasus flowing into the Caspian Sea, not completely separated from the ocean, in mythical times could be the border of Asia and Europe.

### **Tanais - the border of Asia and Europe**

On the map of Hecateus of Miletus (Fig. 7.), in the northeast of the inhabited Oikumena, the outlines of the Caspian appear, entering the ocean with its borders. At the dawn of antiquity, neither Meotida nor Don separated from the basin of the world's oceans.



2.—As known in the time of Hecataeus—500 B.C.  
**Fig. 7. Map of Hecateus VI century BC e.**  
<https://www.stepandstep.ru/istoriya/drevniye-karty/>

The stable idea of ancient geography that the Tanais (Don) river serves as the border between Europe and Asia developed much later (Strabo VII. 4.5; Pomponius Mela I. 15; Pliny. III. 3; Ptolemy III. 5; Ammianus Marcellinus XXXI.2.13). Dionysius, separating Asia from Europe, calls the Scythian river Tanais the border of both these continents [18., p.944].

What was taken for the Tanais River in different periods of antiquity?

Ancient authors considered Tanais to be located in Scythia. Dionysius in the "Description of the Inhabited Earth" 652-710. He noted that: "Tanais, ... Its origins murmur in the distance in the Caucasian mountains, but it, spreading widely everywhere, quickly rushes along the Scythian plains" [18., p.537].

But, the territory of Scythia in different periods of antiquity had different borders. Ancient authors noted: "Phasis is a river in Scythia; the winds blowing on it are extremely cold" [18., p.54]. Apollonius of Rhodes in his wonderful work "The March of the Argonauts. 131. "Far from the Titan land" emphasized: "... Araks is a river in Scythia" [18., p.278]. Diodorus Siculus in the "Historical Library" (ch. XLIII. 2) described the history of the Scythians. "At first, they lived in very small numbers near the Araks River ... but even in ancient times, under the control of one warlike and distinguished by strategic tsar, they acquired a country in the mountains up to the Caucasus, and in the lowlands of the coast of the Ocean and Lake Meotian and other areas up to the Tanais River." The Scythians were located on the territory of Transcaucasia by Herodotus. "... Massagets (Scythians) live" in the east towards the sunrise across the Araks river "[3., p.73], [13]. The Araks River is a river in Scythia that flows into the



Hyrceanian Sea. Those. the ancient authors note the original habitation of the Scythians in the Transcaucasus.

Another distinctive feature of Scythia was its confinement to the Ripean mountains. According to Hippocrates, Scythia lies under the constellation of the Bear, at the foot of the Ripean Mountains, from where the north wind blows. [4 Hippocrates. About air, waters and places (26). Translated by V.V. Latyshev]. Aristotle also pointed out that the Ripaeian Mountains lie behind extreme Scythia, under the Bear itself. Above, we considered the correspondence of the Ripean Mountains and the Caucasus. Arrian calls the Scythian Caucasus the Caucasus proper, a mountain range between the Black and Caspian Seas [18., p.1037].

If Ripa is the Greater Caucasus [33], located beyond Scythia, then Scythia covered part of the Transcaucasia. The Byzantine theologian, poet, philosopher Nikifor Blemmid (1197-1272) in his "Geography" entirely based on the "Description of the Land" by Dionysius Periegetus, describes the location of Tanais in this way: "To the north-east of this river lies the isthmus of the Caspian Sea and the Euxine Pontus. On this isthmus, the eastern Iberians live, who came from Pyrrhenian, migrating from west to east. The Kamarites also live where the Caspian Sea is located" [18., p.854]. It follows that the Tanais River flows in the Transcaucasus.

The name of the river Tanais also led to the Massaget-Scythian tribe. Maxim Tirskey notes a peculiarity in the name of the river. "About Tanais, as about the deity of the Massagets (Scythians). "591. This deity, according to the Iranized mythological version transmitted by pseudo-Plutarch, was a descendant of Berossus and the Amazon Lysippa" [18, p. 1050]. The origin of the name of the river - Tanais, due to its confinement to the Scythian tribes that lived in ancient times in the Transcaucasus, suggests the primacy of this name's designation of one of the rivers of Transcaucasia. Consequently, Scythia, in the 1st millennium BC, was located on the territory of Transcaucasia. This suggests that the name Tanais was originally given not to the Don, but to the river located in the Transcaucasus.

### **About the confluence of the Araks (Araz) with Tanais**

A number of ancient authors report on the connection of Tanais and Araxes before the confluence with Meotida. A.V. Podosinov in the article "The novel about the Hyperboreans of Hecateus of Abder (Problems of interpretation) cites a fragment of the novel of Pseudo-Skimna in" Perieges of the Earth " (Fr.13):

"Next is Lake Meotian, which takes its name from the Meots. Tanais flows into it, which, having received the Araks River, mixes with it, as Hecateus of Theos says" [23, p.120].

- Aristotle in his "Meteorology" (I. 13. 16) reports that from Mount Parnassus "flow, among other things, Bactrus, Hoasp and Aras; from the latter it is separated in the form of a branch Tanais into the Meotian lake".
- Avien (Avien. 29–32) also speaks of Tanais, which, "being torn apart first by the water of the Araks", then flows into Meotida. [23., p.122];
- Basil the Great [Caesarean] Nine Conversations on Six Days III, 6 (M., XXIX, 25). Bactras, Hoasp and Araks flow from the middle east, from which Tanais separates and flows into Lake Meotian; and beyond these rivers, Phasis, flowing from the Caucasus Mountains, and countless others rush from the northern countries to the Euxine Pontus ... And why count other rivers that give rise to Ripa - the mountains located beyond the most remote part of Scythia? [18., p.757].

The Araks River is a river in Scythia that merges with Tanais. Professor Pyankov I.V. noted that the ancient authors could consider precisely the Araks, located in the Transcaucasus, whose origins are in the south-west of the Hyrcanian Sea (South Caspian): "... only this Arak was then known" [29, p.45].

The geographical situation of the Tanais River in the early antique period is described by the Byzantine theologian, poet, philosopher Nikifor Blemmid (1197-1272) in his "Geography" entirely based on the "Description of the Land" by Dionysius Periegetus. "To the north-east of this river lies the isthmus of the Caspian Sea and the Euxine Pontus. On this isthmus, the eastern Iberians live, who came from Pyrrhenian, migrating from west to east. The Kamarites also live where the Caspian Sea is located" [18., p.854]. These fragments of ancient authors confirm that the name Tanais originally belonged to a river in the Caucasus. All authors express the same ancient geographic tradition that preceded the campaign of Alexander the Great. Rips (Greater Caucasus [33] - author's note) are located beyond Scythia. The Araks and Tanais (Scythian rivers) join, and the Tanais arm flows into Meotida.

More definitely, this can be said about the idea of the Tanais River, serving in the itinerai of Ctesias (5th century BC). The internerarium of Ctesias is described in the Geographical Supplement to his work "Peach". "It described the path" from Ephesus to Bactra and India "and indicated" the number of stafmas, days, parasangs "of this path" [28, p.25]. On the one hand, Tanais is the border of Bactriana and the whole of Asia, and at the same time, according to Ctesias, "Pontic peoples" live near it. At the same time, Tanais, as usual, flows into Meotida. By the middle of the 1st millennium BC. The Middle Caspian was still one whole with the "Meotian waters".

"Consequently, Tanais at Ctesias could flow around the Hyrcanian Sea (basin of the South Caspian Sea - author's note) from the north. The idea of Ctesias about such Tanais could have influenced Eudoxus (Eudoxus of Cnidus

(c. 408 - c. 355 BC). In geography, he is known as the author of the book "Detouring the Earth" that has not come down to us) by a contemporary of Ctesias, on that orohydrographic scheme, in which Tanais, being a sleeve of Araks, flows into Meotida. It could be directly borrowed from Ctesias also by Cleitarchus, whose data were reproduced by Curtius (VII, 7, 4; 8, 30)" [29, p. 27]. In our opinion, we are talking about two water bodies - the Caspian and Hyrcanian Seas, where the Caspian Sea (the Middle Caspian basin) was represented as a part of Meotida. The message about the Araks, its arms and swamps, their inhabitants, Strabo notes in two messages. "... [Arake], flowing from the Matien, is divided into forty sleeves ..." (XI, 14, 13). "The stories of the Massagetæ are conveyed in this way: some of them live in the mountains, others on the plains, the third on the swamps that form the rivers, and the fourth on the islands in the swamps. Moreover, according to them, the country is flooded with the Araks River, which, branching into many branches, flows in the north with all its other estuaries into another sea (highlighted by the author) and with only one mouth - into the Girkan Gulf" [31, XI, 8, 6; 1., p.15]. Here again the existence of another body of water, the sea, is mentioned as separate from the Hyrcanian Sea. It is designated as - "another sea", "northern sea", "Ocean", "northeastern part of the outer sea" [29., p.480]. This is the Middle Caspian basin (part of the Meotian waters). Those. ancient authors designated the Tanais river as: mixing with the Araks; separating from the Araks in the form of a sleeve; "Araks torn apart by water." And this Tanais flows into Meotida (Middle Caspian). It is clear that it cannot be either the modern Don or the modern Azov Sea. Initially, this name was used to designate the river connecting with the Araks. Most likely, this is the Kura River, which was designated by ancient authors as Tanais at the beginning of the 1st millennium. Only much later, with the separation of Meotida from the Northern Ocean and the separation of the Don from the Volga, its name passed to the modern Don. As Elnitskiy L.A. noted: "in connection with the identification of the Caucasus and the Ripeyskie mountains and in connection with the northern localization of the latter, due to which some of the Caucasian toponymy was moved on the Ionian maps to the north and west" [14, p.85].

### **The origins of Tanais**

The origins of Tanais, according to some authors, are unknown. Others say that it flows from some kind of "... lake, as if from a source, flows into the Meotian lake and flows into it in two branches" [18., p.545]. Herodotus also says that it flows out of a large lake and flows into an even larger lake - Meotida [18., p.538]. Ancient authors searched for the sources of the Tanais River in antiquity, now in the west of Europe, now in the Caucasus. Strabo notes the opinion of

ancient authors: "... it was assumed that the sources of this river are in the Caucasus Mountains; it flows first to the north, and after the bend flows into Meotida " [31., XI.2.2] and refutes them" indicating its sources in the north (XI, 2, I sl.), in which Ptolemy follows him " [18., p.1170].

A number of ancient authors were sure that Tanais flows from the Caucasus Mountains (Ripeyskie).

- Pliny noted that "the Meotian lake, into which the Tanais river flowing from the Ripaeian mountains flows, is the last border between Europe and Asia" [2, p. 246].
- Philostorgius, a native of Cappadocian, was born about 365, wrote the "History of the Church" in 12 books, embracing the time from 300 to 425 g." [18., p. 790].

Byzantine theologian, philosopher and poet Nikifor Blemmid (1197-1272) "Geography" is entirely based on the "Description of the Land" by Dionysius Periegetus, and "... its origins come from the Caucasus Mountains, where there is the greatest cold. To the north-east of this river lies the isthmus of the Caspian Sea and the Euxine Pontus. On this isthmus, the eastern Iberians live, who came from Pyrrhenian, migrating from west to east. Kamarites also live, where the Caspian Sea is located " [18., p.854,1399].

- Dionysius in his "Description of the inhabited Earth" 652-710 noted about the Tanais river, "663. Its sources murmur in the distance in the Caucasus mountains [18., p.537]. In Scholia to the "Land Description" Dionysius concretizes "7 .... And that he descends from the Caucasus, it is said in the following words:" and its sources are in the Caucasian mountains ", which are the Ripeian mountains [18., p.944]. According to Dionysius, Tanais, flowing out from the Caucasus Mountains, flows along the Scythian plain and flows into the Meotian lake (Strabo XI. 2.2; Ammianus Marcellinus XXII. 8. 27).
- Eustathius considers the Caucasus, in which r. Tanais, the northernmost part of Taurus, reaching the Kronian Sea. Those mountains of the Greater Caucasus. According to other versions, Eustathius continues, the sources of Tanais are either unknown or originate in a certain lake, and then Tanais flows into Meotida in two branches. Modern scholars have suggested that in the commentary of Eustathius, the second mouth of the Tanais could have been the Gipanis (modern river Kuban), which, unlike other ancient evidences, is not mentioned in the text of Dionysius, but could be understood by Tanais, flowing from the Caucasus. Scientists concluded that the Ionian authors: "136 ... took the course of the Manych for the channel of the Tanais" [18., p.1347].

The Ripeian Mountains are the mountains of the Greater Caucasus [33].

Moreover, Tanais (Don) does not flow from mountains covered with eternal snows. In this case, Tanais does not belong to the modern Don. Ancient authors correlate the Tanais current with the territory of the Caucasus.

### **The mouth of the Tanais and the place where the Tanais flows into the Meotida**

The idea of the existence of the northern mouth of the Tanais River on the Scythian Ocean belongs to the mythical - geographical information of the Ionians, which found support in the IV century. BC e. the Massalioi Pitheus in his "Periplus" [18., p.1020], to whose fantastic descriptions Strabo was critical (III, 4, 4; VII, 3, 1).

The description of the confluence of the Tanais and Meotida causes discussion among ancient authors.

- Dionysius "Description of the Inhabited Earth" 652-710. Tanais, flowing into the corner of Meotida [18., p.537].
- Eustathius comments on the "Land Description of Dionysius" "652. Tanais, flowing into the middle of Meotida;" [18., p. 545,938].
- Byzantine theologian, philosopher and poet Nicephorus Blemmid (1197-1272) "650-705. Tanais, flowing into the middle of Meotida " [18., p. 1399, 854].
- Pomponius Mela Second bottling - Pontus Euxine. The junction with the swamp is the Cimmerian Bosphorus, and the swamp itself is Meotida. Tanais, heading from north to south, flows into the middle part of Meotida " [27, book. I, ch. II].
- Marcian of Heraclea Pontic Bypassing the Outer Sea Book I "4 .... The Tanais River separates Europe from Asia ... in the northern part, flowing into the Meotian lake, which flows into the Pontus, called the Euxine ..." [18., p .1284].
- Strabo "We know the mouths of Tanais (there are two of them in the northern part of Meotida, 60 stadia apart); however, above the mouth, only a small part of the river flow is known due to cold weather and scarcity.... " [31., X. II.2].

Such confusion in determining the place of confluence of Tanais presupposes, first of all:

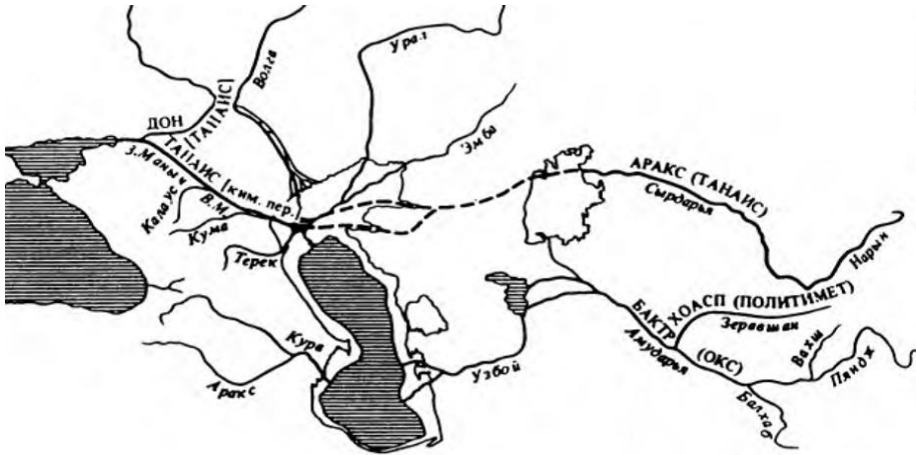
Firstly, different water basins were called Meotida at different times. Meotida (Sea of Azov), gradually separated from the general concept of "Meotian waters" with the separation of the Volga and Don rivers;

Secondly, the migration of the Scythians. The geographical scheme of the Scythian settlement was outlined by Diodorus of Sicily in the Historical Library

(Ch. XLIII. 2): "... they acquired a country for themselves in the mountains up to the Caucasus, and in the lowlands of the coast of the Ocean and Lake Meotian and other areas up to the Tanais River". All these objects are designated in one region - the Caucasus.

Strabo celebrated the presence of the Scythians in this region. Fragment (II, 1.11) describes the path from the southern coast of the Black Sea to Bactria: "Moving across the sea is actually possible from Amis (Amisus) in Colchis in the direction straight to sunrise, which is proved by the fact that everywhere along this line one can observe the same winds, seasons, gifts of the earth, sunrises. Along the same line there is a pass (Suram pass - Georgia - author's note), overlooking the Caspian Sea, and the road to Baktry, which is its continuation". At sunrise "along the same line" is the Absheron threshold (land in ancient times), leading to Bactria. Strabo mentioned the Scythians wandering in this territory: "... and then, over the Hyrcanian Sea (over the basin of the South Caspian, along the Absheron threshold) - the Scythians, Hyrcanians, Parthians, Bactras, Sogdians ..." [31., Book II, Ch. .V, 31; 18., p.361]. Those the nomadic tribes of the Scythians, included in the satrapy of Bactrian, reached Transcaucasia along the Apsheron threshold. Fragments of Pomponius Mela testify that the Scythians are noted in the Middle Caspian region and on the Apsheron threshold. "On the shores of the Caspian Gulf (the Middle Caspian basin - author's note) live the neighbors of the Scythians - the Caspians. There is a report that the Amazons live to the north of them, and even to the north - the Hyperboreans [27, book I, ch. II.]. And, the next fragment, "Beyond the Caspian Gulf lie the regions of the Khomars, Massagets, Kaduzis, Hyrkans, Iberians" [2.p.180]. The Caspian Gulf is the Middle Caspian, which means on the Apsheron threshold. Those. the territory above the Hyrcanian Sea and beyond the Caspian Gulf. Modern researchers mentioned the presence of the Scythians in Transcaucasia: "... at the end of the first millennium BC and in the first centuries of our era, the western coast of the Caspian Sea, including the Absheron Peninsula, was inhabited by the Iranian-speaking tribes of the Scythian Massagets (Maskuts), who had their own kingdom, headed by there was a ruler from the Parthian dynasty. The village of Mashkata, now Mashtaga (Absheron peninsula - author's note), was named after the Massagets " [4., p.19-20]. The characterization of Tanais as penetrating is questionable. "1288. Cutting through the lake Tanais is the river of Scythia "[18., p.256]. What river bed could have such a characteristic? Most likely, this is the bed of the paleo-Volga. According to this geographic situation, from the Sea of Azov (lake), along the combined mouth of the Volga and Don and the Kuma-Manych depression, the water stream - Tanais flowed into the "other lake" - reached the Middle Caspian. Having passed through the Middle Caspian, the water stream (cutting through the lake) through the Absheron threshold flowed into the Hyrcanian Sea. This hydrographic situation is contained in a fragment of

Herodotus about two lakes: “IV, 57. The eighth river, Tanaid, flows from above, from a large lake and flows into another lake, even larger, called Meotida and separating the royal Scythians from the Savromats. A river named Girgis flows into Tanaid ” [18., p.538]. The expansion of the settlement of the Scythian tribes led to the transfer of the name of the Tanais river to the channel of the Volga and Don.



**Fig. 5. Hydrography of the Caspian region 2nd 1/2 VI century. BC e., underlying Representations Hecateus, Herodotus, Aristotle and Alexander the Great. [20.p.135].**

For the functioning of this waterway, only one thing was required: to receive significantly more moisture than now. Which is quite real.

### **Division of the Tanais River: west to Europe and east to Asia**

A number of ancient authors noted the characteristic feature of the Tanais River, "which was recognized as flowing directly from north to south" [11., p.36]. A similar opinion was expressed, for example, by the poet Aeschylus (524-457 BC) in the tragedy "Chained Prometheus" [35, pr. 707-729].

The poet Dionysius emphasized "Description of the inhabited Earth": "652-710. to the west lies Europe, and to the east Asia" [18., p.537].

Byzantine theologian, philosopher and poet Nicephorus Blemmid (1197-1272) 650-705. separates Europe from Asia, so that Europe is to the west of it, and Asia to the east. [18., p. 1399; p.8].

Eustathius, the famous Metropolitan of Thessalonica, who lived in the second half of the 12th century, compiled the Commentaries on Dionysius' Land Descriptions, published between 1170 and 1175.

- "It is necessary, however, to know that not all the lands lying to the north of Tanais are counted among Europe, but only those that are separated to the west of it; the lands to the east of Tanais are counted as Asia" [18., p. 932].
- "652. Tanais ... cuts off Europe from Asia, to the west - Europe, and to the east - Asia. But it was said about it, how much it followed, in the previous one" [18., p. 545.938].

The description of Tanais, suggesting its flow from north to south, cannot refer to the modern Don. If we draw the meridian along the mouth of the Don, then the Don, in its bend, remains in Asia. This picture is typical for the common channel of the Volga and Don, which flows into the Caspian in the 1st millennium BC.

### **Tanais flow**

Ancient authors characterize the area through which the Tanais River flows as a forest plain located in Scythia. Dionysius in his "Description of the inhabited Earth" notes: "652-710. The peoples beyond Tanais and in the Caucasus "dwell in the boundless forest, among which Tanais rolls ... Its origins murmur in the distance in the Caucasus Mountains 73, but it, spreading widely everywhere, quickly sweeps across the Scythian plains; and when he gets very agitated under the breath of Boreas, you will see ice on him, rallied from the frost" [18., .537].

Eustathius, in his comments to the "Land Description of Dionysius", highlighted: "652. ... A huge forest, in the middle of which Tanais is rolling [18., p.545,938].

Byzantine theologian, philosopher and poet Nicephorus Blemmid (1197-1272) 650-705. Meotians and tribes of Savromats live near the Meotian lake, occupying a great and boundless area, in the middle of which Tanais rolls" [18., p. 1399, 854].

The description of the course of the Tanais River resembles ancient Ionian maps, where the Caspian is connected to the Ocean by a strait.

In the work of an unknown author, "II. On the division of the inhabited land", drawn up not earlier than the 5th century. n. e. from different sources: Eratosthenes, Strabo, Ptolemy, Marcian and others, it says: "The entire inhabited land is divided into three continents: Asia, Libya and Europe. The separation is done by isthmuses or straits. The boundaries of the continents are ... Asia from Europe is an isthmus that extends from the farthest corner of Lake Meotian to the North Sea; the Tanais river flows along this isthmus ..." [18., p. 1400].

Claudius Ptolemy also notes an isthmus in his "Geographical Guide". "6. And [Asia] connects with Europe through an isthmus between Lake Meotian and the Sarmatian Ocean (North Caspian) at the crossing of the Tanais River." [28]



According to ancient authors, between Meotida and the ocean flows Tanais (Paleo-Volga). From the north it is the North Sea, and from the east the Sarmatian Ocean, because the direction is east towards Asia. It resembles the Honorius scheme (Fig. 1), where the Caspian Sea was marked at the junction of the oceans, connected with it by a strait.

Thus, according to ancient Greek ideas, the Caspian Sea was connected to the Sea of Azov through the Volga and Don. Above, we noted that the paleographer Kovalevsky SA, in his work "The Face of the Caspian", suggested that about 3500 years ago the Caspian Sea was connected to the Sea of Azov through the Manych Strait ... And this situation existed 2500 years ago. According to S. A. Kovalevsky, "the last time this connection between the Sea of Azov and the Caspian was interrupted only in the IV century BC. e., shortly before the campaigns of Alexander the Great ". [17., p. 46]. Isidor Sevilsky, in "Etymology", relying on ancient sources, asserts about the connection between the Azov and Caspian seas. "In the east, it (Albania) rises from the bottom of the Caspian Sea and extends to the Meotid bog (possibly, the periodic flooding of the Manych depression and, as a result, the connection of the Caspian with the Sea of Azov created the appearance of a swamp - author's note), along the coast of the North Ocean, desert and untreated regions " [32]. The configuration of the Caspian Sea is amazing, changing over a short historical time.

Professor Pyankov I.V. in his work: "Central Asia in the ancient geographical tradition" drew attention to the fact that Bactrian and Sogdiana Diodorus Sicily (XVIII, 5, 4) considers them as a single satrapy, which "lies along the Tanais River" (15.IV, 5, 5) [29., c.210]. Tanais, i.e. the modern Don can in no way be the river along which Bactriana lies. The modern Don flows from the northern heights. Tanais figures as the common border of this single satrapy. Diodorus Siculus noted that Bactriana and Sogdiana were ruled by one satrap (XVIII, 3, 3; 39, 6). The satrapy, which consisted of Bactriana and Sogdiana and stretched to Tanais, was formed on the site of the former satrapy of Bessa just during Alexander's stay in these places " [29, p. 210]. Tanais is listed as the border of Bactriana. "Bactrian in Ctesias, like Curtius, is an extreme country in Asia, and Tanais is the border of Asia and Europe in those places (9., II, 2, 1-4) [29, p. 227].

Strabo noted that the mentioned river really is the Tanais river, Aristobulus saw in the fact that the country beyond the river produces spruce, as evidenced by the spruce arrows of the Scythians beyond the river. [29., p.189]. Aristobulus, defended the old, traditional views on the geography of Upper Asia, which were adhered to by the companions of Alexander, that: "the region beyond the river belongs to Europe, not Asia, for spruce does not grow in Upper and East Asia" (31., XI, 7, 4). Ancient authors, in particular, Dionysius Periegetus in his work "Description of the inhabited land" (translated by I. II. Tsvetkov, comments

by L. A. Elnitsky), characterizes the mountains of the Caucasus, where it denotes, in fact, the "Arctic" zone of the Ciscaucasia and the Caucasus and the same characteristics of the description of the flora: "652-710. The peoples beyond Tanais and in the Caucasus ... leave their land to the will of cold winds, which, raging with terrible gusts, shake the land and the mountains covered with pine trees" [18. p.536]. This confirms that spruce grew in the Caucasus in ancient times. This fragment suggests that the river Tanais called the channel of the Volga and Don, into which the rivers flowing from the Caucasus flowed, and then, along the channel of the Volga, flowed into the Caspian Sea (Middle Caspian - author's note), which is part of the "Meotian waters". Strabo says that Eratosthenes disputed all such statements [29., p.188]. Eratosthenes, relying on the data of Patroclus, refuted these views as outdated and deliberately distorting the truth. Satrapy Bactriana, located on the territory of modern Central Asia, could reach the Caucasus Mountains along the land Apsheron threshold and along the Tanais, i.e. the channels of the Volga and Don. In the II century A.D. Ptolemy in the book. Third, Chapter V. The position of European Sarmatia is given the coordinates of Tanais (Don)

- 14. Western mouth of the Tanais river  $66^{\circ} 20' - 54^{\circ} 10'$
- Eastern mouth  $67^{\circ} - 54^{\circ} 30'$
- River bend  $72^{\circ} 30' - 56$
- River head  $64^{\circ} - 58^{\circ}$
- Behind them is the aforementioned limit of the unknown land, located at  $64^{\circ} - 63^{\circ}$ . [2., P. 319].

This idea of the border between Europe and Asia, thanks to the enormous authority of Ptolemy, existed in science throughout the Middle Ages and existed even until the 18th century.

### **Conclusion**

Orohydrographic ("Orohydrography" - description of the relief, river network, settlements, terrain passability) schemes of the Sea of Azov and the Caspian changed during the ancient period. The water boundaries of Meotida varied, starting from the basin open to the North Ocean and connected with the Caspian through the Volga and Don (Meotian waters), and, finally, the allocation of the basins of the Azov and Caspian seas, as well as the channels of the Volga and Don. According to ancient Ionian ideas, the Phasis River was the border of Europe and Asia. In the map-scheme, the time of Homer of the VIII century BC. e., the scheme of the water basins of the Transcaucasus at the end of the 2nd millennium BC was reflected. When the Phasis branch and other rivers of Georgia (Kvirila, Dzirula, etc.), through the Suram (Likh) pass, connecting with the Kura, flowed into the Caspian Sea, which is considered the Ocean Bay. The

analysis of the ancient authors suggests that the name Tanais was originally given not to the Don, but to the river: "mixing with the Araks"; "Separating from the Araks in the form of a sleeve"; "By the torn water of the Araks". The modern Don does not meet these characteristics. In the 1st millennium BC the name Tanais was used to designate a river in the Transcaucasus, connecting with the Araks. This is the modern Kura River.

The change in the hydrographic situation and the area of residence of the Scythians led to the transfer of the name Tanais to the joint channel of the Volga and Don, flowing into the Middle Caspian. And, in the future, it finally took hold of the modern Don. The historian Polybius (200-120 BC) notes that Tanais does not flow in the meridional direction from north to south (the lower course of the river), as was previously thought, but from the north-east (26, book III, 38, 59; IV, 39; 30., book II, ch. 4, p. 5). And further: "... the Meotid lake, overflowing with them, pours out through the mouth into Pontus, and Pontus into Propontis. The mouth of Meotida is called the Cimmerian Bosphorus, and it is thirty stadia wide and sixty stadia long; it is all shallow" [26., IV.39]. In the 1st century A.D. e. Pomponius Mela wrote about the further expansion of the territory of Scythia: "Europe begins with Scythia, which should not be confused with Asian Scythia. Scythia stretches from Tanais to about the middle of the coast of Pontus. Then comes Thrace, which captures part of the Aegean coast. Macedonia begins immediately after Thrace" [27, book I, ch. III.]. Changes in the border between Europe and Asia in the ancient period "... depended on the breadth of the geographical outlook and the completeness of information about the nature of Europe and Asia" [11., p.35]. But, not the lack of reliable knowledge, but the changing hydrographic situation, the further settlement of peoples, the accumulation of knowledge about the surrounding lands were reflected in ancient sources. However, at times the inertness of geographical thinking continued to live in the poetic, historical and geographical compilations of later authors.

## References

1. Aliyev K.G. Ancient sources on the history of Azerbaijan. B. 1987.
2. Antique geography. prof. M.S. Bodnarsky. State publishing house of geographical literature. Moscow - 1953.
3. Ancient Caucasian Albania. Baku — 1992. Ed. Corresponding Member AN R.A. I. G. Alieva
4. Ashurbeyli S.A. History of the city of Baku. -B.: Azerneshr, 1992.408 s
5. Herodotus. Per. Mishchenko F.S. Published by A.G. Kuznetsov. A type. E. G. Potapova M. 1888
6. Hippocrates. About air, water and localities. Fr. 24  
[http://www.rushrono.ru/istochniki\\_ant\\_011.html](http://www.rushrono.ru/istochniki_ant_011.html)

7. Homer Odyssey Per. from the ancient Greek V. Veresaev.  
[http://lib.ru/poeast/gomer/gomer\\_02.txt](http://lib.ru/poeast/gomer/gomer_02.txt)
8. Homer. Odyssey (translated by V. A. Zhukovsky), V. A. Zhukovsky  
Collection. op. in 4 vols. vol. 3.  
<https://rvb.ru/19vek/zhukovsky/01text/vol4/01odyssey/315.htm>
9. Diodorus of Sicily Historical library. Submitted by von Maygraben on Sunday,  
06/29/2014 - 16:00
10. Dionysius Perieget. Description Oikumeny lane. Ilyushechkina E.V. Bulletin  
of Ancient History, No. 4/2005, No. 1, 2/2006 Submitted by agnostik on Sat,  
03/15/2014 - 19:18
11. Ditmar A.B. To the history of the border between Europe and Asia (pp. 35-49)  
Scientific notes of the Yaroslavl State Pedagogical Institute named after KD  
Ushinsky
12. Issue XX (XXX). h., 1. Geography Yaroslavl, 1958  
<http://tapemark.narod.ru/pedagog/ditmar2.html>
13. Ditmar A.B. The boundaries of the ecumene. Evolution of the ideas of ancient  
scientists about the inhabited earth and natural latitudinal zoning. M.  
Publishing house. Think. 1973.
14. Dovatur A.I., Callistov D.P., Shishova I.A. The peoples of our country in the  
"History" of Herodotus. - M.: Nauka, 1982
15. Elnitsky L.A. Knowledge of the ancients about the northern countries. M.;  
1961.
16. Quintus Curtius Rufus. History of Alexander the Great. M.; Moscow State  
University Publishing House, 1993
17. Cimmerian Bosphorus - Dictionaries and encyclopedias  
<https://slovar.wikireading.ru>
18. Kondratov A. M. Atlantis of the Tethys Sea. 1986.
19. Latyshev V.V. News of ancient Greek and Latin writers about Scythia and the  
Caucasus // Bulletin of ancient history. -1947.- Nos. 1-4; 1948. Nos. 1-4; 1949.  
No. 1 - 4. Source:  
[http://apsnyteka.narod2.ru/l/izvestiya\\_drevnih\\_pisatelei\\_o\\_skifii\\_i\\_kavkaze/index.html](http://apsnyteka.narod2.ru/l/izvestiya_drevnih_pisatelei_o_skifii_i_kavkaze/index.html)
20. Ammianus Marceline. Roman history. St. Petersburg, Aletheya, 2000.
21. S. N. Muraviev The Araks-Tanais-Yaksart problem and the level of the  
Caspian Sea in the 6th-7th centuries. BC (On the issue of paleohydrography of  
the Caspian-Aral basin) Mathesis. From the history of ancient science and  
philosophy. - M.: Nauka, 1991. -- 256 p.
22. Novoseltsev A.P. The most ancient states on the territory of the USSR  
Materials and research 1986. Moscow: Nauka, 1988.
23. Guy Pliny Seconds (the Elder) Natural history. [http://ancientrome.ru/antlitr/  
plinius-secundus / index.htm](http://ancientrome.ru/antlitr/plinius-secundus/index.htm)
24. Podosinov A. V. Novel about the Hyperboreans of Hecateus Abder (problems  
of interpretation) 1 Bulletin of ancient history. 1.2013.S. 116-129.

25. Podosinov A.V., Jackson T.N., Konovalova I.G. Scythia in the historical and geographical tradition of Antiquity and the Middle Ages. - M.: Akvilon, 2016. -- 320 p.
26. Podosinov A.V., Skrzhinskaya M.V. Roman geographical sources: Pomponius Mela and Pliny the Elder. Texts, translation, commentary. M., 2011.
27. Polybius General history. per. Mishchenko F.S. Submitted by Petrovich on Sunday, 02/15/2015 - 17:41.
28. Pomponius Mela. About the position of the Earth. Ancient geography. M., 1953.
29. Ptolemy. Geography (III, 5.22), archive. September 21, 2013.
30. Pyankov I.V. Central Asia in the ancient geographical tradition: Source analysis. - M.: Publishing company "Eastern Literature" RAS, 1997. - 343 p.: maps, schemes.
31. Guy Julius Solin. Collection of memorable information. per. I.I. Makhankova [http://www.ancientrome.ru/antlitr/solin/crm\\_f.htm](http://www.ancientrome.ru/antlitr/solin/crm_f.htm)
32. Strabon. Geography in 17 books M.; Publishing house Nauka. 1964: 1994 trans. G.A. Stratanovsky, ed. prof. S.L. Utchenko.
33. FLNKA [flnka.ru/glav\\_lenta/3999-albanskie-korni-kavkazskoy-ovcharki.html](http://flnka.ru/glav_lenta/3999-albanskie-korni-kavkazskoy-ovcharki.html)
34. Khalilova T.Sh., Khalilov E.N. The secret of the confluence of two seas. Historical and geological research. 2019.114s.
35. Khalilova T.Sh. Representations of the Ripean Mountains in Ancient Greek and Indo-Persian Literature Bulletin of the International Academy of Sciences (Russian Section) • 2020 • 1.p. 64-69.
36. Aeschylus Tragedies. translation from ancient Greek - S. Apt - M.: Khudozh. lit., 1971.
37. Aeschylus. Tragedies / In the lane. Vyacheslav Ivanov; ed. prep. N. I. Balashov, D. V. Ivanov, M. L. Gasparov, G. Ch. Guseinov, N. V. Kotrelev, V. N. Yarkho; otv. ed. N.I. Balashov. - Moscow: Nauka, 1989. -- 592 p. - (Literary monuments / Academy of Sciences of the USSR). Aeschylus. Tragedies - Rvb.ru [rvb.ru ›ivanov› 1\\_critical ›2\\_eshill› toc](http://rvb.ru/ivanov/1_critical/2_eshill/toc)
38. <https://ru.wikipedia.org/wiki>

## WEAPONIZATION OF SARSANG RESERVOIR IN THE NAGORNO-KARABAKH CONFLICT

Kamal Makili-Aliyev

*Faculty of Law, Lund University, Sweden*

*kamal.makili\_aliyev@jur.lu.se*

*«Fierce national competition over water resources has prompted fears that water issues contain the seeds of violent conflict».*

***Kofi Annan***

### **Summary**

The weaponization of water resources is widespread problem that plagues the armed conflicts around the world including the Nagorno-Karabakh Conflict with it Sarsang water reservoir.

### **Abstract**

The Sarsang water reservoir located on the Tartar river, which is very important for Azerbaijan both geographically and economically, lies on the territories occupied by the Armenia. During the years since the cease-fire agreement between Armenia and Azerbaijani reached in the Nagorno-Karabakh Conflict, numerous reports claimed that Armenia is using the Sarsang reservoir in order to inflict damage on the nearby territories of Azerbaijan creating suffering for civilian population and economic losses for the state. In this way Sarsang reservoir becomes a tool of war in the current low-intensity conflict between Armenia and Azerbaijan and serves as an example of "weaponization of water" in an armed conflict. The article will explore this rather obscure and overlooked situation from the perspective of the international humanitarian law.

**Key words:** *Sarsang, conflict, international humanitarian law, Nagorno-Karabakh, water, resources, weapon, war.*

### **1. Introduction**

The water is the key point of life cycle on the earth. The population growth throughout the world, industrial development, an increase in urbanization, and thus the increasing waste put pressure on natural resources. Important changes occur in the world's climate especially due to an increase in carbon emissions. Moreover, the climate change, which is characterized as the biggest environmental problem of our century, creates negative impacts to the extent that it threatens water resources and the life of all living creatures.

There is double pressure on water resources both due to human activities and the changes created by nature. The excessive population growth particularly in regions suffering from water shortage, the increasing migration from rural areas to cities and resulting demographical changes, food safety, an increase in socio-economic welfare, agricultural, domestic and industrial pollution, a change

in precipitation regimes stemming from global climate change affect all the elements of hydrological cycle. As a result, water resources throughout the world change day by day both in quantity and quality.

As a result of a decrease in water resources different countries face the challenges that some species living in their respective geographies will be endangered very soon if not already. In upstream riparian (origin) countries, the use or misuse of transboundary waters directly influences the downstream riparian (lower course) countries. The UN studies on water shortage conclude that 1,8 billion people will live in countries that will suffer from severe water shortage by 2025. /1/

A great many countries are already suffering from water shortage. The surface waters remain insufficient to fulfill the increasing demand for water, and thus underground waters are used in an uncontrolled way and the level of water tables decreases. As water is one of the primary resources of humanity, it provides the continuation of humanity and nature and also ensures that the food and energy production, transportation and industry are developed. The water resources which are becoming scarce worldwide are not equally distributed throughout the world as well. While it creates abundance and vital productiveness in some parts of the world, it might also cause competition, tension and conflicts between people, societies and states in some regions. Besides, it is likely to become the first target that is attacked in order to weaken the opposite side in processes of war and conflict. The water resources influence the international relations and also emerge as an important target which is likely to create an impact on the balance of winners and losers in wars and conflicts, and thus it has become a security issue turning water into a strategic resource. The water structures becoming a target, as well as its balances are an important war target in terms of determining the outcomes of the conflict. Moreover, the encountered problems with water's quality as a fundamental resource lead to social tensions, competition and conflicts. It also happens that the conflicts that were not started and fought over water resources, would still use them as weapons in war and leverage on the opposing party. Such an example can be found in the Nagorno-Karabakh Conflict that has been on the peace and security agenda of the post-soviet space since the dissolution of the Soviet Union. The conflict between Armenia and Azerbaijan over the territory of the Nagorno-Karabakh autonomous region (an enclave in the territory of Azerbaijan populated predominantly by Armenians) began in 1988 while the USSR was still intact and developed into the full-scale armed conflict between newly independent states after the dissolution of the USSR in 1991. In 1994 the sides concluded a cease-fire agreement, that ended the active part of hostilities, but left Nagorno-Karabakh and seven adjacent regions of Azerbaijan under military occupation of Armenia and armies of both states opposing each other over the shaky line of contact. The

cease-fire agreement itself is subject to constant violations since 1994 and until today. Nagorno-Karabakh and seven adjacent regions are self-proclaimed as a "Nagorno-Karabakh Republic" that is not recognized by any state in the world, including Armenia. The conflict remains unresolved until this day.

The activities of the Armenia on the occupied territories in connection to the Sarsang reservoir will be examined here for possible violations of international humanitarian law in the Nagorno-Karabakh Conflict. To have a clear picture of the situation on the ground it is first necessary to understand the context of the ongoing armed conflict between Armenia and Azerbaijan.

## **2. The Armenia-Azerbaijan Nagorno-Karabakh conflict**

### **2.1 Overview of the conflict**

The Armenia-Azerbaijan Nagorno-Karabakh Conflict has been going on for many years. The mountainous territory which stretches from Taman peninsula in the Black Sea up to Absheron that is located in western coast of the Caspian Sea is called Caucasus. The Caucasus Mountains form the boundary between West and East, between Europe and Asia. Karabakh is a geographic region located between the Goyche Lake (within the borders of Armenia) and the Kura and Araz rivers, which covers an area of 4,392 km<sup>2</sup>.

Due to the geographic location of Karabakh region, it has access both to Armenia and Iran. /2/ The Nagorno-Karabakh which was considered a part of Azerbaijan both during the former Soviet Union era and beforehand forms approximately a quarter of the former Karabakh province. The Karabakh dispute which was a domestic problem between two member-states of the former USSR towards the end of the union became a region-wide issue after the independence of Azerbaijan and Armenia. The Nagorno-Karabakh which was occupied by Armenia along with a 20 percent of the territory of Azerbaijan is an issue that even today is largely overlooked by the United Nation's agenda. The territory that was occupied by separation from Azerbaijan with the claim of "Great Armenia" was de facto included within the borders of the Republic of Armenia. Over a million Azerbaijanis previously residing in the region were exiled. /3/

The Armenian party to the conflict argues that the Nagorno-Karabakh is mostly populated by Armenians; and thus they claim that they have the right to have a say in the area and define their fate (right to self-determination). The Azerbaijani side of the conflict, on the other hand, argues that they are entitled to have a say on the Nagorno-Karabakh region both legally and historically. Also, it claims that the ethnographic structure in the region has been changed artificially through Russian and Soviet policies; and that's why it cannot be a basis for a territorial claim. /4/



During the USSR period, the Nagorno-Karabakh was an autonomous region under the Azerbaijani Soviet Socialist Republic (ASSR). In 1988, closer to the dissolution of the USSR, the NKAO (Nagorno-Karabakh Autonomous Oblast) voted to secede from Azerbaijan and unite itself with the Armenia. However, on July 18th, 1988, the Supreme Soviet of the USSR rejected the decision unanimously and declared that NKAO had no right to secede from Azerbaijan SSR under Soviet Constitution. Soviet authorities then placed the region under its direct rule in January 1989. /5/

In 1991, the USSR was officially dissolved. On 8 December 1991, the Belavezha Accords, which declared the Soviet Union dissolved and established the Commonwealth of Independent States (CIS) in its place, were signed. Accordingly, in Article 5 of the Accords, the member states recognized “territorial integrity of one another and immunity of current borders”. The aforesaid principle was also confirmed by the Alma-Ata Protocol signed by Armenia on December 21st, 1991. /6/

On 26 November 1991, Azerbaijan abolished the status of Nagorno-Karabakh Autonomous Oblast, rearranging the administrative division and bringing the territory under direct control of Azerbaijan.

On 10 December 1991, Armenians in Nagorno-Karabakh approved the creation of an independent state. /7/

Following this fact, the Nagorno-Karabakh dispute turned into an armed conflict in 1991. The Armenian side of the conflict occupied 35 out of 57 settlements populated by the Azerbaijanis as a result of the attacks which took place between 16 October 1991 and February 1992. The most violent attack of all during that period was carried out on Khojaly District, populated by Azerbaijanis, on 26 February 1992. According to the Human Rights Watch, 636 civilians were killed in this incident to which Azerbaijan refers as a massacre of civilian population. /8/

Azerbaijan soon became a member of the UN and tried to attract international community's attention to the Armenian aggression. The Republic of Azerbaijan became a member of the United Nations in March 1992. In 1993, four United Nations Security Council Resolutions (822, 853, 874, and 884) were adopted on Armenia – Azerbaijan conflict. In addition, resolution on extraordinary international aid for refugees in Azerbaijan (85th General Assembly meeting, 1993) and eight declarations on the conflict were adopted by the UN General Assembly as well between 1992 – 1996. However, Armenia violated the UN Charter and did not act in accordance with its principles; it essentially refused to follow the resolutions and stop the occupation. Even though the UN is not currently working on the resolution of this issue, the problem was transferred to the Organization for Security and Co-operation in Europe (OSCE) in 1992. /9/

Armenians occupied the Nagorno-Karabakh and the Azerbaijani territories bordering with Armenia through the Nagorno-Karabakh region itself between 1993-1994. Today, five districts (Khankendi, Aghdere, Shusha, Khojaly, Khocavend) in the Nagorno-Karabakh; and seven more adjacent districts (Kelbejer, Lachin, Gubadly, Zangilan, Jabrayil, Fuzuli, Aghdam) or around 15% of Azerbaijan's territory in total are under the occupation of Armenia. The cease-fire, reached on 12 May 1994 through Russian negotiation is still in force. Armenia violated the 822, 853, 874, 884 resolutions of the United Nations Security Council which demand for "the immediate withdrawal of all Armenian forces from all occupied territories of Azerbaijan." The twelve-member OSCE Minsk Group was created on 24 March 1992 by the then Conference on Security and Cooperation in Europe (CSCE, now Organization for Security and Co-operation in Europe (OSCE)) to find a solution to the conflict. The problem attained an international level still remains a low-intensity armed conflict.

## **2.2 Negotiations process**

During the OSCE Summit of Heads of States and Governments held in Lisbon on 2 December 1996, all members (except Armenia) agreed on: 1) withdrawal of Armenia from the occupied territories of Azerbaijan; 2) ensuring the safety of population in the Nagorno-Karabakh and 3) provision of highest degree of autonomy to the Nagorno-Karabakh by Azerbaijan. Then-president of Armenia, Ter-Petrosyan eventually agreed to sign this accord but afterwards had to resign before signing it. The next president of Armenia, Robert Kocharyan refused to accept a peace plan for Karabakh and blocked the process. /10/

In 1997, the OSCE Minsk Group came up with three different options to solve the problem: The first one is the 'package solution', which favored negotiations on all issues, including Karabakh's final status, simultaneously to achieve the optimum balance. The second plan is the 'step-by-step' solution, proposed in October 1997. According to the second plan it is suggested to handle the status of the Nagorno-Karabakh and the occupied territories separately. The third plan was put forward by the Russian Federation in November 1998. Which envisaged to establish a common state between Azerbaijan and Nagorno-Karabakh. Accordingly, the Nagorno-Karabakh would have its own Constitution and Army; and have a veto power on the decisions taken by the National Assembly of Azerbaijan. The first two plans were rejected by Armenia, and the third plan was rejected by Azerbaijan on the grounds of the violation of its territorial integrity and of the principles agreed by the OSCE at its summit in Lisbon on December 1996. /11/ As the latest solution, on 29 November 2007 the OSCE Minsk Group proposed the set of Madrid Principles undisclosed to public. Nevertheless, the peace negotiations held by the OSCE Minsk Group cannot not

be concluded due to the fact that Armenia constantly changes its position and the UN member-states are not engaging the conflict as a priority. In addition, Azerbaijan believes that the OSCE Minsk Group looks out for the interest of preservation of the status quo based on that co-chairs of the OSCE Minsk Groups take the process too slowly and do not take the arguments of Azerbaijan that occupation cannot remain seriously. /12/

According to the 1987 statistics, Karabakh covered 2,87% of the Azerbaijani industry, and 3,2% of the agricultural sector. The loss of Karabakh is more of a cultural – sentimental loss and violation of territorial integrity than an economic loss for Azerbaijan. Accordingly, Karabakh is seen as an important part of the Azerbaijan's national identity and thus its loss is considered unacceptable for the Azerbaijani. /13/

### **3. Examples of weaponization of water and international humanitarian law**

When water is treated as a target of violent conflicts, there is a deliberate effort:

- To damage water and sanitation infrastructure such as natural or manmade water bodies, dams, water treatment plants, supply networks, sewage networks and pipelines,
- To damage supplementary infrastructure such as hydropower plants, electricity cables connected to any water-related activity,
- To contaminate water using chemicals, bacteria, or any other harmful substance,
- To drain natural and manmade water bodies by cutting off of water supply to those bodies, or filling them up with soil, rocks, cement or other material. /14/

When water is used as an instrument of violence, there is a deliberate effort:

- To harm civilians living in urban and rural areas by flooding towns,
- Blocking civilians' access to water by cutting off the water,
- Polluting the water, drying up the water resource, and hindering the hydro-energy production and thus hindering sanitation and power generation,
- To ruin the economy by disrupting supplies to irrigation and industrial areas, flooding farms and industrial areas, over exploitation and destruction of water infrastructure,

- To harm political opponents by flooding or drying up key opponent settlements, poisoning their water supplies, destroying their water infrastructure, imposing sanctions,
  - Destroying the water resource and intervening in nature and the entire system directly dependent on it,
  - Restricting the water and triggering the competition for accessing water and causing violent conflicts across societies, cities, states and regions.
- /15/

There are recent definitions in the academic discourse that categorize the use of water resource as a target, weapon and strategy. In a case when water resource is chosen as a target, direct attacks are made, harm is done and it is rendered nonfunctional. When the water resource is used as a weapon, the aim is to damage civilians or the opposite side through the water resource or structure. The use of water resource as a strategy aims at fulfilling a larger-scale goal such as the expansion of territory (or over the territory). /16/

The use of water as a means of target, weapon and strategy will change the current flow of water resource and impair water quality and also might completely dry out the water resource and result in desertification and impairment of land resource. As a consequence, both social and political results such as agricultural losses, food insecurity, industrial losses and changes in demographic structure and traditional life style emerge. The lack or degradation of water resources causes movements of migration. Such migrations occur within the country or to other neighboring countries. The population movement causes the scarce resource competition, conflicts and tensions in regions where it newly arrives in. People, especially the farmers who lose their jobs and earnings due to scarce resources are forced to make efforts to create working areas and occasionally to be involved in illegal sources of income. Thus, this situation is likely to cause tensions in society. The triggering force of water in social, economic and political conflicts has now turned into an undeniable reality.

There are numerous historical examples of the use of water as a weapon or target: the dams producing hydroelectricity were bombed throughout the World War II; the US bombed the irrigation water supply system of Northern Vietnam in 1960s; the conflicting parties targeted each other's dams, water delivery systems and desalination facilities during the Gulf War in 1991; etc. As one of the most vivid examples of targeting the dams and water structures during conflicts and wars in modern military history, Britain was planning to attack Möhne, Eder, Schwelme (Ennepe), Lister, Dieper and Sorpe Dams in Ruhr Basin, which were very important for the German war industry, in order to weaken Germany in 1943 during the World War II. Britain was going to be able to cut off the energy of Germany's industry and also one fourth of water owned by the

country by attacking those dams. They used the Upkeep bombs, which were capable of bouncing on the water like a stone in order to hit the dams that were protected with anti-aircrafts guns, submerging at the targets, and also exploding under the water and creating shock waves. According to the plans made, Möhne, Eder and Sorpe Dams were supposed to be destroyed first. Unless the plan failed, other dams would also be bombed. As a result of the attack, two dams were destroyed, approximately 300 tons of water was released, water production decreased by 75 percent and 1,600 people lost their lives during the flood that resulted from it. The coal production and other manufacturing were either slowed down or completely stopped on the basin. Germany repaired its dams and restarted the production 40 days after the attack. But the attack inflicted a heavy blow upon the food production and nobody was able to be engaged in agriculture. After the war, attacks against dams during wartimes were prohibited by the international humanitarian law.

As another more recent example of this situation, the news and analyses covered by the Libya press in September 2011 during the active phase of the conflict in Syria, reported that the pipeline delivering water to Tripoli has been under control of the groups supporting Gaddafi and that the water flow has been cut by these groups as a result of sabotage on the pipeline. According to information from the UN reports and experts, Gaddafi was sabotaging his project that he has always showed as a picture of success in order to leave the people living in Tripoli without water. Furthermore, the pumps were reportedly broken and the pipeline was damaged. It was also reported that the UN officials and experts were exerting efforts to repair the pipeline and deliver water to people as soon as possible. /17/

Covering an area of approximately 1.8 million square kilometers, Libya encompasses 95 percent of desert on its surface area. As a result of vaporization and also salination caused by excessive draught occurring in aquifers located in coastal regions with compact settlements, there was water shortage in the country with an annual precipitation of 100 mm. /18/

The desert consists of a many sources of underground water. The Great Man Made River Project aimed at putting underground water maintained in the desert to good use and resolving people's water shortage problem was proposed during the public congress meeting that was held on October 3, 1983. The project started to be implemented in 1984. 1,300 wells have been dug for the four-stage project which has been operating for 20 years. It consists of the world's longest water delivery pipeline of 3,500 km and also five reservoirs that were constructed in the desert. The pipes with a weight of six tons and a diameter of 4 meters deliver 6.5 million cubic meters of water to northern parts of the country. In Libya, more than 1,000 liters of water were available per person thanks to this

water. The actions of the warring parties all but destroyed the project and significantly affected civilians. /19/

Another example discerned from the conflicts, is when the upper riparian region cuts off water of the region below particularly in transboundary water basins. Some sources regarding the Gulf crisis era, which has had an impact in the region and throughout the world, indicate that the United Nations have been concerned with complete cutting off the water flow from the Euphrates River (an important river rising from Turkey and meeting Iraq's water needs) and possibility that Turkey may have been using water as a weapon. /20/

A similar (but reverse) situation have occurred in the strained relations between North Korea and South Korea. In 2009, without previous warning, North Korea released 40 million m<sup>3</sup> of water from the Hwanggag dam, causing a flash flood on the Imjin River. Fisherman and campers were drowned as a result of the flood. Although North Korea claims that the water had to be urgently released, South Korea fears that North Korea would use the water of the dam as a weapon during a violent conflict. /21/

Since the crisis and civil war in Syria, a number incidents occurred that have negatively influenced relations between this failing state and neighboring Turkey, which have been warm before. The tension between Turkey and Syria reached its peak June 2012. One of the points of tension was that Turkey has shut down dam gates of the Euphrates and Tigris Rivers and deprived Syria from potable water, and thus created pressure on Bashar Assad. /22/

As it can be seen from above, there are many examples of the weaponization of water and its targeting in the times of war or conflict. Such examples demonstrate that weaponization and targeting of water resources constitutes the historical practice in the context of armed conflicts. Unfortunately international humanitarian law does not have a clear cut regulations or specific rules regarding water. However, there are related norms that help protect from the weaponization of water and targeting of water sources themselves.

A lot of relevant regulations of international humanitarian law are related to the conduct of hostilities. Those are generally described as prohibitions. Such prohibitions include, for example, ban on use of poison as means of warfare, enemy property destruction, prohibition of attacks on objects critical for the survival of civilian population and of attacks on installations that contain dangerous forces.

Ban on poison derives from norms established as far back as XIX century, such as Lieber Code (1863) of U.S. armed forces and Brussels Declaration (1874). The general customary rule that prohibits the employment of poison or poisoned weapons is grounded in Hague Regulations Article 23(a). The customary rules are general per se and thus apply to water as well. It is a bit different with norms concerning property. It is entirely possible that some water

resources can constitute enemy property. If it is not absolutely imperative, destruction or seizure of enemy property is forbidden by the Hague Regulations Article 24(g). Similar regulations can be found in the Fourth Geneva Convention of 1949. They ban extensive destruction or appropriation of such property and in unlawful context may mean a war crime as a grave breach of international humanitarian law. There is also a prohibition of destruction of the objects necessary for the survival of the civilian population. These regulations can be found in Protocol I Additional to the Geneva Conventions of 12 August 1949 in Article 54. Among the examples that were stated in this article are drinking water installations and supplies and irrigation works. The norms of the article provide only one exception.

The imperative military necessity still entitles a warring party to destroy indispensable objects, provided that they are situated within territory under its own control. Protocol II to the aforementioned conventions adopts a similar approach in Article 14. Protocol I Article 54 also allows for a derogation from the immunity of indispensable objects, but only if they serve as sustenance solely for the members of the armed forces or in direct support of military action. /23/

Extremely dangerous effects that attacks on installations that contain dangerous forces can bear for the civilian population, international humanitarian law bans such attacks.

Within the context of Article 56 of Chapter III of the Protocol I there is a clear provision that: 'Works or installations containing dangerous forces, namely dams, dykes and nuclear electrical generating stations, shall not be made the object of attack, even where these objects are military objectives, if such attack may cause the release of dangerous forces and consequent severe losses among the civilian population. Other military objectives located at or in the vicinity of these works or installations shall not be made the object of attack if such attack may cause the release of dangerous forces from the works or installations and consequent severe losses among the civilian population. /24/

International humanitarian law comes forth with principles that intent to ensure at least minimal normal living conditions for subjects of its protection. Meaning that satisfaction of basic human needs as well as the need to water is included in its practical application. The need for water of medical staff to be able to carry their duties is obvious.

The apparent nature of this fact can be one of the reasons that the norms of international humanitarian law do not explicitly spell out such regulations. The need for water and medical treatment is nonetheless referred to in the Third and Fourth Geneva Conventions. /25/

Although the protection of water in the armed conflict is far from clear and explicit in international humanitarian law, it is undeniably integral in the protection provided by its norms.

The violation of such norms in armed conflicts would constitute grave breaches on international humanitarian law.

#### **4. The sarsang reservoir and its weaponization**

The Sarsang reservoir located on the Tartar river which is very important for Azerbaijan is among the territories occupied by Armenia. During the conflict Armenia took steps to use the aforementioned reservoir in a way to inflict damage on the opposing party.

The Sarsang reservoir itself was built on Tartar River (which is a tributary of the Kura river) to provide irrigation water and electric energy. The length of the Tartar river is 184 km and the total area of its basin is 2,650 km<sup>2</sup>. /26/

It is planned to irrigate 100.000 ha of land through the dam with the capacity of 560 million cubic meters of water. 500 million cubic meters of the reservoir has been allocated to useful storage and 60 million cubic meters to dead storage. However, the reservoir has been under the occupation of Armenia for 23 years and the irrigation cannot be carried out as planned, which leads to a major financial loss. Besides, the dam situated in this reservoir is 125 meters high and is the tallest dam in Azerbaijan.

The reservoir was built with the aims of irrigation, flood control and power generation in 1976. It was aimed to generate 50 megawatts of hydro power in the dam composed of two turbines. The reservoir release potential of each turbine is 30 cubic meters/second. The total amount of reservoir release equals to 60 cubic meters/sec. In addition to this, 240 km-long irrigation canal (composed of two parts) was built in 6 districts (Tartar, Aghdam, Barda, Goranboy, Yevlakh and Aghjabadi) of Azerbaijan in order to irrigate agricultural lands. /27/

##### **4.1 Threats posed by the situation around the Sarsang reservoir**

One of the threats of the hydro-diversion nature is a possibility of using the reserves of the Sarsang water reservoir (Agdara district) with total water capacity of 560 million m<sup>3</sup>, located in the territory of the occupied Nagorno-Karabakh region against Azerbaijan by Armenia both as political-economic means of pressure and hydrological and ecological weapon. Presently, the artificial floods and droughts organized regularly by Armenians through Sarsang water reservoir cause environmental tension in the Azerbaijani low-lying areas and serious difficulties in meeting of needs of the population and sowing areas in fresh water. Besides, the catastrophic state of the dam located at 125 km height casts threat for the life of 400 thousand people residing in the surrounding regions. The water reserves of Kalbajar and Lachin districts occupied by Armenian armed forces are of great strategic importance in the hydro-policy of



the Republic of Armenia and Nagorno-Karabakh's separatist regime. 81% of water resources of the rivers of Nagorno-Karabakh are formed in the territory of Kalbajar district.

Their annual average water reserve is 942,3 million m<sup>3</sup>, but this indices on the districts of Lachin and Kalbajar is more than 2,7 times, i.e. is equal to 2588,5 million m<sup>3</sup>. In the hope that the number of population in the occupied territories will reach 200 thousand people in future, the Armenian statisticians have forecasted the annual fresh water needs in the volume of 365 million m<sup>3</sup> to use in daily activity and in the Industry, which exceeds the reserves of Sarsang water reservoir by 59%.

David Babayan, a representative of Nagorno-Karabakh separatists, writes on the aforementioned points that the districts Kalbajar and Lachin are of paramount importance in the context of providing the Nagorno-Karabakh population with drinking water. /28/

While the importance of these water sources for Armenia is clear, the excess water in reserves is converted to additional threats of disaster that may have natural (unintentional) occurrence. Such a threat of disaster has been partially estimated by researchers from Azerbaijan and Turkey that modeled and evaluated the damage that is likely to occur as a result of an accident on the dam. The results of evaluations and estimations are only correct by 60-70 percent.

This is due to the fact that the field study must be carried out, the topographic maps of dams should be updated, bathymetric measurements must be made in the lake, hydrological researches must be conducted, the watercourse must be known and the water-holding volume of pits must be calculated in order to ensure more accurate results. However, such studies are impossible, as the territory the dam is located on is still under occupation and beyond the access of the researchers. Nonetheless, the existing results show clearly that land and settlements within a distance of 48 km downstream of the dam are under significant risk. The lack of maintenance of the dam poses a threat for 400.000 people inhabiting the downstream. /29/

According to the calculations done by the researchers, it was concluded that 80 percent of the lake water will be released in case of any disaster and water will reach its final point with a 20% loss from the embankment of the dam. At this point, water-holding pits on the watercourse and the soil's absorbing volume were counted as a part of an above-mentioned loss of 20%. Should the dam collapse, the water stream's speed could reach 100-200 km/hour, depending on the level of the lake at the moment.

