



*XI international scientific conference
Stockholm. Sweden
27-28.08.2024*

THEORETICAL AND PRACTICAL PERSPECTIVES OF MODERN SCIENCE

*Proceedings of the XI International
Scientific and Practical Conference*

27-28 August 2024

STOCKHOLM. SWEDEN

2024

UDC 001.1

BBC 1

XI International Scientific and Practical Conference «Theoretical and practical perspectives of modern science», August 27-28, 2024, Stockholm. Sweden. 94 p.

ISBN 978-91-65423-83-1

DOI <https://doi.org/10.5281/zenodo.13647167>

Publisher: «SC. Scientific conferences»

Main organization: 

Editor: Hans Muller

Layout: Ellen Schwimmer

The conference materials are in the public domain under the CC BY-NC 4.0 International license.

The publisher is not responsible for the materials published in the collection. All materials are provided in the author's edition and express the personal position of the participant of the conference.

The sample of the citation for publication is SevdA Aghayeva Aydin kizi, Aynur Rzayeva Elman kizi FAMOUS AZERBAIJAN WOMEN XI International Scientific and Practical Conference «Theoretical and practical perspectives of modern science», August 27-28, 2024, Stockholm. Sweden. Pp.19-22, URL: <https://sconferences.com>

Contact information

Website: <https://sconferences.com>

E-mail: info@sconferences.com

Content

Agricultural sciences

<i>Akhmadova Rahila Rza, Hasanov Hasan Mamed, Gadzhieva KhayalaAmiraslan, Amirova Ruhangiz Maksud</i> DIFFERENT ASH DISPOSAL METHODS	4
---	---

Arts

<i>Rustamova Tahmina Mardan</i> DEVELOPMENT OF STUDENTS' MORAL VALUES IN FINE ARTS LESSONS	7
---	---

Biological sciences

<i>Chibiyev Vadim Yurievich</i> ON THE BIOCEOTIC RELATIONSHIPS OF ARVICOLA TERRESTRIS CENTRAL YAKUTIA	10
--	----

Economic sciences

<i>Nasibova Zumrud Jumshud</i> KEY POSTULATES FOR THE DEVELOPMENT OF THE KARABAKH ECONOMIC REGION IN NEW CONDITIONS	15
--	----

Geographical sciences

<i>Kesheva Lara Asirovna, Teunova Nataliya Vyacheslavovna</i> DISTRIBUTION OF AIR TEMPERATURE AND PRECIPITATION IN THE FOOTHILL ZONE OF THE NORTH CAUCASUS REGION	21
--	----

Historical sciences

<i>Sevda Aghayeva</i> THE GATE OF THE OLD EAST – NAKHCHIVAN	27
--	----

Mathematical sciences

<i>Mamedova Nazaket: Gazanfar gizi, Abbasova Aygun Khanlar gizi</i> INVESTIGATION OF A MIXED PROBLEM IN OIL MECHANICS	34
<i>Antonov A.A.</i> FROM THE EXPERIMENTALLY PROVED IN SRT PRINCIPLE OF THE PHYSICAL REALITY OF IMAGINARY NUMBERS IT FOLLOWS THAT THE INVISIBLE AFTERLIFE WORLD, WHERE GODS AND SOULS OF THE DEAD DWELL, REALLY EXISTS	36

Medical sciences

<i>Bodnar G., Bodnar O.</i> RELEVANCE OF RESEARCH ON COMORBID CONDITIONS IN CHILDREN	57
<i>S.V. Goubkin, S.B. Kokhan, N.D. Titkova</i> EFFECT OF OXYGEN-HELIUM MIXTURE BREATHING TECHNIQUE ON HEART RATE VARIABILITY AND MYOCARDIAL STATE IN PATIENTS WITH ARTERIAL HYPERTENSION	60

Pedagogical sciences

<i>Kismetova G.N., Oryngali N.S.</i> THEORETICAL FOUNDATIONS FOR THE FORMATION OF GRAMMATICAL SKILLS AND ABILITIES IN ENGLISH CLASSES THROUGH INFORMATION AND COMMUNICATION TECHNOLOGIES	65
<i>Kismetova Galiya Nagibudaevna, Shuinishkali Anargul</i> THEORETICAL ASPECTS OF THE USE OF THE FORMATION OF DIGITAL CULTURE OF FUTURE ENGLISH TEACHERS IN THE INFORMATION AND EDUCATIONAL ENVIRONMENT OF THE UNIVERSITY	71
<i>Kismetova Galiya Nagibudaevna, Shuinishkaliev Zamanbek</i> THEORETICAL ASPECTS OF THE USE OF PROFESSIONAL SUBJECTIVITY OF FUTURE LINGUISTS BY THE TECHNOLOGY OF DEVELOPING CRITICAL THINKING+	74

Philological sciences

<i>Lyudmila Abramova</i> LINGUOCULTUROLOGICAL FEATURES OF THE ENGLISH-LANGUAGE ADVERTISING	78
<i>M.M. Issakhanova Kirca</i> THE IMPORTANCE OF ABU AL-LAYS AS-SAMARKANDI IN SPREADING ISLAM AMONG THE MAMLUKS AND THE SIGNIFICANCE OF HIS MANUSCRIPT "AL-MUQADDIM FI-S-SALAT" ("INTRODUCTION TO PRAYER")	81

Technical sciences

<i>Aliaksand Kupo, Yauheni Sharshnev</i> RANGE OF INDUSTRIAL APPLICATIONS OF THERMOCHEMICAL METHODS FOR PROCESSING SYNTHETIC AND NATURAL DIAMONDS	84
<i>Vasily I. Bogdanov, Kononova Victoria Vadimovna</i> NEWTON'S THIRD LAW AND PREREQUISITES FOR THE FORMATION OF A MOTIVE FORCE WITHOUT MASS TRANSFER WITH THE ENVIRONMENT	86
<i>Shafagat Mahmudova</i> ANALYSIS OF INTERNATIONAL EXPERIENCE ON ENSURING CYBER RESILIENCE IN SOFTWARE SYSTEMS	91

Agricultural sciences

UDC 631.8

DIFFERENT ASH DISPOSAL METHODS

Akhmadova Rahila Rza

Candidate of Chemical Sciences, Associate Professor,
Sumgayit State University,
Sumgayit, Azerbaijan

Hasanov Hasan Mamed

Candidate of Chemical Sciences, Associate Professor,
Sumgayit, Azerbaijan

Gadzhieva Khayala Amiraslan

Postgraduate student, senior lecturer
Sumgayit State University,
Sumgayit, Azerbaijan

Amirova Ruhangiz Maksud

Master, specialist coordinator
Sumgayit State University
Sumgayit, Azerbaijan

Abstract

By treating wood ash and grass ash with sulfuric, nitric or phosphoric acid at a temperature of 50-70 °C, a fertilizer mixture rich in macro- and microelements with a pH of 6.5-7.5 was obtained. A test of this fertilizer mixture for vegetables gives a high yield.

The article is devoted to the analysis of wood and grass ash, its solubility properties in water and acids, and the study of its use as a fertilizer. [1,2]

Most plant ash, consisting of inorganic substances, is rich in nutrients, but since it is alkaline (pH-10-13), when it is absorbed by plants, the plant stops growing and dries out. All solid and liquid fuels have a low content of organic compounds and a high content of ash components. As can be seen from the table below, depending on the type of fuel, there are different amounts of evils

Keywords: ash, coal ash, wood ash, wood ash, grass ash, simple superphosphate, double superphosphate.

Table 1.

Fuel type	Amount of ash in %
Burning shale	45-80
Coal (black)	2-50
burning coal	5-55
Burning peat	2-30
Wood fuel	0,8 – 1,3
Fuel oil	0,2-1

As can be seen from the table, from every 100 tons of oil shale used as fuel, 45÷80 tons of ash components are obtained. In fuel oil, ash elements make up 0.2÷1%. Unlike other ashes, fuel oil ash contains 23-25% sodium salt of vanadic acid (Na_3VO_4). This is a good raw material for obtaining valuable vanadium and its compounds. The composition of coal ash includes the following inorganic substances (in % composition). [3]

Table 2

SiO_2	54,3%
Al_2O_3	27,9%
Fe_2O_3	6,6%
CaO	5,8%
MgO	1,85%
K_2O	1,1%
Na_2O	1,0%

SiO_2 -54.3%, Al_2O_3 – 27.9%, Fe_2O_3 -6.6%, CaO -5.8%, MgO -1.85%, K_2O -1.1, % Na_2O -1.0% and the rest 1.5% - heavy (Ar, U, Hg, Ba, Zn, Rn, etc.) are metal compounds. A mixture of these compounds is currently used to neutralize acid gases. According to written data, arsenic (280 thousand tons) and uranium (224 thousand tons) were produced by burning 2.4 billion tons of hard coal and 0.9 billion tons of brown coal, more than arsenic (40 thousand tons) and uranium (30 thousand tons).) 7 times more. [4]

Ash also contains other minerals necessary for plants - phosphorus, calcium, magnesium, sulfur, boron, manganese, various macro- and microelements.[5]

When burning 100 tons of oak, beech, chestnut, 1.3-1.4 tons of ash from 100 tons of coniferous, linden, and willow firewood, $0.9 \div 1$ tons of ash is obtained.

The ash of broad-leaved trees contains 17-19% potassium carbonate (K_2CO_3), 9-12% calcium, magnesium, phosphates and other trace elements.

The ash of coniferous trees contains 10-12% potassium carbonate, 4-6% oxides of calcium, magnesium, phosphates and trace elements.

As can be seen from what has been written, tree ash, especially the ash of broad-leaved trees, is rich in potassium, calcium, magnesium, phosphates and trace elements necessary for the plant.

Until now, every year thousands of tons of ash from firewood and coal burned in restaurants, wedding halls and homes are dumped in landfills, causing environmental stress. As a result of our experiments, it became known that from every 11 kg of beech, sardine and chestnut coals, 1 kg of pure ash is obtained. From 12 kg of Velasha coal, 1 kg of ash is taken. The part of this ash that is soluble in water is 12%, the part that is soluble in sulfuric acid is 14-16%, and the part that is soluble in nitric acid is 78%.

Our experience has shown that to completely neutralize 100 g of ash, 50 ml of solid (d-1.83) sulfuric acid is needed. The ash of grass and straw contains 19-21% potassium carbonate, 9-11% calcium, magnesium, phosphates, borates and other trace elements. There is more phosphate ion in herbs burned with roots.

Depending on their composition, you can use an aqueous solution of complex fertilizer, obtained by pouring sulfuric, nitric and phosphoric acids in an amount equal to the number of potassium, calcium, magnesium ions in plant ash, and stirring at 20-50°C for 10 minutes. used in agriculture to obtain a rich harvest.

Our experiments have shown that after pouring 5 liters of water onto 2.15 kg of ash at room temperature and stirring as a result of the exothermic reaction that occurs when pouring 1 liter of 96% sulfate, 83% of the ash components are converted into sulfates and a valuable fertilizer mixture is obtained for legumes and potatoes (complex fertilizer). Spreading 5 kg of this fertilizer and 3 kg of urea per acre (100 m²) of potato planting area, pouring and softening 300 kg of bird droppings, we planted potatoes. After watering potatoes 4 times in Absheron, we collected 300-340 kg from each field. This is the highest result in the world. The sulfate ions contained in this fertilizer are converted by potatoes and legumes into the protein mellitin and valuable xanthates.

When ash is treated with sulfuric acid at room temperature, the acid salt KHSO_4 is obtained as a result of an exothermic reaction.



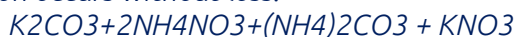
Since this salt is very hydrophilic (47 g dissolved in 100 ml of water at 200°C), it dissolves calcium carbonate (CaCO_3) in the soil and is insoluble in water through a double dissolution process, increasing the synthesis of high molecular weight carbohydrates. (cellulose, lignin) and ensuring intensive plant development. Calcium and magnesium ions in the ash also form calcium sulfate and the very hydrophilic MgSO_4 . The acid neutralization reaction proceeds as follows:



When ash is treated with nitric acid at room temperature, all carbonates are converted into readily soluble nitrates [KNO_3 , $\text{Ca}(\text{NO}_3)_2$, $\text{Mg}(\text{NO}_3)_2$]. This complex fertilizer mixture can be used for grains and vegetables without adding other fertilizers. Phosphorus-rich fertilizers produced by treating ash with phosphoric acid can be used as a fertilizer for oilseeds (sunflower, soybeans) and grain crops by applying nitrogen fertilizers.

It is known that most nitrogen fertilizers [NH_4NO_3 , $(\text{NH}_4)_2\text{SO}_4$, $(\text{NH}_4)_3\text{PO}_4$, $(\text{NH}_2)_2\text{HPO}_4$] (except urea) are acidic (pH-4-5.5). When 4 kg of such acidic fertilizers were scattered over the cultivated area and sprinkled with 1 kg of ash, the pH of the soil solution became 6.5. Soil with a neutral

environment is completely suitable for sowing; all plants grow well in such an environment. At this time, the following neutralization reaction occurs without loss:



Ash suspension (an aqueous solution of ash) neutralizes acid gases (NO_x , SO_2) generated in production and protects the environment from pollution, and also makes it possible to obtain a valuable fertilizer mixture. Since there are many absorbent components in this ash solution, a lot of acid gas is absorbed.

It is known that to neutralize acidic soils, the soil is treated with calcium carbonate sand (sprinkling). Our experiments have shown that when such soils are sprinkled with wood ash, along with neutralizing the environment, $AlPO_4$ and $FePO_4$ precipitates formed in acidic soil with K_2CO_3 contained in the ash become soluble in water and are easily absorbed by the plant:



Wastewater containing nutrients is known to lead to eutrophication and green algae formation, which negatively impacts aquatic life and the environment. When 15÷25 g of coal ash was poured onto 10 liters of such wastewater, water with nutrients was not subject to eutrophication for several months.

Since ash water has strong disinfectant properties, when it is sprayed on trees in February and March, some tree diseases are destroyed.

The ash itself also has a beneficial effect on plant diseases (late blight), and when it gets into the soil, as a result of soil buffering it turns into a neutral potassium fertilizer.

Bone ash is 90-95% environmentally friendly calcium phosphate. ($Ca_3(PO_4)_2$) Our experiments have shown that from 5 kg of dry bone 4.1 kg of ash is obtained. When this ash is treated with phosphoric acid at a temperature of 60-700C, an environmentally friendly double superphosphate fertilizer is obtained.



When bone ash is treated with sulfuric acid at a temperature of 60-700C, instead of harmful heavy metals (cadmium, selenium, strontium, lead) obtained from apatite, an environmentally friendly simple superphosphate fertilizer is obtained. When treating bone ash with nitric acid, 82-86% of water-soluble calcium dehydrogen phosphate and calcium nitrate are obtained. Because they dissolve easily in water, plants absorb them easily and grow quickly.

Additionally, since bone ash consists of pure calcium phosphate, it can be used as a feed additive for chickens and cattle.

Since plant ash is a diphilic molecule (hydrophilic and hydrophobic), it significantly reduces the surface tension of water, making it more easily absorbed by the plant.

It has been established that when 1.6 kg of ash is added to 10 kg of acidic (pH 4.5÷5) bird droppings, the pH of the solution becomes equal to 7, which is a normal absorption medium for all plants.

Literature

1. Lebedev V.V. and others. Complex state of coal M 1980. st. 234.
2. H.M. Hasanov et al., materials of the VII International Scientific Conference "Protection of Ecology and Life Activity". Page 158.
3. A.I. Rodionov and others. Environmental protection technology. Moscow ed. "Chemistry" 1989. p.79.
4. Agrochemistry of Moscow VO "Agrokhimizdat" 1989. p.630
5. Mamedov G.Sh. Khalilov M.Yu. Information book of ecologists. Publishing house "Elm". Baku: 2003

Arts

DEVELOPMENT OF STUDENTS' MORAL VALUES IN FINE ARTS LESSONS

Rustamova Tahmina Mardan
ADPU, teacher, Azerbaijan

РАЗВИТИЕ НРАВСТВЕННЫХ ЦЕННОСТЕЙ УЧАЩИХСЯ НА УРОКАХ ИЗОБРАЗИТЕЛЬНОГО ИСКУССТВА

Рустамова Тахмина Мардан
ADPU, преподаватель, Азербайджан

Abstract

The article is devoted to the research of a topical problem - the need for modern fine arts as self-expression of the artist's personality. Modern art is considered as a mirror reflecting the surrounding reality. The boundaries of the concept of 'modern fine art', its intentions and the dangers of entropy development in artistic creation that has no creative purpose are defined. principal essential identifying criterion freedom freedom in artistic creativity, significance and illusory essential for artist conceptual 'freedom' and 'creativity'.

Аннотация

Статья посвящена исследованию актуальной проблемы — потребности в современном изобразительном искусстве как самовыражении личности художника. Современное искусство рассматривается как зеркало, отражающее окружающую действительность. Определяются границы понятия «современное изобразительное искусство», его намерения и опасности развития энтропии в художественном творчестве, не имеющем творческой цели. Рассматривается принципиально важное выявление критериев свободы в художественном творчестве, значимость и иллюзорность существенных для художника понятий «свобода» и «творчество».

Keywords: culture; modern fine arts; artistic creativity; synthesis of arts; contemporary art.

Ключевые слова: культура; современное изобразительное искусство; художественное творчество; синтез искусств; современное искусство.

В настоящее время суждения о современном изобразительном искусстве становятся все более амбициозными. При этом содержание понятия «современное изобразительное искусство» трактуется произвольно, часто по наитию, и имеет крайне абстрактный смысл. Чаще всего под современным искусством понимают творческую деятельность, которая: а) не связана с художественной традицией, выработанной человечеством на протяжении тысячелетий; б) признает неограниченную свободу творца-художника, поскольку речь идет о создании «актуального» искусства; в) часто использует художественные приемы и материалы, ранее не применявшиеся в традиционном искусстве; г) активно использует различные пиар-технологии и эпатаж для популяризации своего творчества и идей. Очевидно, что перечисленные признаки являются преимущественно технологическими характеристиками и не рассматривают содержание изучаемого понятия по существу. Вследствие этого необходим ряд уточнений. Самопонятие «современное искусство», активно противопоставляемое классическому, традиционному, крайне неудачно. Ведь слово «современное», как и слова «сегодня», «завтра», «левое», «правое» и т. д., относится к так называемым «логическим ловушкам языка», которые нуждаются в постоянных пояснениях. Неясно, когда возникла заявленная современность и в какой момент она устаревает. Уместно вспомнить высказывания русского философа XIX века В.С. Соловьева о необходимости различать актуальное и злободневное. По мнению мыслителя, актуальное сохраняет свою значимость в прошлом, настоящем, будущем, а злободневное всегда сиюминутно [3, с.120-134]. Настоящее искусство не может быть сиюминутным (злободневным), оно всегда значимо (актуально). Кроме того, непонятно, почему современные тенденции классического изобразительного искусства нельзя отнести к современному изобразительному искусству? Возможна ли в принципе абсолютная, ничем не ограниченная

свобода художника? Из известного определения, данного Б. Спинозой, свобода, в том числе и свобода художника, понимается как осознанная необходимость, означающая наличие и добровольное осознание как внешних, так и внутренних ограничений. Следовательно, свобода творчества не может быть чистой, абсолютно независимой [4, с. 384-387]. Эту идею поддерживал и В. С. Соловьев: «Современный человек сознает себя внутренне свободным, сознает себя выше всякого внешнего... начала, утверждает себя центром всего, а между тем в действительности является лишь одной бесконечно малой и исчезающей точкой на мировом круге. Современное сознание признает за человеческой личностью божественные права, но не наделяет ее ни божественной силой, ни божественным содержанием, так как современный человек и в жизни, и в познании допускает лишь ограниченную условную реальность, реальность частных фактов и явлений, и с этой точки зрения сам человек есть лишь один из таких частных фактов» [3, с. 20]. Очевидно, что все происходящее творится с необходимостью и по определенным законам. Искусство без творческой цели, идущее «от противного», не признающее нравственных основ, несет в себе потенциал энтропии. Этот фактор активно проявляется и распространяется как мощная разрушительная сила, которая нарастает в последние годы. Важно понимать, что высказанная художником идея, подобно «мячу», приведенному в движение, ударяясь о другой, заставляет удерживать заданное им информационное сообщение. Поэтому четкое представление художника о заданном направлении мысли очень необходимо.

Рождение художественного замысла нового произведения неразрывно связано с творческой свободой автора. Свобода — один из видов необходимости, хотя свобода художника в искусстве часто порождает иллюзию некой «чистой свободы», ничем и никем не ограниченной. Ведь для художника понятия «свобода» и «творчество» во многом неразделимы: творить — значит жить; свобода творчества — единственно возможное существование.

В этом контексте принципиально важно выявить критерии свободы в художественном творчестве. Один из подходов к выявлению таких критериев обозначил немецкий философ Ф. В. Й. Шеллинг, определивший свободу как нравственный выбор, основанный на различии добра и зла. Если по каким-то причинам творческий процесс не имеет положительной нравственной основы, не направлен на достижение Истины, Добра и Красоты, то он тут же приобретает отрицательную (безнравственную) основу, приводящую к бессилию высокого духовного начала. Как сила любой лжи заключается в бессилии истины, так и сила зла питается бессилием добра [5, с. 140-147, 267]. Бессилие искусства заключается не столько в утрате самой истины, сколько в бессилии человека сделать правильный выбор [6, с. 369-370]. Однако, даже сделав, на первый взгляд, правильный выбор, художник часто не удосуживается довести этот выбор до конца, что порождает новые просторы для распространения его заблуждений. Идея произведения искусства должна не только зримо восприниматься, не только служить средством для реализации определенного концептуального решения, но в еще большей степени влиять на моральное, эстетическое, мировоззренческое видение. Воля, разум и чувства имеют большое значение как способы или средства воплощения творческой идеи в реализацию определенного художественного содержания, но сами по себе они не составляют этого содержания [7, с.203]. Такую подмену часто можно встретить в современном изобразительном искусстве, в котором вдруг оказывается, что мы чувствуем ради чувства, слушаем потому, что слышим, и в результате видим потому, что смотрим. А как быть с тем, что человек должен что-то переживать, чтобы чувствовать, и чувствовать, чтобы думать, мыслить, чтобы духовно совершенствоваться — разве это не то, что придает всему смысл?

Духовность, на мой взгляд, является главной составляющей любого творческого процесса, будь то живопись или скульптура, поэзия или проза, театральное искусство или кинематография. Почему духовность, присущая изобразительному искусству эпохи Возрождения, не находит отражения в современном изобразительном искусстве? И почему технический и интеллектуальный прогресс, характерный для этой эпохи, не оказал отрицательного влияния на духовные составляющие искусства эпохи Возрождения? Почему в наш информационный век мы видим только глазами и разумом? Не потому ли, что не можем решить, какая именно творческая свобода нам нужна?

И вот, наконец, прекрасная, возвышенная идея начинает волновать сознание и зажигать душу художника-творца. В этот момент возникает второй вопрос — о ее воплощении: какими средствами, буквально или формально, представлять идею? Нельзя забывать, что художник воспроизводит не сами предметы и явления, а лишь то, что он в них видит, а настоящий или

истинный художник видит характерные черты, которые, пройдя через сознание, обогащаются внутренним духовным миром его творца, реализуясь в произведении. Задача художника не в том, чтобы создавать что-то новое в ответ на все созданное на земле и вопреки этому, а наоборот, уметь распознавать истинную красоту природных явлений, которая скрыта в окружающем мире. В то же время искусство — это обман, иллюзия, сказочный мир, созданный художником. Даже изображая бытовые сцены, он привносит в них свои особые краски и доселе не существовавшие образы. Поэтому идея, воплощенная художником, — это призрак, обман, в нее должен искренне верить сам автор, иначе его творчество обречено на провал. Только беззаветно веря в истинность своего произведения, художник может заставить зрителя погрузиться в свою «сказку», свой волшебный, ни на что не похожий мир. В этом случае нельзя не верить в свое детище ни на секунду. Именно так художник-творец создает абсолютную идею — прекрасную и незыблемую. Возникая в результате творческих усилий художника, произведения искусства в своем настоящем бытии приобретают надличностный характер. Восприятие произведения искусства свидетельствует не только об индивидуальной, художественно-образной самобытности творца, но и характеризует коллективные формы опыта, свойственные его эпохе. Так, в гегелевской эстетике красота есть воплощение всеобщей и вечной идеи в частных и преходящих явлениях, и они остаются случайными, исчезающими, как отдельные волны, в потоке материального процесса, лишь на мгновение отражая сияние вечной идеи. Но как бы ни был прекрасен иллюзорный мир художника, мы воспринимаем то, что нам предлагается, опираясь на наши чувства, на наше представление о морали, о добре и зле. Видение художника заключается в его особом «неправильном», несколько непонятном восприятии мира. В его художественной концепции существует только одна истина, а все остальное — ложь. Вот почему очень важно задать себе вопрос, насколько правильно они показывают нам истину, или это искренняя трансляция «обмана» [1, с. 105-107].

Посещая выставки, я часто задаюсь вопросом: «Что такое современное искусство?». Возможно, это единство содержания и формы в символической интерпретации, выражающей современную идею неоднозначно, двусмысленно и злободневно? Если современное изобразительное искусство принято отождествлять только примерно со стремлением к модернизму, то актуальность этого искусства сомнительна. Нельзя слепо следовать нестабильным и капризным модным тенденциям, не использовать новаторство в искусстве, ведь искусство не обязательно должно быть злободневным, оно должно быть актуальным. Иначе его с таким же успехом можно назвать «сиюминутным» искусством. Искусство существует вне времени. Оно существует сейчас, а не завтра, не вчера, и, конечно, по каким-то причинам оно не может быть востребовано сегодня и неактуально завтра. Иначе это просто не искусство [2, с. 105-107]. Совершенно точно, что искусство, которое создается на профессиональном уровне, всегда должно оставаться реальным в настоящем, потому что способность человека творить в любой области выступает как творчество, и именно в творчестве человек раскрывает себя как художник.

Литература

1. Гончаренко Н. В. Гений в искусстве и науке. М.: Искусство, 1991. 432 с.
2. Гройс Б. Искусство утопии. М., 2003. 320 с.
3. Соловьев В. С. Чтения о Богочеловечестве // Соловьев В. С. Собрание сочинений и писем: в 4 т. М.: Логос, 1993. Т. 3. С. 13-168.
4. Спиноза Б. Собрание сочинений: в 2 т. СПб.: Наука, 1999. Т. 1. 489 с.
5. Шеллинг Ф. В. Я. Сочинения: в 2 т. М.: Мысль, 1987. Т. 2. 636 с.
6. Шеллинг Ф. В. Я. Философия искусства. М.: Мысль, 1966. 496 с.

Biological sciences

UDC 59/59009 (591.5)

ON THE BIOCENOTIC RELATIONSHIPS OF ARVICOLA TERRESTRIS CENTRAL YAKUTIA

Chibyiev Vadim Yurievich

Candidant of Biological Sciences, Director of the Zoological Museum, M. K. Ammosov North-Eastern Federal University. Republic of Sakha (Yakutia).

УДК 59/59009 (591,5)

К БИОЦЕНОТИЧЕСКИМ ОТНОШЕНИЯМ ARVICOLA TERRESTRIS ЦЕНТРАЛЬНОЙ ЯКУТИИ

Чибыев Вадим Юрьевич

к.б.н., директор Зоологического музея, Северо-Восточного федерального университета имени М.К. Аммосова. Республика Саха (Якутия)

Abstract

Materials from a study of the ecology of *Arvicola terrestris* on the territory of Central Yakutia are presented, where human intervention with the aim of enriching the commercial fauna contributed to the formation of new interspecific relationships after the acclimatization of *Ondatra zibethica*. Populations of these species, in interaction with each other and with the habitat transformed by humans, represent a variable natural system, the study of the relationships and patterns of which is of undoubted scientific interest.

Currently, the once numerous species *Arvicola terrestris* has been undergoing a decline in numbers in the places of its traditional existence since the early 80s of the last century. Consideration of the geographical and stationary distribution of the animal allows one to assess the state and stability of the population dynamics of this species using specific examples.

Ondatra zibethica is like a rodent, with a more active ecological position and a territorial species (family areas), surpassing its fellow in size, aggressiveness and agonistic behavior. Apparently, he was driven out of his habitat. As a result of a comparison of habitat data and a comprehensive analysis of the modern ecology of *Arvicola terrestris*, we state the formation of new biocenotic relationships in the food and spatial relationships of *Arvicola terrestris* and the acclimatized species, in the form of competition in the biogeocenoses of Central Yakutia.

Аннотация

Приводятся материалы исследования экологии *Arvicola terrestris* на территории Центральной Якутии, где вмешательство человека с целью обогащения промысловой фауны, способствовало формированию новых межвидовых отношений после акклиматизации *Ondatra zibethica*. Популяции этих видов во взаимодействии между собой и с преобразуемой человеком средой обитания представляют изменчивую природную систему, изучение взаимосвязей и закономерностей которой имеет несомненный научный интерес.

В настоящее время, некогда многочисленный вид *Arvicola terrestris*, претерпевает с начала 80-х годов прошлого века спад численности в местах своего традиционного существования. Рассмотрение географического и стационального распределения зверька позволяет на конкретных примерах оценить состояние и стабильность динамики численности популяций этого вида.

Ondatra zibethica как грызун, с более активной экологической позицией и территориальный вид (семейные участки), превосходящий своего собрата в размерах, агрессивности и агонистическим поведением. По-видимому, вытеснил его из мест его обитаний. В результате сопоставления данных по местообитанию и комплексного анализа современной экологии *Arvicola terrestris*, мы констатируем формирование новых биоценологических отношений в пищевых и пространственные взаимоотношения *Arvicola terrestris* и акклиматизированного вида, в виде конкуренции в биогеоценозах Центральной Якутии.

Keywords: Ecology, stationary, species, acclimatized, biocenotic, nutrition, aquatic, semi-aquatic, biotope.

Ключевые слова: Экология, стационарного, вид, акклиматизированный, биоценотический, питание, собственно-водные, околотоводные, биотоп.

Введение

Arvicola terrestris L. (1758) - Водяная полевка, типичными местообитаниями этого вида на территории естественных ландшафтах Центральной Якутии, являются заболоченные осоково - кочкарниковые луга по низким террасам, острова, долины среднего течения р. Лена, болота, пойменные озера с густой околотоводной и собственно - водной растительностью, злаков, *Carex*, *Equisetum* и *Salix*. Грызун в течение теплого времени года, находит защитные, кормовые и микроклиматические условия существования в этих биотопах. Зимовочные норы устраивают на возвышенных гривах (по - местному «кырдал» якут.), лугах, иногда под стогами или рулонами сена и обязательно вблизи кустарников [1; 2].

Методы исследования

Пространственное распределение грызунов изучалось нами методом крупномасштабного картирования их поселений. Учет численности ондатр проводился по методическим разработкам, составленным Г.А. Новиковым (1953) и Г.К. Корсаковым (1963). Питание изучалось путем сбора и определения остатков растений на кормовых столиках ($n = 21$). Кроме того, проводились визуальные наблюдения в местах жировки, осмотр кротовин с определения видов растений с погрызами [3; 4; 5; 6; 7; 8]. Это дало возможность установить посезонное использование биотопов в разные сезоны года и более точно оценить перекрытие экологических ниш в тот или иной сезон года.

Экология

Питается *Arvicola terrestris* сочными частями собственно-водных и околотоводных растений. Срезанные стебли *Carex*, *Phragmites*, *Sagittaria* и других растений она доставляет к берегу вплавь и поедает их на кормовых столиках небольших утопанных площадках у уреза воды ($n = 21$). Ее кормовой столик похож на столик *Ondatra zibethica*, но обычно меньших размеров. Осматривая кормовые столики, можно заметить, что этот грызун, как и *Ondatra zibethica*, объедает лишь нижнюю беловатую часть стеблей, наиболее сочную и нежную.

В питании полевок обитающих прибрежной полосе озер, ведущее значение в питании имеют более 5 - 6 собственно – водных (у ондатры 8 видов) и 10 видов злаков и *Carex*, в качестве дополнительного корма используются еще столько же видов травянистых и кустарниковых растений. Наиболее широкий спектр кормов от 30 до 40 видов имеют полевки, обитающие вдоль

береговой линии стариц (табл. 1). Это связано с большим разнообразием видового состава растительности в таких типах местообитаний.

Arvicola terrestris устраивает норы и убежища разного типа: весенние, летние и зимовочные. Весенние и летние норы имеют значение защитных и выводковых, зимовочные – защитные и кормовые. С весны и все лето зверек

держится вдоль береговой линии водоемов, по тихим речным заводям и старицам. Летом живет в простых норах, оканчивающихся гнездовой камерой, расположенной в 10 - 15 см от поверхности земли, прорытые ходы имеют овальную форму. При этом высота ходов больше их ширины. Зверек также поселяется и внутри болотных кочек или в выгнивших стволах деревьев, устраивая внутри них круглые гнезда из сухой травы.

В конце июля начале августа водяные полевки переходят на места своих зимовок и начинают рыть зимовочные норы. В этот период питание зелеными вегетативными частями растений постепенно заменяются корнями и корневищами. Зверек прокапывает длинные норы, к местам кормежки под землей, и выследить её очень трудно. При этом на поверхности земли остаются холмики разного размера «кротовины», содержащие стебли трав и т.п. По кротовинам можно определить места жировки грызуна.

Таблица 1

Список кормовых растений водяной полевки Средней Лены (наши данные)

№	Вид	Встречаемость на кормовых столиках*
1.	Осока изящная – <i>Carex delicata</i> C.B. Clarke.	+++
2.	Осока вилуйская – <i>C. wiluica</i> Meinsh.	+++
3.	Осока носатая – <i>C. rostrata</i> Stokes.	++
4.	Осока пузырчатая – <i>C. vesicaria</i> L.	++
5.	Хвощ речной – <i>Equisetum fluvatile</i> L.	+++
6.	Хвощ полевой – <i>E. arvense</i> L.	+++
7.	Аир обыкновенный – <i>Acorus calamus</i> L.	+++
8.	Камыш озерный – <i>Schoenoplectus lacustris</i> (L.) Palla.	++
9.	Бекмания восточная – <i>Beckmannia syzigachne</i> Fern.	++
10.	Вахта трехлистная – <i>Menyanthes trifoliata</i> L.	+
11.	Водяная сосенка – <i>Hippuris vulgaris</i> L.	+
12.	Калужница болотная – <i>Caltha palustris</i> L.	++
13.	Лисохвост вздутый – <i>Alopecurus arundinaceus</i> Poir.	++
14.	Мытник – <i>Pedicularis</i> L.	++
15.	Поручейник – <i>Sium</i> L.	++
16.	Рогоз широколистный – <i>Typha latifolia</i> L.	+++
17.	Тростник обыкновенный – <i>Phragmites australis</i> (Cav.) Trin. Ex Steud.	+++
18.	Тростянка овсяницеvidная – <i>Scolochloa festucacea</i> (Willd.) Link.	++
19.	Герань луговая – <i>Geranium pratense</i> L.	+
20.	Лапчатка гусиная – <i>Potentilla anserina</i> L.	+++
21.	Лапчатка вильчатая – <i>P. bifurca</i> L.	+
22.	Кровохлебка аптечная – <i>Sanguisorba officinalis</i> L.	++
23.	Крестовник Якова – <i>Senecio Jacobaea</i> L.	+
24.	Крестовник болотный – <i>S. paludosus</i> L.	++
25.	Одуванчик – <i>Taraxacum</i> F.H.Wigg.	+
26.	Полевица якутская – <i>Agrostis jacutica</i> Schishk.	+
27.	Подмаренник северный – <i>Galium boreale</i> L.	+
28.	Полынь – <i>Artemisia</i> L.	+
29.	Подорожник большой – <i>Plantago major</i> L.	++
30.	Пырей ползучий – <i>Elytrigia repens</i> (L.) Desv.ex Nevski.	++
31.	Тысячелистник – <i>Achillea</i> L.	+
32.	Ячмень луговой – <i>Hordeum brevisubulatum</i> (Trin.) Link.	++
33.	Шлемник – <i>Scutellaria</i> L.	+
34.	Береза – <i>Betula</i> L.*	+
35.	Ива – <i>Salix</i> L.*	+

Примечания:

*Встречаемость на кормовых столиках: +++ - часто, ++ - средне, + - редко.

*Древесные породы.

Несколько позднее они приступают к заготовке зимних запасов. Зимой и ранней весной питаются главным образом подземными частями травянистых растений, а также корой некоторых кустарников. В течение этих месяцев зеленые корма потребляются в незначительном количестве. Из литературных данных известно, что иногда *Arvicola terrestris* поедает насекомых, моллюсков, маленьких рыбок [1; 9].

Биоценоотические отношения

В настоящее время некогда многочисленный вид *Arvicola terrestris*, претерпевает уже несколько десятилетий спад численности. Мы считаем, что здесь сработал принцип конкурентного исключения закона Г.Ф. Гаузе. В законе Г. Ф. Гаузе говорится, что два вида живых организмов не могут существовать на одной и той же территории, если их экологические потребности одинаковы или говоря иными словами, они занимают одну экологическую нишу. То есть, два близкородственных вида, не могут занимать один и тот же биотоп. Перекрывание

станций возникает, если различные виды при совместном обитании используют одни и те же ресурсы. Перекрытие может быть полным (активная конкуренция) или частичным (пассивная конкуренция), по одному или нескольким параметрам экологической ниши [10]. На наш взгляд, этот закон проявился в условиях Центральной Якутии в связи вводом в экосистемы республики интродуцента – *Ondatra zibethica*.

В нашем случае, в весеннее - летний период возникает конкуренция в трофических и стациональных отношениях между этими видами. Береговую зону и водную акваторию водоема в летнее время кроме *Ondatra zibethica* заселяет и *Arvicola terrestris*.

Arvicola terrestris весной переселяется с мест зимовки на околотовдные биотопы водоемов для сезонной смены станций - принцип стациональной верности. Здесь зверёк активно поедает околотовдную и собственно водную растительность и строит выводковые норы, поэтому конкуренция биотических отношений несомненно существует. Список кормовых объектов *Arvicola terrestris* включает 35 видов из них околотовдных и собственно-водных растений – 7. У *Ondatra zibethica* в Центрально-якутской низменности нами выявлено 32 вид растений, из них 8 околотовдных и собственно-водных растений излюбленные компоненты рациона (Табл. 2). Излюбленная кормовая база *Ondatra zibethica* схожа с *Arvicola terrestris* на 70-80 % и более. Между этими видами перекрытие станций в летний сезон можно считать полным (активная конкуренция).

Таблица 2

Список поедаемых кормовых растений ондатры Центральной Якутии (наши данные)

№	Название растений	Латинские названия
1.	Осока носатая	<i>Carex rostrata</i> Stokes.
2.	Осока пузыреватая	<i>C. vesicata</i> Meish.
3.	Тростянка овсянцевидная	<i>Scolochloa festucaceae</i> (Willd.) Link.
4.	Рдест сплюснутый	<i>Potamogeton compressus</i> L.
5.	Рдест пронзеннолистный	<i>P. perfoliatus</i> L.
6.	Рдест гребенчатый	<i>P. pectinatus</i> L.
7.	Рдест влагалищный	<i>P. vaginatus</i> Turcz.
8.	Рдест злаковый	<i>P. gramineus</i> L.
9.	Уруть мутовчатая	<i>Myriophyllum verticillatum</i> L.
10.	Водяные мхи	
11.	Кипрей болотный	<i>Epilobium palustre</i> L.
12.	Хвостник обыкновенный	<i>Hippuris vulgaris</i> L.
13.	Черёда трехраздельная	<i>Bidens tripartite</i> L.
14.	Крестовник Якова	<i>Senecio Jacobaea</i> L.
15.	Бекмания восточная	<i>Becmannias yziqachne</i> (Steud.) Fern.
16.	Ежеголовник всплывший	<i>Sparganium emersum</i> Rehm.
17.	Пузырчатка малая	<i>Utricularia minor</i> L.
18.	Ряска маленькая	<i>Lemna minor</i> L.
19.	Ячмень короткоостистый	<i>Hordeum brevisubulatum</i> (Trin.) Linr.
20.	Горец земноводный	<i>Polygonum amphibium</i> (L.) S.F. Gray
21.	Болотник болотный	<i>Callitriche palustris</i> L.
22.	Лютик Гмелина	<i>Ranunculus Gmelinii</i> DC.
23.	Бескильница Гаупта	<i>Puccinellia Hauptiana</i> V.Kzecz
24.	Болотница болотная	<i>Eleocharis palustris</i> (L.) Roem.et Schult
25.	Хвощ речной	<i>Equisetum fluviatile</i> L.
26.	Хвощ полевой	<i>E. arvense</i> L.
27.	Лисохвост тростниковидный	<i>Alopecurus arundinaceus</i> Poiz.
28.	Сабельник болотный	<i>Comarum palustre</i> L.
29.	Тростник южный	<i>Phragmites australis</i> (Cav.) Trin. ex Steud.
30.	Аир обыкновенный	<i>Acorus calamus</i> L.
31.	Кувшинка четырехгранная	<i>Nymphaea tetragona</i> Georgi.
32.	Стрелолист плавающий	<i>Sagittaria natans</i> Pall.

