REVIEW ARTICLE
DOI: doi.org/10.30932/1992-3252-2022-20-1-13

World of Transport and Transport, 2022,
Vol. 20, Iss. 1 (98), pp. 242–248

Chemist, Practitioner, Teacher... Ivan Alekseevich Kablukov (1857–1942)

Nikolay D. GRIGORIEV

Nikolay D. Grigoriev
Ph.D. (Eng), Moscow, Russia.
✉ *9165688074@yandex.ru.*

ABSTRACT

2022 marks the 165th anniversary of the birth of the outstanding Russian scientist Ivan Alekseevich Kablukov. The main field of scientific interests and discoveries of Academician Kablukov relates to electrochemistry of non-aqueous solutions. I. A. Kablukov is also known as a teacher and populariser of science, the founder of the school of physical chemists in Russia, as the author of a number of works on the history of chemistry.

In 1896, at the Moscow Imperial Engineering School of the Department of Railways (now Russian University of Transport), Kablukov founded the Department of Chemistry, which he led for a long time. In total, Kablukov's scientific heritage includes more than three hundred works.

Corresponding Member of the Academy of Sciences of the USSR (1928), Honorary Member of the Academy of Sciences of the USSR (1932), Honorary Member of the Society of Lovers of Natural Science, Anthropology and Ethnography (since 1921), Member of Russian Physico-Chemical Society, Society for Acclimatisation of Animals and Plants (since 1898), All-Union Chemical Society n.a. D. I. Mendeleev (in 1934 he was elected vice-president of Moscow branch of AUCS) and many other scientific societies. Honoured Professor of Moscow University (since 1910).

I. A. Kablukov owns fundamental work on the theory of solutions, thermochemistry, and processing of mineral raw materials into fertilisers. He was an outstanding teacher.

Keywords: I. A. Kablukov, history of chemistry, theory of solutions, organic chemistry, physical chemistry, thermochemistry, salt equilibria, electrochemistry of non-aqueous solutions, solvation theory, transport education history.

For citation: Grigoriev, N. D. Chemist, Practitioner, Teacher… Ivan Alekseevich Kablukov (1857–1942). World of Transport and Transportation, 2022, Vol. 20, Iss. 1 (98), pp. 242–248. DOI: https://doi.org/10.30932/1992-3252-2022-20-1-13.

The text of the article originally written in Russian is published in the first part of the issue.
Текст статьи на русском языке публикуется в первой части данного выпуска.

INTRODUCTION

In Moscow region, not far from the famous Pirogovo, there is a small village of Prussy. It was there that on September 2, 1857, a boy was born in the family of the former serf Alexey Fedorovich Kablukov. His father, Alexey Kablukov, served as a dentist for a local landowner. On this occasion, Ivan Alekseevich wrote: «Perhaps they will think that my father studied at some medical institute. No. Then we had no idea about dental schools. Everything happened simply – the master identified my father as a courtyard servant, so he learned his future art in the manor's house. And then the master let him go – my father was one of the freedmen. In 1841, as I recall, he took the exam for the title of dentist. That's all…» [1].

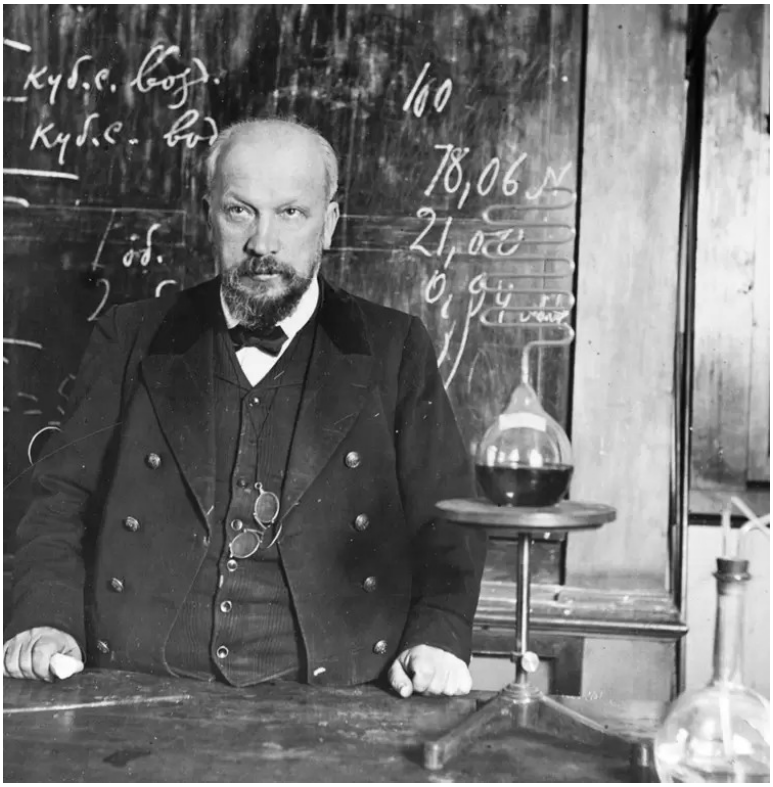
Ivan Kablukov always spoke of his parents with love, respect and dedicated his doctoral dissertation to them: «My father had no education. Mother was more educated. She taught me to read and write. And they both worked, both were healthy and they gave me good health. I have been living for so long, and my teeth, – he opened his mouth with a smile, – are all intact» [1].