The speed of the water flow changes in proportion to inclination of the land on which the water flows. As a result, the water flow time as from the main construction of the dam until the final point that could be reached by water has been calculated inferentially. /30/

**The table below shows the height and flow process of water at critical points. /31/**

Distance from the main construction of the dam across water flow (km)	Water height (m)	Water flow time (Minutes)	Distance from the main construction of the dam across water flow (km)	Water height (m)	Water flow time (Minutes)
0+000	65	0	13+000	35	7.8
1+000	50	0.6	15+000	20	9.0
2+000	60	1.2	17+000	14	10.2
3+000	40	1.8	20+000	10	17.4
4+000	24	2.4	27+000	8	23.4
5+000	38	3.0	30+000	7	25.8
6+000	38	3.6	33+000	6	33.0
7+000	37	4.2	36+000	4	36.0
8+000	36	4.8	39+000	2	46.8
9+000	32	5.4	41+000	1	49.2
10+000	25	6.0	45+000	0.6	67.8
11+000	28	6.6	48+000	0.4	72.0
12+000	32	7.2			

As seen from the table above, water level decreases to 0.4 m on the 48th km as from the 17th km as a result of a change in inclination and also extension of the land. Nevertheless, the water flow can be destructive for Azerbaijan's many settlements and cities of Tartar and Barda until the 41st km and still dangerous between 41st and 48th km (in an area with a width of approximately 10-12 km).

The analysis of the map of the land with a scale of 1:50 000 and also the longitudinal and transversal profile section on the watercourse show that when the Tartar River flows up to a relatively flatland in its course between steep mountains at the time of flood, the water might spread into a large land and submerge some settlements in the region.

Such situation causes danger of serious destruction. In that case, many of Azerbaijan's villages and towns, as well as the city of Tartar come under the risk of being completely submerged. Other villages in the region (Chaylı, Seydimli, Hajigarvand, Zolkaran, Duyerli, Sarıjalı, Alasgarlı, Bayandur, Buruj, İrevanlı, Gulabatlı, Hajallı, Yenidashkand, Gapanlı, Shatırlı, Gasımbeyli, Zumurkhach, İmamgulubeyli, Dilenchiler, Muganlı) and smaller settlements (Shıkharkh settlement, Madagiz, Hesengaya, Sahlabad, Korpusındıran, Kazaklar, Soyulan, Dargalar, Nezirli) are likely to be submerged partially. It is estimated that if the watercourse is changed towards south, depending on the relief, other villages are likely to be under the threat of being submerged as well.

#### **4.2 Misuse of Sarsang reservoir as a result of the protracted armed conflict**

Tartar and Barda regions of Azerbaijan are water-scarce areas, and the Sarsang reservoir was built on Tartar river especially for irrigation purposes. While water of the reservoir came under the control of Armenia it has been letting it flow during winters and this situation lead to serious floods and damage to the agricultural lands, roads and settlements. On the other hand, during summers, when water is needed most, the water was held back from downstream. /32/

Following the occupation, it was impossible to irrigate the land and agriculture of the neighboring regions of Azerbaijan has been significantly damaged. Moreover, Armenia threatens that it could explode the dam and cause the downstream to be flooded. Besides, as known in the example of Araz river which is a major tributary of the Kura river, Azerbaijan is a lower riparian. Armenia discharges domestic and industrial wastes right into the Araz river without any treatment. Which leads to an intense pollution due to the heavy metals and toxic wastes in the Araz river. If Azerbaijan which is in need of the Kura and Araz river water for drinking, irrigation and industrial purposes use the water without treating, land resources and products might be damaged. It is required to treat water to use for the aforesaid purposes. This situation poses an additional cost to Azerbaijan. /33/

In transboundary waters which are generally used by several countries, it has been observed throughout the history that water is cause of either a conflict or a cooperation; and upper/lower riparian uses the water resources of the upper/lower riparian however it likes by resorting to its geographic, economic, political or military force. In addition to the fact that water is essential in human life, it appears also as an important element that affects food production, energy generation, sustainable development, socio-economic life. Therefore, water can be used to harm, threaten and make the opposing party obey during conflicts. Armenia could use the Sarsang reservoir, which is of great importance for Azerbaijan in terms of irrigation and preventing flood in the country, in a way to harm Azerbaijan in addition to the attacks carried out on the territories it has occupied since 1992. Armenia imposes financial damage to agricultural lands and settlements in Azerbaijan through floods and drought stemming from the water cuts. International organizations such as the UN, GEF and EU implement many projects encompassing Armenia, Azerbaijan and other Araz – Kura riparians. These projects are aimed at using the water resources in the region efficiently and in cooperation of a good quality. Nevertheless, Armenia's use of the a water reservoir as a means of threat and a weapon negates efforts for cooperation. In order to efficiently use the water resources in the region, it is critical to solve the problem caused by Armenian control over the Sarsang reservoir. The described situation is a clear (albeit obscure) example of water resources being used as a weapon during a protracted armed conflict.

## 5. Conclusion

A country's water supply can depend on another country if transboundary waters flow within the borders of more than one country. This situation turns water resources into one of internal security issues. As the water resources have been involved in conflicts in recent years, global water problems are with the status of primary policy.

The water resources could become a driving force for both peace or war. The policies to be followed by states could result in either cooperation or conflicts. The water conflicts are mainly caused by the issue of fairness. The definition of fairness criteria is ambiguous and relative. In case of this study it is quite clear that the international law that maybe an objective answer to the problem is either insufficient in regulation or somewhat inconsistent in enforcement. Nevertheless, fair water sharing agreements create a precondition for hydro-political balances and enable political powers to be in favor of cooperation rather than conflict.

There are several factors that contribute to the confrontation related to the water resources in a particular situation under the consideration of this study:

- Unequal distribution of the water resources, their tendency towards reduction;
- Widening of the arable areas, construction of uncoordinated hydro-plants on the transboundary water resources;
- Absence of any legal base in regulation of intergovernmental relations in connection with water resources;
- Use of the rivers located in the territories under occupation and hydro-technical plants by Armenia against Azerbaijan as possible weapons of war;
- Sustainable nature of pollution of environment and water resources;
- Increase of influencing ability of water resources as political-economic means.

Despite the fact that Azerbaijan is amongst the troubled states from the standpoint of the volume of the fresh water resources, the state's economic potential, duties resulting from its national interests, correct estimation of the problems related to the water resources increase the effectiveness of remedial measures. However, if the hydro-political relations of the regional countries are not regulated within the framework of intergovernmental agreements and international legal norms, as well as mutual interests, new disputes and conflicts in the field of using transboundary water resources may arise.

As it seen from the above analysis of the risks of political, social-economic and environmental problems related to the water shortage and the

hydro-policy of Azerbaijan, if the Nagorno-Karabakh Conflict is not resolved before reaching the global and regional water shortage, the real danger to the peace and security of the whole region cannot be excluded as a scenario. The use of transboundary watercourses and water resources of the occupied regions by Armenia against Azerbaijan as means of war, maybe connected to the understanding that the return of Kalbajar and Lachin districts and loss of fresh water resources in this region will also mean the loss of Nagorno-Karabakh for Armenia once and for all.

The case study presented here, specifically covers the current situation around Sarsang reservoir. As Azerbaijan is suffering from water shortage and there are concerns over an increase in this shortage in the upcoming years, the impacts on social and economic structure of the country can be severe. Moreover, a large part of water resources in Azerbaijan has transboundary characteristics. At the same time the ongoing Nagorno-Karabakh Conflict has an incumbent problem of Sarsang reservoir. As seen from the above, Armenia clearly uses the Sarsang reservoir located on the territories under occupation as a weapon against Azerbaijan and threatens to destroy this dam. It shuts down the dam gates in irrigation seasons in which water is needed and also causes damage to agricultural activities in regions of Azerbaijan which are in need of water. It releases water in winter times and creates artificial floods. Furthermore, it threatens Azerbaijan with dams destruction. The destruction of the dam may cause significant damage to cultivated lands and settlements and also lead to the loss of lives. Using the Sarsang reservoir as a weapon, Armenia prevents the region from normal access to water that it needs and bringing socio-economic, environmental and developmental damage to Azerbaijan.

In accordance with the Protocol I Additional to the Geneva Conventions of 1949 (1977) Articles 54 and 56, Armenia (party to the Protocol I since 1993) with its actions is in breach on international humanitarian law and inflicts damage to the civilian population of Azerbaijan. Moreover, the misuse of the Sarsang reservoir puts both occupied and other adjacent territories of Azerbaijan and the civilian population that is residing there at grave risk of destruction. While the Nagorno-Karabakh Conflict awaits its resolution, the misuse of Sarsang reservoir by Armenia in grave breach of international humanitarian law can and should be investigated further.

## References

1. UN-Water 'Coping with water scarcity. Challenge of the twenty-first century' FAO, 2007; UNDP 'Human Development Report 2006', 2006 <http://www.un.org/waterforlifedecade/scarcity.shtml>.

2. R Yılmaz, 'Azerbaycan Dış Siyasetinde Bağımsızlık Sonrası Yıllar ve Karabağ Problemi', 2010, 2 Sosyal Bilimler Araştırmaları Dergisi 70.
3. EV Özyılmaz, 'Geçmişten Günümüze Dağlık Karabağ', 2013, 15 /2 Gazi Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi 193.
4. Yılmaz , n 2, 71.
5. A Sapmaz, 'Gökhan Sarı, Dağlık Karabağ Sorununda Azerbaycan Tarafından Kuvvet Kullanım Olasılığının Analizi' (2008) 15 Güvenlik stratejileri 4.
6. Özyılmaz, n 3, 200.
7. Sapmaz, n 5, 6.
8. C Abdullahzade, 'Hukuki Yönleriyle Karabağ Sorunu', 2014, 1 Adalet Yayınevi 256.
9. S Seyidova, 'Uluslararası Kuruluşların Dağlık Karabağ sorununa bakış açıları ve etkileri', 2014, 9/4 Turkish Studies - International Periodical For The Languages, Literature and History of Turkish or Turkic 1043.
10. Sapmaz, n 5, 6.
11. K Kasım, 'Dağlık Karabağ Sorunu: Dar Alanda Büyük Oyun', (2011) 11-07 Uluslararası Stratejik Araştırmalar Kurumu 8-11.
12. Özyılmaz, n 3, 203.
13. Özyılmaz, n 3, 205.
14. Strategic Foresight Group, Water and Violence. Crisis of Survival in the Middle East (SFG 2014) 2.
15. Ibid.; P Gleick, 'Water and Conflict; Fresh Water Resources and International Security, 1993, 18/1 International Security 85; M McDonald, 'The Environment and Security: The Euphrates River' Department of Government University of Queensland 86.
16. These definitions were compiled from the notes taken during the Water's Link to Middle East Peace meeting which was held in Jordan on March 18-19, 2015 in cooperation with the SFG and WENA.
17. P Gleick, 'Water as a weapon: Qaddafi's last desperate gamble', Forbes, 3 September 2011.
18. [http://www.fao.org/nr/water/aquastat/countries\\_regions/libya/index.stm](http://www.fao.org/nr/water/aquastat/countries_regions/libya/index.stm)
19. Information has been obtained from the field survey that was carried out in Libya in 2004 and its results presented on the 5th World Water Forum that was held in 2009.
20. Gleick, n 15, 85; McDonald, n 15, 1.
21. J Sturcke, 'South Korea demands North Korea apology for flash flood that killed six', The Guardian, 8 September 2009.
22. A Rettman, 'Intelligence experts: NATO has options on Assad', EUObserver, 18 June 2012.
23. A Zemmali, 'The protection of water in times of armed conflict', 1995, 308 International Review of the Red Cross 3.
24. Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts, Protocol I, adopted 8 June 1977, 1125 UNTC 3, Government of Switzerland, art 56.

25. Zemmali, n 23, 4.
26. Data of the Ministry of Ecology and Natural Resources of Azerbaijan; M Avazova, 'Water Resources of Azerbaijan, Their Management and Bilateral Agreements', 2012, Almaty, September 10-13, <http://bit.ly/2PULqJv>
27. Ibid.
28. D Babayan, 'Ethno-Political and Security Aspects of the Azerbaijan-Karabakh Conflict ', New Eastern Outlook, 27 June 2010.
29. FA Imanov, 'Water Infrastructure of Kura River Basin Within Azerbaijan' 1 International Congress on River basin management 100.
30. Ibid.
31. Ibid.
32. A Mustafayeva and R Garayev, 'Legal Aspects of Reparation for Damage Caused to Azerbaijan as a Result of Armenian Aggression', 2013, 14 IRS Heritage 55.
33. Ibid.

## **TOUR HEYERDAL AND AZERBAIJAN**

A.S. Mammadov

*Azerbaijan Section of the  
International Academy of Sciences H&E  
[afet.xalg@gmail.com](mailto:afet.xalg@gmail.com)*

In the early 1990s, while researching the history of relations between the peoples of Azerbaijan and Norway, I began to study the life and work of Tur Heyerdahl, a researcher of the origins of these peoples, the history of early relations, a text-oriented, courageous man who devoted his entire life to travel and scientific research. The famous Norwegian traveler and scientist Tur Heyerdahl, who conducted research in this field, visited Azerbaijan along with a number of other countries, saw Gobustan rock paintings and began new research.

The world-famous traveler and scientist Tur Heyerdahl has made great contributions to the study of the unopened pages of the ancient and modern history of cultural relations between Azerbaijan and Norway, considering Azerbaijan one of the oldest cultural centers in the world.

The culture of Azerbaijan and Norway is as ancient and rich as its history. The discovery of material and cultural monuments, dwellings of our ancestors, various tools and household appliances during archeological excavations in Azerbaijan dates back to the 5th-1st millennia BC.

The first human settlement in present-day Norway dates back to prehistoric times, when the giant ice continent began to move in Scandinavia. Ten thousand years ago, the ancestors of the Norwegians hunted deer and other wild animals, and traveled a long way to the North. This land, where they came to hunt, has been under glaciers for thousands of years. Scientists are still unable to agree on where and how the Norwegian ancestors came to the North. Today we study the occupation, life and traces of the first Norwegians with the weapons, pottery and rock paintings they made /1/.

Archaeological excavations in both Norway and Azerbaijan suggest that our millennia BC, In 1500-500, the first tribes of these peoples were engaged in hunting, made household items, and lived in tribal associations.

Recently, the interests of the peoples of Azerbaijan and Norway have been involved in socio-cultural, scientific and economic cooperation. The developing relations show once again that our peoples will rise to new heights on the path to independence and democracy in the XXI century, and will have secular values /2/.

From an early age, Tour Heyerdahl, who traveled the countries, seas and oceans with his Kon-tiki, Ra and Ra-2, Tigris boats with endless interest, created a great history with his professional friends, covered many countries. Tour Heyerdahl managed to reconstruct the ancient sea routes.



At one point in his life, Tour Heyerdahl set aside the sea and sought answers to questions about the migration and travel of the oldest Norwegian people, and one day he arrived in Azerbaijan on August 28, 1981, / 3 /

The great explorer and traveler came to Azerbaijan to see among the paintings on the rocks of Gobustan the boat-like rock carvings of human culture - the symbol of the Sun reflected on the front of ships. T. Heyerdahl wanted to open his new research - the traces of similar cultures of our peoples, which tell about the most ancient periods of history, the pages of the great history engraved on the rocks. He is visit Gobustan, Devechi region, ancient city of Shabran, Sheki region, Kish village, Gabala region, Nich village, Oguz region.

It was then that Tour Heyerdahl became attached to Azerbaijan and began to be recognized in our country.

In the book T. Heyerdal "My 20th century. In the footsteps of Adam" he spoke about his visit to Azerbaijan and his meetings with President Heydar Aliyev, academician Hasan Aliyev and other scientists, as well as his new visits to Azerbaijan after the collapse of the Soviet Union. Excerpts from the book: "On the Other Side of the Iron Curtain": "During my visit to Azerbaijan, I with an academician Hasan Aliyev, toured the country, got to know this beautiful land, loved its people and nature ... In these and other places, the symbol of the Sun was stamped on the front of the ships. These paintings were reminiscent of ancient Viking ships." / 4 /

T. Heyerdahl writes about this in the same book: "On my first visit, Hasan Aliyev invited me to Azerbaijan to show me the images of a rock ship with the oldest history in the world."

After his first visit to our country, T. Heyerdahl saw rock paintings depicting the traces of highly developed ancient civilization in Gobustan. Based on this fact, T. Heyerdahl began new research and made new discoveries.

During his subsequent visits, the world-famous Norwegian researcher Tour Heyerdahl discovered the relations between Azerbaijan and the Scandinavian countries. The new researches and discoveries of Tour Heyerdahl were published in the European and world press, and the unknown facts of the ancient history of the country called Azerbaijan were revealed among the researches of the world-famous scientist.

On November 22, 1994, Tour Heyerdahl paid his second visit to Azerbaijan. At that meeting, President Heydar Aliyev said: "I welcome the visit of my dear friend Tur Heyerdahl and his wife to our country. 14 years ago, he arrived in Azerbaijan. There was no Statoil, no contract, no independent Azerbaijan. Because at that time Azerbaijan was part of the Soviet Union. But Mr. Tour Heyerdahl had traveled all over the world. Probably, Azerbaijan was a white place in his biography and had to fill it. If he had not come to Azerbaijan, his travels would not have been complete." / 5 /

Presentation of the book "Researcher Tour Heyerdahl" took place at the Presidium of the Academy of Sciences of Azerbaijan / 6 / ... At that time, T. Heyerdahl answered journalists' questions about the world, ocean problems and environmental protection as follows:

"In 1947, while sailing on the Kon-Tiki, the ocean was clear. In 1969, while sailing in the boat "Ra", we saw all kinds of rubbish, especially a lot of fuel oil. The chemical waste also changed the color of the water and made it gray. The ocean is in great danger. Although I deal with the past, I look to the future. The world must fight effectively for the cleanliness of the ocean. For this, all forces must be mobilized. A country, even the most powerful in the world, cannot solve this problem alone. We live under one sky, and the ocean should be one for all of us." / 7 /

That's what happened. After traveling across the oceans with his companions during his travels around the world, T. Heyerdahl saw how huge oil slicks polluted the oceans and the whole environment. Immediately, a statement was issued through the UN, and after this protest, which was joined by many countries around the world, active work began in the field of security of oil production. Norway was one of the first countries to join this work. This country is still one of the most active in the field of environmental protection.

Heyerdahl said he was very pleased with the increase in the number of supporters of nature protection in Azerbaijan, especially in the protection of the Caspian Sea. He said that the Republic's cooperation with Norway in studying environmental problems will help solve them.

The visit of the President of the Republic of Azerbaijan Heydar Aliyev to Norway in April 1996, the signing of agreements between the two countries, the establishment of new economic relations began to develop rapidly. Azerbaijani-Norwegian relations are developing in all areas. Cooperation between the two countries is manifested in economic, social, scientific, cultural, educational, environmental and other fields.

During his third visit to Azerbaijan on May 11 (1999), Tour Heyerdahl said at a meeting of the Presidium of the Academy of Sciences of Azerbaijan: "There are close similarities between the peoples of Azerbaijan and Norway. While still in high school, we were taught that our ancestors were Azeris. This was reported in the "Saga" written by Snorre Sturlason. Azerbaijan has been a very important country in the past. I am writing a book, in which I intend to dedicate a special section to this ancient land. The purpose of my current visit is to collect more relevant materials about Azerbaijan / 8 /. President of the Academy, academician Faramaz Magsudov, academician Budag Budagov, corresponding members of the Academy of Sciences Teymur Bunyadov, Igrar Aliyev and others thanked Tur Heyerdala for introducing Azerbaijan to the world.

The prominent traveler met with the public in Baku (May 12, 1999, Hyatt Regency-Nakhchivan Hotel). T. Heyerdahl made an interesting report on "Ancient relations between Azerbaijan and the Nordic countries." He said, "In many ways, Norway has Scandinavian mythology that has replaced its history up to the 800s. It states that the Scandinavian tribes, led by Odin, came to Northern Europe from the country of Azer, east of the Black Sea. Odini and his people were forced to leave this country in about 84 AD when Roman troops approached the country of Azer. I know this legend well and did not associate it with Azerbaijan until I came to Gobustan. I was amazed when I saw the rock paintings in Gobustan. Here I saw a stone plaque with a Latin inscription on it, along with pictures of boats. After inquiring about this inscription to the Azerbaijan Academy of Sciences, I received not only an exact copy of the plaque, but also a scientific justification for the history of its creation. The inscription was written after 84 CE, when Roman troops were here, about 84-87 CE As I researched this issue, I found more and more evidence to support my conclusions. All this gives me reason to confirm that Azerbaijan has played a greater role than anyone could have ever imagined, and that Azerbaijan has been an extremely important center of civilization, standing at the center of civilization. The rock paintings of Gobustan prove it better than anything. " / 9 /

T. Heyerdahl began to study the ethnography and archeology of Azerbaijan in 1980. The scientist says, "Azerbaijan is one of the oldest cultural centers in the world. Azerbaijani culture needs in-depth research. I accept Gobustan's rock paintings as one of the symbols of the Azerbaijani people. I have published a book on my scientific research on Azerbaijan. Regardless of where we are in the world, we call ourselves the "Caucasian type" in terms of anthropological structure. You can view all the relevant documents. We are proud to be connected to a region with such an ancient, rich culture, especially Azerbaijan. It is no coincidence that the Baltic peoples also acknowledge that they have Turkish roots in their roots and origins. I hope that the work I have written as a result of our many years of research will become a table book in Azerbaijan. Azerbaijan has the right to be proud of its culture and art all over the world ... Whether we like it or not, it is so. Azerbaijani culture is as ancient and rich as the culture of China and Mesopotamia " / 10 /.

September 2, 2000 was T. Heyerdahl's fourth and last visit to Azerbaijan. While receiving the famous traveler Tur Heyerdahl in Baku, President Heydar Aliyev said, "I laid the foundation of our relations with you in 1981. I think that in the XXI century, these relations will further develop. I appreciate your interest in our country and its history. ... When I met you in Baku 20 years ago, perhaps you and a few other people in Norway did not know that there was is country - Azerbaijan. What kind of country is Azerbaijan? Many did not know it. Because Azerbaijan was not an independent state, it was a republic within the Soviet

Union. Now Azerbaijan is well known in Norway. Norway is also recognized in Azerbaijan ... I think that these relations will further develop in the 21st century. You and I will be at the helm of the development of these relations! ”/ 11 /.

Speaking about his visits to Azerbaijan, Tour Heyerdahl addressed President Heydar Aliyev: “ - I attach special importance to our cooperation with the Academy of Sciences of your country. I declare that both geographers and experts in the field of genetics, specialists, linguists and archeologists work together in this cooperation. Everyone contributes to the part they know. Thus, the truth arises from this cooperation when we gather and summarize the results of scientific research known to us separately. The main purpose of my current visit is to work with your scientists to get acquainted with the information about Azerbaijan in the pre-Viking history, to cooperate with them in this field. As a result of the information I received here, I came to the conclusion that the royal families in the Scandinavian countries originated in Azerbaijan. Their ancestors were born and left this country in the first century BC or after our era. ”/ 12 /

At that time, Heyerdahl met with Azerbaijani historians and ethnographers at the Azerbaijan University of Architecture and Construction, the Presidium of the Academy of Sciences.

Those who watched the meeting with the head of state on television, and then read this information in the newspapers, greeted with great pride that our countries are connected by historical roots and the closeness of our peoples of the same ancestry. The researcher of this history, Tour Heyerdahl, was recognized as one of the most famous personalities as a close friend of Azerbaijan.

April 20, 2002. A friend of Azerbaijan, a great scientist, traveler Tour Heyerdahl, who introduced Azerbaijan to the world, died at the age of 88. This news was remembered with great sadness in Azerbaijan. President Heydar Aliyev has sent his condolences to His Majesty King Harald V of Norway and the Norwegian people ... / 13./

That day I heard the news of Heyerdahl's death. When I went to the Norwegian embassy in the Old City of Baku, I thought that I could visit Gamigaya with him, but this dream did not come true. September 2, 2000, I proposed this to the Ambassador of the Kingdom of Norway to Azerbaijan, Olav Berstada, to arrange a visit to Gamigaya when Tur Heyerdahl visits Azerbaijan next time. The ambassador approved my proposal. I met with translator Elmira Mirzayeva at the embassy. Then I wrote my heartfelt words in a book of memories placed in front of the black ribbon-framed portrait of Tour Heyerdahl on the table, and expressed my condolences to the people of Norway and the family of Tour Heyerdahl for this great loss.

Years pass, time passes. At the highest point of the Zangazur range of the Lesser Caucasus Mountains, where our ancestors lived for centuries, Gapigig Peak, located at an altitude of 3904 meters above sea level, is located at the foot

of this mountain. There are images of people and animals on black, dark and silver stones, as well as paintings, signs and inscriptions, many of which are still unsolved. Legend has it that these mountains once held Noah's ark in their arms and withstood heavy floods. Centuries have passed since then, but the majesty of the mountains has not been broken, the bloody, eternal traces of history are engraved on the rocks ... Every time I look at the pictures on the rock paintings, I think about the works of art engraved on them by our ancient ancestors.

I expressed my views on the similarities and kinship of Norwegian rock paintings, stone monuments, as well as common features with Gamigaya's paintings: These researches will be carried out by the followers of Tour Heyerdahl together with Azerbaijani scientists ... The samples engraved on the rocks by our ancestors 8-10 thousand years ago, the secrets of the images and writings that have been considered legends for centuries are revealed to our generations. We are proud of our ancient history and culture”/ 14 /.

Due to all this, Tour Heyerdahl is famous in Azerbaijan. Tour Heyerdahl, whom I talked about above, is known in our country as a famous traveler, scientist and researcher for his life and activity, secular research and scientific research.

### References

1. Dagne, Tour: History of Norway. Oslo: “New from Norge”, 1998
2. Afet Sadigoglu, “Azerbaijan-Norway relations”, Baku, "Nurlan" publishing house, 2002
3. "Communist" newspaper, Baku, August 28, 1981.
4. Heyerdahl, Tour: My 20th century. In the footsteps of Adam. Moscow, Bagrius, 2001
5. "Azerbaijan" newspaper, Baku, April 25-27, 1996
6. Thor Heyerdahl, Oslo, Norway, 1994.
7. Afet Sadigoglu, "Tour Heyerdahl in Azerbaijan" Baku, Elefant Polygraphy Publishing House, 2006
8. "Respublika" newspaper, Baku, May 12, 1999
9. Afet Sadigoglu, "Tour Heyerdahl in Azerbaijan"
10. Afat Sadigoglu, "Tour Heyerdahl in Azerbaijan"
11. "Respublika" newspaper, September 3, 2000.
12. "Respublika" newspaper, September 3, 2000.
13. Afat Sadigoglu, "Azerbaijan-Norway relations",
14. Afat Sadigoglu, "Tour Heyerdahl in Azerbaijan"

## ECONOMIC SCIENCES

### AZERBAIJAN'S VICTORY IN THE 44 DAY WAR CHANGED THE COURSE OF HISTORY IN THE KARABAKH CONFLICT

**Z.A. Samedzade**

*Union of Economists of Azerbaijan,  
Azerbaijan Section of the International  
Academy of Sciences*

*The Second Karabakh War, which resulted in the restoration of Azerbaijan's territorial integrity and the liberation of the occupied territories, created completely new realities in the region and significantly strengthened the position of our republic both in the South Caucasus and globally. The victory achieved on the battlefield by the Supreme Command of Ilham Aliyev introduced Azerbaijan, which has been experiencing a period of rapid growth in recent decades, as a victorious state in the international arena. This victory was the culmination of our last two centuries of history. Although the war is over and the conflict is over, Azerbaijan continues its success on the Karabakh square.*

#### **A historic trip made on a historic day**

On the eve of the 30th anniversary of the restoration of Azerbaijan's independence, the next glorious page of the annals of statehood is being written. Our people witnessed the next event engraved in golden letters in our history on June 15 - the Day of National Salvation - with the visit of Turkish President Recep Tayyip Erdogan to our republic and the signing of the Shusha Declaration between Azerbaijan and Turkey.

The Declaration of Alliance between Turkey and Azerbaijan signed in Shusha was another historic success after the Karabakh victory. As in the victory in the Second Karabakh War, the authors of this Declaration are Azerbaijan and Turkey. The leaders of the fraternal states - Ilham Aliyev and Recep Tayyip Erdogan - raised the existing relations and cooperation to a new level with this Declaration.

First of all, I would like to note that the Azerbaijani-Turkish relations have reached their highest peak years ago. The fact that our peoples have the same ancestry, language, religion, culture and many other ties has always

brought our countries closer to each other, and our peoples have stood by each other in happy and sad days. Today, sincere relations between Azerbaijan and Turkey based on common values are a rare event in the international arena. The friendship and brotherhood of the two states is their greatest asset. Speaking to the press in Shusha, President Ilham Aliyev said the two brotherly states set a unique example of cooperation, alliance and alliance in the world press: "Today, Turkey and Azerbaijan are the countries closest to each other in the world. There are many factors that unite us, first of all, history, culture, common ethnic roots, language, religion, national values, national interests, brotherhood of our peoples have ensured this unity. Today, we are setting a unique example of cooperation, collaboration and alliance on a global scale ".

Azerbaijani-Turkish relations, which have no analogues in the world in terms of scale and content, were further strengthened during last year's Patriotic War, having successfully passed the historical test. During the 44 days of the war, which ended with the liberation of our lands, the whole world was once again convinced of the strength and inviolability of the Azerbaijani-Turkish brotherhood. The Turkish state, resolutely supporting the cause of Azerbaijan, has fulfilled its fraternal and moral mission. From the first days of the war, fraternal Turkey provided political and moral support to Azerbaijan. Turkish President Recep Tayyip Erdogan made clear and unequivocal statements that Azerbaijan is not alone in this war and that Turkey has always supported Azerbaijan. This strengthened our forces and played an important role in the Karabakh Victory. In particular, the standing of Recep Tayyip Erdogan next to President Ilham Aliyev at the Victory Parade on Freedom Square in Baku once again demonstrated to the world the unity of our countries and the brotherhood of our peoples. The liberation of Shusha was a very important event not only for Azerbaijan, but for the entire Muslim and Turkic world. The Azerbaijani armed forces, which liberated Shusha under the leadership of Azerbaijani President and Supreme Commander-in-Chief Ilham Aliyev, once again clarified the question of who has a real right to vote in the South Caucasus region. The visit of the President of Turkey to Shusha was another confirmation that such a great power stands next to Azerbaijan in the form of a fraternal country, and that the strategic alliance between these countries has become a stronger alliance. The visit of Turkish President Recep Tayyip Erdogan to the liberated Shusha, who made another visit to Azerbaijan in June 2021, and the meeting of the heads of the two states here were the most important political events of recent times in terms of the content of Azerbaijani-Azerbaijani Turkish relations. This visit once again announced the Azerbaijani-Turkish brotherhood to the world, became a great political success for the Turkic world, made our friends happy, and the dagger plunged into the heart of the enemy. "The Azerbaijani and Turkish flags flying

in Shusha today testify to our unity. From the first hours of the Second Karabakh War, my dear brother, President Recep Tayyip Erdogan expressed unequivocal, clear and open support for Azerbaijan. From the first hours of the war, he said that Azerbaijan was not alone. This inspired us, but at the same time stopped all the forces and circles that were going to interfere. He said that Turkey was with Azerbaijan and from the first hours until the last minutes of the war, the support of my dear brother and the Republic of Turkey, the fraternal Turkish people, gave us additional strength. This political and moral support inspired us. "Messages, congratulations, expressions of support and solidarity from all over Turkey once again demonstrated our unity to the whole world", Ilham Aliyev said. Meeting of President Ilham Aliyev and Recep Tayyip Erdogan in Shusha, participation of heads of state in the musical composition "Musical heritage and Karabakh horses in the Cidir plain" organized by the Heydar Aliyev Foundation, visits to "Khan gizi" spring, visiting statues of famous Azerbaijani personalities Natavan, Bulbul and Uzeyir bey Hajibeyli, The meeting of the First Lady of Azerbaijan Mehriban Aliyeva and the First Lady of Turkey Emine Erdogan became another embodiment of the Azerbaijani-Turkish brotherhood. Every event held in Shusha also went down in history as an open message to the enemy. As in the Karabakh war, Azerbaijan and Turkey will continue to support each other at the highest level. In general, the visit of the President of Turkey to Shusha is one of the most obvious indicators of the fact that the unshakable friendly and fraternal relations between the two countries and their leaders are really at the highest level. Therefore, this visit is a historical event of great importance both for our countries and for the entire Turkic world. Another interesting point about this visit is the choice of date. Given that this is the first visit of the President of Turkey to the liberated territories of Azerbaijan, then we can say that the choice of the date and destination of the visit is not accidental. Usually, significant days in the destiny of a nation or a country are called historical days. Just as June 15 is one of the most important historical days for the people of Azerbaijan. On this day in 1993, the great leader Heydar Aliyev was elected chairman of the Supreme Soviet of the Republic of Azerbaijan to fulfill his mission of salvation, and June 15 entered the history of Azerbaijan as the Day of National Salvation. For 25 years, the people of Azerbaijan have been celebrating this day with great solemnity as a national holiday. But from now on, future generations will celebrate June 15 not only as a historic day, but also as a starting point for the most recent history of the entire Turkic world. On June 15, 2021, President of the Republic of Azerbaijan Ilham Aliyev and President of the Republic of Turkey Recep Tayyip Erdogan made history in Shusha, the ancient city of Azerbaijan, the cradle of Turkish culture.



The fact that the visit took place on June 15 should be taken as a sign that this significant day is a day of great beginnings in the history of the Azerbaijani people. The fact that the Way of Salvation born of the genius of the Great Leader is the beginning of the unity of the whole Turkic world in a new format today shows that Heydar Aliyev's political course will continue to make an unprecedented contribution to the welfare and development of all mankind.

**The signing of the Shusha Declaration is a continuation of the historic victory of the two brotherly states in the Karabakh war on a new level.**

On June 15, 2021, Azerbaijan and Turkey took a historic step and signed a Declaration that will change the geopolitical landscape of the region. The signing of the Shusha Declaration on Allied Relations between the Republic of Azerbaijan and the Republic of Turkey in Shusha was a continuation of the historic victory of the two brotherly states in the Karabakh war on a new level. Noting the historical significance of this visit, President Ilham Aliyev said that the joint declaration on alliance raised our relations to the highest level: "My dear brother has visited Azerbaijan many times, but for the first time we are together in the land of Karabakh - Shusha. This visit has historical significance. Because the Joint Declaration - the Declaration of Alliance, signed today, raises our relations to the highest level. The name of the Declaration is the Declaration of Alliance, and this name in itself indicates everything, says everything. Today, we have established a qualitatively new relationship, and all the provisions of this Declaration are the guarantor of our future cooperation.

The Shusha Declaration, which has exceptional political and historical significance, states that Azerbaijani-Turkish relations are characterized by the words of national leader Heydar Aliyev "One nation, two states" and the founder of the Turkish Republic Mustafa Kemal Atatürk "Azerbaijan's joy is our joy, our sorrow is our sorrow" has reached its peak and entered a qualitatively new stage.

Turkey's moral and political support in ending 30 years of Armenian aggression, liberating the occupied territories and restoring the territorial integrity of Azerbaijan is highly appreciated by our people. At present, the joint initiatives of our countries to strengthen stability and security in the Caucasus region, restore all economic and transport ties, as well as normalize relations between the countries of the region and ensure long-term peace are the best example of the need to increase efforts in this area. At the same time, the activity of the Turkish-Russian Joint Center in Karabakh attracts attention as an effective mechanism for establishing peace in the region. The Shusha Declaration is aimed

at defining the political and legal mechanisms for establishing allied relations between the two countries, which pursue the principles of independence, sovereignty, territorial integrity, inviolability of internationally recognized borders, non-interference in the internal affairs of states and pursue an independent foreign policy to protect and ensure national interests. Have a major importance. Demonstrating solidarity and strategic cooperation on international issues of mutual interest, Turkey and Azerbaijan share the same position and deepen bilateral cooperation, as well as within international and regional organizations, including the UN, OSCE, Council of Europe, Turkic Council and Organization of Islamic Cooperation provide mutual support. Those who intend to threaten the state sovereignty of Azerbaijan will face a new regional military-political bloc. One of the most important points in the declaration is military cooperation and alliance. It states that the territorial integrity and sovereignty of the two states will protect each other in the event of a threat or aggression by a third state or states. The declaration reads: "In the opinion of either Party, in the event of a threat or aggression by a third State or States against its independence, sovereignty, territorial integrity, inviolability or security of its internationally recognized borders, the Parties shall hold joint consultations and consider this threat or aggression They will take initiatives in accordance with the purposes and principles of the UN Charter and provide each other with the necessary assistance in accordance with the UN Charter. The amount and form of this assistance will be determined through immediate discussions, it will be decided to meet the defense needs for joint action, and the coordinated activities of the Armed Forces and management structures will be organized. The inclusion of this provision in the Declaration is a very important message for individual neighboring and non-regional states, starting from the revanchist forces in Armenia today. With the Shusha Declaration, Turkey openly informs the international community that it will stand by the army and our country in the event of violations of Azerbaijan's territorial integrity and threats to state borders. Of course, we are talking about actors and states that have been pursuing their state interests in the region for centuries under the name of the Armenian issue.

After that, all neighboring countries and the world community should know that those who intend to threaten the state sovereignty of Azerbaijan will face a new regional military-political bloc. The two brotherly countries also make joint efforts to reshape and modernize the armed forces of the two countries in accordance with modern requirements, implement measures to strengthen defense capabilities and military security, increase the joint capacity of the two countries' armed forces, modern weapons and ammunition management agreed to promote close co-operation and, for this purpose, to ensure the coherent functioning of the competent structures and institutions.

The holding of regular joint meetings of the Security Councils of the two countries on national security issues and the agreement to discuss regional and international security issues affecting the national interests of the two countries are an indication of the close and principled relations between Azerbaijan and Turkey. This means that from now on, the Security Councils of Azerbaijan and Turkey will hold regular joint meetings and work together against threats.

**The statement of the Zangazur corridor in the statement shows that Azerbaijan and Turkey will soon realize a great bridge of regional cooperation.**

With the signing of the declaration, Azerbaijan and Turkey will achieve the diversification of national economies and exports, as well as the organization of free movement of goods in trade and economic relations with each other. Thus, the document calls for increasing efforts to diversify national economies and exports, taking necessary measures to establish mechanisms for organizing the free movement of goods, coordinating efforts to effectively use and further develop the Southern Gas Corridor, international cooperation using intelligent transport systems. There are also topical issues such as further development of transit-transport potential in the Azerbaijani-Turkish sections of transport corridors, restoration of transport-communication links in the region, promotion of the development of international transport corridors. In this regard, one of the main issues touched upon in the document is related to the Zangazur corridor. The parties note that the opening of the corridor (Zangazur corridor) between the western regions of the Republic of Azerbaijan and the Nakhchivan Autonomous Republic of Azerbaijan and the construction of the Nakhchivan-Kars railway as a continuation of this corridor will make an important contribution to intensifying transport and communication between the two countries. The Zangazur corridor will be a bridge connecting the entire Turkic world. The mention of this issue in the Shusha declaration shows that Azerbaijan and Turkey will implement the Zangazur corridor as soon as possible in accordance with the new reality of the region.

The opening of the Zangazur corridor, a historical fact, is undoubtedly an important blow to the anti-Turkish propaganda carried out by Armenians in the region for more than a hundred years. It should be noted that the Armenians, through lobby groups in Christian countries, have long stressed the importance of establishing a Christian vassal state in the Caucasus, trying to increase their geopolitical weight under the pretext of Turan. However, the victory of Azerbaijan in the war in Karabakh in the autumn of 2020, the opening of a new transport corridor through Zangazur will be a significant blow to the ongoing

geopolitical weight of the Republic of Armenia and will significantly reduce the "importance" of Armenians in some countries. Let's not forget that some time ago an agreement was reached that Azerbaijani and Turkish citizens can travel with ID cards. So, with the Shusha Declaration, we will witness the opening of a new page in tourism and trade relations between the two countries. This is also an indication that the border between the two countries will be formal.

**Ilham Aliyev: "We demonstrate our loyalty to our ancestors and guide future generations"**

Speaking about the Shusha Declaration, the list of areas to be emphasized includes information policy and lobbying issues that are currently relevant. Thus, there is a need for joint steps in the field of media platform and diaspora for the parties to operate more effectively in the international arena. The declaration includes provisions on further strengthening cooperation between the relevant agencies of the two countries in the field of information, communication and public diplomacy within the capabilities of the Azerbaijan-Turkey Media Platform and closer cooperation between the Azerbaijani and Turkish diasporas, joint steps and consistent solidarity is a clear example of what is said. Given Armenia's unfounded claims against Turkey, attempts to falsify history and politicize historical facts, threatening peace and stability in the region, it is important to open archives on the events of 1915 and strongly support the efforts of historians to investigate this issue. The Declaration also contains a provision on the foreign policy behavior of Azerbaijan and Turkey. The document states that the parties pursue an independent foreign policy aimed at ensuring their national interests. According to the document, joint efforts will be made to develop international relations and address local, regional and global security and stability issues. It emphasizes the importance of foreign policy coordination and bilateral political consultations. The importance of activities in this direction within the High-Level Strategic Cooperation Council between Turkey and Azerbaijan is noted. In general, all the issues included in the Declaration are very important for Azerbaijan and Turkey. In this regard, the Shusha Declaration fully covers the national interests of Azerbaijan and Turkey. In general, Azerbaijani-Turkish relations have always had a strategic content. So far, the two countries have signed documents defining the strategic alliance. The Shusha Declaration further strengthened this alliance and gave it a new political content. This historic document will further increase the regional and international role and weight of our countries as a logical consequence of combining opportunities to protect the common interests of the two brotherly countries, as well as coordinating activities on regional and international strategic issues of common interest. President Ilham Aliyev described the signing of the Alliance Declaration

as a demonstration of our loyalty to our ancestors and a guide for future generations: “The signed Declaration is based on history. The declaration reflects the words of the great leaders of our peoples, Mustafa Kemal Ataturk and Heydar Aliyev. At the beginning of the 20th century, Mustafa Kemal Ataturk said: "Azerbaijan's joy is our joy, our sorrow is our sorrow". At the end of the 20th century, Heydar Aliyev said: "Turkey and Azerbaijan are one nation, two states". These historical words are the main factor for our activity. We are faithful to this testament and demonstrate our loyalty to our ancestors and guide future generations by signing the Alliance Declaration in Shusha, liberated in the 21st century”. The Shusha Declaration signed by President Ilham Aliyev and President Recep Tayyip Erdogan is a historical fact that the whole world must reconcile. The agreement, aimed at combining opportunities to protect the common interests of both countries, as well as coordinating their activities on regional and international strategic issues of mutual interest, is the beginning of a new regional geopolitical configuration led by Baku and Ankara. This marks the end of nearly 200 years of geopolitical configurations in the region and the beginning of a new regional order that will continue under the leadership of the Azerbaijani-Turkish tandem. The declaration defines a new strategic content of relations between Azerbaijan and Turkey, opens the way for a qualitatively new stage by raising relations to the highest level. It is safe to say that the Azerbaijani-Turkish relations will further develop rapidly and bring new great successes to our peoples and states. This Declaration is also a message to the enemies of Azerbaijan and Turkey. This Declaration is an example of integration between Azerbaijan and Turkey in all areas. Most importantly, this Declaration means a new historical reality for the region.

### **The Shusha Declaration is the largest historical agreement since the Kars agreement**

The Shusha Declaration on Joint Alliance is the largest historical agreement since the Kars Agreement, reflecting the development of relations between the two countries at a new stage. In this regard, the fact that the Declaration coincides with the Day of Salvation of the Azerbaijani people, as well as the 100th anniversary of the Kars Agreement, which is very important for Karabakh and Zangazur, has a special symbolic meaning. We are witnessing the repetition of history and the recurrence of similar events. Even now, the United States, Russia, Britain, France and Iran are openly fighting for the region. But this time the difference is that the events are in the interests of Azerbaijan. It is no coincidence that while signing the Declaration with the Turkish leader in Shusha, the President of Azerbaijan reminded everyone of the Kars Agreement. He noted: “The historic Kars agreement was signed exactly one hundred years

ago. This also has a great symbolic meaning. The joint declaration of alliance signed in the liberated city of Shusha a hundred years later shows the direction of our future cooperation. The declaration covers many important issues. At the international level, joint cooperation, our activities, political relations, economic and trade relations, culture, education, sports, youth policy cover almost all areas. The importance of the Southern Gas Corridor for Turkey, Azerbaijan and the world is highlighted. Every issue is very important".

Of course, it is not accidental that President Ilham Aliyev referred to the Kars agreement and what happened 100 years ago. Because situations similar to those that took place 100 years ago are still happening. With just one difference. If then the events ended in favor of Armenia and its supporters, the new reality in the South Caucasus today means a direct victory of the Azerbaijani state and people. As a result of the far-sighted policy pursued by the President of our country, our people restored historical justice exactly 100 years later. In this regard, the historic Kars Agreement with the Shusha Declaration has become a new stage and an international legal guarantee of stability in the region. The land of ancient Azerbaijan, Nakhchivan, has been a constant target of Armenians. Only the Kars agreement signed between Turkey and Soviet Russia prevented all claims of Armenians 100 years ago. This agreement was signed in a historical context in which Russia's transformation into a superpower in the eyes of the world community seemed mysterious and was dictated by history. As a result of the agreement, Nakhchivan was able to gain the status of an Autonomous Republic within Azerbaijan with the support of Turkey. The fact that the Kars agreement plays a guarantee role in the protection of this autonomy has already been confirmed in history. I reminded that the great leader Heydar Aliyev always praised the importance of the Kars agreement in maintaining the territorial integrity and autonomy of Nakhchivan". As Nakhchivan is separated from the main land of Azerbaijan, the Kars agreement is a great and irreplaceable document for us to ensure the integrity, security, statehood and autonomy of Nakhchivan in the future," he said.

Armenians have always opposed the Kars agreement. Even after the end of World War II, there were Armenians who were active during the political tensions between the USSR and Turkey over this issue. However, at that time, Turkey adequately secured its national interests, and the USSR had to give up its territorial claims against Turkey. 100 years later, the Supreme Commander-in-Chief, President Ilham Aliyev, referring to the Kars Agreement in the historic Shusha Declaration, declared to the world that Azerbaijan is a leading state in the Caucasus and Turkey is the main guarantor of peace and stability in the region. The Shusha Declaration has already become a perfect international legal document determining the future of the South Caucasus region. At present, this

document is being seriously studied, analyzed and drawn conclusions by the South Caucasus states and international centers of political will with interests in the region. Probably, the Shusha Declaration will remain the main topic of the regional agenda for a long time.

### **Messages from Azerbaijan to the world**

After the signing of the Shusha Declaration, the statements of the President of Azerbaijan Ilham Aliyev and the Leader of Turkey Recep Tayyip Erdogan contain very important messages on the future development prospects of the South Caucasus. Both presidents make no secret of their readiness to make any sacrifices and take decisive steps to bring the region to a stage of development in peace and tranquility.

The choice of Shusha to sign the declaration is a clear signal that Armenia, devastated by Armenia, is becoming a venue for the liberation of occupied territories, hosting cultural events, as well as the signing of diplomatic agreements. Before arriving in Azerbaijan, Recep Tayyip Erdogan attended a NATO summit and met with US President George Biden, French President Francois Macron, British Prime Minister Boris Johnson and German Chancellor Angela Merkel. At a press conference after the NATO summit in Brussels, the Turkish president said that justice had been done in Karabakh, albeit late, and called for strong support from NATO in this matter. The gates of a time when war could be replaced by peace, tension by peace, and instability by permanent peace were opened. We consider it necessary for the union to give strong support to these operations, which we support beyond the borders of our country ". Following this important meeting, Erdogan's visit to Azerbaijan and the signing of the Shusha Declaration once again showed the world that Turkey will always defend the cause of Azerbaijan. Azerbaijan's victory in the Second Karabakh War has created a new reality in the South Caucasus. Today, with the joint efforts of Azerbaijan and Turkey, projects that change the geopolitical landscape of the region will be implemented in a planned and determined manner. These issues are also reflected in the Shusha Declaration. The new reality serves the development and prosperity of all countries in the region.

Armenia, whose policy of occupation ended in the 44-day war, has no choice but to come to terms with this reality. Because for Armenia, the alternative to this path is poverty and darkness. The Presidents of Azerbaijan and Turkey, who sent messages to the world from Shusha, also invited everyone to see the truth, accept the Victory of the Azerbaijani people and look to the future. At the same time, messages from Shusha were addressed to all countries in the region. President Recep Tayyip Erdogan stressed the cooperation of the six countries for lasting peace in the region: "As Turkey, we also want to focus our geographical

neighborhood relations on deeper cooperation. We wish Armenia to extend a hand of solidarity extended to it with good intentions and take advantage of the opportunity to form a common future together. We said six platforms. As you know, there are Russia, Turkey, Azerbaijan, Armenia, Georgia and Iran on these six platforms. Together with these six platforms, we now want the region to be a zone of peace and tranquility. My brother and I are ready to make any sacrifice to take this step. Mr Putin is equally ready for such a sacrifice. With the steps taken in this direction, the region will become a zone of peace ".

The Turkish President's speech in the Milli Majlis was mainly based on the explanation of ways to open additional opportunities for the development of the South Caucasus countries. The Turkish leader offers a new platform for international cooperation. According to him, the new platform, which unites six countries - Russia, Turkey, Azerbaijan, Iran, Armenia and Georgia, will bring stability to the region and eliminate existing hostilities. The new platform will serve the development of the entire region.

The Turkish leader is setting an example of Azerbaijan's state policy to overcome obstacles to development in the region. Undoubtedly, the Turkish president is absolutely right. Because the state policy of Azerbaijan is based on mutual trust and ensuring common geopolitical interests in the region. The cooperation platform proposed by the Turkish leader is of great interest in this regard. Because the example of Azerbaijan's regional state policy seems to be one of the important conditions for the realization of this platform, which can bring peace and development to the South Caucasus. But there is an issue that Armenia is still pursuing a policy of strong hostility towards Azerbaijan and Turkey. It poses a serious obstacle to peace and development prospects in the region. And official Yerevan, which is only trying to bring its conditions to the fore, is still reluctant to abandon this policy. Therefore, first of all, it is important for official Yerevan to renounce its principles of regional hostility and accept the geopolitical conditions that allow the opening of transport and communication lines with neighboring countries. Otherwise, regional cooperation with a state that is hostile to its neighbors and makes territorial claims is unlikely. Armenia, whose policy of occupation ended in the 44-day war, has no choice but to come to terms with this reality. Because for Armenia, the alternative to this path is poverty and darkness. On the other hand, there are serious problems between Russia and Georgia. Official Tbilisi is cautious about participating in any geopolitical platform represented by Russia, so far preferring only bilateral relations. The reason is that Russia does not respect the territorial integrity of Georgia. However, the regional cooperation platform proposed by the President of Turkey promises very attractive development prospects. It opens wide



prospects for all participating states in terms of transport and communications, as well as sustainable financial revenues in the economic and trade spheres. Therefore, these attractive financial and economic prospects may encourage the countries participating in the platform to make concessions in the near future. All this shows that the presidents of Azerbaijan and Turkey, in fact, are proposing a development scenario on a new "road map" that can involve the countries of the South Caucasus and the region in normal relations. It is possible that the states that can join the platform will soon respond positively to this avant-garde "road map". This is because countries that are hesitant or fail to assess regional development prospects in a timely manner may be left out of the process.

From this point of view, it is possible that the countries with interests in the region will try to use the theses in the messages of the Presidents of Azerbaijan and Turkey for future partnership opportunities. The path to lasting peace passes through mutual trust and cooperation of all peoples and states in the region. The best basis for creating this environment is the history, culture and state policy of Azerbaijan. The positions of Turkey and Azerbaijan are clear. These two brotherly states are committed to stability and security in the region. Russia's position is also clear. The trilateral statement signed last year also shows that Russia is interested in restoring ties in the region. The position of the Georgian state is also clear. It should be noted that official Tbilisi expressed its good intentions through its mediation in the transfer of mine maps from Armenia to Azerbaijan. At the official level, the Iranian state also respects the processes taking place in the South Caucasus and the restoration of Azerbaijan's territorial integrity. We hope that the newly elected President of Iran will continue this policy. We must also emphasize that the Azerbaijani people historically believe that Russia also played a role in the emergence of the Karabakh problem. It is impossible not to justify such a thought. Because what happened during the reign of Tsarist Russia, the purposeful resettlement of Armenians in the region, discrimination against the local Azerbaijani population, the subsequent establishment of the Nagorno-Karabakh Autonomous Region, from time to time led to the emergence of Armenian claims here. In this regard, the Azerbaijani people are right. Today, with its policy, Azerbaijan ensures the stability of the region with the participation of Russia. In this regard, the Shusha agreement will also serve the development of the entire region in cooperation with our close neighbor Russia. One of the most important issues is that Russian political circles are already convinced that Azerbaijan is Russia's main partner in the South Caucasus. Russia also considers Azerbaijan a leader in the South Caucasus. This leadership, of course, is not limited to borders. This leadership is determined by the projects implemented by Azerbaijan in the region as a whole, the new realities brought to the region by the Karabakh victory. President Recep Tayyip Erdogan's speech in the Milli Majlis after his visit to Shusha was a logical

continuation of the great political and historical process we have witnessed. Saying that they were in Shusha with Azerbaijani President Ilham Aliyev and their delegations the day before, Turkish President Erdogan said they were happy to see the Azerbaijani flag proudly waved in this ancient Azerbaijani city, the land of free Karabakh. Expressing confidence that the benefits of the Karabakh victory over Azerbaijan, the Caucasus and the world will be better understood over time, President Erdogan stressed that this victory is a victory of construction, justice and peace. The speech of the President of Turkey in the Milli Majlis once again showed that the friendship and brotherhood between Turkey and Azerbaijan are eternal and unshakable. The President of Turkey gave a number of messages in his speech. One of the most important messages was that Turkey is still with Azerbaijan with all its capabilities, and the whole world should know that it will be with it tomorrow.

### **The political and economic power of the Turkic world is growing**

The results of the Second Karabakh War, the new realities in the region, the signing of the Shusha Declaration, along with all its merits, bring the Turkic world to the forefront of regional processes and increase its weight on a global scale. The successful results of the Turkish state's policy in the region are in sight. We must emphasize that in recent decades, the political and military weight of official Ankara in the region has increased significantly. The Turkish government, which has made great strides in the fight against terrorism and separatism at home and has prevented the activities of foreign-run religious and political groups, has resolutely eliminated threats posed by its borders in recent years. Another important issue is that Turkey pursues a completely independent policy on any issue. It is clear that in the past there was a different environment for Turkey's foreign policy. But now Turkey is pursuing a completely independent policy, resolutely pursuing its political and military interests in the region. Of course, these successes of Turkey deeply concern certain political circles in the West. As a result, we have witnessed serious influence on Ankara by the United States, France and other political centers in Libya and Syria, as well as in intelligence work in the Mediterranean. But in the end, they saw that it was impossible to turn Turkey away from its path.

In particular, the brotherly state came under pressure in the Karabakh issue. However, President Erdogan and Turkish military and political figures declared their support for Azerbaijan to the end and proved their words by their actions. And this victory, in the example of Azerbaijan and Turkey, brought the whole Turkic world to the fore in international processes.

At the same time, the tripartite statement signed last year and the Shusha Declaration are a great victory of the Turkic world in the example of the victory

in Karabakh. The whole world is witnessing new realities in the region, which are the successes written in the name of the Turkic world. With the establishment and restoration of new transport links, one of these successes, the Zangazur region will become a bridge connecting the entire Turkic world. President Ilham Aliyev defined this as Azerbaijan's national interest 12 years ago. At the IX Summit of Turkic-speaking countries in Nakhchivan on October 3, 2009, President Ilham Aliyev said in this regard: "the activity of the Turkic world as a single family, as a single force has been suspended for decades. However, we are strengthening this connection with the decisions taken today and the steps taken". Speaking at the 7th Summit of the Cooperation Council of Turkic Speaking States in Baku on October 15, 2019, President Ilham Aliyev reiterated that the annexation of Zangazur from Azerbaijan to Armenia divided the great Turkic world geographically, but with the decisions we made in Nakhchivan and our joint work we have further strengthened the unity of the Turkic world and continue our brotherhood. Another point that highlights the Turkic world in the example of Azerbaijan is the activity of President Ilham Aliyev within the Non-Aligned Movement. Diplomatic activity in this political sphere has led to a correct assessment of the Karabakh issue on a global scale, which has dealt a major blow to the anti-Azerbaijani and anti-Turkish propaganda carried out by world Armenians for hundreds of years.

### **Restoration and preservation of historical and cultural heritage in Shusha, the capital of culture of Azerbaijan, focuses on improving governance**

For months, Azerbaijan has begun rapid construction work in its liberated territories. The implementation of some infrastructure projects has already been completed, the foundation of the city of Agdam has been laid, and the implementation of "smart village" concepts has begun in Zangilan. Doing very important work in a short period of time is also a message to the world that Karabakh is the ancient land of Azerbaijan. Yes, many countries did not say openly, but even during the occupation they accepted that Karabakh was the land of Azerbaijan. Today's international recognition of the reconstruction work in Karabakh confirms that the international community accepts Azerbaijan's victory. It is no coincidence that former Armenian President Levon Ter-Petrosyan recently stated that the world recognizes Karabakh as Azerbaijani land.

In particular, the complex construction and landscaping work carried out in Shusha is a message to the world. As I mentioned earlier, the selection of Shusha for the signing of the Declaration is a clear message that Karabakh, devastated by Armenia, is becoming a venue for the signing of diplomatic agreements, as well as hosting cultural events.

Shusha has historically been one of the important centers of historical, cultural, socio-political life of Azerbaijan. In 1977, on the initiative of the national leader of our people Heydar Aliyev, a decision was made to "declare the historical part of Shusha a historical and architectural reserve". As a result of this decision, significant steps have been taken to protect monuments in Shusha and perpetuate the memory of prominent cultural and artistic figures. As a result of the military aggression against Azerbaijan, the Republic of Armenia occupied the city of Shusha on May 8, 1992 and pursued a policy of destroying the historical and cultural heritage of our people in the city.

With the resolute struggle of our army, historical justice was restored and on November 8, 2020, the city of Shusha was liberated from occupation. Immediate inventory of damage to the city, its historical and cultural heritage and nature was carried out, and restoration work began. Under the leadership of President Ilham Aliyev, large-scale restoration and construction work is being carried out in the city, historical, cultural and religious facilities are being restored, and new urban planning projects meeting modern requirements are being implemented. The measures taken within the framework of the President's regular visits are inspected on the spot and detailed information is provided on their implementation. It is known that Armenians celebrate May 8 every year with a special ceremony and were proud of the occupation of Shusha on May 8, 1992. Our enemies have been lobbying in various countries, distorting the history of Shusha and trying to present it as "Shushi" in order to gain international support for the occupation. President Ilham Aliyev's great political goal is to convey to the world community that Shusha is truly an ancient Azerbaijani land, a cultural center. Undoubtedly, after the restoration and construction of the city, which will be completed in the near future, Shusha will be restored to its historical glory as the ancient land of Azerbaijan, and will become a great city of culture, peace and friendship. By strengthening the tourism potential, many foreign tourists visiting the city will have the opportunity to see the realities of history in Azerbaijan and Karabakh. Special attention was paid to public administration in Shusha region to ensure efficiency and effectiveness in the organization of restoration, construction and landscaping work. In accordance with the current conditions, the first special envoy of the President of the Republic of Azerbaijan in the liberated territories was appointed to Shusha region ". The first appointment is to Shusha region. This is natural. Shusha has a special place in the hearts of the Azerbaijani people. Shusha is the crown of Karabakh, Shusha is a unique city. The location, nature, air, climate, historical monuments, religious monuments, architectural ensemble of Shusha are our national treasures. We must protect Shusha. We have returned to Shusha, and from now on the people of Azerbaijan will live in Shusha forever, said President Ilham Aliyev.

Its historical and cultural significance and exceptional moral value for the people of Azerbaijan make it necessary to treat Shusha with special care and sensitivity. In this regard, further improvement of public administration and legal regulation in Shusha will not only serve the restoration and preservation of historical and cultural heritage in the city, but also create conditions for its continuous development. On May 7, 2021, President of the Republic of Azerbaijan Ilham Aliyev signed an order declaring Shusha the cultural capital of Azerbaijan. In the modern world, cities that are considered the capital of culture have an important historical past at the national and regional levels, contribute to human culture in the field of science, art, literature, have cultural institutions that organize individual and collective cultural events and other necessary factors. As I mentioned, today, under the leadership and special attention of President Ilham Aliyev, the city's historical and cultural monuments are being restored with high quality, and the great contribution of the Heydar Aliyev Foundation and its head, First Vice President Mehriban Aliyeva should be noted. The announcement of Shusha as the cultural capital of Azerbaijan was the first step in achieving the goal set by the President to make this city one of the most beautiful cities not only in our country and the region, but also in the world. "Khari Bulbul" music festival, "Vagif Poetry Days" and other events organized after a long break will make Shusha one of the most important cultural centers in the world.

We note with great pride that the words of the great leader Heydar Aliyev "Karabakh without Shusha, and without Karabakh there is no Azerbaijan at all" "Dear Shusha, we will revive you"! The work done on the instructions of President Ilham Aliyev, who said that the city would be restored to its former appearance, is connected with the national spirit and moral values. Today Shusha is free. Under the leadership of President, Supreme Commander-in-Chief Ilham Aliyev, this ancient city, liberated from occupation as a result of the bravery of our victorious Army, was renamed the cultural capital of Azerbaijan. "I am happy to have fulfilled my father's will. We liberated Shusha! This is a great victory! The souls of our martyrs, the Great Leader, are happy today! Let your eyes be clear, Azerbaijan! Let your eyes be clear, Azerbaijanis of the world"! President Ilham Aliyev's "iron fist", which restored the value given to Shusha by national leader Heydar Aliyev, silenced the enemy forever.

### **Legal regulation was applied in Shusha by a special law**

In order to strengthen the institutional framework of activities in this direction, the President of Azerbaijan submitted a draft law "On the Cultural Capital of Azerbaijan - Shusha" to the Milli Majlis. After discussions in three

readings, the spring session of the parliament in 2021 adopted a very important document in the history of our legislation - the Law "On the cultural capital of Azerbaijan - the city of Shusha". This law, addressed by the President to the parliament as a legislative initiative and adopted after extensive discussions, is a fundamental legal document stemming from the celebration of state-people's unity. The law defines the legal and organizational basis for the protection, restoration, study, development and promotion of Shusha, the capital of culture of Azerbaijan regulates environmental protection, construction, architectural and urban planning activities in Shusha, transport organization, housing management, entrepreneurship, advertising, tourism and other activities, as well as holding international events in Shusha and a number of other important issues. The inclusion of economic provisions in the law will revive the city's economic life, make Shusha attractive to investors, as well as make Shusha an example for Azerbaijani cities as a center for innovative solutions in the future. The author of the idea of this law is President Ilham Aliyev and the vision of the President of Azerbaijan to protect the city of Shusha. Probably, there will be a need to adopt new bills regulating a number of issues specified in the law. Thanks to the adoption and implementation of such laws, Shusha will become one of the leading cities not only in the region, but also in Europe and cultural centers in Europe. Legal regulation was applied in Shusha by a special law. In order to strengthen the institutional framework of activities in this direction, the President of Azerbaijan submitted a draft law "On the Cultural Capital of Azerbaijan - Shusha" to the Milli Majlis. After discussions in three readings, the spring session of the parliament in 2021 adopted a very important document in the history of our legislation - the Law "On the cultural capital of Azerbaijan - the city of Shusha".