Заключение

Количество поедаемой собственно-водной растительности у *Arvicola terrestris* по объему меньше, чем у *Ondatra zibethica*, но конкуренция в питании, по нашим наблюдениям есть. Так как видовое разнообразие растений, потребляемых в летний период этими видами в тех или иных водоемах идентичны. Зимой конкуренции в трофической сфере между этими видами нет. Так как грызуны, начиная с августа, обитают в различных экологических нишах.

Причины снижения численности *Arvicola terrestris*, некогда многочисленного вида в регионе, окончательно не выяснено, требует более тщательного исследования. Есть не изученная микробиологическая сторона вопроса. Возможно, *Ondatra zibethica* акклиматизированный вид является носителем парвовируса, патогенного аборигенным видам [11].

Список использованной литературы

1. Млекопитающие Якутии / В.А. Тавровский, О.В. Егоров и др. М.: Наука, 1971. – 660 с.
2. Соломонов Н.Г. Экология водяной полевки Якутии. Новосибирск: Наука, 1980. - 136 с.
3. Ралль Ю.М. Методы полевого изучения грызунов и борьба с ними. – Ростов-на-Дону: Изд-во «Ростиздат», 1947. – 157 с.
4. Новиков Г.А. Полевые исследования по экологии наземных позвоночных. М.: Советская наука, 1953. 502 с.
5. Корсаков Г.К. Количественный учет ондатры в лесостепи Западной Сибири и зависимость её численности от водного режима озер // Ресурсы фауны промысловых зверей в СССР и их учет. М.: Изд-во АН СССР, 1963. С. 187-190.
6. Соломонов Н.Г. Очерки популяционной экологии грызунов и зайца - беляка в Центральной Якутии. Якутск: Кн. изд-во, 1973. - 248 с.
7. Попов М.К. Определитель млекопитающих Якутии. Новосибирск: Наука, 1977. - 424 с.
8. Москвитина Н.С., Сучкова Н.Г. Млекопитающие Томского Приобья и способы их изучения. Учебное пособие. Томск: Изд-во Том. ун-та, 1988. - 185 с.
9. Мордосов И.И. Млекопитающие таежной части Западной Якутии. Якутск, 1997. - 219 с.
10. Gause G. F. The Struggle for Existence. Baltimore, 1934
11. Cossart Y. E., Field A. M., Can't B., Widdows D. Parvovirus - like particles in human sera // Lancet. - 1975. - Vol. 11, no. 1. - P. 72 - 73.

Economic sciences

KEY POSTULATES FOR THE DEVELOPMENT OF THE KARABAKH ECONOMIC REGION IN NEW CONDITIONS

Nasibova Zumrud Jumshud

Dissertation of Azerbaijan University of Cooperation
AZ1124, N.Nərimanov, 93, Baku, Azerbaijan Republic
<https://orcid.org/0009-0006-7505-0709>

Abstract

The article deals with the key postulates of economic development of the Karabakh region in the new conditions. The conceptual bases and priorities of the conducted restoration and revival works in the Karabakh economic region are analysed. Priority directions of building the economic structure of the region taking into account the resource potential are considered. The importance of the most effective use of traditional and new economic spheres in the period of ensuring the Great Return of former settlers is noted. Possibilities of newly created economic structures, including Aghdam industrial park, were considered. Recommendations and proposals on realisation of key directions of socio-economic revival of Karabakh are prepared.

Keywords: Azerbaijan, Karabakh, Karabakh economic region, Aghdam, Shusha, structure of the region's economy, key postulates of Karabakh's development, development goals of Karabakh economic region.

In the context of global transformations, Azerbaijan is carrying out a historic mission - the restoration of the territories liberated from occupation. The development of newly created economic regions will strengthen the country's competitiveness. At the same time, it will create additional opportunities for the development of many sectors of the economy, including agriculture, which is important for ensuring food security. It is well known that the agricultural sector plays a special role in creating food security [1]. At the same time, the creation of competitive enterprises accelerates the creation of new sources of financial and economic growth [2]. From this point of view, the creation of modern technology-based enterprises in post-conflict areas will give an additional boost to the development of the country's economy in general. It should be noted that the development of innovative segments of economic regions, high-tech production and the formation of a modern professional structure of their population can contribute to the creation of favourable institutional conditions for the purpose of attracting investments to the region and the development of market infrastructure for the capitalisation of existing resources [3]. On the other hand, the use of new approaches and economic mechanisms is preferred in the development of the Karabakh region [4]. The financial system of economic regions has a great influence on their development. It conditions the existence, constant development and normal functioning of the financial system of these regions [5]. The considered components of the financial system allow to explain and reveal its role and importance in economic regions [6]. Also, the problems of creation of banking infrastructure in the territories freed from occupation for implementation of financial mechanisms and financial-credit organisation should be solved [7]. The financial system of the economic regions is an important part not only of the national economy. Important components of financial markets of economic regions are investment funds and companies [8]. This is due to the growing role of each region in the overall economic development of the country, where investments are the main stimulus [9]. Thus, the creation of such funds reduces the budget burden of economic regions in terms of increasing investment attractiveness [10]. This mechanism is implemented through private and public partnership. The financial and credit system of economic regions is closely related to other areas of its economic and social life and has a significant impact on them [11].

After the Great Karabakh Victory, new realities emerged in Karabakh, in general, in the territories liberated from occupation [12]. Our public buildings, production infrastructure and degraded lands, destroyed for almost 30 years, have been liberated from the enemy and new realities have already been formed. In such a situation, the strategic goal is to revitalise these areas as soon as possible, to ensure their socio-economic development and to implement measures related to the return of the population in a complex and systematic manner. In Azerbaijan, work in this regard is ongoing at the state level. Before

the end of the war, the construction works were started, the relevant conceptual ideas, approaches, the main directions of the state economic policy were defined, and appropriate measures were taken [13]. It is known that in the territories liberated from occupation, if we approach the analysis of the pre-occupation period, there were enough natural resources, and due to their effective use it is possible to restore the infrastructure destroyed during the occupation and to create sources of socio-economic development. In addition, there is the question of improving the management system of the liberated territories, establishing a more flexible form of management, i.e. in accordance with the challenges of the modern era.

Each of the newly created economic regions of Karabakh and East Zangezur has its own unique development characteristics, natural and economic resources [14]. Currently, the main task is to effectively use these economic resources, to take into account the realities of modern economic development in addition to the traditional economic sectors of the region, to evaluate the priorities and effectively use the resource potential related to the Great Return, to form the production infrastructure, to improve the standard of living and to provide employment to the population. Considering the problems is one of the important conditions [15]. From this point of view, the solution of the development problems of the Karabakh economic region is a constant topic of discussion for the state and society and remains relevant. Among the traditional economic sectors of the Karabakh economic region, there are undoubtedly more agriculturally oriented directions. Already during the Soviet period, various agricultural sectors developed strongly in Karabakh, especially in the regions of Agdam, Fuzuli, Barda, Agjabadi and Tartar [16].

The mechanisms of benefits and state support that will be applied in the economic zone are very attractive, and these factors will give a serious impetus to the development of manufacturing industries of various sectors of the region. We believe that here will be created a fundamental basis for the development and application of innovations for the technological development of the region [17]. Along with this, in the modern era, the urgent problems of the development of the Karabakh economic region come to the forefront, as new realities have emerged in the territories liberated from occupation after the Great Karabakh Victory [18]. Finally, our public buildings, production infrastructure, degraded lands, which were destroyed for almost 30 years, have been liberated from the enemy. Under such conditions, the strategic goal is to revive these territories as soon as possible and ensure their socio-economic development, as well as the comprehensive and systematic implementation of measures related to the return of the population. In Azerbaijan, work in this direction is being carried out at the State level. Even before the end of the war, the relevant conceptual ideas, approaches, main directions of the economic policy of the state were defined and adequate measures in this direction were initiated [19]. Undoubtedly, first of all, it is necessary to demine these territories and create appropriate conditions for safe life and work of the population. In our opinion, the work in these directions is proceeding according to plan, but we believe that additional measures are needed to further intensify these issues. We would like to note one issue separately: given that demining of territories takes time, more intensive measures are needed to accelerate construction and reconstruction activities and, in general, the processes of socio-economic development [20]. It is known that in the territories freed from occupation, if you approach the analysis of the pre-occupation period, there were enough natural resources, and due to their effective use, it is possible to restore the infrastructure destroyed during the occupation. In addition, issues of improving the management system of liberated territories, establishing a more flexible form of management in accordance with the challenges of the modern era deserve attention. In particular, attention should be focused on creating a network of export-oriented and competitive enterprises [21]. Taking into account global challenges, in terms of approaches to the problems of developing the Karabakh economic region, we can note that the formation of the main economic sectors here requires a certain time [22]. But it is possible to restore the activity of agricultural fields in a short period of time, and considering that the application of modern technologies, including "smart" technologies, is preferred. In this regard, the provision of modern and "smart" technologies in the development of the Karabakh economic region will allow to increase productivity, optimize costs and obtain more income [23].

On the other hand, we believe that it is important to develop, prepare and put into operation a wider network of agro-industrial processing enterprises in the context of the production infrastructure that has already begun to be created. Thus, there are great prospects for the development of agriculture and the agricultural sector as a whole in Karabakh and other territories liberated from occupation [24]. We believe that when considering these issues, special attention should be paid to the European experience, including the experience of other countries of the world, and the issues related to their

application should be studied in depth, taking into account the local conditions, and the financial mechanisms of related measures should be resolved. On the other hand, taking into account the characteristics of the socio-economic development of Karabakh, special attention should be paid to the complex development of economic sectors that can be important in the modern era. We believe that one such sector can be tourism. Tourism is a very characteristic field for Karabakh, even in the Soviet era. In the city of Shusha there was a large sanatorium which was known throughout the Soviet Union. There was also an "Istisu" complex in Kalbajar. Of course, these are quite few, and the possibilities of the Karabakh economic region in terms of tourism are much greater, and almost every region has tourism potential. But here, in our opinion, the problem of tourism development is connected with the city of Shusha.

Currently, the restoration and revitalisation of Shusha has entered an intensive phase. Hundreds of ancient buildings and monuments of historical significance are being restored and large-scale works are being carried out. Despite the fact that the territory of the city of Shusha is small, there is a great opportunity to create hotel complexes and tourist enterprises here, and this, in turn, will bring tourist areas and tourist brands to Shusha, the formation of national tourist brands can create additional conditions for the intensive development of the tourism sector in Shusha, and the development impulses of Shusha will contribute to the Karabakh economic region as a whole [25].

At the same time, it is important to objectively evaluate the opportunities for tourism and recreation and to build tourist-hotel complexes accordingly. This, in turn, can be a strong stimulus and motivation for the development of other sectors, public catering, transport, other employment, handicrafts in the city of Shusha, expansion of added value and financial sources, increase in employment opportunities, creation of new jobs. It should be noted that the acceleration of the development processes in the territories freed from occupation is the organisation of service areas in a wide segment and, undoubtedly, the intensification of the development of the transport sector - public transport, the development of other service areas of the city economy and, at the same time, the creation of public catering and hotel complexes in the service sector, giving importance and creating areas of activity based on knowledge economy and digital technologies based on intellectual resources in the city can have a positive effect on the current development of more attractive and renewable cities [26].

It is possible to restore the activity of agricultural fields in a short period of time with the application of modern technologies, including 'smart' technologies. In this regard, the introduction of modern technologies in the development of the Karabakh economic region will increase labour productivity, optimize costs and generate more income. On the other hand, we believe it is important to put into operation a wider network of agro-industrial processing enterprises in the context of the production infrastructure that has already started to be created. Thus, there are good prospects for the development of agriculture and the agrarian sector as a whole in Karabakh and other territories liberated from occupation [27].

The creation of agro-parks, various enterprises for processing meat and meat products, milk and milk products, creation of fruit processing enterprises to meet domestic demand for these products and export opportunities abroad is very relevant. In these directions, the prospects of organising economic activity zones with the status of free economic zones are also of interest. Free economic zones provide additional incentives for strengthening economic security. Diversification of the economy and mobilisation of the determinants of its development are among the priority postulates of modern development [28]. On the other hand, as we noted at the beginning, in the processes of revitalisation of post-conflict territories, serious importance should be attached to the reliability of financial mechanisms and measures to ensure financial stability [29]. Such approaches can give an additional impetus to the intensification of economic development processes, first of all, to the formation of real economic sectors in the territories liberated from occupation. In general, the improvement of the competitiveness of the spheres of the real sector of the economy should be carried out systematically [30]. It is planned to use more productive mechanisms and practical tools for intensive development of the economy [31].

We believe that there are great opportunities for the development of sericulture and the creation of industrial processing enterprises in Karabakh. Their use will contribute to the development of the textile industry in our country, the strengthening of its activities in its separate directions, and the use of raw materials available here, including the development of cocoons, cotton cultivation, wool supply, etc. it can give a serious impetus to the creation of additional jobs and processing-supply enterprises in these directions. Development of the city of Shusha, which is the center of Karabakh, representation of service areas in a wide segment and, of course, ensuring the development of the transport sector - public transport, development of urban economy areas, primarily service areas, and at the same time, more

importance to activities in the direction of public catering and hotel complexes drawing attention [32]. Formation of fields of activity based on intellectual resources in Shusha through knowledge economy and digital technologies can be more attractive and suitable for the current situation of the city [33]. Thus, taking into account the protection of the city of Shusha by the state, it is important to seriously evaluate these issues in the modeling of the socio-economic development of the city [34]. But at the same time, we believe that in order to ensure the socio-economic development of the city, to solve the problems of provision and supply of the city population, the creation of suburban infrastructure and the more efficient use of the potential of the villages of Shusha district close to the city should be kept under strict control. In our opinion, the creation of various segments of light industries, including food products enterprises producing competitive high-quality food products, could be effective here. We believe that our country has relevant experience in this regard, for example, a network of competitive and export-oriented modern enterprises has been put into operation in the Sumgayit industrial center over the past 10 years [35].

At the same time, the development of all segments of the ancient art of carpet weaving, which is quite characteristic of Karabakh, in the areas of light industry, the creation of a carpet weaving museum, and the expansion of activities in the direction of carpet weaving, including processing enterprises for various segments of textiles and the creation of national brands, could be more effective. The use of local toponyms in the branding of products to be produced, mainly the use of the toponyms of Karabakh and Shusha, as well as the promotion, promotion and greater focus on Shusha and Karabakh at the world level, will make Azerbaijanis all over the world more aware of the symbols, values and national treasures associated with Shusha [36]. Thus, the intensification of the socio-economic development of the Karabakh economic region, the realisation of the existing potential, the creation of a transport-logistic complex and a warehouse are among the important conditions for solving the problem of the region's economic security, first of all, the food security with quality food products, and these should be taken into account in the context of the socio-economic development of the city of Shusha. In our opinion, more attention should be paid to the more efficient use of the mechanism of free economic zones in the realisation of these indicated directions of activity in Karabakh [37]. The creation of such economic zones is widespread in the world experience, for example, similar economic zones have played a great role in the economic success of many countries of the world, first of all, in China [38].

Taking measures in the mentioned directions is one of the factors of great importance for the development of the city of Shusha, and taking into account all of them in the near future will lead to the revitalisation of the city of Shusha, more efficient use of its development elements through "smart" technologies, intensification of the processes of urban construction and creation of infrastructure networks, and acceleration of the Great Return [39]:

- Development of entrepreneurship in economic regions, provision of effective employment, reduction of poverty, provision of continuity of development of processing enterprises;
- Investments in economic regions for the development of regional entrepreneurship, including the assimilation of agricultural technologies, preparation and implementation of investment programmes;
- We consider it expedient to develop and implement purposeful recovery plans that take into account all directions of action and that more clearly identify the development priorities of each of the Karabakh and East Zangezur economic regions;
- We consider it important to prioritise the creation of processing enterprises in the East Zangezur economic region, and in this regard it is more appropriate to create similar enterprises, especially in the Zangilan and Jabrayil regions;
- It is important to solve the financial and insurance mechanisms without delay in order to accelerate the socio-economic development in the Karabakh and East Zangezur economic regions and to create the corresponding infrastructure and service package in the region, etc.

References

1. Quliyev, E.A. Qlobal ərzaq təhlükəsizliyi: reallıqlar, çağırışlar və perspektivlər. – Bakı: Kooperasiya, – 2018. – 480 s.
2. Ataşov, B.X, Novruzov, N.A, İbrahimov, E.Ə. Müəssisələrin maliyyəsi. Bakı: Kooperasiya. – 2009. 336 s.
3. Quliyev, E.A. Qarabağ və Şərqi Zəngəzur iqtisadi rayonlarının Azərbaycanın davamlı inkişafında rolu. Monoqrafiya. Kooperasiya nəşriyyatı, Bakı, 2023. – 320 s.

4. Алиев, Ш. (2024). Современные особенности и направления развития Карабахского экономического региона. *Scientific Collection «InterConf+»*, (41(185), 35–43. <https://doi.org/10.51582/interconf.19-20.01.2024.003>.
5. Меликова Л.А. Вопросы совершенствования финансово-экономических аспектов налогового механизма по стабилизации и роста экономики страны. *Audit № 4*, 2016. - с.22-29.
6. Melikova, L., & Hasanaliyev, V. (2024). Role of financial markets in the context of global economic challenges. *Scientific Collection «InterConf»*, (199), 83–91. <https://archive.interconf.center/index.php/conference-proceeding/article/view/6086>.
7. Алиев, Ш.Т., Азимов, А.Р., Гурбанова, Р.В. Стратегические аспекты развития банковской инфраструктуры в Карабахском и Восточно-Зангезурском экономических районах Азербайджана/ III International Scientific and Practical Conference Recent Scientific Investigation held in Oslo, Norway. *InterConf*, (74), September 16-18, 2021. – p.18-27. <https://ojs.ukrlogos.in.ua/index.php/interconf/article/view/14492>.
8. Алиев, Ш.Т., Гусейнова, Н.Э., Яхьяева, А.Ю. Проблемы повышения инвестиционной привлекательности Карабахского региона Азербайджана и пути их решения/ II International Scientific and Practical Conference Current Issues And Prospects for the Development of Scientific Research held on in Orléans, France, May 7-8, 2021, p.13-19. - <https://ojs.ukrlogos.in.ua/index.php/interconf/issue/view/7-8.05.2021/534>
9. Ataşov, B.X. *Aqrar sahədə struktur və sətərəlilik problemləri (nəzəriyyə və praktika)*. Monoqrafiya. Bakı, "Kooperasiya", 2017, 536 s.
10. Алиев, Ш.Т., Аббасова, Ч.И., Гамидова, А.М. Оценка потенциала и пути развития Карабахского экономического района Азербайджана/ VIII International Scientific and Practical Conference International forum: problems and scientific solutions held in Melbourne, Australia. *Scientific collection «interconf»*, September 6-8, 2021, № 73, p. 7-15. <https://ojs.ukrlogos.in.ua/index.php/interconf/article/view/14257/13074>.
11. Алиев, Ш.Т. Экономика Азербайджана. Сумгаит – 2018, – 376 с.
12. Səmədzadə, Z.Ə. *Qarabağ iqtisadiyyatı 100 ildə: 5 cild/ Z.Səmədzadə; [baş red.A.Səmədzadə; red. Y.Məmmədova]*. Bakı: Kitab Çapı, 2022. – 856 s.
13. Əliyev, T.N. *Azərbaycanın işğaldan azad edilən ərazilərində sahibkarlığın müdaxiləçisi menecment formaları əsasında inkişaf istiqamətləri*// AMEA İqtisadiyyat İnstitutu "İqtisadi artım və ictimai rifah" elmi jurnalı – Bakı: "Avropa" – 2021. №1, – s. 11-19.
14. *Azərbaycan Respublikasında iqtisadi rayonların yeni bölgüsü haqqında Azərbaycan Respublikası Prezidentinin Fərmanı*. Bakı şəhəri, 7 iyul 2021-ci il
15. Алиев, Ш.Т. Стратегическая важность возрождения Карабахского и Восточно-Зангезурского экономических районов Азербайджана // "Вопросы истории", Москва, 2022, № 6, Сəh. 148-155. <https://elibrary.ru/item.asp?id=48808624>.
16. Əliyev, Ş.T. *Ağdam və Füzuli rayonlarında postkonflikt ərazilərinin intensiv inkişafının Qarabağın dirçəldilməsində strateji əhəmiyyəti* // "Geostrategiya", Bakı, 2022, №4, Сəh. 89-94.
17. Алиев Ш.Т. Важность перехода к инновационной экономике промышленности Азербайджана в условиях экономического кризиса // Материалы II Всероссийской науч.-практ. конференции «Инновационное развитие и промышленная политика». Биробиджан, Россия. 18–29 мая 2009.- с. 45-50.
18. Алиев, Ш.Т., Меликова, Л.А. Актуальные проблемы и объективные реалии мирового опыта в восстановлении освобожденных от оккупации территорий/ IX Международная Научно-Практическая Конференция «Развитие науки и практики в глобально меняющемся мире в условиях рисков». – Россия, г. Москва, 28 марта 2022 года - С.277-286.
19. Алиев, Т.Н. Восстановление экономики Карабаха и Восточного Зангезура на основе коопераций устойчивого и инклюзивного развития. *The scientific heritage*, № 82 (2022), с.19-33.
20. Алиев, Ш.Т. Внешнеэкономическая политика Азербайджана. Сумгаит: Изд-во Сумгаитского государственного университета, 2015, – 185 с.
21. Алиев, Ш.Т., Сазмани Н.Э. Проблемы диверсификации экспортного потенциала Азербайджана в современных условиях// *International scientific review*. 2017. № 2 (33). – С. 41-45.
22. Гасымлы, В. Карабах и Восточный Зангезур будут новым драйвером экономического роста в Азербайджане/ В.Гасымлы// *Интерактивная наука*. – 2022. № 3(68), – с. 69-70.
23. Megits, N., Aliyev, S. T., Pustovhar, S., Bielialov, T., & Prokopenko, O. (2022). The «Five-Helix» Model as an effective way to develop business in Industry 4.0 of selected countries.// *Journal of Eastern European and Central Asian Research*, 9(2), 2022. 357-368.

<https://doi.org/10.15549/jeecar.v9i2.92012>,

<https://ieeca.org/journal/index.php/JEECAR/article/view/920>

24. Fikrətzadə, F.F., Hacıyeva, S.İ. İşğaldan azad olunan ərazilərimizdə kənd təsərrüfatı sahəsinin bərpası istiqamətləri və istehsal göstəricilərinin proqnozlaşdırılması // *Kənd təsərrüfatının iqtisadiyyatı*, 2020. № 4 (34), s.23-37.

25. Əliyev, Ş.T. Şuşa şəhərinin sosial-iqtisadi quruculuğunun strateji aspektləri və inkişaf drayverləri / *AR Mədəniyyət Nazirliyi və Elm və Təhsil Nazirliyinin İqtisadiyyat İnstitutunun birgə təşkilatçılığı ilə "Azərbaycanda Mədəniyyət İqtisadiyyatı: Şuşadan İnkişaf Impulsları"* mövzusunda beynəlxalq elmi-praktiki Konfransı keçiriləcəkdir (18-20 sentyabr, 2022-ci il / Şuşa – Bakı). - s.78-86

26. Алиев, Ш.Т. Актуальные вопросы экономической безопасности Азербайджана в условиях пандемии и постпандемии// *Известия*, НАНА, Институт Экономики, 2020, №5. - С. 5-12.

27. Ataşov, B.X. Ərzaq təhlükəsizliyinin aktual problemləri, "Elm", Bakı, 2005-336 s.

28. Алиев, Ш.Т. Важнейшие детерминанты устойчивого развития экономики Азербайджана. Книга. Баку, «Элм», 2010. - 196 с.

29. Əliyev, Ş.T. Azərbaycanla maliyyə sabitliyinin təmin edilməsi problemləri və maliyyə-kredit sisteminin inkişafının müasir aspektləri// *Audit*, – 2017. № 03, – s. 26-40.

30. Aliyev, Sh.T. (2014). *Economics of Azerbaijan: upgrading and implementation of effective instruments*. *Life Science Journal*, 11, 321-326.

31. Алиев Ш.Т. Проблемы конкурентоспособности реального сектора экономики Азербайджана в условиях глобализации// *Журнал «Доклады» НАНА*. – 2008. – № 6. – С. 135–143.

32. Əliyev, Ş.T., Cəbiyev, F.A. Şuşa şəhərinin sosial-iqtisadi inkişafının təmin edilməsində Heydər Əliyevin rolu // "İnnovasiyalı iqtisadiyyat və menecment" jurnalı, 2023, №1. – s. 11-18. <https://innovation.uteca.edu.az/az/archive/>.

33. Əliyev, Ş.T. Şuşa şəhərinin sosial-iqtisadi inkişafının təmin edilməsində Heydər Əliyevin tarixi rolu// "Geostrategiya" jurnalı, Bakı, 2023, №2(74). – s. 86-90- <https://geostrategiya.az/pdf/2023/0274.pdf>.

34. Алиев, Ш.Т. Стратегическая важность возрождения Шуша в интенсификации социально-экономического развития Карабахского экономического района/ Ш.Т. Алиев, Л.А. Меликова// *Современные тенденции развития науки и мирового сообщества в эпоху цифровизации: Сборник материалов VII Международной научно-практической конференции*, Москва, 30 июня 2022. – с. 321-329.

35. Aliyev, Sh.T. *Strategic role of Sumgayit in the development of petrochemical industry of Azerbaijan / The International Conference on Actual Problems of Chemical Engineering - APCE 2020. - Azerbaijan State of Oil and Industry University. 24-25 december 2020. – p.430-435.*

36. Şuşa-270. Şuşanın demoqrafik, sosial-iqtisadi inkişafı: dünən, bu gün və perspektivlər. Bakı, – 2022. – 268 s.

37. Алиев Ш.Т. Перспективы развития свободных экономических зон в странах СНГ в контексте опыта Турции/ Шафа Алиев// *Zarubejye*. – Стамбул, 2009. – январь. – с. 1-9.

38. Azərbaycan Respublikasının işğaldan azad edilmiş ərazilərinə Böyük Qayıdışa dair I Dövlət Proqramı. AR Prezidentinin 16 noyabr 2022-ci il tarixli Sərəncamı ilə təsdiq edilmişdir.

39. Aliyev, Sh.T. (2010). *The Problems of the Variety of Formation and Functioning of the Special Economic Zones in Azerbaijan in the Context of the World Experience. Marketing and Management of Innovations*, 1, 144-148.

Geographical sciences

DISTRIBUTION OF AIR TEMPERATURE AND PRECIPITATION IN THE FOOTHILL ZONE OF THE NORTH CAUCASUS REGION

Kesheva Lara Asirovna

*Candidate of Physical and Mathematical Sciences
FSBI "High Mountain Geophysical Institute", Nalchik, Russian Federation*

Teunova Nataliya Vyacheslavovna

*Candidate of Physical and Mathematical Sciences
FSBI "High Mountain Geophysical Institute", Nalchik, Russian Federation*

Abstract

This article analyzes the atmospheric air temperature and precipitation regime based on information from meteorological stations located in the foothill zone of the North Caucasus region for four 30-year periods: 1961-1990, 1971-2000, 1981-2010 and 1991-2020. Graphs of the annual distribution of air temperature and precipitation amounts for six meteorological stations were constructed: Kislovodsk, Vladikavkaz, Stavropol, Cherkessk and Nalchik in the specified periods. The studies showed that an increase in intra-annual and average annual temperature is observed in each subsequent period under consideration at all stations. Unlike changes in temperature, changes in precipitation are uneven, with periods of decrease and increase in precipitation amounts. In assessing the change in climatic characteristics for the foothill zone of the North Caucasus region, averaged values obtained at six meteorological stations over four thirty-year periods were used. It was found that the angular coefficient of the linear trend of average annual temperature in each subsequent thirty-year period is higher than the previous one, and the linear trends of precipitation amounts are not unidirectional.

Keywords: *temperature, precipitation regime, North Caucasus region, foothill zone, intra-annual distribution, linear trend.*

Air temperature and precipitation are fundamental indicators for describing climate and can have widespread impacts on human life and ecosystems.

According to the materials presented in the Third Assessment Report, since the 1980, each subsequent decade has been warmer than any previous one since 1850. The current average global surface air temperature is about 14.9°C, which is 1.2°C higher than in the pre-industrial era. The average rate of surface air warming during 1976-2020 was 0.18°C/10 years globally, and during this period alone, the global temperature increased by 0.8°C [1].

Russia occupies a special place in the context of the climate change problem due to its size, geographic location and exceptional diversity of climatic conditions. In Russia, the rate of warming since the mid 1970 is now more than two and a half times higher than the global average [2].

Around the world, 2016 was the warmest year on record, 2020 was the second warmest year, and 2012-2021 was the warmest decade on record [3].

Climate change has a significant impact on atmospheric processes and the natural and climatic characteristics of all regions [4, 5, 6].

When describing the regional climate, temperature and precipitation data are also fundamental climate indicators. Using information on the temperature and precipitation regime allows us to solve a wide range of scientific and practical issues.

To study climate change at meteorological stations in the foothill zone of the North Caucasus region, we used data on atmospheric air temperature series and precipitation amounts. The foothill zone of the North Caucasus is a strip about 300 km wide, stretching from northwest to southeast for more than 900 km. Average heights are 500–1000 m above sea level. This paper examines changes in climate indicators at six meteorological stations in the foothills of the North Caucasus region: Kislovodsk (Stavropol Krai, 819 m above sea level), Vladikavkaz (Republic of North Ossetia-Alania, 680 m above sea level), Buynaksk (Dagestan, 560 m above sea level), Stavropol (Stavropol Krai, 540 m above sea level), Cherkessk (Karachay-Cherkessia, 526 m above sea level), Nalchik (Kabardino-Balkaria, 500 m above sea level). The physical and geographical characteristics of the meteorological stations are shown in Fig. 1.



Figure 1. Physical and geographical position of meteorological stations

The analysis was carried out using data from hydrometeorological observations at meteorological stations of the state observation network of Roshydromet, provided by the North Caucasus Department of Hydrometeorological Service and data using an electronic resource [7].

This work is a continuation of the study of climate change in the foothill zone of the region [8, 9].

To assess changes in the temperature and precipitation regime in the foothill zone of the North Caucasus region, a comparative analysis of meteorological data for four 30-year climatic periods (1961-1990, 1971-2000, 1981-2010 and 1991-2020) was carried out.

Changes in intra-annual temperature over several decades indicate its increase in each subsequent period at all stations (Fig. 2). Comparing the first basic climatic period (1961-1990) with the later climatic period (1991-2020), it can be seen that at all weather stations in the foothill zone of the North Caucasus region, an increase in the average temperature was observed in all months. In Stavropol and Cherkessk, the increase in the average annual temperature was 0.8 °C (from 9.2 °C to 10.0°C and from 9.0°C to 9.8°C, respectively). Similarly, in Nalchik, Vladikavkaz and Buynaksk, the average annual temperature increased by 1.2°C (from 9.3°C to 10.5°C, from 8.5°C to 9.7°C and from 9.9°C to 11.1°C, respectively), and in Kislovodsk by 0.9°C (from 7.8°C to 8.7°C).

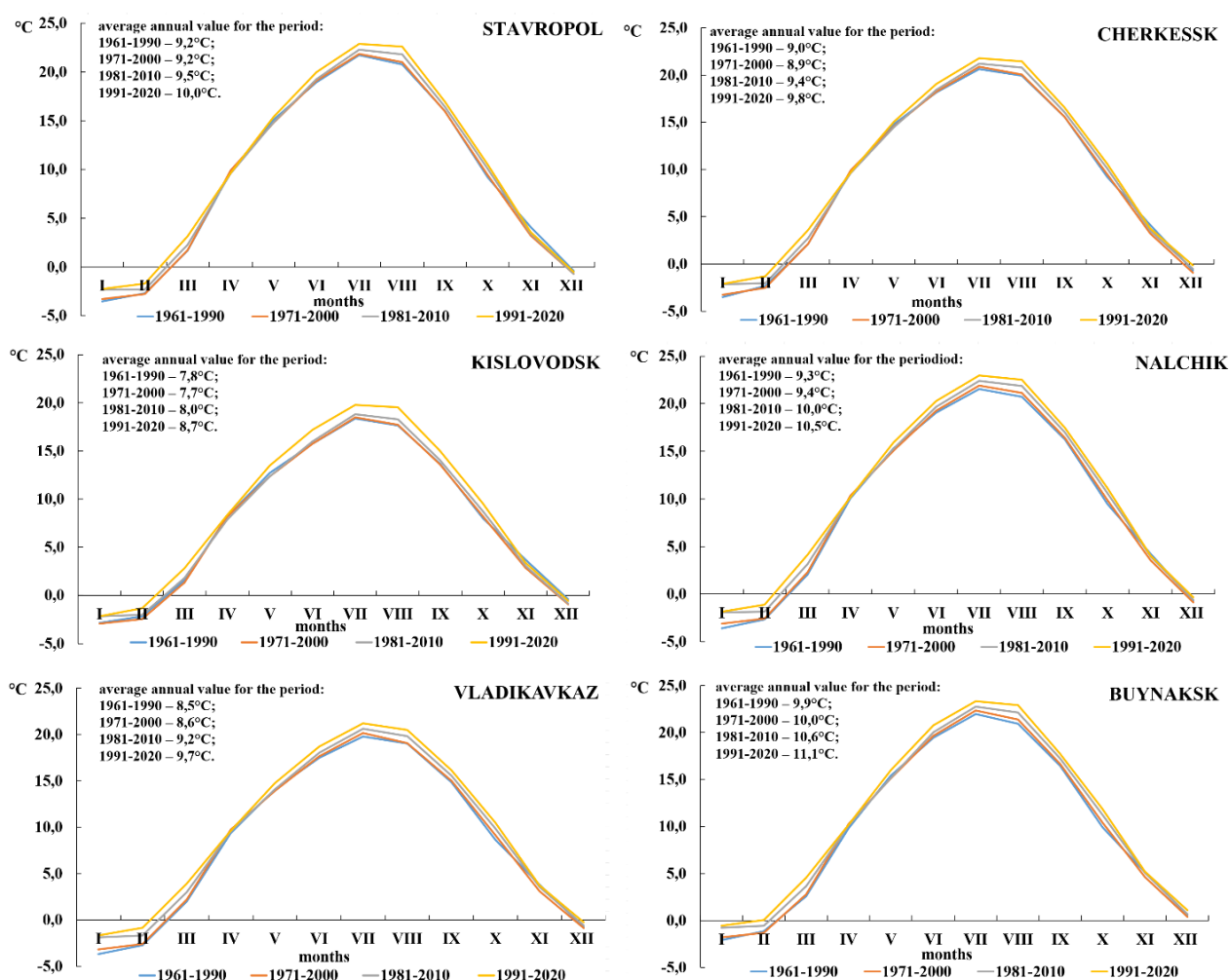


Figure 2. Intra-annual distribution of air temperature in the foothill zone of the North Caucasus region in the periods 1961-1990, 1971-2000, 1981-2010 and 1991-2020.

Changes in precipitation patterns in the region were uneven. There were periods of decrease and increase in precipitation. In Stavropol and Vladikavkaz, the average long-term precipitation was lowest in the second period of 1971-2000 (554.0 mm and 935.6 mm, respectively) and highest in the first period in Stavropol (1961-1990 - 569.1 mm) and in the fourth period (1991-2020 - 954 mm) in Vladikavkaz. In Kislovodsk, Nalchik and Buynaksk, the highest amount of precipitation was observed in the third period under consideration (1981-2010 - 672.1 mm, 647.4 mm and 675.5 mm, respectively), and the least in the second period (1971-2000) in Kislovodsk (645.8 mm) and Buynaksk (463.2 mm) and in the fourth period (1991-2020) in Nalchik (634.5 mm). In Cherkessk, the highest amount of precipitation occurred in the period 1991-2020 (592.9 mm) and the least in the period 1961-1990 (569.1 mm). The differences in average annual precipitation between the first and fourth climatic periods were -10.2 mm in Stavropol, +0.6 mm in Kislovodsk, -1.9 mm in Nalchik, +44.8 mm in Vladimir, and +5.3 mm in Buynaksk.