At the age of nine, Ivan Kablukov entered the second Moscow gymnasium. Studying was mainly paid for by older brothers. After graduating from the gymnasium, Ivan Alekseevich entered Moscow University's Natural Department of the Faculty of Physics and Mathematics: «I will never forget the day when, in September 1876, in a shabby coat that passed to me from the shoulders of my older brother, I went as a student to Moscow University for the first time. I thought that the people I met should have envied me: I am a student at Moscow University» [1; 2].

During his second study year, student Kablukov decided to do science. At first, there were experiments in the field of zoology. Then the sophomore Kablukov decided to try himself in the laboratory of V. V. Markovnikov. Moreover, already in 1879, at the congress of natural scientists and doctors in St. Petersburg (chemical section), Markovnikov made a presentation on the topic «Obtaining esters of hexyl glycerin», where student Ivan Kablukov was listed as a co-author. Therefore, the future scientist considered this year the beginning of his scientific career. A little later, he wrote his first monograph «Polyhydric alcohols in connection with the nearest derivatives». In the year of graduation from the university (1880) he will be awarded a gold medal for this work, and at the suggestion of Markovnikov, he will be left at the university to prepare for a professorship. A year later, Kablukov was sent to St. Petersburg University, to Professor A. M. Butlerov. There they will conduct experiments on production of formaldehyde using a new method proposed by Kablukov. At present, this method is close to the factory method for obtaining formalin used in medicine, agronomy, and other fields. During this trip, the scientist listened to lectures by the famous Butlerov, Mendeleev, Menshutkin, Lyubavin...

Returning from St. Petersburg, Kablukov passed the exams, received a master's degree in

Ivan Alekseevich Kablukov (August 21 (September 2), 1857 – May 5, 1942). Hereinafter photos are retrieved from the Internet page of the Department of Chemistry and Engineering Ecology of Russian University of Transport (MIIT). [Electronic resource]: http://www.ecomiit.ru/istoriya-kafedry/kablukov/. Last accessed 18.02.2022.



chemistry and continued to work in Markovnikov's laboratory. In 1887, Ivan Alekseevich defended his thesis «Glycerols, or trihydric alcohols and their derivatives». The work was dedicated to Alexander Butlerov, who had died in 1886.

SCIENTIFIC AND TEACHING ACTIVITIES OF I. A. KABLUKOV

In 1889, the young scientist was sent to Leipzig to the laboratory of the future Nobel laureates W. Ostwald and S. Arrhenius, where he worked on electrical conductivity of solutions. Returning from there, Ivan Alekseevich continued his teaching activities.

The scientific work of Kablukov in those years developed in three directions:

1. The study of organic chemistry.

2. The study of physical chemistry, «especially the question of electrical conductivity, vapour pressure of aqueous and other solutions, thermochemistry, salt equilibria».