This law, addressed by the President to the parliament as a legislative initiative and adopted after extensive discussions, is a fundamental legal document stemming from the celebration of state-people's unity. The law defines the legal and organizational basis for the protection, restoration, study, development and promotion of Shusha, the capital of culture of Azerbaijan regulates environmental protection, construction, architectural and urban planning activities in Shusha, transport organization, housing management, entrepreneurship, advertising, tourism and other activities, as well as holding international events in Shusha and a number of other important issues. The inclusion of economic provisions in the law will revive the city's economic life, make Shusha attractive to investors, as well as make Shusha an example for Azerbaijani cities as a center for innovative solutions in the future. The author of the idea of this law is President Ilham Aliyev and the vision of the President of Azerbaijan to protect the city of Shusha. Probably, there will be a need to adopt

new bills regulating a number of issues specified in the law. Thanks to the adoption and implementation of such laws, Shusha will become one of the leading cities not only in the region, but also in Europe and cultural centers in Europe. Defining the status of Shusha by a special law is a very important political event in the field of state building. According to the Law consisting of fifteen articles, by the Decree of President Ilham Aliyev dated June 22, 2021, the Shusha City State Reserve was established within the administrative boundaries of Shusha, the cultural capital of Azerbaijan. After that, the main task ahead is the restoration of Shusha, which the enemy could not Armenianize, but destroyed. With the attention and care of Ilham Aliyev, who returned Shusha to our people, the crown of Karabakh will be rebuilt, restoring its former glory as the address of our national culture. Shusha, which did not bow to the enemy during the occupation, will become one of the most magnificent cultural centers in the region and the world. Defining the status of Shusha by a special law is a very important political event in the field of state building. According to the Law consisting of fifteen articles, by the Decree of President Ilham Aliyev dated June 22, 2021, the Shusha City State Reserve was established within the administrative boundaries of Shusha, the cultural capital of Azerbaijan. After that, the main task ahead is the restoration of Shusha, which the enemy could not Armenianize, but destroyed. With the attention and care of Ilham Aliyev, who returned Shusha to our people, the crown of Karabakh will be rebuilt, restoring its former glory as the address of our national culture. Shusha, which did not bow to the enemy during the occupation, will become one of the most magnificent cultural centers in the region and the world.

## ENERGY SECURITY AND PROBLEMS OF SUSTAINABLE ENERGY EFFICIENCY SUPPLY

**E.M. Hajizadeh**

*Azerbaijan State Economic University – UNEC,  
Center of Energy Economics  
elshan@hajizada.com*

### **Abstract**

In paper investigates issues dealing with some aspects of enhancing energy security and increasing energy efficiency. An extensive research related the role of energy in economic life and people's business activity, as well as, its modern market system being formed as a global commodity was carried out. After analytic generalization, new interpretation of "Energy security" concept was presented. It was clarified once more that, in contemporary world, energy security is measured not only by the quantity of energy consumption supply, but also by its quality values and standards. Given the fact that in the Azerbaijan Republic, as in a sustainable social country, energy security is not separated from energy efficiency and is considered as an important indicator in the supply of fuel-energy resources for increasing the national development level of the economy, the paper intends to investigate these features. It also studies preparation of national energy security strategy and criteria, activities, and objectives that define its conditions being justified by analysis for providing sustainability of these activities.

**Key words:** *energy security, energy efficiency, Azerbaijan Republic, fuel-energy resources, energy strategy.*

**JEL Classification Codes:** *D61, F63, H156.*

### **Introduction**

Energy is not only the source of mechanical power, but also a tool that provides vital services to human's business activity and household. It is obvious that nowadays energy turned into a global commodity. Respective market system formed by it has already overcome even the financial market by most of parameters. Energy and issues of its reliable supply is considered as one of the most important problems of contemporary civilization. There is no doubt that our future life will mostly depend on its availability. Therefore, despite of energy resources are limited or non-renewable, energy security takes the forefront, planned activities are conducted to provide its sustainability and respective



strategies are prepared and implemented.

In contemporary world energy security is measured not only by the quantity of energy consumption supply but also by its quality values and standards. From this point in social country energy security is not separated from energy efficiency and considered as an important indicator of country's development level of fuel-energy resources supply to the economy. Azerbaijan Republic is also one of the countries with promising hydrocarbon energy resources in perspective. In addition, it increases its energetic potential by actions performed in wind and solar energy, river, thermal springs sources usage. In spite of this, country's energetics still mostly depends on oil-gas resources usage which is classified as non-renewable resources. Relying on abundance of such resources at the moment and realizing the fact that they will run out in perspective, income from oil-gas sector export accumulates at national oil fund. Although some of these funds are used for economic diversification and social purposes, as the final result they will be delivered to future generations not in contemporary material form - energy carriers, but as financial capital. This perspective determines the development of appropriate strategies that will provide finding alternatives to replace oil-gas resources in country's energy balance and sustainable energy independence.

It should be noted that the strategic roadmap for the national economy and key sectors of the economy approved by the Decree of the President of the Republic of Azerbaijan in 2016, aims to continue reforms in the electric power sector, to carry out appropriate restructuring and liberalization activities. In this regard, extensive institutional reforms are being carried out in electric power sector and appropriate Decrees and Orders were signed by the President in respective fields. Within this factors tasks like preparation of long-termed development strategy project of power sector, suggestions on gradual transition to liberal market model, which is based on competitiveness in this sector and also various draft law acts to increase energy system efficiency were set. To fulfil these tasks reforms in this field will deepen, adequate efficient institutional environment will be formed, numerous new institutions such as energy efficiency service, energy audit and energy manager will be established. All factors mentioned above will bring new social values to life quality and provide fortifying of energy security and energy efficiency.

It also promotes the expansion of research in the scientific field in order to achieve these goals, which are relevant and timely. Relying mentioned factors, in this article, in accordance to global challenges providing energy security and energy efficiency in wide range in Azerbaijan and promotion appropriate

conceptual ideas based on conducted analysis become a subject of research.

Conducted analysis and researches have theoretic and methodological basis in accordance to concepts presented in research works on strategic role of energy sector of contemporary world and country scientists and materials indicating energy policy in Azerbaijan Republic. Research process was organized by usage of instruments and mechanisms of comparative economic analysis in systematic and logical approach.

### **1. Theoretical-conceptual basis of Energy Security**

Modern economic and political life gives us enough actual material about affection of energy sector on a broad spectrum palette of the world. Such phrases as “energy policy”, “energy diplomacy”, “energy efficiency”, “energy economy”, “energy nationalism” and “energy terrorism” take wide dispute in the world press and contemporary scientific and public literature. All of this generally originates from “energy security” phenomenon.

But which problems are covered by “energy security”, what does it justify, measure and finally, which components do its characteristics and strategic structure contain of? Firstly, what do its political and economic importance and strategic power characterized with?

Investigations show that understanding of world’s energy security problem first time came out amid drastical increase of world oil prices associated with Arab-Israel conflict. Complete suspension of oil supply to Western countries became the reason of conducting some actions in supply of energy security. But about half a century has passed since this severe cataclysmic accident. During this period, development has reached such a level that the energy has taken its dominance among the constituent elements of the structure of the economy and has become an integral part of it. From this point of view, the provision of energy security is at the forefront of the conditions for the normal functioning of all sectors of the economy.

In spite of the fact that in the half a century history of energy security concept it was evaluated by different aspects there is no definite description of it in a single conceptual sense. “Energy security” concept which is formed from “energiya” - activity, operation (*from the Ancient Greek: ἐνέργεια*) and English “security” word, can carry the technical, technological, socio-economic, political and philosophical gist as multi-level category concept in scientific-encyclopedic

literature.

Considering the energy sector as a technological purpose factor, it is assessed as a technogenic security characteristics of this system. With the reliability assignment of society and state protection from energy resources scarce, it gains not only social and economic, but also political and philosophical status. But along with all this, in modern civilization energy security mostly increases its value as an economic category. Increasing of its importance in society's sustainable energy supply and outstanding role in country's national security system makes this evaluation even more relevant.

It should be emphasized that the concept of national security, as a political doctrine, is a complex system of measures that protects the identity, public and state security of the state against foreign aggression and terrorism. And economy is its basis. From this point of view energy security performs as a subsystem of economic security and is regarded as a material basis of national security for the country's economic potential.

Due to its economic gist energy security is measurable. Availability of energy resources of the country is the main indicator of energy security. Availability is calculated by the formula given below:

$$E_{rp} = E_{pg} : E_{pc}$$

Where:	$E_{rp}$	resource availability coefficient;
	$E_{pg}$	energy production in country;
	$E_{pc}$	energy consumption in country.

If the resource availability coefficient is more than 1 country's energy security is considered as normal. Configurations below 1 indicate crisis situations. But this definition should not be considered as a benchmark. The reason is that energy security is not provided only by adequacy of production and consumption. The availability of relevant resources, their accessibility, as well as the range and quality parameters in the structural composition also play a key role here. As a notable example, there is a number of oil producer countries which are rich of energy resources that do not possess processing enterprises with appropriate power. For this reason, they import most of the fuel types, especially gasoline.

A number of encyclopedic publications characterize energy security as "the state of protection of country and region's population, citizens, the state and the economy from the scarce of appropriate qualitative energy resources and the

danger of its supply stability interruption”.

Energy security is pragmatically determined in many economically developed countries as a part of the national energy strategy. Energy strategy expresses the determining of national energy policy and becoming its operation document. It settles conditions for achieving exact purposed activity goals by movement management in exchange for the necessary resources and potential opportunities. In the structural composition, the energy strategy performs as an activity program of modernization and radical reconstruction that combines planning, management documents, schedules, budget and other necessary elements. Considering this, other definitions of energy security listed below are also considered in the scientific literature and national energy strategies of individual countries:

- Energy security - confidence of availability of energy with sufficient quantity and quality in disposal in current economic conditions;
- Energy security - state of protection of citizens, society and country's essential “energy interests” from internal and external perils;
- Energy security - a compilation of economic capabilities at the national and international level to adequately and efficiently meet public consumption with energy resources;
- Energy security - full provision of energy resources for development of living conditions and personality, stability of society, state, social economy and military aspects and also preparedness of economy to resist to internal and external threats in those fields;
- Energy Security - a compilation of conditions and facts of capability to maintain national economy's independency, stability and sustainability, continual refreshment and improvement.

World Energy Council, a huge international non-commercial energy organization accredited by UN, comments on energy security as availability of energy in current economic conditions in necessary quantity and quality at its disposal.

Energy security, in addition to its various interpretations, also differs by a number of features and characteristics, including structural complex. From this point it is classified according to locational, social, production etc. features. Locational features cover global, regional and state levels, social features cover country, society, social group, family and individual levels, production features cover national economy, areal complex, enterprises and companies. As the structural components of energy security, the configuration, range and quality of energy carriers are considered as the main factors.

By analyzing and evaluating all aspects mentioned above, it is possible to

form a generalized definition of the concept of energy security that is more laconic to the scientific aspect. Thereby, “Energy security, being a functional characteristic of the energy system, reflects the situation of protection of energy interests from internal and external threats”.

## **2. Current situation related to energy security and efficiency in Azerbaijan and priorities of areal development**

Energy independence and energy security are vital aspects for Azerbaijan Republic which has abundant energy resources. There are 1-2 billion tons of oil, 2.4 trillion m<sup>3</sup> of gas, 25-27 million tons of coal, 400-450 million tons of oil shale as a reservation in Azerbaijan. Country's overall generation power is more than 8000 MW. 1 billion kWh of annually produced 25 billion kWh energy is exported.

According to energy availability coefficient Azerbaijan Republic is considered to be ensured with energy security. This is also sufficient in the terms of natural resources, production, transportation and logistics infrastructure. The country's economy and population still use half of the existing electricity potential. Immensity of hydrocarbon resources makes it sufficient to meet the needs of Azerbaijan for many years. In addition, these resources will continue to play a role in the export structure of the country for many decades, and will continue to stimulate economic growth. The reality is that Azerbaijan's vast natural oil and gas fields play an important role in ensuring energy security in Europe and some countries around the world. It is provided by sufficient oil and gas export pipelines. Among such projects “Baku-Tbilisi-Ceyhan pipeline” has the biggest role and importance. Realization of one of the largest gas projects in the world, authored by Azerbaijan, “Southern Gas Corridor”, launch of Trans-Anatolian Natural Gas Pipeline - TANAP, alongside with its Trans-Adriatic Pipeline - TAP part will make Azerbaijan a more reliable European supplier of gas.

Apart from oil and gas resources, other natural sources of energy in the Republic of Azerbaijan are promising in terms of sufficiency and prospects. Sunny and windy terrain, numerous rivers, and thermal waters provide a great opportunity to create alternative energy resources in the country as a separate energy source. Preliminary calculations show that Azerbaijan has about 27,000 MW of renewable energy reserve. The qualities embedded in the energy sector originates from the oil strategy founded by national leader Heydar Aliyev and enriched by new values by the President of Azerbaijan Republic Ilham Aliyev.

At the same time, it should be emphasized that, despite the exploitation potential of the country's natural resources for the 21st century is sufficient, they

are also depleting. This brings the need activate alternatives in strategic plan to ensure country's energy security sustainable provision. Problems in the industrial and infrastructure complex must be eliminated and a more modern system should be built to strengthen the reliability of energy security. Thus, the existing oil and gas refineries in the country are not able to meet all of its demand for fuel and energy resources and a number of energy products are still imported. There are also a number of perennial problems in gas processing, purification and supply, that conforms standards. Increase of gas reserves and further expansion of gas storage facilities to provide the population with more reliable gas resources are also included here. There is also a need for large-scale reconstruction and modernization in the electric power system. On the other hand, the share of renewable energy sources in the total energy balance is a bit less than 2%. This means that only 0.5% of the country's renewable energy potential is used. In addition, energy efficiency and energy efficiency issues are also pending for any activity. There is an urgent need for broad institutional reforms in this area, new infrastructure construction, increased use of low-power installations, reduction of losses, establishment of an energy audit institute, and the need for progressive standards in the construction of new buildings. On this basis we can state that energy security is not a time-framed, cyclic aspect. It is the priority that will stay as a strategic goal for a long time. It is delicate pragmatic strategic responsibility that needs corrections on each new economic cycle. Therefore, efficient consumption, division, usage and primary increasing and transforming to future generations of the energy resources is very important. All of these are main goals of energy policy in Azerbaijan Republic and energy security is on the forefront among them. To ensure realization of the policy new reformation process was initiated in the country, a number of establishments was targeted and new development points were determined. In this direction was determined to strengthen the normative-law basis, and as the first step preparation of the new law project for the "of the energy power" law of Azerbaijan Republic. Also the Decree for haste of reforms in energy power sector was signed by the President of Azerbaijan Republic at the beginning of 2019. This Decree includes the draft of the long-term energy sector development strategy of Azerbaijan Republic and suggestion on the gradual transition to a competitive market model in the electricity sector, as well as promoting the use of renewable energy sources and support of private business in this sector. To this end, it is instructed to develop new drafts of the Law "On the use of renewable energy sources in the production of electricity", "Regulation in the sphere of energy and utilities" and the existing laws on "Energy Power" and "Gas Supply". In addition, the work on drafting the law "On the efficient use of energy resources and energy efficiency" was completed. With the adoption of these laws, energy sector reforms will be deepened, a more efficient institutional environment will be created, and many

new service institutions will be established to improve energy efficiency. In addition to expanding the use of renewable energy sources, prospects for nuclear energy, in particular the construction of a nuclear power plant (NPP), can also be considered. The idea of NPP is not a new manifestation for Azerbaijan. Even during the USSR era, the construction of NPP in Azerbaijan was among the central government's master plans. The process has even entered a stage of implementation, in this regard a specific area has been identified, and appropriate buildings and structures have been built to establish the infrastructure. This fact gives the basis to assume that the construction of a NPP has a strategic importance for Azerbaijan, which is also a traditional oil country and is also known for its promising hydrocarbon reserves. This strategy was considered acceptable, despite high seismic factors. Experts of the International Atomic Energy Agency (IAEA) gave a positive review of the nuclear power plant construction in Azerbaijan at the 49th Session of the Organization in Vienna in 2005, without the seismic factor and the basis of hydrocarbon abundance. In 2014, the President of the country signed the relevant order "On establishment of the "National Nuclear Research Center" Closed Joint-Stock Company" for peaceful use of nuclear technologies in Azerbaijan Republic. The main areas of activity of the company include the implementation of comprehensive measures in the field of nuclear science, nuclear technology and nuclear energy, the peaceful development of relevant technologies in line with modern requirements and national interests, and the development of highly qualified human resources in the field. Work is underway to establish a 20 MW nuclear research reactor to provide comprehensive operation of the facility. There is no doubt that the continuation of these efforts will also ensure the establishment of nuclear energy sector in the country. The solution of issues related to economy of energy and energy efficiency in Azerbaijan Republic will be substantiated by the adoption of the law of Azerbaijan Republic "On the efficient use of energy resources and energy efficiency". This Law will create the rights to ensure efficient and efficient use of energy resources, to determine the rights and obligations of participants, to regulate their relations, and to adapt energy use to modern requirements and standards. With the adoption of the law, a number of subordinate regulatory and legal acts based on international best practice will also be developed. It will also set normative and standards for areas such as energy audits, energy efficiency services, and energy management systems that are not included in the current legislation. These innovations will also address issues such as protection of consumers' rights by distributors and suppliers, eliminating unfair competition, enhancing transparency in energy efficiency services and accessing relevant markets, and applying advanced management technologies, standards and certification. The new normative-law regulations will also establish development

processes in the institutional sphere.

These studies and analysis show that the reliability of energy supply in Azerbaijan is sufficient. Statistical comparisons also show that Azerbaijan holds one of the leading positions among the CIS countries in terms of energy security. The national energy security category should be developed and implemented in order to further strengthen the country's energy independence by making this leadership irrevocable.

## Results

The results of the studies show that in the modern world, energy security will remain the leading element of any country's national security system. In Azerbaijan Republic, appropriate strategies must be developed to ensure sustainable and stable energy security, to align and coordinate government programs to be implemented for the development of the economy. In addition, a national energy security sustainability strategy should include the following priorities that strengthen energy security and increase energy efficiency:

### **On macroeconomic, organizational and management fields:**

- determination of the main criteria and indicators of national energy security and establishment of an appropriate information database;
- establishment of indicative management system of energy security of the country;
- preparation of optimal energy balance for long-term period of the country;
- determination of norms and limits of incentive efficiency in order to realize rational use of energy resources in all sectors of economy;
- the introduction of new high-performance services that provide citizen satisfaction, the transition to a more sustainable pricing system that stimulates development, the strengthening of financial discipline and accounting;
- expansion of scientific activity in the study of important problems of the energy complex;
- Reorientation of the State Oil Fund's assets to renewable and nuclear energy production areas and the development of the post-oil concept.

### **In the context of institutional and structural modernization:**

- continuation of measures to improve the legal and regulatory framework to ensure favorable market conditions in the energy sector and restriction of monopoly;
- carrying out continuous structural reconstruction, enhancing the functionality of the fuel and energy complex;
- Increasing gas reserves to provide more reliable gas resources to the population and economy (*accelerating the gradual inclusion of "Umit", "Babek", "Absheron", "Karabakh", "Shafaq-Asiman", as well as other new reserves and structures*), expand



gas storage capacity, improve gas processing, purification and supply, and improve gasification;

- creation of an effective system of market relations on competitive types of activity in the electric power industry, formation of new generating forces in accordance with the development prospects of the country;

- development and gradual implementation of the concept of tariff regulation with free pricing mechanisms;

- stimulating the use of renewable energy sources, bringing the share of alternative energy in the country's electric energy by at least 25% by 2030;

- increasing energy efficiency and economy of energy in the energy sector, and increasing innovation by expanding the use of high technology in the relevant direction.

### **In the format of international cooperation:**

- expanding energy integration based on national interests and mutually beneficial cooperation with world countries and leading companies;

- increasing export diversification of energy resources, especially electric energy;

- taking permanent measures to promote the country's leadership and prestige in the activities of the “OPEC plus” format;

- expanding SOCAR's presence as a shareholder in the operation of promising fields abroad.

Studies and analysis give the basis to assume that reform measures in the energy sector should be systematic and that the investment process in this sector must be adequate and uninterrupted in order to ensure national energy security.

The priorities presented in the national energy security Sustainability strategy do not fully cover all relevant strategic measures. In the practice area, these priorities will be subjected to a more fundamental economic justification, and they will be formed in a different and alternate structure, consistent with the changes in political and economic situation, and with more scientifically logical justification.

### **References**

1. Parthemore, C. Fueling the Force: Preparing the Department of Defense for a Post-Petroleum Era, Center for New American Security. 2010, 360 p.
2. Жизнин С.Г. Основы энергетической дипломатии. М.: МГИМО-Университет, 2013, 140 с.
3. www.iea.org - The International Energy Agency.
4. Алиев И. Каспийская нефть Азербайджана. М.: Известия, 2003, 798 с.
5. Мирзаджанзаде А.Х., Султанов Ч.А. Этюды нефтяной концепции Азербайджана, Баку: Элм, 1994, 100 с.
6. Cordesman, A. “Global Oil Security”. Center for Strategic and International

- Studies*. 2006, 400 p.
7. [www.oilfund.az/en](http://www.oilfund.az/en) - The State Oil Fund of the Republic of Azerbaijan.
  8. [www.president.az](http://www.president.az) - Official site of the President of the Republic of Azerbaijan.
  9. Зеркалов Д.В. Энергетическая безопасность. Киев: Основа, 2012, 920 с.
  10. [www.hajizada.com](http://www.hajizada.com) - Professor Elshan Hajizadeh's site.
  11. [www.europa.eu.int](http://www.europa.eu.int) - European Union.
  12. Ершов Ю.А. Глобальная энергетическая безопасность и интересы России. М.: 2009, 229 с.
  13. Самедзаде З.А. Экономическая безопасность. // Научные труды Международного Союза экономистов и Вольного экономического общества. Том первый. Москва, Санкт-Петербург 1994, С. 178-194.
  14. Свидерская, О.В. Основы энергосбережения. М.: ТетраСистемс, 2016, 176 с.
  15. Лисенко, В.Г. Хрестоматия Энергосбережения. М.: Теплоэнергетик, 2012, 699 с.
  16. Kreith F., Goswami D.Y. (Eds.) Handbook of Energy Efficiency and Renewable Energy CRC Press, 2007, 1560 p.
  17. Zobaа A.F., Bansal R.C. Handbook of Renewable Energy Technology World Scientific Publishing Company, 2011, 851 p.
  18. Султанов Ч. Электроэнергетика Азербайджана. Баку: Чашыюглы, 2013, 223 с.
  19. Гаджизаде Э.М. Императивы нефтяной стратегии Азербайджана. “Стратегия развития минерально-сырьевого комплекса в XXI веке”. Международная конференция: Федеральное Агентство по Образованию, Российский Университет Дружбы Народов, Российская Академия Наук, Российская Академия Государственных Служащих при Президенте РФ. М.: 2004, С 214-218.
  20. Hajizadeh E.M. Cumdominium safety and new financial architecture The 15<sup>th</sup> International Conference on the Persian Gulf: “Persian Gulf: Regional Security & Cooperation in the Process of Changing World Politics”. Tehran, Institute for political and International Studies, 2005, pp 78-86.
  21. Hajizadeh E.M. Development of the national oil-gas sector and its role in economic growth. Tax Jurnal of Azerbaijan. Baku: 2012, pp 34-49.

# ARCHITECTURE AND CONSTRUCTION

## FEATURES OF DEVELOPMENT OF THE NEW CITIES IN THE REPUBLIC OF AZERBAIJAN

**N.Y. Mammadov**

*Department of Fundamentals of Architecture of AzUAC, SOCAR's Oil and Gas  
Research and Design Institute, Department of Architecture and Construction,  
memar373@hotmail.com*

### **Abstract**

The article deals with the growth of the population of new cities and in this regard the peculiarities of their territorial development. The analysis of changes of architectural and planning structure of the new cities in Azerbaijan due to growth and change of their territories is given in the article. Population growth in cities is studied in detail every decade on an average and is shown in exact figures based on statistics. Construction of cities in the post-war period. The population growth in these cities is studied during the periods of construction of large hydro-technical facilities and industrial enterprises. The necessity of the developing of new projects and the solution of the issues arising from this need have been investigated taking into account the expansion of the city's territory, Issues of formation of new urban centers in Sumgayit, Shirvan and Mingachevir. Due to the growth of the cities in question, the increase in traffic intensity and consequently overloading issues of the streets and avenues are the subject of extensive research.

New districts are created in different directions from the first core of the city and these districts gradually form a new compact city. Such development is typical for the city of Mingachevir in Azerbaijan.

More difficulties in urban development, problems arising during the development of construction and industrial zones in the opposite direction and ways of solving these problems are widely investigated.

The division of city development into three types according to the structural ratio, and the pros and cons of each type are analysed separately.

The article analyzes changes occurring in architectural planning structure according to the growth and change of new cities in Azerbaijan.

**Key words:** *new cities, growth rate, population growth, city development, functional zones, new district, number of floors in buildings, transport intensity, development structure, territorial expansion, construction, residential zone.*

## **1. Introduction**

When the new city is expanded, the amount of directions of growth is not so important, as the character of the development of functional zones relative to each other.

The features of the development imply the following:

- a) in separate directions or combined
- b) in one or several directions

Similar difficulties arise during semi-separated development. At first, functional zones develop together and then divide in different directions

The development of the city can be divided into three types according to structural ratio:

1. sustainable development of each zone
2. intermittent (discrete) development through the growth of complex structural units (industrial and residential regions)
3. adapted development

The study of the general characteristics of the development of new cities in Azerbaijan shows that they have high growth indicators. For example, in the first 30 years of its development in new cities such as Sumgayit, Mingachevir and Shirvan, the population was 50-60 thousand or more, while in Sumgayit the population is currently 300 thousand people. The population growth in these cities averaged about 20-30 thousand people every decade.

Currently, a higher growth rate is observed during the construction of the largest hydro-technical facilities and industrial enterprises in new cities, which arose after the war. During the period of construction, the annual population growth in these cities was 5-10 thousand people. This applies especially to new cities with favorable economic and geographical and natural-urbanization condition. The general plans, which took into account rapid population growth in intensively developing Sumgayit, Mingachevir and other new cities, were repeatedly revised.

In many new cities, where the projected population has been achieved in a planned manner over the estimated period (20-25 years), it is now necessary to develop new projects taking into account the future growth of the population and the territorial expansion of the city.

## **2. Analysis**

The analysis of numerous examples shows that the successful solution of this important project issue is largely predetermined by how rational the conditions such as unimpeded expansion and urban development are taken into account in the first effective projects.

In a number of post-war urban development projects, the conditions for

the development of the city were not fully taken into account, which led to known contradictions.

For example, in Sumgayit, the areas necessary for the development of the city in the future were occupied by low-cost, extensible residential and industrial buildings due to the initial project. The project did not envisage the development of highways and the creation of winding (surrounding) roads, as a result, due to the growth of the city and the intensification of transport, the district and residential streets were loaded with the function of tense citywide roads. The center of the city remained on the construction periphery with the development of the residential zone, although the population of the city did not reach 100 thousand people in the 70s of the 20th century, the issue of the formation of a new city center arose. A similar situation is typical for Mingachevir and Shirvan. The creation of objective conditions in which new cities can freely develop is the most important criterion for the rationality of the city planning structure. The development of the city, accompanied by an increase in population, is due to the expansion of the territory, the density of buildings and the increase in the number of floors, the increase in the capacity and number of highways and transport nodes, engineering networks and main buildings, the development of the public center, the complexity of the architectural and planning composition of the city. Under certain circumstances, the development of the new city as a single planning derivative moves to a higher and more complex stage of development in the form of a new group system of cities. The territorial growth of new cities is very diverse, and for their planning structure, the issue how to expand the territory of the city is an important factor: due to the internal resources or the surrounding empty lands; on one, two or more directions; with a continuous or territorial gap (breakage).

In new cities, growth in one or two directions is more efficient, as it allows the concentration of construction and the formation of larger structural parts of the city (industrial districts, residential areas, public centers, parks) in a short time. Conducting civil construction simultaneously in several directions and in sites in new cities, which are not as large as bigger ones particularly inadequate from an economic perspective and planning issues. However, due to local conditions, the development of the city is characterized by the fact that new districts are emerging from the first core of the city in different directions, gradually forming a new compact city. Such development is typical for the city of Mingachevir in Azerbaijan. Reconstruction of the previously extensively emerged region in the neutral part of the city will play a reserve role in one of the future stages of its development. During the development process of the new city, the growth in the density and the number of floors is more typical for new districts in the direction of the expansion of the city (the city of Sumgayit).

When the new city is expanded, the amount of directions of growth is not

so important, as the character of the development of functional zones relative to each other: either individually or jointly, on one or on several directions. While the construction and industrial zone emerge in opposite directions much more difficulties arise in the development of the city.

In such cases, separate development for space is largely inevitable and requires a solution to complex urban issues, e.g. the creation of fast longitudinal links, and construction of land dams for speed connections, non-street transport types, etc. Similar difficulties arise during the semi-detached development: first functional zones develop together, then they are divided in different directions.

The joint spatial development of industrial, residential and green areas of the city, for example, parallel development in one or several directions, is more rational. The development of the city can be divided into three types in structural proportions: continuous development of each zone, intermittent (discrete) development through the growth of complex structural units (industrial and residential regions), adapted development. The sustainable development of all functional zones is characteristic for the city of Shirvan. The development of the city is due to the gradual development of machine-building production and equal development of settlements. Both zones develop continuously without territorial separation. The advantages of urban development of such a sustainable development scheme are that the development of industrial zones and settlements at a given period has its own characteristics. For example, the development of production is expressed in some cases by an increase in the number of employees, without expanding industrial sites, in this case, the residential zone expands territorially, while the industrial zone remains in its previous dimensions. With the automation of production, the use of labor force is reduced, which may be more necessary in another sphere, resulting in the industrial zone grows without a significant increase in the number of personnel, while the residential zone remains relatively stable. It is very important that despite the indicated features of the development of individual zones in the scheme of sustainable development, there are conditions for the regulation of the city and its harmonious development. Another advantage of sustainable development is that each zone has the ability to develop through the addition of structural units that best express internal functional organizational regularities. For a residential zone, a residential district, for an industrial zone, an enterprise or an entire industrial district serves as such a unit. At all stages of development, these structural units do not change their rational organization. Thus, the sustainable development of new cities responds better to the dynamics of the formation of a part of the city, than to the formation of complex districts. For example, when the development direction of functional zones is changed or moved to new areas, there is a need to create new production sites and residential areas. To prevent unsystematic placement, it is possible to integrate industrial and residential areas into the city's

complex planning areas. It is expedient to protect the land resources to expand the residential and industrial areas in order to be able to meet the changing conditions of settlement in the production process, science and other fields in each of the districts. The difficulty of creating such territorial resources in the discrete (intermittent) development of the city is not a prerequisite for rational development. Another problem is the complexity and extension of labour relations during the fragmented growth of the city as a whole, even if it is possible to reduce Interurban Labor Relations to a relatively small percentage of all displacements. Therefore, the main part of the city is constantly developing, and in parallel, if a complex planning district of the city is formed, or if one of the zones of the same type is continuously developing, and the other is discrete, the combined (combined, adapted) forms of development are expedient here. The growth of the new city and its development character are largely determined by the development features of the production base. The latter, in most cases, develops on the following stages: the construction of the main enterprise, the creation of a production complex on its basis, the organization of new enterprises and complexes not connected with the first, as in the city of Mingachevir. As a result, the growth of the city does not occur equally in many cases, it changes with leaps and bounds depending on the location and time. Initially, the city of Mingachevir was developed on the basis of a hydropower station with a population of 50 thousand people, and the development of urban zones was of parallel sustainable nature. Then the construction of the largest textile complex, 3 km from the first industrial district and residential area of 10,000 people, separated from the first by the Kur River was started. The development of the city continued with a prolonged parallel scheme but in a new direction. Thus, a structure consisting of two parts of the city, interacting with each other, was formed. The construction of new large manufacturing enterprises often leads to the construction of new squares and the formation of the new city structure. The emergence of a new system of group settlement, which is one of the complex steps of the development of the new city, is associated with this activity. New cities should be created, mainly by designing (forecasting) the planning structure of future settlement groups, in the settlement system or by designing a separate city, provided that they are not isolated. In these conditions, the choice of a particular structure of a separate new city is not the only task that ensures its unobstructed growth. In this case, it is important to establish the correct phase of transition from the development stage of the city to the creation of a settlement system, where each city forms part of the entire framework. Thus, the formation of the urban group system is the most complex and promising type of development of the planning structure of the new city. Such development sets certain requirements for the construction of external (in connection with this) high-speed communication lines on the planning structure of the initial urban

formation and the formation of a system of recreation areas and community centers with future elements of agglomeration.

### **3. Methodology**

One of the main problems of the growth of a new city is the possibility of developing a system of highways and transport. The growth of the city is accompanied by the extension and expansion of the transverse profile of the initially built highways, the construction of new highways in the formed cities (on the reserve lines in construction), the creation of high-speed roads and new winding roads, the creation of off-road types of transport etc. The analysis shows that the closed networks of the main streets, the absence of reserve lines in the construction and transverse profile of the highways, as well as the closure of any types of construction preventing the promising directions of the road-street network have caused even greater difficulties in the development of new cities. For new cities with significant development prospects (with sustainable or other schemes), it is necessary to develop open transport systems that allow increasing the numerical composition, density and complexity of the highway.

The analysis of the existing transport network of cities allows us to claim that the necessary directions and lines for highways are kept on track; for high-speed transport types – on the transverse profile of highways and at the crossroads of intersections between them is considered positive. Closed (circular, semicircular and others) highway systems can be applied to new cities that are not large, provided that their convenient connection to high-speed city roads will be ensured. One of the most complex problems of the development of the planning structure of the new city is the development of the center. Practice shows that when the general plans of Sumgayit, Mingachevir, Shirvan cities are prepared or adjusted, the location of the centers and their planning solutions are radically changed, and because of the mistakes made in the initial general plans, it is not always possible to achieve a harmonious solution of the center in the general structure of the city. The development problem of the citywide center, first of all, reaches to the growth (or change) of the territory and the increase in the level of services for inhabitants of the city and the growth of urban population, and secondly, when the urban area grows, to ensure the favorable connection of the center with new districts. Finally, the growth of the city center should take into account the complexity of the composition structure of the new city and the formation of architectural appearance.

The growth of the city and the development of the center have three main directions:

- 1) continuous spatial development of the center – monocentric and linear;
- 2) development of the previous center and creation of additional urban centers



in remote residential areas - polycentric system;

3) establishment of a city center in one of the newly built residential areas by transforming the previous one into the center of one of the residential areas.

The monocentric development of the center is characteristic for cities expanding equally in many directions. The concentration of public buildings in a single complex of the city center and the protection of the territory for its sustainable development can improve the quality and effectiveness of public services, as well as create a unified architectural ensemble of the city. Along with other advantages, it requires the availability of reserve areas that have not been used for a long time around such development centers, and if it is revealed that their number is insufficient, then there is a need for reorganization of the districts for the development of the center. In both cases, additional costs are required for the temporary improvement of the reserve areas and subsequent reconstruction. During the one-sided development of the city, the monocentric development is irrational, so with the growth of the city, the center remains in the periphery. Therefore, when the city grows in one direction, the center usually develops in the same way. It is more expedient to gradually develop the center in a linear or other direction, where the first phase of its formation is carried out in the form of the first completed urban ensemble. The polycentric system is advantageous in the development of the city in several directions when there is a need to create several public centers with urban values in new planning districts. The less compact the residential zone of the new city is formed, the more scattered (incoherent) the system of centers. In the unregulated development of urban settlements, there is usually a practice of changing the location of the city center to a new and larger residential area of the city. In this case, the primary city center, intended for a smaller number of residents, should be a secondary district center. In fact, such a displacement is a long-term and difficult process, because the city already has operating buildings of public institutions (administrative, cultural and household services, culture), the construction of the new center is always delayed. The inconvenient site of city center remains unchanged until there are additional ways to develop the city. Therefore, instead of the idea of "displacement" of the main urban center, which is consciously accepted in many projects of new cities, spatial development in the form of a linear continuous or intermittent strip of important public complexes should be proposed. As a rule, in the construction of a new city (5-10 years), it may be more justified to start with the formation of parts of the city center or individual elements of the system of urban centers (in large cities). Therefore, it is not recommended to attach importance to the city center, for example, to one of the centers of residential districts "temporarily", because the service functions that are not inherent in it for a long time (with the construction of administrative

buildings) are attached to it. As a result, general facilities, as a rule, occupy an unfavorable place in construction, and the possibilities for the future center of the city are reduced. If the problem of planning the formation of the city center is not laid at the first stage, then the city objects are placed in random places. To ensure the conditions for the development of the new city center, its relationship with urban elements and territories with certain development opportunities is very important. These include urban highways, open spaces and greenery intended for urban use.

#### 4. Solution

In the design of the green space system, the general plan of the new city solves the following main tasks:

- placement of mass recreation places of citywide importance and green spaces of general use taking into account the requirements of convenient accessibility for the population and improvement of sanitary and micro-climatic conditions in all zones of the city;
- providing the unity of the structural and planning organization of the city and the expressiveness of its architectural appearance with the help of landscaping system. Facilities for everyday leisure are located mainly in the structural elements of the residential area; devices for short-term rest - mainly near the city (in the forest belt and suburban area). Often park and forest areas are part of the overall structure of the new city.

Determination of the territory of suburban areas of short-term rest is made either based on the approximate norm of 500-600 m<sup>2</sup> per 1 vacationer, taking into account the departure to the recreation areas at the same time up to 10-15% of the population of the new city, or based on the prospective indicative norm of 50-70 m<sup>2</sup> per 1 resident of the new city (only for areas of short-term rest. In areas that do not have great opportunities for the facilities of suburban recreation areas, these calculated data can be reduced by half. The total area of public green spaces is rounded up to 20-25% of the residential area of the city.

The system of recreational green places, considered as a whole, combines all the functional areas of the city and its immediate environs. Therefore, the existing green areas should be included as an integral part of the city structure. The location of the main parts of the landscaping system is influenced by the position of existing forests and groves or the availability and configuration of areas suitable for planting. Built taking into account these natural factors, the terrain and water spaces, their diverse combination with each other and with future architectural structures, the system of green spaces should receive an individual planning solution. It definitely appears on the composition of the residential zone and the public center of the city, on the layout and construction

of residential areas and neighborhoods, as well as, ultimately, on the landscape architectural and planning composition of the green facilities themselves. The concept of a citywide system of green spaces includes: the entire composition of urban green facilities, the conditions for their placement in the city, the requirements for the organization of functional and architectural and planning relationship with each other and green spaces of the suburban area. The landscaping system is an organic part of the architectural and planning structure of the city and includes all the necessary facilities associated with the three main areas: housing, labor, recreation. The system of green spaces forms green facilities in residential areas (city park, gardens of residential areas connecting their alleys and boulevards), landscaping of the industrial area, the sanitary protection zones and areas of recreation. The continuous system of green spaces provides convenient landscaped pedestrian connections of residential complexes with public centers of the city and places of recreation in the countryside.

### **5. Conclusions**

Analysis of the practice of planning new cities reveals two approaches to the organization of the system of green spaces:

- when it acts as a consequence of the division of the city in the main structural elements or outlines of the system of highways;
- when it acts as a structural forming system of the city.

In the first case, the system of green spaces does not have a decisive influence on the planning of the city and in the composition of the city plays a subordinate role to a certain extent. The second reveals the importance of the structural value of green areas. In new cities characterized by calm and windy weather, large solid areas of green space can lead to stagnation of air. To preserve the mobility of the air, it is recommended to build a wedge-shaped system of green spaces along the direction of the winds, in which the wind flow enters the depth of the built-up areas and thereby activates the ventilation of the city. Rational alternation of green and open spaces in the city plan can cause desirable local breezes in these conditions.

When solving the greening system in the city's master plan, it is necessary to map out the structure of its large elements (areas or zones of suburban recreation, urban parks, gardens of residential areas).

The country recreation areas of the population may consist of country parks and forest parks of various purposes, meadow parks, green and landscaped areas of reservoirs, as well as green hiking roads connecting green areas with each other and with cities. The main structural unit of the recreation area is a complex of public recreation facilities (holiday homes, boarding houses, tourist bases, pioneer camps, etc.). Planning zoning of the territories of the recreation area should be made depending on the differences in the nature of their use, forms

and organization of recreation, transport and pedestrian accessibility and attendance, highlighting: a) a zone of mass attendance; b) a walking area (more rarely visited by individual tourists or their groups). Each of these zones is distinguished by the nature of use, the techniques of architectural and planning decisions of the territory and the degree of improvement. Areas of mass attendance are located in the places of transport accessibility (for public transport), at the beaches on the banks of water bodies and water channels, in the most picturesque and attractive places of the landscape, for example, in the cities of Sumgait and Mingachevir. The area of mass attendance, depending on its radius, can range from 3-5 to 60-75 hectares, and the radius should be set on a case-by-case basis based on the number of vacationers. However, it is not recommended to take the size of this area over 60-75 hectares in all cases (which corresponds to the radius of the zone of about 500 m), since the remaining area over this size, as experience shows, will practically remain underutilized (in the absence of public transport). In each of these zones, local compositional centers can be established. Compositional centers are created in places with the most interesting elements of the landscape: in open areas and elevated terrain elements. Extensive water surfaces are also the compositional centers of architectural and planning organization of the forest park. Urban parks provide a recreation of the population in a healthy, well-maintained, landscape and aesthetically designed natural environment. They are the main largest arrays of plantations in the system of inner-city resting places. According to the Regulations, the area of urban parks in the city as a whole should be: 80-100 hectares in big cities, 20-40 hectares in medium-sized cities, 35 hectares in small towns. One of the criteria for determining the optimal size of the park area is the pedestrian accessibility of the entire park area. The limit can be considered parks with an area of up to 300 hectares, having a rational planning scheme. If under local conditions the park is allocated an area that exceeds the possibility of developing it as a city for the rest of residents, in such a recreation area should be allocated areas of the highest density of visitation, improve them well and create garden-park compositions. The rest of the zone is left completely or almost completely untouched as a reserve for the organization of the forest park. Violation of the task of zoning the park for functional purposes affects besides natural conditions, the location of the territory in the city plan in relation to residential development and the configuration of the site. Thus, in the park area of the city, located peripherally in relation to the building, the territory of the most mass visits tend to the public centers of citywide importance and transport hubs, the recreation zones is an alternation of territories with a dense network of institutions and forest parks of a tranquil regime. Water reservoirs are a necessary landscape element of the urban and district park. In the absence of natural reservoirs, it is necessary to look for the possibility of creating artificial reservoirs and basins. It is very important to provide convenient transport links to residential

areas with the city park. A good connection of housing places with a recreation area is achieved by placing the city park in parallel with the settlement and at the central position of the city park in the residential zone. Parks of residential areas are the most important elements in the system of places of recreation of the city. They are intended for recreation of residents of the whole area during the week and on non-working days, as well as for everyday recreation living in a radius of up to 500 m. This determines the large number of visitors to the park and the need to have sufficient territory for their reception, which according to the estimated standards should be 24-30 hectares. In the planning of the district parks system, it is important to organize green paths of pedestrian traffic from residential development to the park. These paths should be decided as part of the common system of urban and suburban pedestrian roads and serve to unite individual facilities of greening the city. In order to make the most rational and full use of the natural landscape already at the stage of the feasibility study of the general plan, it is necessary to develop a project of landscape zoning of the city and suburban areas.



**Fig. 1. Zaha Hadid Heydar Aliyev Cultural Center**

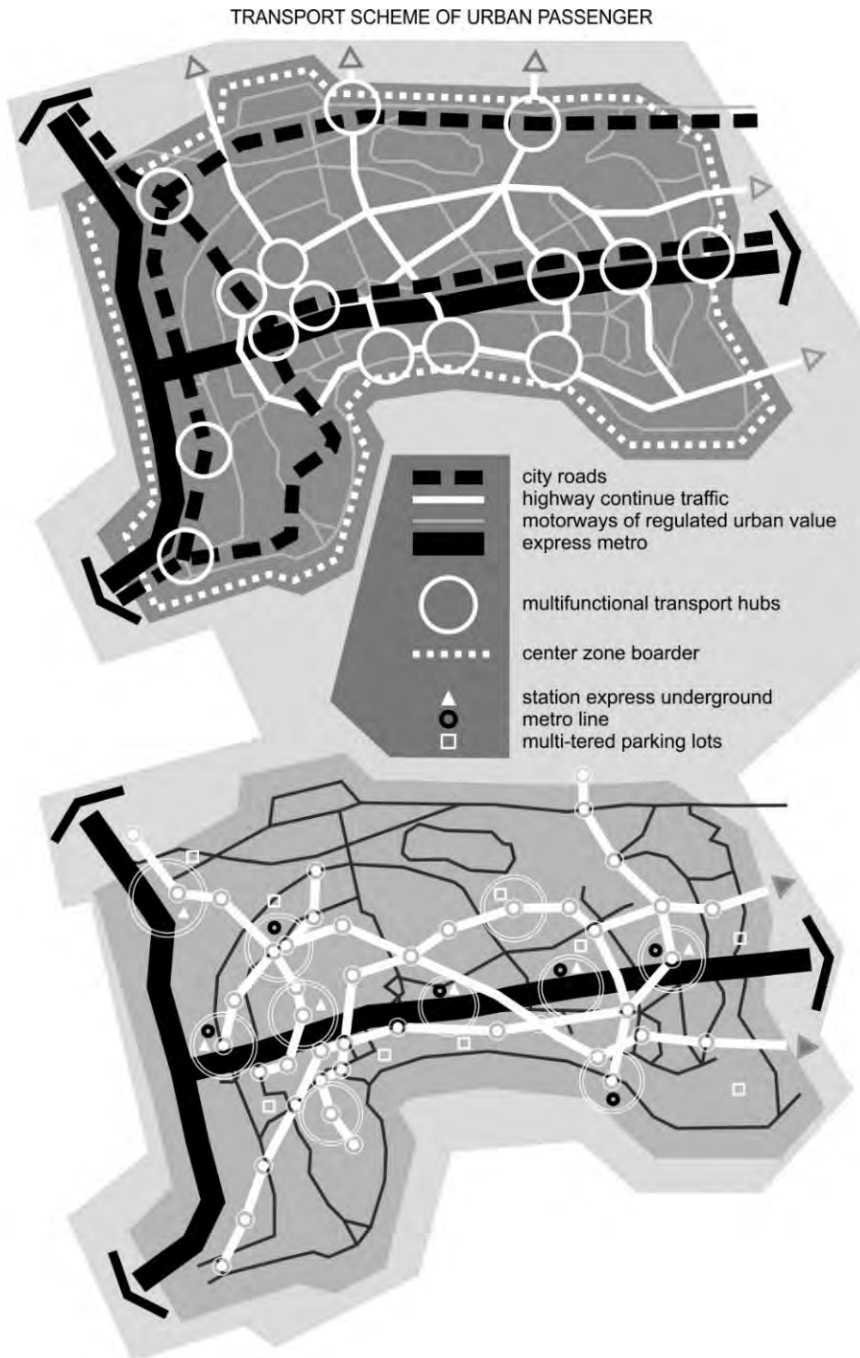
Sites of residential and suburban areas, to be greened or preserved on them natural landscape (existing plantations, relief, reservoir, etc.), are established on the basis of consideration of the natural conditions of the area, a comprehensive assessment of its natural conditions, a comprehensive assessment of its landscape advantages and determining the most appropriate functional zoning of the territory, including areas of short and long-term recreation countryside. In order to choose the territory for urban and district parks, as well

as recreation areas at the general plan stage, appropriate maps of the entire planned city and suburban area are required. Based on the initial data, it should be given a comprehensive view of the territory with the allocation of sites, especially favorable for the accommodation of recreational areas of the population, and a scheme of landscape zoning should be drawn up.

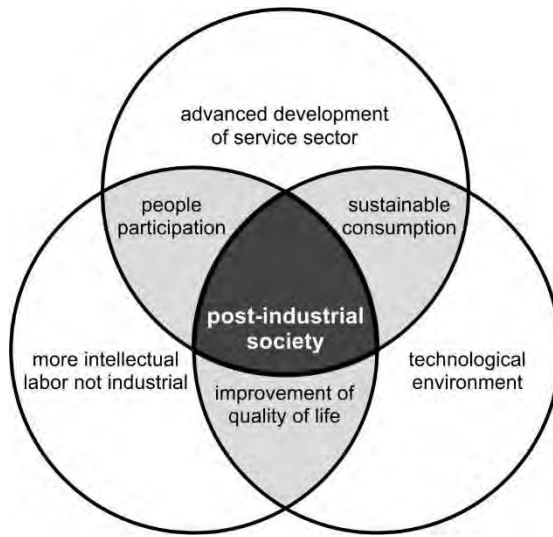
Depending on the nature of the landscape is determined by the degree of suitability of individual sites for recreation, in accordance with which the following areas are allocated in the city:

1. protected areas with a picturesque landscape, intended for recreation;
2. protected areas with the potential for the formation of a picturesque landscape, followed by use for recreation (the presence of vegetation, rugged terrain, water sources);
3. unsuitable for the construction of the territory.

The latter include sites that can be converted for recreational purposes (high groundwater standing, flooded, waterlogged, with a surface slope of more than 20%), or requiring the restoration of a disturbed structure surfaces (ravines, waste rock dumps, quarries of inert production).



**Fig. 2. The scheme of urban passenger transport in Baku (author's scheme, based on research of Prof. F.M. Huseynov)**



**Fig. 3. Concept of competitiveness in the context of post-industrial society (developed by author)**

**Table 1.** Environmental planning: the historical context (updated and modified version of the framework provided in Healey and Shaw (1994))

<b>Methods</b>	<b>Function story</b>
Welfare utilitarianism (1940 - 1950)	Separation of town and countryside was central to planning activities in the pre and immediate post-war period, emphasizing the restriction of urban sprawl through devices such as green belt and the protection of agricultural land
Growth management (1960)	During a period when planning was preoccupied with growth, the environment was treated largely in functional terms as a resource for recreation, an amenity and a provider of an aesthetic setting
Active environmental care (1970)	During the 1970, the attitude towards countryside nature changed from being a back-cloth to one where natural systems needed to be managed. Local authority intervention in the countryside increased with a new emphasis on recreation
Market utilitarianism (1980)	In a period of deregulation with a presumption in favour of development, moves to relax green belt policy fell foul of Conservative Party supporters in the shire counties and were withdrawn. Elsewhere, the environment was viewed as a tradable asset with private developers promoting the idea of planning-gain
Environmental sustainability (1990)	Following the return to a 'plan-led' system and the 1992 Rio Earth Summit, sustainable development became the buzz word in planning. Early attempts to operationalize sustainable development focused on techniques designed to protect



	environmental assets such as carrying capacity, environmental capital, and environmental appraisal
Quality of life (later 1990 - 2000)	In part arising from professional concerns about the lack of attention to the socioeconomic aspects of sustainable development, and following the election of the Labour Government, sustainable development was re-defined as a holistic concept about 'quality of life'. The environment was one of four objectives of sustainable development, to be met at the same time in pursuit of win solutions
Not quantitative evaluation of standards for urban planning (2012-2018)	Characterization of city by social support, healthy life expectancy freedom to make life choices, generosity, trust. Although, happiness has been evaluated by many researchers, there are very limited studies on happy environment, specifically happy cities. In addition, different methods that have been introduced for measuring happiness by previous studies have several major shortcomings. Firstly, happiness is considered equivalent to satisfaction or the quality of life. Secondly, the majority of these methods are not easy to follow and it is difficult to connect them to design process. Furthermore, these methods support only a limited number of indicators and majority of them are not related to the happy environment

## References

1. Naghiyev N.H., Huseynov F.M. History of Azerbaijani Architecture. Volume 1-5, "Azərbaycan Respublikasının müasirdövr memarlıq tarixi", History of modern architecture of the Republic of Azerbaijan - volume 5, Publishing House "Şərq-Qərb", Baku, 2013, pages 338
2. Bocharov Y. P., Kudryavchev O.K. Планировочная структура современного города, Planning structure of modern city. Ed. Литература по строительству, References on construction, 1972, Moscow, page 160
3. Bretanichkiy L., Salamzadeh A. Архитектура Советского Азербайджана, Architecture Of Soviet Azerbaijan. Ed. Литература по строительству, References on construction, 1973, Moscow, page 264
4. Naghiyev N. G. Современное градостроительство Азербайджанской Республики, Modern urban planning of the Republic of Azerbaijan. Publishing House "Təhsilçi", 2011, Baku. page 361
5. Smolyar I.M. Новые города, планировочная структура городов промышленного и научно-производственного профиля, New city planning structure of industrial and scientific and production cities, Ed. Литература по строительству, References on construction, 1972, Moscow, page 184
6. Реконструкция крупных городов (методическое пособие для проектировщиков) / Литература по строительству, Москва 1972.,

- Reconstruction of large cities, a manual for designers / Ed. Building Literature, Moscow, 1972
7. Qəhrəmanova Ş.Ş. Şəhər mühitinin yenidənqurulması/AzMIU Memarlıq fakültəsinin magistr pilləsi üçün dərs vəsaiti, Çəşioğlu, Bakı, 2003, Kahramanova Sh.Sh. Urban Reconstruction /Textbook for Masters Degree in Architecture Faculty of AzSU, Chashoglu, Baku, 2003
  8. Бретаницкий Л., Саламзаде А. Архитектура Советского Азербайджана. Изд. Литературы по строительству, Москва, 1973, 264с., Brittanyitsky L., Salamzade A. Architecture Soviet Azerbaijan. Search Literature in the Building, Moscow, 1973, 264 p.
  9. Бунин А.В., Ильин Л.А., Градостроительство, Bunin A.V., Ilyin L.A., Urban Planning
  10. Поляков Н.Х., Шквариков В.А. Градостроительство в мусульманских странах, Polyakov N.Kh., Shkvarikov V.A. Urban planning in Muslim countries.

## ISSUES AND METHODS OF IMPROVEMENT, UPDATING OF NEW CITIES OF THE REPUBLIC OF AZERBAIJAN

**N.Y. Mammadov**

*Department of Fundamentals of Architecture of AzUAC, SOCAR's "Oil and Gas  
Research and Design" Institute, Department of Architecture and Construction,  
memar373@hotmail.com*

### **Abstract**

A thorough study of modern development trends of new cities of the 20<sup>th</sup> century in the Republic of Azerbaijan is the most important issue waiting for its solution today. Formation and development features of architectural and planning structures of new cities are of great importance in this regard. The development of several cities of Azerbaijan in 20<sup>th</sup> century plays a significant role in the solution of issues of the modern urban planning policy in the Republic. Thus, the engineering and technical management of Mingachevir, Shirvan and Sumgayit, standing and dynamically developing among the newest modern cities of the republic and solution of urbanization problems is one of the important issues. The theme of the dissertation on "Formation and development of new cities in Azerbaijan (in the example of the cities of Mingachevir, Shirvan and Sumgayit)" is a relevant topic in the field of urban science. In this regard, the subject of my dissertation has a relevant and peculiar role in our modern architecture.

**Key words:** *new cities, renovation, landscaping, public requirements, environment, residential areas, development, town planning, business, industrialization, urban population, number of population, master plan, production profile, design, technical progress*

There are historical, industry and tourism-oriented cities in the Republic of Azerbaijan. New cities have their own role among them. These are cities emerged and developed in the 20<sup>th</sup> century. Mingachevir, Sumgayit, Dashkesen, Shirvan and others can be mentioned among them. A substantial period has elapsed since their establishment, and modernization and reconstruction of their architectural-planning structure is required.

Reconstruction of cities is an important part of town-planning aimed at changing and renovating them in order to radically improve the condition for labor, living, service, and recreation of the population in these settlements. It would be wrong to bring the reconstruction of cities to the destruction of outdated buildings and facilities and replacing them with new ones and partially radical alteration of building types and landscaping of some urban areas. Reconstruction involves the change and renewal of the cities in their integrity and changing all

material life to another form.

The reconstruction of cities has complicated and complex nature. It involves project and construction experience and theory of renewal and improvement of planning, construction, and landscaping of settlements, developed under the influence of productive forces of social fabric and community.

The issues and methods of reconstruction of cities, its nature and extent have changed dramatically in the historical development of habitat.

Social demands, functional requirements, engineering-technical and economic opportunities, as well as aesthetic needs of the Soviet society find a specific explanation and materialistic expression while the cities of our country were built in a separate plan. Scientific and technical progress means are used to improve the planning structure of cities. Reconstruction is the development of the city and the ability of society to build a future based on the creative vision of the prospects of this development in order to create the most favorable conditions for the improvement of human habitat during the planned economy. The reconstruction of cities cannot be converted to personal issues, the development of cities on the basis of scientific meetings can serve as a means of resolving the deep-rooted contradictions.

The reconstruction of cities, upgrading and replacement - these are the terms of the same concept. The difference between them, however, is one of the subtle features of these regular or other remedial actions that characterize the degree of radicalism in the radical renewal of each city's development stage. The concept of reconstruction of cities has dual meaning. On the one hand, it reflects the development of residential areas, the process of their spatial planning and improvement of structures and landscaping processes, which last for hundreds of years. On the other hand, the reconstruction of cities - this is a material result, the condition of the building and landscaping in the present time. Once you understand these aspects of reconstruction and their relationships, it is possible to properly assess the issues and determine the methods of rebuilding the cities.

Reconstruction is a continuous process in every city, depending on the direction and speed of its development, its previous growth and modern requirements. It predetermines the significance of the city as a historical manifestation of the different periods of history, of which they are wrapped around one another. When planning measures to improve the planning structure of the cities, it is necessary to rely on the modern city, which is a growing social organism that is constantly changing.

The contradictions arising during the early stages of the development of cities serving as an incompatible source between the planning structure and the new requirements that existed before the restoration of society on the history and social development of society are gradually eliminated. For this reason, there

exist active and rapidly changing parts, capable of dealing with conflicts between the old planning structure and the new life requirements, which are posed by changing the conditions of urban life and able to serve long-term and develop in the city.

The reconstruction of the cities comes from the renewal of the old, the long-standing parts of the city, and the adoption of new territories necessary for the development of buildings and placement of engineering and technical facilities. The development of cities in the new areas and the reconstruction of old parts are based on common urbanization requirements and depend on one another.

Restoration problems are of great importance to the fact that the cities of our country are developing under the conditions of the logistics of communism, the planning structure and their partial structure still preserve the lines of the ancient cities.

The main issues of restoration are:

- reconstruction of the urban planning structure, as well as the regulation of their development within the administrative borders of the city as well as within the suburban zone, feasible territorial zoning and implementation of planning zoning of urban areas;

- cleansing of air and water basins, reduction of industrial and transport noise, greening and regulation of open sites, withdrawal of hygiene and fire hazardous enterprises and facilities around the city, urban environment improvement through complex, interconnected activities to ensure aeration in urban areas;

- modernization of industrial areas and other mass workplaces, improvement of planning structure and technical equipment, taking into account progress in all areas of activity, regulation of workplaces compared to other areas and warehouses, industrial waste disposal;

- organizing public mass service by improving the living environment of the city and changing small-sized neighborhoods to useful living areas, development of system of cultural and household service enterprises, creating new, more comfortable and transformational residential buildings and businesses, reconstruction of buildings that have significant material value, removal of residential buildings from sanitary zones and other places;

- the development and expansion of the public center in connection with the increase of the number of public buildings, Inclusion of different local and specialized centers into a single interconnected planning system, protection of architectural monuments and their compatibility with modern buildings;

- radical improvement of city highways and street networks for the acceleration, convenience and safety of traffic, installation of transport and parking points, establishment of parking and garage network;

- the regulation of external transport systems, removal of railroad technical and diversification stations out of city, improving the showing of the direction of suburban highways and entering the city, convenient placement of air transport facilities compared to the city;

- undertaking necessary measures for engineering preparation of the city territory and abolition of useless territories, changing and improving natural conditions, efficient use of the urban areas;

- radical improvement of engineering equipment, development and modernization of municipal economy networks, bringing the retail underground and surface technical networks into a single planning system and linking this system with the overall structure of the city;

It is necessary to rely on the broad experience of development of the modern urban planning of Azerbaijan, to take into account the best practices of world urban planning, to properly evaluate it and to get acquainted with it by developing comprehensive urban restoration projects and implementing their reconstruction.

The search for ways to rebuild cities on the basis of modern requirements is basically implemented in two directions. The first one is related to the development of city planning structures in connection with the problem of settlement. The second focuses on the arrangement of spaces in the construction of separate parts of the city, with little or no detail on general planning concepts.

The industrialization of the country gave a great impetus to the question of the urbanization practice and the question of how the city of modernity was different from the city that emerged in the current socio-historical conditions. There were various, sometimes contradictory views on this.

In some cases reconstruction of cities was understood as their desentralization or desurbanization, which was denied as a means of urban settlement. Desurbanization supporters believed that the shortcomings of cities in developed countries (density, ruin, separation from the nature, etc.) are common to all cities. They claimed that the city was a contingent of antagonist class society with its all contradictions, antihumanism, and industrial anarchy. The right conclusion here is that the urban form of settlement is characteristic of the class society, and in the classless society the city is deprived of its social-public base and is gradually disappearing in the process of transition of employees to industrial and agricultural enterprises, along the road, to the cross-border settlement. This concept has been expressed in a functional interconnection scheme based on the principle of parallel zoning of different targeted areas. Otherwise urban development was understood as a historically

conceived process, not the destruction of the city, but the radical transformation of its structure and planning structure.

Issues related to the reconstruction of cities in the Republic of Azerbaijan have been highlighted by the recent problems of the development of the modern city reflected in the theoretical and project solutions: creation of complex regions, open and evolving structure of the city plan, functional zoning of the city territory, etc. Progressive ideas for their era were included in the projects: the city's borders were expanded, and the surrounding districts were more favorable for their subsequent adoption, and as a result of the relocation of the population to the new districts of the expanding city, gradual reduction of the central partition was intended, and great attention was paid to the replacement of the highways.