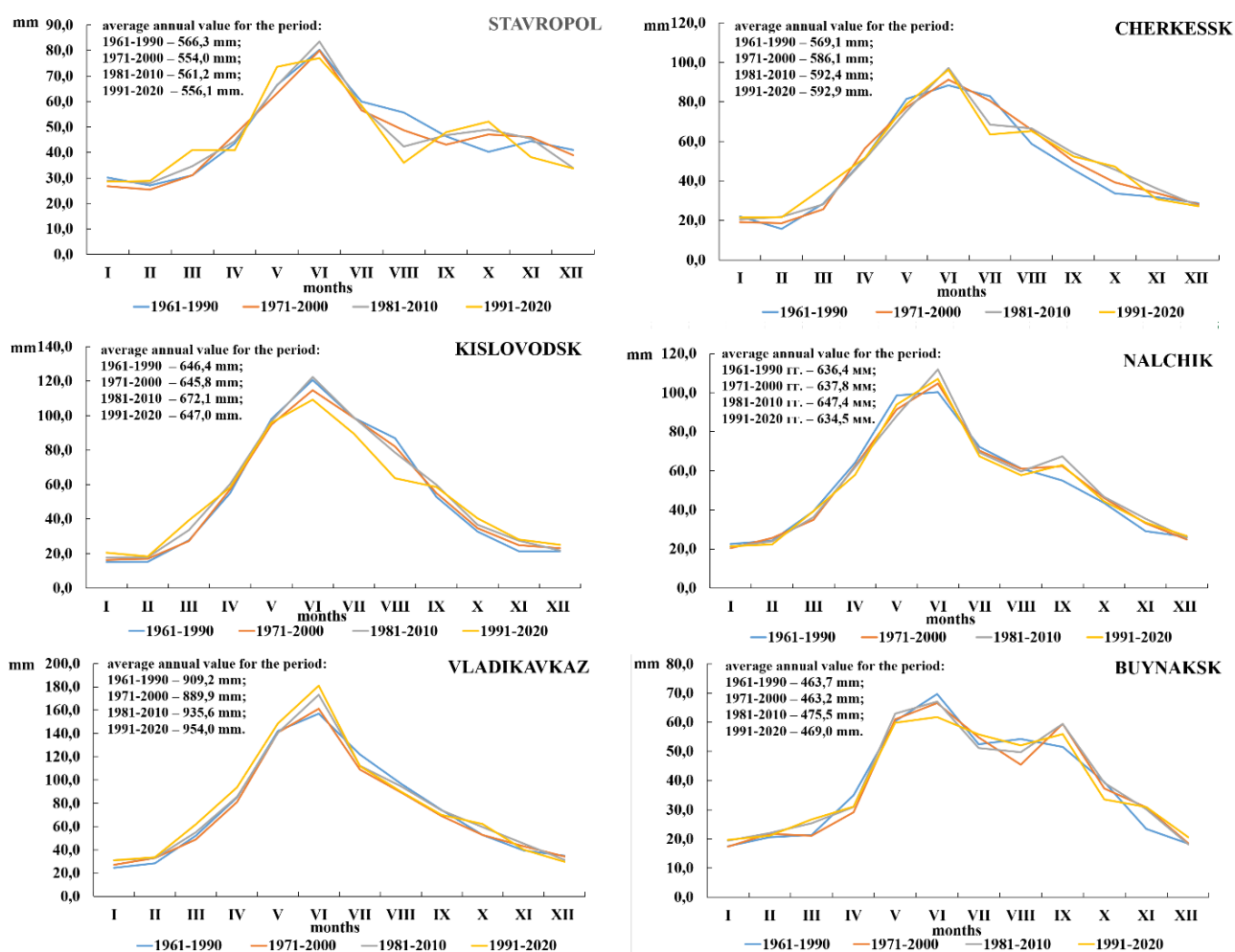
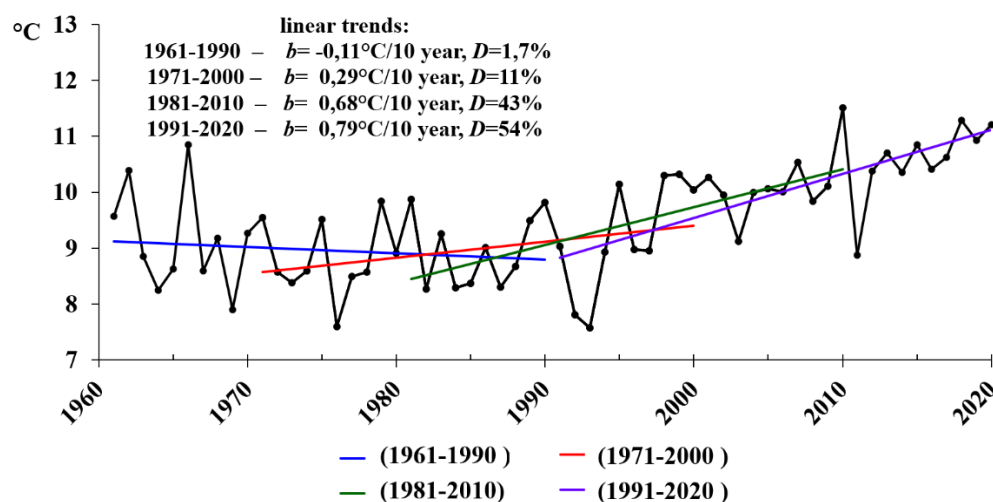


Figure 3. Distribution of precipitation in the foothill zone of the North Caucasus region in the periods 1961-1990, 1971-2000, 1981-2010 and 1991-2020.

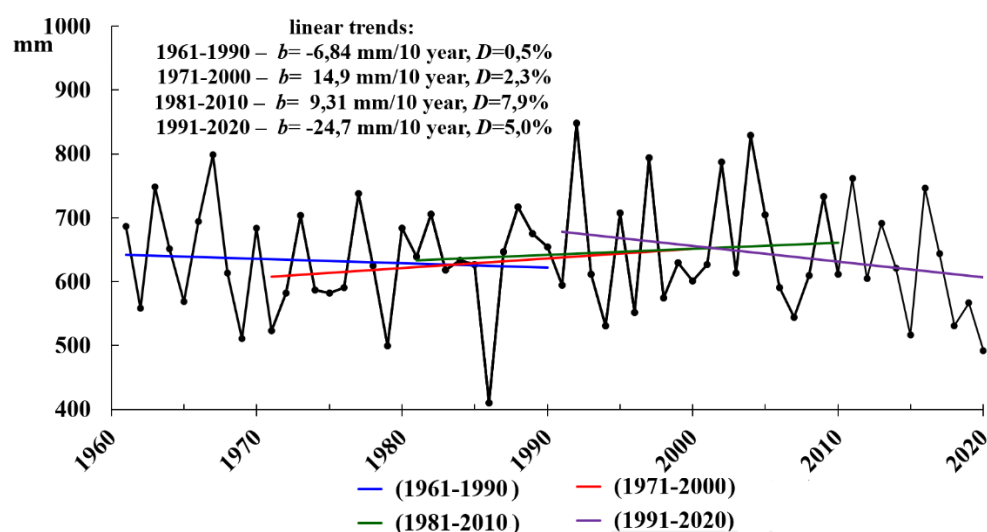
To assess the changes in meteorological parameters for four thirty-year periods for the foothill zone of the North Caucasus region, the average values were calculated and the analysis of changes in meteorological parameters was carried out using the methods of mathematical statistics. The trends were calculated using the well-known least squares method. The angular coefficient of the linear trend equation b is expressed in degrees per decade ($^{\circ}\text{C}/10$ years, temperature) and in millimeters per decade ($\text{mm}/10$ years, precipitation). The strength of the trend, its statistical significance, was estimated by the value of D (%), the contribution of the trend to the explained variance.

Figure 4a presents comparative estimates of the rate of change in the average annual surface air temperature in the foothill zone of the North Caucasus region. It is evident from Figure 4 that the angular coefficient in each subsequent thirty years is higher than the previous one. In the period 1961-1990, there was a statistically insignificant decrease in the trend $b = -0.11^{\circ}\text{C}/10$ years, with $D = 1.7\%$. In the period 1971-2000, the trend is positive, statistically significant, and the growth rate was $b = 0.29^{\circ}\text{C}/10$ years, with $D = 11.0\%$. In the period 1991-2020, the growth rate of the average annual temperature reached $b = 0.79^{\circ}\text{C}/10$ years with a contribution to the total variance of $D = 54\%$. When considering the precipitation amounts (Fig. 4b), we can conclude that the linear trends are not unidirectional: in the periods 1961-1990 and 1991-2020. A decrease in linear trends is observed at a rate of $-6.84 \text{ mm}/10$ years and $-24.7 \text{ mm}/10$ years, respectively, while a slight tendency towards an increase in the growth rate is observed in the periods 1971-2000 ($14.9 \text{ mm}/10$ years, $D = 2.3\%$) and 1981-2010 ($9.31 \text{ mm}/10$ years, $D = 7.9\%$), respectively.

a)



b)



a) temperature, b) precipitation

Figure 4. Average annual temperatures and precipitation amounts with linear trends in the foothill zone of the North Caucasus region in the periods 1961-1990, 1971-2000, 1981-2010 and 1991-2020

The conducted analysis of changes in intra-annual and average annual air temperature indicates ongoing warming in the foothill zone of the North Caucasus region. Changes in intra-annual temperature indicate its increase in each subsequent thirty-year period at all the stations under consideration. Analysis of changes in the average annual temperature for the foothill zone of the North Caucasus region showed that the angular coefficient in each subsequent thirty years is higher than the previous one and in the period 1991-2020 reaches a value of $b = 0.79 \text{ }^{\circ}\text{C} / 10 \text{ years}$, with $D = 54\%$.

Changes in the precipitation regime in the region were uneven. There were periods of decrease and increase in the amount of precipitation, both intra-annual and average annual, at all meteorological stations and in the foothill zone of the region as a whole.

References

1. Third assessment report on climate change and its consequences in the Russian Federation. General Summary. – St. Petersburg: Science-Intensive Technologies, 2022. – 124 p.
2. Report on Climate Features in the Russian Federation for 2022. – Moscow, 2023. – 104 p.
3. <https://www.epa.gov/report-environment>
4. Ashabakov B.A., Fedchenko L.M., Tashilova A.A., Kesheva L.A., Teunova N.V. Spatio-temporal Climate Change in the South of European Russia, Assessment of Its Consequences, Methods and Models of Adaptation of the AIC. Nalchik: OOO Fregat, 2020. – 476 p.

5. Perevedentsev Yu.P., Parubova E.M., Sherstyukov B.G., Shantalinsky K.M., Myagkov M.A. Variability of the main climatic indicators on the territory of the Volga Federal District in the period 1966–2018. // *Bulletin of the Udmurt University*. 2021. T. 31, issue. 1. pp. 65–75.
6. Sherstyukov B.G. Regional and seasonal patterns of modern climate change. Obninsk: Publishing house. State Institution. All-Russian Research Institute of Hydrometeorological Information - World Data Center, 2008. – 246 p.
7. <https://rp5.ru>.
8. Fedchenko L.M., Tashilova A.A., Kesheva L.A., Teunova N.V. Changes in the Main Climate Indicators in the Foothill Zone of the North Caucasus for the Period 1961-2022. // *Geographical Bulletin*. 2024. No. 1. pp. 113–123.
9. Ashabokov B.A., Fedchenko L.M., Kesheva L.A., Teunova N.V. Analysis of changes in surface air temperature and precipitation in the foothill zone of the North Caucasus region for the period 1961–2019 // *Scientific Notes of the Vernadsky Crimean Federal University. Geography. Geology*. Vol. 7 (73). No. 3. 2021. pp. 230–240.

Historical sciences

THE GATE OF THE OLD EAST – NAKHCHIVAN

Sevda Aghayeva

Azerbaijan State Pedagogical University, Baki, Azerbaijan
Philology Faculty, Senior Teacher of the Foreign Languages Centre
ORCID: <https://orcid.org/0000-0002-5615-692>

Abstract

Nakhchivan often refers to as the "Gate of the Old East," is a region in Azerbaijan with deep historical roots and cultural significance. This ancient land, rich in historical monuments and natural beauty has been a crossroads of civilisations, particularly as a key stop on the Silk Road. Nakhchivan's history, marked by influences from various cultures and states, reflects its strategic importance and enduring connection to Azerbaijan's cultural heritage. Nakhchivan remains crucial to understanding Azerbaijan's broader history and identity as a unique blend of ancient history and vibrant tradition.

Keywords: Azerbaijan, Nakhchivan, Silk Road, Tomb of Noah, Momina Khatun Mausoleum, ancient city, architecture, the Autonomous Republic, Caucasus region, Alinja Fortress.

Introduction

Nakhchivan, a region steeped in history and culture, holds a special place in the heart of Azerbaijan. Often referred to as the "Gate of the Old East," this ancient land is a testament to the rich tapestry of civilisation that flourished in the Caucasus over millennia. With its strategic location along the historic Silk Road, Nakhchivan has been a hub of trade, culture, and spiritual significance. Today, it stands as a living museum, where the echoes of the past blend seamlessly with the traditions and landscapes that define its unique identity. In exploring Nakhchivan, one embarks on a journey through time, discovering the essence of Azerbaijan's historical and cultural heritage.

Nakhchivan is one of Azerbaijan's ancient cities with great historical significance. Known as the "Gate of the Old East," this region stands out for its rich culture, historical monuments, and beautiful nature. The Nakhchivan Autonomous Republic is separated from the main part of Azerbaijan but remains closely connected historically and culturally.

As one of Azerbaijan's oldest regions, Nakhchivan is a fascinating blend of history, culture, and natural beauty. The area's strategic importance has been recognised for centuries, making it a vital point of interest for various empires and civilisations that have passed through or settled in the Caucasus region.

The history of Nakhchivan dates back to ancient times, with evidence of early settlements from the Eneolithic period. Historical sites like the Tomb of Noah, linked to the prophet Noah, and the Momina Khatun Mausoleum showcase the region's rich past. Situated on the historical Silk Road, Nakhchivan is a centre for trade and cultural exchange.

Nakhchivan's history is intertwined with the history of Azerbaijan deeply and the broader of Caucasus region. Various civilisations, cultures, and states have influenced this ancient land over the centuries, making it culturally and strategically significant.

When thinking about Nakhchivan, one envisions a unique place where ancient history, cultural heritage, and stunning natural landscapes come together. This region serves as a key to understanding Azerbaijan's past and cultural identity.

The Nakhchivan Autonomous Republic is an integral part of the independent state of Azerbaijan, one of its beautiful corners and lands.

Great Leader Heydar Aliyev

Nakhchivan is considered one of the oldest human settlements in the world. It is no coincidence that the architectural pearls of Azerbaijan, Momina Khatun's tomb and Khan's Palace are located in Nakhchivan. It is possible to find ancient buildings, historical monuments of different centuries, and examples of cultural heritage in this land. There are many stories and legends about Nakhchivan.

On February 9, 2024, the 100th anniversary of the establishment of the Nakhchivan Autonomous Republic was completed. On December 30, 2023, President Ilham Aliyev signed the Decree "On holding the 100th anniversary of the Nakhchivan Autonomous Republic". It was stated in the order: "The land of

Nakhchivan occupied a worthy place in the centuries-old rich past of Azerbaijan and played a unique role in its social, political, scientific and cultural life. The heroic population of Nakhchivan saved this ancient Azerbaijani land from the threat of occupation and sacrificed for the restoration, preservation and strengthening of national statehood with the brave steps taken for the independence of Azerbaijan. During the 44-day Patriotic War in 2020, brave sons of Nakhchivan wrote bright pages in our glorious annals of victory. (4)

Nakhchivan became the capital of the Atabays-Eldagiz state of Azerbaijan and gained wide fame



as one of the important centres of science, culture and craftsmanship of the Islamic civilisation. The relics of the school of architecture, founded by Ajami Nakhchivani, which have survived to this day, add a special colour to the appearance of Nakhchivan. "Nakhchivan has contributed to the progress of Azerbaijan's statehood, culture and science with its outstanding personalities over the centuries."

Nakhchivan has given the people of Azerbaijan and the world geniuses, thinkers, and generals. The Great Leader Heydar Aliyev is an irreplaceable world leader who stands above such personalities. Throughout his life, he set an example of loyalty to his native country

and people, he did his best for the progress and development of our country. The genius leader always kept in mind the continuous development of Nakhchivan and managed to make the most important decisions about its future. (1)

A century ago the establishment of the Nakhchivan Autonomous Republic in this ancient land of Azerbaijan, in the great Turkic land, played a significant role in the 1st century historical destiny of the region, preserving its territory and ensuring its security. The Nakhchivan Autonomous Republic has made a worthy contribution to the rise and comprehensive development of the economic power of Azerbaijan over the years.

President Ilham Aliyev said: "The bold steps taken by Nakhchivan on the path to national independence were welcomed by the Azerbaijani people and had a positive and decisive impact on the social and political processes taking place in the republic. Today, the Nakhchivan Autonomous Republic is an active participant in the national state-building process, making valuable contributions to increasing the economic power and strengthening the intellectual potential of our country." (4)

The Nakhchivan Autonomous Republic is located in the southwestern part of the Lesser Caucasus, between the Daralayaz and Zangazur mountains. About a third of its territory is located in the southwestern corner of the Lesser Caucasus, between the Daralayaz and Zangazur mountains of the Nakhchivan Autonomous Republic. The most important aspect of Nakhchivan, rich in ancient material and cultural monuments, historically called the "Gate of the East" and "Nagshi-Jahan", is the gateway connecting the West and the East. About a third of its territory is 600-1000 meters above sea level. The highest point is Gapijik and Ilandagh. It is located 560 kilometres from Baki.

Nakhchivan borders Armenia in the north and east (the length of the borderline is 246 km), Turkiye in the west (11 km), and the Islamic Republic of Iran in the south (204 km). The natural border with Armenia is formed by the watersheds of the Zangazur and Daralayaz ranges and the Araz River forms the border of Turkiye and Iran. Its territory stretches for 158 km from northwest to southeast. As a result of the transfer of ancient Zangazur to Armenia by the Soviet leadership in 1920, a 44-45 km wide strip extended towards Araz and separated the Nakhchivan Autonomous Republic (NAR) from the territory of the Republic of Azerbaijan. The territory of the Nakhchivan Autonomous Republic is 5500 km², and the population is about 450 thousand. According to the relief, the territory of NAR consists of mountains occupying most of the economic-geographic region, and a relatively narrow zone stretching along Arazboyu consists of plains. (2)

Nakhchivan has a continental climate, the temperature range varies between +45 degrees in summer and -30 degrees in winter. A large number of medicinal plants grow in Nakhchivan: beech, oriental oak, walnut, willow, birch and so on. Bear, wild boar, Asia Minor mouflon, mountain sheep and other animals live here. The location of the city in a strategic position led to periodic raids by neighbouring states. As a result of these wars, the city was destroyed and rebuilt several times. Nakhchivan was one of the main cities of the Atabay state of Azerbaijan.

Yusif ibn Kuseyir (ancestral tomb), Momina Khatun's Tomb, Goshia minaret and Juma Mosque with minaret created by the great architect of the 12th century, Ajami ibn Abubakr Nakhchivani have survived to our time in Nakhchivan and they are considered to be beautiful architectural traditions of Memar Ajami.

Famous European travellers and scientists highly



appreciated the buildings built by Ajami, and after the construction of the mausoleum of the tomb, it was widely used in European architecture.

Other historical monuments - Imamzadeh Architectural Complex, Zaviya Mosque and "Khan's House" are among the objects protected by the state in the city.

French travellers Pierre Chardin, Dubois de Montper and English traveller Porter wrote that Nakhchivan is a rich and beautiful city with ancient architectural monuments.

Historically, Nakhchivan was also known for its potters, jewellery and architects. The famous palace complex of Eldagiz, Juma Mosque, madrasa, and various

government buildings and palaces were built mainly in the region where architecture is more developed.

The ancient land of Azerbaijan Nakhchivan stands out for its rare nature. Especially the region is rich in springs and lakes and there are favourable conditions for the development of eco-tourism.

*The only floating island in the world **Lake Batabat** is one of the places that attracts tourists. The floating island is considered a mysterious natural monument, it was formed from Sphagnum mosses and growing grass. The island changes its location depending on the direction of the wind. There are rare gold and silver fish species in Batabat Lake. The surrounding areas of the lake, which have ideal conditions for fishing enthusiasts, are rich in medicinal plants.*

Batabat, which is 65 kilometers away from Nakhchivan, at an altitude of 2445 meters above sea level, is also famous for its healing water. The region



is famous for its clean mountain air, forests, sweet waters such as Zorbulag and Sudlūbulag, and Batabat, which is 65 kilometres away from Nakhchivan city and is 2445 meters above sea level, is also famous for its healing water.

The regions of the autonomous republic Ordubad, Julfa, Babek, Shahbuz, Sharur and Kangarli attract attention with their historical monuments, rich cultural examples, and mysterious natural landscapes.

Rare petroglyphs from III-II millennia BC are preserved in the Gamigaya monument, located 60 kilometres south of Ordubad. There are thousands of paintings depicting domestic and hunting scenes.

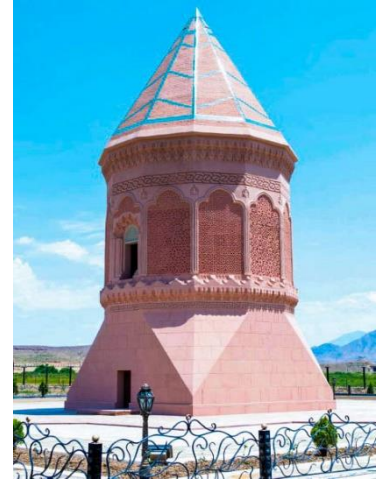
In Ordubad, the second largest city in the autonomous republic, there are stone ram statues from the Bronze Age, the remains of a settlement from the 2nd-1st millennia BC, the ruins of the ancient cities of Gilan and Anabad, medieval buildings and many historical monuments in the villages of Kilit, Aylis, Bilav, Vanand.

Near the city of Julfa, located in the east of the autonomous republic, on the banks of the Araz River, the remains of the 13th-century caravanserai, the bridge built at the beginning of the 14th-century, the Gulustan Mausoleum, the Alinja Fortress and many other monuments and ancient buildings remain.

The prominent monument **Momina Khatun Mausoleum** was



built in the 12th century by the famous Azerbaijani architect Ajami Nakhchivani. This masterpiece of medieval architecture is a symbol of Nakhchivan's rich artistic heritage and a testament to the advanced state of art and architecture in the region during the medieval period. (2)



There is an ancient human settlement called "Farhad's House" in the Shahbuz region. The unusual-looking residence was carved into the mountain and shaped like a four-room house. Sharur has a mild climate. The temperature rarely falls below +3 degrees in winter and does not rise above +26 degrees in summer in Sharur located in the west of Nakhchivan.

The region is also known for its unique culinary traditions, which reflect the diversity of influences from neighbouring regions and the broader Middle East. Dishes such as "dovgha" (a yoghurt-based soup), "qovurma" (a type of stew), and various types of kebabs are staples of Nakhchivan's cuisine.

Historical Significance

The origins of Nakhchivan date back thousands of years, with archaeological evidence suggesting human settlement as early as the Eneolithic period (around the 6th to 5th millennium BC). Over the centuries, it has been home to various civilisations, including the Urartians, Persians, Romans, and later the Seljuks, Mongols, and Safavids. Each of these cultures has left its mark on the region, contributing to its rich tapestry of history.

The issue of the status of Nakhchivan, which is considered one of the oldest settlements in Azerbaijan, was one of the most important issues on the agenda in the 20s of the 20th century. The important strategic geographical position of Nakhchivan and the groundless territorial claims of Armenians made the solution to this issue more urgent. In the Moscow and Kars agreements signed between Turkiye, Russia and the South Caucasus republics, the fact that Nakhchivan is the ancient territory of Azerbaijan and it is kept within it was once again confirmed. In the charter presented in the spring of 1922, Nakhchivan was declared an autonomous republic under the auspices of the Azerbaijan SSR under the name of the Nakhchivan Soviet Socialist Republic (SSR).

From February to December 1923 it became an autonomous part of the Azerbaijan SSR. On December 31, 1923, the Central Executive Committee of the Azerbaijan SSR adopted a decision on the re-organization of the Nakhchivan state. Based on that decision, the country of Nakhchivan became the Nakhchivan SSR within Azerbaijan. (3)

Finally, on February 9, 1924, the Nakhchivan Autonomous Soviet Socialist Republic was established. Thus, despite the claims of Armenia and the patronage of Soviet Russia, which patronized it,

it was ensured that the Nakhchivan Autonomous Republic, which is the ancient and eternal land of the Azerbaijani people, remained a part of Azerbaijan.

On February 18, 1929, the Transcaucasia MIC adopted a decision to join 9 villages of Nakhchivan ASSR (3 villages of Sharur, 5 villages of Shahbuz, 1 village of Ordubad), as well as a part of the lands of the Kilit village to the Armenian SSR.

According to the Constitution of the Azerbaijan Republic adopted on November 12, 1995, the Nakhchivan Autonomous Republic is an integral part of the Azerbaijan Republic and its status is determined by this constitution.

During the archaeological excavations conducted in Nakhchivan, the discovery of material and cultural samples dating back to the 3rd millennium BC confirms that this land existed in ancient times. They explain the meaning of the word Nakhchivan in different ways. The earliest information about Nakhchivan belonged to historian Iosif Flovi (1st century BC) and geographer Claudius Ptolemy (2nd century AD). In Ptolemy's work "Geography", the name of the city of Nakhchivan was presented as Nakhuana, in medieval Arabic and Persian sources it was presented as Nasava, Nagchuan, Nakhchuan, Nakhchavan, and in other sources as Nagshi-Jahan (decoration of the world). The toponym of Nakhchivan is also associated with the "world storm" in connection with the legendary prophet Noah. (3)

One of the most significant historical landmarks in Nakhchivan is the **Tomb of Noah**. According to local legend, Nakhchivan is considered one of the places where Noah's Ark came to rest after the flood, and the tomb is said to be the final resting place of the prophet Noah. While the historical accuracy of this claim is debated, the tomb remains an important cultural and religious site.

Residents connect the creation of a settlement in Nakhchivan with the story of Prophet Noah, who survived the Great Flood. According to that legend, Prophet Noah lived there for a long time after the water was drawn and died there.

Nakhchivan was the capital of the Atabays State, which was established in Azerbaijan in the 12th century. Alinja Castle was built for the defence of Nakhchivan on the instructions of Atabay Shamsaddin Eldagiz. As the castle was in a strong and secure place the state's treasury was also stored there. The Spanish traveller Clavijo wrote about the Alinja Fortress: "The fortress was on a high mountain. It was surrounded by walls and towers. There were many vineyards, gardens and plantations, a lot of water, and rooms in the castle. The castle was at the top of the mountain."

Mirza Rza Kangarli created the first cavalry division to protect Nakhchivan from foreign enemies at the beginning of the 17th century, Heydar Gulu Khan Kangarli from this generation declared himself the Khan of Nakhchivan after the death of Nadir Shah in 1747 and he included all territories to Nakhchivan from the Zangazur Mountains to the Araz River (including Mehri and Gafan).

In ancient times, caravan routes went from Nakhchivan to other cities of Azerbaijan, as well as to Iran, India, and Central Asian countries. Because these roads connect Nakhchivan with the biggest cities in Eastern countries, Mustafa Kemal Atatürk called Nakhchivan the "Gate of the Turks". Nakhchivan artisans made pottery, jewellery, and various metal objects. 7 types of cotton, grapes, famous Nakhchivan carpets, silk fabrics were produced here. (3)



The ancient land of Nakhchivan is also home to military generals such as Ismail Khan Nakhchivanski, Jumshud Khan, Ehsan Khan, Kalbali Khan, well-known scientists such as Habibulla and Toghrul Shahtakhtinsky, Yusif Mammadaliyev, Hasan Abdullayev, Jalil Mammadguluzadeh and national leader Heydar Aliyev, one of the world-renowned personalities of the victims of Stalin's repression such as prominent poet Huseyn Javid.



Nakhchivan's cultural heritage is deeply intertwined with the broader history of Azerbaijan. The region has been a melting pot of various cultures, each contributing to its rich traditions, language, and arts. Traditional crafts such as carpet weaving, pottery, and metalwork have been practised in Nakhchivan for centuries, and these skills continue to be passed down through generations.

The silk industry began to develop in Nakhchivan in the 13th century. Silk was exported from Ordubad to Venice, Marseille, Amsterdam and other European countries.

Nakhchivan is not rich in only history and culture but also in natural beauty. The region is characterised by its rugged mountains, fertile valleys, and mineral springs, making it a popular destination for eco-tourism and health tourism.



Nakhchivan is also rich in underground mineral waters. Rare mineral waters such as Sirab, Badamli, Vaikhir, Nahajir, Kyziljir have no equal. Badamli with hydro-carbonate, Sirab with hydro-carbonate and chloride, Vaykhir and Daridagh, Jugha, Alinjachay with hydro-carbonate, sulfate and carbon dioxide mineral waters have great therapeutic value. Sirab, Vaikhir mineral water sources and rock salt deposits are located in the territory of the Babak region.

The region, famous for its clean mountain air and forests, is famous for its sweet waters such as Zorbulag, Sudlülbulag, and "Narzan" mineral water. Archaeological monuments with the ancient ruins of Gultepe, Abbasabad, Vaikhir and Aznabyurd are also located here. The Babek region is also rich in sulfur and peat deposits.

Modern-Day Nakhchivan

Nakhchivan is an autonomous republic within Azerbaijan, with its own government and administrative structure today. Despite being separated from the rest of Azerbaijan by Armenian territory geographically, Nakhchivan has maintained its cultural and economic ties with the mainland. The region continues to develop, with modern infrastructure and facilities enhancing the quality of life for its residents while preserving its rich historical and cultural heritage.

Conclusion

Nakhchivan stands as a remarkable testament to the enduring legacy of Azerbaijan's history and culture. As the "Gate of the Old East," this region has witnessed the rise and fall of civilizations, each leaving an indelible mark on its landscape and identity. From its ancient monuments like the Tomb of Noah and the Momina Khatun Mausoleum to its rich art, cuisine, and craftsmanship traditions, Nakhchivan encapsulates the essence of Azerbaijan's cultural heritage. Its unique blend of historical significance, cultural depth, and natural beauty makes Nakhchivan a vital link in understanding the broader narrative of Azerbaijan and the Caucasus region.

In the modern day, Nakhchivan continues to thrive, balancing development with the preservation of its ancient heritage. This region is not only a repository of the past but also a vibrant part of Azerbaijan's present and future. Nakhchivan's story is one of resilience and continuity, a place where history lives on and where the spirit of the East remains alive and influential. As such, Nakhchivan remains



a symbol of Azerbaijan's enduring connection to its historical roots and its place in the cultural mosaic of the Caucasus.

References

1. Nərgiz qəhrəmanova, naxçıvan muxtar respublikasının yaradılmasından 100 il ötür <https://science.gov.az/az/news/open/28705>
2. Şərqi qapısı – Naxçıvan <https://portal.azertag.az/az/node/2273>
3. Cavid Əkbərov Qoca şərqi qapısı – Naxçıvan 08 fevral 2016 <https://ikisahil.az/post/152-news-152>
4. İsmayıl Hacıyev Qədim türk yurdu - Azərbaycanın ayrılmaz hissəsi https://www.elibrary.az/docs/qazet/qzt2024_975.pdf

Mathematical sciences

INVESTIGATION OF A MIXED PROBLEM IN OIL MECHANICS

Mamedova Nazaket Gazanfar gizi

*Candidate of Physical and Mathematical Sciences, Associate Professor, Baku State University,
faculty of Applied Mathematics and Cybernetics, Department of Mathematical Physics
Equations,
Baku, Azerbaijan*

Abbasova Aygun Khanlar gizi

*Candidate of Physical and Mathematical Sciences, Associate Professor, Baku State University,
faculty of Applied Mathematics and Cybernetics, Department of Mathematical Physics
Equations,
Baku, Azerbaijan*

Abstract

The work focuses on solving a mixed problem with nonlocal boundary conditions for an equation relevant to oil mechanics. Specifically, it addresses a differential equation that describes the motion of the vertical section of a drill string. The problem is solved using the Rasulov residue method, and the solution is formulated as a complete integral of residues.

Keywords: mixed problem, Rasulov residue method, pole

Introduction

One of the fields where methods of mathematical modelling are widely applied is the oil and gas extraction industry. The extraction of oil and gas involves complex technological processes, starting from conducting exploration operations and drilling exploration wells to their extraction through production wells, collection, transportation, and storage. The development and exploitation of oil and gas reservoirs, being a system, are distinguished by their extreme complexity and uniqueness compared to other physical and technical systems. The uniqueness of these systems is related to the fact that the processes occurring within them cannot be directly observed and cannot be repeated. Each oil and gas reservoir can only be exploited once, and it is not possible to conduct numerous experiments on these systems or correct errors made during the development process. Therefore, it becomes necessary to use mathematical modelling methods and computer technology at all stages of the development of reservoir systems. The use of mathematical modelling methods allows for the calculation of various exploitation scenarios before the exploitation of reservoir systems, the selection of the most efficient exploitation option, the prediction of exploitation indicators, as well as the management of the reservoir development process.

Materials and methods

Transverse vibrations of drill pipes, self-excited oscillations of production casings in flowing wells, the stability of oscillations of measuring instruments used in directional drilling, vibrations of offshore platforms caused by random impacts, as well as the optimization of oscillatory system parameters are among the key issues in the oil industry. Since the main oil reserves are located underwater and on the shelf, drilling wells from floating platforms at great water depths is more efficient. In this case, the drill pipes, situated between the vessel and the wellhead on the seabed, undergo transverse vibrations. The transverse vibrations of the drill string occur as a result of the vessel's drift or the pitching of the vessel's bow when immersed in water. The differential equation of motion for the vertical rod-like part of the drill pipe string, in a special case, is described by the equation.

$$\mu \frac{\partial^2 u}{\partial t^2} + EJ \frac{\partial^4 u}{\partial x^4} - I_0 \frac{\partial^4 u}{\partial x^2 \partial t^2} - F(x, t) = 0 ,$$

where μ - mass of a unit of the rod, E - modulus of elasticity of the material, J - moment of inertia of the cross-section of the rod relative to the neutral axis of the section, I_0 - moment of inertia of a unit length of the rod relative to the central axis perpendicular to the plane of its oscillations. The intensity of the external load acting on the rod is $F(x, t)$.

Thus, a mixed problem for the equation

$$\frac{\partial^2 u}{\partial t^2} + a^2 \frac{\partial^4 u}{\partial x^4} + b \frac{\partial^4 u}{\partial t^2 \partial x^2} = f(x, t) , \quad (1)$$

$$(\text{ where } a^2 = \frac{EJ}{\mu}, \quad b = -\frac{I_0}{\mu}, \quad f(x, t) = \frac{F(x, t)}{\mu}, \quad x \in (0, 1), 0 < t < T)$$

under boundary conditions

$$u_x^{(k)}(0, t) - u_x^{(k)}(1, t) = 0, \quad k=0, 1, 2, 3 \quad (2)$$

and initial conditions

$$u_t^{(k)}(x, 0) = \Phi_k(x), \quad k=0, 1. \quad (3)$$

is considered

Functions $f(x, t)$, $\Phi_k(x)$ ($k = 0, 1$) are considered sufficiently smooth.

The solution to the problem is constructed using the residual method of Rasulov. For this purpose, two auxiliary problems have been solved: the spectral problem and the Cauchy problem.

Results and discussion

We will seek the solution to problem (1)-(3) in the form of

$$u(x, t) = -\frac{1}{2\pi\sqrt{-1}} \sum_v \int_{C_v} \lambda d\lambda \int_0^1 G(x, \xi, \lambda) Z(t, \xi, \lambda) d\xi, \quad (4)$$

where $G(x, \xi, \lambda)$ Green function of the spectral problem and satisfies to equation

$$y^{IV} - \lambda^4 y = 0$$

and boundary conditions

$$y^{(k)}(0) - y^{(k)}(1) = 0, \quad k = 0, 1, 2, 3.$$

Calculations show that the numerator of the Green's function

$$G(x, \xi, \lambda) = \frac{\Delta(x, \xi, \lambda)}{\Delta(\lambda)}$$

has the form

$$\Delta(x, \xi, \lambda) = g(x, \xi, \lambda) \cdot \Delta(\lambda) + \Delta_1(x, \xi, \lambda),$$

$$\begin{aligned} \Delta_1(x, \xi, \lambda) = & sh\lambda\xi ch\lambda x - ch\lambda\xi sh\lambda x - sh\lambda\xi ch\lambda(x-1) + ch\lambda\xi sh\lambda(x-1) + \\ & + sh\lambda(1-\xi)ch\lambda(x-1) + ch\lambda(1-\xi)sh\lambda(x-1) - ch\lambda x sh\lambda(1-\xi) - \\ & - ch\lambda(1-\xi)sh\lambda x \end{aligned}$$

and denominator

$$\Delta(\lambda) = 2\lambda e^\lambda + 2\lambda e^{-\lambda} - 4\lambda = 2\lambda e^{-\lambda}(e^\lambda - 1)^2,$$

which proves the regularity of this problem in the sense of Rasulov, C_v - a simple closed contour enclosing only λ_v , the sum over v is extended to all poles.

By computing the residues with respect to the simple poles $\lambda_v = 2\pi vi$ and $\lambda_0 = 0$ the terms of the residue series (4) have been calculated and under certain conditions imposed on initial data and the right-hand side of the equation the solution of the given problem has been constructed in the form of a series

$$\begin{aligned} u(x, t) = & 4 \sum_{v=1}^{\infty} \int_0^1 \left[\Phi_0(\xi) \cos \frac{4a\pi^2 v^2}{\sqrt{1-4b\pi^2 v^2}} t + \right. \\ & + \frac{\sqrt{1-4b\pi^2 v^2}}{4a\pi^2 v^2} \Phi_1(\xi) \sin \frac{4a\pi^2 v^2}{\sqrt{1-4b\pi^2 v^2}} t + \\ & \left. + \frac{\sqrt{1-4b\pi^2 v^2}}{4a\pi^2 v^2} \int_0^t f(\xi, \tau) \sin \frac{4a\pi^2 v^2}{\sqrt{1-4b\pi^2 v^2}} (t-\tau) d\tau \right] * \\ & * [\sin 2\pi v \xi \sin 2\pi v x + \cos 2\pi v \xi \cos 2\pi v x] d\xi + \\ & + 2 \int_0^1 [\Phi_0(\xi) + \Phi_1(\xi) t + \int_0^t f(\xi, \tau) (t-\tau) d\tau] d\xi. \end{aligned}$$

References

1. Mirzajanzade A. Kh., Kerimov Z. G., Kopeyakis M. G. Theory of Oscillations in Oilfield Engineering// Moscow-Izhevsk: Institute of Computer Research, 2005, 364 pages. (published in Russian)
2. Rasulov M. L. Applications of the Residue Method to Solving Problems of Differential Equations // Baku - Elm, 1989, 328 pages. (published in Russian).

**FROM THE EXPERIMENTALLY PROVED IN SRT PRINCIPLE OF THE PHYSICAL REALITY OF
IMAGINARY NUMBERS IT FOLLOWS THAT THE INVISIBLE AFTERLIFE WORLD, WHERE GODS AND
SOULS OF THE DEAD DWELL, REALLY EXISTS¹**

Antonov A.A.

PhD, HonDSc, H.Prof.Sci

Independent researcher, Kiev, Ukraine

Abstract

Rightly recognized as a great scientific achievement of physics of the XX century, the special theory of relativity (SRT), however, turned out to be incorrect, because at that time there was no experimental knowledge necessary for its creation, which had to be replaced by postulates. But not everything was guessed. And this is quite natural. All new theories are always subsequently refined and corrected. However, none of the many subsequent corrections and experimental refutations of SRT was not accounted for and still is not taken into account. As a result, SRT has remained uncorrected.

It is in this form that SRT is now studied in all physics textbooks, used in the educational process even in the most prestigious universities.

However, a corrected version of SRT has already been created, in which instead of the incorrect principle of non-exceeding the speed of light, the experimentally proven principle of physical reality of imaginary numbers, which refuted this postulate, is used. The corrected version of SRT has allowed to solve many unsolved in the noncorrected version of SRT problems. And from relativistic formulas of the corrected version of SRT follows the existence of numerous mutually invisible parallel universes. In the corrected version of SRT also it is explained that these invisible universes about which it is spoken in all religions, and are invisible afterlife world in which Gods and souls of dead dwell.

Keywords: imaginary numbers; complex numbers, hypercomplex numbers, special theory of relativity, invisible parallel universes and antiuniverses, Multiverse, Hyperverse, Gods, invisible afterlife world, souls of dead.

Introduction

Created in the twentieth century by the works of Joseph Larmor [1], Nobel Prize winner Hendrik Anton Lorenz [2], Jules Henri Poincaré [3], Nobel Prize winner Albert Einstein [4] and other outstanding scientists, the special theory of relativity (SRT) [5]-[7] because of its use of the principle of relativity is rightly considered a very great scientific achievement. However, in the XXI century it was proved that this theory is incorrect, because:

- the relativistic formulas obtained in it are not correct;
- they've been incorrectly explained using the wrong principle of light speed non-exceedance;
- from them were made incorrect conclusions about physical unreality of discovered 400 years before creation of SRT by Scipione Del Ferro, Niccolo Fontana Tartaglia, Gerolamo Cardano, Lodovico Ferrari and Rafael Bombelli¹ [8] imaginary numbers and the existence in nature of our only visible universe, in which all measurements are carried out only using real numbers.

As can be seen from the graphs (see Fig. 1a,b,c) of relativistic formulas of this version of SRT

$$m = m_0 / \sqrt{1 - (\frac{v}{c})^2} \quad (1)$$

$$\Delta t = \Delta t_0 \sqrt{1 - (\frac{v}{c})^2} \quad (2)$$

¹ And perhaps even before them imaginary numbers were discovered by Paolo Valmes [9], who was burned alive at the stake by the Spanish Inquisitor Tomas de Torquemada.

$$l = l_0 \sqrt{1 - \left(\frac{v}{c}\right)^2} \quad (3)$$

where m_0 is the rest mass of the moving body;

m - relativistic mass of the moving body;

Δt_0 - rest time of a moving body;

Δt - relativistic time of a moving body;

l_0 - rest length of a moving body;

l - relativistic length of a moving body;

v is the velocity of the moving body;

c - speed of light;

in the range of pre-light speeds $v < c$ all these quantities take values measured by real numbers, in the range of superluminal speeds $v > c$ take values measured by imaginary numbers, and at the speed equal to the speed of light $v = c$, the function $m(v)$ has a gap. Therefore, in the pre-light speed range formulas (1)-(3) have been explained. And in the superluminal range of speeds the results of calculations in the form of imaginary numbers the creators of SRT could not explain. And in modern textbooks of physics they are not explained till now. After all, what is 5 meters, 6 grams and 7 seconds is clear to everyone, but what is $5i$ meters, $6i$ grams and $7i$ seconds, where $i = \sqrt{-1}$, and now no one can explain.