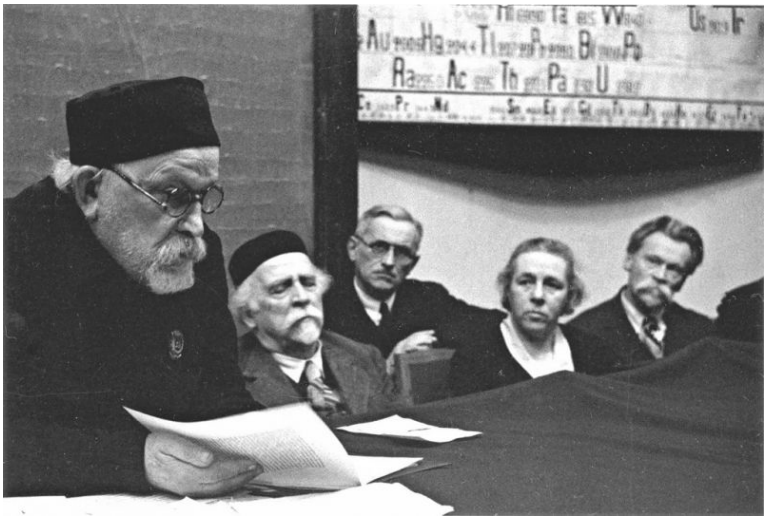
3. Chemistry of honey and wax.

During those years, Kablukov wrote about two hundred works, most of which were related to development of industry.

Relatively speaking, the theory of solutions can be divided into two areas: physical-mechanical and chemical. Both directions have always existed in parallel, «without interfering with each other». But at the end of 19th century, they sharply collided. This was especially facilitated by the scientific activity of the first Nobel Prize winner in chemistry, the Dutch scientist Jacobus Henricus van't Hoff.

Ivan Kablukov, unlike many, considered solutions as «systems that have completely new properties». And these new properties, according to the scientist, were not at all inherent in «none of the bodies forming it». This idea of Kablukov was to create a «bridge» between the physical theory of van't Hoff and the hydrate theory of Dmitry Mendeleev. It is this idea that will form the basis of the modern understanding of solutions in the future [3–4].

In Western Europe, scientists in those years studied only aqueous solutions. Non-aqueous were considered non-ionising. It was Russian scientists who were the first to study the electrochemistry of non-aqueous solutions. Kablukov was especially successful in this, he first established (1889), that some non-aqueous solutions do not obey the Arronius theory. It was he who proved that, for example, «hydrogen chloride in ethyl and amyl alcohols, when diluted, does not increase, but reduces the molecular electrical conductivity». His doctoral thesis on the theory of solutions was the first Russian fundamental



work on this topic. It followed from his thesis that physical and chemical theories do not exclude each other, but go, as they say, hand in hand. In connection with later discoveries in modern chemistry, Kablukov's theory, called the «solvation theory» [3], has taken its rightful place in the modern theory of solutions.

WORK AT IMPERIAL MOSCOW ENGINEERING SCHOOL

In 1895, Kablukov's second trip abroad took him to France, Holland and Switzerland, where he adopted the experience of «using lecture demonstrations and organising museum collections for teaching purposes». He mastered experimental methods of teaching chemistry, which were studied while visiting laboratories at universities and high schools. He also mastered the practical applications of achievements of chemical science, being interested in the chemical processing of mineral raw materials and physical and chemical aspects of production processes when inspecting factories and mines.

After defending his thesis, Ivan Kablukov continued his scientific work and teaching. In 1896, in the newly opened Moscow Imperial Engineering School of the Department of Railways (now Russian University of Transport), Kablukov founded the Department of Chemistry [5; 6], where he conducted classes in inorganic and analytical chemistry, building materials technology and iron metallurgy on the basis of foreign teaching methodology and own developed program. The chemical building was built in 1898 according to the project of the architect Kitner with participation of Kablukov. Lecture and laboratory audiences corresponded to the curriculum and were modelled after the Ostwald laboratory in Leipzig, personally equipped by Kablukov with equipment, very advanced for that time: instruments, reagents, consumables, chemical glassware and preparations purchased from German firms. Gas and water were supplied to the laboratory, individual fume hoods were equipped. The building was equipped with a system of interfloor lifts for dishes and laboratory preparations.

In 1900, based on the experience of teaching chemistry at the school, Ivan Alekseevich published the textbook «Basic Principles of Inorganic Chemistry» [7], which was recommended as the main textbook at Moscow University. The textbook contains a lot of information related to practical applications of chemistry and production technologies. For example, when presenting the topic «Air», the author proposes for consideration an experiment that describes diffusion of air through the walls of a building. The material on iron is accompanied by a story about the methods of casting steel and iron used at that time. The textbook contains illustrations of factory settings, descriptions of materials, and a demonstration collection he has assembled.