Construction of new cities is one of the most important directions of urban development in the Republic of Azerbaijan. Sustainable development of economic activity on the basis of industrialization and mechanization of agriculture in the country leads to a rapid increase in urban population and a decrease in rural population.

In the 20th century, new cities like Dashkesen, Mingachevir, Sumgayit, Shirvan, Yevlakh were emerged in Azerbaijan. There are two key features of the typological characteristic of the new cities created in our country: the functional structure and the population of the city.

The functional structure of the city is defined by its economic profile, which is quite different in new cities. Cities are formed as production and processing industrial centers, agricultural regions, mass recreation and resort services, transport, science cities. As a result, some of the new cities emerged as industrial centers have become even more complicated. Such cities have become administrative and cultural centers of large districts. But still, the majority of new cities are not only multi-functional, but also specialized (single-profile) cities.

The big difference in the specialization of functions has also determined the significant differences in the size of the new cities. The number of residents in these cities varies from 30 to 300,000. According to the number of residents, grouping of new cities is an indication of the location of cities based on typical functions and scale. To determine the population of the new city, it is necessary to prepare the feasibility study of the new city's general plan.

The development of the feasibility study of the new city plan covers the analysis of the structure of labor resources, their completion through mechanical and natural growth, and the rational use of labor resources in the development stages of the new city.

In the rapidly developing cities - Mingachevir, Sumgayit and Shirvan, the need for labor force is repaid through the flow of people from other regions, countries and rural areas.

The developmental analysis of the number of new urban population in the country shows that the flow of new populations to the new towns at the first stage of the construction (5 - 7 years) is particularly significant - at the expense of construction workers, and then by the flow of key industry and energy workers. In the subsequent era (second decade), the magnitude of the mechanical increase is usually reduced.

In the first decade of the city's development, young people and young families dominate the population. The working age-related population group reaches its peak, and the proportion of people at the age of retirement decreases. The next period when the composition of the population began to stabilize was characterized by an intensive increase in the number of families, and, respectively, children's age groups. At the same time, a slight decline in the specific weight of the working age population and the increase in the number of pensioners are observed. The proportion of people at the age of working age, reaching the maximum level (70% or more) in the first decade of the new city, is reduced to 62-65% at the subsequent stages of its development. Redistribution of the proportion of age groups, especially the child age group and the specific weight of retirees, occurs. Analysis of the modern age structure of new cities shows that the proportion of children in new cities (up to 15 years old) is 50-60% higher than in those older cities and is 23-33%.

Taking into account the current trends of the new cities, the share of promising labor resources, ie people who can participate in public production, will be 62-64% in the first stages of the construction, and in the future will be 60% of the whole population of the city.

Determination of the amount of labor resources is a preparatory stage in identifying the proportion of populations for urban populations, service providers and non-active groups, and for determining the number of prospective population in the new city.

The specific weight of the city-generating group on separate cities may be 40% and more especially in the first stages of the construction, and 35-37% in the future because individuals working in new cities are more than 20-25% of the urbanized contingent.

The trends in the structural change of the city-generating group on the development stages in the new cities have different legalities than those found in the cities. This particularly refers to the ratio and number of employees.

In the new cities, the share of industry personnel is increasing. In the early stages of the development of the new city, the contingent of builders may be 40% or more of the total number of city-generating groups. Upon the completion of the city's production base, the share of construction workers will decline by about 10%.

The above-mentioned characteristics of the age structure of the population



of the new cities are influenced by the structure and number of labor resources, the employment of different groups of population in public production, the proportion of urban population and service groups, and the determination of the population of the new city in the project.

In the preparation of the feasibility study of the development of the new city, it is necessary to take into account the increasing significance of social and demographic issues in the creation of a favorable environment for the population to live and adapt in the construction period.

It is especially important to create important conditions for the development of leisure time, social relations, and information receiving in the new cities in terms of culture, out-of-production and residents, since only in this case can solve the difficult problem of social integration and the strengthening of the population in the new place. The development of the new city's socio-cultural environment can be facilitated by taking into account the social-occupational and demographic characteristics of the population. Studies show that it is the most difficult issue for non-productive activities and leisure time for their younger age categories. Therefore, trends in the planning of the city's urban services industry depend on the particular situation of the "family" in the city, including many important social conditions, the different ages and the families of its members, and in what proportional relationships are. Most new cities are dominated by simple and young families (married couples and younger children).

Given the above, it should be noted that the design of new cities should primarily focus on these types of families, and within the overall development of the demographic structure of the new cities.

A comprehensive analysis of the needs of different types of families allows determining which needs and components of the city, such as the spatial distribution of functions of different types of families, and the more accurate assessment of their attitude to the system of municipal services. The results of the analysis show that the development of new cities in general and specialized public centers (not only their district and suburban areas) is primarily consistent with the demographic characteristics of the population, which allows them to integrate and adapt to new places. At the same time, this analysis also emphasizes the particular importance of the development of education and training functions in the living zone.

The determination of the profile of the design of the new city, one of the most important problems, as well as a reliable basis for all measures for the development and renovation.

Combining the individual (separate) forces of the equipment, and on the basis of which the overall tendency of technical progress in the industry to increase the output of each enterprise, the development of the urban development industry, advantages gained in the urban economy, and the results of industrial

development and economy, should be solved.

The determination of the profile of the design of the new city is one of the most important problems, as well as a reliable basis for all measures for the development and renovation.

At present, 80% of workers in urban areas of Shirvan, Mingachevir, Yevlakh, Sumgayit and other cities of the Republic of Azerbaijan work in industry. Analysis shows that the population of the new industrial cities play a crucial role in shaping the industry personnel (60% of the total number of city-generating staff) remains. A slight decline in the share of industry personnel will come as a result of a tendency to increase the contingent of employees in academic institutions and educational institutions (in the future, they will account for approximately 20% of all urban-generating cadres instead of their current 10%).

Sumgayit, which closely cooperates with the Baku oil refining industry and develops as the center of the petrochemical industry, is the most interesting example of the new industrial city with its well-established production profile. Setting up Sumgayit as a satellite of Baku, which is part of the settlement system, allows Baku to be emptied in agriculture and in urban relations.

The key condition for the rational formation of the new city production base is the abandonment of industrial enterprises by "one by one" and their transition to complex placement in the common tendency of the growth of business power. The complex placement of production ensures the following advantages: specific investments in construction are 14%, production costs fall by 16%; labor productivity increases by 70% compared to the construction of specialized enterprises with the same strength. Additionally, a combination of auxiliary workshops, transport and engineering communications will reduce the size of the required area of the entire industrial complex (in comparison with individual settlements) by 1.5 times, and the number of personnel is almost doubled. In the new city, it is necessary to find the optimal composition of enterprises for the merger of enterprises in the industrial complex and their strengths that meet the concrete economic-urban conditions of the city and the settlement system. Such conditions include rational boundaries of cooperatives and a combination of enterprises entering the complex, dimensions of industrial grounds, sanitary damage of enterprises of the whole complex, total dimensions of cargo turnover, size of water resources, the total number of necessary personnel, the location of the city in the settlement system etc.

The strength and character of the complex of enterprises placed in the city predetermines the size of the city population according to its production profile. Based on one of the industrial production complexes in the Republic of Azerbaijan, cities with a population of 50-100 thousand people were established, which is actively growing. Currently, the population of Sumgayit has reached

300,000.

Combining the individual (separate) forces of the equipment, and on the basis of which the overall tendency of technical progress in the industry to increase the output of each enterprise, the development of the urban development industry, advantages gained in the urban economy, and the results of industrial development and economy, should be solved. Technically, this is due to the combination of the required costs for the provision of good living conditions in the city for the exploitation of the urban economy in the construction and the utilization of industrial enterprises.

The multifarious nature of the economic base created during the growth of cities, with a decrease in the share of workers in the manufacturing industry (up to 30-40%). These conditions require the functional zoning of cities to be substantially larger than the industrial lands and the relatively smaller resources of the construction site.

The required capital investments for the organization of the construction base reach 8-12% of the overall construction of the city and industry.

Buildings, components, structures and their combined installation, as well as repair and maintenance of construction machinery and vehicles, form the production base of the construction.

The construction base is a part of the ongoing highways, engineers, and energy and steam networks, etc. cooperatives (both between themselves and with other enterprises) in the form of enterprises. The composition and strength of the construction base depends on the volume of construction and installation works. The calculation of the volume of construction and installation works is based on the definition of prospective capital investment in the industrial, residential, cultural and domestic construction and engineering equipment of the new city. The average specific weight is divided by the volume of construction and installation works that are 90% of the total capital investment, depending on the area of industrial construction, in the range of 50-75%, and the total capital investment.

The share of construction and installation works in the construction of non-developed areas is considerably higher than in the construction of similar enterprises in the developed regions.

### **Summary**

After reviewing the above, it can be concluded that reconstruction of cities is complicated and complex. It covers the design and construction experience and theory of renewal and improvement of planning, construction and renovation of living spaces, developed under the influence of the public and community production forces. Scientific and technical progress means are used to improve the planning structure of cities. Reconstruction is the development of the city and the ability of society to build a future

based on the creative vision of the prospects of this development in order to create the most favorable conditions for the improvement of human habitat during the planned economy. The reconstruction of cities can not be converted to personal issues; the development of cities on the basis of scientific meetings can serve as a means of resolving the deep-rooted contradictions. The reconstruction of cities, upgrading and replacement - these are the terms of the same concept. The difference between them, however, is one of the subtle features of these regular or other remedial actions that characterize the degree of radicalism in the radical renewal of each city's development stage. The concept of reconstruction of cities has dual meaning. On the one hand, it reflects the development of residential areas, the process of their spatial planning and improvement of structures and landscaping processes, which last for hundreds of years. On the other hand, the reconstruction of cities - this is a material result, the condition of the building and landscaping in the present time. Once you understand these aspects of reconstruction and their relationships, it is possible to properly assess the issues and determine the methods of rebuilding the cities. It is especially important to create important conditions for the development of leisure time, social relations, and information receiving in the new cities in terms of culture, out-of-production and residents, since only in this case can solve the difficult problem of social integration and the strengthening of the population in the new place. The development of the new city's socio-cultural environment can be facilitated by taking into account the social-occupational and demographic characteristics of the population.

### References

1. Naghiyev N.H., Huseynov F.M. History of Azerbaijani Architecture. Volume 1-5, "Azərbaycan Respublikasının müasir dövr memarlıq tarixi", History of modern architecture of the Republic of Azerbaijan - volume 5, Publishing House "Şərq-Qərb", Baku, 2013, pages 338
2. Bocharov Y. P., Kudryavchev O.K. Планировочная структура современного города, Planning structure of modern city. Ed. Литература по строительству, References on construction, 1972, Moscow, page 160
3. Bretanichkiy L., Salamzadeh A. Архитектура Советского Азербайджана, Architecture Of Soviet Azerbaijan. Ed. Литература по строительству, References on construction, 1973, Moscow, page 264
4. Naghiyev N. G. Современное градостроительство Азербайджанской Республики, Modern urban planning of the Republic of Azerbaijan. Publishing House "Təhsilçi", 2011, Baku. page 361
5. Smolyar I.M. Новые города, планировочная структура городов промышленного и научно-производственного профиля, New city planning structure of industrial and scientific and production cities Ed. Литература по строительству, References on construction, 1972, Moscow, page 184
6. Реконструкция крупных городов (методическое пособие для проектировщиков) / Литература по строительству, Москва 1972., Reconstruction of large cities, a manual for designers / Ed. Building Literature,

- Moscow, 1972
7. Qəhrəmanova Ş.Ş. Şəhər mühitinin yenidənqurulması/AzMIU Memarlıq fakültəsinin magistr pilləsi üçün dərs vəsaiti, Çasıoğlu, Bakı, 2003, Kahramanova Sh.Sh. Urban Reconstruction /Textbook for Masters Degree in Architecture Faculty of AzSU, Chashoglu, Baku, 2003
  8. Бретаницкий Л., Саламзаде А. Архитектура Советского Азербайджана. Изд. Литературы по строительству, Москва, 1973, 264с., Brittanuyitsky L., Salamzade A. Architecture Soviet Azerbaijan. Search Literature in the Building, Moscow, 1973, 264 p
  9. Бунин А.В., Ильин Л.А., Градостроительство, Bunin A.V., Ilyin L.A., Urban Planning
  10. Поляков Н.Х., Шквариков В.А. Градостроительство в мусульманских странах, Polyakov N.Kh., Shkvarikov V.A. Urbanplanningin Muslim countries.

# OIL INDUSTRY AND KHEMICAL

## ARTIFICIAL LIMESTONE STONE BASED ON CARBONATE ROCKSWASTES

**A.A. Quvalov**

*Azerbaijan University of Architecture and Construction  
abbas-guvalov@mail.ru*

### **Abstract**

The compositions of artificial stone based on waste products of carbonate rocks are investigated. The cement content in the composition of the artificial stone mixture was 10-20%. It was established in order to obtain effective artificial stone, it is necessary to take into account the grain composition of waste products, the likelihood of microfissure during molding, as well as the low water resistance of screenings for crushing carbonate rocks. To improve the characteristics of artificial stone, the use of a modifying additive Rheobuild 561. A positive effect of moist hardening conditions has been established to increase the water resistance and frost resistance of artificial stone. The research results solve the problem of the integrated use of carbonate rock waste products in the production of building materials.

***Key words:** artificial stone, carbonate rock waste products, moulding sand moisture, pressing pressure, Rheobuild 561, curing conditions, frost resistance, water resistance*

### **Introduction**

Among the most important modern tasks in the field of building materials science is the task of developing and introducing into production highly efficient, resource-saving technologies focused on the integrated use of local mineral resources and industrial waste [1-4]. In particular, the issue of the integrated use of carbonate rocks deserves special attention, since the natural reserves of this raw material are widespread in Azerbaijan. Carbonate rock sawmill waste (CBMP) averages about 40% of the breed. Carbonate rocks of the Karadag region are characterized by high heterogeneity in density and mineralogical composition [2,3].

Their density varies between 1600 ... 2400 kg/m<sup>3</sup>, water absorption by weight, respectively, in the range of 15-18%, the coefficient of water resistance is 0.7-0.9. Limestones containing siliceous components, quartz and feldspars are widespread. The content of SiO<sub>2</sub> within one deposit varies from 5 to 11%, the content of clay impurities in some cases reaches 5%. The complexity of the use

of OPKP in the production of artificial building stone also lies in the fact that a significant part of them is characterized by low water resistance. Thus, the problem of the rational use of IPPC remains relevant today. The performed studies are devoted to the study of the possibility of producing artificial limestone based on low-strength and non-water-resistant carbonate rock sawdust.

### **Materials and research methods**

As binder, CEM I-42.5 non-additive Portland cement with a specific surface area of  $370 \text{ m}^2 / \text{kg}$  (NORM cement plant) was used. In the manufacture of artificial limestone, the main raw materials used were crushed carbonate rocks from the Karadag quarry with a clay impurity content of 5%. Natural quartz sand of the Balakhaninsky deposit with a particle size of 1.2 was used as a fine aggregate. The properties of the samples were determined after 7 and 28 days of their hardening under normal conditions.

### **Research results and discussion**

The influence of the preparation methods, the content of cement, water, OPKP and natural quartz sand on the properties of artificial limestone based on OPKP was studied [3, 4]. The result of the optimization of the cooking process is the formation of a structure of artificial carbonate material with a sufficient and uniform degree of compaction and the achievement of high physical, mechanical and operational properties. Theoretical studies have established that to improve the physical and technical properties of products made of cement-carbonate compositions, methods of vibrating and vibrocompressing products are used. Studies of the properties of artificial stone material made by the technology of vibration compaction of low-plastic mixtures are carried out. Portland cement of the CEM I-42.5 grade of the NORM cement plant was used as a binder. As a placeholder, the OCPP of the Karadag quarry was used.

In crushing screenings, the fraction of particles of crushed stone fraction was 10%. Vibration compaction method for 120 sec. samples of cubes  $100 \times 100 \times 100 \text{ mm}$  in size were prepared with a cement content of 10 ... 30% from mixtures with a diffusion diameter of 110 ... 130 mm on a shaking table. The test results of the samples with the addition of Rheobuild 561 and without it are shown in table 1.

**Table 1**

**Compressive Strength of Artificial Limestone Based on OPKP**

№	Consumption of materials,% by weight				The diameter of the mixture, mm	Compressive strength, MPa
	cement	OCP	Rheobuild 561	W / C		
1	10	90	-	2,45	110	1,4
2	10	90	1,0	2,15	110	1,7
3	20	80	-	1,45	110	12,2
4	20	80	1,0	1,25	110	15,5
5	30	70	-	0,82	110	18,2
6	30	70	1,0	0,70	110	22,8

An analysis of the results revealed a high water demand of the compositions, with a cement content of 10% component B/C = 2.45. The result is due to the high proportion (about 20%) of fine fractions with a size of less than 0.16 mm, increasing the viscosity of the mixtures. The water demand of concrete mixtures due to the introduction of Rheobuild 561 admixture decreased by an average of only 12-15%. The use of Rheobuild 561 additive in compositions with a constant consumption of cement contributed to an increase in the strength of vibrated samples by an average of 20-25%.

The effectiveness of regulating the properties of the studied mixture compositions using two-component aggregate made from OPKP and natural quartz sand is considered. The effect of the content of natural quartz sand in the composition of a two-component aggregate and Portland cement on the formation of concrete strength in the presence of Rheobuild 561 additive is investigated.

The content of the additive corresponded to the maximum of the recommended range, that is, it was taken in all compositions equal to 1.0% by weight of cement. As a filler in the compositions, a two-component mixture of OPKP and natural quartz sand of the Balakhani quarry with a particle size of 1.2 was used. In the experiment, quartz sand was partially replaced, in the range from 0 to 50%, by OCP. The analysis shows that with a partial replacement of sand up to 50% of the PCB in the presence of Rheobuild 561 additive, concrete compositions with a compressive strength of 5-30 MPa can be obtained (Table 2). In the presence of 10 - 20% cement on a two-component aggregate containing up to 50% carbonate rock waste product in the presence of Rheobuild 561



additive, compositions were obtained that are not inferior in strength to cement-sand. These compositions have a strength of not more than 10-20 MPa. From the point of view of the high water demand of the moldable mixtures (H/C greater than 0.7), it seems problematic to obtain durable material by the technology of vibrating inactive mixtures based on OCPP. The formation of the properties of artificial limestone material based on OCPC using compression technology, which allows the formation of rigid mixtures, is considered.

**Table 2**

**Influence of the content of PCMP and quartz sand on the compressive strength of the material**

№ п/п	Consumption of materials, % by weight				The diameter of the mixture, mm	Compressive Strength, MPa (28 days)
	cement	OCPP	Quartz sand	Rheobuild 561		
1	10	0	90	1,0	110	4,9
2	10	45	45	1,0	110	5,2
3	10	22	68	1,0	110	5,8
4	20	0	80	1,0	110	27,0
5	20	40	40	1,0	110	21,0
6	20	20	60	1,0	110	26,8
7	30	0	70	1,0	110	40,2
8	30	35	35	1,0	110	31,2
9	30	18	52	1,0	110	38,2

Equipment that allows you to obtain products by pressing is quite affordable. The influence of the cement content and pressing pressure on the strength of concrete made by pressing on the basis of carbonate rock sawing waste (OPKP) was studied. The studies were performed using Portland cement CEM I-42.5 of the NORM plant. The water content of the mixture was 12% of the mass of dry materials, which ensured its formability within the framework of a given pressing technology. Samples of cylinders (h = 50 mm and Ø = 50 mm) were formed from a mixture of cement, OCPP and water, which were tested for compressive strength after 28 days of hardening under normal conditions.

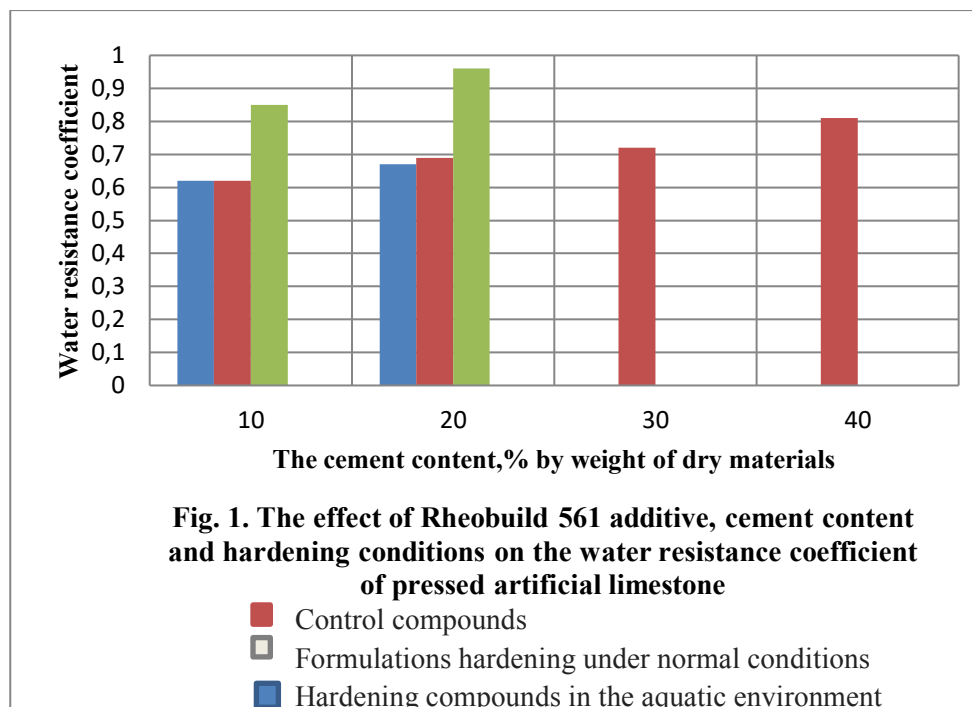
The following factors were selected as variable factors: X1 - binder (cement) content in the range of 10-30% by weight of dry materials; X2 - the value of the pressing pressure in the range of 5-15 MPa. A set of laboratory studies has been implemented aimed at identifying the dependence of the strength

of pressed artificial limestones made on the basis of OPKP on selected variable factors.

An analysis of the study made it possible to establish the actual possibility of obtaining a pressed artificial limestone material based on waste product from carbonate rocks with a strength of 5 to 25 MPa. A significant influence on the formation of the strength index of a composite material is exerted not only by the amount of cement introduced into the composition, but also by the pressure value. In particular, the strength of a composition with a cement content of 10% by weight of dry materials molded at a pressure of 5 MPa was 3.5 MPa, while the strength of a similar composition molded at a pressure of 15 MPa increased to 6.5 MPa, i.e., 85.7%. In compositions with a cement consumption of 20%, an increase in pressing pressure from 5 to 15 MPa contributed to an increase in strength by 20%.

The studies showed that for mixtures of cement and OCPP it is advisable to apply a pressure of at least 15 MPa, which was implemented in further studies. It was also established that the coefficient of water resistance of the material does not exceed 0.5, which limits the scope of its application. Further research was aimed at finding ways to increase the water resistance of artificial stone material. In order to increase the water resistance of pressed artificial limestone material based on PCMP at a cement consumption of 10-20%, Rheobuild 561 additive manufactured by BASF in the amount of 1% by weight of cement was added to the compositions of the molding mixtures. The influence of hardening conditions on the water resistance of artificial stone was studied in the framework of a technology that provides hardening of samples under normal conditions and under immersion in an aqueous medium 3 days after molding. The influence of the hardening conditions of the samples on the coefficient of water resistance at different cement contents is shown in the figure in comparison with control compositions not containing Rheobuild 561.

The water resistance and water resistance of the artificial pressed material depends not so much on the volume of crystalline hydrates formed in the pore space of the artificial stone during its hardening, but on the number and size of crystals. In the process of hydration, a decrease in humidity occurs in the pore space of a semi-dry pressed artificial stone.



This contributes to the destruction and recrystallization of ettringite crystals formed at the initial stage of hardening into larger crystals, which leads to an increase in porosity and a decrease in the water resistance of artificial stone [5]. Rheobuild 561 facilitates the placement of crystalline hydrate nuclei in the pore space of an artificial stone. The flow of water into the pore space of an artificial stone during hardening leads to a decrease in the concentration of  $\text{Ca}(\text{OH})_2$  in the liquid phase to a level at which highly basic calcium hydroaluminates become unstable. As a result, the binding of alumina to the cryptocrystalline calcium hydrosulfoaluminate of the trisulfate form occurs in watered pores and capillaries. The accumulation of finely dispersed stably existing ettringite crystals is accompanied by their intensive intergrowth, increase in density, impermeability, increase in water resistance and frost resistance of artificial stone material [6]. The results of the experiments show the possibility of obtaining a water-resistant and frost-resistant pressed artificial stone material based on PCB at a cement flow rate of 10-20% with a compressive strength of 25.0-30.0 MPa using Rheobuild 561 additive based on technology involving immersion of samples in an aqueous medium 3 days after molding. The most important influence on the formation of the operational properties of the studied material is exerted by the parameters of its pore structure. The results of the study of the average density of the material, determined in accordance with GOST

12730.1-78, confirm the fact of compaction of the structure of the material. It was found that the average density of the material under the influence of the modifier increases by 5%. The microstructure of a modified artificial stone material based on sawdust from carbonate rocks was investigated. The microstructures of the artificial stone show that in the presence of the Rheobuild 561 additive, it is substantially densified.

Comparative studies show that the use of Rheobuild 561 as a chemical modifier of pressed stone material allows to increase the strength of products by 16.5% with a cement content of 10% by weight of dry materials and by 18.8% with a cement content of 20% compared with similar compositions material without modifier. The main physicochemical and operational characteristics of rational compositions of pressed stone material on the basis of HCPF, modified with Rheobuild 561 additive at a cement consumption of 10-20% (compressive strength 20-25 MPa, water resistance coefficient  $> 0.8$ , frost resistance - F50, average density) are determined - 2100 kg / m<sup>3</sup>, total porosity of 20–23%, water absorption by weight of 6.5–6.2%). In the course of comparative studies, it was found that the developed material is not inferior in quality to silicate brick of the M200 brand, but at the same time it has higher water resistance.

## Conclusion

- The use of Rheobuild 561 modifying additive was recognized as the most rational decision regarding the use of rock-casting stone in the production of artificial limestone.
- A positive effect of moist hardening conditions has been established to increase the water resistance and frost resistance of artificial stone. The research results solve the problem of the integrated use of carbonate rock sawdust in the production of building materials.

## References

1. Guvalov A.A., Mamedova A.A. The effect of carbonate filler on the structure formation of cement compositions The collection of materials "Physical Materials Science" VI International School with elements of a scientific school for youth. Tolyatti, September 30 - October 5, 2013, pp. 130-131.
2. Guvalov A.A., Mamedova A.A. The use of finely divided mineral sludge to control the properties of cement compositions Actual problems of strength: abstract of the LVII international conference, May 24-27, 2016 / SevSU. - Sevastopol, 2016. Page 68.
3. Guvalov A.A., Bayramov A.A. The use of secondary mineral resources in the production of effective wall materials Actual problems of strength: abstract of

- the LVII international conference, May 24-27, 2016 / SevSU. - Sevastopol, 2016. Page 69.
4. Guvalov A.A., Abbasova S.I., Heydarova E.A. The influence of fine-grained limestone on the properties of multifunctional concrete Actual problems of strength: LIX International Conference collection of materials and competitive reports. - Tolyatti: TSU Publishing House, 2017, p. 211.
  5. Kononova O.V., Cherepov V.D. Modified artificial stone based on screenings of crushing carbonate rocks // Modern problems of science and education. - 2013. - No. 1; URL: <http://www.science-education.ru/107-8295> (accessed: 02/05/2013).
  6. Moshkovskaya S.V. Development of compositions of dry construction mixtures for waterproofing purposes: author. dis. ... cand. tech. sciences. - M., 2000. –18 p.

## STUDY OF SEDIMENTATION ENVIRONMENT OF PRODUCTIVE SERIES DEPOSITS IN DARVIN BANK AREA

**L.N. Khalilova**

*Azerbaijan State Oil and Industry University, Baku, Azerbaijan  
lala\_khalilova@mail.ru*

### **Abstract**

Study of nature of reservoir-rocks facies has significant importance while exploration for non-anticline traps of oil and gas. It is commonly known that not always the non-anticline traps, i.e. lithological traps are related to sand bodies. In this respect it became necessary to perform detailed studies of conditions under which sand bodies within the study area were formed in order to identify the most perspective lithological traps and oil and gas accumulations. This paper expounds results of applying of logging facies techniques, which allowed to identify nature of facies and sedimentation environment of the Early Pliocene deposits of Productive Series. It must be noted that applied methodology allows to perform reliable interpretation, visually analyzing the form of gamma-log (GL) curves and spontaneous polarization (SP) curves.

**Key words:** *Productive Series (PS), non-anticline traps, sedimentation environment, facies, lithological and facies composition, qualitative logging models of facies.*

### **Introduction**

It is commonly known that under continental environment the lithological deposits of oil and gas are attributed mainly to deposits of fluvial-alluvial genesis. Channels of ancient rivers made of sand formations and crossed by clayey deposits of flood plain represent the favorable combination of good permeable and impermeable rocks which is necessary condition for hydrocarbon accumulations. It is known that the highest number of lithological deposits of oil and gas are related with deltaic deposits. Deltaic deposits are significant oil and gas accumulation objects [1-3]. In this respect, the major attention in the paper is paid to study of conditions under which sandy reservoir-bodies and sealing clay rocks of fluvial and alluvial genesis have been forming. Detailed study of setting and sedimentation conditions of Productive Series deposits have theoretical, as well as significant practical value as over 90% of oil, gas and gas-condensate produced in the Republic are extracted from this series. The study target is one of the structures of Absheron-Pribalkhan zone of uplifts – Darwin bank, which is considered for exploration drilling. Absheron-Pribalkhan tectonic zone embracing the South-Caspian basin from the north, structurally represents the

tying element between the south-eastern end of the Great Caucasus and Pribalkhan zone of uplifts of Turkmenistan [4-5]. Uplifts of Absheron-Pribalkhan zone have complicated setting and this is explained by their location in the geosyncline part of the Caspian sea. The zone involves the anticlinal line of Darvin Bank – South Khali – NeftDashlary – Guneshli – Kyapaz. The common feature of these structures are their morphological similarity and complication by a multiple longitudinal and cross faults making them of block structure. All structures of this zone with almost no exceptions are complicated by mud volcanoes and severely dislocated. Darvin bank has brachianticlinal setting. Its axis has submeridional strike. The field of Darvin bank has been discovered in 1950 after the oil extraction from the well drilled in the western flank of the structure. Four portions have been outlined due to the nature of oil distribution across the layers of Darvin bank: the southern, the central, the northern and north-eastern. Perspectives of the lower part of Productive Series have been studied. The main subject of studies included deposits of Qyrmakalyand Qyrmaky suites of PS, with established oil and gas presence across the study area. The studies also covered Qyrmakyustu sand and Qyrmakyustu clay suites of Productive Series.

### **Methods**

The advantage of logging facies methodology applied in this study consists in its use in case of absence or limited quantity of core samples. The qualitative analysis of logging curves (GR and SP) has been applied for researches on sedimentation process and prediction of lithofacies composition of Early Pliocene productive suites. The type and generation conditions of facies have been defined by comparison of anomalies identified on logging curves with curves of qualitative genetic electrometric models of facies. As a result of processing and further interpretation of logging curves of GR and SP in wells Darvin bank №X1, Darvin bank №X2, Darvin bank №X3 and Darvin bank №X4 (indicated well numbers are conventional) we have defined facies type, facies group and facies unit of deposits in the lower part of PS. Gamma-Ray and Spontaneous Polarization diagrams acquired from wells Darvin bank №X1, Darvin bank №X2 and Darvin bank №X3 were used for correlation of earlier identified similar groups of facies (Fig. 1, 3-4). Analysis of drawn correlation lines has been also done. Analysis of available data enabled us to derive the following results.

## Results and discussion

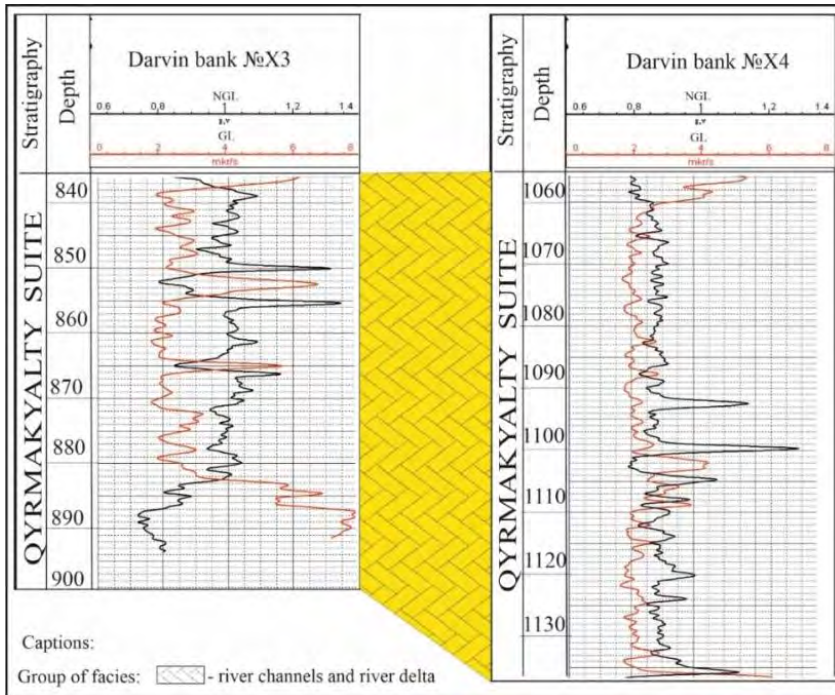
Qyrmakyalty suite is made of medium and large-grained quartz sands with thin clay interlayers (Fig. 1). Thickness of Qyrmakyalty suite in some places reaches 80 m, the average thickness is 47m. Oil and gas presence in this field is related to Qyrmakyalty suite. In well Darvin bank №X3 in section of Qyrmakyalty suite 4 reservoirs have been identified, 3 of them are with oil presence. Oil saturation coefficient of these reservoirs varies within 60-65% interval, porosity coefficient varies as 16-17% .Two of four reservoirs outlined in this suite section in well Darvin bank №X4 have hydrocarbon reserves. Oil and gas saturation coefficient of these reservoirs is 63% and 64%, coefficient of porosity is 21% and 23%. Lithology of all identified reservoirs is represented by silty sands. Qyrmakyalty suite is represented by alluvial facies, which includes the group of facies of river channels and riverbeds. Sedimentation environment is continental. The other suite deserving the interest from the point of view of hydrocarbon presence is Qyrmaky suite (Fig. 2). Qyrmaky suite consists from alternation of clay and fine-grained quartz sand. Down to the section with increase of grain sizes the increase of sand content is observed. 13 of 25 reservoirs identified in section of Qyrmaky suite in well Darvin bank №X1 are oil and gas bearing reservoirs. In well Darvin bank №X2 hydrocarbon presence identified in 9 reservoirs out of 35 outlined, while in well Darvin bank №X3 hydrocarbon presence was identified in 14 out of 40 reservoirs.

In the lower portion of Qyrmaky suite the group of facies of seaside marshes is replaced by group of facies of behind-bank lagoons (Fig. 3). In the middle part of section the group of facies of rip flow is replaced by delta bars in upward direction. Finally, close to the top of the section the group of facies of coastal bar is replaced by group of facies of behind-bank lagoons and rip flow.

Section of Qyrmaky suite at its top is finished by group of facies of river channel. Thus, all outlined facies can be attributed to the fluvial-deltaic facies. Sedimentation environment is transitional. Analysis of section of Darvin bank wells №X1–X4 display that reservoirs with the best values of coefficient of oil and gas saturation (59%-68%) are within delta bar facies. Porosity coefficient in these deposits varies as 16%-18%. They are succeeded by facies of rip flow.

Coefficient of oil and gas saturation of reservoirs attributed to this group of facies varies within the range of 53%-63%, porosity coefficient constitutes 17%-18%. In deposits of facies of seaside marshes the reservoirs with oil and gas saturation coefficient as 57%-61% is outlined. Porosity coefficient of these reservoirs varies within the range of 15%-18%.

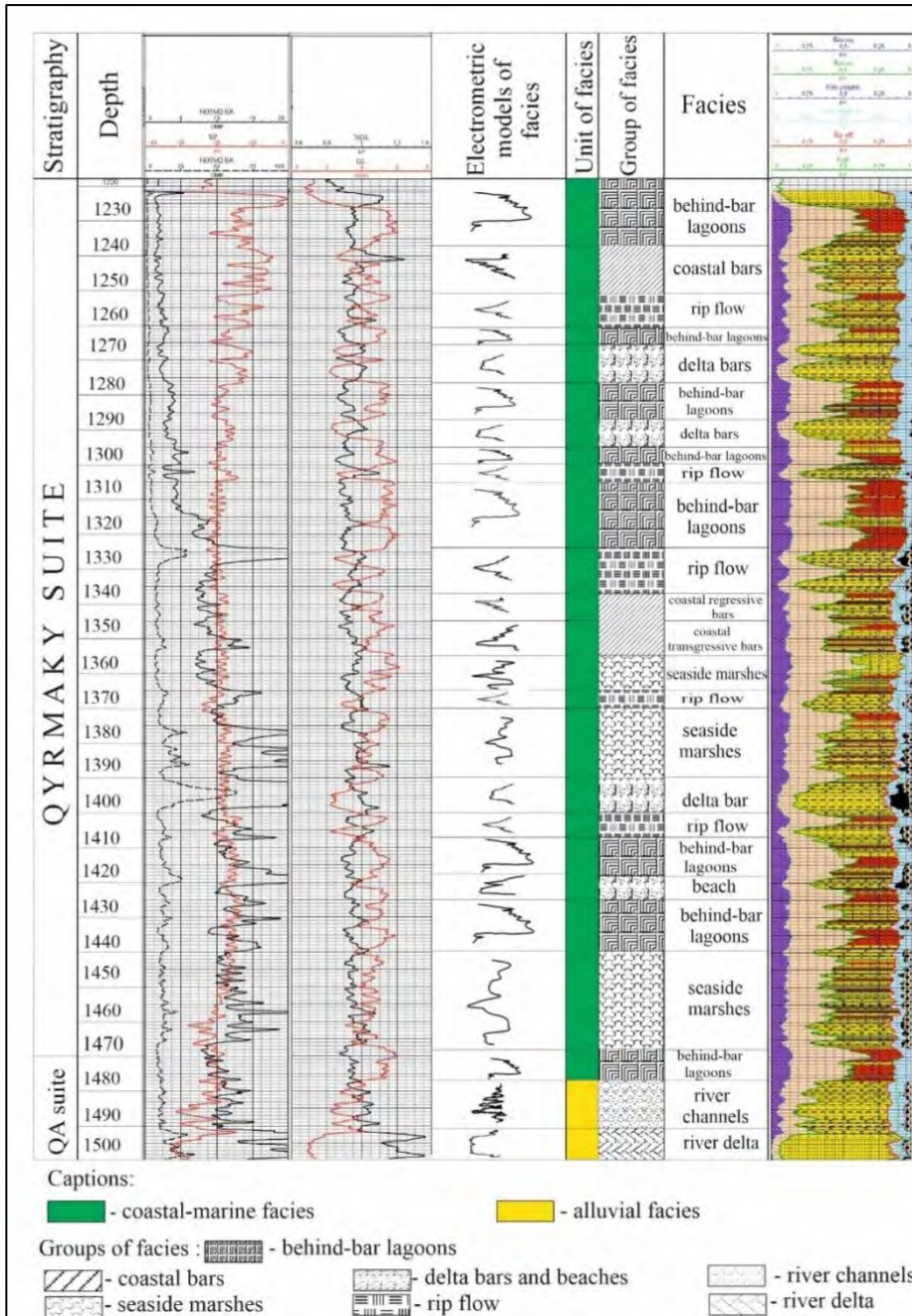




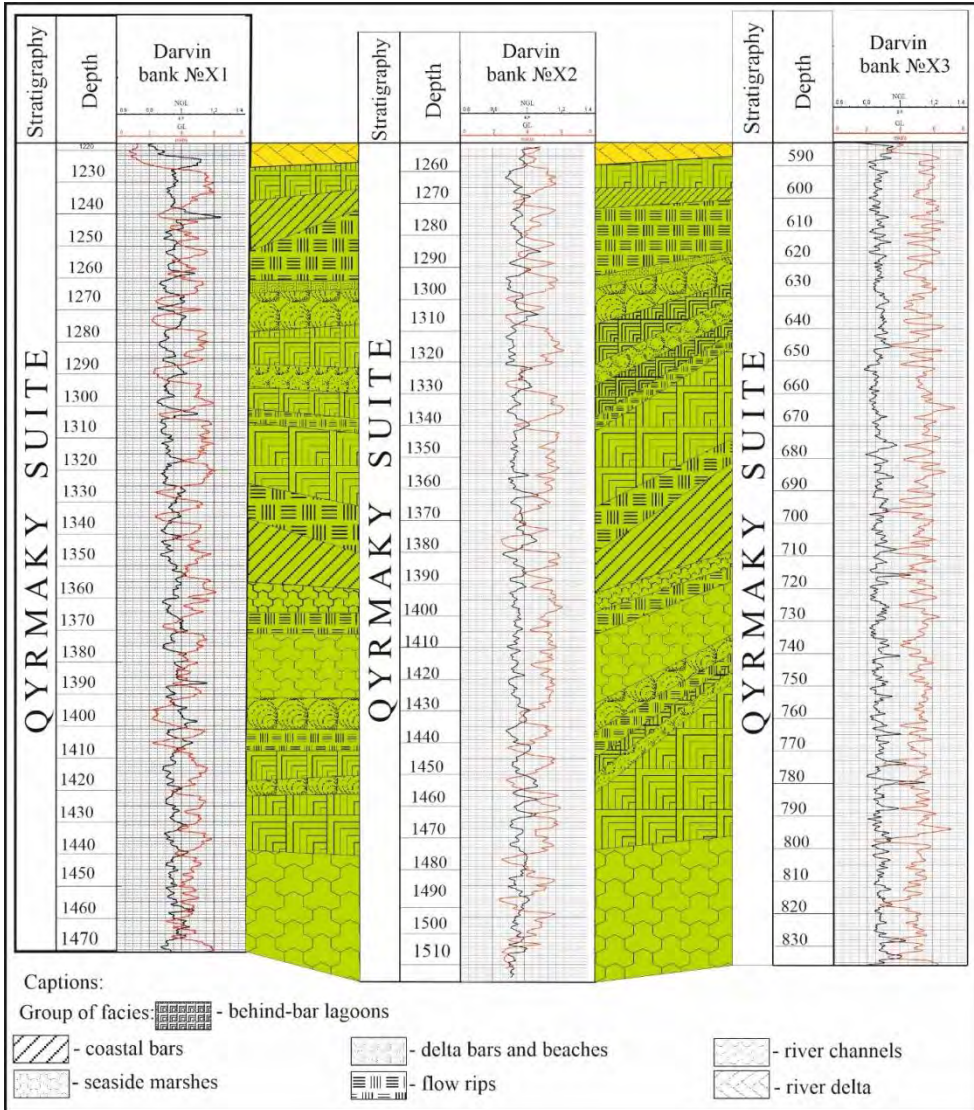
**Fig.1 Correlational line of Qyrmakyalty suite of Productive Series deposits in the Darwin bank area by the data of logging facies technique Section of well Darwin bank №X1**

**Table 1**

Type of facies	Total thickness,m
River delta	6
Coastal bars	33
Rip flows	38,5
River delta and beaches	33
Behind-bar lagoons	79,5
Seaside marshes	60

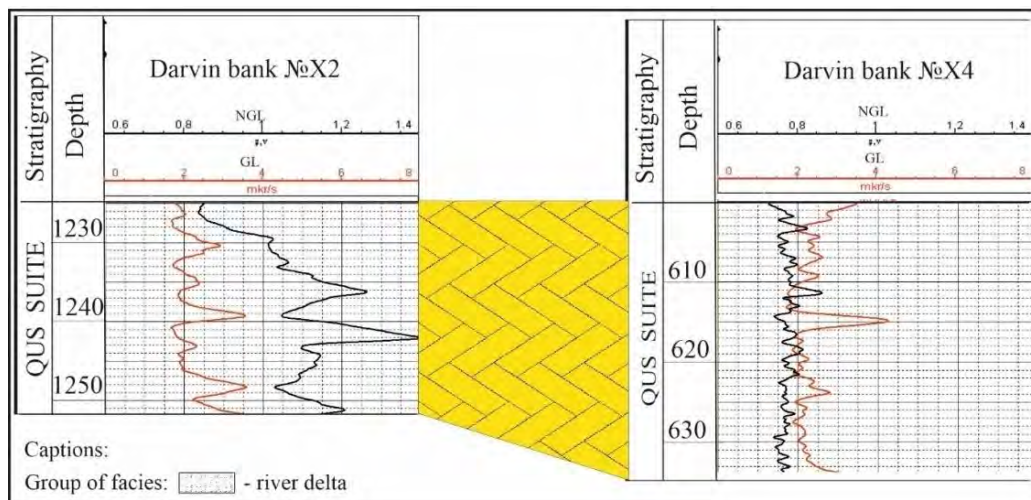


**Fig.2 The scheme of successive deposition of Qyrmayk suite facies (well Darwin bank №X1) and their interpretation**



**Fig. 3. Correlational line of Qyrmaky suite deposits of Productive Series in the Darwin bank area by data of logging facies technique**

Deposits of behind-bank lagoons and coastal banks are characterized by the similar values of oil and gas saturation coefficient (55%-58%) and porosity coefficient (16%-19%) respectively. In this paper we will consider in detail the section of well Darwin bank №X1 as this is the most hydrocarbon bearing section of Qyrmaky suite.



**Fig. 4. Correlational line of Qyrmakyustu sand suite of Productive Series deposits in the Darwin bank area by the data of logging facies technique**

It has been noted already that maximal coefficients of oil and gas saturation (68%) for this interval refer to the group of facies of delta bars. Two oil and gas bearing reservoirs of 11.3 m total thickness are outlined within this group. Three reservoir layers are identified in the group of rip flow facies of 11.6 m total thickness and oil and gas saturation coefficient as 56%-63%. In the group of facies of behind-bank lagoon three reservoirs of 19.9 m total thickness and 55%-58% porosity coefficient are outlined.

Total thickness of 2 reservoirs with oil and gas saturation coefficient as 53%-57% and outlined in the seaside marshes is 29.1 m. Oil and gas saturation coefficient of 3 reservoirs (total thickness – 8.9 m) of coastal bar facies is 51%-58%. 1 reservoir with oil and gas saturation coefficient as 57% is identified in the beach facies. Thus, the total thickness of reservoirs is 82.5 m while the thickness of Qyrmaky suite section is 250 m.

Qyrmakyustu sand suite is represented by medium-grained sands. Rare interlayers of clay with 1.5 m thickness is observed in the section of this suite. The average thickness is 45 m. In the section of Qyrmakyustu sand suite in the Darwin bank area 2-3 reservoirs are observed (Fig.4). All of them are water bearing reservoirs. Coefficient of oil and gas saturation is not high and varies within 10-18% interval, porosity coefficient is 20-22%. This suite is represented by silty sand. Deposits of this suite can be attributed to river channel facies. Sedimentation environment is continental. Qyrmakyustu clay suite is made of clays. In this suite section the thin interlayers of sand and fine-grained sandstones are observed. Thickness of the suite is 80-90 m.

Fig. 5 a), b) and c) shows the circular diagrams of distribution of various types of facies through the section of wells Darwin bank №X1-X3. They have been drawn on the basis of interpretation data acquired earlier and displayed in the Tables 1-3. Analysis of these diagrams made it possible to infer the dominance of facies of behind-bank lagoon and coastal banks in the section of Qyrmaky suite. The lowest thickness is observed in the groups of river channels, delta bars, rip flows and coastal bank facies. However, in all these four groups of facies the oil and gas reservoirs with good oil and gas saturation coefficient have been identified.

### Conclusions

- Qyrmakyalty suite of Productive Series in the field of Darwin bank is represented by facies of river delta and river channels, which are alluvial deposits.

-Qyrmaky suite is made of facies of behind-bank lagoons, coastal bars, rip flows, coastal marshes, river channels, delta bars and beaches, which are alluvial-deltaic deposits.

- Total thickness of reservoirs identified in each of the above indicated groups of facies (excluding facies of river channels) in the most oil and gas bearing section of Qyrmaky suite is 82.5 m, which is 33% of the total thickness of the suite.

- Deposits of Qyrmakyustu clay facies refer to lake deposits.

-Deposits of Qyrmakyustu sand suite represented by the group of river channel facies refer to alluvial deposits.

- The analysis displayed that Qyrmakyalty and Qyrmaky suites of Productive Series are the oil and gas bearing deposits in the area of Darwin bank. The major oil and gas accumulations are identified in general in the facies of river channels, behind-bank lagoons, rip flows, delta bars and seaside marshes, which refer to fluvial-deltaic deposits.

### Section of well Darwin bank №X2

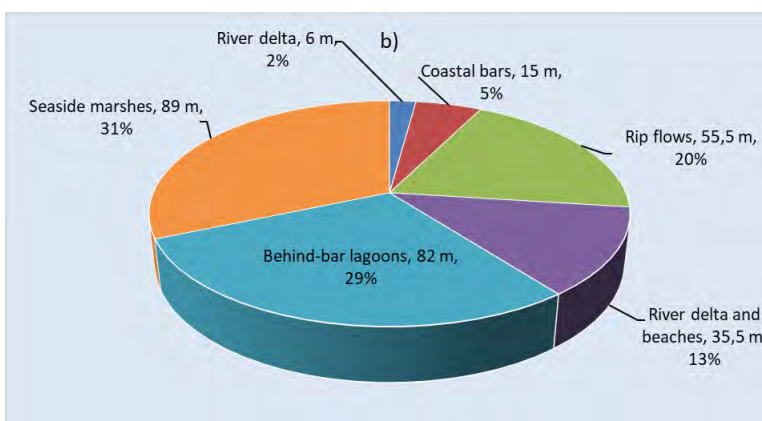
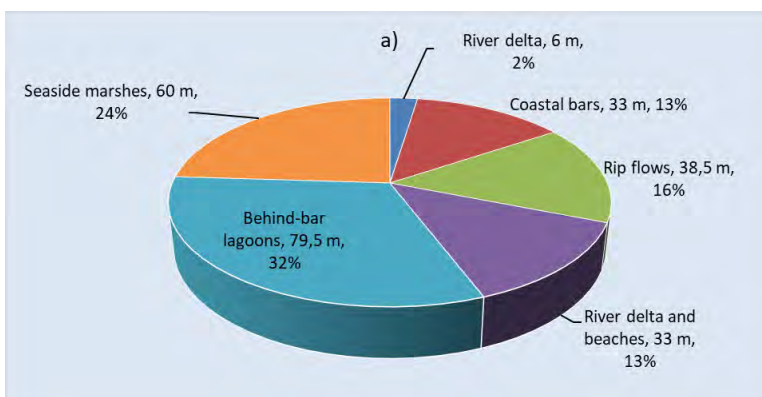
Table 2

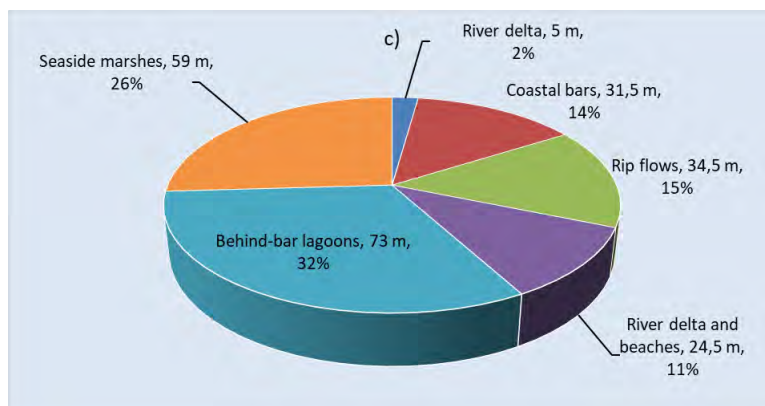
Type of facies	Total thickness, m
River delta	6
Coastal bars	15
Rip flows	55,5
River delta and beaches	35,5
Behind-bar lagoons	82
Seaside marshes	89

**Section of well Darwin bank №X3**

**Table 3**

Type of facies	Total thickness, m
River delta	5
Coastal bars	31,5
Rip flows	34,5
River delta and beaches	24,5
Behind-bar lagoons	73
Seaside marshes	59





**Fig. 5. Distribution of facies across the section of wells Darvin bank №X1 (a), Darvin bank №X2 (b), Darvin bank №X3 (c)**

### References

1. V.S.Muromtsev. Electrometric geology of sand bodies – lithological traps of oil and gas, Nedra, 1984, p.259.
2. V.I.Pakhomov, V.N.Koskov. Lithology of natural reservoirs by use of facies-cyclic technique and oil-field geophysical data. Perm. 2011, p.168.
3. G.Ya.Shilov, I.S.Jafarov. Genetic models of sedimentary and volcanogenic rocks and technology of their facies interpretation based on geological and geophysical data. Moscow. Information center of VNII geosystems. 2011, p.394.
4. L.N.Khalilova. Some result so fsequence-stratigraphyan dloggingfaciestechniqueappliedtostudyAbsheron-Pribalkhan zone of uplifts. Azerbaijan Oil Industry. Baku. 2008, №1, p. 58-63.
5. L.N. Khalilova. Lithofacies analysis of sediments of productive thickness of North-Absheron and Absheron-Pribalkhanskiy tectonic uplift zones. SCIENCE WITHOUT BORDERS. Transactions of International Academy of Science H &E. Vol.3 2007/2008, Innsbruck, p. 639-646.

# CONCEPTUAL ISSUES

## A GUIDE THROUGH THE COVID-19 JUNGLE

Kofler Walter, Oleg Glazachev  
*International Academy of Science H&E*  
[walter.kofler@ias-he.com](mailto:walter.kofler@ias-he.com)  
[glazachev@mail.ru](mailto:glazachev@mail.ru)

*(In Collaboration with Ephraim Madeiros, Giuseppe Fumarola, Joao Pedro de Silva)*

### EDITORIAL

This is a position paper, created for and with members of the International Academy of Science - Health & Ecology and partners<sup>1</sup>. The current situation, which is also unique due to the worldwide social action, challenges us to elaborate such a paper to form an opinion and to make it available to others: As a contribution for everyone to find his or her own answer to the controversial specifications, if she or he wants to. We are - to put it simply - alienated by two seemingly irreconcilable groups, each of which, in its own way, sees the situation in a highly simplified way: Those who deny COVID-19 or belittle it despite the horrible images, and those who do not want to take note of the antiseptic and even against better information. Both positions lead to the same result in one point: the "Semmelweis phenomenon" is repeated: that obvious knowledge is not applied for extra-scientific reasons: In the 19th century, because people did not want to accept its effectiveness against puerperal fibers, with the consequence that two decades longer mothers had to die unnecessarily. In the 21st century because the historically known possibilities and limits of non-specific defenses are being suppressed. This time, millions are affected. Affected also by the decisions of others, but always with a rest of own possibility: modified one can come to the conclusion with Schiller: "Man is free, although he is born into chains." Therefore, each person must act for himself or herself or decide not to act. Hopefully because she or he has thought for himself. SARS-CoV-2 is not only a challenge to the medical sciences due to the increasing number of diseases

---

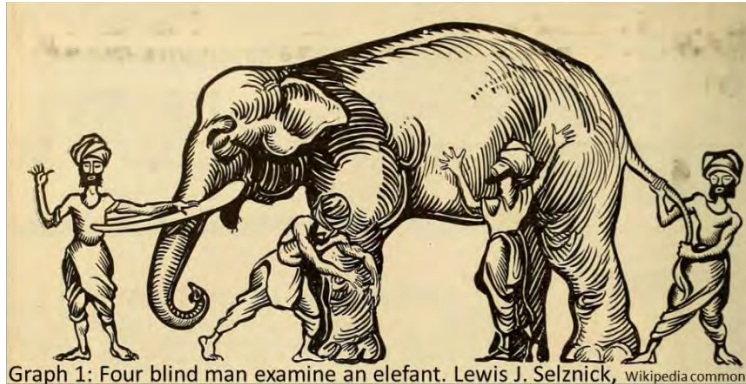
<sup>1</sup> Prepared by the President and the Secretary General. An essential insight in the creation was that each individual should be able to contribute his or her position without running the risk of having to give it up. The merit of an argument should be seen independently of the individual and their particular circumstances.



the virus can cause. It also has the potential to threaten peace: individual and social at local, regional and global levels.

With a position paper, one can and will only provide arguments so that everyone can put his or her own limited conclusions to the test. If one wants to acquire a really well-founded position on such a complex issue, there is nothing left but to make an effort to gain access to the essential aspects and their interconnectedness. It is helpful to be pointed to the different aspects. This is less about factual knowledge. That can be easily "googled" today. It is also not necessary to know the techniques of the different disciplines, which are practically relevant for dealing with COVID 19 and SARS-CoVB-2. In this regard, one can rely on the experts. It is more a matter of understanding the process flows and interconnections. In doing so, you have to venture into the world of thinking of the most diverse and mostly foreign disciplines. Whether you like it or not, you have to get an idea of whether the position of a decision-maker or a statement by an expert - no matter how recognized he may be in his field - is meaningful overall for the complex issue at hand. Can one be sure that this person has appropriately brought his or her specialized knowledge to bear on the complex issue at hand, or that he or she is only selectively representing a position from one point of view? In order to be able to assess this, one must be prepared to form a complex opinion oneself. This requires positions on the various partial aspects - which are, of course, open to discussion. That is why this position paper has to be so complex and sometimes only seem to be away from the core problem. One should not expect more and only demand that others are also prepared to state why they take this or that position. Such controversial arguments have been considered in the position paper: Contributed by members and friends from the most diverse scientific disciplines, from art and culture. In particular, however, also from their life partners, who want to live together with them in everyday life, although they concentrate most of the time on their own - foreign - world of thoughts.

From this diversity arise considerable formal requirements to a position paper: Even the highly qualified representatives of the individual disciplines are laymen in most of the other disciplines, but they are indispensable for the understanding. Nevertheless, many assume that the interlocutor, as an educated person, has mastered at least the basic knowledge and terminology from their fields. What a momentous mistake! Nobody is able to do this, even if he does not want to admit it. But nobody should feel caught as a layman, if in this position paper - "only" because of the needs of the life partners - terminologies and connections from all fields of expertise are presented in a simplified way. Rarely is it so essential to strive for a constructive error culture. Now it is still possible to learn before the mistakes are implemented or wrong decisions are repeated. Especially when dealing with momentous risks, this has proven its worth .



This diversity gives rise to considerable formal requirements for a position paper: even the highly qualified representatives of the individual disciplines are laypersons in most of the other disciplines, but they are indispensable for understanding. Nevertheless, many assume that the interlocutor, as an educated person, has mastered at least the basic knowledge and terminology from their fields. What a momentous mistake! Nobody is able to do this, even if he does not want to admit it. But nobody should feel caught as a layman, if in this position paper - "only" because of the needs of the life partners - terminologies and connections from all fields of expertise are presented in a simplified way. Rarely is it so essential to become aware of one's own limitations, to strive for a constructive error culture and to be happy to learn as in such a complex and novel situation as right now. It is still possible to learn now, before mistakes are implemented or wrong decisions are repeated. This has proven to be particularly effective in dealing with serious risks<sup>1</sup>.

## INTRODUCTION

Almost everyone's daily life has changed since March 2020 as a result of SARS-CoV-2 and COVID-19. People have had to restructure their priorities. More and more people feel threatened not only because of a possible infection. They fear or have already gone through, for example, a collapse of the basis for their individual economic existence, their psychosocial integrity and integration. They are affected in a different way than the politicians who have to lead the community through the pandemic and its also unexpected consequences. Both groups, however, have choices to make: The owner of a restaurant or the minister of health or the single mother in the home office and home schooling with three children in a 60 square meter apartment. All need sufficient information: Information that allows for coherent reasoning to decide what to do or not to do, and how to deal with the unavoidable. Each individual needs such information to accept constraints, especially under the pressure of limited resources and options. Otherwise, one feels unlawfully restricted in self-determination (reactance<sup>ii</sup>):

Meanwhile, negative health effects of deficiencies as well as the positive effects that can be achieved with successful coping even under extreme conditions have also been scientifically proven.<sup>iii</sup>, <sup>iv</sup> Who decides needs the cooperation of the affected persons. However, both must be able to integrate the complex interactions including their uncertainty aspects into a comprehensive view. However, uncertainty is now often part of daily life with and without the disease itself. This also easily leads to unmeasured fears and panic because risks are often classified irrationally.<sup>v</sup>

Whether the individual or the official decision maker, both need support to understand the options for addressing individual challenges. Official decision makers can convene experts into task forces; the ordinary person cannot. But it is the individual who becomes ill. His risk may be reduced if options, not just limitations, are also offered. Both can be more adequately managed by those who can better assess the possible influences and interactions. This would suggest more hope.

The purpose of this paper is to provide an aid to self-help. It draws in particular on possibilities in applied hygiene, social medicine and public health, and physiology. These subjects often collaborate with other disciplines. This, too, is incorporated into the texts. This interdisciplinary approach, which is also open to non-experts, is atypical for scientific articles. Usually, these offer new results for a scientific discussion within a subject discipline. The present text offers selected information for interactions. At the same time, much is uncertain, so it can only be estimated by applying the laws of reasoning and the experiences of daily life. But this situation is typical for daily life: In everyday life, too, one has to make decisions, and one has to do so with a limited level of knowledge. Here, the precautionary principle is given special importance. As an optimist, it is better to assume that, given our state of knowledge, it is wiser to count on the less favorable. Then one will probably go into the future prepared. One will gladly take note of improvements in the state of knowledge! The situation also requires the readiness to imagine new kinds of processes that have not yet been discussed. Possibly, however, they will become necessary to make phenomena understandable, which are in need of explanation because they point to otherwise overlooked threats. Therefore, it is necessary to deviate from the usual approach in science on a case-by-case basis: Conjectures lead to experiments in normal situations. But there is no time for that in a new kind of epidemic. One has to act, because non-action is also relevant to health and therefore has to be justified in the same way as action. Thus, there is often nothing left to do but to evaluate the available experience and the limited available knowledge, to make assumptions and to implement them. But the reader must be clear: Such speculations are indispensable only in order to be able to do justice to the precautionary principle. It is often to be hoped that they will later turn out to be unnecessary.