Moreover, as can be seen from the graphs of formulas (1)-(3), in the superluminal range of velocities $v > c$ (see Fig. 1a,b,c) these formulas correspond to physically unstable processes that cannot exist in nature at all. Indeed, let us assume that the material body in the range $v > c$ for some reason began to move faster. Then its mass according to the function graph $m(v)$ in Fig. 1a will decrease. But because of this lighter body will move faster. This, according to the graph of the function, will lead to a further decrease in the mass $m(v)$ of the moving body. And this will again lead to an increase in the velocity v of the material body. And so on. Therefore, in the end this material body with zero mass and infinitely high speed flies to 'nowhere'.

And assuming that the material body on the graph of the function $m(v)$ in the range $v < c$ for some reason began to move slower and reasoning in a similar way, we will come to the conclusion that this material body moving slower and slower, will overcome the point of astrophysical singularity $v = c$ and, being in the range $v < c$ will, stop.

So, at any point in the range $v > c$ on the graph of the function $m(v)$ the ongoing process will indeed be unstable and therefore cannot exist.

And so the fate of SRT hung in the balance. After all, no one would not need a theory that even its authors could not explain. But SRT was saved by the fact that in it introduced a postulate called the principle of non-exceeding the speed of light, the meaning of which is clear from its name. And from this postulate followed that the formulas (1)-(3) in the superluminal range of speeds $v > c$ do not need to be explained, since imaginary numbers allegedly do not describe any processes that do not exist in nature.

So the fate of the SRT hung in the balance. After all, no one would not need a theory that even its authors could not explain. But SRT was saved by the fact that it introduced a postulate called the principle of non-exceeding the speed of light, the meaning of which is clear from its name. And from this postulate followed that formulas (1)-(3) in the superluminal range of speeds

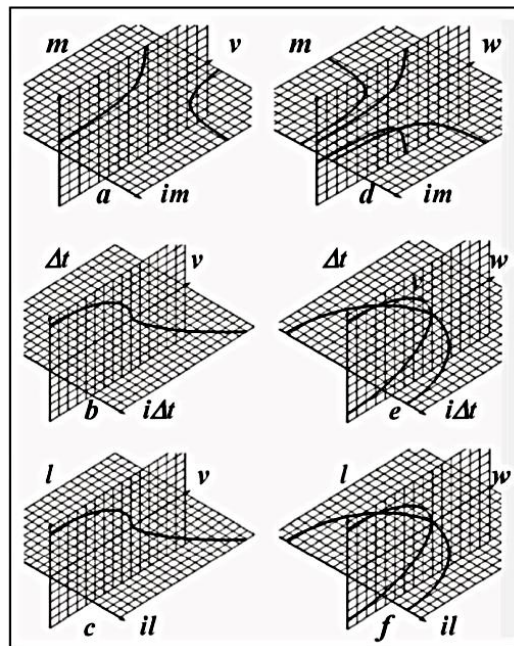


Fig. 1. Graphs of functions $m(v)$, $\Delta t(v)$ and $l(v)$ corresponding to the existing and the corrected versions of the STR in the subluminal $v < c$ and superluminal $v > c$ ranges

could not be explained, as imaginary numbers no existing in nature processes are allegedly not described. Here in such a form the uncorrected SRT is studied in all textbooks of physics up to now.

Nevertheless, at the initial stage of creation of SRT such variant of its statement was quite acceptable, though it obviously contained, as well as all new theories, some misconceptions. However, at present, when it has been found out the fallacy of some assumptions used by its authors a hundred years ago, which are further explained, ignoring these circumstances is no longer justified. All the more that now such a corrected interpretation of SRT already hinders the development of the whole science.

Physical reality of imaginary numbers

But there are other sciences besides physics. Including electrical engineering and radio engineering created before SRT. And in these sciences the theory of linear electric circuits of alternating current is used, in which the fundamental is the Ohm's law discovered in 1893 in the interpretation of Steinmetz [10]. And a simpler version of this law for DC electric circuits [11], [12], studied now in school physics textbooks, was discovered by Ohm himself in 1826, when no electrical measuring device existed yet. About the physics of that time, the professor of the Imperial Moscow University, Alexander Grigorievich Stoletov wrote: "...physics especially seduced natural philosophers. What a grateful theme for the most unbridled fantasies were electrical phenomena... Beautiful and vague deductions were in the foreground: painstaking work of the experimenter, precise mathematical analysis were not in honor; they seemed superfluous and harmful in the study of nature...". Therefore, in 1828 Ohm was dismissed from his job by the Minister of Education for publishing about the law he had discovered. The high-ranking official believed that the use of mathematics and experimental research in natural philosophy was inadmissible.

And Ohm's law as interpreted by Steinmetz is now used daily in practice by millions of electrical and radio engineers all over the world. Thereby, of course, confirming that it is true.

But in SRT the existence of this law is ignored, because from the postulate about the non unexceeded speed of light the conclusion about physical unreality of imaginary numbers is made, which is obligatory not only for physics but also for all other sciences. Including electrical and radio engineering. After all, mathematics is the common language of all exact sciences. Therefore, mathematics cannot be one in physics and another in electrical and radio engineering. And in SRT it is stated (although it is not written anywhere) that Ohm's law as interpreted by Steinmetz is wrong, because it follows from this law that electrical resistances of capacitors and inductors (also called inductance coils) are measured by imaginary numbers, and only resistances of resistors are measured by real numbers. Due to this circumstance imaginary resistances of capacitors and inductors SRT proposes to consider actually imaginary, i.e. physically non-existent.

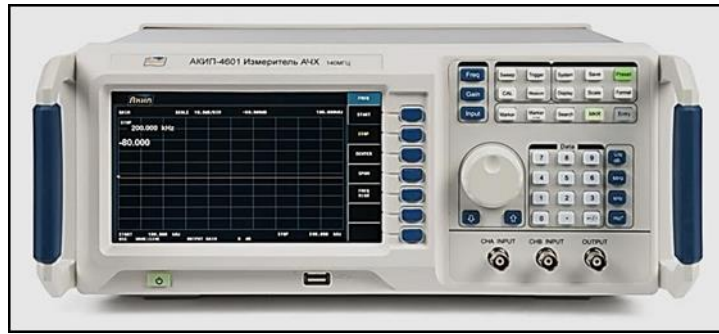


Fig. 2. In any radio-technical laboratory there are devices called frequency response meters, which prove the physical reality of imaginary and complex numbers by their mere existence

Note - the formulation of Ohm's law in Steinmetz's interpretation states that imaginary resistances are measurable. And in fact, any electrical and radio laboratory has been using commercially available devices for measuring imaginary resistances and other imaginary electrical quantities for many decades (Fig. 2)

But everything that can be measured always exists. This is the fundamental position of any science. If people in their activities did not use instruments, and relied on knowledge obtained only from their sensations, then science would not exist. And physicists can't help but know this. And since in electrical and radio engineering the resistances of capacitors and inductors, which someone unsuccessfully called imaginary, are in fact measured by existing devices, then they are not imaginary at all, but the most real physically existing ones.

Nevertheless, in SRT, in accordance with the principle of non-exceeding the speed of light, it is actually asserted that imaginary resistances of capacitors and inductors, since they are called imaginary, should not really exist. Therefore, electrical and radio engineering also should not exist [13]-[32].

In fact they existed even before the creation of SRT by publications of Einstein and Poincaré in 1905. But physicists of that time probably did not know and/or did not understand these sciences. They don't want to understand them now, since the theory of linear AC electric circuits is not taught to physics students.

Nevertheless, since in electrical and radio engineering the used imaginary quantities - resistances, transfer functions, etc. - correspond to real physical entities (since they are measured), it proves in the most indisputable way that the named imaginary numbers contrary to the postulate of SRT about non-exceeding the speed of light not only in electrical and radio engineering, but always and everywhere in all sciences are physically real. And it is time to realize that mathematics cannot be one for Einstein, another for Steinmetz, another for someone else. So imaginary numbers are physically real in all sciences. Textbooks on different sciences (for example, physics textbooks and radio engineering textbooks) should not contradict each other. And it is unethical to teach schoolchildren and students using such textbooks.

There are other experimental proofs of the general scientific principle of the physical reality of imaginary numbers [33]-[44]. And no experiments are never refuted by postulates. And since the following from the postulate about not exceeding the speed of light SRT statement about physical unreality of imaginary numbers turned out to be incorrect, this postulate itself is incorrect. Therefore the generally accepted version of the SRT itself also turned out to be incorrect. There are also other proofs of the incorrectness of the version of SRT [45]-[65] still studied in all physics textbooks

Corrected version of SRT

Since the principle of the physical reality of imaginary numbers has been experimentally proven in the most indisputable way, the relativistic formulas must now be explained for the super-luminal speed range [66]-[73]. But for these relativistic formulas to be explainable, they must first be corrected. To their graphs in the superluminal speed range $v > c$ (Fig. 1a, b, c) were similar to the graphs of the same quantities in the sublight speed range $v < c$, as shown in Fig. 1d,e,f. And for this, it is necessary to introduce the factor i^q into formulas (1)-(3). After which they will take the form

$$m(q) = m_0 i_1^q / \sqrt{1 - (\frac{v}{c} - q)^2} \quad (4)$$

$$\Delta t(q) = \Delta t_0 i_1^q \sqrt{1 - \left(\frac{v}{c} - q\right)^2} \quad (5)$$

$$l(q) = l_0 i_1^q \sqrt{1 - \left(\frac{v}{c} - q\right)^2} \quad (6)$$

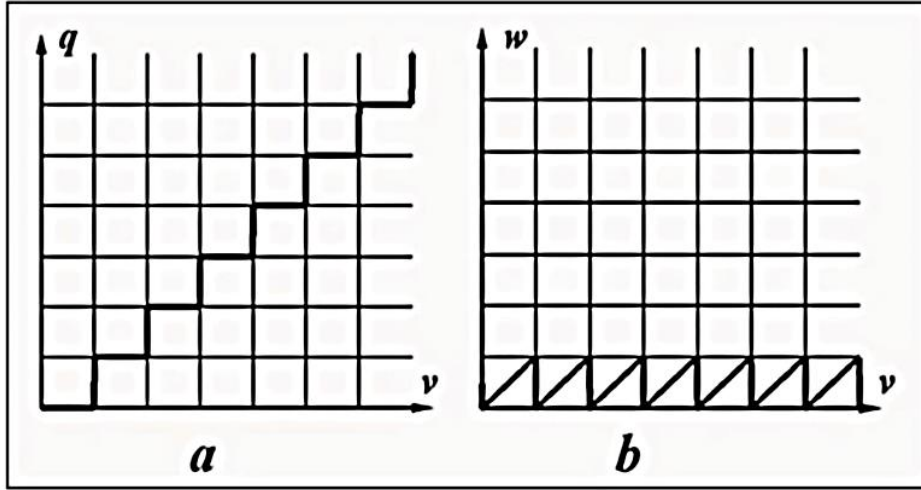


Fig. 3. Graphs of functions $q(v)$ and $w(v)$, illustrating the meaning of the "floor" function of discrete mathematics

where $q(v) = \lfloor v/c \rfloor$ is the "floor" function of discrete mathematics of the argument v/c (its graph is shown in Fig. 3a), which is the fourth spatial dimension;
 $w(v) = v - qc$ is the local velocity for each universe (its graph is shown in Fig. 3b).

Therefore, the function i^q for successive values of $q(v)$ equal to 0, 1, 2, 3, 4, 5, ... takes the values $+1, +i, -1, -i, +1, +i, \dots$. And the value $q(v)=0$ in formulas (1)-(3) for the speed range $v < c$ corresponds to our visible universe, which for definiteness we will call the tardyon universe. The value $q(v)=1$ in the speed range $v > c$ corresponds to the invisible universe, since it is beyond the event horizon. For definiteness, we will call it tachyon. The value $q(v)=2$ will then correspond to an invisible tardyon antiuniverse, the value $q(v)=3$ will correspond to an invisible tachyon antiuniverse, the value $q(v)=4$ will correspond to another (and therefore also invisible) tardyon universe, the value $q(v)=5$ will correspond to another tachyon universe. Etc.

Thus, from the corrected relativistic formulas (4)-(6) it follows that in reality in nature there exists a Multiverse, which contains, in addition to our visible universe, also many other mutually invisible parallel (since they do not intersect) universes², since relative to each other they are all located beyond the event horizon. And such a Multiverse, which we will therefore call hidden, has an opened screw structure (as, for example, in Fig. 4).

² In other dimensions, therefore on Earth invisible

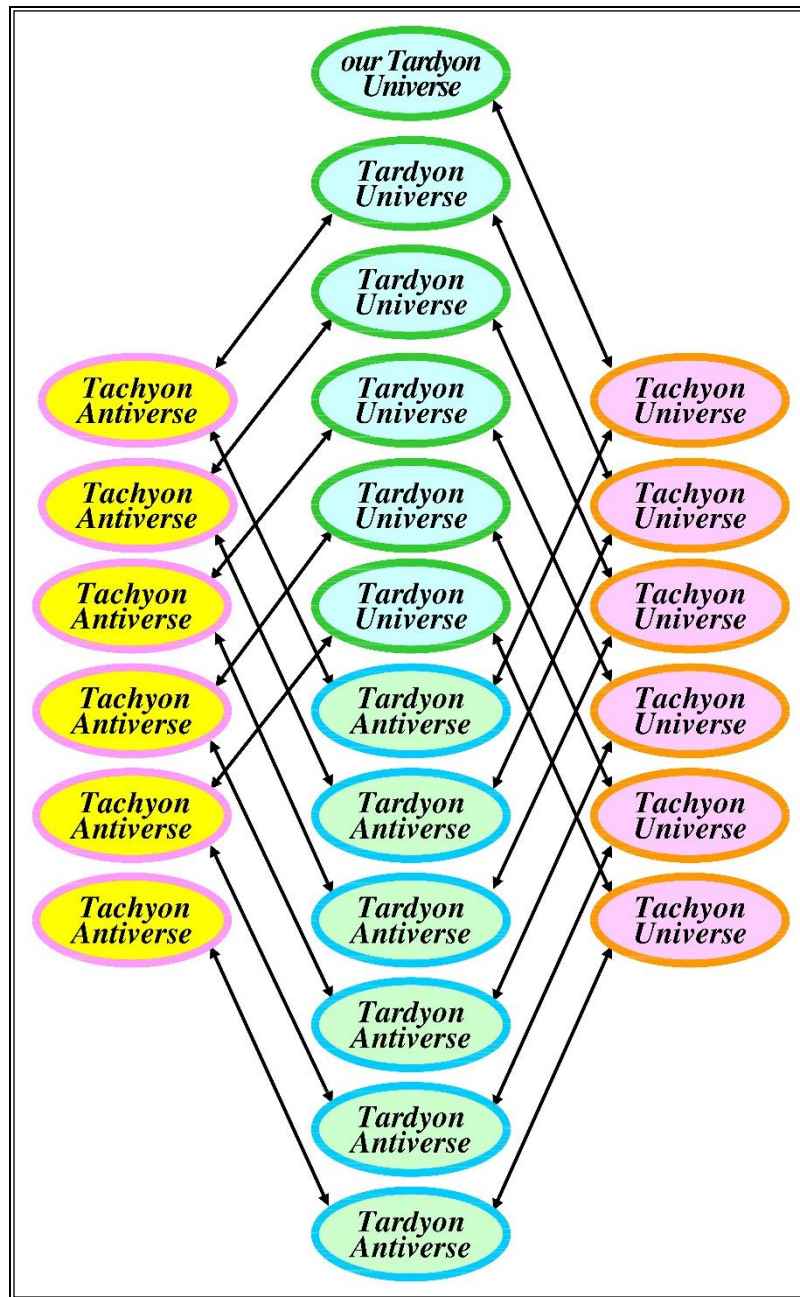


Fig. 4. Structure of the hidden Multiverse corresponding to the principle of physical reality of complex numbers

And in this structure of the hidden Multiverse the distribution of material contents in each three-dimensional parallel universe will be determined by its function $f_q(x,y,z)$, and the value iq is the coordinates of these universes. I.e. the structure of the hidden Multiverse is described by the formula $f_q(x,y,z)+iq$. The same formula can be used to describe, for example, our apartment, since all rooms in it are never visible to us at the same time.

How to calculate the function i^q for non-integer argument values?

But the function i^q which was very convenient and understandable in the presentation of the previous section, is not currently used in the theory of functions of a complex variable. Therefore, it is useful to clarify this situation. The i^q function is not used because it is now known how to calculate it only for integer values of the argument - you just need to multiply by i the original value, equal to one, q times. But in the case of non-integer values of q , this algorithm does not work. That's all.

Nevertheless, this situation is completely solvable. After all, the values $+1, +i, -1, -i$, etc. are the same as the function i^q for integer argument values 0, 1, 2, 3, etc. function $e^{iq\pi/2}$ also accepts in Euler's formula $e^{iq\pi/2} = \cos(q\pi/2) + i\sin(q\pi/2)$, which allows you to calculate its values for non-integer values of the argument. Therefore, it is acceptable to assume that these two formulas i^q and $e^{iq\pi/2}$ are identically equal to each other. And then we get the formula

$$i^q = \cos(q\pi/2) + i\sin(q\pi/2) \quad (7)$$

by which for the function i^q one can find its values for both integer and non-integer values of the argument q .

Thus, the last mathematical operation from algebra, which until now was not feasible in the theory of functions of a complex variable, has now also become feasible.

Analysis of experimental data obtained by the WMAP and Planck spacecraft

In order to obtain more information about the possible structure of the hidden Multiverse and to verify that it is correct, we will analyze the data obtained by the WMAP [74] spacecraft, launched in 2001 by the National Aeronautics and Space Administration (NASA), which operated until 2010, and Planck [75], launched by the European Space Agency (ESA) in 2009, which operated until 2013.

According to the data obtained by the WMAP spacecraft, the entire universe (in fact, the entire hidden Multiverse) consists of 4.6% baryonic matter, 22.4% dark matter, and 73.0% dark energy. And according to more recent data obtained by the Planck spacecraft, the entire universe (again, in fact, the entire hidden Multiverse) consists of 4.9% baryonic matter, 26.8% dark matter, and 68.3% dark energy. As you can see, these results differ little from each other, which proves their truth. But what dark matter and dark energy themselves are has never been explained.

It is for this incomprehensibility that these physical entities were called dark. Therefore, Stephen William Hawking wrote: "The missing link in cosmology is the nature of dark matter and dark energy."

And since it was proven above in the most indisputable way that in nature there is not a monoverse, but a hidden Multiverse, then dark matter and dark energy must somehow be present in it [76]-[80]. Consequently, the structure of the hidden Multiverse discussed above, shown in Fig. 4, must be accordingly corrected.

But how? To do this, we will abandon the assertion of the version of STR presented in textbooks that explanations for the phenomena of dark matter and dark energy must certainly be sought in our visible Universe. And we will look for them in the hidden Multiverse, since its existence has been proven. Let us assume that these phenomena are somehow generated by the very structure of the hidden Multiverse and are caused by the mutual influence of invisible parallel universes on each other. And then it's possible it is quite clear and convincing to explain the hitherto inexplicable main features of these phenomena - their invisibility and undetectability of corpuscular contents:

- dark matter and dark energy are actually not some kind of material physical entities, but just phenomena (presumably a gravitational shadow) generated by the existence, in addition to our visible tardion universe, of other invisible ones parallel universes of the hidden Multiverse;
- moreover, dark matter is a phenomenon generated by the existence of invisible parallel universes of the hidden Multiverse adjacent to our visible universe;
- and dark energy is a phenomenon generated by the existence of the rest, in addition to our visible universe and the invisible universes adjacent to it, the remaining invisible parallel universes of the hidden Multiverse;
- and precisely because dark matter and dark energy are just phenomena, they have no material content, as a result of which they themselves are invisible.

Then it becomes obvious that some unusual material content in dark matter and in dark energy in nature probably does not actually exist. Just as there is no material content in our shadow on a sunny day. Therefore, attempts to detect some subatomic particles of dark matter and dark energy by the ongoing research at the Large Hadron Collider are probably not very promising.

This explanation of these phenomena also makes it possible to clarify the structure of the hidden Multiverse. Indeed, assuming the mass of different invisible parallel universes in the hidden Multiverse

with a high degree of accuracy due to the presence between them of a large number of portals that have existed for billions of years is almost identical³, it is possible to determine:

- how many parallel universes form the hidden Multiverse. And in accordance with the above data obtained by the WMAP spacecraft, their number is $100\% / 4.6\% = 21.74$. And in accordance with the data obtained by the Planck spacecraft, their number is $100\% / 4.9\% = 20.41$. Consequently, their real number is equal to 20...22 universes. Those in addition to our visible universe, there are also 19...21 invisible universes.
- how many parallel universes are neighboring our universe and give rise to the phenomenon of dark matter. According to data obtained by the WMAP spacecraft, their number is $22.4\% / 4.6\% = 4.87$. And in accordance with the data, received by the Planck spacecraft, their number is $26.8\% / 4.9\% = 5.47$. Therefore, their real number is most likely equal to 5...6 parallel universes.
- how many parallel universes give rise to the phenomenon of dark energy. And in accordance with the data obtained by the WMAP spacecraft, their number is $73.0\% / 4.6\% = 15.87$. And according to data obtained by the Planck spacecraft, their number is $68.3\% / 4.9\% = 13.94$. Consequently, their real number is presumably equal to 14...16 parallel universes.

Corrected version of SRT (continued)

As can be seen, the experimental data obtained by the WMAP and Planck spacecraft did not confirm the above conclusions about the structure of the hidden Multiverse, since our visible universe in this structure should have not two neighboring invisible universes - more precisely, one tachyon universe and one tachyon antiuniverse - but five or six.

Therefore, it is logical to assume that there was some error in the previous reasoning. And this error is that earlier, for the sake of simplicity, we assumed in the hidden Multiverse⁴ the existence of only one additional dimension q and, consequently, its correspondence to physically real complex numbers containing only one imaginary unit. And in order for our universe to be neighbors of six other parallel universes⁵ - three tachyon universes and three tachyon antiuniverses - it is necessary to have three additional dimensions q, r, s , which will determine their position in space. Consequently, the space of such a hidden Multiverse will be six-dimensional (see Fig. 5). And its structure will correspond to quaternions $\sigma + i_1\omega_1 + i_2\omega_2 + i_3\omega_3$, i.e. hypercomplex numbers [81], containing three imaginary units i_1, i_2, i_3 , which are related to each other by the relations

$$i_1^2 = i_2^2 = i_3^2 = -1 \quad (8)$$

$$i_1i_2i_3 = i_2i_3i_1 = i_3i_1i_2 = -1 \quad (9)$$

$$i_1i_3i_2 = i_2i_1i_3 = i_3i_2i_1 = 1 \quad (10)$$

In such a quaternion structure of the hidden Multiverse [82], [83] the distribution of material content in each three-dimensional parallel universe will be determined by some the function $f_{q,r,s}(x, y, z)$ and the quantities i_1q, i_2r u i_3s and are the coordinates of these universes. Those. the structure of the hidden Multiverse is described by the formula $f_{q,r,s}(x, y, z) + i_1q + i_2r + i_3s$. This is exactly what Lisa Randall predicted: "We could be living in a three-dimensional slit of higher dimensional space."

³ according to the law of communicating vessels

⁴ Just like in the single visible universe in the generally accepted version of STR

⁵ Or less. Then some parallel universes of our hidden Multiverse may be absent and replaced by universes of neighboring Multiverses.

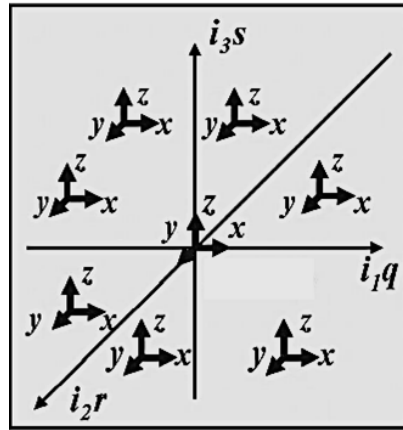


Fig. 5. Six-dimensional space of the hidden Multiverse, where q, r, s are the coordinates of invisible parallel universes, and x, y, z are the coordinates of the matter content in each parallel universe

And therefore the relativistic formulas (4)-(6) must be corrected once again as follows

$$m(q, r, s) = \frac{m_0 i_1^q i_2^r i_3^s}{\sqrt{1 - [v/c - (q + r + s)]^2}} \quad (11)$$

$$\Delta t(q, r, s) = \Delta t_0 i_1^q i_2^r i_3^s \sqrt{1 - [v/c - (q + r + s)]^2} \quad (12)$$

$$l(q, r, s) = l_0 i_1^q i_2^r i_3^s \sqrt{1 - [v/c - (q + r + s)]^2} \quad (13)$$

Information about the helical structure of such a hidden Multiverse is contained in formulas (11)-(13). It follows from them that it is possible to move from a tardion universe to a tardion antiuniverse and from a tardion antiuniverse to a tardion universe in different ways, but not in an arbitrary way, but only in such a way (see Fig. 6) that the quantity $i_1^q i_2^r i_3^s$ will successively take on the values $+1, +i_1 \oplus +i_2 \oplus +i_3, -1, -i_1 \oplus -i_2 \oplus -i_3, +1, \dots$ etc., where \oplus is the symbol of the logical operation of discrete mathematics 'exclusive OR'. In this case, different trajectories of movement from one universe (or antiuniverse) to another can differ only due to the replacement of some tachyon universes $i_1^q i_2^r i_3^s$ with others and some tachyon antiuniverses $i_1^q i_2^r i_3^s$ with others. Consequently, the tachyon universes $i_1^q i_2^r i_3^s$ in the hidden Multiverse are located parallel to each other. The tachyon antiuniverses $i_1^q i_2^r i_3^s$ for the same reasons are also located parallel to each other. And therefore, in the hidden Multiverse, when moving from any tardyon universe to a tardyon antiuniverse and then to another tardyon universe, parallel universes and antiuniverses must alternate in the following sequence – 'tardyon universe', 'one of the tachyon universes', 'tardyon anti-universe', 'one of the tachyon anti-universes', 'tardyon universe', 'one of the tachyon universes', etc.

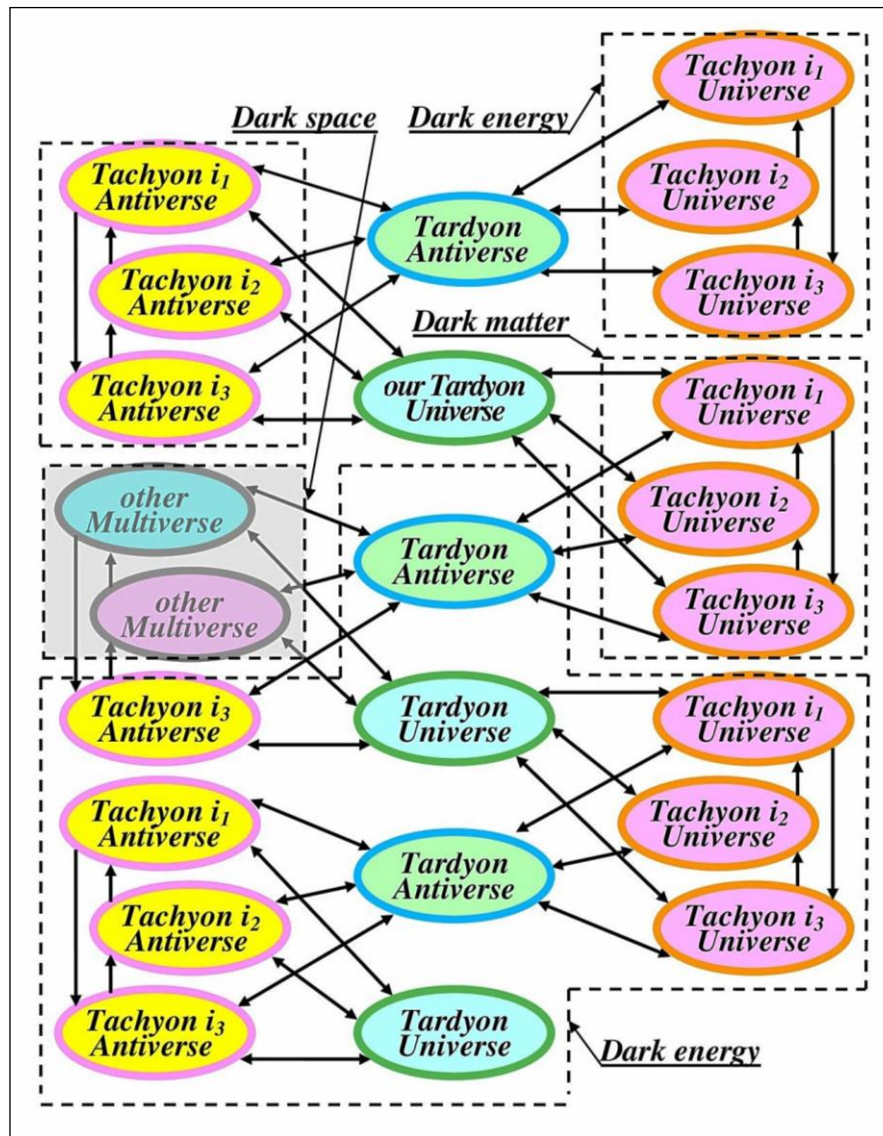


Fig. 6. Possible quaternion structure of the hidden Multiverse containing twenty-two parallel universes, including six invisible universes adjacent to our visible universe

The simplest such quaternion structure of the hidden Multiverse to explain is shown in Fig. 6. However, it is possible that more complex structures exist in nature, formed by the interweaving of many (perhaps even infinitely many) sequences of tardion and tachyon universes and antiuniverses in the hidden Multiverse and located beyond it in the Hyperverses. But we will not consider them, since we do not have any experimentally obtained knowledge for this, and one can assume a great many such hypothetically possible structures.

The difference between the structure shown in Fig. 6 structure from the structure shown in Fig. 4 is the presence in it of several different tachyon universes and antiuniverses corresponding to three imaginary units i_1^q , i_2^r , i_3^s . Another difference is the presence in such a structure of the Multiverse of not only bidirectional portals corresponding to formula (8) and designated by double-sided arrows, but also unidirectional portals⁶, corresponding to formulas (9), (10) and designated by single-sided arrows.

Moreover, naturally, the movement from our tardyon universe to the tardyon antiuniverse through some tachyon universe – for example i_1 – does not necessarily have to proceed further through the tachyon antiuniverse i_1 . It can proceed further through the tachyon antiuniverses i_2 and i_3 . The same

⁶ Due to what circumstances in such portals movement is possible only in one direction - from entrance to exit - it is difficult for us, living in a space in which movement in nature is possible in any direction, even to imagine. And the processes that make such movement possible in nature are yet to be understood. But they are more dangerous for visitors who have fallen into such unidirectional portals than bidirectional portals, because it is impossible to return to one's own universe from them. And while there is one-way travel on escalators in the subway, the subway is not nature,

reservation applies to the situation if the movement from the tardyon universe to the tardyon antiuniverse begins through the tachyon universes i_2 or i_3 .

In Fig. 6 all these transitions are shown. Moreover, since the data obtained by the WMAP and Planck spacecraft correspond to the open spring-like structures of our hidden Multiverse, united through the corresponding portals with other Multiverses, then all together they form the Hyperverses.

And there may be many other similar structures. And to clarify which of them really exists in our hidden Multiverse, additional experimental research is naturally necessary.

Physical reality of invisible universes

But this is not the main thing for us now.

The main thing is to prove experimentally, in an indisputable way, that there is a Multiverse in nature, and not the only visible universe in nature, as it is asserted not only in the generally recognized version of SRT, but also in string theory and in quantum physics.

And for this purpose, without wasting time on analyzing complex theories, it is necessary to prove experimentally that invisible universes corresponding to the corrected version of SRT, actually exist in nature. And it is possible to do it, if to see on a starry sky corresponding to them other constellations [84]-[89]. But that can only be done where no one has ever seen them before. And these other constellations⁷ (invisible outside the portals) can be seen in the starry sky in the portals, i.e. in the transitions between our visible universe and neighboring invisible universes. Similarly, as it is possible to see neighboring with our visible room, in which we are now, neighboring invisible room (or at least its edge to be convinced of its existence), only if you go into the corridor between the rooms. Portal are such corridor between universes.

And for this purpose, without wasting time on the analysis of these complex theories, let us try to prove experimentally that invisible universes corresponding to the corrected version of SRT, actually exist in nature. Then theoretical considerations on this subject will become unnecessary. And it can be done, if to see on a starry sky corresponding to other universes other constellations. But this can only be done where no one has ever seen them before. And these other constellations (invisible outside the portals) can be seen in the starry sky in the portals, i.e. in the transitions between our visible universe and neighboring invisible universes. Similarly, as it is possible to see neighboring to our visible room, in which we are now, the neighboring invisible room (or at least its edge to make sure of its existence), only if you go into the corridor between these rooms. Such corridors between universes are portals [90]-[92]. And the entrances to the portals are the so-called anomalous zones, of which there are many on our planet - more than a hundred thousand [93]-[96]. And in some of these anomalous zones even already placed observatories. As, for example, the Main Astronomical Observatory of the National Academy of Sciences of Ukraine, which is located in the Goloseevsky forest just 12 km. from the center of the capital of Ukraine, Kiev.

But people avoid going into portals. And rightly so, because portals are invisible labyrinths. That's why it's almost impossible to get out of them after accidentally entering them. But it is possible to create equipment for orientation in portals. It is also possible to use unmanned remote-controlled robotic means to explore portals. You just need to want to do all this.

⁷ During the transition from one universe to another, the map of the starry sky in the portal, continuously changing all the time, smoothly transforms from the map of one universe into the map of the neighboring universe. But at the same time it will naturally differ from the map of the starry sky on the Earth outside the portal at any place in the portal

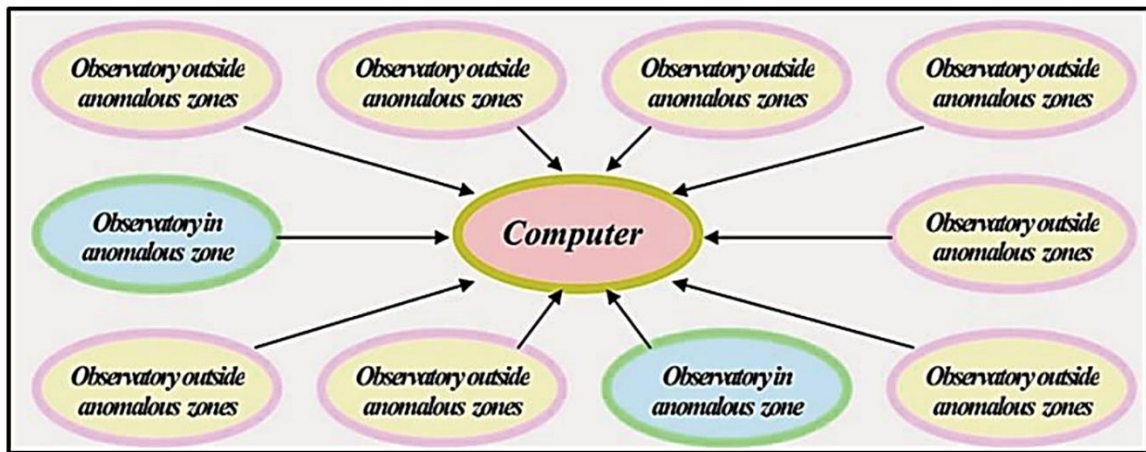


Fig. 7. Scheme of an astronomical experiment to detect invisible universes

It is even possible not to go far into the portals, but to limit ourselves to the use of anomalous zones (e.g., the above-mentioned Main Astronomical Observatory of the National Academy of Sciences of Ukraine). Although in anomalous zones, i.e., at the very edge of the portals, the change in the appearance of familiar constellations is very small, they can still be detected with modern equipment, comparing on the computer (Fig. 6) observations of the same areas of the starry sky by different observatories located both in the anomalous zones and outside the anomalous zones in the same region.

After all, the English astrophysicist Sir Arthur Stanley Eddington [97] was able to his famous experiment, similar to the one described above in Fig. 7, back in 1919 to confirm the predicted by the general theory of relativity deviation of light rays in the gravitational field of the Sun. That's what it means to actually want to.

Why hasn't this experiment been done yet?

So why hasn't this simple and very low-cost experiment has not yet been done? Even though in case of a positive result one could hope for a Nobel Prize for the discovery of invisible universes neighboring our visible universe. And in the case of a negative result, one could hope to get a very authoritative proof that Einstein and his theory were right. That is, any result of such an experiment is very important for science.

And because astronomers don't need the first result at all, so as not to complicate their relations with relativistic physicists. It is more important for them than even the Nobel Prize. And the second result, as they themselves realize, is very unlikely. But after realization of such experiment all scientific disputes about whether the version of SRT studied in physics textbooks is correct or incorrect, and also any references to string theory, to quantum physics and to nothing else will not be taken into account any more, as on this question will be received indisputably correct answer. And this answer is most likely to prove unambiguously the infidelity of the generally recognized version of SRT.

Even physicists themselves are sure of it. After all, if physicists hoped that this experiment would confirm the truth of the existing version of SRT, it would have been done long ago⁸

Why hasn't this experiment been done yet?

So why hasn't this simple and very low-cost experiment has not yet been done? Even though in case of a positive result one could hope for a Nobel Prize for the discovery of invisible universes neighboring our visible universe. And in the case of a negative result, one could hope to get a very authoritative proof that Einstein and his theory were right. That is, any result of such an experiment is very important for science.

And because astronomers don't need the first result at all, so as not to complicate their relations with relativistic physicists. It is more important for them than even the Nobel Prize. And the second result, as they themselves realize, is very unlikely. But after realization of such experiment all scientific disputes about whether the version of SRT studied in physics textbooks is correct or incorrect, and also any references to string theory, to quantum physics and to nothing else will not be taken into account any

⁸ For example, instead of the very expensive and unsuccessful OPERA experiment

more, as on this question will be received indisputably correct answer. And this answer is most likely to prove unambiguously the infidelity of the generally recognized version of SRT.

Even physicists themselves are sure of it. After all, if physicists hoped that this experiment would confirm the truth of the existing version of STO, it would have been done long ago⁹.

Civilizations and supercivilizations

But even if there were only our visible universe, then, despite the big bang theory, when exploring the cosmos it is impossible not to take into account that different stars with their planets arose in our visible universe at different times. And they still continue to arise. According to modern estimates, the number of galaxies in our visible universe alone is about $2E11$. And each galaxy contains about $1E8$ stars. Of these, at least $8E9$ contain Earth-like planets on which life is possible. And the ages of the stars are very different. For example, the star HE1523-0901 is $13.2E9$ years old, the Sun is $4.6E9$ years old, Sirius is $2.3E8$, and the recently discovered star SwiftJ1818.0-1607 is only about 240 years old. For comparison, recall that the age of our visible universe is about $13.8E9$ years. In the invisible universes of the hidden Multiverse and Gi-universe this diversity is surely even greater. And even the invisible universes themselves, contrary to the Big Bang theory, probably did not appear in nature at the same time. Consequently, at least on some planets, the age of the super-civilizations existing there exceeds the age of our earthly human civilization by billions of years. And comparing our civilization of the XXI century with the human civilization, for example, of the IXX century, i.e. existing only 200 years ago¹⁰ it is not difficult to understand how much our civilization is surpassed by super-civilizations.