In the engineering school, Kablukov worked as the head of the department of «Chemistry» until 1903 (according to other sources until 1904). At the entrance, on the right side on the wall of the building of the educational building No. 5 (Obraztsova str., 9, build 9) a memorial plaque was installed at Russian University of Transport, and the chemical laboratory on the second floor bears the name of a famous chemist.

Professor Kablukov during those years invented a special open laboratory vessel with a

coil, the liquid in which can be stored without spoiling and almost evaporating. 125 years ago (November 8, 1897) Ivan Alekseevich poured chicken broth into a flask, which is currently a monument of science. This flask is exhibited in the Museum of the History of Russian University of Transport (educational building No. 1, room No. 1149) (water is periodically added to it). On the basis of certificate No. 800 issued by the Expert Council at the Polytechnic Museum of Moscow (protocol No. 16 of November 15, 2007), it was recognised as a monument of science and technology of the First category. Therefore, this museum object is a cultural national achievement of Russia.

Everything connected with the name of Ivan Kablukov is still carefully stored within the walls of RUT: a collection of chemical glassware, pure substances and minerals, collected by him at leading European chemical plants and universities, dissertations of his students, made in the laboratories of the department «Chemistry» he created. And the laboratories of the department themselves keep the memory of their creator.

Today, in the «Chemical Laboratory named after I. A. Kablukov» (auditorium 5203), partially preserved, partially recreated according to old projects and modernised to meet the latest requirements of time and science, RUT students listen and «watch» lectures on chemical disciplines.

Ivan Alekseevich's study (room 5202) adjoins this «historical» laboratory. Here, as well as more than a hundred years ago, there is his large carved desk, bookcases, fume hood and laboratory cabinets, a long preparation table, on which reagents for lecture demonstrations have been prepared for the second century. Also in the office, a «place of honour» is occupied by a huge oak cabinet-showcase with a collection of chemicals of that time and «new things» in the form of a new collection of metals, crystals and dishes. Teachers still use this collection for lecture experiments. Tables of atomic spectra, brought by Kablukov from Germany, hang on the walls.

Perhaps, as a lecturer, Ivan Kablukov was not «the most brilliant example» and, perhaps, was inferior in this respect to many of his contemporaries, but his audience, even with optional attendance at lectures, was always overcrowded.

The reason was that the teacher Kablukov never gave knowledge «in finished form, in their final, generally accepted version». He always «drew» the process in development: from the moment the idea itself appeared in its original form to its modern execution. He always urged to remember the «imperfection of the form of the birth of scientific truth».

«A person currently living in comfortable and beautiful high-rise buildings in the city should always remember with gratitude that primitive hut, that cave that sheltered our distant ancestors from the weather and helped them escape from the primitive state» (from the notes of a student from one of the lectures of Kablukov at Timiryazev Academy).

Of course, every student wants to listen to lectures by real, great scientists, to which Ivan Kablukov undoubtedly belonged. But they say that when Kablukov began to talk about the famous Zinin, Butlerov or Mendeleev, with whom he was personally acquainted, not only their great scientific discoveries loomed before the hushed audience... Ivan Alekseevich's lectures were always distinguished by very personal «Kablukov's phrases» and sweet humour. In the lectures there was a place for unsuccessful experiments and theories, which, with the comments of the scientist, sometimes turned out to be more instructive than successful ones. This peculiar manner of communication gave rise to many good-natured «Kablukov's» jokes and anecdotes among students and colleagues.

EDUCATOR, RESEARCHER, ORGANISER OF SCIENCE

Ivan Kablukov travelled a lot in Russia and Western Europe to get acquainted with natural resources (salt lakes, oil deposits, etc.): «Now

I'm like a sponge, I'm in a hurry to take in myself as much as possible so that later I can get more out of me squeeze out» [8], – he wrote to his parents from his first trip to the Urals (1887). Actually, the trait of «sharing everything» (be it knowledge or impressions) is the main one in his character.

During these trips, he visited factories and plants, mines and laboratories, educational institutions, and did not forget about local museums, art galleries, exhibitions, theatres, concerts.

An important direction in the activities of Kablukov was the study of the natural resources of our country. He did not divide science «into pure and applied», but believed that «there is science and its practical application». For example, domestic production of mineral fertilisers owes its appearance to Kablukov.