The current situation therefore requires two approaches: The first is the pragmatically short one: Where do we stand? Where can we go from here? Does it fit at all? An offer is made for this in Part 1. But then, when you realize that you have come to a conclusion that differs from the one that is being advocated all around, you need further foundations. These are offered in part 2.

However, one thing should already be anticipated at this point because time is pressing: In the current situation, it is recommended that two measures be tested for their usefulness. These should be used IN ADDITION to the currently planned measures:

- 1) The use of a well-tolerated antiviral active antiseptic for regular inhalation of those admitted to normal hospital wards with COVID 19.
- 2) The use of a well-tolerated antiviral active antiseptic as a nasal spray for those individuals who are scheduled to have a negative antigen test as a requirement for selected activities.

This is expected to reduce personal risk, the risk of infecting others, and the possibility of mutants forming. Individuals with a negative test and an acutely used antiseptic nasal spray should not pose a higher risk than vaccinated and recovered individuals. But there is absolutely no such thing as zero risk.

## **PART 1 A GENERAL APPROACH**

### **1) THE ROAD MAP .....**

The structure of the booklet is based on the premise that while urgent action is needed now because of COVID-19, it is also now determining the medium- and long-term trajectory for the future. COVID-19 is therefore more than a health challenge. The pandemic therefore compels fundamental reflection, if only because it and the way it is being dealt with present fundamental challenges. For the application-oriented scientist, it is particularly painful that it has not yet been possible to combine the different approaches, each of which admittedly concerns an important partial aspect, into a balanced problem-oriented and holistic approach. Essential aspects and especially the "intellectual band" are missing. The situation is characterized by the fact that in itself six principles determine whether COVID-19 and its consequences occur, but in practice only two are consistently taken into account. From a pragmatic point of view, it is possible to draw conclusions from this and work out what additional things should and should not be done in order to be more successful at present. This is the approach taken in Part 1. But it does not address the root cause of why this incomprehensible situation has come about. Obvious essential influences have

been left unconsidered. How does one get this "spiritual bond", which is the prerequisite for being able to link the different aspects in a networked way of thinking? Only with it does the hope germinate that in the medium and long term solutions for COVID 19 and its networking with all the other upcoming reorientations will be chosen, which are more future-oriented already from the approach. This is the subject of Part 2, which requires more intensive discussion and is therefore deliberately separated from Part 1: However, in order to ensure that the proposals for the current pragmatic approach remain compatible with the necessary overall orientation, some of the contents of Part 2 must already be anticipated in Part 1.

The pragmatic approach presupposes corresponding preliminary work: starting points are analyses of the current status and the successes achieved by the measures taken so far, but also of the strategic considerations that can be imputed to the current measures. The Australian virologist Mackay seems to have modeled this very well and expressed it in a visually impressive way in his version of Reason's Swiss cheese model. Therefore, Mackay's Swiss cheese model is well suited both as a starting point for analysis and for presenting the necessary supplements. It turns out to be helpful that Reason's approach offers many more possibilities for reducing the risk of disasters, despite the error-proneness of human actions, than can be seen from Mackay's graphic, which is widely used today.

Reason assumes that humans are error-prone. Therefore, they must expect errors and develop a constructive error culture. Risks can only be reduced, but not fundamentally avoided. Therefore, one should develop as different instruments as possible to cushion the effect of any errors that may occur: Then it can be expected that the consequence of an error that occurred despite protective measure A will be compensated by measure B. Cheese slice C would compensate for faults that happen to A and B, so that no catastrophe occurs. However, Mackay's model describes the reality very well: it contains a large number of protective measures against SARS-CoV-2. They have only one crucial drawback: they are based on the same protective goal: to avoid that a person comes into contact with the virus. If, for example, someone was infected because their neighbor was not wearing a mask, then having to pass a special check when entering the country afterwards will not help them. But that should not occur. Mackay and the political concepts do not assume that people make mistakes. They have to implement the requirements correctly. Mackay also built into his model the measure that is envisioned worldwide against COVID-19: vaccination. Both conceptions are necessary. Even if all people avoid contact as planned, their susceptibility to SARS-CoV-2 does not change. You cannot do lockdowns, home schooling, etc., in perpetuity. Therefore, you have to vaccinate, assuming that

everyone will then be permanently immune, never get sick again, and never infect anyone else. So much for the theory. The practice looks different.

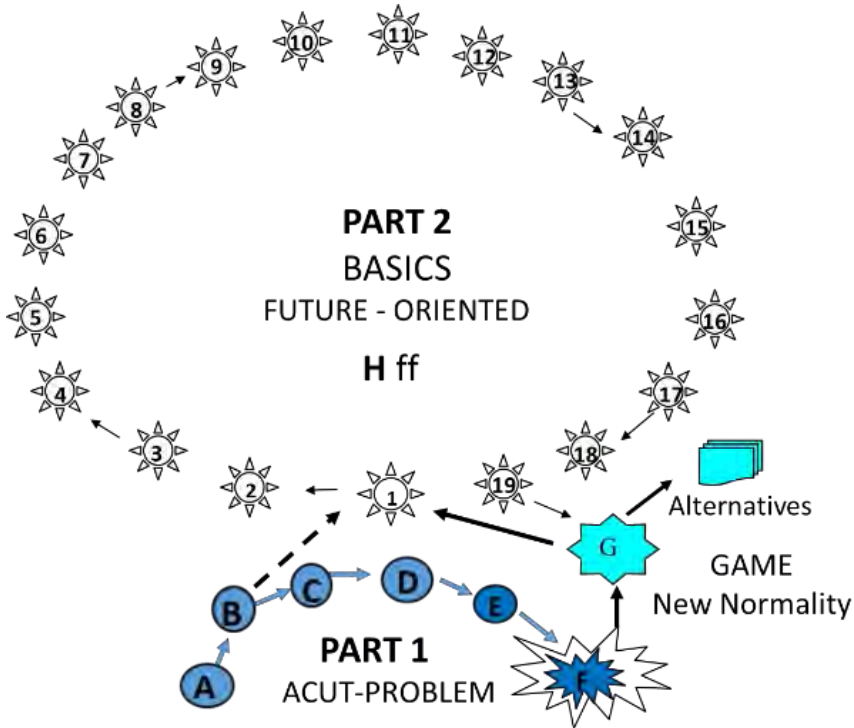
The analysis of the causal chain that ultimately leads to death from COVID 19, however, reveals that six steps, different in nature, are necessary for this. Thus, six principles are also possible in the effort against death from COVID-19: SARS-CoV-2 had to form first. If SARS-CoV-2 can be made to disappear or inactivated locally, it cannot enter the environment. Then it also cannot reach people who can carry it further. If the virus does not reach the nose or lungs, contamination cannot occur. However, this only occurs if the non-specific defense cannot prevent penetration into the organism. Then the phase of non-specific defense inside the body begins. It can, but does not have to end with manifestation. In case of immunity, the manifestation does not lead to a severe disease. With appropriate therapy, one need not die from COVID 19.

It is possible to intervene at all these levels. As exemplified in Part 1.

Political decision-makers can seek advice from experts. This is an unfamiliar role for many scientists, who are accustomed to making statements only within their narrow field of expertise and relying on the state of the art. Both are incompatible with the requirements arising from the interconnected problems with a new pathogen. The legislator has taken this situation into account and clarified that the most appropriate conclusion is to be derived "by applying the laws of reasoning and the experiences of daily life". The responsibility for action and inaction remains with the responsible e.g. minister or government. These have been endowed with far-reaching rights and duties for the duration of the epidemic. The review of the appropriateness of their decisions is the responsibility of the competent supreme court, which must examine whether the measures taken were proportionate. This presupposes that at least an attempt was made to take less disadvantageous measures before fundamental rights were suspended. From a medical point of view, it is expected that the same standards for assessing the justifiability of measures will be used for the immediate (such as death as a result of the breakdown of intensive care due to the high number of COVID-19 patients) as for the indirect health hazards. Thus, for example, because of the increased risk of suicide among children as a result of their special situation during the epidemic.

Decisions in the private sphere depend strongly on one's own possibilities. What to use or not to use often does not depend on oneself. Especially in the case of limited possibilities, it is essential to know which one to choose. This requires information and the willingness to think through alternatives on a trial basis. To facilitate this, we have developed the "New Normal Game". In order to be successful here, however, one needs better basics. These are offered in the second part. Its structure corresponds to the classical sequence of steps in application-oriented science. But this structure is also helpful for the one who wants to

acquire key information for "The Game of New Reality". For this purpose, it is helpful to make clear what one should think about in order to be able to understand one's own situation and the field of tension in which decisions have to be made. The list of questions below can help. Each question also identifies where in the text considerations for answering them are presented for discussion. Page references for Part 2 are shown in Part 2.



Graph 2: THE ROAD-MAP

**a. Road map to answer important questions**

This guidance document justifies the designation "Signpost."

- Why is the mother and the sweaty athlete right in demanding the wearing of protective clothing, even though the number and type of contacts with others, and therefore the viral load of the breath, is not affected? [E(a); E(4b); F3]
- Why do some people get a cold sore just because they are so disgusted?
- Is polio a harmless disease, even though fewer than one in a hundred people become infected with the virus on first contact?[A2 b; F3]
- Why has tuberculosis been radically reduced even in countries without vaccination and antibiotics as a cause of death per year between 1900 (e.g., 500

per 100,000) and 1950 (to about 50 in 1950), even though certain e.g., immigrant populations are still at the same risk today as in 1900? [B1; B3; E 3a)]

- Is pain (and other subjective experience) always THE guardian of health, although one does not feel the radiation exposure, the increased blood pressure, the already inoperable tumor? [A 2,d) i; A 2d)iii; ]

- How quickly might nonspecific defenses change if an asthma spray immediately prevents impending death, the cold spray allows the fouled spar to continue, and the eye can grossly adapt to darkness in a fraction of a minute? [H]

- Should death under torture conditions not be a social challenge merely because a virus causes it? [B 3;]

- Is the preventable suicide of a student less relevant just because it is the indirect consequence of action against a preventable death in a viral epidemic? [B3; A 2 f); C 1); E4 d)]

- How responsible is it to forego a proven diversity of methods and, despite unexpected failures, continue to rely only on diverse techniques that are all built on the same principle (interrupting contact of infectious persons with germ carriers) [ E 4d; C 1); ]

- Is a government free to consider whether or not special powers delegated by Parliament (e.g., in medical device and drug law) can be used in an emergency? [B 6 (a) F 4; C; ]

- In case of imminent danger due to a new pathogen, may one base one's measures only on established knowledge and is otherwise obligated to inaction [B 6);].

- Every Complex Problem has a simple answer, but the answer varies depending on the area of expertise of the expert consulted. Therefore, each must be wrong, although each may contain a "kernel of truth": How does one deal with this problem? What should be given priority, e.g., because of the terms used? [Preface, A2),3,f, B 4)b,d , C 1]

- Why doesn't everyone who is infected with a virus that can lead to death die even though they don't receive medical services? [A 2 c) d]

- Why hasn't humanity died out beautifully long ago, even though there are so many deadly infectious diseases? [A 2 c) d]

- Why do pathogenic viruses disappear and what influence do our measures have on this? [E 1) c)]

- Why doesn't everyone who is infected with a virus that can lead to death die even though they don't receive medical services? [A 2 c) d]

- Why hasn't humanity died out beautifully long ago, even though there are so many deadly infectious diseases? [A 2 c) d]



- Why do pathogenic viruses disappear and what influence do our measures have on this? [E 1) c)
- Can we even expect to be able to trace all infection chains, when there could be a dark net and its dynamics (Dark Net?) E 1); B 5 d) E 1)c; F 3]
- Who infected the person who carried the germ home, how long ago can this be and why is this person so often untraceable? [H]
- How can you influence the clearance of viruses in your own body? [E 1); B 5 d) E 1)c; F]
- Why don't you change the strategy if it obviously doesn't do what you told everyone it would? [H][A 2) a; B 5b) ]
- Is it allowed to set measures as a society without empirical experience that are also known to be detrimental to health? How does the legislator regulate this? [B6) ]
- Why were other countries (China, New Zealand..) so successful, but not Europe? [D 2); C 1)b]
- Could a different strategy have eradicated SARS-CoV-2 or at least limited the pandemic? (H) [B4); E6); E 7]
- Is the price paid by China, New Zealand, etc. on a permanent basis justified? (H)
- What do I need to know, how exactly, what do I need to understand, so that I can form my own opinion or check my current opinion? [Preface, H]
- How meaningful are the results of the tests? Can it really all be calculated? How meaningful are these numbers? [E2); D3 b); E1) e; 3a); 4c),d); F 4); G 5)]
- Why are methods based on Kermack & McKendrick used in ways that they have testified are inappropriate for these questions?[H].
- Why have the predictions for effectiveness of interventions been so unsatisfactory while the predictions for ICU occupancy have been so accurate? [H]
- What can and cannot be predicted by the models used? [H]
- Will vaccination bring a return to normal as promised in 2019?
- At what point does one become immune to SARS-CoV-2? How long will one remain so? How does one become this again and how does this affect whether I might infect others4? [A 2)d; E1)d, H]
- What ways does the body have to protect itself against infections caused by viruses? What possibilities does the person have to protect himself and his own against the virus, and what possibilities does the community and society have?[H] [A2)d, i, v; E4)d]
- What possibilities does the virus have to prevail against inactivation and the cell barrier? [A 2 c)]H

- How does the body defend itself against infection by viruses? How the virus defends itself against inactivation
  - How can you influence the risk yourself, especially when you are exposed to this stress? ? H] [A2)d, i, v; E4)d];
  - Is it possible to use other tools besides vaccination in this process? H
  - If the pandemic threat is over, should COVID-19 have been successfully lowered to the relevance of "normal flu waves"? What are the arguments in favor, what are the arguments against? [H]
  - Is it possible to influence the occurrence of mutants? ...[Preface, A 2 b, d)v, g; B 2); C 1b, c; E 1,b, )]
  - What makes COVID-19 so special? What is "long COVID?" [ H;B 3); E 4)d; 5c; ]
  - How can asymptomatic courses with full antibody formation occur? Why, for example, can asymptomatic antibody-bearing children become life-threateningly ill with PIMS (Pediatric Inflammatory Multisystem Syndrome) weeks later?[H]
  - How long is someone infectious and how sure do we know? [A 2)d iii;B 2); E 1) c)]
  - What is the booster effect? What influence does it have in determining the duration of immunity protection? [H; D 3)b]
  - How is the fight against COVID-19 related to other challenges? [D1),2), E 5); 7;];
  - What has been learned in the fight against epidemics over the centuries and therefore what can be expected now in terms of development? [B 1]
  - Can lessons be lost, and if so, might that affect strategy? Why is the experience of TB not being used...[B 4)b]
  - Not only the intellectual understanding of epidemics and the resulting possibilities to understand and fight them have continuously expanded. Does this evolutionary process also apply to the understanding of all processes, i.e. also the physical, chemical, biological ones in the body and its use for performance claims of the person on it? ? [B4, H]
  - How do such dynamic processes at the different levels enter into the disease process? For example, how do the communities of life and function on our external surfaces (esp. intestines, lungs, nose, throat) influence the occurrence of infections? [H; E 1)d,e]
  - What is the current and long-term role of nonspecific mechanisms in the effort to prevent an era of rampant pandemics? [B 2)]
  - What is the intended goal in the fight against COVID-19? [B 3)]
  - How capable is science in general and during periods without sufficient knowledge? H E 7; G 3,

- Is it permissible as a society to set measures that are known to be detrimental to health without empirical experience? How does the legislator regulate this? [B 6].
  - To err is human - Can risks be reduced to zero? How can one deal with it? No[ Preface, C 2)a, c; ]
  - What influence do therapy and vaccination have on the spread of the pandemic? [H]
  - What is the benefit to whom if I get tested?
  - What is needed today, what is needed in the medium and long term? Who is responsible for what in the process? [H]
  - Is there evidence why COVID-19 can cause systemic disease, not just lung disease, and pre-disabled and seniors are at particular risk? [H]

**b. As in a circumstantial trial:**

Some questions will take us to the limits of available knowledge. That is precisely why it is important that they be asked. Take the example of PIMS (Pediatric Inflammatory Multisystem Syndrome). This very rare disease has only been around for a few months. Children and adolescents, although they had no symptoms for weeks but had antibodies against SARS-CoV-2, suddenly become ill unexpectedly with severe multiple symptoms in different organs<sup>vi</sup>. What does this tell us about the virus, about the interaction between the cells of the organism and the virus? What is the role of the diseased person? Only a model that can give an insightful answer to all these questions will ultimately help. For the mother, of course, it is enough to know that a very successful therapy is available, especially with cortisone. The process and the importance of SARS-CoV-2 will only be understood when it becomes clear how these and all other reproducible phenomena in connection with the infection, manifestation of COVID-19 as a respiratory disease and its transition to the various systemic processes can be integrated into a framework of thought. The scientific way to this resembles a circumstantial trial, in which the accused - i.e. the virus - and the potential voluntary or forced accomplices - i.e. the diverse cells and structures of the organism - steadfastly refuse to testify, and the injured party - i.e. the diseased child - is only a very poor witness of the events. But all are affected: the viruses up to the person! One can understand the process therefore only if one can make the interaction between them comprehensible in a single access. Isolated knowledge about the virus, the individual cells and the person is of limited help. It is just like in a trial of circumstantial evidence: Without complete proof why all circumstantial evidence can be assigned to whom, the perpetrators will go free and will be allowed to continue their mischief. In case of doubt for the accused!

Surely it is comforting that the currently affected child can be cured. But wouldn't it make sense to prevent the next illnesses through prevention? For this, science would have to be able to do something that works without problems in everyday life all the time: The causal interaction of the most diverse types of physical, chemical, biological, intellectual, etc., effects. effects to an overall effect. But science has not been able to do this so far, because the individual disciplines have only developed an approach oriented to their specific problems<sup>vii</sup>. But this can be done differently, as will be shown in part 2.

If one applies a comprehensive approach coherently built up in this sense, which is in harmony with the diverse sectoral theories, it corresponds to the so proven requirements for Einstein's principle theories. Nevertheless, it must not be claimed that the so helpful thought building offers the only useful solution. Also this approach is only "a free invention of the human mind" in the best possible agreement with the facts, as Einstein has formulated this<sup>viii</sup>. At best, it can become a recognized "conjectural knowledge" in the sense of Popper's "logic of research"<sup>ix</sup>. But the way developed by Einstein for this purpose has the advantage, especially in phases of time pressure, to be able to present novel conclusions which can claim to be a logical application of different positions, which is recognized as state of knowledge thanks to empirical proof. This substantiation of a new position is much faster than Popper's epistemic technique, which is widespread in the natural sciences: after all, it is based on the fact that sufficiently frequent unsuccessful falsification is necessary. This shows that it can be useful to deal also with the techniques how knowledge can be extended<sup>x</sup>. Therefore, part 2 will also deal with this and its concrete application for COVID-19.

Currently, however, the focus is on the need to stop the epidemic, and to do so with the limited knowledge that is currently available, and with insightful conclusions that may be assumed "using the laws of reasoning and the experiences of everyday life".

## **2) OVERVIEW**

What information can the reader expect in Part 1. On the one hand, it is about the necessary analyses. On the other hand, the connectivity to a comprehensive approach must be established. Therefore, it is unavoidable to present core information from different fields of knowledge for discussion. They touch very different fields of knowledge, which would have to be linked to each other in an unusual way. Therefore it makes sense to work out the core statements in an overview. This should make it easier to grasp the importance of the individual aspects in the holistic view.

### **a. The situation**

In spring 2020, the world was overwhelmed by the first wave of the epidemic with SARS-CoV-2. The causative agent was unknown. Therefore, only measures that have proven effective in other epidemics could be put in place. The focus was on reductions in personal contacts until lockdown. Forecasts suggested a return to normality once new infections had dropped to extreme levels. This occurred surprisingly quickly, as if SARS-CoV-2 and COVID-19 were actually adequately detectable by the forecasting models. Contact restrictions were relaxed again to varying degrees during the summer, in line with continued low contact rates, without striking increases in new cases and deaths in large areas of Europe over a period of months. With the end of the travel and holiday season in September, however, there was a second wave in numerous countries, e.g. in Europe, which had not been foreseen on this scale. Nevertheless, many European countries still gave the impression in late fall that they were doing very well in combating the pandemic. However, despite all the restrictive measures taken in accordance with the repeatedly adjusted forecast models, the increase was not only not brought under control: There was an increase in the number of new cases that led to fears of a collapse of the health system, as had occurred in the first wave in Lombardy. Since then, the fight against this collapse has been at the center of societal efforts, rather than the fight against SARS-CoV-2. Contact restrictions and all measures to implement them in a more targeted manner (testing, border controls, contact tracing, masks, hand disinfection...) have been reinforced, and new lockdowns have been imposed. In the meantime, the unintended consequences of these measures dominate the present in practically all areas: Public life largely came to a standstill. Economic burdens are rising to unimagined heights, health consequences are appearing in areas that were virtually ignored during the planning in the spring and in the further aftermath. The situation can be summed up by the statement attributed to German Chancellor Merkel: "The thing has slipped away from us."

If a comparable situation occurs in medicine, e.g. that a therapy that has proven itself does not and cannot prove itself contrary to the prognoses, it is state of the art to fundamentally reconsider the course of action - even at the risk of replacing or supplementing the obviously insufficient<sup>4</sup> therapy. This did not happen in the case of COVID-19

The bright spot that everyone is hopeful about is the surprisingly rapid progress in vaccine development and production. This provides tools to expect that the overall number of diseases will decline, especially the severe courses and deaths. This is what can be expected from vaccination. Whether the vaccinated may also be neglected as carriers of the viruses is another matter. This is of particular importance because new, more aggressive mutants have appeared in the meantime, which also give rise to fears that vaccinations against them will be less effective. Obviously, it is only a matter of time before mutants "escape"

vaccines. Moreover, it must be clear: animals in close proximity to human habitat are hosts to approximately 625,000 and 800,000 virus species that can easily mutate into human pathogenic forms. Thus, an era of pandemics is looming<sup>xi</sup>. The currently available vaccines are unlikely to protect against this, irreplaceable as they are today.

**b. Central: Pathogen virulence vs. susceptible infection manifestation**

To date, however, there is no fundamental change in the strategy currently being pursued. The associated measures have been depicted in a graphic that is going around the world as the "Swiss Cheese Model" in many languages<sup>xii</sup>. Many see their implementation as the solution to all the problems ahead. That is why this chart is so well suited to show what possibilities are overlooked if only this approach is taken into account: Namely, it envisages only two types of intervention: 1) various ways of restricting contact of not-yet-infected persons with infectious agents, and in particular with infected persons, and 2) vaccination. Of course, there can be practically no infection if no one who is infected has contact with someone who is not yet infected. However, contact with others is only the (most important) condition for becoming infected. To become infected it needs the contact of the virus with the cells of the outer boundary of the body. This is not the same as contact of one person with another! However, the presence of SARS-CoV-2 in the nose does not mean that one has to be infected either. The person, more precisely the cells of the "outer boundary" of his body, can defend himself against the invasion and thus against the infection. And if this fight was unsuccessful and the pathogen was able to penetrate the outer barrier, so that the infection of the body came about, then even this does not mean that one gets sick. The body also fights against this. If this fight is not successful, the so-called manifestation occurs. This can lead to observable effects of SICKNESS (with subjective symptoms) or to asymptomatic SICKNESS. In the asymptomatic course, the effects of the body are not subjectively experienced. We all know that asymptomatic diseases do not have to be harmless, e.g. from cancer. There, too, one often notices the consequences only when it is too late. The physician notices that an asymptomatic disease has occurred by the fact that specific antibodies can be measured. The course of the disease also depends on the characteristics of the pathogen and the reactions of the organism, influenced by the behavior of the sick person. Here, too, one can intervene non-specifically (bed rest, oxygen administration..) and specifically therapeutically and preventively (especially by vaccination). From a medical point of view, the process from contact with a germ carrier to the severe course of the disease in the

intensive care unit is a sequence of extremely complex interactions, which offer a variety of consciously and unconsciously effective possibilities of influence.

*i. The contents of terms are summarized or differentiated in a problem-related way*

A widow will not choose this sober description of the sequence of individual steps to tell her sister how her beloved husband died so terribly: "He came back from the choir still so happy. That's when he caught it. Three days later, he got such severe symptoms that we had to take him to the hospital the next day. 10 days later he died in the intensive care unit despite artificial respiration. I wasn't even allowed to visit him." With that, she expressed what was essential to her.

Kermack & McKendrick, two progenitors of infectious disease epidemiology, might have emphasized quite different aspects. They would have reported, for example, that they were not surprised that the members of the choir who could not attend the performance did not become ill. However, it was noticeable that only one of those who stood at the very back next to the window fell ill, and even those who only brought in the new sheet music and left right away remained healthy. Then only the intensity of contact was decisive for whether a choir member was infected and fell ill. Thus, one could imagine how the two researchers came up with the idea of demonstrating the importance of contact intensity as an additional, independent factor influencing the epidemic. For this purpose - as will be explained later - it was legitimate to assume the plasticity ("adaptability") and other characteristics of the pathogenicity of the pathogen as well as all influencing factors of the infected person together with the time span between contact and the appearance of the symptoms as constant and to summarize them with a term, e.g. "infectivity", "force of the epidemic" or similar. Then one can use the frequency and intensity of contacts between the infected choir director and the non-infected choir members as the only variable remaining as different and also make it mathematically tangible. Then one can calculate, for example, when how many of the choir members' contacts thus generalized will be newly infected or newly ill. But Kermack & McKendrick were aware, of course, that in the practice of an epidemic, the partial aspects that were summarized by method will vary independently. But to demonstrate the usefulness of the sub-aspect of the epidemic event they were interested in, they did not need quantities for variable cellular and organismal non-specific defenses, nor for the possibly changing strength of infectivity/pathogenicity of the pathogen (mutant..).

*ii. The content of the terms used determines the conclusions*

However, applying these formulas to real-world processes has far-reaching consequences for misconceptions: If the observed frequencies of new cases deviate from the calculated value, there can only be one answer for this: The contacts occurred differently than assumed. After all, the model does not provide for any other possible explanations. But possibly the reason lay somewhere else: e.g. because the non-specific defense was weakened. But this method cannot make any statement about that. And the researcher, who uses terms with such summarizing contents, will possibly not be able to get the idea that the process described by him in a general way would have to be differentiated, so that one can correctly seize the relevant single processes. Not only that: if word-similar terms with different contents are used, there is a danger that the interlocutors will talk past each other: One then believes that the other has understood that infectivity means a characteristic of the pathogen and not susceptibility, i.e. the characteristic of the host to be infected. The other person, e.g. a representative of the Robert Koch Institute, thinks that he was talking about a characteristic of the host<sup>xiii</sup>. But which host did he mean?

This shows how important it is that all possibly changeable influences on the substeps of a process sequence can be recorded exactly separately. The first prerequisite for this is that a clear term is used for each relevant substep. All those involved in a process should also always be clearly recorded. If, for example, it is the interaction that is to be interrupted, it must be made clear what interaction is to be interrupted, by whom and with whom: Only when this is stated, the reader's or the listener's attention is also drawn to the different possibility of interruption. The one "partner" will therefore ALWAYS be the infectious virus. Whether the "partner" to be interrupted otherwise gets contact to the air, a sink, the hand or the cell in the nose is immaterial. But already from this it is clear that the partner can NEVER be the person, but always only a physical part of him. So when speaking of "host", one should not mean the infected person. "Host" of a virus can always be only a cell. A person can be "infected" with an idea, an aversion, etc., but not with a virus. Nor can the person be infectious insofar as: it can infect someone. However, one can be infected when visiting a person, but with a virus exhaled by him with the air. Of course, the behavior of the person influences whether contact of the pathogen with the hands, mucous membrane cells in the nose, etc. can occur. This is not a quibble but crucial to realize where one can intervene everywhere to break the contact<sup>xiv</sup>. But such widespread terms as "contact pattern" hide the fact that it is about the virus with its changeable properties, which can come more or less directly into the interior of e.g. the nose, if people behave in one way or another. But whether this actually results in effective contact is then still an open question: The effective contact with the nasal cells necessary for infection depends, after all, also on the properties of these cells. But this all or nothing is summarized e.g. with the term "transmission



dynamics" X . The necessary clarity is thus lacking precisely in this key area so essential for understanding infection epidemiology.

*Important terms used*

Therefore, the terms used in this paper are clarified as follows: SARS-CoV-2 is a (human) pathogenic virus. "Pathogenic" because SARS-CoV-2 is, in principle, capable of infecting any non-immune human. The PATHOGENITY of a pathogenic virus indicates the degree of INFECTIOSITY. This can be measured, for example, by the number of viruses that must be present in the nose for the viruses to penetrate the cells of the "outer boundary" of the organism (e.g., the nasal mucosa) of a "standard person." If this succeeds, the person is considered infected. The infectivity of a virus - as well as e.g. its dangerousness (virulence) and the resistance to vaccines - can be changed by its plasticity (= its adaptability), however one wants to imagine this process. Obviously, the consequence of plasticity is the changed characteristics of the mutants in comparison with those of the initial virus.

In the organism, a second characteristic of the virus becomes essential: its VIRULENCE. It influences the severity of the course of the disease. Virulence and pathogenicity/infectivity do not depend on each other: thus, the infectivity of the virus for polio is very low, its virulence is terribly high.

Whether SARS-CoV-2 viruses in the nose lead to an infection = penetration of the "outer boundary" depends not only on characteristics of the virus, but also on the RECEPTIVENESS or SUSCEPTIBILITY of the person, more precisely of the affected cells of his outer boundary. Everyone can defend himself against the infection more or less successfully with the help of his cellular and exudative - by releasing substances like NCT e.g. into the nose - non-specific defense (or also called "non-specific innate immunity"). Since their performance is individually variable, the susceptibility or susceptibility can even change rapidly under certain circumstances. If one wants to compare pathogens in their infectivity among themselves with regard to the standard population, one assumes an equal distribution of the capacity for non-specific defense in a collective. This is expressed by the CONTAGION INDEX. This indicates the proportion of non-immune individuals in a collective who are infected with a virus on first contact - ideally by a standardized viral load.

Unfortunately, people also talk about an infected person being infectious. Strictly speaking, this is not true: the germs that the person gives off are infectious. Often one speaks also of the fact that e.g. SARS-CoV-2 is particularly infectious for this or that group of people (e.g. fringe groups). With this choice of words one summarizes the "human" sphere of influence of the unspecific defense of this group of people and the virus-related sphere of influence, as if they were an inseparable whole. The important questions of why viruses penetrate more frequently in these groups of people and whether this can be

influenced are thus practically excluded: this is also because they are more susceptible.

The onset of infection and the penetration of a correspondingly high number of viruses is only the beginning of an interactive process that can, but need not, lead to the classic disease. Again, the non-specific defense - this time that of the organism - influences whether and when it comes to manifestation and thus to the classical disease. It is not known for SARS-CoV-2 how high the proportion of those is who do not develop a manifestation, but the MANIFESTATION INDEX is known: However, this usually only covers those patients who also show classical symptoms. (As the example of PIMS shows, other types of disease can also manifest themselves later without passing through the stage of "classical lung disease") For this subgroup, the INCORPORATION TIME can be determined, i.e. the time interval between contact with the person who spread the germs and the manifestation. In simplified terms, it can be said that the more effective the nonspecific defense, the longer the incubation period. From an epidemic hygiene point of view, it is not only their mean value that is of interest. The extreme values are also significant: since the nonspecific defense can be changed individually and via societal measures, it must be assumed that the average incubation time (or the so-called "serial interval" or "generation time" derived from it in the formulas of experimental epidemiologists) can also change approximately within this range, even in the case of longer-lasting epidemic events. Thus, one must reckon with this possibility in the current long duration of the epidemic of more than one year.

#### *1. confusion possibilities due to different questions*

It is important to be aware that the incubation period itself has nothing to do with detection of viruses e.g. in the nose by a laboratory test (like PCR test). The person with positive laboratory test may or may not have clinical symptoms. She is infected. So, she is in the stage when viruses could infect cells of the outer boundary of the body, for example, the mucous membrane of the nose, so that they could reproduce the viruses and release them into the nasal cavity. Therefore, the number of viruses in the nose could increase so much that they could be detected by the test. Therefore, these viruses can be released into the environment through sneezing, etc. This can lead to a viral load of persons, which becomes the starting point of an infection. According to experience, the viral load in the nose of the spreader must be so high that the viruses can also be detected in his nose with a correspondingly sensitive test method. For this reason, for example, the PCR test is essential from a medical point of view: to be able to detect whether people who do not yet and possibly never show symptoms themselves are the cause of infection of others. Since each test is a snapshot, it says little about how significant the person was as an excretor on the day and the days before: after all, the test can be done in the waning phase. It does, however,

suggest that the person who tested positive and is symptom-free is already a carrier and will be even more so, especially tomorrow, possibly with symptoms of his or her own. The person tested positive is considered a "proven case".

We only know from the persons on whom the test has been performed whether they are "cases" or not. Their daily number does not tell us anything about the collective to which they belong: After all, we know nothing about those not tested: they may or may not be positive. There is no generalizable reason why those who have been tested have been tested.

It is possible to determine the time that elapsed between the contact of the first infected person and the appearance of the criterion to be used for evaluation in "his" secondary infected person. This information is used in the calculation of the "serial interval". If the criterion used is laboratory detection, e.g. with PCT, the "serial interval" is shorter than the incubation period. After all, the test becomes positive before the subjectively ascertainable symptoms appear. However, if evidence of the onset of the disease - i.e. the presence of such symptoms - is used, this "serial interval" corresponds to the incubation period. However, investigations of the time intervals between the first sufferers of the disease and the subsequent sufferers who can be assigned to them provide the best information on both the serial interval and the incubation period.

But the data, which are related to laboratory-detected cases, strictly speaking have nothing to do with the incubation period in the classical sense. Their definition dates from a time when PCR tests, etc., did not exist. The condition of the person was ascertained on the basis of the presence of symptoms agreed upon by the scientific community. Since these symptoms are expected to be the reason for going to the doctor and they are judged by the same criteria, it is much more justified to use this figure if one wants to compare collectives. Even more meaningful for comparisons between collectives would be the daily new hospital admissions with COVID-19 and their individual length of stay. The hardest data are the deaths from and/or with COVID-19 related to a collective. But it is essential how the collective is defined to which the number of deaths is related. In medicine, a "classical" distinction is made between lethality and mortality. The lethality refers already historically to the number of persons who died with the classical symptoms. Mortality to the number of deaths per 100,000 persons in a state. Thus, lethality is obviously different from other figures, such as the number of deaths related to proven cases (case fatality rate). But these figures belong to the domain of model calculators. These have different questions than the disease hygienists and clinical physicians, even if in public these differences tend to blur. Therefore, not all data are mutually helpful.

## *2. on the interface medicine - model calculations*

Various models of infectious disease epidemiology assume that there are only ill persons with symptoms. Therefore, only these are taken into account. If

this were the case, it should be possible to trace back all chains of infection without gaps, provided that enough personnel are available and no interviewee is lying or forgetful. However, if asymptotically ill persons (persons in whom positive antibodies can be detected) or COVID patients with inconspicuous symptoms could also become the starting point for the infection of others, this assumption would no longer be conclusive. In that case, the course of the epidemic could be quite different. However, the sources of infection of the children carrying/ill for weeks inconspicuous germs, who then suddenly fall ill with PIMS, remain just as hidden as possible third parties, who could have already infected these children<sup>xv</sup>. This fact alone shows the relevance of the "dark figure" of germ carriers and challenges us to think about the consequences: not only with regard to the claim of a 100% success rate in tracing.

The German National Academy Leopoldina, for example, points out the consequences as follows: *"A substantial part of the infected population is hardly or not at all ill even for the entire duration of the infection. Therefore, the so far strongly symptom-guided surveys lead to a distorted perception of the infection occurrence, which hardly allows robust (data- or even model-based) estimates regarding the efficiency of measures<sup>xvi</sup>."*

All these interrelationships, which are essential for understanding the processes and for considering which measures can be targeted to get the epidemic under control, must remain hidden if the computational models used, against whose correspondence of the forecasts and the results that actually occurred the success or the additional need for measures is determined, do not incorporate the individual variables that are actually possible. However, typical models summarize these and assume constancy of the few variables over the total duration of the epidemic, such as the serial interval.

This position paper is based on medical principles, but strives for connectivity with all other disciplines concerned with researching and influencing health-related aspects.

c. Why does not every infected person die?

COVID 19 can lead to death. Why doesn't everyone die if the pathogen has the potential to do so? And why hasn't mankind died out long ago, even though there are so many pathogens that can lead to death? Because the human organism has the means to inactivate the pathogen in time. The individual person will not be infected if the structures whose functionality is the prerequisite for penetration through the external barrier of the organism are denatured, for example, by oxidative processes. Then the problem of how to deal with the penetrated viruses does not arise. Once the virions have entered the organism, denaturation processes can only be expected again inside the phagocytes. For this purpose the formation of the antigen-antibody complex is essential. However, in case of the disease, not all virions are captured in time with the help of antibodies. They can

enter other cells and are reproduced there. During this phase, the plasticity of the virus may also change, resulting in the formation of mutants. Thus, the diseased person may become the starting point for the spread of a new mutant. The longer it takes for the viruses to be denatured in the organism and thus eliminated, the greater the risk for the diseased person that further cell systems will be affected with the typical impairment of functions. On the other hand, the risk of evolutionary further development of the viruses into mutants with higher pathogenicity, virulence and the ability to evade the effectiveness of vaccines also increases. This must therefore also be expected in phases in which there is not yet complete immunity or in which immunity has declined again. Latent phases, in which viruses remain functional in a kind of equilibrium with the cells over a longer period of time, therefore also deserve special attention with regard to the evolutionary development of new mutants.

Thus, the infected person will survive the infection, which would basically lead to death, whose organism - possibly supported by a vaccination - can destroy the viruses in time. Lethality expresses the "average" failure in these efforts. This figure indicates the average number of patients in a collective whose denaturation processes are no longer sufficient to prevent death. It depends not only on the infectivity of the pathogen and its virulence, both of which characteristics may be altered in mutants. Numerous host-related processes also exert a promoting and inhibiting influence on the denaturation processes. Therefore, the lethality of the disease can be expected to change over the course of an epidemic and between affected groups. One influencing factor is vaccination, even when there is only partial immunity or only partial immunity.

Mortality, i.e. mortality per 100,000 inhabitants, includes not only lethality, but also how many inhabitants are infected. This depends, for example, on the frequency and the way in which people come into contact with each other. The strategies currently used to control the epidemic are based on this. But the decisive factor is whether contacts with infected persons also lead to infection. This is influenced by the non-specific defense of the cells of the outer border of the respiratory tract. The more successful the denaturation processes there are, the fewer people will be infected and the viral load that can penetrate the outer boundary will be correspondingly lower. This increases the chance of overcoming the disease with the help of the natural organismic defenses. If this succeeds, mortality will decrease radically, even without vaccination and specific therapy. How this was achieved with tuberculosis in Austria between 1900 and 1950 is described in Chapter B 1.

Mortality and lethality can be altered by the evolutionary development of viruses into new mutants. How relevant this is, especially in COVID 19, is shown e.g. by the "English", the "South African" mutants and "P 1" from Manaus. The evolutionary dynamics of viruses depends on the length of time viruses remain

in the organism and their transmission: Partially immune individuals pose some risk in this regard. This could have importance in the context of the prolongation of the two vaccination steps, which are carried out for lack of available vaccines. However, since partial vaccination already leads to a reduction in lethality, Harvard researchers nevertheless see a preponderance of the benefits of using the limited available vaccines on more individuals at the expense of the interval to the second vaccination .

#### **d. The holistic response to COVID-19.**

##### **i. Biology influences the person**

Infection is first and foremost a process between a virus and a cell. It only indirectly affects the person, as long as no functions are impaired by the cell that are relevant for the person. This is just as true for all processes that take place on a purely biological level. Therefore, we do not feel the growth of cancer cells, even if the cancer has grown so large and is scattered throughout the body with metastases that it has become inoperable. However, the doctor notes that the person After attending a soccer game, however, you may be hoarse for hours because you shouted so loudly to cheer on the team. Pain is thus not a good guardian of health. It communicates much more whether functions can be retrieved by the body or not. The person feels sick, although so according to medical point of view.

Therefore, it is understandable that during the incubation period the person does not notice that the viruses are multiplied more and more by the cells. However, more and more cells in the organism are affected. Therefore, functions in the organism have to be reorganized in order to maintain the so-called homeostatic balance despite the needs caused by the infection (or cancer). The messenger substances necessary for this can be measured under certain circumstances. The structures that the organism forms to defend itself against the infection (or cancer) can also be measured. Thus, the detection of specific antibodies proves that the person has or has had COVID 19. Regardless of whether the person feels symptoms or not. Therefore, in children, for example, infection with SARS-CoV-2 can go unnoticed for weeks, but in the meantime result in impaired functions in multiple organs without being noticed.

The reorganization will sooner or later affect functions that are significant to the person. This leads to subjective experiences: One feels weakened, lacking drive, etc., gets fever, headache, e.g. after vaccination. Or the weeks of conflict in the body of the children then suddenly lead to massive symptoms in them. They have to be hospitalized immediately with multi-organ defects. There they are diagnosed with PIMS.

In order for the organism to be able to perform the services required in dealing with the disease, it needs resources. These are limited and must therefore be withdrawn from other demands. This is why cancer patients often lose weight. The multitude of theoretically possible biological processes are in competition with each other, so to speak. In order for one function to be enhanced, others must be curtailed. If this leads to restrictions in the currently necessary demands of the person on his body, there is a reduction in performance and at best subjective sensations. That is why the sick tooth hurts as soon as it comes into contact with ice or you bite on it. But the organism prepares itself for expected performance: Therefore, antibodies remain in the blood even against pathogens that are not currently present.

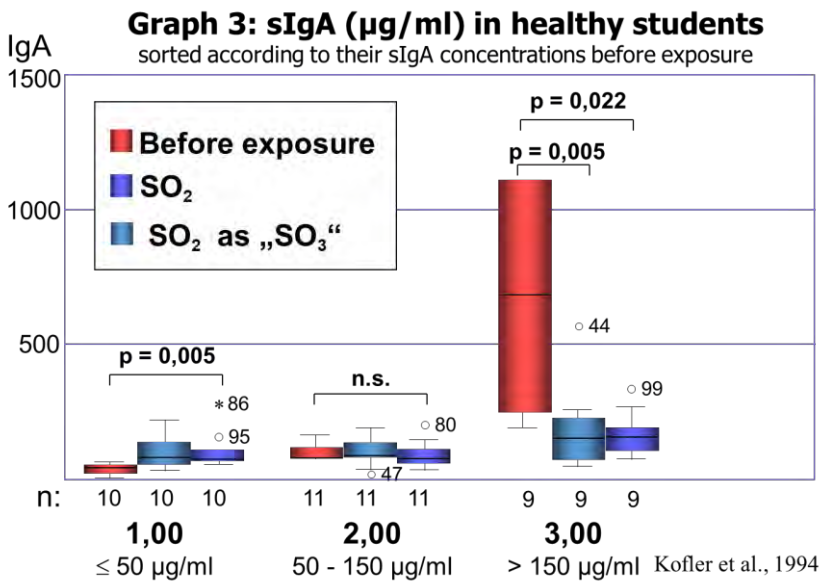
ii. The person influences the biology

The person also has current demands on the organism or is in anticipation of coming demands. Therefore, athletes warm up before competition and one prepares for a discussion by mentally considering the possible issues. The mind and body are therefore aligned accordingly. Ultimately, all functions that a person performs must be implemented by cells of the body. Therefore, the person also intervenes in these interconnected processes in the organism between cells, tissues and organs. Thus the requirements of the person are in competition with the biological requirements of the organism. The person has no other possibilities to become effective than to organize the biological modes of operation accordingly, which are just as available to the organism. Since neither the organism knows what the person wants, nor the person what the body needs, surprising consequences can occur from the person's demands on the body. Many people are familiar with the placebo phenomenon. Here, unconscious control processes of the brain trigger biological functions that can also be triggered by, for example, toxins or drugs. But this is only one example of how the person influences biological processes with evaluation processes. However, these central control processes can also be detrimental to the person. As said: The brain cannot know, which demands are actually delivered, if a help call of the body takes place. Then it would be of better, the message would not reach the brain at all. Who does not know this from soccer games: Despite a heavy foul, after which one could not go for hours, the soccer players run after few minutes as before, because with a cold spray the transmission of the stimulus to the brain was interrupted and therefore the disservice was omitted, which would have occurred otherwise by the controls of the brain. The effectiveness of anesthesia and artificial deep sleep prove to everyone how fundamentally different the consequences would be if central control were not prevented by the interruption

of the flow of information. Many biological processes would occur differently, and often more efficiently, if they were not centrally interfered with.

iii. The interdependence of organism and person

Such influences can also be expected on the effectiveness of non-specific defenses, and within a short time. This is proved e.g. by the following experiment: The influence was investigated which the intellectual assignment of meaning has on the one hand on a subjective perception and on the other hand on a biological effect which can neither be influenced consciously nor chemically<sup>xvii</sup>. For this purpose, students were invited to participate in an experiment. The aim was to determine how strongly the odor threshold varies between young people and whether odor has an influence on the concentration of the antibody IgA in saliva. Healthy volunteer students were alternately offered one breath (2.2 seconds) of odorless air and one breath of test gas at continuously increasing concentrations via a breathing mask. The administered dose is harmless even at high concentrations because of the short exposure time. Students entered the odor threshold and pain threshold and again provided a saliva sample. Offered in both tests was the much more harmless sulfur dioxide. However, in the second test, it was stated to be the much more toxic sulfur trioxide. Both odor threshold and pain threshold decreased significantly when the students believed they were being exposed to the more toxic SO<sub>3</sub>. The concentration of antibodies in saliva also changed significantly: the third with the highest sIgA values before the experiment dropped abruptly and massively, the concentration of the third with the lowest sIgA values increased slightly<sup>xviii</sup>.





These effects occurred within a short time. This means that one should expect meaning attributions to influence whether an objectively given biological burden is subjectively perceived or not. These scientifically supported conclusions are in good agreement with countless empirical socio-medical studies that have provided evidence between intellectual, emotional, and cognitive evaluations with biologically beneficial and detrimental effects. This is discussed in more detail in Part 2. Evidence between such assessment processes and the genome (telomere and telomerase) has been pointed out several times by Nobel Laureate Blackburn<sup>xix</sup>, e.g., improvements in neglected children after successful training of parents<sup>xx</sup>. These approaches open the understanding of bio-psycho-social processes leading to the evidence of the link between social situation, poverty, helplessness etc. and increased COVID-19 risk.<sup>xxi</sup>

Assuming such process principles also in the context of assessment processes and COVID-19, it makes sense why asymptomatic individuals can be germ carriers and infectious. However, it also makes one understand why even short-term changes in immune defenses become conceivable, which can cause viral loads that would be successfully repelled by nonspecific defenses in the absence of the change in meaning to lead to penetration of the organism's outer boundary and thus to infection. Once the viruses are inside the organism, the incubation period begins. During this period, infected individuals are usually symptom-free.

Such processes make it understandable why persons can be germ carriers without an increased viral load being detected in the nose and why they do not need to be additionally infected. Under stressful conditions, however, this initial load may be sufficient for the onset of manifest symptoms. Such stresses are conceivable under homo office, home schooling, etc. in close living conditions.

#### iv. The accumulation of unexplained cases of disease

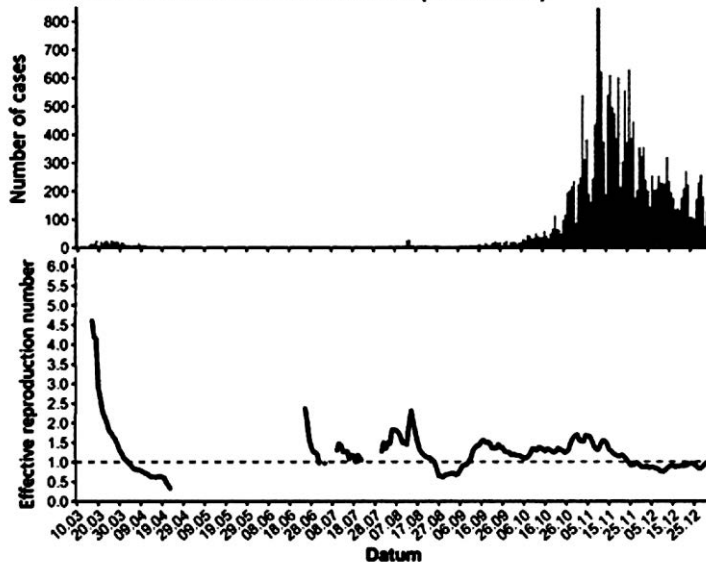
That such processes will more often lead to manifestations when the resources necessary for the biological processes are limited (poverty, physical overload...) is conclusive. This demonstrates the biological bridge to the higher risk of marginalized groups. These groups of people are also more likely to be exposed to assessment-related stresses, e.g., due to their housing conditions. Such processes provide insight into why there may be an increased incidence of new disease within families, even if the available evidence does not provide any indication of the origin of the germs that have been introduced into the family.

The dynamics between the pathogenicity of the pathogen and the variable susceptibility of the person or, more precisely, his organism explains the variability of the incubation period, but also the option that pathogen latency occurs.

These processes deserve attention not only because they could lead to the formation of a viral dark net: That is, a network of symptom-free infected individuals who can spread viruses to individuals who also need not become manifestly ill. When and in whom this network leads to manifestation can be predicted just as little as it is possible to trace who passed on the infection.

Such considerations would make the graph below understandable: Carinthia, with a population of about 560,000 and an area of about 9,400 km<sup>2</sup>, is an intensively touristically used area, especially in the, summer of 2020, because of its lakes, mountains, and diverse cultural offerings. Despite the probably strong increase of the contacts during the tourism months (June - September) the new disease rate sank so strongly that over weeks the reproduction number could not be computed any longer. Dead #13 died on May 5, dead #14 from October 23. The second wave struck with an intensity that had not been predicted.

**Graphic 4: Epidemiological curve of daily incidence by laboratory diagnosis and the time course of the estimated effective reproduction rate in Carinthia, Austria. In each case, 13 epidemic days were used. Data after January 2, 2021 were excluded from the model calculation. (AGES 2021)**



All processes that influence the duration of the presence of viruses in the body - from the formation of an increasing viral load e.g. in the nose before manifestation to death from COVID-19 - are also significant because they contribute to an increased risk that mutants can form.

Both this and the personal risk of becoming infected and manifesting disease, such as the likelihood of passing the viruses to others, should be able to

be reduced by the prophylactic administration of antiviral antiseptics, e.g., as a nasal spray.

v. Once again: disease - being sick and COVID-19

Meanwhile, the question of whether and how to recognize excretors of SARs-CoV-2 is gaining more and more attention, regardless of whether they also individually experience symptoms or not. This question is also becoming more urgent because it has so far been open to what extent individuals who have already experienced the disease and have therefore acquired specific immunity or vaccinated individuals are possible carriers. Therefore, the preliminary results of the SIREN study are briefly mentioned<sup>xxii</sup>. In this study, more than 25,600 employees (average age about 47 years) in English hospitals were regularly examined for one year (from March 2020) for their antibodies, PCR values and objective and subjective clinical findings. Of these 25,600, 32.3%, or about 8200 individuals, had contracted COVID-19 by about mid-July. These 8,200 were screened for recurrence of COVID-19 by January 2021. The antibody-negative (approx. 17,300) employees up to mid-July were examined in parallel for the occurrence of first infections using the same methods. In the period up to January 2021, "only" about 10% contracted COVID 19 for the first time, despite the largely similar composition of the study groups. Of these individuals, about 66% exhibited the classic subjective COVID symptoms. These persons therefore also felt ill. About 17% stated that they had never noticed any symptoms at all. However, according to objective criteria, they had COVID-19. In the case of COVID, therefore, a distinction must be made between being ill and being sick.

At 17%, the proportion of atypically ill persons in this collective was thus remarkably high. Even more strikingly, a further 14% of individuals with now positive AK detection reported subjective symptoms. However, these symptoms were atypical for COVID 19, which is why it would probably not have been assumed that they had COVID without the study. Thus, about 31% had COVID-19 but would not have been recognized as such.

In order for antibodies to be formed, the phase must have been passed in which the viral load, e.g. in the nose, has become so large that others can be infected, but there is still no manifestation. This phase may last individual days<sup>xxiii</sup>. Therefore, it can be assumed that both symptomatic and asymptomatic patients were potential carriers.

The authors of the SIREN study also present a graph and data from 155 suspected reinfections among the approximately 8,300 people who had contracted COVID between March and July and had therefore acquired immunity. That immunity declines after illness is not unusual. Therefore, it is not surprising that reinfection occurs and at an increasing rate with an increase in the distance from the initial illness. For our considerations, another statement is of importance: the suspected reinfections are namely distributed significantly

differently among those with typical COVID symptoms, those with inconspicuous symptoms and those with atypical disease: Now, instead of 66% percent suffering from COVID 19 as in the initial infections, only about 33% do so. The proportion of persons with inconspicuous symptoms (approx. 18%) and asymptomatic sufferers (approx. 49%) rises to 67%. Thus, the ratio has reversed. If one assumes ("thumb times pi") that this collective had approximately the same risk of being infected as that of the 10% who were infected for the first time, then it is reasonable to assume that those who had already been infected in the past (approx. 7.5%) (difference of approx. 10% and the calculated approx. 2.5% of those who were reinfected) were also more successful in avoiding infection. This is also not a really surprising result for the epidemic hygienist. It has been observed time and again that once an infectious disease has been successfully overcome, protection against a new infection is improved. Thereby, a shift of the proportions on the continuum from "not infectable" - over "infected" - to "manifestly slightly" - to " manifestly severely ill" can occur in the direction of an increase of the "not infectable". With increase of the time distance of the new infection from that of the healing at the first illness the continuum shifts again more in the direction of the illness. Something similar has been found with vaccination against cholera in comparison with non-vaccinated individuals.

However, this means that the possibility of virus transmission must be expected in all persons in whom corresponding antibody increases - due to the new disease - are found, which entitle to the diagnosis "COVID-19". The increase must have been caused by a specific stimulation of the immune system by virions, which succeeded in penetrating through the cellular outer boundary of the organism. This penetration is also preceded by a phase in which the viral load, e.g. in the nose, is sufficient to infect others. This can lead to infection followed by asymptomatic disease, which can then lead to symptomatic disease "sometime and somewhere" when the virus infects a person with weakened defenses. This situation is not unknown either: We know it, for example, in infectious hospitalism. There, symptom-free persons with a good immune system transmit the so-called "facultative pathogenic germs" not only between other persons with a good immune system without any consequences, but unfortunately also to immunocompromised persons, who then fall ill. This is particularly problematic when it comes to germs that have become resistant to conventional antibiotics over the years. Fundamental problems could also arise in connection with the emergence of particularly pathogenic mutants of viruses.

e. Not static monocausal - interactive multicausal and multi-intentional.

Thus, understanding the infectious disease for each of the sub-steps from transport of the virus in the environment to death from COVID-19 requires a comprehensive process approach that takes into account physical, chemical, biological, psychosocial, legal, economic, etc., aspects in a balanced manner. Multiple causes will need to be considered simultaneously in order to incorporate diverse goals, as well as existing concerns, into a process. This results in interactions, which themselves have an influence on the events and intentions. This requires a scientifically correct approach that allows statements about the cause - i.e. causality. This encounters the methodological problem that the scientific disciplines used are based on different world views or paradigms. Therefore, they cannot be causally linked. The problem can be solved by using a comprehensive paradigm in which the sectoral views are integrated like subsets in a common basic set. This has been achieved in the model used here because it has been implemented that all sectoral disciplines used agree on two assumptions:

1) Everything that is today is only a consequence of yesterday's circumstances and processes, yesterday's the consequence of the day before yesterday, and so on. All thus accept a comprehensive evolutionary understanding.

2) At least partial aspects of our world can be explored and predicted. Therefore all statements of all disciplines can also be related to these basic assumptions and therefore be connected with each other.

Thus three directions of looking at one and the same problem are open to us:

- a. the classical approach of the respective discipline
- b. the comprehensive approach resulting from the assumption of a continuous evolutionary process from the "Big Bang" to the "Big Mac"<sup>xxiv</sup> and
- c. the approach using the laws of thought and the experiences of everyday life.

The third approach will possibly be even more surprising than the second. But it has a key significance in an epidemic with a completely unknown pathogen. Crucially, action and inaction must also meet the requirements of our legal system: And this system provides, in cases where only limited knowledge is available but a decision must be made, that the decision must be "based on the experience of everyday life and the application of the laws of reasoning. These issues, which are particularly significant from a scientific point of view, will be discussed in more detail in the "long road" (Part 2).

The current situation cannot be answered by anyone who has to decide with the help of already secured knowledge alone. "Compared to the pond of our

knowledge, our ignorance is Atlantic", already said the R. Duncan and M. Weston-Smith, the editors of the Encyclopedia of Ignorance, supported by numerous Nobel Prize winners<sup>xxv</sup>. Thus also this route finder can point out in many areas only, with what one should count for precautionary reasons. Nobody knows the future, nevertheless one must act today in such a way or differently or decide not to act. Not acting also needs the same good justification.

#### **f. Necessary and sufficient justification**

Despite this often severely limited knowledge, rapid and correct decisions are needed in epidemics. Measures that may or must be taken or avoided to protect health and prevent deaths need sufficient justification. What is sufficient is determined, on the one hand, by the principles of science. Ultimately, however, the determining factor is whether the action is in accordance with the law. Parliaments have delegated special authority to responsible decision makers in the event of an epidemic, pandemic, or other disaster. Scientists who are appointed, for example, as experts to advisory bodies to these decision-makers are thus in an unfamiliar situation. Arguably, they are required to state what would be considered reasonable, unreasonable, hazardous to health, etc., using the laws of reasoning and their experience of daily life. In doing so, the health expert will have to point out both that SARS-CoV-2 can lead directly or indirectly to death from or with COVID-19, for example<sup>xxvi</sup>. He will also have to point out to the decision-maker the consequences of the measures planned to prevent such deaths, e.g. that lockdowns may increase the risk of suicide among children. Whether and to what extent this is followed is not the responsibility of the experts, but of the decision-makers. The proportionality of the measures taken is a matter for the competent supreme court.

#### **g. Conclusions**

This leads to the fact that among the correct techniques to expand knowledge, the scientist should also use the possibilities that allow to use the empirical and logical experiences of different disciplines that until now seemed incompatible. For this purpose Einstein obviously successfully developed a technique which can be used also in medicine<sup>xxvii</sup>. This has the additional advantage that its expressiveness extends, but does not replace, the possibilities offered so far by the state of knowledge. The "third leg" for the sufficient scientific justification is provided by the legislator with the requirement to close any remaining gaps even without further empirical proof "by applying the laws of reasoning and the experiences of everyday life".

A strategic concept is required for the measures in order to be able to achieve the short, medium and long-term goals efficiently. This requires a regular

review to determine whether the expected goals have been achieved. Deviations are to be expected, since people are not ideal and also technical aids can fail and organizational structures can be deficient.

As the timeframe changes, so does the emphasis placed on local, regional and global aspects of pandemic response. Currently, the focus will be on the avoidance of medium and immediate fatalities and the functioning of the health care system. However, the impact on education, jobs, cultural and sporting diversity, etc., is also significant from a health perspective. Without ecological, spatial planning measures with consideration of the international interdependencies, there will be no adequate long-term handling of COVID-19 and the next pandemics and their integration into the other structural changes that are currently pending (keywords climate change, mobility, local and global inequalities).

Basic adjustments are necessary when the epidemic cannot be stopped at the stage of new emergence, but there has been a spatially and temporally uncontrollable spread of germ carriers. In principle, although five different principles are theoretically available to stop the epidemic and prevent death from or with COVID 19. However, since none of these principles can be implemented in an ideal way, it is necessary to combine all methods so that the consequences of insufficient protection in one area are offset by the effectiveness of another. In this way, risk can be reduced. But there is no such thing as zero risk in a non-ideal world. Rather, the fear is that paying attention to one approach to a solution may lead to unexpected consequences in an entirely different area. This appears to have occurred in the course of the fight against COVID-19. Unexpectedly, mutants of SARS-CoV-2 have appeared and continue to appear, including those that are more infectious and dangerous. Most ominously, they could also escape vaccine efficacy (escape mutants). Such a mutant could condition a situation similar to that in March 2020. This represents a threat that was not anticipated in March 2020.

From a health perspective, such considerations lead to numerous suggestions and deductions. At the top is the avoidance of the occurrence of escape - mutants. The likelihood of their occurrence is related to the duration of persistence of SARS-CoV-2 in cells of the host organism. The most efficient way to reduce this is to denature the virus before it penetrates the outer boundary of the organism in the nose, throat, or larynx. The use of, for example, appropriately effective and tolerant nasal sprays also temporarily reduces susceptibility. It would reduce them already in the nose located virus loads. This reduces the relevance of infected persons as carriers and the probability of manifestation of the disease in the infected person. Inhalation with such substances should also reduce the recent infection of patients hospitalized in normal wards by viruses formed by themselves and released into the lung and nasal cavity.

## B) INTRODUCTION

### 1) A brief history of concepts to combat the hostage of infections.

Living beings have had to deal with viruses and other pathogens for billions of years. They survived and were able to evolve until now - thanks to the successful fight and - in part - successful cooperation with them (mitochondria as viruses "integrated" into the cell, etc.). Therefore, the tools for interaction have also changed over time. Additional tools had to be developed for situations where the non-specific and specific biological tools were not sufficient: Since the Stone Age, the secretion of infectious agents has been used as a tool against epidemics. Since then, the available tools and focus areas have expanded as knowledge has increased. As a result, a variety of tools can now be integrated and sequenced into a comprehensive approach to epidemics.

1) Isolation and quarantine: since the Stone Age ... social norms and laws.

2) Influencing virulence: Jenner, Pasteur, Koch, (1796, 1895, 1896).

I. Indirect improvement of nonspecific physiological defenses and comprehensive coping capacities: Virchow (1848 hygiene, social medicine, PH), Bismarck (1883, social insurance laws).

II. Behring (1890, passive immunization thanks to antitoxins)

III. Metschnikow (1863): phagocytosis thanks to white blood cells

3) Antiseptic - aseptic: Semmelweis and Lister: (1847, 1865)

4) Contact avoidance and natural herd immunity: Kermack & McKendrick: (1927)

IV. specific therapy: Ehrlich (1909 Salvarsan), Waksman (1943 Streptomycin),

V. "Immunology as usually understood": Alick Isaacs & Lindemann 1957 (interferon); Porter R 1959 antibody globulin structure.

5) "Test, test, test" WHO 2020.