Therefore, the inhabitants of supercivilizations are real all-powerful Gods for us. And some information about these supercivilizations is contained (though in a in allegorical form to be somehow understandable to people) in the church books of all world religions.

But other civilizations also exist on Earth. These are numerous communities of living beings - mammals, birds, dolphins, even ants and bees - which form hierarchical structures united by common vital interests and coordinate their activities for the benefit of the whole community as a result of exchange by information between these living beings. Only these civilizations, unlike human civilization, are not machine civilizations. Although primitive human civilizations, still existing now according to some reports in some remote areas of the Earth, are not machine civilizations either.

And these non-machine civilizations are also of great interest for people, because due to the fact that other living beings have sensory organs different from those of humans, they possess knowledge about nature unknown to humans. For example, cats feel geopathogenic zones, which are not registered by any existing equipment. Consequently, there are some other physical fields unknown to people in the nature, besides electromagnetic and gravitational fields known to people. Cats can also cure people in some unknown way. But people don't know how they do it. And how to learn it from them.

Fermi paradox, which proves the existence of supercivilizations in other spatial dimensions.

The Fermi paradox is a statement of a seemingly paradoxical situation in which, on the one hand, it is known that there are many star systems suitable for life in the cosmos, and on the other hand, despite all the efforts of scientists, no signs of life have been found in this cosmos. And it would seem very strange [98]-[100].

But in fact there is nothing strange about this. After all, what are we looking for? What signs of life do we expect to see? The same as on Earth now? So that the same radio stations as on Earth would work, which, when transmitting signals, would spend most of their energy on transmitting signals to nowhere due to the use of a non-optimal directional diagram? So that, in addition, these radio stations would also spend a considerable part of their energy on out-of-band radiation? So that aliens would detonate atomic and hydrogen bombs? And so on.

But first of all, these are all defects of our imperfect civilization, which supercivilizations have long ago got rid of. And that's why they're invisible. And secondly, why not assume that we do not see their ships in space also because they have different logistics as a result of using their super knowledge. Even on Earth, people on their way to work in big cities often use the subway. And then their movement underground cannot be detected from space. But then it is necessary to recognize the existence of invisible parallel universes, portals between them and admit that the generally accepted version of SRT is wrong.

⁹ For example, instead of the very expensive and unsuccessful OPERA experiment

¹⁰ When russian writers A. S. Pushkin and M. Yu. Lermontov lived, there were no computers, no Internet, no cars, no rail transport, no aviation, and many other things that have become familiar to us in the 21st century.

Besides, they certainly know stealth technology or some other super stealth technology. So the cost of all the searches for signs of life in space is money wasted.

And finally, why do we assume that as soon as people want to establish contacts with the inhabitants of supercivilizations, for example, on the Moon or on Mars, their inhabitants will immediately want to contact us? Always and everywhere to be or not to be contacts are decided by the masters of the situation. To be sure of it try to meet your director or minister at least. That is why in this situation the inhabitants of supercivilizations make decisions, not us. After all, we also do not seek contact neither with wild animals, nor with insects, nor with snakes that try to get into our dwellings. For example, rats are very smart and even in some situations, out of gratitude for the fact that the miners fed them, they sometimes saved their lives. Nevertheless, no one keeps rats as pets. And we lock our houses even from people we don't need.

And the inhabitants of supercivilizations are perfectly capable of protecting themselves to protect themselves from unnecessary human contact, even on Earth. For example, presumably in Shambhala. Or Antarctica. Or at the bottom of the oceans.

And another thing. Why do we seek contact with supercivilizations? We won't understand anything. After all, they have been sending us messages in the form of crop circles for centuries. But we don't have enough intelligence to read them. So we should not try to solve problems that are beyond human intellect. We need to increase our intelligence. And first we have to read the crop circles in the margins. And what to do next will be clear late

The phenomenon of déjà vu, which proves the existence of super civilizations in other time dimensions

This is an extremely interesting phenomenon [101]. Déjà vu from French translates as "already seen". There have even been 84 films made on this topic at different times and in different countries.. The essence of the phenomenon is that practically every person (more precisely, about 97% of people) sooner or later, at least once in his life, found himself in a situation in which he had already been once before. Or so it seems to him. Psychologists have offered many medical explanations for this phenomenon. But all of them are not very convincing, since science does not know of any disease, much less a mental one, with which 97% of the world's population could have been infected (and how?).

So let's offer another explanation, but this time a physical one. It is also quite unusual. Let's assume that this phenomenon is explained by interference in our life by our descendants from the distant future, who have unusually perfect computers capable of calculating our behavior down to the smallest detail, as well as time machines, with the help of which our descendants can move both to the past and future time. Which is plausible. And then these descendants of ours, in order to correct their existence in their future, go by time machines (and for them it is easier and cheaper than other variants of obtaining the same result) to our past and correct this past by algorithms created by supercomputers of the future (for example, Hitler's mother is married to another man). Then the inhabitants of the future, naturally, get to another future, which they like better. And in order not to lose any of their relatives, who have many other relatives and friends, etc., they have to interfere in the lives of all the people currently living on Earth. That is why the above-mentioned figure of 97% appeared.

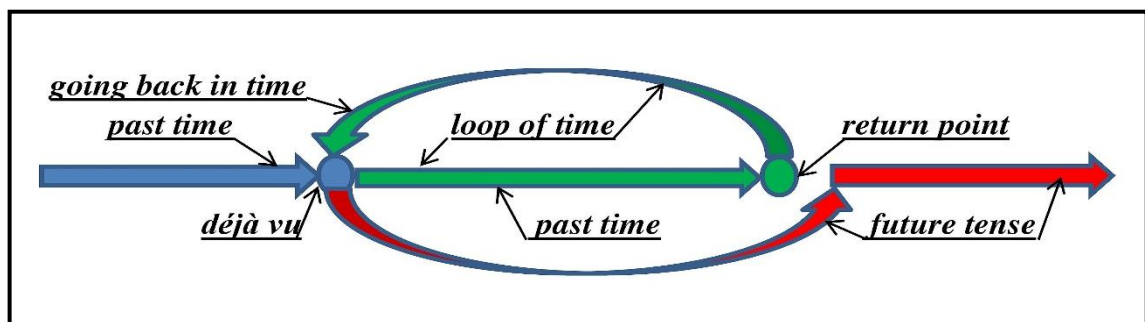


Fig. 8. Explanation of the phenomenon of déjà vu occurring as a result of intersection of timelines "going back in time" and "past time" with the formation of a "loop of time"

And people of our time on Earth because of this interference in our lives of aliens from the future make a journey through a time loop (see Fig. 8). Which they then forget. Or our descendants from the distant future erase it from our memory. But because of the existence of the time loop, they have to actually visit the 'déjà vu' point twice. And this is not erasable from their memory.

The invisible afterlife world, where the Gods and souls of the dead dwell, really exists

But religions, unlike many modern scientific hypotheses that have not been confirmed experimentally, which for some reason in the twentieth century unreasonably began to be called theories, do not try to deceive people. At least because all world religions, without collusion, actually tell people about the same thing.

That there are Gods. Well, it's true. It was explained above that the Gods are all-powerful inhabitants of super-civilizations in star systems that appeared billions of years before our solar system. And who help humans to become more civilized and advanced. Gods also through Religions somehow allegorically (and otherwise people would not understand anything and this information was not preserved to the next generations) explain to us the structure of the world in which they and we actually live. Church books are therefore invaluable teaching aids for us to learn the science of the distant future. They also try to instill in us a more humane morality of these super-civilizations (e.g., in the form of Christ's commandments), in contrast to the far from perfect morality that people live by today. And largely due to the efforts of Religions, people are becoming more and more humane.

But Gods and the souls of the dead also have to be somewhere. The invisible world in which they dwell in religions is called beyond the grave. And as it is shown above in the hidden Multiverse and Giperuniverse there are many (perhaps even infinitely many) mutually invisible parallel universes in which there are inevitably super-civilizations. Which therefore may be this invisible afterlife world.

Religions also tell us that people have an immortal soul that passes into this afterlife world after death. There are many testimonies of this from people who have been in a state of clinical death. And the author believes that this is also true. Therefore, the author is happy that after his death he will be able to reunite with his beloved parents, his wife and his wife's parents.

But in the version of STR, studied in physics textbooks, the existence of an invisible afterlife is denied for quite understandable reasons. It and its inhabitants - Gods, souls of the dead and others - simply have no place in this, the only one existing in nature according to the generally accepted version of STR, our visible Universe.

Conclusion

Thus, in the article it is experimentally proved and theoretically explained that up to now studied in all textbooks of physics the version of SRT, created in the XX century, is incorrect, because:

- the relativistic formulas obtained in it are incorrect;
- these formulas are incorrectly explained using the incorrect postulate called the principle of non-exceeding of the speed of light;
- from these formulas wrong conclusions about physical unreality of imaginary numbers and about existence in the nature of our only visible universe in which everything is measured only by real numbers are made.

But in the XXI century, a corrected version of the STR was created, in which, instead of the incorrect postulate about not exceeding the speed of light, an experimentally proven principle of the physical reality of imaginary numbers is used. And the physical reality of such numbers is proven by the existence of not only electrical engineering, radio engineering and computer technology (which was written about above), but also by the existence of the natural phenomenon of tsunamis and even swings swinging on playgrounds, as well as music created by pianos and other musical instruments. What more convincing refutations are needed? After all, these refutations have not been refuted by anyone.

Thus, naturally, the postulate of the generally accepted version of STR about not exceeding the speed of light, from which this conclusion about the physical unreality of imaginary numbers was made, is also experimentally refuted. For the same reasons, the conclusion about the existence in nature of our only visible universe is also refuted. And instead, it is asserted that in fact, in addition to our visible universe, there are many other mutually invisible parallel universes. The corrected version of STR also explains that the existence of these invisible universes can be experimentally proven by astronomical observations in the starry sky in the portals of constellations that are invisible outside the portals.

But the significance for science of the principle of physical reality of imaginary numbers is not limited to the possibility of correcting the generally recognized version of SRT. From this principle follows the necessity of corresponding correction in exact sciences of all theories and hypotheses in which imaginary numbers are used.

It also follows from this principle that around us there exists not only the visible world known and clear to us, but also a much larger almost completely unknown and not yet completely cognized by us

invisible world [102]-[111]. Including the invisible afterlife world [112]-[123], where Gods, souls of the dead and numerous other inhabitants of supercivilizations dwell.

The author hopes that the realization of all this will encourage Science and Religion to cooperate mutually beneficially in their activities for the benefit of people.

Acknowledgments

The author sincerely thanks his wife Olga Ilyinichna Antonova for her participation in the discussion, understanding and valuable advice, with whose support he also wrote the book "A Corrected Version of the Special Theory of Relativity". And for its publication he is now looking for a sponsor and publisher

References

1. Larmor J.J. (1897). A Dynamical Theory of the Electric and Luminiferous Medium. Part III. Relations with Material Media. Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences. 190, 205-300.
2. Lorentz H.A. (1899). Simplified Theory of Electrical and Optical Phenomena in Moving Systems. Proceedings of the Netherlands Academy of Arts and Science. Amsterdam. 1, 427-442.
3. Poincaré H. (1905). On the Dynamics of the Electron. Comptes Rendus. 140. 1504-1508.
4. Einstein A. (1905). Zur Elektrodynamik bewegter Körper. Annals of Physic. 17. 891-921.
5. Einstein A. (1920). Relativity: The Special and General Theory. H. Holt and Company. NY.
6. Bohm D. (2006). The Special Theory of Relativity. Routledge, Abingdon on Thames.
7. Penrose R. (2010). The Nature of Space and Time. Princeton University Press. Princeton.
8. Weinstein E.W. (2005). The CRC Concise Encyclopedia of Mathematics. 3-rd ed. CRS Press. Boca Raton. FL.
9. Beckmann P. (1976). A history of π . 3rd edition. St. Martin Press. NY.
10. Steinmetz C. P. (2010). Theory and Calculation of Electric Circuit. Nabu Press.
11. Ohm G. S. (2014). Die galvanische Kette. Verlag Der Wissenschaften. Ohm Göttingen.
12. Ohm G. S. (2015). Gesammelte Abhandlungen. Severus Verlag, Hamburg.
13. Antonov A. A. (2021). The version of STR stated in physics textbooks is incorrect because it denies the existence of radio engineering. 82nd International Scientific Conference of the Eurasian Scientific Association "Scientific result in theory and practice". Moscow. ESA. 11-15. <https://esa-conference.ru/sborniki/?y=2021>
14. Antonov A. A. (2022). The version of STR presented in physics textbooks is incorrect, since it follows from it that radio engineering should not exist. European Journal of Applied Sciences. Services for Science and Education. UK. 10(1). 440-445. DOI: doi.org/10.14738/aivp.101.2022
15. Antonov A. A. (2022). The existence of radio engineering refutes the physics text-books version of STR. The scientific heritage. (Budapest, Hungary). 83(1). 19-22. DOI: 10.24412/9215-0365-2022-83-1-19-22
16. Antonov A.A. (2022). The fundamental Ohm's law in radio engineering as interpreted by Steinmetz, which proves the physical reality on imaginary capacitive and inductive reactances, refuted the version of the STR presented in physics textbooks even before its creation. German International Journal of Modern Science. 26. 50-53. DOI: 10.24412/2701-8369-2022-26-50-63
17. Antonov A.A. (2022). The version of STR stated in physics textbooks is refuted by the existence of radio engineering. Danish Scientific Journal. 56. 56-59. <http://www.danish-journal.com>
18. Antonov A.A. (2022). The version of STR presented in physics textbooks is incorrect because it denies the possibility of the existence of Ohm's law as interpreted by Steinmetz and, consequently, the existence of radio engineering. Annali d'Italia. 28(1), 43-47. <https://www.anditalia.com/>
19. Antonov A.A. (2022). The version of STR stated in physics textbooks is refuted by the existence of radio engineering. Norwegian Journal of development of the International Science. 78(1). 63-67. DOI: 10.24412/3453-9875-2022-78-63-66.
20. Antonov A.A. (2022). If the physics textbook version of STR were true, then Ohm's law should not exist in nature, and therefore all radio engineering would not exist. International independent scientific journal. 36. 16-19. <http://www.iis-journal.com>
21. Antonov A.A. (2022). If the version of STR in physics text-books were true, then there would be no radar, no television, no radio navigation, no telecommunication and many other things. Journal of science. Lyon. 28. 76-79. <https://www.joslyon.com/>

22. Antonov A.A. (2022). *The version of STR set out in physics textbooks is incorrect because it states that Ohm's law as interpreted by Steinmetz does not really exist, and therefore radio engineering does not exist either. Sciences of Europe (Praha, Czech Republic). 87(1). 54-57.*
DOI: 10.24412/3162-2364-2022-1-54-57
23. Antonov A.A. (2022). *Why the physics textbooks teach an in-correct version of the special theory of relativity which denies the existence of radio- and electrical engineering. III international scientific conference "Challenges and problems of modern science". London. Great Britain. 78-86.* DOI: <https://doi.org/10.528/zenodo.7486814>
24. Antonov A. A. (2023). *Why is the incorrect version of the special theory of relativity being studied in physics textbooks, refuted the existence of radio- and electrical engineering even before its creation? The scientific heritage. (Budapest, Hungary). 105. 83-89.* DOI: 10.5281/zenodo.7560145
25. Antonov A.A. (2023). *Why is an incorrect version of the special theory of relativity that denies the possibility of the existence radio and electrical engineering being studied in physics text-books? German International Journal of Modern Science. 48. 23-29.*
DOI: <https://doi.org/10.5281/zenodo.7541137>
26. Antonov A.A. (2023). *Who needs the incorrect version of special relativity taught in physics textbooks despite all its experimental refutations? Annali d'Italia. 39, 64-70.*
DOI: 10.5281/zenodo.7568916
27. Antonov A.A. (2023). *Why is incorrect version of the special theory of relativity that denies the possibility of the existence of radio and electrical engineering being studied in textbooks of physics? Norwegian Journal of development of the International Science. 100. 27-33.*
<https://doi.org/10.5281/zenodo.7528512>
28. Antonov A.A. (2023). *Why is incorrect version of the special theory of relativity, refuted by the existence of radio and electrical engineering, is still studies in all university physics text-books? Danish Scientific Journal. 69. 66-72.* <https://doi.org/10.5281/zenodo.7692053>
29. Antonov A.A. (2023). *Why is incorrect version of the special relativity still being studied in physics textbooks, which denies Ohm's law for alternating current used worldwide by millions of radio- and electrical engineers? International independent scientific journal. 46. 38-44.*
<https://doi.org/10.5281/zenodo.7525751>
30. Antonov A.A. (2023). *Why is the generally accepted version of STR, which denies the possibility of the existence of radio engineering and electrical engineering, tsunamis and bell ringing, the physical phenomenon of resonance and Ohm's physical law for alternating current, music created by the piano and even swing swings on the playground, nevertheless is still considered cor-rect and studied in physics textbooks? Sciences of Europe (Praha, Czech Republic). 112. 44-50.* DOI: 10.5281/zenodo.7708515
31. Antonov A.A. (2023). *Why is the incorrect version of the special theory of relativity still being studied in physics textbooks, despite all its experimental refutations. European Journal of Applied Sciences. Services for Science and Education. UK. 11(2). 61-71.*
DOI: <https://doi.org/10.14738/aivp.112.14128>
32. Antonov A.A. (2023). *Why the incorrect version of the special theory of relativity, which denies the possibility of the existence of radio engineering and electrical engineering, has not yet been refuted. Journal of science. Lyon. 40. 19-25.* <https://doi.org/10.5281/zenodo.7704392>
33. Antonov A. A. (2008). *Physical Reality of Resonance on Complex Frequencies. European Journal of Scientific Research. 21(4). 627-641.* <http://www.eurojournals.com/ejsr.htm>
34. Antonov A. A. (2009). *Resonance on Real and Complex Frequencies. European Journal of Scientific Research. 28(2). 193-204.* <http://www.eurojournals.com/ejsr.htm>
35. Antonov A. A. (2010). *New Interpretation of Resonance. International Journal of Pure and Applied Sciences and Technology. 1(2). 1-12.*
http://doi.org/10.17686/sced_rusnauka_2010-888
36. Antonov A. A. (2010). *Oscillation processes as a tool of physics cognition. American Journal of Scientific and Industrial Research. 1(2). 342-349.* doi:10.5251/ajsir.2010.1.2.342.349
37. Antonov A. A. (2010). *Solution of algebraic quadratic equations taking into account transitional processes in oscillation systems. General Mathematics Notes. 1(9). 11-16.* http://doi.org/10.17686/sced_rusnauka_2010-887
38. Antonov A. A. (2013). *Physical Reality of Complex Numbers. International Journal of Management, IT and Engineering. 3(4). 219-230.*
http://doi.org/10.17686/sced_rusnauka_2013-898

39. Antonov A. A. (2014). *Correction of the special theory of relativity: physical reality and nature of imaginary and complex numbers*. *American Journal of Scientific and Industrial Re-search*. 5(2). 40-52. doi:10.5251/ajsir.2014.5.2.40.52
40. Antonov A. A. (2015). *Physical reality of complex numbers is proved by research of resonance*. *General Mathematics Notes*. 31(2). 34-53. http://www.emis.de/journals/GMN/yahoo_site_admin/asets/docs/4_GMN9212-V31N2.129701.pdf
41. Antonov A.A. (2015). *Principle of physical reality of imaginary and complex numbers in modern cosmology: the nature of dark matter and dark energy*. *Journal of the Russian physico-chemical society*. 87(1). 328-355. (In Russian) http://doi.org/10.17686/sced_rusnauka_2015-1119
42. Antonov A. A. (2016). *Physical Reality and Nature of Imaginary, Complex and Hypercomplex Numbers*. *General Mathematics Notes*. 35(2). 40-63. http://www.geman.in/yahoo_site_admin/assets/docs/4_GMN-10932-V35N2.31895146.pdf
43. Antonov A. A. (2017). *The physical reality and essence of imaginary numbers*. *Norwegian Journal of development of the International Science*. 6. 50-63. <http://www.njd-iscience.com>
44. Antonov A. A. (2018). *Physical Reality and Essence of Imaginary Numbers in Astrophysics: Dark Matter, Dark Energy, Dark Space*. *Natural Science*. 10(1). 11-30. doi:10.4236/ns.2018.101002
45. Antonov A.A. (2021). *The special theory of relativity stated in physics textbooks is incorrect*. 77th International Scientific Conference of the Eurasian Scientific Association "Theoretical and practical issues of modern science". Moscow. ESA. 11-15
46. Antonov A. A. (2021). *Version of the special theory of relativity that is studied in all physics textbooks is incorrect*. *Österreichisches Multiscience Journal (Innsbruck, Austria)*. 43(1). 17-22. <http://osterr-science.com>
47. Antonov A. A. (2021). *Generally accepted version of the special theory of relativity contained in physics textbooks is incorrect*. *The scientific heritage*. (Budapest, Hungary). 73(2). 39-43. DOI: 19.24412/9215-0365-2021-73-2-39-43
48. Antonov A. A. (2021). *Special theory of relativity, which is studied in physics text-books, is incorrect*. *German International Journal of Modern Science*. 16, 49-53. DOI: 10.24412/2701-8369-2021-16-49-53
49. Antonov A. A. (2021). *Special theory of relativity, which is studied in all physics textbooks, is incorrect*. *Danish Scientific Journal*. 51(1). 31-35. <http://www.danish-journal.com>
50. Antonov A. A. (2021). *Special theory of relativity taught in all physics textbooks is incorrect*. *Annali d'Italia*. 22(1). 39-44. <https://www.anditalia.com/>
51. Antonov A. A. (2021). *Special theory of relativity presented in physics text- books is wrong*. *Norwegian Journal of development of the International Science* 68(1). 3-7. DOI: 10.24412/3453-9875-2021-68-3-7.
52. Antonov A. A. (2021). *In all physics textbooks an erroneous version of special theory of relativity is given*. *International independent scientific journal*. 31.34-39. <http://www.iis-journal.com>
53. Antonov A. A. (2021). *Special theory of relativity taught in physics textbooks is wrong*. *Journal of science*. Lyon. 23. 47-52. <https://www.joslyon.com/>
54. Antonov A. A. (2021). *All physics textbooks study incorrect special theory of relativity*. *Sciences of Europe*. (Praha, Czech Republic) 79(1). 30-35. DOI: 10/24412/3162-2364-2021-79-30-35
55. Antonov A. A. (2021). *Experimental proofs of infidelity of the version of the special theory of relativity studied in physics textbooks and the truth of its alternative version*. 80th International Scientific Conference of the Eurasian Scientific Association "Development of science and education in the conditions of global instability". Moscow. ESA. 8-17. <https://esa-conference.ru/sborniki/?y=2021>
56. Antonov A. A. (2021). *The fallacy of the STR version studied in physics text- books proved experimentally*. *Österreichisches Multiscience Journal (Innsbruck, Austria)*. 45(1). 17-26. <http://osterr-science.com>
57. Antonov A. A. (2021). *Experimental evidences for the fallacy of the STR version in the physics textbooks*. *European Journal of Applied Sciences. Services for Science and Education*. UK. 9(6). 349-364. DOI:10.14738/aivp.96.11304.
58. Antonov A. A. (2021). *If the STR version in physics textbooks were true, we would never have heard the music of the piano and the bell ringing, there would be no television, no cellular telephony, no radar or GPS navigation, we would not even be aware of the existence of resonance and Ohm's law as*

- interpreted by Steinmetz, and our children could not swing on the swings. The scientific heritage (Budapest, Hungary). 78(2). 41-50. DOI: 10.24412/9215-0365-2021-78-2-41-50
59. Antonov A. A. (2021). Experimental refutations of the STR version contained in physics textbooks and confirmations of the truth of its alternative version. *German International Journal of Modern Science*. 22. 52-61. DOI: 10.24412/2701-8369-2021-22-52-61
60. Antonov A. A. (2021). The STR version in physics textbooks must be corrected, because if it were true, there would be no tsunamis or indian summer in nature, we would be never have heard piano music, engineers would be not have been able to create television, cell phones, GPS trackers, and even children would not be able to swing on swings. *Danish Scientific Journal*. 54(1). 29-38. <http://www.danish-journal.com>
61. Antonov A. A. (2021). Experimental evidence of the incorrectness of the STR version studied in physics textbooks. *Annali d'Italia*. 25(1). 32-41. <https://www.anditalia.com/>
62. Antonov A. A. (2021). The incorrectness of the STR version presented in physics textbooks proven experimentally. *Norwegian Journal of development of the International Science*. 74(1). 3-7. DOI: 10.24412/2453-9875-2021-74-53-62.
63. Antonov A. A. (2021). Experimental refutations of the generally accepted version of the SRT studied in physics textbooks. *International independent scientific journal*. 34(1). 23-32. <http://www.iis-journal.com>
64. Antonov A. A. (2021). Experimental refutations of the SRT version in the physics textbooks. *Journal of science*. Lyon. 26(1). 29-37. <https://www.joslyon.com/>
65. Antonov A. A. (2021). Experimental evidences for the fallacy of the STR version in physics textbooks. *Sciences of Europe (Praha, Czech Republic)*. 82(2). 19-28. DOI: 10.24412/3162-2364-2021-82-2-19-28
66. Antonov A.A. (2023). The Corrected Version of the Special Theory of Relativity. *European Journal of Applied Sciences. Services for Science and Education*. UK. 11(5). 68-83. DOI:10.14738/aivp.115.15474
67. Antonov A. A. (2023). Corrected special theory of relativity. *Journal of science*. Lyon. 48. 27-36. <https://doi.org/10.5281/zenodo.10277156>
68. Antonov A. A. (2023). Corrected special theory of relativity. *Annali d'Italia*. 49, 25-35. DOI: 10.5281/zenodo.10214679
69. Antonov A. A. (2023). The Corrected Version of the Special Theory of Relativity. The scientific heritage. (Budapest, Hungary). 123. 72-81,
70. Antonov A. A. (2023). The Corrected Version of the Special Theory of Relativity. *Norwegian Journal of development of the International Science*. 118. 40-49. <https://doi.org/10.5281/zenodo.10009500>
71. Antonov A. A. (2023). Alternative Version of the Special Theory of Relativity. *Sciences of Europe. (Praha, Czech Republic)*. 128. 62-71.
72. Antonov A. A. (2023). Special Theory of Relativity. *German International Journal of Modern Science*. 67. 64-73. DOI: 10.5281/zenodo.10966458
73. Antonov A. A. (2023). Corrected Version of the Special Theory of Relativity. *Danish Scientific Journal*. 77. 88-97. <https://doi.org/10.5281/zenodo.10054677>
74. Hinshaw G., Larson D., Komatsu E., et al. (2013) Nine Year Wilkinson Anisotropy Probe (WMAP) Observations: Cosmological Parameter Results. *arXiv:1213.5226 [astro-ph/CO]*.
75. Adam R., Ade P.A.R., Aghanim N., et al. (2015). Planck 2015 Results. 1. Overview of Products and Scientific Results. *arXiv:1502.01582v2 [astro-ph.CO]*.
76. Antonov A. A. (2015). Hidden Multiverse. *International Journal of Advanced Research in Physical Science*. 2(1). 25-32. http://doi.org/10.17686/sced_rusnauka_2015-903.
77. Antonov A.A. (2015). The astrophysical phenomenon of dark matter and dark energy proves the existence of the hidden Multiverse. *American Journal of Modern Physics*. 4(4). 180-188. DOI: 10.11648/j.jamp.20150404.14
78. Antonov A. A. (2015). Hidden Multiverse: explanation of dark matter and dark energy phenomena. *International Journal of Physics*. 3(2). 84-87. doi:10.12691/ijp-3-2-6
79. Antonov A. A. (2015). Principles and structure of the real Multiverse: explanation of dark matter and dark energy phenomena. *American Journal of Modern Physics*. 4(1). 1-9. doi: 10.11648/j.ajmp.20150401.11

80. Antonov A. A. (2016). *Hypothesis of the Hidden Multiverse: Explains Dark Matter and Dark Energy*. *Journal of Modern Physics*. 7(10), 1228- 1246. doi: 10.4236/jmp.2016.710111
81. Kantor I. L., Solodovnikov A. S. (1989). *Hypercomplex Numbers: An Elementary Introduction to Algebras*. Springer-Verlag
82. Antonov A. A. (2015). *Quaternion structure of the hidden Multiverse: explanation of dark matter and dark energy*. *Global Journal of Science. Frontier Research A: Physics and Space Science*. 15(8). 8-15.
https://globaljournals.org/GJSFR_Volume15/2-Quaternion-Structure-of-the-Hidden.Pdf
83. Antonov A. A. (2016). *Verifiable Multiverse*. *Global Journal of Science Frontier Research: A Physics and Space Science*. 16(4) 4-12.
doi: 10.17406/GJSFR
84. Antonov A. A. (2020). *How to See Invisible Universes*. *Journal of Modern Physics*. 11(05), 593-607. DOI: 10.4236/jmp.2020.115039
85. Antonov A. A. (2020). *Can invisible universes be seen?* *International independent scientific journal*. 21(2). 51-60. <http://www.iis-journal.com>
86. Antonov A. A. (2020). *How to discover invisible universes*. *Norwegian Journal of development of the International Science*. 42(1). 36-48. <http://www.njd-iscience.com>
87. Antonov A. A. (2020). *Universes Being Invisible on Earth outside the Portals Are Visible in Portals*. *Natural Science*. 12(8). 569-587. <https://doi.org/10.4236/ns.2020.128044>
88. Antonov A. A. (2020). *Invisible universes can be seen in anomalous zones*. *Danish Scientific Journal*. 43(1). 9-24. <http://www.danish-journal.com>
89. Antonov A. A. (2021). *Invisible universes can be seen in anomalous zones*. *International independent scientific journal*. 23(1). 28-44.
90. Chernobrov, V. (2000). *Encyclopedia of mysterious places of the Earth*. Veche Publishing House. Moscow. (In Russian).
91. Chernobrov, V. (2004). *Encyclopedia of mysterious places of Russia*. Veche Publishing House. Moscow. (In Russian).
92. Chernobrov, V. (2007). *Encyclopedia of mysterious places of the Earth and space*. Veche Publishing House. Moscow. (In Russian).
93. Chernobrov, V. (2009). *Encyclopedia of mysterious places of Moscow and Moscow region*. Helios ARV Publishing House. Moscow. (In Russian).
94. Antonov A. A. (2012). *Earth, portals, parallel universes*. *American Journal of Scientific and Industrial Research*. 3(6). 464-473. doi:10.5251/ajsir.2012.3.6.464.473
95. Antonov A. A. (13 January 2016). *How Portals of the Invisible Multiverse Operate*. *Science PG Frontiers*.
<http://www.sciencepublishinggroup.com/news/sciencepgfrontiersinfo?articleid=7>
96. Antonov, A. A. (2016). *Star gates of the hidden multiverse*. *Philosophy and cosmology*. 6. 11-27. (In Russian). <http://ispcjournal.org/journals/2016-16/Antonov16.pdf>
97. Dyson F.W, Eddington A.S., Davidson C. (1929). *A determination of the deflection of light by the sun's gravitational field, from observations made at the total eclipse of May 29, 1919*. *Philosophical transactions of the Royal Society A*. 220. 291-333.
<https://doi.org/10.1098/rsta.1920.0009>
98. Sagan C. 2000. *The Cosmic Connection: An Extraterrestrial Perspective*. ed. by J. Agel. 2nd ed. Cambridge University Press, New York
99. Webb S. 2002. *If the Universe Is Teeming with Aliens. Where Is Everybody? Fifty Solutions to Fermi's Paradox and the Problem of Extraterrestrial Life*. Springer Science+Business Media. New York
100. Michaud M. 2010. *Contact with Alien Civilizations: Our Hopes and Fears about Encountering Extraterrestrials*. Springer Science+Business Media. New York
101. Brown A. S. 2004. *The Deja Vu Experience*. Psychology Press, New York. 2004.
102. Antonov A. A. (2017). *The physical reality and essence of imaginary numbers*. *Norwegian Journal of development of the International Science*. 6. 50-63. <http://www.njd-iscience.com>
103. Antonov A. A. (2018). *Physical Reality and Essence of Imaginary Numbers in Astrophysics: Dark Matter, Dark Energy, Dark Space*. *Natural Science*. 10(1). 11-30.
doi:10.4236/ns.2018.101002
104. Antonov A. A. (2023). *Proving physical reality and explaining the physical essence of imaginary numbers*. *Norwegian Journal of development of the International Science*. 123. 26-36.
<https://doi.org/10.5281/zenodo.10451085>

105. Antonov A. A. (2024). *Physical reality of imaginary numbers and their physical essence*. Danish Scientific Journal. 80. 25-35. <https://doi.org/10.5281/zenodo.10594282>
106. Antonov A. A. (2024). *Proof of physical reality of imaginary numbers and explanation of their physical essence*. German International Journal of Modern Science. 72. 17-27.
107. Antonov A. A. (2024). *Physical reality of imaginary numbers and their physical essence*. Sciences of Europe. (Praha, Czech Republic). 133(1). 79-90. DOI: 10.5281/zenodo.10575590
108. Antonov A. A. (2024). *Physical reality of imaginary numbers and their physical essence*. The scientific heritage. (Budapest, Hungary). 129. 43-53. DOI: 10.5281/zenodo.10558263
109. Antonov A. A. (2024). *Proving Physical Reality and Explaining Physical Essence of Imaginary Numbers*. Journal of science. Lyon. 50. 25-35. <https://doi.org/10.5281/zenodo.10609816>
110. Antonov A. A. (2024). *Physical reality of complex numbers and their physical essence*. International independent scientific journal. 58. 3-13. <https://doi.org/10.5281/zenodo.10491923>
111. Antonov A. A. (2024). *Proof of physical reality of imaginary numbers and explanation of their physical essence*. Annali d'Italia. 51, 25-35. DOI: 10.5281/zenodo.10573831
112. Antonov A. A. (2024). *From the experimentally proven principle of the physical reality of imaginary numbers follows the existence in nature of an invisible afterlife world predicted by all religions*. XV international scientific conference. "Challenges and problems of modern science". London. Great Britain. 36-44. DOI <https://doi.org/10.5281/zenodo.11485534>
113. Antonov A. A. (2024). *From the physical reality of imaginary numbers it follows the invisible afterlife world actually physically exists*. The scientific heritage. 136 21-26. DOI: 10.5281/zenodo.11125107
114. Antonov A. A. (2024). *From the physical reality of imaginary numbers it follows that the invisible afterlife world mentioned in all religions actually physically exists*. German International Journal of Modern Science. 80. 26-32. DOI: 10.5281/zenodo.11211891
115. Antonov A. A. (2024). *From the physical reality of imaginary numbers it follows that the invisible afterlife world, mentioned in all religions, is in fact physically exists*. Danish Scientific Journal. 83. 13-19. <https://doi.org/10.5281/zenodo.11097801>
116. Antonov A. A. (2024). *From the physical reality of imaginary numbers it follows that the invisible afterlife world, predicted by all religions, is in fact physically real*. Journal of science. Lyon. 53. 22-27. <https://doi.org/10.5281/zenodo.11114254>
117. Antonov A. A. (2024). *From the physical reality of imaginary numbers it follows that the invisible afterlife world actually physically exists*. Annali d'Italia. 55. 15-22
118. Antonov A. A. (2024). *From the physical reality of imaginary numbers it follows that the invisible afterlife world actually predicted by all religions actually physically exists*. Norwegian Journal of development of the International Science. 130. 36-41. <https://doi.org/10.5281/zenodo.10975059>
119. Antonov A. A. (2024). *From the physical reality of imaginary numbers it follows that the afterlife invisible world, referred in all religions, in fact physically real*. International independent scientific journal. 62. 3-9. <https://doi.org/10.5281/zenodo.11519773>
120. Antonov A. A. (2024). *From the physical reality of imaginary numbers it follows that the invisible afterlife world, predicted by all religions, is in fact physically real*. Sciences of Europe. (Praha, Czech Republic). 140. 34-40. DOI: 10.5281/zenodo.11171388
121. Antonov A. A. (2024). *It follows from the special theory of relativity that the invisible afterlife world predicted by all religions is in fact physically real*. Polish journal of science. 75. 45-51.
122. Antonov A. A. (2024). *It follows from the special theory of relativity that invisible afterlife world is in fact physically real*. Slovak international scientific journal. 84. 52-58. DOI: 10.5281/zenodo.11624422
123. Antonov A. A. (2024). *It follows from the special theory of relativity that the invisible afterlife world predicted by all religions actually physically exists*. Scientific-discussion. (Praha, Czech Republic). 89. 18-24.

Medical sciences

RELEVANCE OF RESEARCH ON COMORBID CONDITIONS IN CHILDREN

Bodnar G.

Bukovinian State Medical University, Professor, MD, Professor

Bodnar O.

Bukovinian State Medical University

Doctor-intern of the department of anesthesiology and resuscitation

The study of comorbid conditions in children is gaining increasing importance in modern pediatrics due to the rising prevalence of these disorders and their complex, multifactorial nature. Recent epidemiological studies indicate a steady increase in the number of comorbid conditions, especially those associated with chronic allergic and autoimmune diseases. This not only adds to the burden on healthcare systems but also underscores the need for a more comprehensive approach to diagnosis, treatment, and prevention.

Children with comorbid conditions often experience more severe symptoms, a reduced quality of life, and an increased risk of long-term complications. These disorders frequently interact with other health issues, such as growth delays, nutritional deficiencies, and psycho-emotional disorders, necessitating a deep understanding of their interconnections to develop effective management strategies that address the full spectrum of a child's health needs.

Advances in understanding the role of the microbiome, genetic predisposition, and the impact of environmental and psychosocial factors have opened new horizons for research and treatment. For instance, the role of dysbiosis is increasingly recognized as a key factor in the pathogenesis of various diseases, highlighting the potential of microbiome-targeted therapy. Additionally, the identification of genetic markers associated with an increased risk of developing these conditions creates opportunities for personalized medicine, enabling the application of more precise and effective interventions.

Moreover, the impact of modern lifestyle factors-such as dietary changes, reduced physical activity, and increased exposure to environmental toxins-on the prevalence and severity of comorbid conditions in children cannot be underestimated. These factors not only contribute to the development of disorders but also complicate their management, requiring a multidisciplinary approach that includes nutritional counseling, psychological support, and lifestyle modifications.

Thus, the relevance of research on comorbid conditions in children lies in the urgent need to deepen our understanding of the complex interactions that contribute to their development. Advancing knowledge in this area will allow the development of more effective prevention and treatment methods, ultimately improving the health and quality of life for children with these conditions. This research is crucial for informing clinical practice and developing healthcare strategies aimed at addressing the growing challenge of comorbid conditions in the pediatric population.

The relevance of the prevalence of gastrointestinal (GI) disorders in children is driven by their high occurrence and significant impact on children's quality of life and overall health. Over the past five years, there has been an increase in the incidence of these disorders, linked to various factors, including lifestyle changes, dietary habits, environmental conditions, and genetic predispositions. Epidemiological data indicate an increase in the incidence of GI disorders in children, particularly functional disorders such as irritable bowel syndrome (IBS) and functional dyspepsia. A European study found that approximately 13-22% of children suffer from functional GI disorders, which is a significant public health concern, requiring attention from both pediatricians and gastroenterology specialists [Van Tilburg, Felix, & Palsson, 2020].

The role of the microbiome in the development of GI disorders in children has been actively studied in recent years. Numerous studies have shown that gut dysbiosis can play a key role in the pathogenesis of IBD and other comorbid conditions. For example, a recent meta-analysis demonstrated that alterations in the microbiota composition are associated with the development of IBD in children, highlighting the importance of maintaining a healthy microbiome for the prevention of these disorders [Ijaz et al., 2019].

Genetic and epigenetic studies have also become an important aspect of understanding the pathogenesis of GI disorders in children. The identification of genetic markers, such as polymorphisms in genes related to immune response and gut barrier function, has deepened our understanding of the

mechanisms underlying the predisposition to these disorders. This, in turn, opens up opportunities for the development of more personalized approaches to diagnosis and treatment [Kelsen & Baldassano, 2018].