In August 1895, at the congress of the French Association of Sciences in Bordeaux, the 38-year-old Russian chemist Ivan Kablukov was elected honorary chairman of the chemical section.

In 1899, he was elected an adjunct professor at the department of inorganic chemistry at the Moscow Agricultural Institute (now Timiryazev Academy), where he would work until the end of his life. In May 1903, Ivan Alekseevich became an extraordinary (freelance) professor at the Department of Inorganic Chemistry at Moscow University and already in 1906 – an ordinary (full-time) professor.

In 1907, Professor Kablukov published the pamphlet «The Newest Theory of the Structure of Atoms» and published an article on the same topic in the journal «Russian Thought». True to his calling as an educator in the broad strata of Russian society, in 1914 he published his book «Essay on development of our knowledge about the structure of matter», in which figuratively and in an accessible way «paints a picture» of how the ideas of scientists about the structure of matter changed.

In 1912, Kablukov went to the Eighth International Congress on Applied Chemistry in the USA. In America, he is also very interested in organisation of chemical laboratories. He visits research institutes, industrial enterprises, uranium ore deposits, educational institutions, museums, apiaries.

In 1913, Ivan Alekseevich organised research in the chemistry of radioactive elements at Moscow University, having purchased the necessary equipment for this purpose abroad. This marked

the beginning of research in the chemistry of radioactive elements.

In 1915, he became the head of the only thermochemical laboratory in our country (now the laboratory named after prof. V. F. Luginin), which Kablukov led until 1933. In 1928, the USSR Academy of Sciences elected him a corresponding member. Despite being very busy, I. A. Kablukov finds time to continue creating his scientific work in the field of solutions, thermochemistry and inorganic chemistry. He writes about 120 articles for the encyclopedic dictionary of the Granat brothers, publishes works on the activities of outstanding chemists of the past.

Ivan Alekseevich Kablukov is the author of numerous textbooks on various branches of chemistry. They were created by the scientist in preparation for the lectures he gave at various higher educational institutions. The most important, undoubtedly, are and will be considered his manual «Basic Principles of Inorganic Chemistry», the first edition of which was published in 1900, and the last (13th) in 1936. Each subsequent reprint, in comparison with the previous one, was improved, supplemented, becoming at the level of science of its time. The actual material of inorganic chemistry received physico-chemical illumination in it. Tens of thousands of chemists studied according to this manual [9]. For many years (1900–1934) I. A. Kablukov worked on the course «Basic Principles of Physical Chemistry», publishing it in separate issues on the main sec-

tions of the discipline. This course also played its main role in chemistry education in the USSR, especially since for a long time it remained the only one in Russian [10].

In 1940, with participation of associate professor V. A. Polosin, Kablukov published his last work «Course of Lectures on Inorganic Chemistry». In the preface to it, Ivan Alekseevich writes: «As I approach the end of my activity, I would like to share my experience as a teacher and publish lectures on chemistry that I have been reading for a number of years» [11].

In July 1940, I. A. Kablukov fell seriously ill and after the operation could not get on his feet for a long time. In October 1941, Timiryazev Academy was evacuated to Central Asia, and Ivan Alekseevich also had to agree to leave Moscow. The Uzbekistan government showed exceptional attention to I. A. Kablukov, meeting him with great love and providing him with an apartment, thorough medical care in the capital of the republic. But on May 5, 1942, Ivan Kablukov died. He is buried in Tashkent. One of the streets of the city is named after him. A portrait of the great chemist is exhibited in the portrait gallery of the Faculty of Chemistry of the National University of Uzbekistan.

Ivan Alekseevich Kablukov was famous for his amazing sense of humour, which he retained until the last days of his life. In the spring of 1942, in Kazan, where chemists who worked at the Academy of Sciences were evacuated, a rumour spread that the great Kablukov had died in Tashkent. They urgently called a mourning event, noted the merits of the scientist to the party and the people, and sent an obituary to the journal Izvestia of the Academy of Sciences. A few days later, Kazan received a telegram from Tashkent: «I found out about your meeting, please send the minutes. Kablukov». Unfortunately, immediately after this telegram, Academician Kablukov passed away. In Kazan, they did not even have time to remove the erroneous obituary from the journal − and so it came out, written in advance.