VI. individual comprehensive behavior

6) One World concept "escape the era of pandemic" thanks to comprehensive sustainability: IPBES 2020

7) Mucosal antiseptics (2020).

The "naïve evidence-based" responses against an epidemic consisted of keeping a distance from the sick and agreeing on norms that such people must or want to live segregated even in special valleys (leprosy). This is evidenced not only by data on humans, but also for animals<sup>xxviii</sup>. Epidemic areas were consistently demarcated: No one was allowed in-no one was allowed out.

The principle of contact avoidance also works less radically. Kermack & McKendrick proved its usefulness mathematically<sup>xxix</sup>. Their approach became the basis of various models (e.g. SEIR). The extension by WHO with the



requirement for "testing, testing, testing" takes into account the fact, specific to COVID 19, that the infectious individual can pass on viruses asymptotically or presymptomatically. Therefore, these individuals must be recorded, isolated, and their contacts identified, and the potential carriers of germs thus recorded must also be isolated.

Jenner used evidence-based experience that infection with a less pathogenic virus caused protection from the "black death" - without knowledge of immunology and infectious agents such as microbes or viruses. Pasteur and Koch developed the "germ theory" of infectious diseases. They recognized the possibility of artificially altering the virulence of pathogens. Behring discovered that an antitoxic substance could be the cause of a curative effect. This could be obtained from the blood of cured people and artificially infected animals. He used it, for example, against diphtheria and tetanus. Kermack & McKendrick referred to the influence on virulence as the second tool against an epidemic, which has been used in addition to radical secretion, when they developed the third approach.

Virchow made references to the relationship between poverty and risk of infection (1848). The fight against poverty, social insecurity, work overload, inadequate nutrition and housing conditions was a non-specific tool against almost all infectious diseases. This manifested itself in a decline in the contagion/contagion and manifestation index. For example, mortality from tuberculosis - the most important cause of death at the time - was reduced in Austria from about 500 deaths per 100,000 persons per year (1900) to about 50 in 1950 without the influence of vaccination and antibiotics. The physiological explanation for the decrease in infections and manifestations is the increase in the efficiency of the non-specific defense. However, the non-specific defense does not cause specific immunity. Therefore, even if individuals have come into contact with and successfully repelled e.g. SARS-CoV-2, they remain fundamentally susceptible to e.g. SARS-CoV-2. Thus, they may later contract COVID-19 upon renewed contact with SARS-CoV-2 if their nonspecific defense status is worse. The nonspecific immune status can change rapidly, as will be shown below. The risk of infection can therefore increase - if the exposure to SARS-CoV-2 viruses remains constant - even in the short term, e.g. in the wake of a severe physical strain. However, the risk can also be permanently improved or worsened by the living conditions that are so essential for contracting the disease, e.g., with tuberculosis. Therefore, contagion and manifestation index may vary within the same collective and depending on the currently given situations in the individual. The success of the non-specific defense against contamination with respiratory pathogens is based on the antiseptic efficacy of substances produced, for example, by mucosa cells of the nasal mucosa.

Semmelweis discovered the basic principle of antiseptic in 1847 in his special form of disinfection. Disinfectants can destroy viruses but are too aggressive for the mucosa. Semmelweis applied chlorine-containing solutions to disinfect the hands of obstetricians. This made him the "savior of mothers," although university and ministerial authorities prevented its implementation for about 20 years. Lister rediscovered the principle in 1865 and applied it to surgical operations. Since then, antisepsis has been the most fundamental principle of every medical activity worldwide. And Semmelweis has also gone down in history because the Semmelweis effect is named after him: that obviously effective measures are not implemented for unscientific reasons and social harm is accepted as a result.

Using mathematical techniques, Kermack & McKendrick demonstrated a third principle with the delay of contacts between infected and infectious persons, by which one can influence the course of an epidemic (1927): One does not have to lock infectious persons away permanently. One can also start with the non-infected. If the number of those who are no longer infectious thanks to immunity increases above a critical value, then the contact of an infectious person with infectious persons leads to fewer new cases of the disease than at the same time persons who are (permanently) healthy, become permanently immune and no longer infectious. Then the so-called reproduction number falls below 1. The reproduction number can also be reduced by measures of contact restriction and quarantine of (potential) germ excretors. Then the epidemic will change to an endemic or sporadic occurrence. Kermack & McKendrick are thus the intellectual fathers of herd immunity and reproductive numbers. However, they understood this way to contain an epidemic only as an additional offer and not as a substitute for the possibilities of permanent segregation or influences on virulence, on pathogenicity and on susceptibility.

Ehrlich, thanks to the invention of salvarsan against syphilis, opened the way to be able to act with drugs against infectious diseases. Waksman discovered streptomycin in 1943, the first drug produced by microbes (antibiotics).

Immunology "*as normally understood*"<sup>xxx</sup> and occurring only from mammals onwards, is based on cellular immunity (e.g. phagocytosis thanks to leukocytes; Metschnikow 1883) and globulin-based specific antibodies (e.g. Porter 1961). Therefore, Kermack & Kendrick in 1927 could only consider the possibilities of quarantine and virulence or susceptibility, but not modern vaccination. Recently, many techniques have become available to construct an artificial vaccine, including RNA techniques. They made it possible to extend the concept of Kermack & McKendrick thanks to vaccination by artificial herd immunity.

The Director-General of WHO proposed an additional tool in March 2020 to break the chains of contact for COVID-19: "*We have a simple message for all*

*countries: test, test, test; test every suspected case. If they test positive, isolate and find out who they were in close contact with for up to 2 days before they developed symptoms, and test those people as well*"<sup>xxxix</sup>. This takes into account the fact that people infected with SARS-CoV-2 are infectious before they show symptoms. In March 2020, however, it was impossible to know that these tools would not achieve the predicted goal. It was predicted by virtually all decision makers at the time that the measures recommended by WHO would stop the epidemic.

The IPBES (Intergovernmental Science-Policy Platform for Biodiversity and Ecosystem Services) presented the sustainable measures concept to escape the "era of pandemics"<sup>xxxix</sup>. It is necessary to prevent the threat of about 620,000 to 850,000 potentially pathogenic viruses for which animals are the host and can easily become human pathogens, he said. The next pandemic is therefore only a matter of time - with all the direct and indirect consequences that we are currently experiencing, at least until adequate vaccines, therapies and the necessary preventive measures would be available.

Contact with a virus is not identical with infection, and infection is not identical with manifestation: this is because the non-specific (innate) physiological defenses intervene in these processes. The resulting indirect means of combating infectious diseases have been used since Virchow and the legal initiatives of Bismarck. It has since been demonstrated that deficiencies in the physiological defense against infection can be compensated for by administration of a synthetically produced substance of the nonspecific defense, namely N-chlorotaurine (NCT) or by other antiseptics. The use of N-chlorotaurine (NCT) as a mucosal antiseptic may therefore help to bridge the gap between the outbreak of such an epidemic and the prevention of the severe illnesses and deaths with the help of a specific vaccine. NCT was discovered in 1970 by a group of Polish researchers. In the 1990s, Gottardi developed the technology at the Medical Faculty in Innsbruck to synthesize this substance of innate defense on a large scale. Together with Nagl, therapeutic applications were tested, including tolerability and efficacy against SARS-CoV-2<sup>xxxiii, xxxiv</sup>. Kofler et al. proposed its preventive use to prevent SARS-CoV-2 infection and COVID-19 manifestation<sup>xxxv</sup>.

## **2) A praise of non-specificity.**

In the discussion of necessary measures, the importance of specific procedures is emphasized. This is particularly evident when talking about immunity, as if there are only specific immunological effects. But nonspecific processes are indispensable, e.g.

- a. The success of the nonspecific (innate) defense ensures the survival of the infected individual until the specific defense of the individual has developed to the point of being effective against the disease.
- b. Nonspecific defenses reduce the number of infected and diseased individuals. This reduces the reproductive number, i.e., the average number of individuals infected by a diseased individual. This is particularly important in the period before vaccines increase the proportion of immune individuals and thus artificial herd immunity.
- c. Artificial boosting of infectious defenses is also effective against any kind of mutants. Their widespread use helps to reduce the development of mutants.
- d. Nonspecific processes can contribute in several ways to combating the collapse of the critical care system, e.g., also by being effective against other viruses. The demand for beds due to "other" infections, e.g. with Influenza, therefore decreases. If used in a targeted manner, an increased protection of e.g. the staff in intensive care units can be expected.
- e. Nonspecific processes also contribute to improving the level of health in general, quality of life and coping with a variety of challenges, independently of the defense against infections. For example, increasing the potential to absorb and transmit oxygen is helpful not only to combat infection and the severity of COVID-19, but also to enable the elderly, for example, to care for themselves for longer.
- f. Long-term success against many infections (and behavioral diseases) relies on non-specific elevation of health levels (e.g., against tuberculosis).
- g. The tools to escape the "era of pandemics" cannot target specific viruses or microbes. After all, today we do not know which pathogens will cause the next pandemic. So today, prevention can only be achieved with non-specific methods.

A strategy without the integration of non-specific tools would thus forego relevant, indeed irreplaceable, opportunities

### **3. The goals of a health-oriented strategy**

The goals have changed profoundly from a medical perspective since March 2020:

- It began with the intention of eliminating the impact of the newly emerged infectious agent on health, disease, and well-being by eradicating the virus.

It has since become clear that, at least now, it is no longer possible to eradicate SARS-CoV-2

- The goals of medicine and public health (PH) are now oriented toward combating the manifestation of COVID-19: the goal is to be able to deal with COVID-19 as with "any other infectious disease, even the far from harmless influenza" - thanks to successful prevention, promotion of health, and cure.

This includes the appropriate impact on the global import and export of the virus.

But these goals have not yet been satisfactorily achieved. Vaccine development, on the other hand, has been successful and provides hope for addressing the threat of severe disease progression and many deaths resulting from SARS-CoV-2.

- However, the actual defining goal is currently (early 2021) based on preventing a collapse of the intensive care system with the possible consequence of a collapse of the entire healthcare system. This fight is directed against premature, unnecessarily painful or forced death. It is pointless to fight against death in principle or to believe that one can exclude risks in principle.

In the meantime, it has been possible to prevent a collapse of the health care system in numerous countries. This was and is connected with extreme also health-relevant side effects as a result of lockdowns and other measures, which are set to inhibit the contact of persons among themselves as a precaution. This technique also reduces contacts between asymptomatic germ carriers. However, the approach of interrupting contact between individuals has no relevant impact on future population susceptibility. It should also be borne in mind, in a strategy aimed at avoiding the collapse of intensive care, that patients with COVID-19 are not the main reason to occupy ICU beds. Therefore, other measures, e.g., against other serious infectious diseases, against traffic accidents, etc., must also be considered to prevent the collapse of the ICU system. In addition, the available personnel in particular limits the resilience.

It should also be taken into account that it is not only the overload of intensive care that can lead to triage. A similar situation is reported for psychiatric care of children: Priority must now be given to those at risk of suicide.

It is time for all disease-related intermediate and immediate effects of the pandemic response to be included in the assessment of the appropriateness of interventions.

The strategies of local, regional, and global institutions will vary. ("Think global, act local") The importance of health levels is obviously of a significance that goes beyond health: both the EU and WHO confirm that the development of health levels is the relevant measure of effectiveness in overall policy<sup>xxxvi</sup>.

The political strategy should be prepared for the next pandemic. Therefore, the fight against COVID-19 is just a model example of how to be prepared against epidemics and pandemics in the future.

#### **4. Five principles against SARS-CoV-2 and COVID-19**

The primary goal is to prevent death from COVID-19. Death is the final step in a sequence of conditions without which death would not have occurred. Therefore, everyone will agree that the goal can be achieved if the substeps can be prevented. The substeps involve processes based on different principles. Suitable techniques can be used for these. If one succeeds in implementing them in an ideal way, the goal should be achievable. These principles are:

- a. Principle 1: If SARS-CoV-2 did not occur at all or disappeared, then there would be no transmission of SARS-CoV-2;
- b. Principle 2: Without transmission of SARS-CoV-2 - no contact with germ carriers of SARS-CoV-2;
- c. Principle 3: Without successful contact with SARS-CoV-2 - no infection with SARS-CoV-2.
- d. Principle 4: Without infection with SARS-CoV-2, no manifestation with COVID-19 and no need to hospitalize a COVID patient.
- e. Principle 5:
  - a) If all individuals were successfully and permanently immunized, e.g., thanks to an appropriately qualified vaccine, no one would be able to contract COVID-19 and would - hopefully - never be contagious again
  - b) If we had a successful specific therapy, the risk would decrease that a high number of the scarce number of beds in intensive care units would be occupied for COVID-19 for such a long time  
and would not have the risk of a collapse of the health care system
  - f. If 1 -5 are successful: no more risk of lockdown because of the threat of health care system failure - no need for repeated lockdowns with their inevitable long-lasting side effects (e.g. risk of "Lost - COVID generation", economic consequences only comparable to the post-war period)

#### **5. Are all principles equally valid and also implementable?**

The argument is conclusive that the pandemic could be blocked by SARS-CoV-2 even if only one of the principles 1 - 5 is realized in an ideal way. However, this does not mean that each of the principles is equivalent in

application. Therefore, they are not interchangeable. Therefore, there must be good reasons for choosing principle 2 and not principle 1, for example. If Principle 1 could be implemented in an ideal way, the measures for Step 2 would not be necessary. Then SARS-CoV-2 viruses could not develop into threatening mutants. Principle 2 has virtually no effect on the inactivation of viruses, so it does nothing to prevent mutants. It is possible that the decision against Principle 1 came about because there was a fear that Principle 1 could not be implemented ideally. This would be a very good argument.

#### **a. Inhibition - Enforcement**

Since principle 1 does not promise a resounding success, it is clear that one looked for an alternative. Principle 2 offered itself: It has been implemented in a radical way for centuries. Thanks to Kermack and McKendrick, a more "humane" way of implementation was available, which also allowed mathematically tangible predictions. Therefore turning to principle 2 and turning away from principle 1: Connoisseurs of physiology will connect this with the principles which Sechenov and Pavlov proved for physiological processes. However, it is also true for these that they are not ideally balanced: Inhibition is often overemphasized and attention and resources are inappropriately allocated to the chosen path: This is consistent with the distribution of recommended measures (e.g., WHO)

#### **b. Collective forgetting?**

Breaking the chain of infection suggests that the epidemic can be brought to a halt. But it does not make individuals in the population immune. In a pandemic, there is always a fear that the pathogens will be reintroduced. Therefore, the risk of falling ill is only postponed. If one assumes that the dangerousness of the disease remains constant and can be described by the probability of dying in the case of illness, it can be determined how many deaths must be expected if the pathogen has not been eradicated and the population has not become naturally or artificially immune. By interrupting the chain of infection, it is not possible to change this number, but it is possible to extend the time period in which people will die. This can help ensure that hospitals are not overburdened and that patients receive the available therapy for which lethality has been identified. On this basis, the chief ideologist of the Charitee had to come to the prognosis in March 2020 that in the long run ultimately more than 250,000 people would die of COVID 19 in Germany alone and that an exponentially increasing wave could be expected in the fall of 2020. Only immunity of two out of three persons could stop the epidemic<sup>xxxvii</sup>. Principle 2 was obviously not sufficient. Immunity can be achieved artificially through vaccines. This may have

been the impetus why the responsible politicians were willing to massively promote vaccine development. But no one assumed at the time that development could be completed before the summer of 2021, let alone the necessary licensing, production and vaccination coverage. It was therefore necessary to bridge at least 20 months without vaccination protection and also without specific medication.

It would have been possible to build on the positive experience gained with the improvement of nonspecific immunity. It is undisputed that the massive decline in the incidence of tuberculosis in the 20th century can be traced back to the improvement of nonspecific immunity. This will be discussed in the example of Austria below (B 3a) and in Part 2. It would also have been open to promote scientific interest in this option in a similar way as has been done for the development of vaccines worldwide. Any systematic literature search should have come across NCT, for example. But this has not happened worldwide. It is possible that this is a process that is well known to historians: they are repeatedly confronted with the phenomenon that millennia-old technical and intellectual achievements can no longer be made today: Just think of the processing of the enormous building blocks of the Minoan fortress walls, between which no sheet of paper fits. Or the technology required to build the pyramids. There seems to be a process that leads to collective forgetting. Otherwise, it is difficult to explain why worldwide hygienic knowledge, banal in itself, has been disregarded by recognized medical experts. Not only this: This consideration of non-specific defenses would, after all, open up the possibility of a temporary reduction in susceptibility. Nevertheless, there is no reference to these possibilities in the Saudi Arabia Communiqué of the Presidents of the National Academies of Sciences of the G 20 countries. The experts had access to the leading specialists in all fields of science. The Communiqué deals, among other things, with immunity, but *expressis verbis* only with specific immunity.<sup>xxxviii</sup>

It is obvious: It is an ethical/moral obligation to deal with the possibilities which threaten to be lost by the decision for a paradigm which is now recognized as dominant. Thereby the problem already raised by Th. Kuhn is that the representatives of the new paradigm assume that they would dispose of the final and only correct world view. Therefore, all world views even successfully used so far would be falsified, and all statements would have to be rejected as unscientific. But also the new paradigm is only an invention about the world. Also here one can learn from Einstein: The refuted paradigm of Newton does not lose its usefulness, if one restricts its range of application appropriately.<sup>xxxix</sup>

Already Sechenov has pointed out the principle that attention allocation is connected with an inhibition of other, at best essential aspects<sup>xl</sup>. The danger of omission (Occam's razor) should not be underestimated. Therefore it needs Comprehensive simplicity (Einstein: As simple as possible but not simpler)



Simplifying is helpful, but only so far that everything observable can be described separately and everything explicable remains explicable<sup>xli</sup>.

c. What was not thought of.

The first wave was caused by the wild form of SARS-CoV-2. This corresponded to the situation as given in the epidemics that have been used as examples of the course and influenceability of epidemics worldwide, e.g. in the cases described by Cori et al<sup>xlii</sup>. At that time, there was therefore no reason to worry about whether mutants would occur and what influence the chosen strategy could have on them. In the meantime, this has changed fundamentally. In the meantime, there is talk of the evolution of viruses and it is understood that more aggressive, more virulent viruses and so-called escape viruses - viruses that evade the effects of vaccination - must be expected to assert themselves more and more against the "more harmless" wild form in the future. Since the development of these viruses is tied to their presence in host cells, strategies that also lead to inactivation are superior in this respect to strategies that only interrupt the chain of infection.

During the first wave, the obvious prerequisite for manifestation was that the virus, now appearing for the first time, entered the nasal and pulmonary cavities. It was therefore obvious to attribute the frequency of manifestation only to the infectivity of the virus. But this was not enough, as could be seen in the course of the summer with the decline of the epidemic to a sporadic occurrence of the diseases (e.g. graphic Carinthia) distributed over the entire province despite the increase in contacts thanks to the high season in tourism. Thus, one must also reckon with infected and infectious persons who are asymptomatic and never show symptoms and those who are not recognized because their symptoms are atypical. Indisputably, this was already the case in March for a short period before the infected person shows the characteristic symptoms. However, there are now increasing findings that such transmissions cannot be ruled out in general. They give rise to fears of a viral dark net in which inconspicuous germ carriers infect other persons who themselves remain inconspicuous. This can be explained by the fact that the occurrence of classic symptoms not only presupposes that a pathogen is present, but also that the non-specific defense is weakened, at least for a short time. In this "window of weakness" during the incubation period - which may last a long time - a manifestation may occur, preceded by a high viral load in the nose, which is necessary for the infection of others.

Precautionary testing is of little help against this. Measures to inactivate the viruses before and during the incubation period would be necessary. Overall, it seems essential to plan for these three stages in all planning and to adjust measures as the epidemic progresses.

d. The result: two monocausal approaches

No matter how the deliberations have proceeded. The result is the same worldwide: people rely on one principle to tackle SARS-CoV-2: Interrupting transmission. A second is directed against COVID-19: Vaccination. These two approaches are being pursued "with all available means" and increasingly sophisticated techniques (e.g., the collection of infected but still asymptomatic individuals by antigen mass testing). The aim may well be to reach the last unteachable. At the same time, the danger of being able to recognize others without their own infectivity should be eliminated. With it ideal effect should be attainable nevertheless.

Of course, it is true in theory that the causal chain only has to be interrupted at one point. But is this mathematically logical conclusion also applicable to the real world. We do not live in an ideal world! We have to accept: No principle can be realized in an ideal way.

**6) The principles and their legal compatibility**

A scientist who is called as an expert to advise a decision-maker cannot be presumed to know about the particular legal situation in which he finds himself, since he is to make recommendations for action in a situation where there is "imminent danger." It is therefore assumed in the considerations below that the experts have had their particular situation and responsibilities unambiguously communicated to them by legal experts.

This includes making it clear that it is not the experts who decide what happens. Exclusively the responsible minister is authorized to decide. But if he relies on the unanimous vote of the government on a regulation, all members probably share that responsibility. After all, they would not have had to agree.

Neither the individual scientist nor the scientific community is responsible for ensuring that the scientific facts are available that are needed to safeguard health and prevent avoidable illness and death. The responsibility for this has been placed by the legislature on policy makers. Governments have met this responsibility in the context of vaccine development. Virtually in all other areas of Principles 1 -5, there is a need to catch up.

For the physician and all other health scientists, there is no difference in the value of protecting premature, inhumane, and forced death. Thus, for example, protection from an increase in the rate of child suicide as a result of the collapse of the health care system deserves the same value as protection from death from COVID-10 or other preventable death as a result of the collapse of intensive care.

Injury to the body by injection or ingestion of a drug by absorption is physiologically a fundamental difference from an action that is relevant to health or healing without penetration of the organism. Aids used in this process are

therefore not considered medicines but medical devices. This is also reflected in the legal system: medicines are more strictly regulated than medical devices. However, in epidemics, both can be made freely available via emergency ordinances even without the proof of these conditions required under normal circumstances. In this way, the government in Israel made an antiseptic nasal spray available even to children over 12 years of age in March 2021<sup>xliii</sup>.

Obviously, two standards were and are applied: For the proof of the justifiability of a drug, empirical evidence is required that the benefits clearly outweigh the possible health disadvantages to be concretely ascertained accordingly. Double-blind studies are required for this purpose.

This is quite different for measures that do not penetrate the organism. There are no double-blind studies to prove that lockdowns, closing schools, etc. have more health advantages than disadvantages. The considerations do not even seem to include what health disadvantages might occur in the first place. One is content with the logical proof that the measure is expected to lower the specific impact on COVID-19.

a. The obligation to make appropriate use of delegated authorizations

It also seems legally remarkable that the legislator has created the possibilities of being able to force the production and distribution of medicines and medical devices even by decree. Obviously, the legislator has provided for the possibility of being allowed to interfere with fundamental rights in this respect as well, if this seems unavoidable from a health perspective. The presumption is that all coercive measures are only proportionate if a comparable harm-preventing effect cannot be achieved or could not have been achieved by other, less burdensome measures if the possibilities had been exhausted that Parliament has delegated to the decision-maker during an epidemic. If this reasoning is correct, then the responsible minister would probably be obliged to make available by emergency regulations a substance for which there is scientific evidence that it is tolerable and antiviral, not absorbed into the body and not injected, even if there is no CE marking.

However, the task of the experts is only to point out that such substances exist. It should be known that in Israel, in March, an NO-based nasal spray was approved by the Minister of Health as an antiseptic by emergency order, even for children 12 years and older.

**C) Spotlight on currently applied strategies**

**1) Frameworks and experiences**

**a. Experiences from Europe including Austria**

However, almost all European countries have decided to follow the path described above in the fight against SARS-CoV-2 and COVID-19. Accordingly, those responsible still believe that they will ultimately be able to implement these principles in an ideal manner. This approach has one more advantage. It can be implemented by means of a decree: Its effect also appears to be mathematically detectable. If the calculated effect in the reduction of new infections does not occur, one seems to be justified in assuming that the measures were not implemented correctly. "Blame" is then placed on the citizens. Therefore, nothing helps but to tighten control and extend the duration of restrictions. This will be understood by all those who have complied with the measures: We must manage to bridge the time gap so that the specific vaccines can be developed and distributed to all. Again, it is assumed that after vaccination coverage all problems would be solved. Life would be the same as in 2019. Everyone knows such stories in different variations, which are repeated similarly even now. The only problem, he said, was finally implementing the restrictions that individuals were ordered to inhibit transmission.

Austria and many other European countries began an immediate lockdown in March 2020. They gradually weakened the restrictions thereafter, in line with expected declines in the rate of new cases. Their extent was based on the predictions of descriptive and experimental epidemiology. The measures were limited to reducing, in particular, contacts between healthy persons with infected persons or possible other carriers of SARS-CoV-2, so that the so-called R-value (reproductive number, i.e., the number of secondary infections caused by each ill person on average) should be below 1. This was realized over many weeks in May 2020, but COVID-19 did not disappear. On the contrary, after a phase in which the epidemic seemed to have ended in wide areas (see the curve in Carinthia), the second rise began with unexpected intensity, not only in Austria.

For Austria, a new start was then made in forecasting and implementing the measures. Suddenly, the need for a third "hard lockdown" with massive restrictions was appropriate. But as with the previous forecasts, the expected improvements did not materialize. The risk of a collapse of the critical care system remained. Such mispredictions do not only characterize the situation in Austria. Press and Levin therefore called for the introduction of additional U.S. federal authority to model pandemics "to be better prepared to save lives in the future." Kofler and Nagl supported this editorial by suggesting that the overall strategy for COVID should also be adjusted-beyond the need for better modeling in the future.<sup>xliv</sup> Kofler, Glazachev, Lysol, and Tellnes began the discussion, "Is the fight against COVID-19 enough?"<sup>xlv</sup>

## **b. What can be learned from others?**

The only global commonality seems to be that all countries have the same emphasis in the methods used: Contact restriction by all socially acceptable means, reliance on vaccination as a solution where financial strength permits. Nevertheless, successes vary.

i. "Nip it in the bud."

Some states have succeeded in becoming "SARS-CoV-2 free." What they have in common is that they have succeeded in keeping the carriers localized. The basis for this in all cases was that germ carriers were rigorously shielded and contacts were massively restricted. This was implemented particularly radically in WUHAN. The "Diary from a Blocked City" provides evidence of this from the point of view of one of those affected.<sup>xlvi</sup> By interrupting the chain of infection, it is possible to stop the epidemic and, at this stage, the spread of the germ outside the quarantined area. It does not change the susceptibility of the individuals. As long as immunization is not achieved, the sword of Damocles of a COVID-19 epidemic continues to loom as long as SARS-CoV-2 viruses are present somewhere on earth. Therefore, profound measures are permanently necessary. In China and other countries, it has been made compulsory to carry a cell phone at all times. With it the position of each citizen is centrally seized. Nevertheless, clusters occurred in China. These were controlled with rigorous and wide-ranging quarantine measures. Systematic controls continue to be carried out on who is allowed to enter the country, e.g. to South Korea. The goal here is also artificial herd immunity through vaccination. China is the only country whose economic output increased - albeit slightly - in 2020. The decline in economic output in South Korea is remarkably small.

Various island states (Australia, New Zealand, Iceland..) have also managed not to be included in the pandemic with a broad epidemic and without being able to permanently monitor the position of each citizen. They have been able to "nip the epidemic in the bud", also through consistent contact avoidance. The risk of introducing a new epidemic remains. To ensure that this does not occur, Australia and New Zealand have currently imposed massive travel restrictions. And anyone who enters the country nevertheless has to endure long and expensive quarantine stays in special hotels. Thus, travel to these countries will be prevented for foreigners for practically the entire year 2021. Again, hope lies in herd protection through population-wide vaccination. The two far-flung island states of New Zealand and Australia are among the countries with particularly high economic consequences. But this is likely to be primarily due to the global consequences of the temporary collapse of the transport system, and thus of supply chains, rather than to the cost of testing, large-scale construction of new infrastructure to combat the epidemic. Countries such as Australia and

New Zealand are therefore particularly affected by the global consequences of the pandemic in other countries. As a result, issues such as stockpiling, "basic self-sufficiency", etc. become important not only from the point of view of epidemic hygiene. Fundamental considerations will probably also be necessary in the context of "tourism", not only in Australia.

The global management of the pandemic in the low-income countries should therefore be an indispensable focus, at least in the medium-term strategy of combating the disease, if only out of self-interest.

It might also be of interest there to consider more complex preventive approaches in order to be prepared in one's own country if the protection provided by vaccination is not as far-reaching and lasting as hoped.

ii. "The thing got away from us".

Despite considerable efforts, the majority of countries did not succeed in using the initial phase of the epidemic to eradicate the viruses. It may be that this would have been possible in the initial phase of the epidemic, or would be possible in a new pandemic using more complex approaches. This is a question that should be addressed today as a precautionary measure. In principle, the same two monocausal approaches (contact interruption - vaccination) were used, but with less success. But currently the German Chancellor Merkel describes the situation correctly: "The thing has slipped away from us". Therefore, in countries where the local distribution of germ carriers can no longer be estimated, the question should be openly asked today whether this nevertheless very one-sided concept can still be promising under the now fundamentally changed epidemic hygiene conditions?

The framework conditions for the feasibility of measures, which are already given by cultural-historical differences between systems in China and Western Europe, indicate that increases in the intensity of measures that are basically oriented toward the same coping strategy will sooner or later reach their limits. Necessary adjustments and expansions of the range of measures can be implemented more easily if one is still allowed room for maneuver.

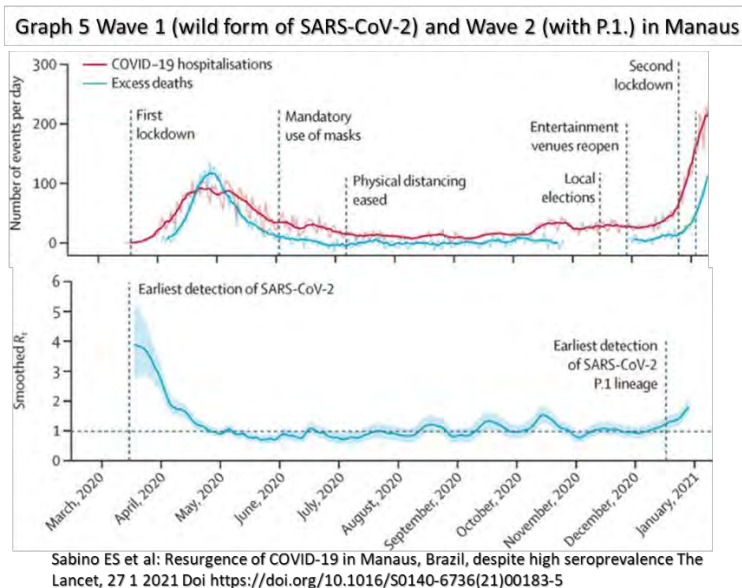
iii. The beacon from Manaus

The whole world looks with pity on Manaus with its more than 2 million inhabitants. Left alone by a presidential federal policy that officially denies COVID-19 and puts the brakes on state action against COVID-19, a health system that is in itself exemplary struggles with increasingly scarce resources against the increasingly unchecked course of an epidemic in a densely populated population. Nowhere was the incidence of disease and death as high as in Manaus even in the first wave. On the one hand, this led to excess mortality and, on the other, to an infestation in which herd immunity was to be expected. Nevertheless, the rate of new cases and deaths increased exponentially and again with COVID

19 in December, as if the first wave had not occurred. This was caused by mutant P 1.

Mutants are formed in the bodies of infected individuals, as explained above. These individuals can thus pass on mutants other than those with which they themselves were infected. They thus become the starting point of the next generation of an epidemic. Herd immunity to the wild form of SARS-CoV-2 has not protected people in Manaus. Vaccines can be adjusted to the specific structures of the mutant. This is now happening at an encouraging pace. Nevertheless, this requires time. Time is also needed for production, distribution and inoculation to the entire population, as well as another 3 weeks for vaccine protection to kick in. That's several months, requiring appropriate measures (lockdowns, school closures...?). Then the danger of serious diseases and deaths is largely averted, although no vaccination is 100% effective. The question of the potential importance of vaccinated people as carriers of the germs that give rise to the prevention of the disease remains open.

The situation in Manaus only makes clear what is to be expected in principle: that infected persons can become the starting point of mutants. This applies irrespective of whether they are ill with classical or atypical symptoms. And even more so for asymptomatic diseases. Persons with latent viral load would be particularly critical: viruses then have a long time to develop increased plasticity.



The 2nd generation of the epidemic with P 1 will probably not be the last. One must be aware of the danger of an arbitrarily long succession of generations

of epidemics with mutants of SARS-CoV-2. This requires further preventive measures. It is not enough to prevent the transmission of the virus. Efforts must be made to destroy the virus before it reaches humans and, in particular, the indoor respiratory tract. Thus, for example, the air in schools, ships, department stores, hotels must not only be exchanged, but filtered or inactivated with UV, ozone, etc.. But especially to prevent contamination or infection by antiseptic measures preventively during an epidemic or cluster: Without wild form in the host cells, no mutant that can be spread by the host cell.

**c. Inferences: (at least) three stages of epidemics.**

In any case, global experience to date suggests that different stages have occurred in the course of pandemics in different countries. This makes it necessary to adjust the strategy. But these adjustments have not been made.

a. The initial stage is characterized by the fact that the germ carriers can be confined spatially with sufficient precision to as small an area as possible. These are the cases described, for example, by Cori et. al. The processes can be focused in the short term on the control of one pathogen, i.e., SARS-CoV-2. The goal is to prevent spread, but also to prevent mutants from forming. As long as the virus is not under control worldwide, permanent precautionary measures must be taken.

b. If the spread of the virus could not be contained locally, the strategy should be fundamentally reconsidered and metrics sought that are meaningful for the new situation. The conventional calculation methods will be used for the possible and expected clusters. Their application to second-stage epidemics suggests misalignment. After all, they do not allow the assessment of all the reasons that may have prompted the transition from stage 1 to stage 2.

c. The less it has been possible to prevent persons - even if only temporarily - from becoming carriers of wild forms or already existing mutants, the greater the risk that they will become the cause for the spread of new mutants. In principle, it must be expected that the plasticity of SARS-CoV-2 can lead to mutants that are much more pathogenic and virulent, but also more successful against the use of vaccines. Therefore, it is not enough to prevent contact with the viruses, as essential as these techniques are. The viruses must be inactivated as far as possible in the immediate vicinity of everyday life (school, shopping, ...). Techniques are already available for this purpose. They can be used at short notice, e.g., in large-scale test series, not only to detect germ carriers at an early stage, but also to reduce their viruses preventively. The expansion of the range of



possibilities justifies international cooperation comparable to that achieved in the development of vaccines.

d. The history of mankind shows that the possibilities were used to obtain own advantages, even if others were harmed against better knowledge ("Semmelweis effect"). Even more frightening is the experience that existing possibilities are used for criminal purposes and to harm the "enemies". Therefore, it should be expected that a new global threat may emerge because knowledge is now widespread on how to create pathogenic and virulent mutants

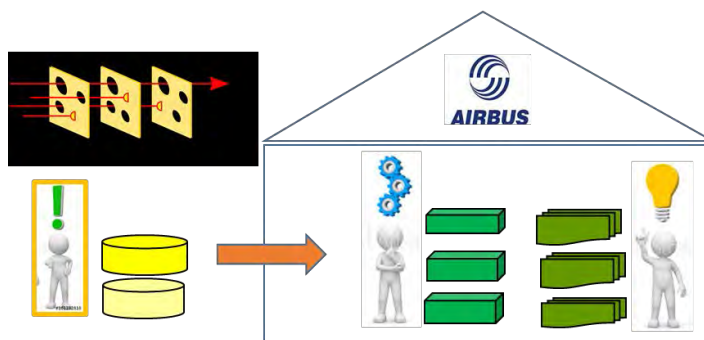
## **2) Reason's Swizz Cheese Model and Pareto's 80: 20 Rule**

Every strategy needs not only a clear goal but also clarity about the available resources and any systemic consequences associated with their use. Both have to be considered strategically. In this context, experience with risk management can be helpful. Reason has made valuable contributions to the health care sector<sup>xlvii</sup>.

### **a) Reason's approach**

A discussion of risk and risk management should start from the realization: It is impossible to eliminate risk. "Life is always life-threatening" (E. Kästner). Risk management, therefore, means weighing different risks or undesirable aspects and allocating available resources accordingly. Reason analyzed man-made disasters (e.g., Chernobyl, Seveso). He came to the conclusion: the best trained and organized personnel and the use of sophisticated machines are not enough to reduce accidents as effectively as one could. The starting point of his considerations was the recognition of the fact that people are not ideal. They make mistakes. Moreover, no one can predict exactly when and under what conditions mistakes will occur. Therefore, he suggested that organizations that use sophisticated technical methods (e.g., hospitals, aircraft manufacturing, etc.) should integrate their own structures that develop and implement methods to manage the risk for as yet unknown combinations of errors.<sup>xlviii</sup> In doing so, he said, one should not so much look for the culprits of errors, but rather assume that people make mistakes all the time. Therefore, he said, there needs to be an appropriate system with a culture of error in which there can be open, free discussion: What has been overlooked? What could still lead to mistakes, etc.? Outstanding people and key employees in particular make mistakes, which are then often particularly serious. In addition, mistakes that people make due to inattention, fatigue, etc. are often ultimately mistakes in the system: lack of qualified personnel, overload, poor planning, lack of technically possible safety precautions, etc. Of course, what is needed first and foremost is first-class technical, logistical and personnel equipment. But even this is only ideal in theory. People make mistakes.<sup>xlix</sup> But the cleverly structured system is built so

that the types of errors of one kind are intercepted by the protections of another kind. Reason's focus, therefore, is not oriented toward combating human inadequacy, but toward building systems in such a way that several different goals, or approaches, are used so that they collectively reduce the risk of momentous errors. The diversity of different principles gives hope that an error not inhibited by principle A will be captured thanks to principle B. And if an error cannot be detected and offset by, for example, management principle A or the technical precaution of B, its effects could be detected and neutralized by a third safeguard that does not rely on the approaches of A and B. This strategic approach can be extended by many additional risk management methods. This approach would also have the advantage of capturing very different types of failures with this system. The major man-made disasters, such as Chernobyl, were characterized by the simultaneous occurrence of different types of errors. For this reason alone, different approaches are needed for management. One can compare these errors with holes that people drill into the various only theoretically dense protective walls of the system. Therefore, they appear perforated like a Swiss cheese. The catastrophe occurs because the last layer could not prevent the additionally caused error. After all, the catastrophe is only avoided if there are enough slices that defacto act like hard cheese due to their differently positioned weak points: Nothing goes through any more, although no measure could be ideally implemented. The well-known graphic (in graphic 3, top left) therefore describes the occurrence of the catastrophe - although the yellow structures (symbolizing the risk management) have been built into the structure of the aircraft production according to Reason's recommendation.

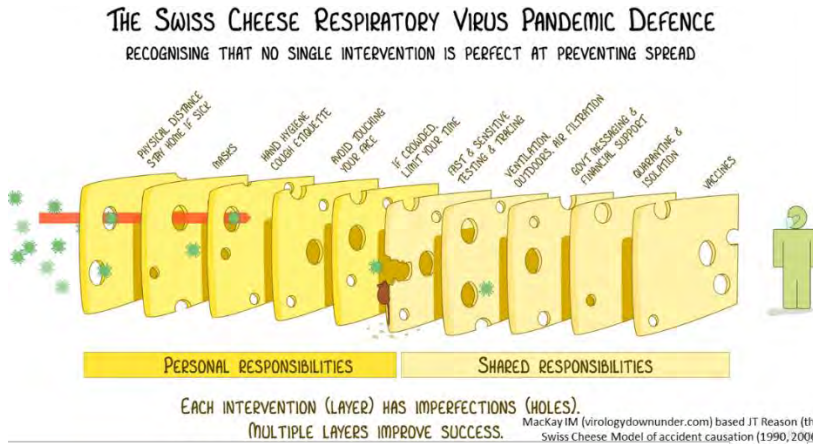


Graph 6: The integration of a risk management unit into a well-organized enterprise.

**b. Mackay's interpretation**

Follow-up of cheese slices with holes has recently been used to address the need for tools to combat COVID-19 in a comprehensive manner. J. M. Mackay,

an Australian virologist, developed the "Swizz Cheese Respiratory Pandemic Defense Model" based on JT Reason<sup>1</sup>. It has since been modified and translated into many languages. It serves as a demonstration of the steps necessary to adequately fight the COVID-19 pandemic. The wide acceptance of this clever graphic is reflected in the high number of translations (more than 20) and the discussions in blocks of famous newspapers, e.g., the Wall Street Journal or the New York Times. Even leading scientific journals refer to the presentation, e.g. in the BBC <sup>li</sup>: no word goes in the direction that this model would not be sufficient.



Graph 7: The version of MacKay of a Swiss Cheese Model according to J.T. Reason for a comprehensive fight against COVID 19 (MacKay IM (virologydownunder.com))

This model is later used to characterize the current situation in many countries (e.g., Austria) at the end of 2020. However, Mackay's concept already differs significantly from Reason's concept: Now it is not used preventively, but as a guideline for concrete action, and this without taking up Reason's recommendations for the additional services needed to make Reason's special approach to risk management about the benefits of error culture effective. In addition, no one is asking: are the "traditional" resources, sufficient staff, etc., available for the challenges currently being encountered?

Other deviations from the concept:

- a) Reason proposes his own approach to managing the risk of highly complex machines and techniques that can be inadequately managed by individuals within a complex organizational system. In doing so, he assumes that people make mistakes all the time. We must learn to live with the errors and develop appropriate systems so that the errors are reduced rather than compounded. In his examples, Reason assumes that systems are necessary and that they are constantly improved as a precaution through an appropriate error culture. The problem of errors

thus concerns processes of quasi-ideal man-made techniques and organizational structures. However, an infection is not a technical process, but a natural biological process. It runs without machines, supervising persons or complex organizational structures. The natural processes involved are therefore not planned on a drawing board. Much of it is not yet known to us. But we intervene in these processes in many ways, consciously or unconsciously. Our systems must therefore be much more flexible. Error culture is already essential in the "standard case". Here it becomes indispensable. However, the approach does not address this.

b) The reasons why people are responsible for errors when operating machines can also have many causes: They range from distraction, drunkenness, forgetfulness, fatigue, lack of practice in dealing with new situations, to sabotage. This can be counteracted in a targeted manner. But often personal errors are also consequences of system errors. This alone shows that a mix of methods is indispensable. Risk management basically needs different approaches for this, not only different methods, in order to reduce the SAME principle - in the chosen approach, the avoidance of contact with infectious agents. But this is not what the modified model provides.

c) The holes in Mackay's diagram exist regardless of what the acting persons do. This means that the individual techniques, systems, etc. are inherently assumed to have severe deficiencies in prevention. But that is not what Reason was implying at all! Theoretically the procedures etc. would be quasi ideal. But the persons make the mistakes! Moreover, Mackay arranges the cheese slices one after the other. This is supposed to give the impression that the third slice normally compensates for the error of the second slice. But this is not the case in Mackay's approach against the spread of the pandemic: If viruses get through any Emmentaler slice, infection can occur. Then it doesn't help if so many more holey slices are supposed to protect you. Once you have been infected, e.g. as a result of "maskless" contact, the strict controls at the airport no longer help.

d) Mackay's graphic contains two creatures, a mouse enlarging an existing hole and the threatened person. The mouse can stand for "corona deniers." These undermine so-and-so's already holey effectiveness. Just as well, this mouse could stand for those who deny the biological nature of the infectious process, or even those who purposefully prevent the options provided by it from being considered ("antiseptic deniers," etc.). But this kind of presentation underlines the systematic weakness: The holes in the cheese just belong to an Emmentaler - even without human intervention. Humans can still

increase the risk out of malice. But this idea does not correspond to Reason's position. The system of cheese slices would be tight if it were implemented ideally thanks to the dynamics between the individual system approaches. People are flawed - even without bad intentions. Therefore, only one symbol for people should be used.

e) The core problem, however, lies in the fact that - with one exception - all the measures listed are only modifications of a single principle to achieve the same goal: To prevent contact of the infectious with the infectious. That this is a principle to prevent the cascade of steps from the appearance of pathogenic agents to death from infectious disease is indisputable. (See Principle 2) But one should not expect to be able to implement a concept ideally in a non-ideal world with non-ideal people. The contact of the infectee with the germ carrier is - like the presence of SARS-CoV-2 - a necessary but not a sufficient explanation: neither for a person to become infected with SARS-CoV-2, nor for the infected person to also manifest COVID-19.

f) There is, however, one exception to the set of listed measures: The Emmental disc for vaccination. It belongs to the principle No. 5 listed under B. It is good that this slice is also shown with holes from the beginning.

The graphic of Mackay is therefore very helpful to show the different tools of the same "principle". A variety of tools for a principle is also consistent with the principles of risk management: there are usually several ways to increase the efficiency of a given principle. These must be skillfully integrated, not only for the goal of reducing risk from contact with vectors. Therefore, this type of graphic will be used later to illustrate the different tools of the different principles.

### **c. Pareto's 80:20 rule**

However. A hospital or a company that manufactures airplanes must also use the money available for risk management. When allocating resources, one can rely on the Pareto principle: One can achieve 80% of the achievable effectiveness by using 20% of the resources. For the remaining 20%, one would have to use 80% to achieve the total possible 100%. This is another reason why it makes sense to combine tools: This applies equally to the different tools used according to the same principle and to the allocation of resources to different principles. Thus, using 100% resources for risk management could theoretically achieve 400% if resources were allocated according to 5 different equally effortful and effective principles to achieve the same end goal.

**d. The "post-hoc" application.**

Mackay does not use Reason's proposal to be prepared for a risk that is to be expected. He applies it as a guide to action for a disaster that has already occurred. The first question, therefore, is: Are the conditions for a successful fight in place? If not - then make sure that all the necessary equipment, qualified personnel, premises, etc. and a clear strategy are available! If the available means have been deployed, but the expected success has not occurred, there needs to be an appropriate open fault analysis - preferably without attributing blame. Is it the people? Is it the system?

1. Then there are two conclusions: then expand or adjust the range of services through an additional precautionary principle in the hope of thereby being able to lower the threat to an acceptable risk, at least in the future.

2. change the emphasis in the access, arrange the distribution of the resources including the manpower in such a clever way that the given problem can be treated appropriately! Personnel, etc., must therefore be shifted from their traditional activities to fighting the disaster, perhaps in terms of the 80: 20 rule. Otherwise, an unjustifiable lack of otherwise necessary efficiency must be expected, e.g., if all police officers have to do is to check the correct application of the quarantine and removal rules, or if hospital beds are not allowed to be occupied according to need in order to keep them free for COVID-19 patients.

**D) The changes in the situation within 2020.**

**1) Initial situation - integrated into the "Swizz Cheese Model".**

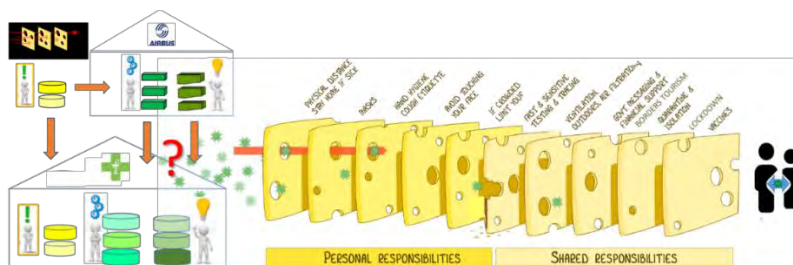
Mackay's graphic contains the planned elements of the strategy used in the West, but leaves out the question of resource availability. However, it was precisely their lack that determined the initial situation in many Western states: Pradetto's analysis showed the differences worldwide<sup>lii</sup>. He points to a multiple failure of WHO, the EU and Germany in the Corona crisis by June 2020, a situation without collapse and with low incidence and mortality rates. He pointed out the shortcomings in the availability of adequate technical resources, logistical structures, national and international communication systems, a lack of well-trained personnel, sufficient space, etc. Various countries in Asia and on islands were much more successful: these had drawn the consequences from MERS and SARS.

So far, these deficiencies have been remedied only partially and at extreme financial cost. The consequences can also be seen in the large differences in the declines in, for example, gross national product in different states.

This situation forces the relevance of a comprehensive medium- and long-term strategy. Training well-qualified staff, e.g. for the intensive care unit, takes

years. Is there a need for health-oriented land use and urban planning due to the negative consequences of the proximity of infection departments in the center of hospitals? There are experiences that the fear of being infected in the hospital was a reason not to go to the hospital. How do you solve the education problem if epidemics are expected to continue in the future? How do you integrate the currently deferred but overall determining restructuring (climate change, energy demand...) into the overall concept, etc.?

Therefore, Mackay's graphic had to be modified to fit the initial situation: It needs infrastructure, not "mice." It needs the basic structures of the system for the people involved and cared for according to Reason's considerations.



Graph 8: For "MacKay's Swiss cheese model", the application-oriented framework conditions must first be created so that they correspond to the starting point of Reason's well-equipped ventures: There was/is a need for infrastructure expansion in virtually all areas to address the ongoing epidemic.

## 2) The current situation at the turn of the year 2020/2021.

Contrary to forecasts, the pandemic could not be controlled in many states. This was not achieved despite several lockdowns, which have now lasted for months, and only more or less significant facilitations of everyday life. Currently, the fight against the imminent collapse of the health care system determines the measures. We have thus reached stage 2 of the epidemic and no longer stage 1! In addition, new mutants determine more and more the events. They force the reorientation e.g. of the adjustment of the vaccines and limit again the possibilities to turn with indirect health consequences and the lining up general structure problems. There are therefore good reasons to assume that we are in the transition to stage 3.

The strategy adopted in spring 2020 has not been fundamentally scrutinized. The range of measures has also not been changed significantly to date. What has increased is the duration and consistency in prosecuting those who do not comply with the measures to avoid contact with those who may be infected.

Therefore, the Mackay's Swizz Cheese model is well suited to represent the current situation along with the measures taken so far, if some measures are added: These are border control, lockdowns, and the CORONA APP. But the

thrust of these measures is the same: to detect (potentially) infectious persons early, to keep away from infectious persons also thanks to simple hygiene principles, to successfully trace back the contact chains.

However, the situation is determined by the inevitable, unintended effects as a result of the fight against the collapse of the health care system. Currently, in many countries, the danger of having to allocate beds in intensive care units according to the patient's chance of survival seems to have been averted. But this is not the case everywhere. The stresses of the restrictions on freedom of movement that have now lasted for so many months, the compulsion to home schooling and the consequent increasing threat of loss of irrecoverable influences on personal development and teaching units (Lost COVID generation?), home office, the increasing tensions in families, the economic consequences, being locked away without culture or sport, etc. are probably having long-lasting effects. On various occasions, there have already been public violent confrontations. Is it really only a matter of time before civil war-like conditions arise? Unemployment has reached levels not seen since the end of World War II. And this despite the fact that short-time work is an irreplaceable means of preventing the collapse of the economy. The confidence of many in those responsible, but also in each other and in their own ability to shape the future for themselves and their own, is dwindling more and more. Worries about basic rights are depressing many. The willingness to show solidarity within one's own sphere of life, but also globally, is being put to the test. Important indicators of stability in communities are deteriorating, such as the Gini index. This indicates how wealth is distributed in society.

Many people probably find it particularly depressing that not even the next few weeks can be planned in advance. Everyone is given the hope that at the latest when enough people - supposedly about 60% or even 80% or more - would be vaccinated, everyday life would return, without masks and restrictions in leisure time, travel, school attendance, etc. However, more and more reports, e.g. of mutants, which may currently be difficult to address by vaccination, make it clear that this "light at the end of the tunnel" could once again be just a mirage. The number of scientific papers showing that COVID-19 cannot be defeated by vaccination alone is increasing almost daily<sup>liii</sup>. This is also the view of key figures in the day-to-day fight, such as the president of the Red Cross<sup>liv</sup>. But this has hardly been communicated to the general public. The shift of societal activities from the focus on "stabilizing intensive care" to other even indirect health challenges could therefore take even longer than hoped.

It is now far from any scientific conclusion to assume that the health consequences of unemployment, for example, can only be attributed to the lack of money. The cause of much of this damage touches on the essence of the processes that make Homo sapiens Liné a psycho-socio-cultural person: The

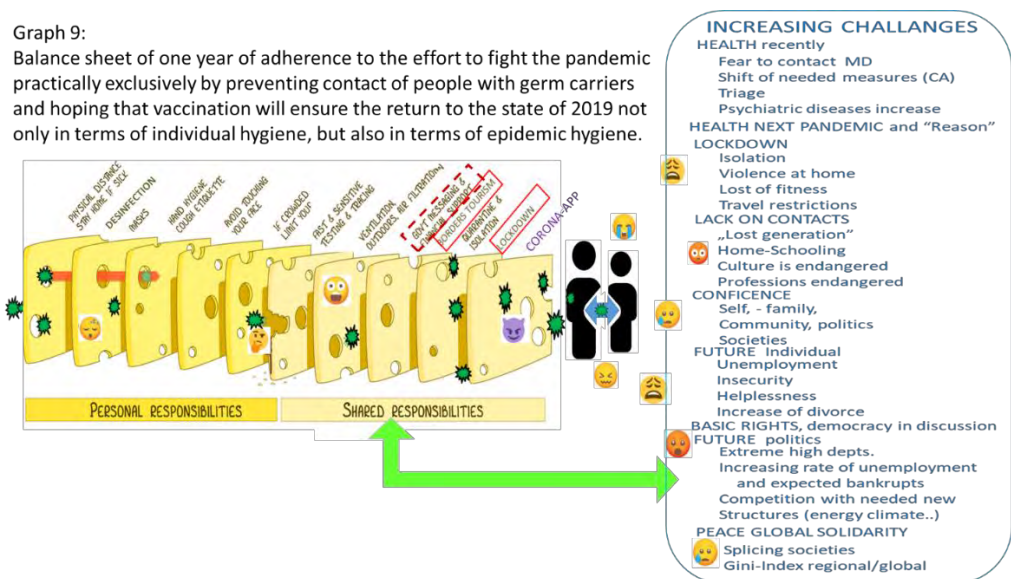


way situations are individually evaluated and how these intellectual, cognitive or emotional classifications lead to a holistic response. This also relates to the modification of biological processes. Part 2 will discuss this in more detail. In part 1 these connections were briefly pointed out : There also the profound effects on the concentration of immunoglobulin A in the saliva are presented, which the change of the meaning to the identical and harmless substance in the air had, if it was classified once as more, the other time as less toxic. <sup>lv</sup>

The graph 9 illustrates that all these processes and the related evaluation processes and other consequential effects also have influences on the susceptibility of individuals to SARS-CoV-2. However, this cannot be detected by the prediction models, which are only designed to detect the sufficient or insufficient interruption of contacts.

Graph 9:

Balance sheet of one year of adherence to the effort to fight the pandemic practically exclusively by preventing contact of people with germ carriers and hoping that vaccination will ensure the return to the state of 2019 not only in terms of individual hygiene, but also in terms of epidemic hygiene.



### 3) Analysis of the strategy used

We have distinguished above five different principles on how to theoretically make SARS-CoV-2 or COVID-19 disappear. Current policies in EU countries and many other countries are based only on the following two principles:

**a. Principle Nr 2: Without transmission, no contact with germ carriers of SARS-CoV 2 -.**

To this end, policy makers have implemented the methods described in the graphic above. If these measures could be implemented ideally, all secondary infections would indeed be prevented. The person who brought the virus into the

country would be isolated, could be cured and therefore released immune. Or he would die. SARS-CoV-2 would be destroyed. COVID-19 could not reoccur unless a germ carrier brought SARS-CoV-2 in again from the outside.

This is obviously pure theory. In the meantime, SARS-CoV-2 has spread worldwide. Everywhere there are infected persons with and without symptoms. Island states do prove that it is possible to be SARS-CoV-2-free if they succeed in preventing the spread and subsequently implement extremely strict controls against the introduction. But this is also fraught with consequences: in Australia and New Zealand, the borders are virtually closed to entrants for the entire year 2021. Therefore, even this path does not lead to a "normal state" as it has been in 2019. After all, it must always be expected that an epidemic can occur as soon as even one infected person enters the country: after all, no one is immune as long as vaccinations are not carried out.

Normality has also been achieved in China, but a different one than in 2019. The epidemic was achieved through extremely consistent contact prevention and tracking measures. The lockdown in Wuhan lasted 60 days, much longer than would have been necessary according to model calculations. The segregation measures, even of suspects, were extremely restrictive. Since then, everyone has had to carry a cell phone so that every step can be centrally monitored. Nevertheless, there were sporadic occurrences of SARS-CoV-2 cases. They were again met with extreme restrictions. However, China is probably the only country that had economic growth in 2020.

Basically, successfully stopping contact with infectious individuals will not change the proportion of infectious BARES in the short term or permanently. Therefore, the risk of being infected with SARS-CoV-2 is only postponed. Therefore, the risk remains unchanged that one can also become manifestly ill and at best die from or with COVID.

The risk of a severe disease or of dying from COVID can so far only be decisively reduced by vaccination. The chance of being cured despite severe disease will also be increased by the currently so hopeful developments of specific drugs. However, their widespread use is still a long way off.

**b. .Principle 5a: Full protection through artificial herd immunity**

If all persons were permanently immunized, e.g. thanks to a vaccine, so that no one could infect a third person and not fall ill again, no one could fall ill with COVID-19 and therefore no one could die of or with COVID. This also seems logically compelling and is also communicated worldwide in this or a similar way.

Not only that the vaccination alone would theoretically still take many months, it is obvious that these assumptions are also only pure theory: There is no vaccination that is 100% effective. There are large groups of people who should not be vaccinated (e.g. pregnant women) or are not allowed to be vaccinated (currently no vaccine for children). In addition, there are those who refuse to be vaccinated. And how often must vaccinations be given? The question is still open, to what extent the vaccination leads to the fact that the vaccinated person is eliminated as a potential carrier in principle - and therefore also permanently. The question here is whether the vaccinated person not only does not become ill himself in the event of subsequent contact with an infected person thanks to the existing or newly formed antibodies, but is not able to pass on viruses in any phase (including the phase until the pathogen enters the body and triggers the booster effect there for his own protection). The question of vaccine protection against mutants is also open. Good: Today, vaccines can be adjusted relatively quickly. But what if a fundamental change occurs tomorrow, the day after tomorrow or in three years' time and again completely unpredictably? Then not only will the vaccine need to be modified, but it will also have to be distributed worldwide? And what about in this phase in between? The next "post-war analog" collapse?

What is indisputable is that vaccination coverage is a crucial step in enabling the transition from an epidemic to an endemic course associated with low numbers of cases, with sporadic clusters at best. The risk of recurrence of epidemics with new mutants remains. The emergence of the current determinant mutants (from Brazil, England, India) shows: SARS-CoV-2 is only under control when the pathogen with all its mutants is under control worldwide. In addition, SARS-CoV-2 is only the current pathogen from the countless possibilities of the emergence of human pathogenic viruses. Therefore, it could be crucial to reduce the conditions for new emergence of pathogenic viruses (e.g., concept of IPBES).

Therefore, a new epidemic must be expected at any time, even with full vaccination coverage. The pharmaceutical industry has made encouraging progress, so that adjusted specific vaccines can be expected relatively quickly. However, during the phase leading up to their use, non-specific tools are needed to temporarily reduce susceptibility to pathogens that are not yet known. In principle, this can be achieved by methods that target the non-specific defense system. So far, these possibilities have been dispensed with.

### **E) Expanded possibilities thanks to all sub-steps of the causal chain**

No one will deny that interrupting contact between germ carriers and infectious persons can effectively intervene in an epidemic. But why not use all

the other possibilities that are available? This question should be at the top of the list when one sees that the measures taken so far have not brought the desired success. And this despite the fact that efforts are being made "with all available means" - i.e., using 100% of the available resources - to implement a single principle against the spread of SARS-CoV-2 and a single one against COVID-19, without achieving any lasting success. Here, borrowings from Reason and Pareto might be helpful.

The point, then, is not to abandon contact interruption options. It is about using available resources in a way that balances all available opportunities. If Reason and Pareto are right, this should lead to an improvement in the situation.

Strictly speaking, the dangerous thing is not the contact between people. It is the fact that a person carries the pathogen with him and therefore the germ can be transmitted from him to others. So if this carrier had not been exposed to the virus himself, because the pathogen no longer existed or was not currently present, he would not have been in danger of infection. Then his contact with others would be insignificant. But this is not the beginning of the causal chain that can ultimately lead to death from COVID-19: It all starts with the appearance of the new pathogenic mutant from the large variety of CORONA viruses.

But SARS-CoV-2 is now airborne because infected and sick people exhale the viruses. Why should there not be environmental factors, for example, that influence whether SARS-CoV-2 can reach another person at all. Can these also be used purposefully? Is there more than airing and hand disinfection? With these measures one is already at the transition from principle 1 (without SARS-CoV-2 no transmission) to principle 2 (without transmission no contact with an infected person) and thus to the methods, which determine at present the fight against SARS-CoV-2. After all, everyone knows from their own experience that you don't have to get sick right away if you are infected. This is true for a minor abrasion, which can heal without problems but can also become festering, just as it is for respiratory infections.

**a. Every mother knows when the sweater protects the child from the respiratory infection**

And every athlete knows that it is easy to catch a cold when standing exhausted and sweaty in the draft. And even more so, mothers know this: as the saying goes, "*A sweater is a garment that the child must put on when the mother is too cold.*" The germ density does not become smaller, because one puts the anorak, the sweater or the rain cape over it. Shouldn't all this also apply to SARS-CoV-2? This concerns the principles No. 2 and No. 3: Without contact no infection as well as without infection no manifest illness. Possibly not every

schoolboy knows this (as Gregory Batson underpins the validity of his core statements). But every medical student had to know this at least during the examinations from hygiene, social medicine and probably also physiology. Nevertheless, so far the possibilities offered here remain unused by the political decision makers, although one can influence the unspecific defense with it. Remarkably, there is no reference to these possibilities in the resolutions of the National Academies of Sciences of the 20 CIS countries, although the various networks are discussed in detail there. With their help, it is possible to achieve non-specific immunity for a limited period of time and to reduce the risk of spreading germs. This is exactly what is urgently needed to bridge the period with a lower risk of disease until the vaccination date is finally reached or until the adjustment of the vaccines to new mutants is completed and the vaccines are distributed.

One can put it even more clearly: without non-specific defenses, humans would probably already be extinct. Since we are so often exposed to infections and the specific defense only sets in with a time lag, without the non-specific defense we would be at the mercy of the pathogens without protection in this phase.

Of course, the specific defense is often ultimately decisive for one's own fate, since the nonspecific defense is not ideally effective. But are there not other possibilities to use it specifically than vaccinations applied with injections? For example, the use of artificially produced antibodies against SARS-CoV-2, which are used as a nasal spray, is also being tested today. Thus, Principle 5 may also offer further untapped options.