The impact of dietary factors and stress on children's GI health has also become the subject of numerous studies. It has been shown that deficiencies in key nutrients, such as vitamin D and omega-3 fatty acids, can worsen the course of GI disorders and increase the risk of developing comorbid conditions. Additionally, psychosocial factors, including chronic stress, can exacerbate clinical manifestations, requiring a comprehensive approach to treatment [Papandreou & Karabouta, 2021; [van Tilburg, Palsson, & Turner, 2020].

Thus, the prevalence of gastrointestinal disorders in children remains high, making this issue extremely relevant for contemporary research and clinical practice. Further study of risk factors, pathogenetic mechanisms, and the effectiveness of various treatment approaches is key to improving clinical outcomes in this patient group.

Increased prevalence of comorbid conditions: recent epidemiological studies show an increase in the prevalence of comorbid GI disorders in children, particularly in conjunction with allergic and autoimmune conditions. The rising prevalence is attributed to environmental factors, dietary changes, and reduced physical activity.

Role of the microbiome in the development of comorbid conditions: recent research highlights the significant role of the gut microbiome in the pathogenesis of comorbid GI disorders in children. Dysbiosis, or alterations in the microbiome composition, may contribute to the development of inflammatory processes and autoimmune diseases, including IBD and celiac disease.

Impact of genetic predisposition: in the past few years, several genetic markers associated with an increased risk of developing comorbid GI disorders in children have been identified. Polymorphisms in genes related to immune response and gut barrier function can increase susceptibility to inflammatory and allergic conditions.

Link between IBD and extraintestinal diseases: new data suggest a strong association between inflammatory bowel disease and the development of extraintestinal comorbidities, such as arthritis, skin diseases, and mental health disorders. These findings emphasize the importance of a multidisciplinary approach to treating children with IBD.

Influence of dietary factors and nutrients: studies in recent years have demonstrated the impact of dietary factors, such as deficiencies in vitamin D, omega-3 fatty acids, and antioxidants, on the development and course of comorbid GI disorders. Nutrient deficiencies can worsen clinical outcomes and increase the risk of developing associated conditions.

Psychosocial aspects and stress: recent data indicate that stress and psychosocial factors play a significant role in the development and exacerbation of comorbid GI disorders in children. Chronic stress can impair gut barrier function and immune response, contributing to the development of inflammatory diseases and IBS.

Personalized treatment approaches: in recent years, there has been a shift towards personalized treatment approaches for comorbid GI disorders in children, including genetic testing, microbiome analysis, and assessment of food intolerances. This allows for more precise therapy and dietary recommendations, improving clinical outcomes.

Need for long-term research: despite significant progress in the study of comorbid GI disorders in children, knowledge gaps remain, requiring long-term clinical and genetic studies. Key areas of focus include the study of early risk factors and the development of new prevention and treatment methods.

Conclusions.

1. The rising prevalence of comorbid GI disorders in children over the past five years highlights the growing significance of this issue in pediatric healthcare. The integration of recent findings into clinical practice is essential to effectively manage these conditions and improve patient outcomes.

2. The increasing incidence of functional GI disorders, such as IBS and functional dyspepsia, calls for heightened awareness among healthcare professionals. Early diagnosis and intervention are critical to mitigating the long-term impact on children's health and quality of life.

3. The emerging understanding of the gut microbiome's role in the pathogenesis of GI disorders underscores the need for microbiome-targeted therapies. Strategies to maintain or restore a healthy microbiome could be pivotal in preventing and managing conditions like IBD and other comorbidities.

4. *Advances in genetic research offer new avenues for personalized medicine in pediatric gastroenterology. Identifying genetic predispositions can lead to more tailored treatment plans, reducing the burden of GI disorders and enhancing therapeutic efficacy.*

6. *The impact of dietary deficiencies and psychosocial stress on GI health necessitates a holistic approach to treatment. Addressing these factors through nutritional support and stress management could significantly improve outcomes of children with GI disorders.*

6. *Continued research into the mechanisms underlying GI disorders, including the role of the microbiome and genetic factors, is essential. Long-term studies are needed to evaluate the effectiveness of emerging therapies and to develop preventive strategies that can be implemented in clinical practice. In conclusion, the high prevalence and complex etiology of GI disorders in children require a multidisciplinary approach that integrates recent scientific advancements. By embracing personalized medicine, microbiome science, and holistic care strategies, healthcare providers can enhance the management of these conditions, ultimately improving the quality of life for affected children.*

References

1. Van Tilburg, M. A., Felix, C. T., & Palsson, O. S. (2020). *Functional Gastrointestinal Disorders in Children: Epidemiology, Mechanisms, and Management. Journal of Pediatric Gastroenterology and Nutrition, 70(2), 270-278.*

2. Ijaz, U. Z., Quince, C., Hanske, L., Loman, N., & Hegazy, A. N. (2019). *Dysbiosis and Its Impact on the Microbiome in Pediatric Patients with Inflammatory Bowel Disease. Inflammatory Bowel Diseases, 25(7), 1202-1212.*

3. Kelsen, J. R., & Baldassano, R. N. (2018). *Genetic Susceptibility and the Microbiome in Pediatric Inflammatory Bowel Disease. Frontiers in Pediatrics, 6, 157.*

4. Papandreou, D., & Karabouta, Z. (2021). *Impact of Vitamin D Deficiency on Pediatric Gastrointestinal Diseases. European Journal of Clinical Nutrition, 75(2), 210-219.*

5. Tilburg, M. A., Palsson, O. S., & Turner, M. (2020). *Influence of Stress on Functional Gastrointestinal Disorders in Children. Pediatric Gastroenterology, Hepatology & Nutrition, 23(4), 209-218.*

EFFECT OF OXYGEN-HELIUM MIXTURE BREATHING TECHNIQUE ON HEART RATE VARIABILITY AND MYOCARDIAL STATE IN PATIENTS WITH ARTERIAL HYPERTENSION

S.V. Goubkin

*MD, PhD, DSc, Professor, Corresponding member of the NASB, chief scientist,
Institute of Physiology, NASB
Minsk, Akademicheskaya 28, Republic of Belarus*

S.B. Kokhan

*Head of the medical prevention and rehabilitation team,
Institute of Physiology, NASB
Minsk, Akademicheskaya 28, Republic of Belarus*

N.D. Titkova

*Senior Researcher at the Laboratory of Biomedical Technologies and Medical Rehabilitation,
Institute of Physiology, NASB
Minsk, Akademicheskaya 28, Republic of Belarus*

ВЛИЯНИЕ МЕТОДИКИ ДЫХАНИЯ КИСЛОРОДНО-ГЕЛИЕВОЙ СМЕСЬЮ НА ПОКАЗАТЕЛИ ВАРИАбельНОСТЬ СЕРДЕЧНОГО РИТМА И СОСТОЯНИЕ МИОКАРДА У ПАЦИЕНТОВ С АРТЕРИАЛЬНОЙ ГИПЕРТЕНЗИЕЙ

С.В. Губкин

*доктор медицинских наук, профессор,
член-корреспондент НАН Беларуси, главный научный сотрудник,
Институт физиологии НАН Беларуси
г. Минск, Академическая 28, Республика Беларусь*

С.Б. Кохан

*руководитель группы медицинской профилактики и реабилитации,
Институт физиологии НАН Беларуси
г. Минск, Академическая 28, Республика Беларусь*

Н.Д. Титкова

*научный сотрудник лаборатории медико-биологических технологий и медицинской реабилитации,
Институт физиологии НАН Беларуси
г. Минск, Академическая 28, Республика Беларусь*

Abstract

The effect of oxygen-helium mixture breathing technique on heart rate variability (HRV), myocardial state and acid-base state and venous blood gases in patients with arterial hypertension (stage I and II) aged 39-61 years, men (10), women (10), staying in sanatorium-resort conditions of the health resort of the Republic of Belarus was studied. The control and target groups were formed from the number of volunteers. All volunteers received oxygen-helium inhalations in the ratio of 30% oxygen and 70% helium, heated up to 75°C. Under the influence of the course of oxygen-helium inhalations in the patients of the target group (n=10) there was noted an increase in heart rate variability due to the increased influence of the parasympathetic nervous system. Decrease in centralization of heart rhythm control indicated a tendency to normalization of heart rhythm regulation. Expansion of adaptive capabilities of the organism was noted due to the decrease in the integral index of activity of regulatory systems (PARS). In the control group no statistically significant changes in HRV indices were recorded. When analyzing the integral index "Myocardium", it was found that 30% of patients have the value of this index within the norm (up to 15%), which indicates the absence of heart pathology. Pre-threshold cardiac abnormalities were found in 40% of patients (Myocardium index 15-25%) and 30% already had signs of pathology (Myocardium index more than 25%). The favorable effect of CGS on metabolic and energetic processes in the heart muscle was marked by a decrease in the numerical index of the area of the zone of electrophysiological disorders "Myocardium" in patients of the target group. In volunteers

of the control and target groups the decrease of oxygen saturation (sO₂) and oxyhemoglobin fraction (FO₂Hb), as well as the increase of deoxyhemoglobin (FHb) in venous blood was noted, which indicates the increase of oxygen absorption by tissues of the body after a short-term course of inhalation of heated CGS.

Аннотация

Изучено влияние методики дыхания кислородно-гелиевой смеси на показатели variability сердечного ритма (BCP), состояние миокарда и кислотно-основного состояния и газов состава венозной крови у пациентов с артериальной гипертензией (I и II стадии) в возрасте (39-61 год), мужчин (10), женщин (10), находящихся в санаторно-курортных условиях здравницы Республики Беларусь. Из числа добровольцев сформированы контрольная и целевая группы. Все добровольцы получали кислородно-гелиевые ингаляции в соотношении 30% кислорода и 70% гелия, подогретой до 75° С. Под влиянием курса кислородно-гелиевых ингаляций у пациентов целевой группы (n=10) отмечено повышение variability ритма сердца за счёт увеличения влияния парасимпатической нервной системы. Снижение централизации управления ритма сердца свидетельствовало о тенденции к нормализации регуляции ритма сердца. Расширение адаптационных возможностей организма отмечено за счёт снижения интегрального показателя активности регуляторных систем (ПАРС). В контрольной группе статистически значимых изменений показателей ВРС не зафиксировано. При анализе интегрального показателя «Миокард», было установлено, что 30% пациентов имеют значение этого показателя в рамках нормы (до 15%), что свидетельствует об отсутствии патологии сердца. Предпороговые нарушения в работе сердца были установлены у 40% пациентов (показатель «Миокард» 15-25%) и у 30 % уже имелись признаки патологии (показатель «Миокард» более 25%). Благоприятное влияние КГС на обменно-энергетические процессы в сердечной мышце отмечено снижением численного показателя площади зоны электрофизиологических нарушений «Миокард» у пациентов целевой группы. У добровольцев контрольной и целевой групп отмечено снижение насыщения кислородом (sO₂) и фракции оксигемоглобина (FO₂Hb), а также повышение дезоксигемоглобина (FHb) в венозной крови, что свидетельствует об усилении поглощения кислорода тканями организма после кратковременного курса ингаляций подогретой КГС.

Keywords: *inert gases, helium, heated oxygen-helium mixture (HOGM), inhalation, arterial hypertension, KARDiVAR, Cardiovisor.*

Ключевые слова: *инертные газы, гелий, подогретая кислородно-гелиевая смесь (КГС), ингаляции, артериальная гипертензия, KARDiVAR, Кардиовизор.*

Введение. Артериальной гипертензией (АГ) страдает каждый третий взрослый человек в мире. Это распространенное и опасное для жизни заболевание приводит к развитию инфарктов миокарда, инсультов, сердечной недостаточности, поражению почек и многим другим проблемам со здоровьем, а значит, является ключевой причиной модифицированного характера, вызывающей, как общую, так и сердечно-сосудистую смертность во всех странах мира (Williams B., Mancia G., Spiering W. et al., 2018; Lip GYH., Coca A., Kahan T., et al., 2017; Gottesman R.F., Albert M.S., Alonso A., et al., 2017). По данным ВОЗ с 1990 по 2019 г. количество людей, живущих с гипертензией (имеющих артериальное давление от 140/90 мм рт. ст. и выше или принимающих антигипертензивные препараты), увеличилось вдвое – с 650 миллионов до 1,3 миллиарда человек. Психосоциальный стресс также существенно влияет на формирование АГ [1, 2]. Существуют клинические исследования, которые показывают, что у кардиологических пациентов при развитии депрессии в 2-4 раза повышается риск сердечно-сосудистой катастрофы. Последние исследования показывают, что симптомы депрессии и тревоги присутствуют у половины пациентов с артериальной гипертензией. Депрессия в общей популяции в Европейском регионе встречается в 5-10% случаев, что касается Беларуси, проведенное исследование STEPS в 2020 году показало, что распространенность депрессивной симптоматики среди населения около 12,5%. Следует обратить отдельное внимание на тот факт, что сердечно-сосудистая система имеет тесную морфофункциональную связь с дыхательной системой. Нарушения сердечно-сосудистой системы, возникающие в связи с поражением бронхолегочного аппарата и сопровождающиеся развитием хронического легочно-

сердечного синдрома или хронического легочного сердца. Вентиляционные нарушения, встречающиеся при хроническом пылевом и токсическом бронхитах, хронической обструктивной болезни легких, профессиональной бронхиальной астме и др. ведут к нарушению легочного газообмена, в результате чего развивается альвеолярная гипоксия, которая рефлекторно по механизму Эйлера – Лильестранда вызывает вазоконстрикцию легочных артерий, а затем и функциональную гипертензию в системе легочной артерии [3, 4]. Существует ряд широкодоступных и недорогих препаратов-дженериков для лечения сердечно-сосудистой патологии, однако трудно добиться стойкой ремиссии. Представляет интерес использования определенных газовых смесей, в частности кислорода с инертным газом, при лечении системы кровообращения, заболеваний органов дыхания, реабилитации после физических нагрузок. Гелий – инертный газ, по своим физическим свойствам способен ускорять доставку кислорода к тканям, не оказывая какого-либо негативного действия на кровеносную и дыхательную системы. Кислородно-гелиевые ингаляции способствуют своевременной коррекции функционального состояния и восстановлению резервов организма [5, 6]. Соотношение газов в смеси может быть любым, но для достижения терапевтического эффекта, согласно результатам клинических исследований учёных, лучшим признано соотношение 30% кислорода и 70% гелия [7, 8, 9].

Цель: изучить влияние методики дыхания подогреваемой кислородно-гелиевой смеси (He – 70%, O₂ – 30%) при температуре 75° С на показатели вариабельности сердечного ритма, состояние миокарда и кислотно-основного состояния и газов состава венозной крови у пациентов с артериальной гипертензией.

Материалы и методы. Выполнено рандомизированное контролируемое исследование.

Общее количество участников составило 20 взрослых пациентов, (из них 10 мужчин и 10 женщин), отдыхающих на базе Унитарного предприятия «Санаторий «Криница» Республика Беларусь. Отбор участников был проведен на равном включении обоих полов в исследование. Из числа добровольцев сформированы контрольная и целевая группы, все участники исследования подписали информированное согласие. Показатели исходных данных: частота сердечных сокращений (ЧСС), артериальное давление (АД), уровень сатурации измеряли пульсоксиметром Nellcor SpO₂, данные показатели регистрировали ежедневно до и после ингаляций КГС. Активность регуляторных систем организма и электрофизиологические дисперсионные характеристики у лиц с артериальной гипертензией определяли до и после методики дыхания подогретой КГС, используя аппаратно-программный комплекс «Экосан-2007» (Медицинские компьютерные системы, Зеленоград), включающий в себя аппаратно-программные комплексы «Кардивар» (анализ вариабельности сердечного ритма – ВСР) и «КардиоВизор-06» (дисперсионное картирование ЭКГ – ДК ЭКГ).

Статистическую обработку данных осуществляли с использованием ПО Statistica 7.0. Нормальность распределения переменных оценивалась с помощью критерия Шапиро-Уилка. Для описания количественных признаков, распределение которых не является нормальным использовались медиана (Me) и перцентили [Q25; Q75]. При сравнении выборок использовали ранговый U-критерий Манна-Уитни. За статистически значимые принимались различия при $p \leq 0,05$.

Методика дыхания КГС. Ингаляции осуществлялись в режиме: дыхание смесью, содержащей 70 % гелия и 30 % кислорода нагретой до 75° С – 15 мин однократно, курс ингаляций состоял из 1 процедуры в день в течение 10 дней, исключая выходные дни. Проведение КГС осуществлялось с помощью аппарата «ИНГАЛИТ В2-01», разработанного сотрудниками Института медико-биологических проблем Российской академии наук (регистрационное удостоверение на медицинское изделие № РЗН 2015/2466).

Результаты.

Гемодинамические показатели. Исходные данные частоты сердечных сокращений (ЧСС, уд./мин) у лиц с артериальной гипертензией составили 68 [62; 75], после ингаляций 67 [65; 70], систолическое и диастолическое артериальное давление (САД мм.рт.ст, ДАД мм.рт.ст.) находились в пределах 130/80 и отличалось лишь средними значениями до курса ингаляций 130/80 [130; 135]/80 [80; 85], после ингаляций 130/80 [120; 130]/80 [75; 85].

Динамика показателей активности регуляторных систем. Наблюдались исходно сниженные показатели ВСР - SDNN 24 [22; 116] мс, RMSSD 17 [11; 15] мс и PNN50 1 [0.3; 7] %, что указывало на усиление активности симпатического отдела вегетативной нервной системы, а снижение общей мощности спектра ВСР (TP) отражало уменьшение резервных возможностей

регуляторного механизма у пациентов с артериальной гипертензией. Под влиянием курса кислородно-гелиевых ингаляций повышалась вариабельность ритма сердца за счёт увеличения влияния парасимпатической нервной системы и отмечено снижение централизации управления ритма сердца, что свидетельствует о тенденции к нормализации регуляции ритма сердца.

В целевой группе отмечено статистически значимое снижение интегрального показателя активности регуляторных систем (ПАРС) с 6 баллов [5; 8] до 5 баллов [4; 6]), что свидетельствует о расширении адаптационных возможностей организма.

Анализ дисперсионных характеристик миокарда компьютерной системой скрининга сердца «Кардиовизор». Показатель «миокард» интегрально отражает степень обменно-энергетических и ишемических изменений в сердечной мышце, которые не проявляются на электрокардиограмме, но несут в себе риск развития заболеваний сердца. При анализе интегрального показателя «Миокард», было установлено, что 30% пациентов имеют значение этого показателя в рамках нормы (до 15%), что свидетельствует об отсутствии патологии сердца. Предпороговые нарушения в работе сердца были установлены у 40% пациентов (показатель «Миокард» 15-25%), 30 % уже имели признаки патологии (показатель «Миокард» более 25%). После курса ингаляций подогретой кислородно-гелиевой смеси показатель «Миокард» снизился у 60% пациентов, значение показателя «Миокард» уменьшилось с 25 [12; 35] % до 18 [11; 22] %.

Выводы. Результаты проведенных исследований следует рассмотреть с научной и практической точки зрения. Научный аспект тесно связан с практическим, поскольку новые научные данные дают возможность по-новому увидеть проблему и предложить новые пути для ее решения. Практический аспект проведенных исследований заключается в том, что получены научно обоснованные данные об успешном применении методики дыхания кислородно-гелиевой смеси у пациентов с артериальной гипертензией. Следовательно, можно сделать вывод о значительном влиянии методики дыхания подогретой до 75° С кислородно-гелиевой смеси (содержание O₂ – 30%, He – 70%) на организм человека. Благодаря уникальным физическим свойствам гелия, кислородно-гелиевая смесь при поступлении в человеческий организм, провоцирует перестройку работы регуляторных систем, позволяет максимально раскрыть резервные возможности организма, исключая негативные последствия для здоровья.

Литература

1. Вознесенская Т.Г. Эмоциональный стресс и профилактика его последствий // Русс. мед. журн. – 2006; 14 (9): 694–8.
2. Гимаева З.Ф., Каримова Л.К., Бакиров А.Б. и др. Риски развития сердечно-сосудистых заболеваний и профессиональный стресс // Анализ риска здоровью. – 2017; 1: 106–15.
3. Бабанов С.А. Состояние кардиореспираторной системы при пылевых заболеваниях легких // Автореф. дисс. канд. мед. наук. – Самара. – 1999. – 24 с.
4. Бабанов С.А., Аверина О.М., Татаровская Н.А. Особенности кардиогемодинамики при профессиональном бронхите // Известия Самарского научного центра Российской академии наук. – 2012. – Т. 14. – №5-3. – с. 650-654.
5. Павлов Б.Н., Куссмауль А.Р., Жданов В.Н., Логунов А.Т. Влияние кислородно-гелиевой ингаляционной терапии на работоспособность спортсменов. Использование подогретой кислородногелиевой газовой смеси «ГелиОксА» в комплексной профилактике гипоксии, связанной с физической нагрузкой // Отчет Института медико-биологических проблем РАН. М., 2009.
6. Левшин И.В., Поликарпочкин А.Н. Перспективы применения кислородно-гелиевых смесей в спорте высших достижений // Ученые записки. 2010. № 4. С. 62.
7. Лагунов А.Т., Мосягин И.Г., Павлов Н.Б. Подогретые кислородно-гелиевые смеси. Опыт применения в медицине // Морская медицина 2022. Т.8, № 1. С. 20-37.
8. Губкин, С.В. Медицинские технологии в ответ на вызовы пандемии // Система «Наука – технологии – инновации»: методология, опыт, перспективы: материалы Международной научно-практической конференции (Минск, 24–25 сентября 2020 г.) / редкол.: В.В. Гончаров (отв. ред.) [и др.]. – Минск: Центр системного анализа и стратегических исследований НАН Беларуси, 2020. – С. 23-30.
9. Ким Т., Чучалин А., Мартынов М. [и др.]. Эффективность и безопасность термической гелий-кислородной смеси (t-He/O₂) в снижении гипоксемии у пациентов с острым ишемическим инсультом. Евро. Респир. Июль. 2019; 54

References

1. Voznesenskaya T.G. *Emotional stress and prevention of its consequences* // Russ. med. zhurn. – 2006; 14 (9): 694–8 (in Russ.).
2. Gimaeva Z.F., Karimova L.K., Bakirov A.B. et al. *Risks of developing cardiovascular diseases and occupational stress* // Analiz riska zdorov'yu. – 2017; 1: 106–15 (in Russ.). DOI: 10.21668/health.risk/2017.1.12.
3. Babanov S.A. *State of cardiorespiratory system in dust diseases of the lungs*/Autoref.diss. candidate of medical sciences. - Samara. - 1999. – 24 p.
4. Babanov SA, Averina OM, Tatarovskaya NA *Features of cardiohemodynamics in occupational bronchitis* // Izvestia Samara Scientific Center of the Russian Academy of Sciences. - 2012. - Vol. 14. - №5-3. - P. 650-654.
5. Pavlov BN, Kussmaul AR, Zhdanov VN, Logunov AT. *Effect of oxygen-helium inhalation therapy on the performance of athletes. The use of heated HeliOx A oxygen-helium gas mixture in the complex prevention of hypoxia associated with physical activity. Report of the Institute of Biomedical Problems RAS; 2009. (In Russ.)*
6. Levshin IV, Polikarpochkin AN. *Prospects for the use of oxygenhelium mixtures in sports of the highest achievements. Scientists Notes. 2010;4:62. (In Russ.)*
7. Lagunov A.T., Mosyagin I.G., Pavlov N.B. *Heated oxygen-helium mixtures. Experience of application in medicine* // Marine Medicine 2022. Vol. 8, N 1. P. 20-37.
8. Gubkin, S.V. *Medical technologies in response to the challenges of the pandemic* // System "Science - Technology - Innovation": methodology, experience, prospects: proceedings of the International Scientific and Practical Conference (Minsk, September 24-25, 2020) / edited by V.V. Goncharov (ed.). Goncharov (ed.) [and others]. - Minsk: Center for System Analysis and Strategic Research of the National Academy of Sciences of Belarus, 2020. - P. 23-30.
9. Kim T., Chuchalin A., Martynov M. et al. *Efficacy and safety of thermic helium-oxygen (t-He/O₂) mixture in reducing hypoxemia in acute ischemic stroke patients. Eur. Respir. J. 2019; 54. (in Russian).*

Pedagogical sciences

THEORETICAL FOUNDATIONS FOR THE FORMATION OF GRAMMATICAL SKILLS AND ABILITIES IN ENGLISH CLASSES THROUGH INFORMATION AND COMMUNICATION TECHNOLOGIES

Kismetova G.N.

Candidate of Pedagogical Sciences, Associate Professor, Mahambet Utemisov West Kazakhstan University, Uralsk, Kazakhstan

Oryngali N.S.

1st year Master's degree student of Mahambet Utemisov West Kazakhstan University, Uralsk, Kazakhstan

Abstract

The paper discusses the possibilities of using Internet technologies in the process of teaching a foreign language in a general education organization, which is especially relevant in the light of modern requirements of our country. The authors carried out a theoretical analysis of scientific and practical literature with the aim of defining and comparing the most popular Internet resources used by specialists in the process of a foreign language in accordance with the set goal and objectives. An algorithm for teaching grammar of a foreign language at school based on a communicative approach through the use of popular Internet resources has been developed, an algorithm for the formation and improvement of grammatical skills and speech skills of students of the general education level within the boundaries of the chosen topic has been tested. Research in the field of the use of Internet technologies, resources that allow the implementation of interactive methods in teaching aspects of a foreign language are considered promising.

Keywords: *grammatical skills, grammatical structure, Internet resources, information technology, interactive learning.*

Introduction

The modern educational space is undergoing certain changes, which, first of all, are focused on the development of all spheres of society. The field of education is no exception. A graduate of the 21st century school should possess not only knowledge, skills and certain experience of activity, but also be a successful person with qualities that allow him to be flexible and quickly adapt to changing conditions of development and existence. These provisions are reflected, among other things, in the requirements of current federal educational standards of general education for the results of mastering the content of training [1, p.46].

One of the most important planned learning outcomes is the foreign language communicative competence formed at a certain level with respect to each stage of learning, i.e. the ability to communicate in a foreign language with native speakers in a variety of communicative situations. The formation of the latter is not possible without teaching the grammatical side of speech as the basis for the formulation of statements, a tool for structuring speech [2, p.78].

The solution to the problem of increasing the interest of students, their motivation to study grammar as a functional and integral component of the development of foreign language speech, the implementation of the principle of interactivity and speech orientation in the process of mastering grammatical material can undoubtedly be the use of modern information and communication tools, including Internet technologies.

Effective methodological techniques, technologies and methods of work in foreign language lessons, including techniques and methods of teaching the grammatical side of speech, are described and classified in the studies of such famous scientists as I.L. Bim, R.P. Milrud, N.D. Galskova, E.I. Passov, etc. [3, p.60]; the problems of using Internet technologies in teaching are revealed in the works of researchers E.P. Asimov, L.P. Vladimirova, I.V. Kruglova, T.A. Polilova, etc. [4, p.110].

Materials and types of research

The purpose of the presented research is to develop methodological recommendations on the use of modern information technologies in the process of teaching foreign grammar to school learners.

The goal is revealed in the following tasks: to analyze Internet technologies used to teach English grammar; to test an algorithm for the development of grammatical skills using Internet technologies.

The purpose and objectives of the study determined the use of the following methods: methods of systematization and generalization of data from theoretical sources, survey, questionnaire, method of logical and theoretical analysis of scientific literature, methods of induction and deduction, method of analytical generalization, method of interpretation of the results of approbation.

Grammatical skills are the ability to automatically recall from long-term memory the grammatical means necessary for speech communication. Grammatical structure is a certain set of laws of a language that regulate the correctness of the construction of significant speech segments (words, utterances, texts). Grammatical material is that part of the language material, the study of which is provided by the content of the training. It is customary to include grammatical units, forms and structures, rules for changing words and combining them into sentences.

We conducted a survey among future foreign language teachers and current young professionals using the Google-forms service. The survey participants were asked to highlight the main advantages of using the Internet, information technologies in foreign language education. Information technologies – processes, methods of searching, collecting, storing, processing, providing, distributing information and ways of implementing such processes and methods. Internet technologies are a tool for creating and maintaining various information resources on the Internet: websites, blogs, forums, chats, electronic libraries and encyclopedias [5, p.35].

Communicating in a truly linguistic environment provided with Internet resources and platforms, students find themselves in authentic or close to authentic life situations where training and application of grammatical aspect skills can be carried out. Students face a task that reflects the functionality of the language in real life. This task is, most often, new, interesting, realistic. To solve it, spontaneity, adequacy of reaction is necessary, which allows us to speak about the originality of replicas-reactions. Thus, the use of a grammatical rule, structure, is motivated by the need to understand and convey thoughts and meanings, ideas, content.

Kazakhstani researcher Nurzhanova A.P. in her article "Online platform "Flip" as a learning tool for English lessons" wrote: "...The application has three important advantages. First, the instructor can engage all the students in the group. For example, it is impossible to survey all students during class, whereas in the app, all students can be involved. Second, during the class, students may be shy to speak English, while in the app, the student can write down their answer from the comfort of their own home. Third, Flip helps to get to know their classmates better...". [5]

Integrated grammar teaching using Internet technologies is one of the most effective ways to create interaction in the classroom. According to R.P. Milrud's definition, interactivity is "the unification, coordination and complementarity of efforts of a communicative goal and result by speech means" [6, p. 49].

Internet resources can be used in various ways when working on the grammatical side of speech, for example:

- as a visual aid when familiarizing with the material;*
- as a basis for extracurricular work, independent preparation at home, for problem-searching tasks, group or pair work;*
- during the application of elements of the project methodology;*
- in the process of online communication (video, audio, correspondence) with a native speaker;*
- as a tool for modifying the program, which is characteristic of this class in the process of digitalization of learning [7, p.19].*

S.S.Kunanbayeva in her book "The Modernization of Foreign Language education: The linguocultural-communicative approach" wrote: "... The proponents of the communicative method were also right in concluding that the ability to verbal communication should be achieved through the development of 'communicative competence'[8].

Let's consider the most popular Internet resources and technologies used in teaching grammar

Table 1

Comparative analysis of popular Internet resources used in teaching English grammar

<i>Names</i>	<i>Brief description of the main features</i>	<i>Interface</i>	<i>Option for smartphones</i>	<i>The possibility of authentic online communication</i>
<i>AngloLink</i>	<i>- a resource for honing skills in pronunciation and writing short dictation with certain grammatical constructions; - available installations; - convenient thematic search.</i>	<i>high level</i>	<i>no</i>	<i>no</i>
<i>Grammar.net</i>	<i>large visual supports; grammar is presented schematically.</i>	<i>high level</i>	<i>no</i>	<i>no</i>
<i>Activities for ESL</i>	<i>-focused on both teachers and students; - redundant information and tasks for training an active grammatical minimum; -to increase motivation, there are quizzes, riddles, jokes, videos, tasks; -there is a complex information retrieval system that makes it difficult for students to work independently with the resource.</i>	<i>low level</i>	<i>no</i>	<i>no</i>
<i>My language exchange</i>	<i>-possibility of group work online; - the ability to find a pen pal after filling out the questionnaire and indicating personality traits, interests, age; - availability of free access to authentic books and special aspect games.</i>	<i>high level</i>	<i>yes</i>	<i>yes</i>
<i>BBC Learning English</i>	<i>-training courses for different levels of training; -thematic division of information and exercises presented on the site.</i>	<i>high level</i>	<i>yes, but not for all countries</i>	<i>no</i>
<i>British Council Learn English</i>	<i>-interactive exercises, educational videos and games.</i>	<i>Medium level</i>	<i>no</i>	<i>Yes, but only in comment regime</i>
<i>Duolingo</i>	<i>- exercises for the initial level of training are free of charge; - tasks for intermediate and advanced level training are paid.</i>	<i>high level</i>	<i>yes, but for a fee</i>	<i>no</i>
<i>Lingualeo</i>	<i>-accentuated grammar study; -availability of free and paid training courses.</i>	<i>Medium level</i>	<i>yes, but for a fee</i>	<i>no</i>
<i>EngVid</i>	<i>-video lessons for learning English grammar; - thematic division; - preparation of students (partially) for international exams (IELTS, TOEFL)</i>	<i>Medium level</i>	<i>no</i>	<i>no</i>

Memrise	learning grammar using a flashcard system; -the ability to design content by users; - modification of tasks for the level, group, plan.	Medium level	no	no
Bussu	- the ability to find a pen pal; more than 10 languages; in addition to grammar exercises, tasks for vocabulary and pronunciation training are presented; - checking the correctness of performing exercises online; - Interface and applications developed for iOS and Android.	high level	yes	yes
Livemocha	mutual verification and mutual training; - it is possible to coordinate teachers online and independent work of students; - text messaging is possible; - the possibility of online video and audio communication is a paid option.	high level	yes, but for a fee	yes

Work on grammatical material through the WordWall Internet platform (wordwall.net), a site for finding pen pals (<https://www.penpalworld.com/>), an interactive Worldview website (<http://www.lonelyplanet.com>) can be carried out in several stages, according to the algorithm presented in Table 2.

Research questions

Here are research questions that guide this study as follows:

- 1) What grammar games are popular within students?
- 2) What were results after working with different online tools and game technologies?
- 3) What skills could students develop by working with these technologies?

In order to obtain reliable results on the effectiveness of the proposed algorithm, an approbation was carried out with 6th grade students on the basis of a secondary school № 10 named after Akhmet Baitursynov.

Two groups took part in the methodical experiment – control and experimental. The students of the control group studied according to the standard program without using Internet technologies in the educational process. Students from the experimental group studied the same topic as the control group, but the material was worked out on the basis of a developed algorithm for teaching grammar using Internet technologies at the stage of basic general education.

Before and after training on the basis of the developed algorithm using Internet technologies, testing was conducted, the purpose of which was to identify the level of grammar proficiency. If we compare the data obtained, it is clear that the students of the experimental group coped better with the task of testing, showing higher results compared to the students of the control group (Fig. 1, scale – in %).

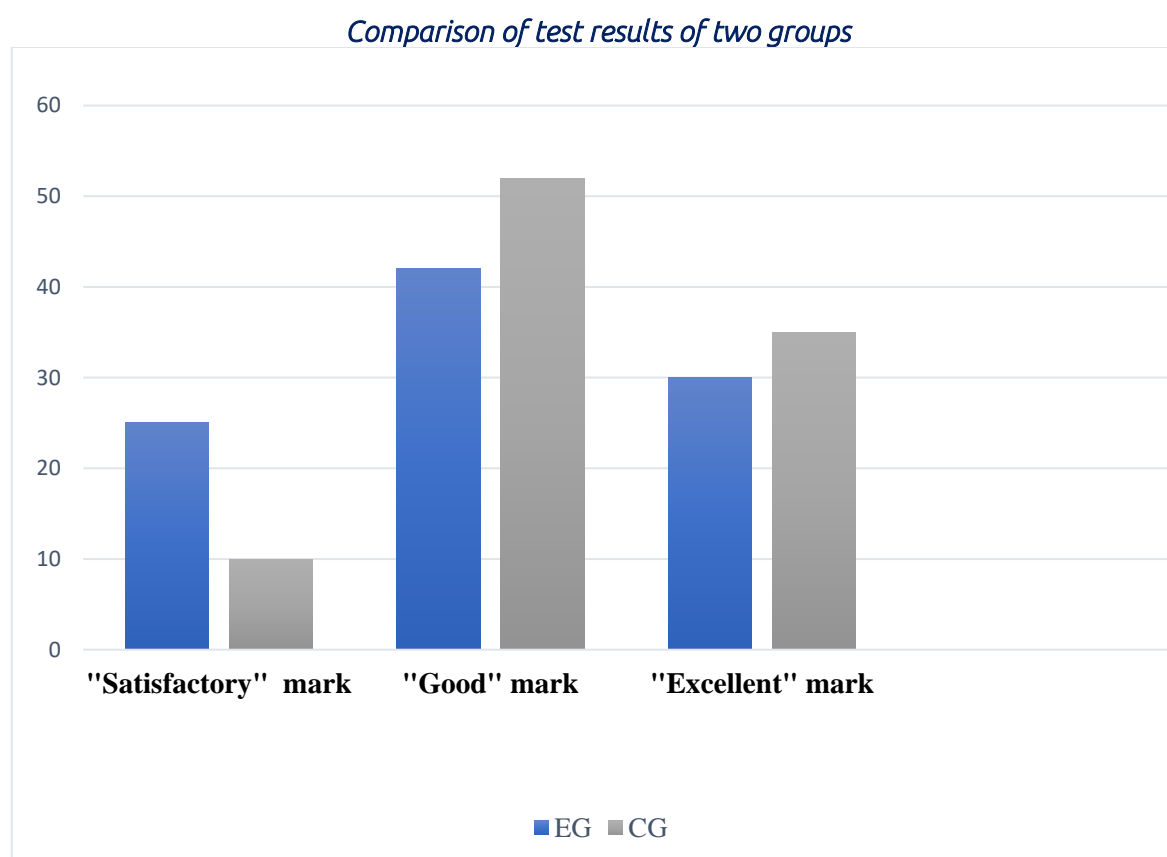


Figure 1. Comparison of the test results of the two groups after the experiment

Research results

Thus, it can be concluded that there is a positive dynamics based on the results of testing, an increase in the effectiveness of grammar teaching within this particular topic, an increase in the number of students with a high level of grammatical skills development and a decrease in the number of students with an average level. The average score in the control group was lower than in the experimental group. Also, we have analyzed different online tools such as AngloLink, Grammar.net, Activities for ESL, Grammar.net, EngVld, Memrise, Bussu and checked whether these tools are effective or not. Furthermore, we find the most suitable tool is "Bussu", which has more than 10 languages; in addition to grammar exercises, tasks for vocabulary and pronunciation training are presented; checking the correctness of performing exercises online; interface and applications developed for iOS and Android. As the purpose of the presented research was to develop methodological recommendations on the use of modern information technologies in the process of teaching foreign grammar to school learners, we could achieve this result. The goal obviously revealed in the following tasks: to analyze Internet technologies used to teach English grammar; to test an algorithm for the development of grammatical skills using Internet technologies.

Conclusion

Thus, the application of the algorithm of teaching English grammar at school presented by the authors of the study on the basis of a communicative approach through the implementation of Internet resources and information technologies makes it possible to increase the efficiency of the learning process, while the teacher should offer students functional installations, direct search activities, coordinate the processing of information and communication online in a foreign language. Overall, grammatical skills are the ability to automatically recall from long-term memory the grammatical means necessary for speech communication. Grammatical structure is a certain set of laws of a language that regulate the correctness of the construction of significant speech segments (words, utterances, texts). Grammatical material is that part of the language material, the study of which is provided by the content of the training. It is customary to include grammatical units, forms and structures, rules for changing words and combining them into sentences. Also, internet resources can be used in various ways when working on the grammatical side of speech, for example: as a visual aid when familiarizing with the material; as a basis for extracurricular work, independent preparation at home, for problem-searching tasks, group or pair work; during the application of elements of the project methodology;

References

1. Asimov, E.P. *Internet materials in the classroom* / E.P. Asimov // *Foreign languages at school*. – 2001. – No. 1. – p. 46.
2. Biboletova, M.Z. *The program of the English language course for the UMK English with pleasure: EnjoyEnglish for grades 2-11* / M.Z. Biboletova, N.N. Trubaneva. - Obninsk: Titul, 2013. – 218 p.
3. Bim, I.L. *Methods of teaching foreign languages as science and problems of a school textbook* / I.L. Bim. – M., 2007. – 134 p.
4. Vladimirova, L.P. *Internet at foreign language lessons* / L.P. Vladimirova // *Foreign languages at school*. - 2012. No. 3. – 240 p.
5. Nurzhanova A.P. (2023) "Online platform "Flip" as a learning tool for English lessons". *Republican scientific and methodological journal "Prosveshcheniye"*. Available at: https://www.prosveshenie.kz/article?id_article=76969
6. Milrud, M.P. *Modern conceptual principles of communicative teaching of a foreign language* / M.P. Milrud. – 2000. – 101 p.
7. Polilova, T.A., Ponomareva, V.V. *Introduction of computer technologies in teaching foreign languages* / T. A. Polilova // *Foreign languages at school*. – 1997. – No. 6. – pp. 19-21.
8. S.S.Kunanbayeva - "The Modernization of Foreign Language education: The linguocultural-communicative approach". 2010 – 32-33.
9. LovelyPlanet [Electronic resource]. – Access mode: <http://www.lovelyplanet.com> (accessed: 28.03.23).
10. Penpal World [Electronic resource]. – Access mode: <https://www.penpalworld.com/> (accessed: 28.03.23)

THEORETICAL ASPECTS OF THE USE OF THE FORMATION OF DIGITAL CULTURE OF FUTURE ENGLISH TEACHERS IN THE INFORMATION AND EDUCATIONAL ENVIRONMENT OF THE UNIVERSITY

Kismetova Galiya Nagibudaevna

Associate professor, Candidate of Pedagogical Sciences, West Kazakhstan University named after M.Utemisov, Uralsk, Kazakhstan

Shuinishkali Anargul

2nd year Master's degree student of West Kazakhstan University named after M.Utemisov, Uralsk, Kazakhstan

Abstract

The article deals with the requirements for a modern teacher of foreign languages in the context of digital education. The article presents the system of training students – future teachers of foreign languages – who have digital competencies, and describes the experience of developing digital competencies in lecturers at the Institute of Language and Literature.