«Great people die, but their creations live and teach us a lot...» [12] − this is how Ivan Alekseevich Kablukov wrote about Mendeleev. These words can be fully attributed to Ivan Alekseevich himself, the great chemist, practitioner, and teacher.

REFERENCES

1. Bogatova, T. V. Kablukov Ivan Alekseevich. New Russian Encyclopedia, Vol. VII (1). Ch. ed. A. D. Nekipelov, Moscow, Encyclopedia publ., 2010, p. 429.

2. Zefirova, O. N. Ivan Alekseevich Kablukov. Materials for the bibliography of scientists of the USSR. Chemical Sciences Series, 1957, Iss. 24, 59 p.

3. Kablukov Ivan Alekseevich. Railway transport: encyclopedia, Ch. ed. N. S. Kanarev, Moscow, Scientific publishing house «Big Russian Encyclopedia», 1994, p. 547.

4. Shits, L. A. Solvation [*Solvatatsiya*]. Great Soviet Encyclopedia, Vol. 24. Ch. ed. A. M. Prokhorov, Moscow, Soviet Encyclopedia, 1976, p. 164.

5. Mishustin, A. I. Electrolytic dissociation [*Elektroliticheskaya dissotsiatsiya*]. Great Soviet Encyclopedia, Vol. 30. Ch. ed. A. M. Prokhorov, Moscow, Soviet Encyclopedia, 1978, pp. 62−63.

6. Handbook of chemistry for applicants to universities. Under the general. ed. A. G. Pilipenko, Kiev, Naukova Dumka publ., 1972, 408 p.

7. Minin, G. A., Apattsev, V. I. Moscow Institute of Railway Engineers (MIIT). Railway transport: encyclopedia, Ch. ed. N. S. Kanarev, Moscow, Scientific publishing house «Great Russian Encyclopedia», 1994, pp. 340−341.

8. Kablukov Ivan Alekseevich. Great Soviet Encyclopedia, Vol. 11. Ch. ed. A. M. Prokhorov, Moscow, Soviet Encyclopedia, 1973, p. 102.

9. Kablukov, I. A. Basic Principles of Inorganic Chemistry [*Osnovnie nachala neorganicheskoi khimii*]. Moscow, Engineering School of the Department of Railways, 1900, 310 p.

10. Kablukov, I. A. Physical and colloidal chemistry [*Fizicheskaya i kolloidnaya khimiya*]. Moscow, Selkhozgiz publ., 1935, 558 p.

11. Kablukov, I. A. Course of lectures on inorganic chemistry [*Kurs lektsii po neorganicheskoi khimii*]. Moscow, Selkhozgiz publ., 1940, 320 p.

12. Kablukov I. A. Mendeleev. Encyclopedic Dictionary, Ed. 7th, Vol. 28, Brothers Granat, Stb. 426.

13. Kablukov Ivan Alekseevich. Great Soviet Encyclopedia, Vol. 19. Ch. ed. B. A. Vvedensky, Moscow, State scientific publishing house «Great Soviet Encyclopedia», 1953, pp. 234−235.

14. Kablukov Ivan Alekseevich. Soviet Encyclopedic Dictionary, Ch. ed. A. M. Prokhorov, Moscow, Soviet Encyclopedia, 1985, p. 1600.

15. Solovyov, Yu. I., Kablukova, M. I., Kolesnikov, E. V. Ivan Alekseevich Kablukov: One hundred years since the birth. 1857−1957. Moscow, Publishing house of the Academy of Sciences of the USSR, 1957, 211 p.

16. Kablukov Ivan Alekseevich. *MIIT at the turn of the century*. Moscow, 2002, p. 372.

17. Rice, R. E. Hydrating ions in St. Petersburg and Moscow; ignoring them in Leipzig and Baltimore. *Bulletin for the History of Chemistry*, 2002, Vol. 27, No. 1, pp. 17–25. [Electronic resource]:
http://acshist.scs.illinois.edu/bulletin_open_access/FullIssues/Vol27-1.pdf. Last accessed 18.02.2022. ●

Information about the author:
Grigoriev, Nikolay D., *Ph.D. (Eng), Moscow, Russia, 9165688074@yandex.ru.*

Article received 23.03.2019, approved 17.06.2021, revised 09.12.2021, accepted 18.02.2022.