However, it is crucial to refrain from believing that one single principle can solve the current situation. Therefore, it is important to integrate the available options into an overall approach. These partial steps will now be dealt with.

## **1. Principle No. 1: No SARS-CoV-2 - No Transmission of SARS-CoV-2**

### **a. Viruses and virions**

This is probably where some clarification is needed: when one speaks of the SARS-CoV-2 virus, one imagines a spherical something with a rounded crown that is the carrier of the specific docking sites for the antibodies. But, strictly speaking, this is the virion. The "actual" virus, which imposes its own reproduction including all the specific and non-specific protein structures on the host cell, is only the associated RNA. This RNA is considered to be capable of stimulating the host cell to produce the viral RNA and the effects determined by it, e.g. the formation of the structures of the virion of SARS-CoV-2 (in particular

four different protein structures as well as a lipid double structure). In this way the virus creates a protection against chemical-physical influences and at the same time the conditions for it to penetrate into the organism. In addition, the virus is granted plasticity. This means that it is capable of modifying and thus improving its own effectiveness against the host structures. This leads to the formation of mutants.

Mutants pose a particular challenge to strategies for managing the COVID-19 pandemic. Mutants can be more infectious than the wild form, lead to more severe courses, and cause the protection of immunity once acquired to be weakened or completely ineffective. This is illustrated by the course of the epidemic in Manaus in 2020: after the first wave, population infestation was reported to be about 70%<sup>lvi</sup>. This corresponds to the extent assumed at the time for effective herd immunity. Nevertheless, the second wave occurred with mutant P 1. It claimed even more victims than the first wave.

The nature of the processes leading to plasticity has not been adequately elucidated. However, only processes within the infected host cell can be practically relevant for the emergence of new mutants: If there were mutations in the virion, e.g. in the air, this would only affect individual viruses. These would probably have no relevant chance to give rise to their multiplication. For this, the virion must enter the host cell. However, it obviously needs considerable loads of viruses to achieve the necessary penetration. So why should just the single mutated one be among them? Penetration is usually achieved only after several days of effective contact of the virion with the cells of the outer boundary of the organism (e.g. the nasal mucosa). Therefore, mutant formation can occur practically only in the host cell. Current studies show that mostly 1 or 2 mutants can be detected in diseased individuals.<sup>lvii</sup> However, the authors point out the importance of individuals in whom a large number of mutants have been detected. They see in the dynamics given thereby a reason for the formation and spread of new mutants. Be that as it may, if one wants to prevent the appearance and spread of new mutants, one must prevent their formation from becoming possible in the host cell. This is most efficiently achieved by inactivating the wild-type mutants before they can become the starting point of plasticity modifications. This can be achieved by inactivating the virion before penetration. There are possibilities for this during their stay in the outside environment, e.g. by special filtration, UV or ozone application in climatic plants. Or in the nose or throat area as well as in the lungs by natural or artificially applied antiseptic effects (sprays, inhalation). This will be discussed in more detail in Principle 3.

The chemical nature of the virion provides conditions for this, e.g. in the nose as the "anteroom" of the organism, which could no longer be so easily ensured in the areas affected by the blood in the organism. Thus, chemical processes can be used in the nose under sufficiently controllable conditions,

which lead to denaturation of chemical compounds of the virion. This involves the decomposition of chemical compounds by oxidative processes. Oak logs burn just as well as a gothic statue made of oak wood! Therefore, the efficacy of an antiseptic is independent of whether the chemical compound also has specific structures that are relevant for specific interactions, for example, when penetrating the cellular protective barrier or as a contact site for antibodies. The control of these processes in the nose is possible because the general conditions are locally largely constant. The physiologically active substances in this process could and had to prove themselves in the evolutionary process insofar as they had to be effective against the pathogens on the one hand and tolerable for their own cell structures on the other. Only mild and specially structured antiseptics are compatible with the cells' own structures of the "outer boundary", but cannot themselves overcome this boundary. For example, N-chlorotaurine does not enter the body. Antiviral disinfectants are also effective against viruses, but would attack the cells. Therefore, they can only be used on dead material. They are incompatible for use on respiratory interfaces. Neither antiseptics nor disinfectants may be injected into the body.

If the virion has succeeded in overcoming the external barrier, it can reach a wide variety of areas with the bloodstream. Therefore, it cannot be assumed that the general conditions will remain the same. Also, how should a mild antiseptic be developed that is compatible with all these systems but can inactivate viruses. How should it be possible to apply such a substance only to the "right" place, moreover in an appropriate concentration and long enough? Once the virions have overcome the cell barrier, another defense principle is obviously required. And this has gradually developed in the evolutionary process up to the vertebrates. In them, antigen-antibody reactions appear for the first time. These are not based on the "aggressive" decomposition of chemical compounds of the virion, as is the case with denaturation, for example, thanks to NCT. On the contrary. It comes to the "harmless" formation of larger structures by coupling in each case specific structures of selected proteins of the virion (epitope) with equivalents with the antibody (paratope) to an AG-AK complex together with virion. Under physiological conditions, this effect can only occur if the specific structures fit together, wherever the AKs go. The AG-AK structures can then be recognized as such by specialists, taken up into the phagocytes, and there - again under locally defined conditions - be fed to denaturation, e.g. by NO.

It is understandable that the modification of the protein structures has an influence on the antibodies required, but not on the efficacy of the antiseptics. To remain with the comparison with the log and the wooden statue: Whether it is a Gothic Madonna or a carnival larva makes no difference to the combustion process, but it does to the circle of interested parties.

**b. Pathogenic viruses arise by mutation**

The majority of scientists currently believe that SARS-CoV-2 naturally modified in an animal infected with a corona virus precursor from that precursor and was able to cause host cells to reproduce. This mutant was able to jump to humans because of their proximity to the host. Comparable things can happen again and again as long as, for example, humans live so closely with domestic and wild animals. If one wants to tackle the problem at its root, one must minimize this risk. IPBES has made proposals to do just that. IPBES (Intergovernmental science-policy Platform on Biodiversity and Ecosystem Services) is an international advisory body affiliated with the UN that currently includes over 130 countries. Its blueprint for ending the era of pandemics is available digitally in English, Spanish and French<sup>lviii</sup>. The link between health and sustainable, including sociocultural, management of the environment is addressed in H.

However, the discussion on the emergence of SARS CoV-2 exposed to everyone that it is possible to artificially modify such mutants and also viruses of other species to become human pathogenic. Recently, it has been published where SARS CoV-2 would have to be altered so that conventional vaccines would be ineffective.<sup>lix</sup> Arguably, all institutions that can design appropriate vaccines would also need to be able to construct new mutants and new pathogenic viruses. This leads to an unprecedented threat potential. Against this threatening era of pandemics, only non-specific instruments of a "biological" but also legal nature are likely to help. The current concepts against SARS-CoV-2 do not take this into account. This shows that it is not enough to provide measures that address the current situation. There is also a need for medium- and long-term strategies and their implementation.

Of practical significance is the possibility of making artificial changes to a virus to reduce its virulence. This is a classical way to produce live vaccines.

**c) Two key questions: Why do pathogenic viruses disappear and why don't they?**

SARS-CoV-2 has suddenly appeared by mutation of apathogenic forms. Why should it not disappear exactly quickly? What are the theoretical possibilities that SARS-CoV-2 could disappear again? How is it that SARS-CoV-2 becomes inactivated in the first place. Surely it needs a host to replicate this virus? And how relevant are the processes involved in this process for the persistence of SARS-CoV-2 according to previous experience?

Why do pathogenic viruses disappear?



- The pathogenic form can change into an apathogenic form by mutation: We have no control over this. However, mutations have occurred so far that are more pathogenic and virulent than the initial form.
- They lead to the death of the host/all hosts and are therefore no longer reproduced and are buried or incinerated with it. This is taken into account by the models of Kermack & McKendrick and the SEIR models, among others.
- Viruses outside their hosts are denatured by UV light, ozone, desiccation, heat, and chemical interactions: This is of practical relevance to SARS-CoV-2: contact transmissions are virtually negligible.
- Viruses are denatured by the microbiome: Therefore, COVID-19 is not a smear infection.
- Viruses are denatured in the course of nonspecific defense. This is where antiseptics, especially N-chlorotaurin as an acute measure, non-specific health promotion (e.g. hyper-hypoxia, sports, nutrition..) and strengthening of non-specific defenses through social measures that are effective in the medium term, come in.
- They will disappear if all viruses that entered the organism are/would be neutralized, phagocytized and denatured in the cell (natural and artificial specific immunity) thanks to antibodies as antigen-antibody complex. But it is an open question whether this can really be assumed in an ideal way. Is there latency of SARS-CoV-2 viruses?
- Immunity is "classically" achieved by successfully passing the disease. Therefore the therapy gets also epidemic-hygienic meaning. Immunity reduces the relevance of the non-infected person as a carrier. The extent to which this person can still be significant as a carrier at times has not yet been adequately clarified.
- Immunity can also be acquired through asymptomatic courses. Here, too, immunity is only temporary. This raises the question of the dynamics of relevance as potential vectors.
- Viruses are inactivated in contaminated persons when they are immune to such an extent that they are neither re-infected nor become ill again and therefore cannot infect anyone else. Kermack & McKendrick and e.g. the SEIR models optimistically assume this ideal variant. It is not tenable.

Why, for example, does SARS-CoV-2 not disappear as a health threat? E.G..

- Because susceptible hosts continue to exist: Lockdown does not make one immune or insusceptible! Acute support of a deficient non-specific defense (e.g. by NCT) leads only temporarily to insusceptibility, but inactivates

pathogens and thus reduces the epidemic hygienic danger of potential germ carriers, e.g. also within families.

- Because asymptomatic germ carriers could transmit the pathogen to others unnoticed and therefore unhindered during the phase of their illness.
- If viruses can remain latent in the body (e.g. herpes, virological dark net of SARS-CoV-2?), they can later become effective and spread.
- If immunity is not permanent
- If the vaccination is not 100% effective
- If not all can be immunized (vaccination of children? tourists, incompatibility) or want to (refusers),
- When, due to mutation of viruses, the acquired specific defense does not protect anymore
- Because they can switch to other hosts (pets, ferrets, mink...).
- Because no process can be ideally implemented in a non-ideal world.

Only a few processes are open to us, which lead to a reduction of the viral load. However, viral load reduction is only one approach in dealing with the epidemic. An essential variable for planning is to be able to make predictions about the spread of the pathogens and their effects, and to be able to derive conclusions for setting measures.

#### **d) On the influenceability of the persistence of SARS-CoV-2.**

Numerous respiratory infections show a seasonal dependence. The findings so far show that during the summer months the rate of new cases and thus also the number of deaths has decreased sharply in very many countries. This is not only true for Austria (see graph 4) and the other European countries, but also for Manaus (graph 5), i.e. on the other side of the equator. The reasons for this are not sufficiently clear. Important is certainly the increased stay in the open air. However, the World Meteorological Association is very cautious: "At this time, the evidence does not support the use of meteorological and air quality factors as a basis for governments to relax their transmission reduction measures."<sup>lx</sup> Still, if only because of the number of people vaccinated, it probably would not be a surprise to see a very significant decline in new cases, even in the summer of 2021.

As a rule of thumb, the infectivity of viruses is lost after 72 hours in the environment. But this is a very rough indication. If SARS-CoV-2 is experimentally exposed to full sunlight, 90% is no longer infectious after a few minutes, but indoors only after about 260 minutes<sup>lxi</sup>. UV radiation, heat, desiccation, the chemical nature of the surface on which the virus rests, etc. are

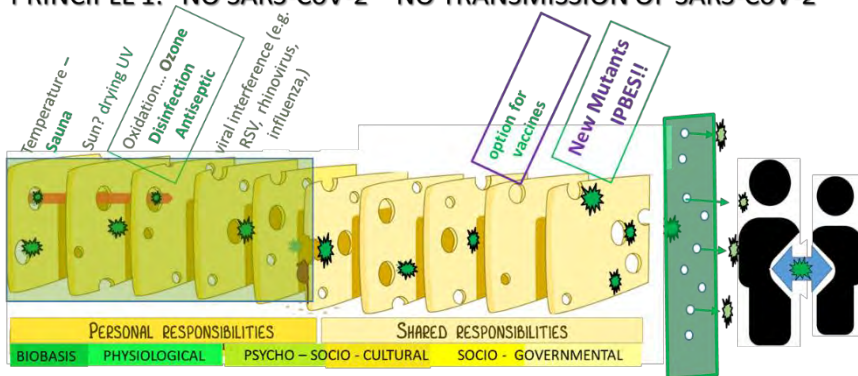
considered to be influencing factors that accelerate deactivation. Their intensity is subject to strong fluctuations. This is used in the application of disinfectants. This is a bridge to principle No. 2 (interruption of contact): Contact with viruses on dead surfaces can also become the cause of infection. However, this route of infection is not considered to be very significant. Why do we not think about the fact that it is only one step to move from the special case of "disinfection" to antiseptics? Inactivation of viruses can also be achieved by mild chemical substances that are compatible with the mucous membrane. Then one would use a method that is also part of non-specific immunity. This also produces more natural antiseptic substances.

Are there really no other possibilities than airing and disinfection esp. of the hands? Department stores reduce the viral load by using UV or ozone in their air conditioning systems. Cruise ships and airplanes have used filtration techniques formerly used only in operating rooms. Temperature can also benefit an: Studies show the health benefits of saunas. <sup>lxii</sup>

Graph 10: Measures against the COVID-19 pandemic and its consequences

THE TOOLS FOR RISK - MANAGEMENT ON BASIS

PRINCIPLE 1: "NO SARS-CoV-2 – NO TRANSMISSION OF SARS-CoV-2"



**e) Conclusions:**

We are in stage 2 or already in stage three. The chance to limit SARS CoV-2 locally and to eradicate it there is therefore no longer given. Obviously, SARS-CoV-2 will not disappear by itself. However, the natural and technical external environment obviously represents an effective sink for the persistence of the viruses. Exposures are to be expected in the vicinity of spreaders and in premises without adequate air exchange. Measures should be considered with respect to two problem areas: First, to reduce exposure of individuals, and second, as a preventive measure to reduce viral loads.

Air exchange is difficult to achieve to a desirable degree by simply opening windows. Filtering devices (e.g. in schools, department stores...) are therefore much more useful.

- Mutants are formed in the host cell. The risk of mutant formation is reduced by preventing the wild form from penetrating. The opportunity to do this can be by inactivation in the external environment (filtering systems,..) and by inactivation in the "anterooms" of the organism (nose, lungs, throat).
- Substantially altered mutants can result in situations as if a new epidemic had begun. Therefore, inactivation is a primary goal - not just separating potential germ carriers from infectious individuals.
- The options available to individuals for themselves, their family and friends deserve to be appropriately indicated by government information systems.
- So far, personal initiative, such as the installation of high-efficiency filtration systems in air-conditioning units, has not gained any advantage over other facilities without them. Does it have to be this way?
- The most effective way to contribute to the disappearance of SARS-CoV-2 is to strengthen the non-specific defenses (see principles 3 and 4)
- Acute shoring up of nonspecific defenses against infection reduces the relevance of those so supported as potential vectors and sufferers by denaturing the pathogens, but does not cause permanent insusceptibility.

The occurrence of human pathogenic viruses cannot be avoided in principle. What can be avoided, however, are structures and behaviors that facilitate the spread of viruses from wild animals directly or via domestic animals to humans. Again, reference should be made to the concept of IPBES:

- Measures are needed to reduce the formation of spontaneously occurring human pathogenic mutants. This requires changes in land use planning toward ecosociocultural sustainability.
- This will probably not succeed without adjustments also in the direction of the production and use of energy, the water balance, climate change and the advancing impoverishment of species and the interconnectedness of natural and near-natural ecosystems.
- There is a threat of a new wave of terrorism from artificially created pathogens. This can be countered at the individual level, but especially by societal measures with the promotion and development of non-specific defenses.
- The resulting requirements presuppose strategies that are staggered in terms of time and success. They will only be successful if they take into account not only small-scale and regional aspects, but also global responsibility. Without taking into account the economically weak

- whether individuals, groups or states - one should not expect any advantage for the prosperous even in the medium term.

## **2. Basics of forecasting models based on Kermack & McKendrick 1927.** <sup>lxiii</sup>

At the center of public discussions are figures used to infer the current situation and what needs to be done to protect the population. Therefore, everyone should be interested in what these numbers really say - other than that so and so many people within the state borders have been found to be carriers of germs or have died from or with COVID. For this, it is useful to look very roughly at two papers: that of Kermack & McKendrick from 1927 and that of Cori et al from 2013. For this, please refer to Part 2.

But a few things in advance: Kermack & McKendrick wanted to prove that there was another way to fight epidemics beyond the methods commonly used in 1927: The usual practice at that time was to lock away lepers, for example, and to isolate everyone for 40 days (hence "quarantine") with the closing of the city gates. Therefore, during this phase, no one could get out and no one could get in. This set of instruments was extended by Pasteur and Koch. They developed special procedures to influence the pathogens. Kermack and McKendrick proved that the close contact between the individual germ carrier and the specifically infected person is another prerequisite that can be used to slow down the epidemic. In fact, if the germ carrier meets the next infectee late enough, then the chain of infection is slowed down without the need to change the properties of the viruses or to sequester them all permanently. In addition, the number of infectious persons is reduced because the infected persons either die or become immune after recovery. The reduction in contacts therefore leads to a flattening of the curve of newly infected people, with all the consequences this has for relieving the burden on the health care system. But the threat of the pathogen may not end until the viruses can no longer infect anyone. The reasons for this may be that everyone has either died or become immune in the meantime, or that the period between the next contact is so long that the viruses have been inactivated in the body of the infected person or in the environment.

To prove their approach, Kermack and McKendrick had to make simplifying assumptions for the effectiveness of the previously recognized methods (locking away, influence on the pathogenicity and virulence of the pathogen) for methodological reasons: they assumed a constant dangerousness of the pathogen and a constancy of the defensive power of all persons. In addition, they assumed that all persons live so close that everyone has the same probability of hitting everyone else. This is the only way to prove that their method of changing the frequency of contact is influential. They also assumed that the infectiousness of a person is lost in any case with his recovery, the cured do not get sick again for

life and they cannot infect anyone else. Therefore, the number of infectious people is permanently reduced by the number of the deceased and the cured. However, you have pointed out that these simplifications should not be assumed in reality. Not only that: they have even emphasized as point 1 of their results that even small changes in infectivity can lead to significant changes in the course of the epidemic: "*Thus a small increase in the infectivity rate may cause a very marked epidemic in a population which would otherwise be free from epidemic.*" However, these simplifications are necessary for methodological reasons, since Kermack & McKendrick wanted to prove that their approach is effective on its own. It follows that Kermack & McKendrick assume that for the description of a real existing epidemic, of course, all variables must also be considered as variable.

For the dynamics of an epidemic it will therefore also be necessary to consider, for example, how long viruses can persist in the environment without losing their infectivity. Kermack McKendrick also take this into account only indirectly: with the insinuation that cured persons cannot pass on the germs and that there are no other sources of infection than infected persons, whose effectiveness formula massively can be sufficiently characterized by contact and time interval. In any "real" case, one must be aware that in the approach of Kermack & McKendrick and all models derived from them, all these indisputably variable aspects of the factor "virus" are included together with all aspects of the factor "human" in the one quantity "infectivity. In their model, only the contact between persons is variable. This obviously does not correspond to reality. Nevertheless, various forecasts are based on this approach, without pointing out the limits of the predictive power.

- Kermack & McKendrick also assume that individual data are available, i.e., information that is precisely and individually attributable to each individual person in the collective. Currently, calculations are made on the basis of aggregate data. These are the "aggregated" data that are reported, for example, by the district headquarters to the central office. This is usually based on the method developed by Cori et al. This is also discussed in more detail in H.
- It is essential for the appropriate use of both techniques that the persons can meet them reciprocally and with approximately equal probability. Therefore, they must live in a correspondingly close spatial relationship, for example. Otherwise they could not pass on their germs. This is not the case with the data for states and federal states.

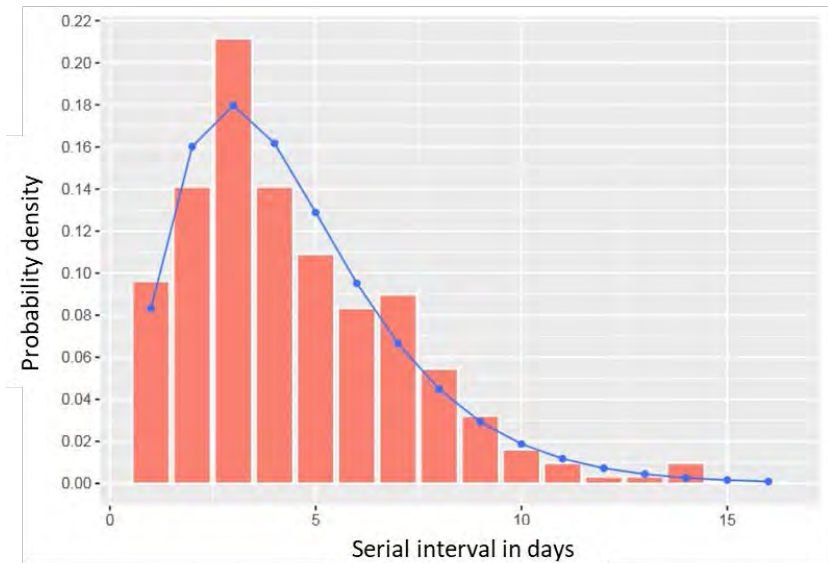
If a person is exposed to a relevant viral load, a confrontation occurs between the viruses and the cells of the outer boundary of the organism - with an open outcome. Viruses can penetrate individual cells and be reproduced by them

and released back into the nasal cavity, for example. This increases the viral load in the nose and increases the risk of penetration into the interior of the body. At the same time, the amount of virus introduced to the outside world through sneezing, etc., increases with the risk of transmission to other people. Therefore, depending on the individual circumstances, the time interval between the contact of the spreader and the manifestation can vary greatly.

Conventional model calculations neglect this range, which is important for the nature of an infection and the dynamics of an epidemic. They assume mean values and calculate with so-called "serial intervals". In doing so, they build on the determinations of the incubation period.

The presentation of the possibilities to reduce the risk by measures based on principle 2 (Without transmission - no contamination) can be omitted here. The corresponding measures have already been referred to under "current situation".

Graphic 11: Distribution of time between disease of a COVID-19 case and its subsequent case (312 transition pairs) and estimated gamma distribution (blue), 2/23 - 4/1/2000, Austria, Richter L et al, 2020.



The mean value of the serial interval determined here for Austria on 312 transition couples in spring 2020 was 3.96 days (standard deviation 4.75 days).  
lxiv

### 3. Principle 3: Without successful contact with SARS-CoV-2 - no infection with SARS-CoV-2.

If the risk management measures based on principles 1 (Without SARS-CoV-2 no transmission) and 2 (Without transmission no infection) have not led to success, a relevant viral load can reach the interior of e.g. the nose. Then the mucosal cells of the mucosa with their non-specific defense come into play. This is a direct follow-up to the introduction to the Kermack & McKendrick model.

**a) Again: Contagion index and serial interval**

Efficacy against the same pathogen can vary greatly between different groups in the same country, but also in individuals depending on their current situation of contact with the virus. Physicians express these differences with the help of changes in the contact index. As explained above, the contagion index indicates how many people who have never contracted the infection in question and have not been vaccinated become contaminated, i.e. infected, when they come into contact with the pathogen. How much this value can change and even - in connection with the manifestation index - lead to a radical decrease in mortality without the use of vaccination and antibiotics can be seen in the example of tuberculosis. Tuberculosis is the most significant infectious disease in the history of mankind. The number of people who died from it was recently estimated at 2 billion people<sup>lxv</sup>. In part 2 it is shown that in Austria it was possible to reduce the mortality from tuberculosis from about 500 per 100,000 inhabitants in 1900 to 50 in 1950, without this being attributable to vaccination or the use of antibiotics. It was societal measures to raise nonspecific defenses and thus lower the contagion and manifestation index. (See part 2 for more on this). Such time spans are not currently available, of course. But the contagion index and manifestation index can be changed at the individual level, even in the short term. But the computational models based on Kermack and McKendrick and Cori et al. do not provide for this. Therefore, it is an extreme simplification to assume constant "serial intervals" even over time in the model calculations.<sup>lxvi</sup> Assuming that the "virus factor" and contact frequency are constant, the average incubation time determines its level. In the spread calculations, one assumes that the "virus" and "human" factors are constant. The only factor that can be changed is the frequency with which infectious persons encounter infectious agents. This is used to calculate the reproduction rate, i.e. the average number of newly infected persons that a diseased person infects. Since the contact index and also the manifestation index can even vary greatly, but this is not included in the spread calculations, they cannot be included in the considerations of why the reproduction number has not changed according to the forecasts.

The experience with tuberculosis emphasizes the importance of starting or strengthening social measures as soon as possible, which will permanently improve the contact index, i.e. reduce it. However, during the epidemic, short-term effects on the contact index are paramount. These will occur whether one is



aware of them or not. However, the changes can be both desirable and detrimental.

Therefore, one must assume that the contagion index has changed and will continue to change as a result of experiencing, for example, a lockdown. These shifts can lead to an - undesirable - increase in the contagion index. However, there are also possibilities of influence that lead to a - desirable - lowering. Once again, we are reminded of the mathematically based prognosis of Kermack & McKendrick: They emphasize that the pathogen-person relationships must not be underestimated. Even small increases in infectivity - i.e., even as a result of a small increase in the contagion index - would lead to severe epidemics.

Policy makers should proceed according to the precautionary principle and anticipate that there will be increasing increases in the contagion index as the pandemic progresses. In considering how to counter this, one can draw on the findings of physiology and, for example, the work of Nobel laureate Blackburn which was referred to under A) 2 d (the holistic answer to COVID - 19). Biological processes always occur at the level of the individual cell, from whatever evolutionarily young level the processes are initiated. Infection is a biological process. Therefore, the effects, but also the possibilities of influence against the undesirable effects such as a deficient non-specific immune defense, will take place at the cellular level. Therefore, as a precaution, one should assume that one has three possibilities to improve a current - and therefore possibly only temporary - weakness of the non-specific immunity, however caused.

- a. One can remedy the deficient natural antiseptic effect due to insufficient production of the corresponding substance by administering the same but synthetically produced substance.
- b. A foreign antiseptic may be used, provided that tolerance is demonstrated.
- c. One can counteract a possible deficit in the efficiency of the cells as a result of a lack of e.g. oxygen by anticipatory training of the intake of oxygen even from oxygen-deficient air.

#### **b. The use of N-chlorotaurine (NCT).**

The only viable non-specific defense substance that can currently be manufactured on a large scale and used at the site where it physiologically occurs is N-chlorotaurin. It is a safe, well-tolerated, endogenous, mild antiseptic with anti-inflammatory properties. NCT can be administered as a nasal spray or via inhalation. It does not enter the body, so in the strict sense of the word it is not a drug, but a medical device. More than 200 scientific articles are listed in PubMed.

The tolerability of NCT has been confirmed several times in humans, e.g. in 2010<sup>lxvii</sup> and 2018<sup>lxviii</sup>. Its broad efficacy against bacteria, fungi, viruses and protozoa has also been demonstrated in numerous studies in animals and humans. In contrast to HOCl, for example, which is only present instantaneously due to its high reactivity and therefore does not persist, NCT belongs to the chloramines. In contrast, these are also referred to as "long-lived oxidants" because it is assumed that they persist for a longer period of time. Lackner, Nagl et al. also recently confirmed virucidal activity against SARS-CoV-2, influenza A virus, and respiratory syncytial virus (RSV)<sup>lxix</sup>. This broad efficacy is not surprising, given the reasoning of Nobel laureate Burnett, elaborated in H : According to this, interactions between chemical structures require that they be connectable to each other. NCT is an amine and not a globulin. It has a "simple" chemical structure: Cl-NH-CH<sub>2</sub>-CH<sub>2</sub>-SO<sub>3</sub> NCT leads to denaturation, i.e. a degradation of the protein of SARS-CoV-2 by oxidation. The combustion of oak wood is also based on oxidation: in the case of a log, just as in the case of an artistically carved statue with a crown. NCT attacks somewhere else than e.g. antibodies. Antibodies combine with a very specific area of the crown of the pathogen to form an antigen-antibody complex. This is thus a "building up" process, which only leads to denaturation after phagocytosis (uptake into the phagocytic cell). The difference between the mutants lies precisely in these characteristic structures in the crown, not in the basic structure of the virus. Therefore, there would need to be good reasons why mutants of SARS-CoV-2 should NOT be inactivated by NCT. The use of an artificially produced but natural substance at exactly the point where it is physiologically used explains why NCT has such good tolerability: After all, the fight against viruses is probably part of the everyday life of the cells of the mucosa. Therefore, only those substances could prove themselves in the evolutionary process that were on the one hand antiviral, but on the other hand well tolerated by the cells of the mucosa.

i. "It would be great and a super idea to have a cure....."

Not many comments can be found from virologists on the topic of "prevention". But recently the topic was basically addressed in a Procast of the Norddeutscher Rundfunk with Prof. Drosten (Charitee Berlin) and Prof. Ciesek (Uni Frankfurt), but not on the example of the unspecific defense, but the possibility to use a nasal spray with antibodies preventively<sup>lxx</sup>. In the Procast Nr 77 (27.2.2021) is stated<sup>lxxi</sup>: : *"...it would also be great if you had a means that can reduce the transmission, if someone is infected. .. For ... virus entry into the cells, a fusion between the membrane of the host cell and the virus is necessary. And that fusion of the membrane can be inhibited. ... And the idea is that you can offer such a ... agent for prophylaxis before and after exposure. .... But it would*

*also be interesting in the context of certain areas of life. For example, if someone who is infected needs medical treatment quite urgently to minimize the risk for the practitioner, if you think of a dentist for example. Or sometimes, if someone is infected and still needs treatment or needs to have contact in order to protect fellow humans, such an application would of course be conceivable. .... And I think if that works, that's a super idea."*

It has now been demonstrated that such agents exist, in particular NCT, the natural antiviral substance of the natural nonspecific defense, which can also be produced on a large scale. Its efficacy against SARS-CoV-2 has been demonstrated in collaboration with Charitee Berlin (Carsten Schwarz) and Robert Koch Institute (Thorsten Wolf), 360biolabs Melbourne in December 2020 and the Section of Virology (v. Laer) and the Section of Hygiene of the Medical University of Innsbruck under the leadership of M Nagl. (Lackner, Nagl et al 2020).

So far, the permissibility of the use as a preventive medical device is missing. This could be achieved - as has been done for NO in Israel - in the short term via an emergency regulation. Even without CE marking and emergency regulation, a nasal spray could be magistraliter prescribed by any physician to his patient and manufactured by a pharmacy, provided that the raw substance would be made available to pharmacies. This step could help to ease the current debate in many countries about the unequal treatment of vaccinated and recovered persons and open up v3equal relief to persons with negative tests and nasal spray without accepting a significant additional risk. Why not allow those people with evidence of a negative AG test and the application of 1% NCT in front of the eyes of the owner to visit a restaurant, by following all the other now "classic" precautions (distance...)? The effectiveness would be higher than by testing. This only helps to recognize asymptomatic carriers of germs in advance and to separate them as potential carriers. The additional administration of the antiviral nasal spray would reduce the risk of illness and infection, even if this person were to provide a positive AG test on the subsequent day. In addition, this would be an effective measure to reduce the viruses and thus a step toward reducing the risk of creating more mutants.

Why not offer regular inhalations with NCT to all patients with COVID 19 on normal wards?

**c. Support of the nonspecific defense with substances foreign to the stock.**

**i. Nitric oxide**

NO can also be used successfully. Extensive studies are available for this substance on its function inside the organism or in and between cells, but no

information is available on whether it is released in the course of excretion, e.g. into the nasal cavity. But the studies on its preventive efficacy as a nasal spray were so convincing to the Israeli health minister that he issued an emergency decree making the use of the Israeli-Canadian product available even to children over the age of 12. In doing so, Israel set a precedent: The first emergency order for an antiseptic against SARS-CoV-2<sup>lxxii</sup>.

Nitric oxide is a poison, namely an irritant gas and methaemoglobin former. Therefore, it has no place in the respiratory tract (car exhaust!). But the dose determines whether something is a poison or not (Paracelsus). In the body, small traces of NO serve as messenger substances. In immune cells, NO is used as part of the non-specific defense against pathogens to denature them by oxidation. Thanks to its small size, NO can easily pass through cell walls. NO has been approved for years as a drug, e.g., for severe pulmonary dysfunction.

In March 2021, NO was approved as a preventive nasal spray ("Endovid" by SaNOice) by way of an emergency regulation probably as a medical device [no studies level 3 available] also for children over 12 years of age<sup>lxxiii</sup>. (Up to now there is no vaccination for children. From an epidemic hygiene point of view, it is essential to reduce their importance as spreaders).

## ii. Various other potential antiseptics

Recently, various proposals have been published for the use of artificial substances as antiseptics for inhalation or as nasal-mouth sprays. (E.g., Cegolon L., M. Javanbakhit, G. Mastrangelo 2020<sup>lxxiv</sup>) They offer the use of antiseptics based on substances not commonly found on the mucosa, e.g., iodine, copper, carragelose from red algae. Therefore, clarification of tolerability is particularly significant.

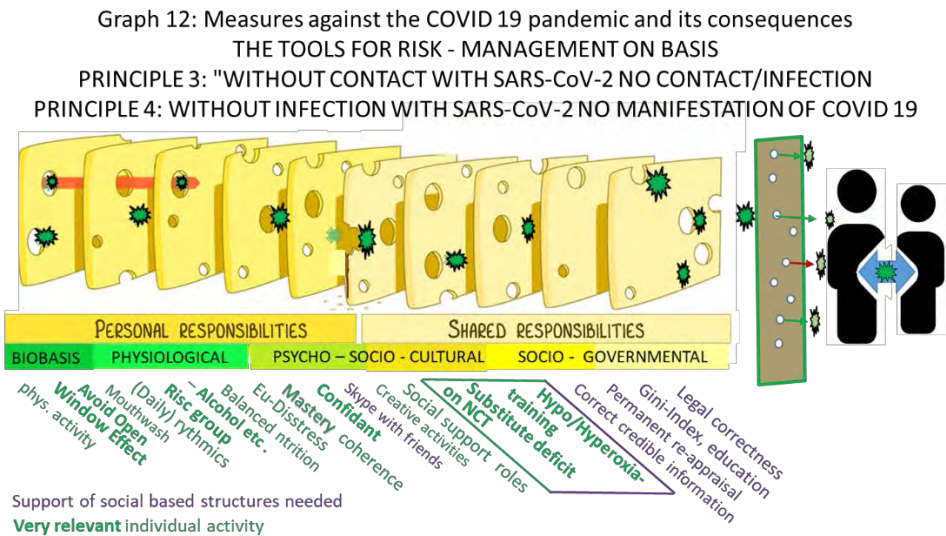
Other research is being conducted to prevent direct contact of SARS-CoV-2 with mucosa thanks to a nasal spray based on lipopeptides. (e.g. Outlaw VK et al,<sup>lxxv</sup> de Vries et al.<sup>lxxvi</sup>) Others offer prophylactics based on nanoparticles (e.g. Koenig PA et al 2021<sup>lxxvii</sup>) and antibodies. These, too, can be applied with a nasal spray. Drugs are also being developed.<sup>lxxviii</sup> Unfortunately, evidence of tolerance is lacking for these substances as well.

It is obvious: specific immunity is not the only indispensable tool in the fight against infection! Everyone agrees: the use of antiseptics does not replace the methods of inhibiting person-to-person transmission through contacts, nor the need to treat the disease thanks to specific therapies or prevention thanks to vaccines. However, nonspecific defense seems to be the only way to achieve temporary immunity so far. Moreover, it leads to a reduction in the risk of infection of others. This is important to bridge the phase until vaccines are developed, adapted to mutants at best, and also distributed population-wide. They

are irreplaceable in the fight against terrorist threats from artificial yet unknown pathogens.

**d. Linkage of contact index with manifestation index.**

Epidemiological studies mostly do not distinguish between the influence of the contact index and that of the manifestation index on the evidence of the effects studied. Therefore, the influencing variables used in risk management for effect principle No 3 (Without successful contact with SARS-CoV-2, no infection with SARS-CoV-2) and effect principle No 4 (Without infection with SARS-CoV-2, no manifestation of COVID-19) are presented in the joint graph No 7.



**Principle No 4: Without infection with SARS-CoV-2 - no manifestation of COVID-19.**

However, this does not mean that the phase between infection and manifestation is not worthy of consideration from a health perspective. Quite the contrary. This is the phase in which it is decided whether and when disease will occur. This phase, in turn, is determined by the performance of nonspecific immunity. Now no longer at the level of the mucosa cells, but of the organism.

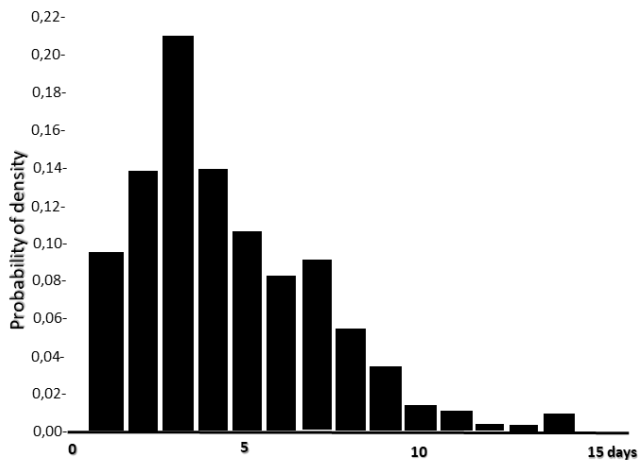
**a. The variability of the incubation period as an indicator**

The more efficient the non-specific defense is, the longer the incubation period will be. In the optimal case, the disease will be prevented despite contamination and thus infection. There is also the remarkable case of a permanently asymptomatic form of disease, which is unnoticed by the person,

but leads to the formation of antibodies. How frequent this pathway to the formation of immunity is is an open question: It seems to be subject to strong fluctuations, which is not surprising in view of the possibilities of influence on the contagion and manifestation index. The Robert Koch Institute suggests that transmission from asymptomatic individuals would play a "minor role"<sup>lxxxix</sup>. As early as April 2020, the German National Academy expressed the opinion that "a substantial portion of the infected population has little to no disease even for the entire duration of infection"<sup>lxxx</sup>. Hu et al's elaborate study, which is informative for Wuhan, demonstrates that although only about 7% of the population in Wuhan was immune at the end of 2020<sup>lxxxii</sup>. Of these, however, 82% of those with antibodies never had symptoms.

If there are no symptoms, the question of the length of the incubation period no longer arises, but the question of whether these persons may have been carriers does. However, if nonspecific immunity is weakened, the incubation period becomes shorter. Nonspecific immunity to the same pathogen can vary widely between individuals for the reasons listed in the graph. The extent of the variation in incubation time for COVID-19 within a group of people considered representative of a population at a given time in practice is evidenced by the graph below for Austria. It shows the distribution of time spans between the infectious contact of an Austrian infected with COVID-19 (primary) and the appearance of COVID-19 symptoms in the person infected by him (secondary)<sup>lxxxii</sup>. Quite a few showed COVID-19 symptoms after only one day, the last ones after 14 days. Nevertheless, this distribution makes a statement about a very specific situation in which the secondarily infected person was during the incubation period. If one takes into account the considerations made under "The interdependence of organism and person [A 2) d]", it becomes conceivable that the symptoms could have appeared earlier in every secondarily infected person, if he or she had had to cope with e.g. a heavy physical or psychological burden, or also that the incubation period would have lasted longer, if such burdens had not had to be coped with. Ultimately, it must even be kept open whether, under particularly favorable conditions, one or the other would not have fallen ill at all.

**Graph 13: Distribution of COVID-19 incubation times per day;**  
 312 individuals collected between 2/23 and 4/1/2020, Austria  
 Data: Richter et al, AGES 2020, <https://www.ages.at/download>



The survey of the AGES served primarily to determine the so-called "serial interval".

Methodologically, this was done in such a way that at the time of analysis (=7.04.2020) 312 source-case-follow-up pairs with reliable information on disease onset were available. From each of these pairs, the time between the days of disease onset was calculated<sup>lxxxiii</sup>. Therefore, this experimental design also meets the requirements to determine the time interval between first contact and disease onset, i.e., the incubation period [as stated in A 2 b). With serial intervals based on laboratory-confirmed cases, the curve would probably be shifted somewhat to the right]. The value averaged from the values of the 312 pairs is needed by calculators of models to determine the dynamics of the epidemic according to Cori et al. The smaller the serial interval, the greater is what Cori et al call the "power of the epidemic"<sup>lxxxiv</sup>. The "force of the epidemic" includes not only the "human factor" with its nonspecific immunity to infection and manifestation and the "pathogen factor" with its infectivity and virulence, but also the frequency of contact between an infected person and an infectious person. In the calculations of dynamics, the factors "infectious person" and "pathogen" are assumed to be invariant. The figure must also include the influence "modifiability of virus excretion". Therefore, the "force of the epidemic" in a model based on Cori et al. can be influenced by only one of the diverse variables: by the influence on contacts with infectables. And this is far from reality from a medical point of view. The medical considerations are obviously quite different from those that model calculators have to make. They must neglect individual behavior. Otherwise, they will not arrive at any calculability.

From a medical point of view, the goal must be to prolong the incubation period, if it is already not possible to prevent the spread of germs per se and also not to prevent the contact of the infectious with the infectious. Here it is a matter of bringing "the power to resist the epidemic" to the center.

### **b. Possibilities of influence**

In graphic 12 a distinction is made between the ways in which the risk can be reduced individually or collectively or socially. Biological and physiological processes can be used as a starting point. However, this may also require upfront efforts on the part of society. For example, NCT can only be purchased if it is available in pharmacies. Devices for training oxygen uptake by means of hyper-hypo-oxia training will also not be available for everyone to buy privately (see also chapter H). However, they could be made generally available, e.g., in day care centers for seniors. Physical activity with respect to the Open Window Effect, on the other hand, is much more within the individual's own sphere of decision, as is the effort to keep to a daily rhythm. Details about this are also given in chapter H. More difficult to classify is the question of alcohol consumption. Here, influences from the pandemic are to be expected. Some people may be surprised that Eu- and Disstress are listed in the graph. COVID-19 is an infectious disease after all. To be sure, the pandemic and the measures taken provide classic examples of the various forms of stress and the associated challenge of dealing with them appropriately. Therefore, reference should be made to the corresponding chapter in the special section. This reference to special chapters also applies to all other aspects of the evaluation processes. The psychosociocultural specifications, for example, flow into these. They lead to individual emotional, cognitive and intellectual assignments of meaning. The classic statement "A chimpanzee is not a chimpanzee" is not only true for chimpanzees, but at least for all primates: They need contact to their own kind. How much more important is this for humans as social beings.

In the graphic 12 also influencing factors on the risk to fall ill with COVID 19 or on the various consequences of the unintended, but inevitably occurred effects of the struggle to secure the health care system are listed. In Graph No. 5, some of the most important ones have been listed. These are related to the influencing variables indicated, such as the credibility of the information transmitted, the compliance with the legal bases, but also to the effects expressed by the Gini index. This index indicates how the distribution of wealth is in a population. It is noteworthy that, thanks to studies that can already be classified as classical, there is evidence that not only the poor are healthier when the gap between rich and poor is not too wide, but also the wealthy. <sup>lxxxv</sup>



i. asymptomatic - atypical - symptomatic - disease - being sick - Long COVID et al.

From a medical perspective, considerations of the importance of asymptomatic individuals with positive antibodies, as well as those with atypical symptoms, take on special weight. Can preventive action be taken to reduce Long COVID: Already estimated to affect millions of people (Hayday Adrina, Francis Crick Institute): "It affects people in the most productive phase of life." (A Nath, NINDS in NIH). "COVID-19 is a new disease that is pushing the research community and the world at large into "uncharted territory" (Jean Laurent Casanova, Rockefeller University). Thus, researchers are embarking on a quest to determine whether "viral reservoirs or residual segments of viral RNA contribute to the ominous findings.<sup>lxxxvi</sup> A lot of unanswered questions. But one thing is already clear. If the viruses can be inactivated before they can penetrate and if the organism manages, primarily thanks to its non-specific defense and secondarily through the specific defense mechanisms, to prevent the disease from developing, the risk of the classic lung infection disease developing into a systemic form of progression is reduced, but also the risk of Long COVID, PIMS, etc. is reduced. The "discarded stone" would have to become the cornerstone: The possibilities of strengthening fundamental biological processes (example hyper-hypo-oxia training) and supporting currently reduced capacities of non-specific defenses by NCT, NO or any other compatible antiseptic cannot be replaced by testing, testing testing, as significant as they are. The success in the fight against tuberculosis shows how effective it is to build up permanent improvement of nonspecific defenses without changing the pathogenicity and virulence of the pathogens. The urgency of such measures, especially for dealing with COVID-19, has been compiled for the WHO by Maxmen<sup>lxxxvii</sup> and Wilkinson and Marmot,<sup>lxxxviii</sup> for example.

**c. Conclusions to reduce the risk of SARS-CoV-2 infection and COVID-19 manifestation.**

- COVID-19 is an infectious disease. Therefore, the interaction of the virus with mucosal cells is the starting point of the health-related biological process.
- At the heart of the options to reduce the risk of infection with SARS-CoV-2 despite contact with germ carriers and the likelihood of contracting COVID-19 are nonspecific processes. Currently, the near-term options that society could provide are very limited: N-chlorotaurine could be made available worldwide in the short term, for an NO preparation there is an approval in Israel

on the basis of an emergency regulation. Technology for enhancing oxygen uptake is available but limited during the pandemic.

- Several promising proposals for antiseptic agents are available. To date, there appears to be a lack of public interest in supporting this approach even to the extent that it has been done for vaccination. Options for the use of e.g. nasally applicable antibodies also deserve attention.

- So far, the possibilities opened up by principles 3 and 4 to influence the epidemic have not only remained unused. It must be feared that the pandemic has been adversely affected by the way things are currently done. At least, this is what the mathematical arguments of Kermack & McKendrick suggest.

- This is all the more incomprehensible since the legal situation in various states has endowed decision-makers with special rights in the event of pandemics to take effect in this area as well, e.g., to make a medical product available even by emergency prescription. Non-use of delegated rights must also be accounted for.

- The risks associated with the use of assistive devices, which may contribute to temporary immunity, are balanced against the reduction of direct and indirect consequences of COVID 19. The appropriateness of their use must therefore be reviewed. Arguably, the same principles should be applied as when assessing the appropriateness of restrictions on personal liberties, etc., against the risk of health care collapse.

- It is also likely to be relevant to consider whether measures leading to the restriction of fundamental constitutional rights are permissible if the possibilities conferred by the legislature for epidemics have not been used.

- In the present case, however, it also seems essential to consider that it is obvious that, as a result of the restrictions that have now lasted so long, serious damage to health has also occurred that might not have occurred, or not to the same extent, had other methods been used earlier to influence the spread of SARS-CoV-2.

- In evaluating NCT, it seems significant that the synthetically produced product has been tested for compatibility. It is chemically the same substance that is regularly produced in nature at the same location - e.g. in the nose, for protection against e.g. viruses.

- The health risks of COVID19 must be weighed against other health risks that are unintended consequences of the fight against the collapse of the health care system.

- Individuals may be at increased risk for health reasons or because of their occupation. In addition, the protection of individuals with system-maintaining jobs is particularly significant. People over the age of 65 are

generally considered to be a high-risk group (about one-quarter in Western countries). Asthmatics, the severely overweight, diabetics, HKH patients, etc. also belong to the group of persons with particularly severe courses. Thus, in Germany, 36.5 mi. of the 83 million are classified as high-risk individuals and 21.6% as a high-risk group<sup>lxxxix</sup>. Taking into account the system maintainers and those exposed particularly often, about half of the population is in need of special protection.

- Individuals with low socioeconomic status are at higher risk for severe COVID-19 courses.

- Many states failed to control the pandemic at the time it occurred. In the meantime, it must be assumed that germ carriers are widely dispersed and will remain so. It seems to be only a question of time until particularly effective mutants determine the course of infection, which at best cannot be combated by the current vaccines.

- It seems foreseeable that delayed effects of infections with SARS CoV-2 will result in unexpected and so far not adequately explained consequences (such as PIMS, Long COVID) in increasing proportions. The best measure currently available is to strengthen nonspecific preventive capabilities. ("The discarded stone should become a cornerstone")

- Successful use of nonspecific defenses does not cause specific immunity. Therefore, Principles 3 and 4 alone are also unable to eliminate SARS-CoV-2 in a situation where infected individuals are spread throughout the country. But both principles can help move the epidemic from epidemic to endemic and sporadic.

- The use of artificial agents to support nonspecific defenses against infection (e.g., NCT, NO) suggests a temporary reduction in both the likelihood of becoming infected oneself and of infecting others. This should significantly improve the very limited temporary possibilities to reduce the risk by e.g. antigen testing, as the viral load will be reduced.

## **5. principle 5:**

**a) Immunization: No need for hospitalization without contracting COVID-19.**

**b) Thanks to successful therapy, no overload of the intensive care system.**

The measures that can be taken on the basis of principles 1 to 4 therefore lead to a reduction in the risk of disease in the current situation. However, they make little difference to the number of individuals who remain susceptible to infection with SARS-CoV-2 the more successful their intervention. At best,

temporary immunity can be achieved in all, but only temporarily! This is not sufficient in the long run.

#### **a) Possibilities and limits of artificial immunization**

Therefore, the presence of SARS-CoV-2 wherever in the world represents a sword of Damocles for the health threat of every single citizen. This risk can be addressed through sustained and global immunization. However, even the use of vaccines does not guarantee that no one will fall ill with COVID-19 or die from it. This is due to the fact that no vaccine is 100% effective and not everyone is allowed to be vaccinated or wants to be vaccinated. In addition, it takes a considerable amount of time to develop and produce the required vaccines. Then they have to be distributed to the entire population and develop their effect. During this time, there remains a considerable risk of disease and death.

The emergence of new mutants is particularly problematic: Their occurrence - in contrast to influenza, for example - cannot be predicted in terms of time. Therefore, the precautionary production of effective vaccines is not possible. Vaccines may then have to be adjusted during an epidemic. This may mean that the population has to be vaccinated again, even though it has just been successfully vaccinated against the "old pathogen".

Therefore, while vaccination is essential, it alone cannot ensure a return to life as it was in 2019. This is not true even if one accepts morbidity and mortality rates as with influenza. COVID-19 is not really comparable to influenza (see part 2).

#### **b. Specific therapy and rehabilitation**

Therefore, the development of specific therapy methods will become increasingly important in the future. It is gratifying to note that considerable successes have been reported in this regard, e.g., in the development of new drugs.

However, cures are not enough to solve the health problems resulting from COVID-19. The late effects after COVID-19 mean that many of those who have recovered are "no longer the same".<sup>xc</sup> Months of rehabilitation are often required. A new "English term" is currently being used for this: Long COVID. Many people first have to learn to breathe again with their own muscles. Possibly this phase can be shortened by using the possibilities of hyperoxia-hypoxia training.

#### **c. Implementation of measures based on principle 5 against COVID 19**

Those who are being vaccinated, are in the hospital or for rehabilitation should be able to be neglected as spreaders at least during this period: After all,

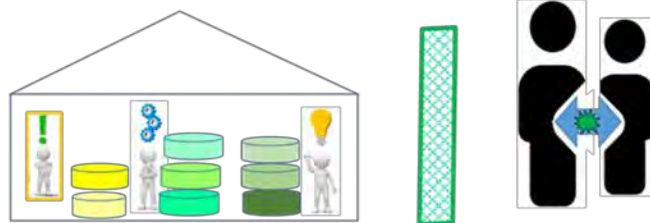
the relevant institutions can be organized and appropriately staffed and equipped so that the risk of transmission is extremely low. It would make sense to use a suitable antiseptic both to support the therapy by reducing the relevance of re-infection with the germs released by the patient's own cells in the nose and especially in the lungs, and also as a measure to safeguard the workplace.

Since many diseased persons are thus already eliminated as causative agents of secondary infections, the question arises, among other things, with what justification one actually always speaks of "effective reproduction rate". The starting point is the number of manifestly ill persons. Therefore, the pre- and asymptomatic carriers are not taken into account. Moreover, the models assume that everyone can contract the disease with the same probability. But this does not apply at all to those who have been detected and suspected, i.e. who are at least in home quarantine. Of course, it is important to know how many people have been newly infected, hospitalized, etc., and where. But why just these persons, who were recorded numerically, should give information about the further course of the disease, can be questioned. Are not completely different persons the carriers of the today freshly infected ones than those "under control"? And where were the people infected who brought the germs into the families?

Regardless of such questions, it remains obvious: In all measures based on Principle 5, the infrastructure, the creativity of the actors and the logistics are in the foreground and not the persons threatened by COVID-19.

This is also reflected in the graphical representation:

**Graphic 14: Principle No. 5:** Increasing the proportion of immune patients and the survival rate through vaccination, therapy and rehabilitation thanks to appropriate structures, logistics, etc.

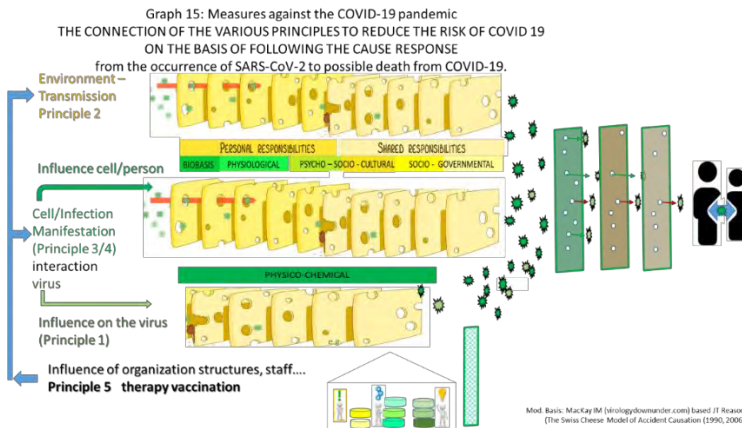


## **6. no single principle alone leads to achievable risk reduction.**

The present chain of reasoning proves: Each of the principles presented suggests a reduction in the risks associated with COVID-19. This is illustrated by the graph no. 10 below. But it is not to be expected that even one of the 5 principles can be implemented in an ideal way. In our world, nothing is ideal. Moreover, errors cannot be excluded in principle. Therefore, risk cannot be eliminated in principle: Life is always life-threatening. One can only strive to

reduce risks. Since our resources are limited, it must be expected that another risk will be increased if one focuses one's resources on only one approach to a solution. This is also true when using a single principle of action, when multiple techniques can be used to achieve the same goal (e.g., preventing the collapse of the health care system). The Pareto Principle 80:20 suggests that greater success can be expected when not one method is used using all available resources, but when there is a balanced distribution of resources.

This is illustrated by the graph below. It is also clear that the 5 principles are linked to each other in a dynamic way.

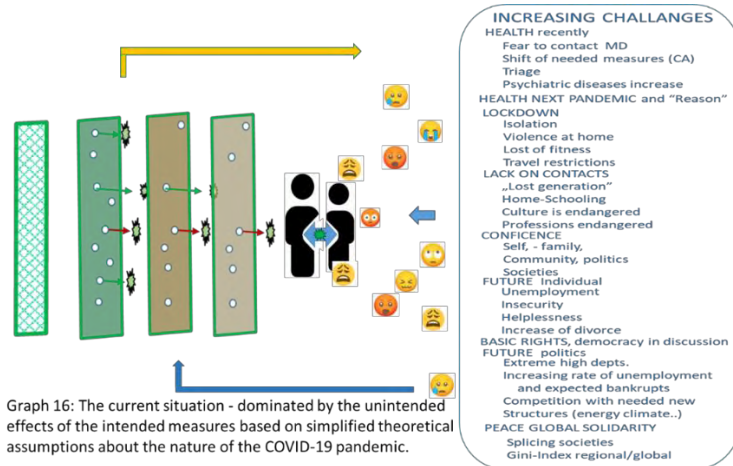


## 7. Linking the fight against SARS-CoV-2 and the collapse of the health system in the comprehensive COVID-19 crisis.

The fight against SARS-CoV-2 was lost in many countries in the early summer of 2020: the opportunity to eradicate the virus with a combined strategy was missed. The situation at the beginning of 2021 is characterized by the fight against the collapse of the health system and the efforts against the unintended consequences of this fight on the economy, society, culture, international connectivity and last but not least against the threat to internal and external peace. The following diagram symbolizes the comprehensive options in the current situation. From the point of view of health, it should be borne in mind that the measures to be used in this context have a reciprocal effect on each other. It is not without reason that both the WHO and the EU, for example, take the view that the development of health levels is an essential measure of the success of the policy as a whole.<sup>xci</sup>

The effect of indirect impacts on COVID-19 represents only the tip of the iceberg. This is demonstrated by the changes in life expectancy in the U.S. demonstrated between January and June 2020<sup>xcii</sup>. The life expectancy of all Americans decreases by a whole year, that of the black population by 2.7 years within this

half year! The difference between white and black Americans thus widened to 6 years. It thus dropped to the 1998 level! <sup>xciii</sup> The last time such changes occurred was after the Spanish flu of 1917/1916.



Graph 16: The current situation - dominated by the unintended effects of the intended measures based on simplified theoretical assumptions about the nature of the COVID-19 pandemic.

**a) "Three times three and three"**

Consideration of the optimal course of action in the event of an epidemic with a novel pathogen can be expressed by the catchphrase "three times three and three."

1. from a temporal point of view, one can distinguish the need to act immediately, in the medium term and in the long term.
2. the course of an epidemic begins when carriers who are known or can be detected at a precisely definable location introduce the pathogen into a population that has never come into contact with it. If it is not possible to destroy the germ in this phase, the germ is spread via areas and persons that can no longer be precisely defined. In the third phase, delayed health effects are in the foreground.
3. an epidemic and especially a pandemic not only have medium and immediate health effects that have to be considered individually, locally, regionally and globally. The epidemic and the measures taken and not taken also have ecological, economic, sociocultural and solidarity-related effects.

The resulting requirements can only be considered in a weighted evaluative manner.

Science can offer valuable assistance in this regard. It can base its reasoning on three foundations:

1. the entire available state of knowledge

2. epistemologically available techniques to make different scientific disciplines, which so far seem to be incompatible on a causal level, compatible with each other (e.g. Einstein's "theories of principles")

3. "The application of the laws of thought and the experiences of daily life".

**b) "Never let a good crisis go to waste (Churchill) "**

Crises require of profound changes. Under these conditions, the population is also ready to accept interventions that under "normal conditions" would lead to massive resistance. Responsible politics can and should use this willingness to set the course for the future: As a yardstick for the success of overall policy, WHO and the EU refer to the development of health and well-being. It is thus about the possibility of each individual as a socio-cultural and responsible being to be able to develop in a future-oriented way<sup>xciv</sup>.

Not without reason risk and chance have the same Chinese character.

## **F) SUMMARY**

**Remember in advance:** The issue is the appropriate course of action during a state of emergency. Therefore, it must not be demanded that every measure is covered by the state of knowledge. On the contrary, the challenge lies precisely in finding the most forward-looking solution, despite a lack of knowledge, which can be justified "by applying the laws of reasoning and the experiences of everyday life" in a weighted manner.

### **1. Create free space at the moment**

- The decision maker is responsible according to his position to act NOW or to refrain from certain possibilities. Refraining from using delegated authority also requires the same justification as acting.

- Experts are selected because they can be expected to provide evaluative advice beyond the state of established knowledge. A reference that something is not yet certain and therefore cannot be taken into account is not justifiable in a pandemic - in the case of imminent danger. This also applies to the neglect of - as is well known after a preliminary review by an expert - publications that have been put online but have not yet been peer-reviewed.

- Individual contribution: Adherence to the various regulations for avoiding contact with contagious material should in itself be indisputable. However, interrupting contact will not increase the number of those no longer susceptible. Therefore, everyone should be shown and given the opportunity to reduce his or her threat in a self-determined way until successful immunization, and without having to accept unreasonable restrictions.



○ For example, in the course of an AG or PCR test, the test person could be given a nasal spray containing a compatible and effective antiseptic. This would potentially protect those testing positive from the disease and reduce the likelihood of transmitting the viruses to others, for a longer period of time if the spray were used regularly.

○ Individuals with a current negative AG or PCR test could be given additional options for action, given the appropriate framework: They could, for example, be allowed to visit a restaurant - while complying with all other currently necessary regulations - by applying a 1% NCT solution to their left and right noses in addition to presenting the test result in front of the restaurant owner. This measure would be effective both in terms of epidemic hygiene and individual hygiene.

○ So far, such possibilities have been withheld from citizens in Austria. Therefore, it makes sense to first read through the examples of how one can reduce one's own risk of contracting COVID-19 beyond the regulations (see e.g. open window effect, green plants, maintain daily structure, maintain confident relationship, gargle with an antiseptic- but do not inject into the nose, into vessels or even eat or drink! For details see chapter H)

This should create the room for maneuver that allows one to approach the situation at hand with a mental distance. Conclusions can also be summarized for this.

## **2. On the nature of the disease**

- Covid 19 is a very dangerous disease with many faces that can lead to a horrible death and threaten the stability of the health care system and not only that of intensive care.

- SARS-COV-2 is an "insidious" pathogen with high "plasticity" (= adaptability).

- This plasticity occurs especially in the host cell and despite "resistance"<sup>xcv</sup> :: One more reason to prevent, if possible and unspecific measures (e.g. NCT), that viruses can penetrate.

- Its mutations cannot be predicted - as in the case of influenza.

- It must be expected that the germ can infect inconspicuously and can be present in the body for a very long time even without symptoms. Therefore, for precautionary reasons, a "viral dark net" should be expected.

- It can cause clinical pictures that are not yet sufficiently understood.

- It can lead to various long-term damages.

- There is no reason to deny COVID-19 or the danger of SARS-CoV-2!

- But there is also no reason to ignore the current possibilities that antiseptics would be against: So no reason for antiseptic deniers and preventers either! A comprehensive approach to the disease and strategy is needed.

- Nevertheless, SARS-CoV-2 is not particularly contagious. For the majority of individuals, contact with SARS-CoV-2 does not result in contamination or manifestation of the disease. This does not mean that SARS-CoV-2 is harmless. Neither are polio viruses, although only about 1% of susceptible individuals become ill after contact with the virus.