Keywords: *a foreign language teacher, professional requirements, digital education, digital competencies, an educational program.*

Introduction

In this context, the urgency of developing new approaches to the formation of the digital culture of future English teachers is increasing. In the context of the introduction of computer technologies in the process of teaching professional disciplines, there is a change in the requirements for bachelor's degree training in educational institutions of higher education. Future English teachers should have a high level of knowledge of a foreign language, information technologies, possess linguistic and socio-cultural information, methods of teaching a foreign language at school using ICT.

Materials and types of research

The professional standard "Teacher" incorporated elements of the teacher's digital competencies. The teacher must possess information and communication competence, which compositionally consists of:

- general user – this is basic computer knowledge, knowledge of the Microsoft Office package (basics of working with text editors, spreadsheets, PowerPoint formats), the ability to use Internet services (e-mail, browsers), multimedia equipment, etc.;*
- general pedagogical ICT (Information and Communication Technologies) competence involves methodically competent use of web resources, training programs to achieve the objectives of the lesson, the ability to organize training in a computer classroom, the ability to maintain documentation in the electronic environment of an educational institution;*
- subject-pedagogical ICT competence includes the ability to optimize the learning process of your subject using information technology.*

Research questions

The formation of the information culture of future English teachers involves the phased implementation of the model:

- the motivational and value stage aimed at the formation of sustainable motivation of students to master ICT in the process of professional training;*
- communicative and productive, involving the purposeful formation of skills and abilities of future English teachers to master methods, techniques, methods and means of obtaining, processing and storing information, as well as computer skills as a means of information management;*
- a professional activity stage aimed at the formation of students' abilities to work with information resources, the practical application of acquired knowledge in the educational process;*
- the reflexive and creative stage is conditioned by the formation of the abilities of future English teachers to analyze, assess their own level of mastery of information culture, and a creative approach to the use of ICT in future professional activities.*

Research results

Having analyzed psychological and pedagogical research, it can be concluded that the preparation of a specialist for pedagogical activity is revealed through the concepts of "readiness for activity", "readiness for work", "readiness for pedagogical activity". The concept of "readiness for activity".

One of the key tasks of a teacher is to transfer knowledge and experience from the older generation to the younger. In professional activity, according to scientists, the teacher performs the following types of activities (functions): diagnostic, constructive and design, organizational, creative, predictive, informational, communicative, reflective. The functions of pedagogical activity proposed by N. V. Kuzmina, V. A. Slastenin, A. I. Shcherbakov are presented in Table 1.

Table 1

Functions of pedagogical activity (according to N. V. Kuzmina,
V. A. Slastenin, A. I. Shcherbakov)

Functions	Characteristic
Diagnostic function	It is based on the teacher's mastery of diagnostic forms, with the help of which he monitors the level of competence, development, and upbringing of students in the educational process
Predictive function	It is connected with the skills of a teacher to determine the directions of pedagogical activity, its goals and objectives, and predict its results
Design and engineering function	it consists in the selection and organization of the content of educational material; designing effective student activities, their own professional activities and behavior in the pedagogical process; designing strategies to achieve specific goals in the educational process
Organizational function	it requires the skills of a teacher to involve students in various types of activities and organize the activities of both a group, a team, and individual students
Information function	It is expressed in the teacher's ability to be a translator of scientific, ideological and moral-ethical information using the latest techniques and pedagogical technologies
The communicative function	It is expressed by the specifics of the teacher's communication with participants in the educational process - students, their parents, colleagues, administration
Creative function	It is represented by the development of new products of professional activity and the proposal of new ways of studying educational material
Reflexive function	it is based on self-assessment and self-correction by the teacher of activities and behavior in the educational process

The functions of a teacher's activity are realized and manifested in pedagogical abilities, which are understood as a set of individual psychological characteristics of a teacher that ensure the success of professional activity [95].

The following requirements are put forward for the theoretical training of future English teachers in the process of mastering the basic professional educational program: knowledge of the main stages of the development of foreign languages; understanding the basic theories of the formation of students' communicative competence; orientation in modern linguistic trends [100].

Thus, the content of professional training of future teachers of the English language is regulated by such documents as the federal state educational standard, the basic professional educational program, the curriculum; includes the formation of competencies necessary for pedagogical activity. The result of professional training is the readiness of future teachers for professional activity. The key components of the English teacher's professionogram are competencies, teacher personality qualities, abilities and psychophysiological capabilities, activity functions and determinants.

First, you need to pay attention and understand what competence is. Competence, translated from Latin, "competentia" means a range of issues where a person is knowledgeable, has knowledge and experience - compliance with the requirements for employment; - the ability to perform special work functions [13]; - generalized methods of action that ensure the productive performance of professional activities (A.G. Sergeeva) [14].

Due to the digitalization of the education system, the ability to use new, advanced educational programs and technologies in teaching is necessary. Today, along with the traditional learning system,

distance learning is also widely used, learning through educational platforms such as Google Classroom, Daryn.online, bilimland.kz, Bilimal.kz and ZOOM. Proper and competent use of these educational platforms helps to improve the quality of knowledge of both students and teachers. For example, online courses, ready-made video lectures, tasks for consolidating the studied educational material and monitoring academic performance can be uploaded to the Open Edx platforms.

Conclusion

We note that the challenges of modern society push teachers to constant development, to the formation of new competencies, in particular, digital competence, the content of which is adjusted depending on the development of Internet technologies. In order to form young people for the digital economy, teachers need to constantly improve their skills and master new technologies themselves.

References

1. Nauchnye shkoly i napravleniya UdGU. Available at: <http://school.udsu.ru/> (accessed: 20.06.2022).
2. Prikaz Ministerstva truda i sotsialnoy zashchity RF ot 18.10.2013 No. 544n "Ob utverzhdenii professionalnogo standarta "Pedagog (pedagogicheskaya deyatelnost v sfere doskolnogo, nachalnogo obshchego, osnovnogo obshchego, srednego obshchego obrazovaniya) (vospitatel, uchitel)" (s izm. i dop.). Available at: http://www.consultant.ru/document/cons_doc_LAW_155553/ (accessed: 20.03.2022).
3. Ukaz Prezidenta RF ot 09.05.2017 No. 203 "O Strategii razvitiya informatsionnogo obshchestva v Rossiyskoy Federatsii na 2017–2030 gody". Available at: <https://base.garant.ru/71670570/> (accessed: 20.03.2022).
4. Natsionalnyy proekt "Obrazovanie". Available at: <https://edu.gov.ru/national-project/> (accessed: 20.03.2022).
5. Vayndorf-Sysoeva M. E., Subocheva M. L. "Tsifrovoe obrazovanie" kak sistemoobrazuyushchaya kategoriya: podkhody k opredeleniyu. Vestn. Moskovskogo gos. obl. un-ta. Ser.: Pedagogika. 2018, No. 3, pp. 25–36.
6. The University's website. M.Utemisov West Kazakhstan University. [electronic resource]. — Access mode: <https://wksu.kz/ru/mstudy/33-catsisobu/365-poliyazychnoe-obrazovanie>.
7. The website of the Kazakh-American Free University [Electronic resource]. — Access mode: <http://www.kafu.kz/razvitie/akkreditatsiya/117-trekhyazychnoe-obrazovanie/1593-trekhyazychnoe-obrazovanie.htm>

THEORETICAL ASPECTS OF THE USE OF PROFESSIONAL SUBJECTIVITY OF FUTURE LINGUISTS BY THE TECHNOLOGY OF DEVELOPING CRITICAL THINKING

Kismetova Galiya Nagibudaevna

*Associate professor, Candidate of Pedagogical Sciences, West Kazakhstan University named
after M.Utemisov, Uralsk, Kazakhstan*

Shuinishkaliev Zamanbek

*2nd year Master's degree student of
West Kazakhstan University named after M.Utemisov, Uralsk, Kazakhstan*

Abstract

The article techniques of use of technology of critical thinking with a view of increase of the linguistic competence of pupils are analyzed.

Keywords: *The teacher, the development developing training, the person, critical thinking, the linguistic competence, training system for future linguists-teachers.*

Introduction

A theoretical analysis of the scientific literature on the problem of the formation of professional subjectivity allows us to state that this aspect has been studied in sufficient depth in psychological and pedagogical science. The formation of professional subjectivity is provided in various ways and means, and one of the most effective should be considered the development of critical thinking.

However, the process of professional subjectivity of future linguists through the technology of developing critical thinking in the process of studying at a university has not yet been the subject of a separate dissertation study in the field of pedagogical science. [2].

Materials and types of research

The theoretical significance of the study lies in the fact that:

The relevance and necessity of the professional subjectivity of a linguist student, understood as a complex of organizational, psychological, pedagogical, didactic actions aimed at strengthening this characteristic among future linguists during university studies, and considered in pedagogical science as a problem having a wide socio-economic context in the new conditions of development of modern society, when professionals are becoming in demand, capable of integration into a changing system of professional requirements for the competence of specialists and to modify the complex of knowledge acquired at the university;

Research question

What are the theoretical and methodological foundations, content and psychological and pedagogical conditions for the effectiveness of the process of professional subjectivity of future linguists through the technology of developing critical thinking during university education? The process of professional subjectivity of a linguist student will be effective if: on the basis of a theoretical and methodological justification of the problem, the definition of professional subjectivity of a linguist student is formulated, a model of professional subjectivity of future linguists is developed and practically implemented through the technology of developing critical thinking in the process of studying at a university, psychological and pedagogical conditions for the implementation of the process under study, The criteria for the formation of the professional subjectivity of a linguist student have been determined and a relevant diagnostic device has been developed to determine the effectiveness of this process.

Research results

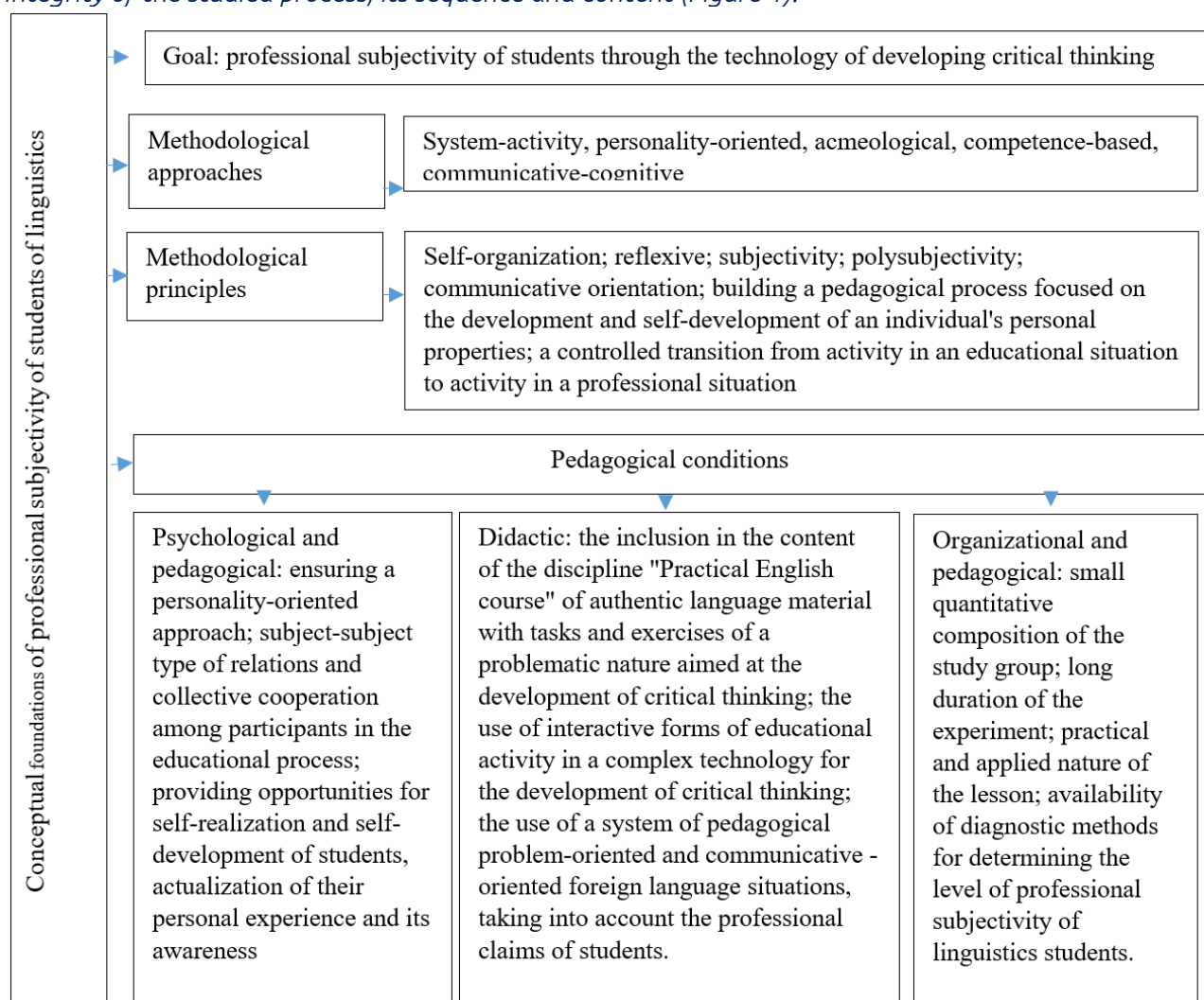
It has been established and proved in the conducted research that the professional subjectivity of future linguists can be ensured with the help of critical thinking development technology, which includes mandatory technological stages (challenge, comprehension, reflection) and methods corresponding to the tasks of the stages (mental map, associations, prediction, concept diagram, brainstorming, problem discussion, oral essay, a multi-level cascade knowledge map);

Pedagogical knowledge is complemented by ideas about the structure of the professional subjectivity of a linguist student, including a cognitive and operational component (theoretical and

practical knowledge that provides the possibility of effective professional interaction, readiness for an adequate assessment of ways to solve professional problems and achieve success based on constant critical analysis), a motivational and activity component (striving for high-quality mastering of the profession at the stage of study at a university, conscious attitude to educational activities and their effectiveness), the reflexive regulatory component (the desire and ability to analyze, generalize, and comprehend ways of business communication), the communicative component (the ability to build constructive business communication with partners, prevent and regulate conflicts, and find a "common language" during professional interaction) [1];

The set of approaches (system-based, personality-oriented, acmeological, competence-based and communicative-cognitive) contained in the study to ensure the process of professional subjectivity of future linguists through the use of technology for the development of critical thinking can be classified as a solution to the problem of identifying the specifics, main directions and technologies to ensure its effectiveness in the higher education system.

The proposed model of professional subjectivity of students of linguistics through the technology of developing critical thinking in the process of studying at a university includes conceptual-methodological, procedural-activity and criterion-effective blocks, which allows you to display the integrity of the studied process, its sequence and content (Figure 1).



The use of cluster analysis made it possible to determine three levels of formation of professional subjectivity: potential-situational, functional-constructive, creative-productive. [3]

The creative and productive level (high) of the professional subjectivity of a linguist student is characterized by the formation of all its structural components at an above-average level. The subjects demonstrating a creative and productive level of professional subjectivity have developed critical thinking, a high level of reflexivity, readiness to effectively solve occupational problems, the ability to take responsibility, and a desire for emotional and psychological self-control in communication and activity.

The functional and constructive level (average) of the formation of the professional subjectivity of a linguist student is manifested in a fairly strong motivation to acquire professional knowledge, the ability to identify cause-and-effect relationships between the productivity of their activities and the effectiveness of the educational process, in the ability to identify and correct mistakes made in their work.

The potentially situational level (low) of the formation of the professional subjectivity of a linguist student is expressed in the absence of persistent motivation to master the profession and subsequent realization of oneself as a professional, a weak level of proficiency in educational and cognitive strategies in the learning process, manifested in the inability to work productively with information, in the instability of professionally significant qualities of a linguist, in the inability to set goals and achieve them, in fear of taking responsibility. Students lack the desire to achieve their goals and predictive abilities. The volume of communication and mutual sympathy is narrowed due to insufficient communication skills, inability to choose an adequate form of interaction.

A creative and productive (high) level of professional subjectivity formation at the organizational and diagnostic stage of the study was recorded in the experimental group in 22.3% of linguistics students, and in the control group in 23.4% of the subjects. At the 23rd evaluation stage of the study, we recorded an increase in the number of students with a creative and productive level of professional subjectivity in the experimental group to 37.9%, and in the control group to 27.1% of respondents (Figure 2).

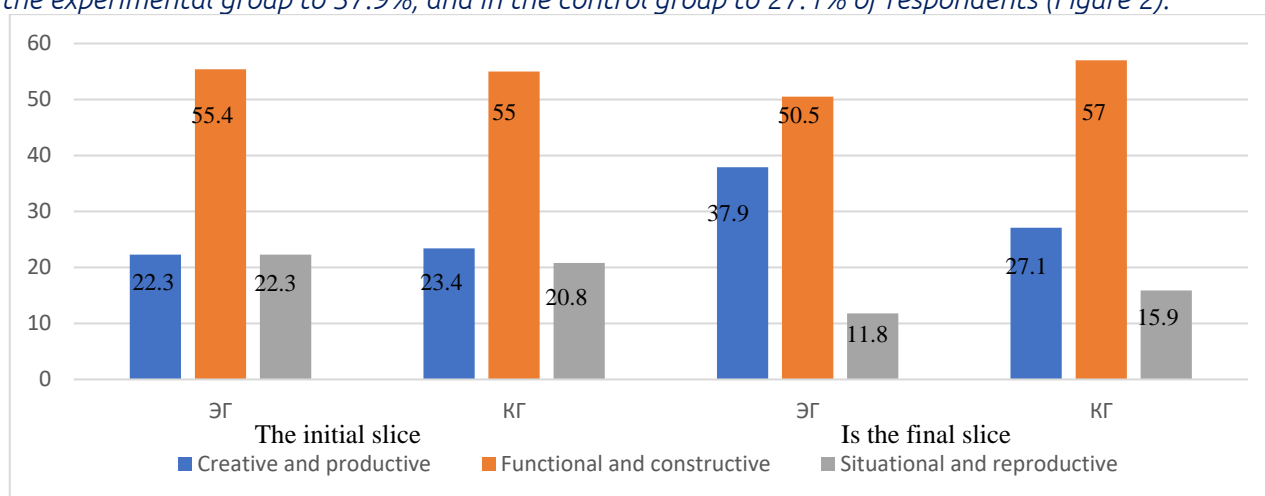


Figure 2 – Dynamics of the process of professional subjectivity among students of linguistics before and after the experiment

Consequently, the number of students with a creative and productive level of professional subjectivity in the experimental group increased by 15.6%, and in the control group of respondents this increase was 3.7%. The number of respondents with situational-reproductive level of professional subjectivity formation in the experimental group decreased by 10.7%, and in the control group – by 4.7%.

Critical thinking strives for convincing argumentation – a critically thinking person finds his own solution to a problem and supports this solution with reasoned and logical arguments; Critical thinking is social thinking – and this does not contradict the first definition, since a person with a similar mindset should use the fruits of his mental attainments for the benefit of society. [Every thought is tested and refined when it is shared with others-or, as the philosopher Hannah Arendt writes, "perfection can only be achieved in someone's presence." When we argue, read, discuss, object and exchange opinions with other people, we clarify and deepen our own position] [17, 36-40].

In recent years, the idea of building CT skills has spread not only in developed countries, but also in developing countries. This is in line with the following statement by the aforementioned author: "From Kansas to Kazakhstan, from Michigan to Macedonia, schoolteachers and university professors strive to instill in their students the ability to think critically. We know that critical thinking is something obviously good, a certain skill that will allow us to successfully cope with the demands of the XXI century, will help us to better understand what we study and do" [ibid.]. The concept of using KM in pedagogical practice was largely caused by the crisis of the education system in Kazakhstan. Over the years of independence, the Kazakh education system has gone through several stages of reform. The key moment in the formation of a new model of higher education can be called Kazakhstan's accession to the Bologna Convention in 2010. Cooperation and integration into the global educational space is one of the main directions in the policy of Kazakhstan, as well as in the development of the country's foreign policy.

Conclusion

Currently, measures are being taken in the country to change the statuses of teachers and students, as well as to change the processes of their interaction in learning. Head of State N.A. Nazarbayev, in his lecture "Kazakhstan in the post-crisis world: an intellectual breakthrough into the future", delivered at Al-Farabi Kazakh National University, noted that "the primary task of the modern education system is to train people with critical thinking and able to navigate information flows" [6].

References

1. Starostina, N.N. *Critical Thinking Development Model as a Tool to Teach Business English Effectively* / N.N. Starostina, E.P. Sosnina // *Business Intelligence and Modelling : Springer Proceedings in Business and Economics*, Springer International Publishing. - 2021. – vol. 1. – pp. 379-385. - ISBN 978-3-030-57065-1 (Print) (DOI: 10.1007/978-3-030-57065-1)
2. Starostina, N. N. *The Role of Critical Thinking in Professional Development of Linguists* / N. N. Starostina, E. P. Sosnina // *Integrating Engineering Education and Humanities for Global Intercultural Perspectives : Lecture Notes in Networks and Systems*, Springer, Cham. - 2020. – vol. 131. – pp. 770-777.
3. Starostina, N. N. *Professional subjectivity of linguistic students in the learning process* / N. N. Starostina, M. I. Lukyanova. – Text : electronic // *Modern problems of science and education*. – 2020. – No. 2. – URL: <https://www.science-education.ru/article/view?id=29695> (date of reference: 09/10/2020)
4. Starostina, N. N. *Longitudinal study of the dynamics of the development of critical thinking of linguistic students: assessment of the delayed experimental effect* / N. N. Starostina, E. P. Sosnina. – Text : direct // *Modern high-tech technologies*. - 2020. - No. 5. – pp. 226-231. - ISSN 1812-7320
5. Arynov, K.T., Zhadrina, M.J. *Materials for the development of the National standard of secondary general education of the Republic of Kazakhstan* / edited by K.T. Arynov, M.J. Zhadrina; P. 18.4, 2004 – 78 p.
6. Bekakhmetov, G., Korzhumbaeva, A. *Fundamentals of critical thinking* [Electronic resource]. URL : http://www.slideshare.net/slideshow/embed_code/38916700.
6. Nazarbayev, N.A. "Kazakhstan's way – 2050: Unity

Philological sciences

LINGUOCULTUROLOGICAL FEATURES OF THE ENGLISH-LANGUAGE ADVERTISING

Lyudmila Abramova

Student, University «Synergy», Moscow

ORCID 0000-0003-3418-2503

ЛИНГВОКУЛЬТУРОЛОГИЧЕСКИЕ ОСОБЕННОСТИ АНГЛОЯЗЫЧНОЙ РЕКЛАМЫ

Л.Ю. Абрамова

студентка, Университет «Синергия», Москва

ORCID 0000-0003-3418-2503

Abstract

The article discusses the linguoculturological features of the English-language advertising in the UK and the US. There are some examples of translation of the linguoculturological features of the English-language advertising.

Аннотация

В статье рассматриваются лингвокультурологические особенности англоязычной рекламы в Великобритании и Соединенных штатах Америки. Приведены примеры лингвокультурологических особенностей при переводе английской рекламы.

Keywords: linguoculturological features, advertising, English-language advertising.

Ключевые слова: лингвокультурологические особенности, реклама, англоязычная реклама.

Реклама в современном обществе является важным элементом общения и взаимодействия, а также вызывает спрос у потребителей. Воздействуя на человека, реклама формирует культурные ценности, привычки, влияет на повседневный выбор людей. Влияние рекламы на общество вызывает интерес и привлекает внимание как к рекламируемым товарам и услугам, так и к творческому и культурному аспекту самой рекламы или рекламной кампании.

При переводе рекламы с языка создателя рекламы на язык потребителя рекламы учитываются культурные ценности, обычаи, привычки людей, система восприятия информации целевой аудиторией.

Социально-культурные факторы играют важную роль при переводах и интерпретации речевых высказываний. Наибольший интерес для теории и практики перевода представляют обычаи представителей определенной культуры. Например, в английских домах спальни часто располагаются на втором этаже, и поэтому фраза «It is late I will go up» легко истолковывается как намерение говорящего отправиться спать.

Когда американец сообщает, что он хочет купить «a three bedroom apartment», его сообщение будет правильно понято лишь людьми, знающими что в США, кроме индивидуальных спален, принято иметь и одну общую комнату, и поэтому речь будет идти о четырехкомнатной квартире. В каждой культуре существуют свои способы предотвращения нежелательного развития событий: «This appointment will make or break me, so keep your fingers crossed, please.» — «Эта встреча решит мою судьбу, так что ругай меня, пожалуйста».

Переводы очень сильно могут влиять на культуру страны перевода. Зафиксировано довольно большое количество примеров, когда сами языки и культуры народов проходили свое становление и формирование под влиянием переводов. В основном имеются в виду древние античные переводы.

Например, переводы сильно повлияли на формирование и развитие культуры славянских народов. Переводы таких деятелей, как Кирилл и Мефодий, легли в основу становления культуры русского языка, письменности и литературы.

К переводчикам и переводческой деятельности на протяжении разных эпох предъявлялись разные требования. Требованиям должны были соответствовать тексты для перевода, методы и приемы, используемые переводчиками для переводов. Выбор приемов для выполнения

переводческой деятельности определялся в том числе теоретическими знаниями, навыками, практическими умениями и установками переводчиков. Переводчики в силу различных социальных, экономических, политических причин и этических и моральных соображений вынуждены были, и практика имеет место в настоящее время, сокращать или опускать часть переводимого текста. Различные нормы культурного обеспечения переводческой деятельности составляют своего рода конвенцию, или совокупность требований, для выполнения переводов.

Например, в Соединенных штатах Америки реклама учитывает требования бизнеса, средств массовой информации, появляющихся новейших технологий, культурных ценностей. Рекламные компании в Соединенных штатах Америки имеют древнюю и богатую историю. Реклама в Соединенных штатах Америки влияет на спрос потребителей, помогает обслуживать процессы производства и реализации товаров, информирует покупателя о всех тонкостях и нюансах производимых товаров, на всех стадиях от идеи создания до выпуска на рынок.

Мировая реклама, реклама отдельных стран оказывает свое влияние на общество в целом и на общество каждой конкретной страны в отдельности. В Соединенных штатах Америки люди очень давно привыкли к рекламе и рекламным компаниям. В рекламе США товар представляется потребителям активно, порой агрессивно, с использованием эмоционального и чувственного подходов. Соединенные штаты Америки производят прагматичную, прямолинейную рекламу в любых сферах и направлениях. Американцы приветствуют яркую рекламу, открытую, вызывающую, побуждающую к чувствам, эмоциям и действиям.

Даже если реклама, создаваемая в США, является навязчивой, то в Америке такая реклама никого не возмутит, так как навязчивость, порой задиристость, в том числе в рекламе, являются для жителей Америки привычным и обычным явлением.

В Соединенных штатах Америки с детства воспитывается культура продаж и само явление и действие продаж является нормальным и приемлемым в Америке. И в рекламе соответственно призыв к продажам воспринимается как должное явление. Очень часто в рекламе американских компаний встречаются прямые фразы, с призывами «мы продаем».

Реклама в Великобритании появилась примерно в 16 веке. Один из торговцев того времени, продавая свои товары, предлагал покупателям, кто приобретал у него товары на «золотую гинейю» бесплатный прейскурант с ценами. Таким поведением торговец изначально вызвал у жителей Лондона того времени насмешки и презрение. Но чуть позже, когда жители увидели эффект от такого поведения в увеличении продаж у торговца, они поменяли свое отношение и поведение с усмешек на благосклонность. С тех пор в Великобритании появилось большое количество различной рекламы.

Язык рекламы в Великобритании отличается своей недосказанностью и сдержанностью.

Англичане уделяют особое внимание традициям, этикету, довольно успешно на практике сочетают рекламу образную с рекламой вербального характера. В английской рекламе встречается очень много ярких и красивых слоганов.

Реклама в Великобритании и в Соединенных штатах Америки, созданная в 20 веке, отличается большим разнообразием, обилием цветов. Современная реклама 21 века более сдержана и лаконична в своих проявлениях. В рекламе 20 века изображены люди, много текста, современная реклама отличается краткостью и отсутствием изображений людей.

Знание и понимание обычаев и культуры стран и народов переводимого языка и языка, на который осуществляется перевод, помогают переводчикам адаптировать рекламные тексты и соответственно приносить успех рекламе и рекламным компаниям.

References

1. Abramova L. Structure of advertising text, Materials of IX International scientific conference Toronto. Canada, 02-03.07.2024, p. 67-68, <https://www.sconferences.com/canads> [Electronic resource], (date of access: 23.08.2024).
2. Garina I.O. Linguistic features of the translation of English-language advertising slogans. [Electronic resource]. – URL: https://dspace.susu.ru/xmlui/bitstream/handle/0001.74/16835/2017_431_garinaio.pdf?sequence=1&isAllowed=y (date of access: 23.08.2024).
3. Dyer G. Advertising as Communication. – London. 1995, 143 p.
4. Komisarov V.N. Modern translation studies. Training manual. – M.: ETS, 2002. – 420 p.

5. Medvedeva E.V. Advertising text as a translation problem/ E.V. Medvedeva Bulletin MGU, Linguistics and Intercultural Communication. — 2003. — № 4 p. 24

Список литературы

1. Абрамова Л.Ю. Структура рекламного текста, материалы 9-й Международной научной конференции, Торонто, Канада, 02-03.07.2024, стр. 67-68, [Электронный ресурс], -URL: <https://www.sconferences.com/canads> (дата обращения: 23.08.2024).
2. Гарина И.О. Лингвостилистические особенности перевода англоязычных рекламных слоганов. [Электронный ресурс]. – URL: https://dspace.susu.ru/xmlui/bitstream/handle/0001.74/16835/2017_431_garinaio.pdf?sequence=1&isAllowed=y (дата обращения: 28.06.2024).
3. Дайер Г. Реклама как коммуникация. – Лондон. 1995, 143 с.
4. Комисаров В. Н. Современное переводоведение. Учебное пособие. – М.: ЭТС, 2002. – 420 с.
5. Медведева Е.В. Рекламный текст как переводческая проблема / Е.В. Медведева Вестник МГУ, Лингвистика и межкультурная коммуникация. — 2003. — № 4 с. 24

**THE IMPORTANCE OF ABU AL-LAYS AS-SAMARKANDI IN SPREADING ISLAM AMONG THE
MAMLUKS AND THE SIGNIFICANCE OF HIS MANUSCRIPT "AL-MUQADDIM FI-S-SALAT"
("INTRODUCTION TO PRAYER")**

M.M. Issakhanova Kirca
Al-Farabi Kazakh National University, Almaty, Kazakhstan

**ВАЖНОСТЬ АБУ ЛАЙСА САМАРКАНДИ В РАСПРОСТРАНЕНИИ ИСЛАМА СРЕДИ МАМЛЮКОВ
И ЗНАЧЕНИЕ ЕГО РУКОПИСИ «АЛЬ-МУКАДДИМ ФИ-С-САЛАТ» («ВВЕДЕНИЕ В МОЛИТВУ»)**

М.М. Иссаханова Кырджа
Казахский национальный университет имени аль-Фараби, Алматы, Казахстан

В период правления мамлюков (1250–1517 гг.) тюркский язык приобрел важное значение в Египте и Сирии. Для обучения тюркскому языку местного населения были написаны словари и грамматические книги на тюркском языке, поскольку правителями были турки. Кроме того, на тюркский язык переведены произведения религиозной, литературной и других тематик [1, 10]

Абу Лайс Самарканди, выдающийся энциклопедист, чья работа и деятельность были связаны с землей Мовароуннахра. Его научное наследие охватывает почти все области исламских религиозных наук. В этой статье рассматривается переведенный трактат «Аль-Мукаддима фи-с-салам».

Одним из произведений, созданных на мамлюкско-кыпчакском языке, является перевод «Китаб-и Мукаддима-и Абу Лайс Самарканди». Работа представляет собой подстрочный перевод арабской книги фикха «Мукаддима фис-Салат» (Мукаддимету'с-Салат) Абу Лайс Самарканди на тюркский язык. В различных библиотеках имеется множество рукописей перевода. В нашем исследовании были использованы два экземпляра, несущие особенности мамлюкско-кыпчакского языка. Один из этих экземпляров находится в отделении собора Святой Софии Стамбульской библиотеки Сулеймание (экземпляр зарегистрирован под номером 1451), а другой — в библиотеке Регионального управления рукописей Коньи. Второй экземпляр в публичной библиотеке города Конья, в отделе имени Проф.Др. Феридуна Нафиза Узлука зарегистрированного под номером 6993, он был передан Библиотеке Регионального управления рукописей Коньи.

Это книга фикха, написанна по правилам ханафитского мазхаба. Произведение начинается с восхваления Аллаха после Бисмиллях и приветствий пророку и его родственникам, затем включает в себя следующие темы (согласно варинату собора Святой Софии 1451 года): условия ислама и молитвы, виды фарда, важность молитвы, виды омовения, чистота, виды воды, фарды намаза, необходимость намаза, сунны намаза, фарды омовения, сунны омовения, истинджа, совершение омовения и молитвы для омовения, виды очищения, виды омовения, объяснение некоторых религиозных терминов. Некоторые религиозные термины были раскрыты методом вопросов и ответов. Темы обсуждаются с включением аятов, хадисов и мнений ученых фикха [2, 181].

«Мукаддима» много раз переводилась на тюркские языки. Возможно, произведение было впервые переведено на мамлюкский-кыпчакский язык во время правления мамлюкского правителя Кайтбая (1468-1495), и самые старые экземпляры с известными датами относятся к периоду правления султана Кайитбая. Переводчик произведения неизвестен. Копии произведения, множество рукописей которого имеется в различных библиотеках, созданных в районе Мамлюка, должно быть, были привезены в Стамбул после завоевания Египта Явужом Султаном Селимом.

Копии Святой Софии (1451 г.) и Узлука по звуковым и формальным характеристикам относятся к огузско-кыпчакской группе. Произведение сочетает в себе черты мамлюкско-кыпчакского и анатолийского языков. Дж. Экман в своих трудах указывает, что язык произведения (копия из собора Святой Софии 1451 г.) является османским и включает произведение в группу, где сконцентрирован османский язык и смешанный диалект огузско-кыпчакского. Такого же мнения придерживается и А. Заджаковский.

Из языка произведения следует, что переводчик свободно владеет арабским и тюркским языками. Понять произведение, написанное простым языком, можно без словаря, за исключением

нескольких слов. Даже многие слова и молитвы религиозного характера даются с турецкими эквивалентами [2, 185]. Также используются турецкие эквиваленты некоторых часто используемых арабских и персидских слов. В тексте также обнаружены слова «авдаз, ебчи, секет-», встречающиеся в мамлюкско-кыпчакских произведениях. Авдаз — новое слово, введенное в тюркский язык путем искажения персидского слова «омовение» [2, 185].

Изучение различных работ автора показывает, что они содержат много новинок исламской научной традиции. Мукаддимету'с-салат, написанный Абу Лайс Самарканди, который мы исследовали, представляет собой книгу типа катехизиса. В работе основное внимание уделяется темам молитвы, а также очищения и омовения, которые составляют ее предварительную подготовку. Однако упомянутые темы рассматриваются в этой работе в манере, отличной от стиля и содержания классических произведений по фикху, и видно, что некоторым темам уделяется особое внимание. Одним из важнейших аспектов работы, который обращает на себя внимание, является то, что пункты, касающиеся условий и столпов молитвы, которые сегодня перечислены во всех катехизисных трудах и многих книгах по фикху, перечислены именно в намазе Мукаддимету. По нашему мнению, намаз Мукаддимету является первым произведением или одним из первых произведений, в котором была сделана такая транскрипция [3, 66].

Взгляды Абу'л-Лейса, сыгравшего важную роль в распространении богословских текстов, написанных Абу Ханифой и его учениками, и их принятии в регионах с преобладанием ханафитской школы, в значительной степени соответствуют линии Матуриди. Абу Убейде Ма'мер б. Абул-Лейс, который активно использовал Мусанна и уделял большое внимание Ибрахиму в своих комментариях, подчеркивая важность причин откровения, различий в чтении и отмене, считается одним из первых представителей суфийского (ишари) тафсира. Многие авторы называют Абу'л-Лейса, "муджтахидом по этому вопросу" в иерархии ханафитских юристов, подчеркивая его значительный вклад в развитие ханафитской школы. Он сыграл ключевую роль в систематизации ханафитского фикха, создав один из первых сборников, и заложил основу литературы хилафа в ханафитской традиции. Можно сказать, что Абу'л-Лейс, сыгравший важную роль в передаче взглядов Абу Ханифы и его учеников, также был автором, который провел важную работу по кодификации этих повествований. Первый образец литературы навазилов в ханафитской школе, целью которой было объединение взглядов и вкладов юристов, живших после имамов школы, принадлежит именно Абу'л-Лейсу. Благодаря этой работе взгляды многих выдающихся ханафитских юристов, живших в III (IX) и IV (X) веках, были переданы последующим поколениям [4]. Подробное изложение таких тем, как условия ислама, виды обязательных намазов, правила молитвы, омовение, чистота и обрезание. Оригинальное произведение было написано Абу'л-Лейсом Имамуд-Худа Насром б. Мухаммадом б. Ахмедом б. Ибрагимом эс-Самарканди (умер в 983 году нашей эры). Оно известно под названиями «Эль-Мукаддима», «Мукаддимету'с-Салат» или «Мукаддима фи'с-Салат». Эта книга по фикху была написана в рамках ханафитской школы и охватывает такие темы, как условия ислама и намаза, виды обязательных молитв, важность намаза, виды омовения, чистоты и воды, а также обязательные элементы (фарды), ваджибы и сунны как намаза, так и омовения. В книге также обсуждаются религиозные термины и доктринальные вопросы, причем некоторые из них рассматриваются в формате вопросов и ответов. Обсуждение тем подкрепляется цитатами из аятов и хадисов, а также мнениями ученых по фикху. Произведение было впервые переведено на турецкий язык в мамлюкско-кыпчакском диалекте во времена правления султана Кайитбая (1468–1496). Особенно важны два рукописных экземпляра, отражающие особенности мамлюкско-кыпчакского тюркского языка. Первый хранится в Стамбульской библиотеке Сулеймание в секции собора Святой Софии под номером 1451; второй находится в библиотеке Регионального управления рукописей в Конье (так называемый «Узлукский экземпляр»). Копия в Конье была создана как минимум за 50 лет до копии собора Святой Софии (1451; 1501–1516). Копия из собора Святой Софии содержит 47 листов, а другая копия — 53 листа. Помимо этих двух экземпляров, в библиотеках сохранилось множество переводов произведения, сделанных в Анатолии. Заячковский (1959; 1962), Топарлы (1987) и Озкан (1994; 2018) проводили исследования по этим копиям, относящимся к мамлюкскому периоду [5].