- The persons do not get sick if their mucosal cells can prevent the penetration of the viruses into the body and the necessary multiplication, so that the disease can be prevented. The person owes this to their non-specific defenses.

- The risk of the disease therefore increases for four reasons in particular

1. that a correspondingly high viral load cannot be prevented from reaching the person.

2. that the viruses increase in infectivity (mutants) and can penetrate more effectively.

3. if the current non-specific defense of the cells cannot prevent the susceptibility and thus the contamination, even if this could be expected under normal conditions, supported by individual hygienic measures ("open window effect").

4. If the non-specific defense of the organism cannot prevent the disease with manifest symptoms.

5. in groups of persons with a permanently reduced immune status for socio-cultural reasons and as a result of previous damage, but also as a result of acute multiple exposures, among other things as a result of measures against the spread of SARS-CoV-2.

- ❖ Against 1) measures like testing, checking, secreting, filter systems ....help.

- ❖ Against 2) the measures of the IPBES and all steps, which lead to an early inactivation of the viruses and thus shorten the duration, in which it can come to the mutant formation, help

- ❖ Against 3, 4 and 5 the preventive strengthening and the substitution of the currently deficient non-specific defenses.

- ❖ We have to fight SARS-CoV-2 and COVID-19 with ALL means, but really with ALL and in a balanced way

### **3. About the current situation**

But what can one do or refrain from doing in one's own area to be able to take appropriate steps oneself. Or how would one act if one were a political

decision maker? What would be the very first starting point to end the current restriction of measures? This would probably require putting up for discussion one of the fundamental pillars on which the founders of the measures are built: The dominance of forecasts based on the calculation of the dynamics of the epidemic. But this should actually be easy to do if only decision makers were aware of the limitations that Kermack & McKendrick (1927) placed on the applicability of their model. Interested parties are referred to the papers in chapter H (Fundamentals): But everyone should at least be aware of the following: The fathers of the experimental epidemiology of epidemics recall that in their model they assume the infection process itself to be constant in order to demonstrate evidence of an independent effect of contact reduction. It should be obvious to everyone that these simplifications are of course not given in practice. This was clear to Kermack & Kendrick especially for the factor "human". They also summarized this unmistakably as follows in the characterization of their "infectivity concept":

- a. *The pathogenicity of the virus, which enables it to penetrate the mucosal wall in the nose, mouth and lungs*
- b. *The ability of the nonspecific defenses of the cells of the mucosa to inhibit infection; and*
- c. *the non-specific ability of the organism to fight against the manifestation of the disease in order to inhibit the symptoms.*

They therefore arrive at point 3 of the abstract: "*Small increases in the rate of infectivity can lead to large epidemics*" (p. 720)

However, every mother already takes this into account at the individual level. She urges her child to wear a sweater when it's cold and a raincoat when it's raining: Clothing does not change the viral load that is inhaled or the number of contacts. But the risk of catching a cold does. But such influences cannot be uncovered by the predictive models used. On the contrary. All adverse influences on infectivity via the "human factor" both as a living being and as a psycho-socio-cultural being can only be interpreted as consequences of inadequate compliance with contact avoidance regulations. A method can only do what it can do. And this is what Kermack & Kendrick pointed out: "*Small increases of the infection rate - e.g. also by evaluation processes - can lead to large epidemics*" -or "*Small reductions of the infection rate - e.g. by targeted use of NCT- can be expected to have relevant braking effects on large epidemics.*

#### **4. Further conclusions.**

Important further conclusions are already listed in the individual chapters. Additional rationales are addressed in the chapters of Part 2 (Hff).

- Risks can only be reduced, not eliminated, in our less than ideal world. If you use your resources to reduce one risk, you must expect that other risks will be increased because you lack the resources to reduce the risk there as well.
  - People make mistakes. This is ultimately unavoidable. In order to reduce risks, one can start with the acting persons as well as with the system. The key is to constantly check for overlooked opportunities instead of "looking for the culprit" and just implementing "the same thing, only with greater severity." (Reason)
    - The efficiency of one and the same effect principle decreases with the increasing demand on the success to be achieved: Pareto states as a rule of thumb that with 20% effort 80% of the possible effects can be achieved, the remaining 80% are needed to achieve the remaining 20%.
      - Therefore, the allocation of resources (Follmer) should be aimed for a comprehensive approach (Comprehensive Care). This is consistent with Reason's model of risk management ("Swiss cheese model"). But this assumes - in contrast to the current widespread approach - the use of different principles of action rather than different techniques of the same principle of action, e.g. to stop the epidemic by interrupting contact.
  - Contact with infected persons is a necessary but not a sufficient explanation for either infection with SARS-CoV-2 or manifest disease with COVID-19. Without penetration of the virus, e.g., through the mucosa of the nose, there is no infection. This step is influenced by the nonspecific defense of the mucosal cells. Current weaknesses of the defense can be compensated by antiseptics. The principle of antiseptics has been known since 1847 (Semmelweis: savior of mothers from puerperal fever). Striving for authority in the university and the ministry prevented its Europe-wide use until 1865. ("Semmelweis effect"). Then Lister rediscovered it.
    - The development of specific protection against pathogens (antibodies...) usually requires the penetration of the pathogens and thus the overcoming of the non-specific defense. It then takes days for the first antibodies to become available. In this phase, non-specific possibilities (e.g. improved oxygen supply after successful training) are still significant.
      - Legally significant in the classification of antiseptics is whether they are to be classified as medical devices or as drugs. Medical devices may not be absorbed into the body, but medications may. Their general use (CE marking) can therefore be achieved with less experimental effort.
      - In Europe, during epidemics, the government/the responsible minister is authorized to approve both drugs and medical devices by emergency prescription, and if necessary, to prescribe their production and distribution.

- Action and inaction must be justified equally with regard to the precautionary principle.

- Doctors in Europe are entitled to issue prescriptions for their patients that are to be produced magistraliter by pharmacies. However, they can only do so if the raw products are delivered. Patent holders can prohibit this.

- Currently, there is only one synthetic, industrially produced, antiviral substance that has been tested for tolerability and can be used in the same place where it occurs naturally and for which extensive studies on its efficacy have been available for years: N-chlorotaurine.

- The efficacy of NCT has been confirmed in vitro by researchers from the Hygiene and Microbiology and Virology sections of the Medical University of Innsbruck, the Robert Koch Institute, Charitee Berlin and 360biolabs Pty Melbourne. This work can be viewed online since December 2020<sup>xcvi</sup>.

- NCT could be used individually hygienically to reduce the risk of infection and disease. This opportunity is currently being withheld from citizens.

- There would also be a desirable impact in terms of disease hygiene: the likelihood of transmission to others would decrease.

- The effectiveness of antiseptics is based on the fact that the structures of the viruses are denatured, i.e. destroyed. Antigens act differently: first, there is not a "crushing" of structures, but an "enlargement": the combination of antigen and antibody into one unit. This takes place at very special, mutant-specific spatial structures (epitope and paratope). This new unit is only broken down in the course of the next step (phagocytosis) in the corresponding cells. Therefore, efficient antiseptics against the parent form of SARS-CoV-2 are expected to be effective against mutants as well.

- In addition, an NO preparation has been available in Israel since March 2021, and its use has been approved by way of emergency regulation even for children over 12 years of age. Thus, a medical product is available in Israel that can influence this group of spreaders.

- In the medium term, various hopeful methods are under discussion to compensate for current deficits in non-specific defenses by means of antiseptics or, for example, locally applicable antibodies. This will require the initiative of policy makers: it is they who are responsible for protecting the health of the population, not scientists or industry.

- Arguably, the government / minister is also obliged to use the competences delegated by parliament in case of an epidemic or pandemics.

- Die unspezifische Abwehr wird durch physikalische, chemisch, emotionale, intellektuelle, kognitive etc. Vorgänge verändert. Dies kann zu ihrer kurzfristigen Verschlechterung aber auch Verbesserung der Abwehrlage führen. Es ist grundlegend falsch, davon auszugehen, die Abwehrlage bliebe

konstant und die Art, wie die Epidemie und ihre Folgen erlebt werden, wäre gesundheitlich und für die Verbreitung der Erreger irrelevant. Dies sollte im Umgang mit den Betroffenen von den Entscheidungsträgern berücksichtigt werden, um die Epidemie besser in den Griff zu bekommen und vermeidbaren Schaden von den Bürgern zu vermeiden.

- Daher sind die mittelbare Gesundheitsrelevanz der Maßnahmen sowie die daraus zu erwartenden epidemiologischen Effekt genauso zu prüfen, wie ihr Einfluss auf die Unterbrechung der Transmission.

- Der Einsatz von Substanzen zur temporären Senkung des Kontagionsindex z.B. durch Unterstützung der unspezifischen Abwehr sollte genutzt werden, um das Gesundheitspersonal besser zu schützen, gerade wenn mit Mutanten zu rechnen ist, gegen die Impfungen nicht voll wirksam sein könnten.

- Die Frühphase von COVID-19 ist mitbestimmt von der Reinfektion von Viren, die im Atemtrakt wieder „nach außen“ (in die Nase, Lunge, Mund) abgegeben werden. Es ist zu erwarten, dass durch Inhalation mit einem verträglichen Antiseptikum dieser Patienten die Heilungsprozesse verbessert und daher der Anteil an Personen, die künstlich beatmet werden müssen und dadurch ein erhöhtes Sterberisiko haben, gesenkt werden kann.

- Zudem wird dadurch das Übertragungsrisiko auf das Pflegepersonal verringert.

- Mittelfristig kann das Risiko für Infektionskrankheiten gesenkt werden, indem die Lebensqualität angehoben, die Vorsorge für vom einzelnen nicht bewältigbare Risiken (Krankheit, Arbeitslosigkeit, Altersversorgung, Pflege) gestärkt und die Hoffnung auf eine bessere, absehbare Zukunft unterstützt wird (Bildung) etc.

- Nicht nur aus individual- und seuchenhygienischer Sicht ist es wesentlich umfassende Strategien zu entwickeln. Der Mensch als soziales Wesen braucht persönlichen Kontakt mit anderen. Er hat einen Anspruch auf transparente, überprüfbare Erklärung, warum welche Maßnahme gesetzt, wie diese (auch mathematisch) begründet werden und ihm damit seine Grundrechte, aber auch Zukunftschancen beschnitten werden. Doch schon aus medizinischen Gründen ist dies wesentlich.

- Auch bei Setzen der Maßnahmen ist ein Restrisiko nicht auszuschließen.

- Gerade dort, wo die betroffenen Personen und ihr aktuelles Risiko die Keime übertragen zu können, bekannt sind, bietet sich an, durch begleitende Maßnahmen die individuelle Handlungsfreiheit zu erhöhen: So könnte man bei Vorliegen eines aktuellen negativen Tests den Besuch in einer Gastwirtschaft denen ermöglichen, die vor Betreten des Lokals ein verträgliches Antiseptikum vor einem Zeugen in die Nase applizieren. Dies ist gedacht als zusätzliche

Maßnahme zu den ansonst den Lokalbetreibern und Gästen vorgeschriebenen Vorkehrungen

○ Mit einer solchen Maßnahme könnten Personen für ausgewählte Situationen den schon geimpften Personen gleichgestellt werden.

• Seit Anfang Jänner 2020 stehen Impfstoffe zu Verfügung. Ihre Aufgabe ist es das individuelle Risiko für den Geimpften wesentlich zu senken schwer zu erkranken oder an COVID-19 zu sterben. Es ist erfreulich, wenn zusätzlich auch seuchenhygienische Vorteile eintreten. Wirksamkeit ist jedenfalls dadurch zu erwarten, dass die Relevanz der Geimpften als klassische Überträger stark reduziert wird. Sie erkranken ja nur mehr viel seltener. Ob es darüber hinausgehende relevante Auswirkungen auf das epidemische Geschehen gibt, kann derzeit nicht endgültig beurteilt werden.

• Es muss damit gerechnet werden, dass plötzlich auch Mutanten auftreten, die durch die aktuell verfügbaren Impfstoffe nicht bekämpft werden können. Will man nicht mit der ständig drohenden Gefahr neuer Lockdowns leben, muss man vorbereitet sein, diese auch durch unspezifische Maßnahmen zu bekämpfen.

• Es sind noch zahlreiche Fragen zum Wesen der Interaktion zwischen SARS-CoV-2 und dem Organismus offen.

○ It is striking, for example, how often it is impossible to trace the chain of infection. Just blaming the infected persons for being unwilling or forgetful is obviously not enough: An epidemiologically excellently constructed study on the course of the effects of the epidemic in Wuhan recently came to the conclusion that 82% of all persons in whom antibodies and thus the disease were detected had no symptoms<sup>xcvii</sup>. The assessment of the relevance of these so-called "asymptomatics" therefore ranges from "probably subordinate role" (Robert Koch Institute<sup>xcviii</sup>) to "urgent need for further clarification" because of the broad differences (4 - 41%)<sup>xcix</sup> to with 82% probably no longer subordinate. The informative value of the persons conspicuous with symptoms or by PCR tests in the follow-up for the characterization of the situation and the estimation of the further course seems thus worth reviewing.

○ Regardless, it would be valuable to know which and how many individuals per day were shown to have been admitted with COVID 19 and how long each lingered. However, this would require individual data.

○ What is the reason that in Carinthia, for example, during the summer of 2020, despite extreme tourist utilization and the associated increase in contacts, the reproduction number was not even calculable for quite some time (end of April to end of June)? The dead no. 13 was registered in Carinthia on May 3, 2020, the dead no. 14 only on October 23. Natural scientific characteristics of the climate cannot find the world organization of the meteorologists for it. <sup>c</sup>

- The global significance of the pandemic deserves special attention. The effort to also provide the financially weak countries with the necessary aid is a priority, if only for self-protection. The aid must come quickly: As honorable as it is to discuss releasing the patents for the vaccines, this will not achieve the necessary protection. It would make more sense to provide a free supply of vaccines throughout the country. These countries would be more helped by releasing the patents for the production of tolerable antiseptics. They could probably produce these themselves very quickly and thus bridge the phase so that the vaccines can be made available to them.

- An era of pandemics is looming. This has various consequences: They also affect internal and external peace in many ways. Anyone who can produce a modern vaccine could also construct a pathogenic virus with terrorist intent. A new form of threat has emerged. In terms of individual hygiene, only non-specific defenses can be used against it. Otherwise, society is challenged.

- This also applies to the implementation of the demands of the IPBES: It estimates the number of different types of viruses for which animals are currently the hosts and are potential threats to humans at 700,000 to 825,000. It is high time to counter the danger of new human-pathogenic viruses forming and causing epidemics. This will require correspondingly comprehensive spatial planning measures and appropriate habitat disentanglement.

- The global confrontation with COVID-19 must not only take into account the ecological framework. The threat also affects cultural diversity. But it is also possible that the experience accumulated over millennia offers evidence-based medical options that have not yet been adequately considered.

### **G) "THE GAME ABOUT THE NEW NORMALITY"- ALMOST A THOUGHT EXPERIMENT**

Nobody knows the future, everybody would like to know at least roughly how it could look like. With the information now available, it is possible to mentally derive one's own model of the future. A game is intended to help with this: Not as a classic scientific thought experiment, but rather as a playful exploration of "What if?". Hence "The game about the NEW NORMALITY". It is supposed to help everyone - whether private person or decision maker - to realize which "NEW normality" would expect us, if which measures are set or would have been set.

The game can be played alone, in pairs or with several people. It is only necessary to agree beforehand on what the content of the game should be this time. The game allows for many creative possibilities. The basics for the game are included in this handout.



Thus, one can think about how the situation might look today if one had not taken the measures actually realized in March 2020, but had also used this or that possibility. You are also free to try to determine, for example, what the consequences would be in the future if this or that measure were taken today. You can focus on the near or distant future of your personal life or think about global changes. One can also make it a goal to consider what measures would be appropriate so that next summer would again be the everyday normal as it was in the summer of 2019.

One can take into account what which concepts have yielded in practice so far, e.g., the actions of most Western countries with their effects that go far beyond health aspects. One can also consider how the current situation in China came about and how surprisingly little impact the models of experimental epidemiologists have had on Chinese policy. Decision makers in so many states, however, have gone by the model that was calculated for WUHAN in the spring. No SEIR model would likely have calculated 60 days of quarantine in Wuhan, linked to the range of other measures. What would the consequences have been if, for example, the South Korean approach had been adopted. This state showed only an approximate 1% decline in GDP for 2020, but requires considerable concessions from its citizens and visitors regarding the state's access to individual behavior.

### **1. Zero-sum game or WINWIN?**

Intentionally, only a few suggestions are made as to how the game should be organized. Playing should stimulate one's own creativity. For many, it is essential to be able to defeat one's teammate in the game, as in soccer: in order to succeed, one must inflict a defeat on the other team. The gain of one is matched by the loss of the other: Hence "zero-sum game". But isn't there another way<sup>ci</sup>? Computer games in particular show us: You can fight together against an anonymous enemy and win by the fact that the other player also wins. Such WINWIN situations are a prerequisite for evolutionary progress. Games have also become established in which one experiences success by successfully managing the processes in a city to the prosperity of its citizens. This does not necessarily mean that one has to cheat one's former partner in the end, as game theory teaches us with the example of the prisoner's dilemma: Here, both prisoners go home with a small penalty as long as both cover each other. Therefore, both would have an advantage as long as one assumes that the partner continues to be satisfied with the small advantage. After all, each has the chance to give the other a severe punishment and himself a greater advantage by betraying him. But why is it necessary to assume that both have something to hide and therefore, objectively, both are delinquent? Must the (economic,

biological) maximization of success always be assumed as the determining control component, as leading economists (e.g. the Nobel Prize winner for economics Nash) and John Maynard Smith, a trendsetter in evolutionary game theory, have assumed? Surely this "classical approach" rarely applies in the case of COVID 19, when the real issue is the successful fight against the pandemic. That one can draw personal advantage from the distress of others is indisputable. But this approach is rather counterproductive when it comes to the problem at hand, namely the fight against the direct and indirect consequences of COVID-19.

## **2. Risk Sharing and Functional Cooperation**

The doctrine of profit maximization imposed on industry draws attention to a little-discussed but crucial change in COVID-19 strategies: the fact that vaccines could be developed and brought to market within a year. Inama-Sternegg attributes this to the fact that, for the first time, the steps in vaccine development that used to take place one after the other were carried out in parallel and in continuous coordination with the regulatory authorities<sup>cii</sup>. In this way, the interests of those developing the vaccines as well as the naturally different, and therefore not competing, requirements of responsible inspection could be secured at the same time. The parallel processing of the previously successive steps could only be justified from an economic point of view because the institutions responsible for health security, namely the EU and the countries concerned, were prepared to share the cost risk of the development in advance. The prerequisite for this success was obviously a paradigm shift in self-image. Not only WINWIN can unite, but also the reduction of different risks. But for this to happen, it was necessary for both sides to abandon paradigms that had been out of discussion for decades. How difficult it is to abandon a position once held and long proven, as logically compelling as it may seem in retrospect, is probably known to everyone from their own experience. Because this is so difficult especially in science and usually only occurs with great sacrifices, Th. Kuhn felt compelled to distinguish between "paradigmatic science" and "normal science".<sup>ciii</sup>

## **3. Against the inner resistance - Max Planck and the peace of mind**

The game opens up another possibility for success: In the game, one is "allowed" to think about things that would be completely out of the question "in real life". But often such considerations later turned out to be completely obviously correct, even if insignificant for everyday life. Let us only think which resistances Galilei, Copernicus, Darwin and Freud have caused with their logical deductions from facts which are in themselves indisputable. Who cares today

whether the earth revolves around the sun or the sun around the earth, that man is biologically a primate and that there are unconscious influences on behavior. But at that time this was obviously not a question of logical evaluation of newly available facts or conclusions. Here it was a question of the "canned stuff" and not only of mankind at that time, but of each individual in his self-conception as a person and member of his community. The resistance grew, so to speak, out of the necessity to protect oneself from the consequences of a new way of thinking against which no logical arguments could be put forward.

a. Who wants to question themselves?

Freud saw in this a "narcissistic mortification" of mankind<sup>civ</sup>. Perhaps Max Planck described such situations better when he speaks of the threat to the "peace of mind" which Max Planck classified as the most fundamental goal of every human being. Thereby he anticipates conclusions which are discussed in different versions in modern communication research: e.g. as "tragedy of risk perception"<sup>cv</sup>. Investigations of the neuronal correlates show that the recognition of one's own basic misperceptions is answered with reactions that one would also expect when threatened, e.g., by a bear.<sup>cvi</sup> How profound such entrenched positions can be is proven by none other than Albert Einstein. He represented the revolutionary scientific opinion that the planets and all particles would move purposefully themselves according to the way most comfortable for them from technical point of view. His friend Bertrand Russell clarified the world view of Einstein with following example: "*Just as the sea is not the cause that the water flows to it, the sun is not the cause that the planets orbit it. The planets move around the sun because this is the easiest possibility for them - in the technical sense of "smallest effect". It is the easiest of all possibilities because of the nature of the area in which they are, not because of any influence emanating from the Sun*"<sup>cvii</sup>. But at the same time Einstein insisted that everything, even himself, had no free will. We would only imagine it. This was incompatible with a model of thought represented in particular by Heisenberg during his life. According to this, one could make the indeterminacy of the individual orientation, e.g. of a particle, understandable by granting them an individual arbitrariness within explorable and narrow limits<sup>cviii</sup>. Heisenberg's proposal is scientifically correct and worth testing. Einstein could react to it - as an avowed follower of the religion view of Baruch Spinoza consequently - only more emotionally. And he did this in an extreme way<sup>2</sup>: "*The thought that an electron exposed to a beam chooses by free*

---

<sup>2</sup> Einstein an Rabbi Goldstein, The New York Times 25 4 1929: *Ich glaube an Spinozas Gott, der sich in der gesetzlichen Harmonie des Seienden offenbart, nicht an einen Gott, der sich mit Schicksalen und Handlungen der Menschen abgibt. I believe in Spinoza's God, Who reveals*

*decision the moment and the direction in which it wants to jump away is unbearable to me. If anything, I would rather be a cobbler or even an employee of a casino than a physicist.*<sup>cix</sup>"

And Darwin wrote to his closest friend Hooker in 1844: *I am almost convinced (quite contrary to opinion I started with) that species are not (it is like confessing a murder) immutable.*<sup>cx</sup> This scientifically correct conclusion inevitably had consequences for Darwin that went far beyond science: They forced Darwin to adopt attitudes that were no longer compatible with his requirements for himself. Therefore, in 1844, they prevented Darwin's peace of mind as murder would have done. Fourteen years later, when Darwin's ideas were first put forward in public, Darwin had ordered his world of thought to such an extent that the idea that species were changeable was incompatible neither with his scientific ideas nor with his ideas about "God and the world". They corresponded - as the later Archbishop of Canterbury emphasized in his sermon before the world-famous confrontation between Bishop Wilberforce and "Darwin's bulldog" Huxley - very well to the view of religion held by the ultimately successful progressive clergy of the Anglican Church<sup>cx</sup>. Einstein and Darwin thus prove two things: On the one hand, that religion-bound world views were significant for them also for the understanding of science and, on the other hand, that scientific correct arguments can be significant far beyond the principles of logic. Just the one who puts forward such fundamental positions in a logically compelling way puts one in the situation of having to question oneself. This must be prevented and the peace of mind must be restored. This is someone who fouls his own nest and must be fought therefore with all means. And the scientific argumentation brought forward is "not even ignored". Also this can be proved with Darwin: The Secretary General of the Lineé Society, in which the world-changing contributions of Darwin and Wallace were presented on July 1, 1858, concludes in the report on the year 1858 that no really significant lecture had been given. A few months later, the first edition of the *Origin of Species*, which had been increased from 500 to 1250, was sold out within a week. As if nobody had recognized the importance of the lecture!

One will now object that the time is past - at least in Europe - when religion-related taboos were violated and the peace of mind of enlightened scientists could be threatened. Today, every argument would be discussed without prejudice, as long as it was logically correct. But is this really true? Or is not Newton's self-assessment confirmed, according to which his importance as a religious philosopher was greater than that as a physicist and mathematician. Einstein relativized Newton as a physicist and his mathematics. He proved mathematically

---

*Himself in the lawful harmony of the world, not in a God Who concerns Himself with the fate and the doings of mankind*

and empirically that Newton's world view of the forces is appropriate only from the evolutionary level, in which there are solid bodies. Popper even tried to convince Einstein that he had thus falsified Newton's formulas. But Newton's world view of the cause of the movement of the solid bodies seems unbroken: The solid bodies are moved passively. To be able to justify this, he had to change the understanding of the being of God as the first mover. Since Aristotle and - for Christianity adjusted by - Thomas Aquinas it was valid that God motivates to the self-movement and every effectiveness and forces nothing and nobody. In this world view, God was the first mover, because he motivates to choose between alternatives the one that is advantageous in the long run, but also leaves other choices open. Newton changed this fundamentally. His God is the first mover because he forces the objects of his creation to act in an externally determined way through his physical omnipotence. Guilt and sin become possible only by the soul breathed into man.

a. Does Newton as a philosopher of religion still determine science today?

With Aristotle only God rests in himself and thus experiences his bliss in this ideal rest. The godlike stars and planets observe God and strive to move as exactly as possible around God, in order to attain thereby as similar bliss as possible. They themselves are empowered to effectively align themselves with self-chosen goals. There is no need for a passive, externally determined cause. Thus, Aristotle anticipated Einstein's world view of physical objects moving themselves constantly as conveniently as possible, but at the price of having to attribute divinity to the stars and planets. For Einstein the stars become inanimate earthly objects. But they remain part of the creation by an ideal God who is therefore himself limited to be able to create only ideal (Baruch Spinoza!). All objects must therefore ultimately come - consciously or unconsciously - to the decision for the ultimately ideal working. Einstein thus refutes not only Newton's machine model of physics. He refutes the being forced, replaces it by conscious or unconscious insight on the ideal. From the effect it comes out to the same: Whether one can be sure as a researcher that an effect will occur, because the objects must act in such a way determined by others (Newton), or because they will decide consciously or unconsciously for it (Einstein) or will probably act in such a way in the expectation of an own advantage (Darwin, extended evolutionary view), one does not even need to disclose: After all, the result corresponds to the prediction. It becomes really interesting when one has to justify why the predicted result does not always occur.

Thus it is well conceivable that also atheistic scientists assume to live in a world which functions so well only because inanimate objects can have only

foreign-determined effects. That these scientists carry on with it the inheritance of a religion-philosophical world view, which was invented only in the late 18th century, these researchers probably do not know at all. Nevertheless, one must reckon with the fact that this irrational position is represented just as consistently as at that time opposite Galilei, Kepler, Darwin, Freud etc.. These questions will be discussed in more detail in part 2.

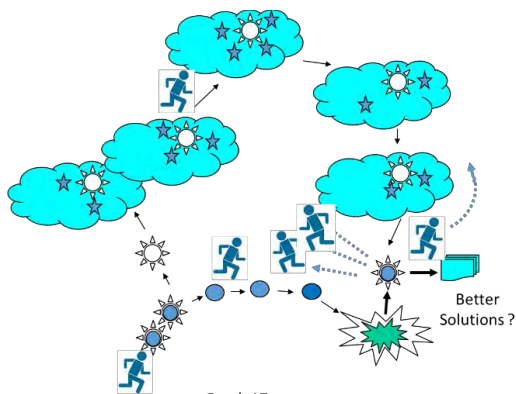
For the discussion of SARS-CoVB-2 and COVID 19, this discussion could become important, for example, when it comes to explaining why there is an increased occurrence of mutants. It is discussed e.g. in Oxford that in the probably rare cases of a simultaneous infection with two variants or different viruses it could come to an exchange or transfer of genetic material. It is in any case also remarkable that it is discussed whether the local coincidence of different mutants is conceded a relevance for a combination of hereditary materials. Then the probability of the occurrence would depend nevertheless also on other influencing variables, than the pure coincidence distribution with the spontaneous mutations for instance in the sense of a Lederberg constant. Remarkable the interpretation by Nels C Elde of his own work on the significance of extensive recombination, i.e. the incorporation of whole gene segments into the genome without their origin being clear<sup>cxii</sup>: *"In some cases it almost looks as if a sequence came from outer space, from coronaviruses, of whose existence we do not even know anything."* But does it even have to be recombination? Feng Gao (Jinan University in Guangzhou) surmises, *"It could simply be that they evolved themselves."*<sup>cxiii</sup>

Thus, Feng Gao takes a position that is very close to the proposed discussion that Burnet presented at the Nobel Prize ceremony as the central position of his work on the rationale for the interaction between the inanimate structures of antigens and antibodies. This is also discussed in Part 2. Other considerations are also pointed out there as to why consensus between powerful people can proceed as Andersen described in the fairy tale of the Emperor and his New Clothes.

#### **4. The playing field and the cloud**

A thought game also needs a playing field: this can be thought of as in a game in which the game piece has predetermined ways of getting to the evaluation point by a shorter or longer path. The shortest path corresponds to the pragmatic sequence of the points dealt with, the longest to that of the application-oriented scientist. The individual chapters of this booklet therefore represent the points that one covers on the way to the evaluation point. For example, you may advance to the next point when you think you have understood the content. Each game character has the possibility to retrieve information "from the cloud": So,

for example, to go the short way and get additional information "from the cloud" to make clear how to understand the message of the current point. Since after reaching the point of meaning the discussion with the other players will start, one can also consult the information from the cloud in order to be better equipped for this discussion. In the end, one wants to be able to represent one's ideas about the "New Normal" well. In the cloud are all the positions that are passed through on the "long road". As with the cloud on the Internet, one can easily get to the targeted information from any point. Of course, one can also skip positions on both the pragmatic, short path and the "long" path oriented to application-oriented science or jump to a position via the cloud at any time.



Graph 17:  
THE „GAME OF NEW NORMALITY“

Once you have reached the evaluation point, the real game is on: Evaluating the content thus acquired and fitting it into an insightful picture for the "New Normal."

## 5. Weighting and linking the arguments

But this is only possible if the game instructions also offer methods for relating the different arguments to each other. One must then be able to weigh the advantages and disadvantages, goals and fears against each other. But these are by their nature much more different than the famous "apples and pears". To compare them would be scientifically inadmissible. But this incompatibility exists only if one assumes a two-value logic. Then apples are apples and not pears. But in everyday life it is self-evident that one must always decide between not comparing advantages and disadvantages according to these strict rules of Aristotelian logic. There are good reasons why someone prefers this kind of apples to those pears, although one actually prefers pears. It becomes even more difficult when one has to weigh up between duty and inclination, would it be better to play soccer now or do homework? And it becomes problematic with predictions about the epidemic with COVID-19 in a certain country, if one is to

estimate how constants change, if they are not constant at all, but are dependent on several mutually independent influencing variables, e.g. the infectivity in the sense of Kermack and McKendrick: There variables of the viruses and innumerable influencing variables on the factor humans go into one and the same constant. The importance of the resulting uncertainties can be seen from the fact that the former CEO of SCIENCE recently called for the establishment of a new Federal Agency in the USA in an editorial in Science: The currently available models, he said, are too less informative and often arrive at extremely different forecasts. We do not need to wait for this Agency for our playbook.<sup>cxiv</sup> It must contain two different approaches to decision making:

First, a handout for weighting judgmental trade-offs, namely the "crosshairs." It allows a semiquantitative and individual classification. The second access can be used for decision making on the level of a two-valued and thus generalizable logic.

#### a. The Crosshair

The name comes from the comparison with a telescopic sight that shooters use. Here, the selected target is in the center. The requirements that have to be taken into account are those that have to be coordinated with each other. In our case, the influencing variables and their effects in relation to the target in the center are to be matched. One can list the different effects on the vertical axis (ordinate) among themselves and on the horizontal axis (abscissa) the different measures to achieve these effects. The importance one attaches to the successful implementation of the measure for the central goal from the personal point of view can be indicated with semiquantitative symbols, e.g. one to three plus or minus points or a zero if no effect is to be expected...

In this way, even contexts that are not comparable in themselves, etc., are made comparable from the point of view of one's own assignment of meaning. Already the creation of the diagram is helpful: One must make clear what is to be brought into the center and which possibilities are given at all. Once the list of possibilities and the list of effects have been drawn up, one is reminded that measures can also have effects in areas that one had not even thought of before. Assigning semiquantitative ratings to each field of the "crosshairs" also helps to check oneself to see if one has "made a mountain out of a molehill" in one context, and "made a molehill out of an elephant in another."

And should one not recognize such misclassifications oneself, one's attention is drawn by a fellow player to the fact that one could, with more or less good reasons, do the weighting of meaning differently.



The procedure presented here is used in a similar form e.g. in environmental impact assessments to make the positions of experts from different disciplines transparent for a project.

The crosshairs can be created simply or very comprehensively. If you also want to convert these assignments of importance into a mathematizable form, you can calculate a score for each measure and each effect by summing up the evaluation points. This can be used, for example, to determine significance, which is useful for using the second technique.

b. A simple fault tree (following G. Fumarola)

There are questions for which weighting is not or no longer decisive. Let us just think of a chess tournament. For the chess players it is essential to be able to think oneself into the other in such a way, in order to guess which of the weighting evaluating decisions he will make and how one should prepare oneself accordingly. The partner can choose between different pieces and then decide in which way he wants to move the chosen piece. But the referee is completely different: he only checks whether the rules have been correctly followed. Who wins and who loses is of no importance to him. Nevertheless, all three have a common goal, for which chess is a means: professional chess players and arbiters are paid. So when it comes to the question of securing a livelihood, the differences fall away. Then there is no longer any need for a weighted evaluation.

Whether behind physical and biological processes weighting evaluating weighing processes are to be assumed, as this e.g. Burnet in connection with the sensitization against potential allergens puts to the discussion (see...) , one can often ignore in practice: In the allergic person, the allergen will trigger the antibody response. Why the two inanimate substances can do this is not relevant for the patient. The same applies to the different interests and fears in the context, which one wants to take into account for one's own appropriate course of action. But once it has been clarified by weighting evaluative weighing how significant what is classified and which methods have been deemed useful for achieving it, then one can move on to a pragmatic yes-no decision. But this also requires a scheme. It is now necessary to consider what needs to be done and in what order, from whom one can get the best expert advice, what technology will perform the necessary service and how successfully, etc. If one proceeds haphazardly here, this can lead to mistakes with serious consequences. So it takes decision support to avoid these mistakes.

Fumarola advises to start very simply<sup>cxv</sup>: That is, by setting a goal that you want to achieve. Then you need influencing variables. These can have an independent effect on the desired goal, or they can influence each other. This then

leads to processes that result in a fundamentally new event. This becomes then the starting point for the next steps, until one determines whether one can reach the goal in such a way or not.

It is also helpful to consider the time factor. How long does which measure need, until when are all conditions fulfilled, so that the measure can be used? Such considerations build a bridge to classical methods of network planning. But for a playful discussion, it is usually sufficient to make clear how important all the sub-aspects addressed are, so that one can also practically implement what one has identified as a priority for oneself with the help of weighting evaluations.

Part 2 is intended to offer helpful information on this.

## References

- 
- <sup>i</sup> Reason J Human error models and management *BMJ*. 2000 Mar 18; 320(7237): 768–770. doi: 10.1136/bmj.320.7237.768
- <sup>ii</sup> Brehm JW: Control, Its Loss, and Psychological Reactance, in: Weary, Gleicher, Marsh (Hg.), *Control Motivation and Social Cognition*. Springer, Heidelberg 1993
- <sup>iii</sup> Frankl V: • *Man's Search for Meaning. An Introduction to Logotherapy*. Simon & Schuster, New York/Beacon, Boston, ISBN 0-8070-1426-5; Random House/Rider, London 2004, ISBN 1-84413-239-0
- <sup>iv</sup> Frankl V: • *Man's Search for Meaning. An Introduction to Logotherapy*. Simon & Schuster, New York/Beacon, Boston, ISBN 0-8070-1426-5; Random House/Rider, London 2004, ISBN 1-84413-239-0
- <sup>v</sup> Altman M: The Nobel Prize in behavioral and experimental economics: a contextual and critical appraisal of the contributions of Daniel Kahneman and Cernon Smith, *Review of political economy*, 2004, 3 – 41, <https://doi.org/10.1080/0953825032000145445>
- <sup>vi</sup> Deutsche Gesellschaft f Pädiatrische Infektiologie. PIMS Survey Update, <https://dgpi.de/pims-survey-update/>
- <sup>vii</sup> Kofler W: Open lecture serious; A future oriented model for physiology: 1a) back to the future, b) Simplicity Potentia Hiroshima c) Physiological consequence of a and b, Sechenov First Moscow State Medical University, 2019
- <sup>viii</sup> Einstein A: *Autobiographical notes*, in Schilpp (ed.) *Einstein Philosopher - Scientist*, Library of Living Philosophers, VII, La Salle, 1949
- <sup>ix</sup> Popper K.: *Die Logik der Forschung - Zur Erkenntnistheorie der modernen Naturwissenschaft*, 1935, 10. Auflage, Mohr Siebeck, Tübingen, 1971, *The Logic of Scientific Discovery* (1959)
- <sup>x</sup> Kofler W: A future oriented model for physiology Part 2b: A model from Big Bang to Big Mac, *Toolbox – Theory of Principles Einstein*, Open Lecture, Sechenov university, Moscow, 2019, 19138\_M-2019.09.02\_02\_2, [https://yadi.sk/d/OmMBG7Zj\\_vpVQ](https://yadi.sk/d/OmMBG7Zj_vpVQ)
- <sup>xi</sup> IPBES (2020) *Workshop Report on Biodiversity and Pandemics of the Intergovernmental Platform on Biodiversity and Ecosystem Services*. Daszak, P., das Neves, C., Amuasi, J., Hayman, D., Kuiken, T., Roche, B., Zambrana-Torrel, C., Buss, P., Dundarova, H., Feferholtz, Y., Foldvari, G., Igbino, E., Junglen, S., Liu, Q., Suzan, G., Uhart, M., Wannous, C., Woolaston, K., Mosig Reidl, P., O'Brien, K., Pascual, U., Stoett, P., Li, H., Ngo, H. T., IPBES secretariat, Bonn, Germany, DOI:10.5281/zenodo.4147317

- <sup>xii</sup> MacKay IM (virologydownunder.com) based on JT Reason (the Swiss Cheese Model of accident causation (1990, 2006)
- <sup>xiii</sup> Robert Koch Institut: ControlCOVID, Strategie und Handreichung 19.3.2021  
[https://www.rki.de/DE/Content/InfAZ/N/Neuartiges\\_Coronavirus/Downloads/Stufenplan.pdf](https://www.rki.de/DE/Content/InfAZ/N/Neuartiges_Coronavirus/Downloads/Stufenplan.pdf)
- <sup>xiv</sup> Kofler W: A future oriented model for physiology Part 1a: Back to the future, Open Lecture, Sechenov university, Moscow 2019, 19138\_M-2019.09.02\_01\_1,  
<https://yadi.sk/d/OmMBG7Zj- vpVQ>
- <sup>xv</sup> <https://www.who.int/news-room/commentaries/detail/multisystem-inflammatory-syndrome-in-children-and-adolescents-with-covid-19>
- <sup>xvi</sup> Leopoldina: Dritte Ad-Hoc-Stellungnahme: Coronavirus-Pandemie- Die Krise nachhaltig überwinden, 13.4.2020. [www. Leopoldina.org](http://www.Leopoldina.org)
- <sup>xvii</sup> Kofler W: A future oriented model for physiology Part 3b Interrelationship environment health Open Lecture, Sechenov university, Moscow 2019, 19138\_M-2019.09.02\_03\_02  
<https://yadi.sk/d/OmMBG7Zj- vpVQ>
- <sup>xviii</sup> W Kofler, M. Wagner, M. Paduch, H. Mannebeck: On combinatory effects of subjective stimulants and physical and chemical loads, Int. Union of Air Pollution and Environmental Protection Associations(ed.) The interface between developing and developed Countries, – NACA, Parklands, ISBN 0-620-23063-0, Vol 2, 7G2, 1998
- <sup>xix</sup> Blackburn E., E Epel: Die Entschlüsselung des Alters - Der Telomer-Effekt, Mosaik, München 2017, orig. The Telomere Effect, Grand Central Publ. NY 2017
- <sup>xx</sup> Brody et al.: Prevention Effects Ameliorate the Prospective Association Between Nun-supportive and Diminished Telomere Length, Prevention Science: The official Journal of the Society for Preventive Research, 16, 2 (February 2015) 5944-5949,  
doi:10.1073/pnas.1404293111
- <sup>xxi</sup> Maxmen A: Inequality's deadly toll, Nature 28 April 2021,  
<https://www.nature.com/immersive/d41586-021-00943-x/index.html>
- <sup>xxii</sup> Hall VJ et al SARS-CoV-2 infection rates of antibody- positive compared with antibody-negative health-care workers in England: a large, multicentre, prospective cohort study (SIREN)Lancet Published: April 09, 2021DOI:[https://doi.org/10.1016/S0140-6736\(21\)00675-9](https://doi.org/10.1016/S0140-6736(21)00675-9)
- <sup>xxiii</sup> Ashcroft P et al: COVID-19 infectivity profile correction, Swiss Med Wkly, 2020;150:w20336, DOI: <https://doi.org/10.4414/smw.2020.20336>
- <sup>xxiv</sup> Kofler W: Open lecture serious; A future oriented model for physiology: 1a) back to the future, b) Simplicity Potentia Hiroshima c) Physiological consequence of a and b; 2a) A model for a dynamic understanding of the evolutionary process b) From Big Bang to Matrix World; c) from Matrix World to Fundamental Break and modern person; 3a) The person – the principles – daily life and health; b) The person and his/her environments; c) The frame for modern health, Sechenov First Moscow State Medical University, 2019
- <sup>xxv</sup> Duncan R., M Weston-Smith (eds.): The Encyclopedia of Ignorance, Poclet Books, NY, 1977
- <sup>xxvi</sup> Kofler W. Umweltmedizinisches Gutachten in Verwaltungsverfahren In: Janauer GA, Kerschner F, Oberleitner F. (Hrsg.). Der Sachverständige in Umweltverfahren. Wien: Manz, 1999: 152-215
- <sup>xxvii</sup> Einstein A: Prinzipien der Theoretischen Physik, Inaugurationsvortrag Preussische Akademie der Wissenschaften, Proceedings, II, 739-744, 1914 in Mein Weltbild 110-113, Principles of theoretical physics, in (Einstein: Ideas and Opinions 220-223 Three Rivers edition
- <sup>xxviii</sup> Stockmaier S et al: Infectious diseases and social distancing in nature, Science 371, eabc8881 (2021). DOI: 10.1126/science.abc8881

- <sup>xxix</sup> Kermack WO, AG McKendrick: A Contribution to the Mathematical Theory of Epidemics. Proc. Royal Society A, Mathematical, Physical and Engineering sciences, 1927  
<https://doi.org/10.1098/rspa.1927.0118>
- <sup>xxx</sup> Micklem HS: Immunology, in: Duncan R, M Weston-Smith (eds.) The Encyclopedia of Ignorance, Wallaby Book, NY, Pergamon Press, 1978, p. 305 - 310
- <sup>xxxi</sup> <https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---16-march-2020>
- <sup>xxxii</sup> IPBES (2020) Workshop Report on Biodiversity and Pandemics of the Intergovernmental Platform on Biodiversity and Ecosystem Services. Daszak, P., das Neves, C., Amuasi, J., Hayman, D., Kuiken, T., Roche, B., Zambrana-Torrel, C., Buss, P., Dunderova, H., Feferholtz, Y., Foldvari, G., Igbinosa, E., Junglen, S., Liu, Q., Suzan, G., Uhart, M., Wannous, C., Woolaston, K., Mosig Reidl, P., O'Brien, K., Pascual, U., Stoett, P., Li, H., Ngo, H. T., IPBES secretariat, Bonn, Germany, DOI:10.5281/zenodo.4147317
- <sup>xxxiii</sup> Gottardi, W. & Nagl, M. N-chlorotaurine, a natural antiseptic with outstanding 577 tolerability. J. Antimicrob. Chemother 65, 399-409 (2010).
- <sup>xxxiv</sup> Lackner M. , M Nagl et al: N-chlorotaurine, a novel inhaled virucidal antiseptic is highly active against respiratory viruses including SARS-CoV-2 (COVID-19)  
<https://www.researchsquare.com/article/rs-118665/v1>
- <sup>xxxv</sup> Kofler W, OS Glazachev, H. Lyshol, G. Tellnes: Is fighting against COVID 19 enough?, Scandinavian Journal Public Health, 1-5, 2020 DOI 10.1177/14043948209069539
- <sup>xxxvi</sup> EUR/&RC48/9 Lissabon treaty Art 168, WHO Strategy H21
- <sup>xxxvii</sup> Drosten Chr. Interview Neue Osnabrücker Zeitung, zitiert Fokus, 278.000 Virus-Tote in Deutschland? Wie der Top-Virologe seine Zahl meint, 13.3.2020
- <sup>xxxviii</sup> [https://www.g20-insights.org/related\\_literature/s20-saudi-arabia-communique/](https://www.g20-insights.org/related_literature/s20-saudi-arabia-communique/)
- <sup>xxxix</sup> Kofler W: A future oriented model for physiology Part 1a: Back to the future, Open Lecture, Sechenov university, Moscow2019, 19138\_M-2019.09.02\_01\_1,  
[https://yadi.sk/d/OmMBG7Zj-\\_vpVQ](https://yadi.sk/d/OmMBG7Zj-_vpVQ)
- <sup>xl</sup> Sechenov I.M. The reflexes of the brain, in I.M. Sechenov: Selected works, reprint Bonset, 1968, 263-336
- <sup>xli</sup> Kofler W: A future oriented model for physiology Part 1a: Inhibition and enforcement, Open Lecture, Sechenov university, Moscow2019, 19138\_M-2019.09.02\_01\_2,  
[https://yadi.sk/d/OmMBG7Zj-\\_vpVQ](https://yadi.sk/d/OmMBG7Zj-_vpVQ)
- <sup>xlii</sup> Cori A, M N Ferguson, Chr Fraser, S Cauchemez: A New Framework and Software to Estimate Time-Varying Reproduction Numbers During Epidemics, American Journal of Epidemiology, 178, 9, 2013, 1505–1512, <https://doi.org/10.1093/aje/kwt133>
- <sup>xliii</sup> Times of Israel: <https://www.juedische-allgemeine.de/israel/viren-einfach-weggesprueht/>
- <sup>xliv</sup> Kofler W, M Nagl: The whole strategy has to be extended now – beyond modeling, eletter, Press WH, RC Levin, Modeling, post COVBIDF-19, Science, 370, 6520, 2020, DOI: 10.1126/science.abf7914
- <sup>xlv</sup> Kofler W, OS Glazachev, H. Lyshol, G. Tellnes: Is fighting against COVID 19 enough?, Scandinavian Journal Public Health, 1-5, 2020 DOI 10.1177/14043948209069539
- <sup>xlvi</sup> Fang Fang: Wuhan Diary: Tagebuch aus einer gesperrten Stadt, M. Kahn-Ackermann (Übersetzer), Hoffmann & Campe 2020
- <sup>xlviixlvii</sup> Reason J Human error models and management BMJ 2000 Mar 18, 320 (7237): 768 - 770,
- <sup>xlviii</sup> Reason J: Managing the Risks of Organizational Accidents, 1997
- <sup>xlix</sup> Reason J Human error models and management BMJ 2000 Mar 18, 320 (7237): 768 -770,
- <sup>l</sup> Mackay JM: Swizz Cheese Respiratory Pandemic Defense-Model based on JT Reason: [virologydownunder.com](http://virologydownunder.com)

- <sup>li</sup> <https://www.bbc.co.uk/news/resources/idt-40ac92b1-1750-4e86-9936-2cda6b0acb3f>
- <sup>lii</sup> Pradetto A: Multiples Versagen: WHO, EU und Deutschland in der Corona-Krise, WIFES Arbeitspapier, 3, Hamburg 6 2020
- <sup>liii</sup> Aschwanden Ch. Five reasons why COVID herd immunity is probably impossible, Nature 18.March 2021, Nature 591, 520-522 (2021) doi: <https://doi.org/10.1038/d41586-021-00728-2>
- <sup>liv</sup> COVID-19: Vaccines alone will not end pandemic, warns IFRC; <https://media.ifrc.org/ifrc/press-release/covid-19-vaccines-alone-will-not-end-pandemic-warns-ifrc/>
- <sup>lv</sup> W Kofler, M. Wagner, M. Paduch, H. Mannebeck: On combinatory effects of subjective stimulants and physical and chemical loads, Int. Union of Air Pollution and Environmental Protection Associations(ed.) The interface between developing and developed Countries,– NACA, Parklands, ISBN 0-620-23063-0, Vol 2, 7G2, 1998
- <sup>lvi</sup> Sabino ES et al: Resurgence of COVID-19 in Manaus, Brazil, despite high seroprevalence The Lancet, 27 1 2021 Doi [https://doi.org/10.1016/S0140-6736\(21\)00183-5](https://doi.org/10.1016/S0140-6736(21)00183-5)
- <sup>lvii</sup> Lythgoe KA et al: SARS-CoV-2 within-host diversity and transmission, Science 09 Mar 2021, DOI: 10.1126/science.abg0821)
- <sup>lviii</sup> <https://ipbes.net/sites/default/files/2020-12/IPBES%20Pandemics%20Report%20Media%20Release.pdf>
- <sup>lix</sup> Starr TN, AJ Greaney, et al: Prospective mapping of viral mutations that escape antibodies used to treat COVID-19, Science 25 1 2021, DOI: 10.1126/science.abf9302
- <sup>lx</sup> World Meteorological Organization: First Report of the WMO COVID-19 TaSK Force; 18 3 2021, <https://public.wmo.int>
- <sup>lxi</sup> Schuit M, Ratnesar-Shumate S, Yolitz J, Williams G, Weaver W, Green B, et al. Airborne SARS-CoV-2 Is Rapidly Inactivated by Simulated Sunlight. The Journal of infectious diseases. 2020;222(4):564-71.
- <sup>lxii</sup> Cohen M: Turning up the heat on COVID-19 Heat as a therapeutic intervention, F1000Research 2020, <https://doi.org/10.12688/f1000research.23299.2>
- <sup>lxiii</sup> Kermack WO, AG McKendrick: A Contribution to the Mathematical Theory of Epidemics. Proc. Royal Society A, Mathematical, Physical and Engineering sciences, 1927 <https://doi.org/10.1098/rspa.1927.0118>
- <sup>lxiv</sup> Richter R et al: Schätzung des seriellen Intervalls von COVID19, Österreich, AGES 2020, <https://www.ages.at/download>
- <sup>lxv</sup> Gibbons A How tuberculosis reshaped our immune systems Science 2021 doi:10.1126/science.abh3787
- <sup>lxvi</sup> Richter R et al: Schätzung des seriellen Intervalls von COVID19, Österreich, AGES 2020, <https://www.ages.at/download>
- <sup>lxvii</sup> Gottardi, W. & Nagl, M. N-chlorotaurine, a natural antiseptic with outstanding tolerability. J. Antimicrob. Chemother 65, 399-409 (2010).
- <sup>lxviii</sup> Arnitz, R. et al. Tolerability of inhaled N-chlorotaurine in humans – a double-blind randomized phase I clinical study. Ther. Adv. Resp. Dis. 12, 1-14, 582 doi:10.1177/1753466618778955 (2018)
- <sup>lxix</sup> Lackner M. , M Nagl et al: N-chlorotaurine, a novel inhaled virucidal antiseptic is highly active against respiratory viruses including SARS-CoV-2 (COVID-19) <https://www.researchsquare.com/article/rs-118665/v1>
- <sup>lxx</sup> de Vries RD, KS Schmitz. Et al Intranasal fusion inhibitory lipopeptide prevents direct-contact SARS-CoV-2 transmission in ferrets, Science, DOI: 10.1126/science.abf4896
- <sup>lxxi</sup> <https://www.ndr.de/nachrichten/info/Coronavirus-Update-Alle-Folgen,podcastcoronavirus134.html>

- <sup>lxxii</sup> <https://www.timesofisrael.com/life-saving-nose-spray-that-kills-99-9-of-viruses-begins-production-in-israel>, abgerufen 31 3 2021
- <sup>lxxiii</sup> <https://www.timesofisrael.com/life-saving-nose-spray-that-kills-99-9-of-viruses-begins-production-in-israel>, abgerufen 31 3 2021
- <sup>lxxiv</sup> Cegolon L., M. Javanbakhit, G. Mastrangelo Nasal disinfection for the prevention and control of COVID-19: A scoping, *Int J Hyg Envir Health*, 239, 113605, 2020
- <sup>lxxv</sup> Outlaw VK et al: Inhibition of Coronavirus Entry In Vitro and Ex Vivo by a Lipid-Conjugated Peptide Derived from the SARS-CoV-2 Spike Glycoprotein HRC Domain” by, 20 October 2020, *mBio*. DOI: 10.1128/mBio.01935-
- <sup>lxxvi</sup> de Vries RD, KS Schmitz. Et al Intranasal fusion inhibitory lipopeptide prevents direct-contact SARS-CoV-2 transmission in ferrets, *Science*, DOI: 10.1126/science.abf4896
- <sup>lxxvii</sup> Koenig PA et al: Structure-guided multivalent nanobodies block SARS-CoV-2 infection and suppress mutational escape, *Science* 12 1 2021, DOI: 10.1126/science.abe6230
- <sup>lxxviii</sup> 20 Higgins TS, AW Wu, EA Illing: Intranasal Antiviral Drug Delivery and Coronavirus Disease 2019 (COVID-19): A State of the Art Review, *Otolaryngol Head Surg*, 2020 Oct <https://doi.org/10.1177/0194599820933170>
- <sup>lxxix</sup> Robert Koch Institut: [https://www.rki.de/DE/Content/InfAZ/N/Neuartiges\\_Coronavirus/Steckbrief.html](https://www.rki.de/DE/Content/InfAZ/N/Neuartiges_Coronavirus/Steckbrief.html), abgerufen 31 3 2021
- <sup>lxxx</sup> Leopoldina: Dritte Ad-Hoc-Stellungnahme: Coronavirus-Pandemie- Die Krise nachhaltig überwinden, 13 4.2020
- <sup>lxxxi</sup> He Zhenyu et al Seroprevalence and humoral immune durability of anti-SARS-CoV-2 antibodies in Wuhan, China: a longitudinal, population-level, cross-sectional study *The Lancet*, March 20, 2021 [https://doi.org/10.1016/S0140-6736\(21\)00238-5](https://doi.org/10.1016/S0140-6736(21)00238-5)
- <sup>lxxxii</sup> Richter R et al: Schätzung des seriellen Intervalls von COVID19, Österreich, AGES 2020, <https://www.ages.at/download>
- <sup>lxxxiii</sup> Richter R et al: Schätzung des seriellen Intervalls von COVID19, Österreich, AGES 2020, <https://www.ages.at/download>
- <sup>lxxxiv</sup> Cori A, M N Ferguson, Chr Fraser, S Cauchemez: A New Framework and Software to Estimate Time-Varying Reproduction Numbers During Epidemics, *American Journal of Epidemiology*, 178, 9, 2013, 1505–1512, <https://doi.org/10.1093/aje/kwt133>
- <sup>lxxxv</sup> Vagero D, O Lundberg: Health inequalities in Britain and Sweden, *Lancet*: 11: 35-36, 1989
- <sup>lxxxvi</sup> Marx V: Scientists set out to connect the dots on long COVID, *Nat Methods* (2021). <https://doi.org/10.1038/s41592-021-01145-z>
- <sup>lxxxvii</sup> Maxmen A: Inequality’s deadly toll, *Nature* 28 April 2021, <https://www.nature.com/immersive/d41586-021-00943-x/index.html>
- <sup>lxxxviii</sup> Wilkinson R, M. Marmot: *Determinants of Health: The solid facts*, WHO, Copenhagen, 2003
- <sup>lxxxix</sup> Rommel A et al: Bevölkerung mit einem erhöhten Risiko für schwere COVID-19-Verläufe in Deutschland. Auswertungen der Studie GEDA 2019/2020-EHIS, *J Health Monitoring*, 2021, 6, 25 2 2021
- <sup>xc</sup> Nalbandian, A., Sehgal, K., Gupta, A. et al. Post-acute COVID-19 syndrome. *Nat Med* (2021). <https://doi.org/10.1038/s41591-021-01283-z>
- <sup>xci</sup> EUR/&RC48/9 Lissabon treaty Art 168, WHO Strategy H21
- <sup>xcii</sup> Arias E, B Tejada-Vera, F Ahmad: Provisional Life Expectancy Estimates for January through June, 2020, *Vital Statistics Rapid Release*, 10, February 2021, US DHHS, CDCP, National Center for Health Statistics
- <sup>xciii</sup> Tavernise S, A Goodnough: A Grim Measure of Covid’s Toll: Life Expectancy Drops Sharply in U.S., *NY Times*, 18 02 2021

- <sup>xciv</sup> Kofler W: A future oriented model for physiology Part 3c The Frame for modern Health Open Lecture, Sechenov university, Moscow 2019, 19138\_M-2019.09.02\_03\_03 <https://yadi.sk/d/OmMBG7Zj- vpVQ>
- <sup>xcv</sup> K. A. Lythgoe et al., SARS-CoV-2 within-host diversity and transmission *Science* 372, eabg0821 (2021). DOI: 10.1126/science.abg0821
- <sup>xcvi</sup> Lackner M. et al: N-chlorotaurine, a novel inhaled virucidal antiseptic is highly active against respiratory viruses including SARS-CoV-2 (COVID-19) <https://www.researchsquare.com/article/rs-118665/v1>
- <sup>xcvii</sup> He Zhenyu et al Seroprevalence and humoral immune durability of anti-SARS-CoV-2 antibodies in Wuhan, China: a longitudinal, population-level, cross-sectional study *The Lancet*, Volume 397, ISSUE 10279, P1075-1084, March 20, 2021 DOI: [https://doi.org/10.1016/S0140-6736\(21\)00238-5](https://doi.org/10.1016/S0140-6736(21)00238-5)
- <sup>xcviii</sup> Robert Koch Institut: [https://www.rki.de/DE/Content/InfAZ/N/Neuartiges\\_Coronavirus/Steckbrief.html](https://www.rki.de/DE/Content/InfAZ/N/Neuartiges_Coronavirus/Steckbrief.html) (29 3 2021)
- <sup>xcix</sup> Byambasuren O et al: Estimating the extent of asymptomatic COVID-19 and its potential for community transmission: systematic review and meta-analysis, 13 9 m2020, doi: <https://doi.org/10.1101/2020.05.10.20097543>
- <sup>c</sup> World Meteorological Organization: Review on Meteorological and Air Quality Factors affection the COVID-19 Pandemic, First Report, 18 3 2021
- <sup>ci</sup> Runkel G: Das Spiel in der Gesellschaft, LIT, ISBN-10: 3825868435, 2003
- <sup>cii</sup> Inama-Sternegg J: Über die zügige Impfstoffentwicklung, GlaxoSmithKline <https://youtu.be/c-qscBagmWE>
- <sup>ciii</sup> Kuhn Th.: Die Struktur wissenschaftlicher Revolutionen, Suhrkamp wissenschaft 25, 1977 engl: The structure of scientific revolutions, Univ. of Chicago, 1962,
- <sup>civ</sup> Freud S: Eine Schwierigkeit der Psychoanalyse. In: *Imago. Zeitschrift für Anwendung der Psychoanalyse auf die Geisteswissenschaften*. Bd. V (1917). S. 1–7.
- <sup>cv</sup> Kahan DM et al: The Tragedy of the Risk-Perception Commons: Culture Conflict, Rationality Conflict, and Climate Change, Cultural Cognition Project, Working Paper nr 89, <http://ssrn.com/abstract=1871503>
- <sup>cvi</sup> Kaplan JT, SI Gimbel & S Harris: Neural correlates of maintaining one's political beliefs in the face of counterevidence, *Nature* 23 12 2016, *Scientific Reports*, 6:39589, DOI: 10.1038/srep39589
- <sup>cvii</sup> Russel B: Das ABC der Relativitätstheorie, 1925, erweitert, überarbeitet 1969 von Pirani, Fischer, 1989
- <sup>cviii</sup> Heisenberg W.: Physik und Philosophie. Hirzel, Stuttgart 2000, ISBN 3-7776-1024-0, Fassung: Heisenberg W: Physics and Philosophy - the revolution in modern science, World Perspectives, unwin university books, London 1959
- <sup>cix</sup> Einstein A: Letter to Max Born, 28.4.1924, e.g. Albert Einstein und Max Born, Briefwechsel, Rowohlt, Reinbek, 1969, S. 67
- <sup>cx</sup> Darwin Ch: Letter to Hooker, JD, 11.1.1844; <https://cudl.lib.cam.ac.uk/collections/darwinhooker>
- <sup>cxii</sup> Brooke JH The Wilberforce Huxley Debate: Why did it Happen? *Science & Christian Belief*, 13, 2, 2001, 127 - 141
- <sup>cxiii</sup> Goldberg AA, NC Elde et al: Extensive recombination-driven coronavirus diversification expands the pool of potential pandemic pathogens, *bioRxiv*, *medRxiv*, 4 2 2021, <https://doi.org/10.1101/2021.02.03.429646>
- <sup>cxiiii</sup> Khamsai R: The Coronavirus Is a Master of Mixing Its Genome, *Worrying Scientists*, NYT 8 2 2021

<sup>cxiv</sup> Kofler W, M Nagl: The whole strategy has to be extended now – beyond modeling, eLetter to Press WH, RC Levin: Modeling, post COVID-19, science 370, 1015, DOI 10.1126/science.abf7914

<sup>cxv</sup> Fumarola G.: persönliche Mitteilung, 15.2.2021



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



**SCIENCE WITHOUT BORDERS.**  
**Transactions of the International Academy of Science H&E.**  
**2020/2021. Vol. 6, Innsbruck, SWB, 2022, 536 p.**

---

**International Publishing House "Science Without Borders" (SWB)**

**Meinhardstrasse 10, A-6020 Innsbruck, Austria,**

**Office in Baku:** Fuad Ibrahimbekov str., 19/21, Baku, AZ1065, Republic of Azerbaijan Azerbaijan  
Section of IAS H&E

**e-mails:** walter.kofler@ias-he.com

prof.khalilov@yahoo.com

***www.ias-icsd.org***

***www.ias-as.org***

*Date of an order: 12.01.2022*

*Order: 08/019*

*Size: 70×100/16*

*Offset printing*

***Book Sponsor: "Biological Medicine" (clinic), LLC,***  
***Baku, Republic of Azerbaijan***

**ISSN 2070-0334**

**ISBN 978-9952-451-07-8**





ISSN 2070-0334

ISBN - 978-9952-451-04-7