Если мы обратим внимание на распространение письменных копий, то увидим, что произведения Абу Лайса Самарканди находили в различных регионах, населенных тюрками на протяжении всей истории. Эти труды изучались и читались не только в мечетях, представляющих общественный интерес, но и в учебных заведениях, таких как медресе, и

хранились в библиотеках, к которым обращались шейхулисламы и государственные деятели. Нет сомнений в том, что в настоящее время среди турков ханафитская школа более распространена, и влияние Абу Лайса и его произведения «Мукаддима фи-с-салам» («Введение в молитву») на этот процесс нельзя игнорировать. Благодаря этим особенностям изучение его трактата о намазе является важным вкладом в научный мир.

References

1. Özkan Abdurrahman (2018). *Kitâb-ı Mukaddime-i Ebu'l-Leysi's-Semerkindî, Introduction-Analysis-Text-Indexes-Fabrication*, Palet Publications, Konya, 275 p. [Özkan Abdurrahman (2018). *Kitâb-ı Mukaddime-i Ebu'l-Leysi's-Semerkindî, Giriş-Inceleme-Metin-Dizinler-Tıpkıbasım*, Palet Yayınları, Konya, 275 s.]
2. Özkan, A. (2000). *Linguistic Features of the Introduction to the Book of Abu'l-Leysi's-Semerkindî*. *SDÜ Faculty of Arts and Sciences, Journal of Social Sciences* (5), 177-200 [Özkan, A. (2000) *Kitâb-ı Mukaddime-i Ebu'l-Leysi's-Semerkindî'nin Dil Özellikleri*. *SDÜ Fen-edebiyat Fakültesi, Sosyal Bilimler Dergisi* (5), 177-200]
3. Dinler, Ferit (2006). *Critique of the Work of Abu'l-Leys Es-Semerkindi and Mukaddimetü's-Salat*, Master's Thesis, Sakarya University, Institute of Social Sciences, 86 p. [Dinler, Ferit (2006). *Ebu'l-Leys Es-Semerkindi Ve Mukaddimetü's-Salat İsimli Eserinin Tahkiki*, Yüksek Lisans Tezi, T.C. Sakarya Üniversitesi Sosyal Bilimler Enstitüsü, 86 s.]
4. <https://islamansiklopedisi.org.tr/semerkandi-ebul-leys> [access date: 27.08.2024] [erişim tarihi:27.08.2024]
5. <https://tees.yesevi.edu.tr/madde-detay/kitab-i-mukaddime-i-ebul-leysis-semerkandi> [access date: 27.08.2024] [erişim tarihi:27.08.2024]

Technical sciences

RANGE OF INDUSTRIAL APPLICATIONS OF THERMOCHEMICAL METHODS FOR PROCESSING SYNTHETIC AND NATURAL DIAMONDS

**Aliaksand Kupo
Yauheni Sharshnev**

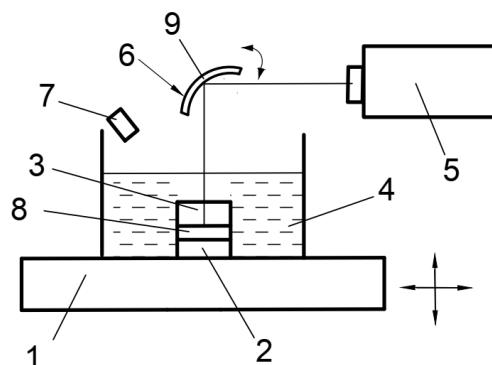
Francisk Skorina Gomel State University, Gomel, Belarus

The thermochemical method of diamond processing is based on the process of catalytic interaction of carbon that is part of diamond with hydrogen or mixtures of hydrogen with water vapor and carbon dioxide [1-4].

When a diamond dissolves in a metal, there is a break in the strong covalent bonds with which the carbon atoms are bound together in the crystal lattice of the diamond. In a solid solution of embedding, carbon is practically in an atomic state, experiencing only a weak chemical reaction with the solvent metal. Therefore, carbon dissolved in metal is much more reactive than diamond or coal. At high temperatures, diamond practically does not interact with hydrogen or mixtures of hydrogen with water vapor and carbon dioxide. At the same time, these gaseous media react well with carbon dissolved in the metal to form gaseous products, which ensures the decarburization of the metal or the continuity of diamond processing. At present, this method is successfully used in the following three areas:

- thermochemical engraving,*
- thermochemical grinding and polishing,*
- thermochemical sawing.*

To ensure the localization of the thermochemical treatment process, laser radiation is used as a surface heat source, which is absorbed by the metal. A general view of the installation and a schematic diagram of the process of thermochemical treatment of diamond is shown in Fig. 1.



1 – technological table; 2 – holder; 3 – diamond to be processed; 4 – process gas medium; 5 – radiation source; 6 – focusing agent; 7 – thermal imager; 8 – metal coating; 9 – rotating spherical or parabolic mirror.

Fig. 1 – Installation and scheme of thermochemical treatment of diamond using laser radiation

Thermochemical engraving or the application of indelible lines on the surface of a diamond is carried out as follows. First, a pattern made of a layer of metal with a thickness of hundredths of a micron is applied to the surface of the diamond, for which stencil spraying of metal in a vacuum or the method of photolithography is used. Then the diamond is heated in a hydrogen atmosphere at 1000 °C. Half an hour of heating is enough for the metal lines to etch the thinnest matte image on the diamond. This technology can be used both for applying artistic images to the surface of a diamond and for technical purposes: for applying indelible marking lines and marking rough diamonds. Thermochemical engraving or the application of indelible lines on the surface of a diamond is carried out as follows. First, a pattern made of a layer of metal with a thickness of hundredths of a micron is applied to the surface of the diamond, for which stencil spraying of metal in a vacuum or the method of photolithography is used. Then the diamond is heated in a hydrogen atmosphere at 1000 °C. Half an hour of heating is enough for the metal lines to etch the thinnest matte image on the diamond. This technology can be used both for

applying artistic images to the surface of a diamond and for technical purposes: for applying indelible marking lines and marking rough diamonds.

Thermochemical polishing consists of chemical polishing of the surface of a diamond crystal oscillating on a rotating metal disk heated to a temperature of 600–800 °C. By adjusting the conditions of the process, it is possible to move from coarser grinding to the finest polishing of the diamond, which made it possible to sharpen the diamond blade tool. The very high quality requirements for the cutting edge of such tools explain the difficulty of sharpening them using conventional mechanical methods, especially when it comes to microsurgical knives and microtomes. When sharpened on a grinding wheel, the thin cutting edge of the knife chips off and becomes sawtooth. There are only a few companies in the world that sharpen diamond knives. The details of the sharpening technology are unknown and diamond knives are expensive. In thermochemical treatment, the mechanism of diamond removal is completely different from that in mechanical abrasion. As a result, blade sharpening has been simplified and the quality of the cutting edge has been improved. Currently, in the field of sharpening diamond blade tools, the thermochemical method is out of competition.

Thermochemical sawing consists in contact dissolution of diamond with a moving two-layer metal wire consisting of a refractory base, on the surface of which a layer of iron is electroplated. Sawing is carried out at temperatures of 1160-1250°C. It is possible in any crystallographic direction. In addition, the speed of thermochemical sawing in the hard direction is about five times higher than the speed of mechanical sawing of diamond in the softest direction.

In thermochemical sawing, the wire cuts the diamond. This method makes it easy to replace some processing operations with sawing, for example, splitting a diamond or peeling. The thermochemical method is very promising for sawing large diamonds and crystals with defects. For the manufacture of small products, such as diamond knives, multi-seam sawing with several wires at once is promising. This dramatically increases labor productivity and reduces the consumption of rough diamonds to a minimum.

At present, the results have been achieved and research on laser microprocessing of diamond is ongoing [5]. In particular, the effect of reducing the surface roughness of a gas-phase diamond during laser etching is studied, and it has been revealed that mechanical polishing of diamond plates of large sizes and hundreds of micrometers thick causes the greatest problems that can be solved by laser treatment of diamonds.

References

1. Matsumoto, T. et al. Inversion channel diamond metal-oxide-semiconductor π eld-e π ect transistor with normally o π characteristics. *Sci. Rep.* 6, 31585 (2016).
2. Inaba, M. et al. Hydrogen-terminated diamond vertical-type metal oxide semiconductor π eld-e π ect transistors with a trench gate. *Appl. Phys. Lett.* 109, 033503 (2016)
3. Micropatterning of diamond crystallites via cobalt-catalyzed thermochemical etching. / Wang, Junsha; Wan, Long; Chen, Jing et al. In: *Journal of Materials Science*, Vol. 52, No. 2, 01.01.2017, p. 709-720.
4. Ohmagari S et al. Characterization of free-standing single-crystal diamond prepared by hot-filament chemical vapor deposition. *Diamond and Related Materials*. 2014;48:19-23.
5. On femtosecond micromachining of HPHT single-crystal diamond with direct laser writing using tight focusing / H. Y. Zalloum [et al.] // *Opt. Express*. – 2010. № 18(12). – P. 13122–13135.

NEWTON'S THIRD LAW AND PREREQUISITES FOR THE FORMATION OF A MOTIVE FORCE WITHOUT MASS TRANSFER WITH THE ENVIRONMENT

Vasily I. Bogdanov

Doctor of Technical Sciences, Expert
Russia, UEC-Saturn
Ph 8-910-974-47-63

Kononova Victoria Vadimovna

Ph.D., design engineer
Russia, UEC-Saturn
Ph 8-902-224-93-92

ТРЕТИЙ ЗАКОН НЬЮТОНА И ПРЕДПОСЫЛКИ ОБРАЗОВАНИЯ ДВИЖУЩЕЙ СИЛЫ БЕЗ МАССООБМЕНА С ОКРУЖАЮЩЕЙ СРЕДОЙ

Богданов Василий Иванович

д.т.н., эксперт,
Россия, ПАО «ОДК-Сатурн»
м.т.8-910-974-47-63

Кононова Виктория Вадимовна

к.т.н., инженер-конструктор
Россия, ПАО «ОДК-Сатурн»
м.т. 8-902-224-93-92

Abstract

It is noted that Newton's third law of equality of action and reaction is valid only for absolutely rigid bodies. Theoretically, taking into account the results of recent studies on the qualitative increase in momentum due to the effects of mass addition in the pulsating working process of jet engines and a shaped charge jet, the possibility of forming a motive force without ejecting a reactive mass during counter dissipative extinguishing of the jet has been shown.

Аннотация

Отмечено, что третий закон Ньютона о равенстве действия и противодействия справедлив только для абсолютно твёрдых тел. Согласно высказыванию Ньютона при ударе неупругих тел имеет место уничтожение движения. Теоретически с учётом результатов последних исследований по качественному увеличению импульса за счёт эффектов присоединения масс в пульсирующем рабочем процессе реактивных двигателей и кумулятивной струи показана возможность образования движущей силы без выброса реактивной массы при встречном диссипативном гашении струи.

Keywords: *Newton's third law, Meshchersky's equation, law of conservation of momentum, law of conservation of energy, attached mass, shaped charge jet, motive force.*

Ключевые слова: *Третий закон Ньютона, уравнение Мещерского, закон сохранения количества движения, закон сохранения энергии, присоединённая масса, кумулятивная струя, движущая сила.*

Основная часть

Третий закон Ньютона, определяющий равенство действия и противодействия двух материальных точек справедлив для абсолютно твёрдых тел [1]. Он определялся следующим образом. Исследовалось взаимодействие шаров разной твёрдости (в виде маятников), но каждая взаимодействующая пара имела одинаковую твёрдость. При этом измерялась встречная скорость перед ударом и обратная скорость после удара. Максимальное соотношение обратной скорости к встречной составило 15/16 для стеклянных шаров, обладающих максимальной твёрдостью [1]. Теоретически это близко к взаимодействию абсолютно твёрдых тел, которых, однако, в природе нет. Таким образом, Ньютону была чужда идея сохранения движения; в подтверждение своего взгляда великий учёный приводил удар неупругих тел, полагая, что в этом случае имеет место уничтожение движения.

Учитывая изложенное выше, представляет научный интерес изучение комбинаций взаимодействия тел с разной твёрдостью (жесткостная асимметричность) с целью возможного образования движущей силы без выброса реактивной массы.

Для частного решения уравнения Мещерского при неизменной массе тела и отсутствии внешней силы:

$$m \frac{d\bar{v}}{dt} = \bar{F} + \bar{u}_1 \frac{dm_1}{dt} + \bar{u}_2 \frac{dm_2}{dt},$$

где m – переменная масса тела; \bar{u} – скорость движения тела переменной массы; u_1 – относительная скорость отделяющихся частиц; u_2 – относительная скорость присоединяющихся частиц;

$\frac{dm_1}{dt}$ – секундный расход (отбрасывание) массы;

$\frac{dm_2}{dt}$ – секундный приход (присоединение) массы; F – внешняя сила,

принято: $F = 0$, постоянство массы тела обеспечивается равенством расходов отделяющейся и присоединяющейся массы. При этом движущая сила может создаваться в реальном процессе за счёт разности потерь при отделении и присоединении одной и той же массы (при взаимодействии с телами разной твёрдости).

В настоящее время существуют два подхода к определению уравнений импульсов для газа и твердых тел.

Так для эжекторного усилителя тяги [2], в котором взаимодействуют активная (эжектирующая) и эжектируемая струи, в соотношении, определяющим коэффициент увеличения тяги введено КПД, учитывающий потери на удар взаимодействующих масс.

$$\frac{P}{P_0} = \sqrt{(n+1)\eta}, \quad (2)$$

где: P/P_0 – отношение тяг с эжекторным усилителем тяги и без него (коэффициент увеличения тяги);

$n = G_2/G_1$ – отношение расходов эжектируемого воздуха и эжектирующего газа (коэффициент эжекции), определяет присоединение массы газа, повышающее тягу;

η – КПД эжекторного усилителя тяги.

Отношение тяг P/P_0 , в зависимости от значений n и η может быть меньше или больше 1, а также как частный случай равно 1 [2].

Соотношение (2) получено из уравнения энергии путём несложных математических преобразований:

$$(G_1 + G_2)w_3^2 / G_1w_1^2 = \eta,$$

где: w_1 – скорость истечения газа из сопла;

w_3 – скорость истечения смеси из эжектора.

При этом воздух эжектируется из атмосферы, $w_2 = 0$.

Таким образом, у автора [2] академика Абрамовича Г.Н. между уравнениями импульсов и энергии существует связь.

Научное Открытие №314 и последующие исследования [3] показали качественное повышение КПД эжекторного усилителя тяги (ЭУТ) при пульсирующем течении.

Закон же сохранения количества движения для двух взаимодействующих твёрдых тел (примем, что тело m_2 до удара покоится, а после удара тела движутся вместе, а тело m_2 становится присоединённой массой) при абсолютно неупругом ударе выглядит следующим образом [4]:

$$w_1 m_1 = w_2 (m_1 + m_2) \text{ или } w_2 (m_1 + m_2) / w_1 m_1 = 1 \quad (1)$$

При неупругом ударе часть кинетической энергии переходит в тепло, т.е. кинетическая энергия уменьшается. Таким образом, здесь, как и в эжекторном усилителе тяги [4] это отношение кинетических энергий можно принять за КПД неупругого удара, однако этот КПД не входит в уравнение количества движения (1). Т.е. уравнения энергии и импульсов не связаны.

$$w_2^2 (m_1 + m_2) / w_1^2 m_1 = \eta \quad (2)$$

Преобразуем это соотношение для энергий в соотношение для количеств движений (как в теории ЭУТ). Извлечём квадратный корень из левой и правой частей уравнения:

$$\frac{w_2 \sqrt{m_1 + m_2}}{w_1 \cdot \sqrt{m_1}} = \sqrt{\eta}$$

и умножим на $\sqrt{\frac{m_1 + m_2}{m_1}}$

Получим отношение количества движений, которое в общем случае

$$\frac{w_2(m_1 + m_2)}{w_1 \cdot m_1} = \sqrt{\frac{(m_1 + m_2)\eta}{m_1}} \quad (3)$$

неравно 1, что противоречит уравнению (1). Данное отношение определяется соотношением масс и КПД, соответствует уравнению для ЭУТ:

$$\frac{P}{P_0} = \sqrt{(n+1)\eta}$$

которое получено таким же образом. Оно может быть равно 1, но как частный случай (тождество), при определённых значениях m_1 , m_2 и η

Сторонники достоверности уравнения (1) доказывают это следующим образом, из него же определяют:

$$w_2^2 = m_1^2 w_1^2 / (m_1 + m_2)^2 \text{ и затем}$$

получают уравнение энергии в виде

$$w_2^2(m_1 + m_2)/2 = ((m_1^2 w_1^2 / (m_1 + m_2)^2)(m_1 + m_2)/2 = (m_1 / (m_1 + m_2)) m_1 w_1^2 / 2, \text{ где}$$

$$m_1 / (m_1 + m_2) = \eta$$

При подстановке данного выражения в уравнение (3) оно конечно становится равным 1, но это, как отмечено выше, является частным случаем его решения (тождеством).

В работе [4] в подтверждение уравнения (1) приведен эксперимент с попаданием пули в ящик с песком, подвешенным как маятник, масса которого в 1000 раз больше массы пули. При этом установлено, что КПД процесса равен 0,001. Измерялось отклонение ящика; усилие, создаваемое ящиком, не измерялось. Возникает вопрос насколько всё это корректно: эксперимент – единственный, а полученный КПД составляет всего тысячную долю от максимального значения и что было бы с результатами, если ящик заполнить материалом с другим сопротивлением проникновению пули или увеличить её массу. Можно предположить, что эксперименты были, но их результаты были не стабильны и не подчинялись каким либо закономерностям не только по причине отсутствия в реальности жесткой связи между m_1 , m_2 и η , но и эффекту присоединения массы на атомарном уровне. Известно, что все атомы твёрдого тела совершают тепловые колебания. Между атомами твёрдого тела имеются сильные взаимодействия. Ядро, в котором сконцентрирована масса атома, колеблется в системе: «ядро - электронная оболочка». Жёсткостная асимметричность этой системы для образования движущей силы (за счёт разных потерь на отбрасывание и присоединение массы) может быть создана за счёт деформации электронной оболочки смещением ядра под действием ускорения. Это подтверждается экспериментами с гироскопическими устройствами [5]. Таким образом при экспериментах следует учитывать возможность влияния эффекта на атомарном уровне на результаты всего эксперимента.

Следует также дополнительно привести дословные высказывания по взаимосвязи уравнений импульсов и энергии других известных учёных [6]:

- Лейбниц – «считал, что истинной мерой движения является произведение массы на квадрат скорости движения тела, а при столкновении неупругих тел количество движения всегда уменьшается»;

- Паули - в первой половине двадцатого века утверждал, что «следует также ожидать определённой связи между законами сохранения энергии и количества движения и свойствами пространства и времени...».

Исследованиями установлено [7], что в пульсирующих ВРД реализуется эффект присоединения массы для улучшения тяговых характеристик. При этом, чем больше длина тем выше эффект. На рис. 3 приведена зависимость удельного расхода топлива от отношения длины двигателя к его диаметру.

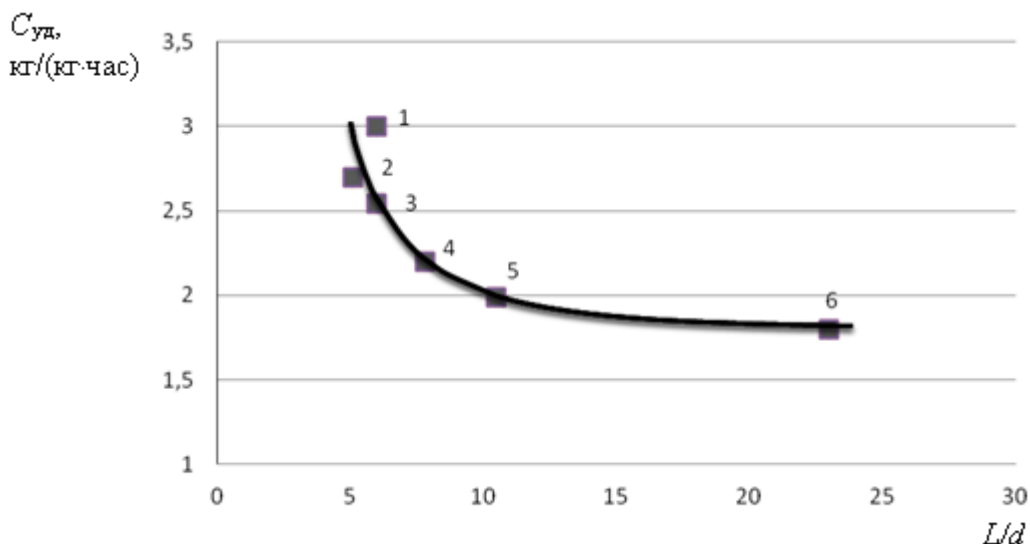


Рис. 3. Зависимость удельного расхода топлива от отношения длины двигателя к его диаметру (1 – AS014, 2 – AU-8-75C (США), 3 – SNCAN (Франция), 4 – Саундерс-РО (Англия), 5 – AS.1 (Германия), 6 – Escopette (Франция))

На рис. 4 изображён экспериментальный пульсирующий ВРД SNECMA 3340 «Escopette», имеющий высокий удельный импульс, благодаря многократному присоединению массы газа на большой длине. Анализ рабочего процесса показал схожесть его с физикой кумулятивной струи, а также их конфигураций (рис.5). Здесь примечателен опыт академика Лаврентьева М.А. по созданию эмпирического метода по оценке импульса, учитывающего явления на молекулярном уровне [8]. Необходимость этого метода обусловлена эффектами взаимодействия масс на атомарном уровне, которые оказывают влияние на эффекты присоединения масс в пульсирующей струе. Согласно формуле Лаврентьева – Тейлора:

$$L = l_{\text{КС}} \sqrt{\frac{\rho_{\text{КС}}}{\rho_{\text{П}}}}$$

глубина проникновения кумулятивной струи L (характеризует импульс) зависит в первую очередь от её длины $l_{\text{КС}}$ (прямая зависимость). Здесь $\rho_{\text{КС}}$, $\rho_{\text{П}}$ – плотность соответственно струи и преграды. При этом по длине кумулятивной струи имеет место периодическое изменение скорости, плотности как у ПуВРД, что предполагает общий принцип многократного присоединения массы.

Импульс струи за соплом может быть погашен за счёт диссипации энергии в специальных устройствах с большим гидравлическим сопротивлением. Можно предположить, что при наличии специально сконструированного отражателя (например, комбинации сеток) закреплённого на сопле будет разрушен ответный процесс присоединения масс (на отражателе) с высоким уровнем гидравлических потерь и погашена скорость газа (как приемлемый ущерб). При этом возможно сохранение части тяги и возврат на вход в двигатель рабочего тела, например, в пульсирующих (импульсных) электроракетных двигателях, что имеет огромное значение для полётов в космосе.

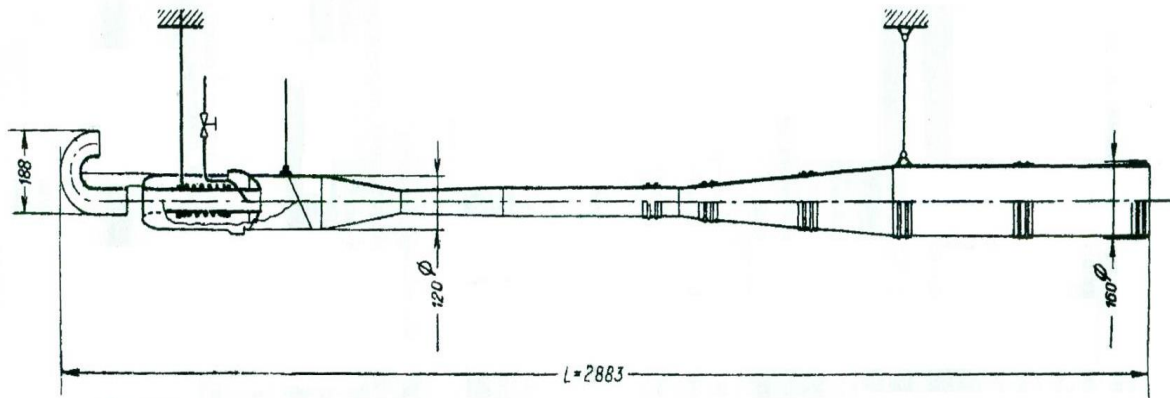


Рис.4. ПуВРД SNECMA 3340 «Escopette» с многократным присоединением массы газа

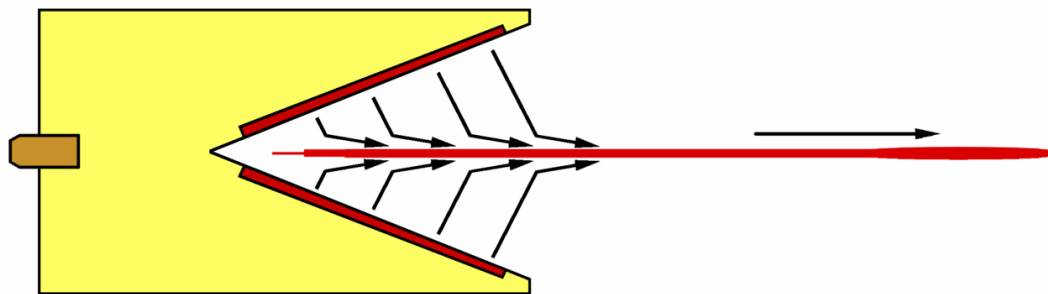


Рис.5. Схема образования кумулятивной струи

В работе [9] обоснована возможность создания космического ракетного двигателя замкнутого цикла с реализацией рассмотренных эффектов присоединения масс.

References

1. Newton I. *Mathematical Beginnings of Natural Philosophy*. Moscow, Nauka Publ., 1989. ISBN 5-02-000747-1.
2. Abramovich G.N. *Applied Gas Dynamics*. Nauka Publ., 1969. - 824 p.
3. Bogdanov V.I. Research on the implementation of pulsating working processes in jet engines. 2017. T.24. №4. Pp. 100-109.
4. Kitaygorodsky A.I. *Introduction to Physics*. Nauka Publ., 1973. - 688 p.
5. Bogdanov V.I. Effect of creating a driving force without the release of reactive mass in agreement with Newton's mechanics and its implementation in technology. Praha, Czech Republic. VOL 1, No. 48, 2020, pp. 10-15.
6. Gelfer Y. M. . *Laws of conservation*. Moscow, Nauka. 1967. 264 p. (In Russian)
7. Bogdanov V.I., Burakova L.I. Evaluation of the effects of mass interaction in pulsating jet engines based on the results of experimental research. *Bulletin of the Russian State Aviation Academy named after P. A. Solovyov*. Rybinsk. 2010. №3. Pp. 89-94.
8. Selivanov V.V. (ed.). *Ammunition*. In 2 vols. Vol. 1. Moscow, BMSTU Publ., 2016, 506
9. Apollonov V.V., Bogdanov V.I. Kontseptsiya kosmicheskogo raketnogo dvigatel' zakrytnogo tsiklika s realizatsiiy efekt adjoining masses [The concept of a space rocket engine of a closed cycle with the implementation of the effects of joining masses]. (September 27, 2023, Ufa). -Ufa: Izd. Research Center Bulletin of Science. Part I. P.5-14.

ANALYSIS OF INTERNATIONAL EXPERIENCE ON ENSURING CYBER RESILIENCE IN SOFTWARE SYSTEMS

Shafagat Mahmudova

Cyber resilience in software systems is the ability to prevent, resist, and recover from various malicious events that occur when using information technology (IT) resources. Computing capabilities, artificial intelligence, digital security systems, connected devices, national defense systems, smart equipment and advanced communication networks such as 5G, 6G, the Internet of Smart Things (IoST) are tools of Industry 4.0.

To ensure cyber resilience, multiple cyber vulnerabilities must be identified and addressed in the country's most critical economic and national security infrastructures. In addition, obviously, it is important to have professionals with the necessary skills, training and experience to solve these problems.

1. Cybersecurity has traditionally and overwhelmingly focused on resistance to cyber-attack: development and deployment of cyber controls that limit the extent and mitigate the impact of attacks, with the core assumption being that the organisation will be able to prevent most attacks, and at worst, continue to function near-normally during an incident and be able to resume normal operations with minimal delay. Robust cyber resistance frameworks such as the NIST Cyber Security Framework have emerged, but in reality, good practices that are being developed every day in the field aren't making their way back into the standards quickly enough in order to make these frameworks practically useful in the fight against cybercrime. At the same time, we also see leading organisations that have successfully mapped out good practices, but struggle to meet their own aspirations across all affected areas of the enterprise [1].

2. The growing sophistication, frequency and severity of cyberattacks targeting all sectors highlight their inevitability and the impossibility of completely protecting the integrity of critical computer systems. In this context, cyber-resilience offers an attractive alternative to the existing cybersecurity paradigm. We define cyber-resilience as the capacity to withstand, recover from and adapt to the external shocks caused by cyber-risks. This article seeks to provide a broader organizational understanding of cyber-resilience and the tensions associated with its implementation. We apply Weick's (1995) sensemaking framework to examine four foundational tensions of cyber-resilience: a definitional tension, an environmental tension, an internal tension, and a regulatory tension. We then document how these tensions are embedded in cyber-resilience practices at the preparatory, response and adaptive stages. We rely on qualitative data from a sample of 58 cybersecurity professionals to uncover these tensions and how they reverberate across cyber-resilience practices [2].

3. Digitalization and related networked systems integration and automation have increased the performance of manufacturing. At the same time, the vulnerability of the systems has increased significantly as networks are potential targets for attacks to compromise companies. Therefore, the study focuses on the functional design of cyber resiliency in cyber-physical production systems. To support functionality while emphasizing the resilience of manufacturing systems, Axiomatic Design is used as a design methodology for the concept design of a cyber-resiliency module. Based on functional requirements, design parameters were decomposed and design guidelines for preparedness for cyberattacks were provided. The guidelines were applied to a cyber-physical demonstrator that realizes the Industrial Internet of Things with a digital twin. As a result, physical/virtual solutions for the system were found. Such an axiomatic design-based approach allowed for studying solution-neutral functional requirements that resulted in functional cyber resiliency solutions. The provided guidelines have practical value in the planning phase of manufacturing system networks to increase their long-term resiliency. This study fills the gap in the solution-neutral design of cyber resiliency in manufacturing companies [3].

4. The electric grid operation is constantly threatened with natural disasters and cyber intrusions. The introduction of Internet of Things (IoTs) based distributed energy resources (DERs) in the distribution system provides opportunities for flexible services to enable efficient, reliable and resilient operation. At the same time, IoT based DERs comes with cyber vulnerabilities and requires cyber-power resiliency analysis of the IoT-integrated distribution system. This work focuses on developing metrics for monitoring resiliency of cyber-power distribution system, while maintaining consumers' privacy. Here, resiliency refers to the system's ability to keep providing energy to the critical load even with adverse events. In the developed cyber-power Distribution System Resiliency (DSR) metric, the IoT Trustability Score (ITS)

considers the effects of IoTs using a neural network with federated learning. ITS and other factors impacting resiliency are integrated into a single metric using Fuzzy Multiple-Criteria Decision Making (F-MCDM) to compute Primary level Node Resiliency (PNR). Finally, DSR is computed by aggregating PNR of all primary nodes and attributes of distribution level network topology and vulnerabilities utilizing game-theoretic Data Envelopment Analysis (DEA) based optimization. The developed metrics will be valuable for i) monitoring the distribution system resiliency considering a holistic cyber-power model; ii) enabling data privacy by not utilizing the raw user data; and iii) enabling better decision-making to select the best possible mitigation strategies towards resilient distribution system. The developed ITS, PNR, and DSR metrics have been validated using multiple case studies for the IoTs-integrated IEEE 123 node distribution system with satisfactory results [4].

5. Article develops a new algorithm by applying the Bayesian method to software using artificial immune systems. An artificial immune system is an adaptive computing system that uses models, principles, mechanisms, and functions used to solve problems in theoretical immunology. Its application to various fields of science is studied. The role that artificial immune systems play in software is invaluable. Methods for detecting malware are explored. Some works in the field of artificial immune system are analyzed and issues to be addressed are identified. The Bayesian method accurately calculates the probability of occurrence of any event under certain conditions. Therefore, the Bayesian method is applied to software using artificial immune systems. By applying this method, fast software performance can be achieved. For this, a new algorithm is developed and experiments are conducted. The developed algorithm is one of the new ones. The results of the experiments provide good performance.

6. Nowadays, according to complexity and level of digitalization of its business and to value offered to social and economic context, every organization has an IT system and the necessity of cyber security tools for protecting information and digitalized processes from fraud attempts and acts of vandalism [5]. Cyber-attacks consist of any action taken by individuals or organizations to undermine the functions of information systems, infrastructures or computer network or personal electronic devices through crimes [6]. These actions are, for example, hacking, bombing, cutting, infecting. They are a real and significant danger for many countries, their citizens, businesses and the economy in general and can be fronted by the implementation of a so-called cyber resilient system [7]. The ability to react to these attacks and to design and implement a more robust organization recalls the concept of resilience, known in physics as the assumption of sustaining crashes without breaking. In management sciences, resilience is defined as the ability of an organization to adapt to unexpected disruptive changes or the intrinsic capacity of a system to modify its functioning before, during and after a disruptive change or a trouble, for being able to continue the necessary operations in both expected conditions and unexpected conditions. Several methods confuse or do not discriminate resilience, i.e. the ability to resist and recover quickly from unknown and known threats, with the risk, i.e. the product between the probability of an adverse event and the extent of the resulting damage [8]. Nevertheless, often, organizations do not recognize the threat until it occurs; therefore, the complexity of cyber systems and cyber threats requires the integration of the risk management process and the resilience management process. Taking the theoretical background on previous researches on cyber resilience management models as a starting point, this study aims to contribute explaining how to manage cyber resilient systems taking into account the business context. More concretely, to comprehend how companies should correctly align the managerial actions and practices in a set of logical steps for enhancing cyber security resilience. Gathering the data using a structured exploratory study based on six exemplary case studies, we aimed at giving some clarifications on how can companies effectively introduce and implement cyber resilient system and how different contexts influence companies' the management of cyber resilient systems in a Managerial Cyber Resilience Framework. The paper is organized as follows. The second section contains the theoretical background about the concepts of cyber resilience and the main models for the cyber resilience based on risk and resilience; further, we formalize the emerging research gap about missing link among contextual factors and cyber resilient systems' implementation and we define the research question. The third section (methods) describes the research methodology, a multiple case studies analysis, and the research protocol. The fourth section (results) contains the descriptive analysis of the cases and the last one (discussion and conclusion) discuss our results and report a Managerial Cyber Resilience Framework, summarizing contributions and research limitations, together with possible future research directions.

Currently, due to the complexity of business and the level of digitization, the value offered in the social and economic context, every organization needs an IT system and cyber security tools to protect information and digital processes from fraud attempts and acts of vandalism [5]. Cyber-attacks consist

of any action taken by individuals or organizations to disrupt the functions of a computer network or individual electronic devices [6]. These actions are, for example, hacking, bombing, cutting, infecting. They are a real and significant threat to many countries, their citizens, businesses, and the economy in general, and can be countered by implementing a cyber-resilient system [7]. The ability to react to these attacks and develop and implement a more resilient organization is reminiscent of the concept of resilience known in physics as the hypothesis of sustaining accidents without breaking. In the management sciences, resilience is defined as the ability of an organization to adapt to unexpected disruptive changes, or the ability of a system to change its performance before, during, and after a disruptive change or problem in order to maintain necessary operations, both under expected and unexpected conditions [8]. Several methods confuse or do not distinguish between resilience, i.e., the ability to resist and quickly recover from unknown and known threats, with risk, that is, the product between the probability of an adverse event occurring and the extent of the resulting damage [8, 9]. However, organizations often don't recognize a threat until it happens; therefore, the complexity of cyber systems and cyber threats requires the integration of the risk management process and the resilience management process. Taking the theoretical background of previous research on cyber resilience management models as a starting point, this work aimed to help explain how to manage cyber resilient systems taking into account the business context. More specifically, it is necessary to understand how companies should properly align their management actions and practices in a series of logical steps to improve cybersecurity resilience.

Conclusion

By collecting data using structured exploratory research based on six representative case studies, this study aimed to shed some light on how companies can effectively introduce and implement a cyber-resilient system and how different contexts influence companies' management of cyber-resilient systems in Management Cyber Resilience Framework [10]. This paper is organized as follows. The second section contains theoretical information on cyber resilience concepts and key models of cyber resilience based on risk and resilience; Furthermore, an emerging research gap is formalized and a research question regarding the missing link between contextual factors and the implementation of cyber resilient systems are defined. The third section (methods) describes the research methodology, the analysis of multiple samples and the research protocol. The fourth section (results) provides a descriptive analysis of the cases, and the last section (discussion and conclusion) discusses findings and reports the Management Cyber Resilience Framework, summarizing the contributions and research limitations along with possible future research directions.

References

1. Phil. Cyber Resilience: Part Two Resistance. February 1, 2016. <https://blog.blackswansecurity.com/2016/02/cyber-resilience-part-two-resistance/>
2. Benoît Duponta, Clifford Shearing, Marilyne Bernier, Rutger Leukfeldt. The tensions of cyber-resilience: From sensemaking to practice. *Computers & Security*. Vol. 132, September 2023, 103372 <https://doi.org/10.1016/j.cose.2023.103372>
3. Tanel Aruväli, Matteo De Marchi, Erwin Rauch, Dominik Matt. Design Decomposition for Cyber Resiliency in Cyber-Physical Production Systems. Conference: 15th International Conference on Axiomatic Design At: Eindhoven, The Netherlands, September 2023. DOI: 10.1007/978-3-031-49920-3_1
4. Partha Sarker, Sajjan K. Sadanandan, Anurag K. Srivastava. Resiliency Metrics for Monitoring and Analysis of Cyber-Power Distribution System with IoTs. 2022. Vol.10 no: 9. *IEEE Internet of Things Journal* PP(99):1-1 DOI: 10.1109/JIOT.2022.3183180
5. Von Solms, R. and Van Niekerk, J. (2013) From Information Security to Cyber Security. *Computers & Security*, 38, 97-102. <https://doi.org/10.1016/j.cose.2013.04.004>
6. Takaaki Kawanaka, Masanobu Matsumaru, Shuichi Rokugawa. Software measure in cyber-attacks on production control system. *Computers & Industrial Engineering*. 2014, vol. 76, pp. 378-386. <https://doi.org/10.1016/j.cie.2014.08.008>
7. Lifan Zhao, Guoan Bi, Lu Wang, Haijian Zhang. An improved auto-calibration algorithm based on sparse Bayesian learning framework. 2013, vol. 20, no. 9, pp. 889-892. https://scholar.google.co.uk/citations?view_op=view_citation&hl=ru&user=lmF7SA8AAAAJ&citation_fo_r_view=lmF7SA8AAAAJ:IWHjjKOFINEC

8. Fotios Petropoulos, Gilbert Laporte, Emel Aktas, Sibel A. Alumur, Claudia Archetti, Hayriye Ayhan. *Operational Research: methods and applications. Journal of the Operational Research Society.* 2023, pp. 423-617
9. Stanley Kaplan, B. John Garrick. *On The Quantitative Definition of Risk, Risk Analysis,* 1981, vol. 44, no. 8. <https://doi.org/10.1111/j.1539-6924.1981.tb01350>
10. Alessandro Annarelli, Fabio Nonino, Giulia Palombi. *Understanding the management of cyber resilient systems. Computers & Industrial Engineering* Vol. 149, November 2020, 106829. <https://doi.org/10.1016/j.cie.2020.106829>Get rights and content



<https://sconferences.com>
info@sconferences.com

ISBN

