

ALEXANDER ALEXANDROVICH GODOVIKOV. LIFE AND ACTIVITY

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Scientific and administrative activity of well known scientist, doctor of geological and mineralogical sciences, professor A.A. Godovikov who was the director of Fersman Mineralogical Museum of RAS from 1984 to 1995 is described. Author recollects 32 years of collaboration with Godovikov.

1 table, 2 photos, 19 references

Alexander Alexandrovich Godovikov was an outstanding scientist in theoretical, descriptive, experimental and genetic mineralogy. His scientific interests were connected to research and development of techniques to investigate natural and synthetic compounds and study of mineral deposits. There are total 200 scientific works of Alexander Alexandrovich Godovikov which include 17 monographs in 14 of which he is the only author. He received 17 certificates of authorship and trained more than 20 Ph.D. candidates in geosciences.

Godovikov's maternal family tree roots into early 18 century. Ancestors of Alexander Alexandrovich put themselves on record of Russian history. They are family members of baron Johan-Albrecht Korf, Bogdan Kreiter, Russian Bashkirovs family. Among members of the mentioned families were Russian envoys to European countries, prominent scientists of their time, remarkable professors (see table).

A.A. Godovikov was keen on mineralogy since his childhood. Being a school boy he visited Moscow construction sites accompanied with his mother, Elena Alexandrovna, looking for nice rocks samples. Later being Moscow Chemistry polytechnic college student he worked as an assistant in *Karpinskiy Geological museum of USSR AS* (now it is *Fersman Mineralogical museum of RAS*) looking through and washing samples. He participated in geological expedition of the team of well-known mineralogist A.N. Labuntsov to Khibiny Mountains as an assistant. He remembered him with sympathy and characterized him as a very intelligent, intellectual man, conversationalist and a mind of wide scope. He regarded Labuntsov as his own teacher. Godovikov continued his education at the chair of mineralogy of geological department after successful graduation from technical college.

At his student years he was occupied with studying of minerals of Moscow region investigating limestone and dolomite quarries and many natural outcrops of sedimentary rocks and their weathered crusts. He published two papers on these studies of carbonates and phosphates of Moscow region (Godovikov, 1961; Godovikov *et al.*, 1961). He lead scientific geological and mineralogical clubs over a period of years and worked in expeditions headed by mineralogists from Moscow state University and Mineralogical museum of USSR AS.

His postgraduate studies concerned cobalt and nickel arsenides from Khovu-Aksi deposit. He defended his thesis on this topic considering isomorphic peculiarities, oxidation conditions and identification techniques for this complex group of minerals. He investigated relations between arsenides while simultaneous deposition in ore bearing hydrothermal veins and a role of colloidal solutions in their formation.

A.A. Godovikov entered Institute of mineralogy, geochemistry and crystal chemistry of rare elements (IMGRE) of USSR AS as a junior research assistant after defending his thesis and started organizing laboratory of experimental mineralogy. He successfully fulfilled this task which enabled him to investigate a nature of admixtures in galena in a laboratory environment. Consequently he wrote his first monograph "Minerals of bismuthite-galena series" as a result of the work (Godovikov, 1965).

A.A. Godovikov started working in the Institute of geology and geophysics of Novosibirsk scientific centre in 1959. He was assigned to organize a laboratory of experimental mineralogy there. It was called laboratory of solution-melt crystallization from the



Alexander Alexandrovich Godovikov, 1990

beginning and there were 5 staff members including the manager. It grew later into a department of experimental mineralogy that comprised of three laboratories. Some 200 staff members worked in the department including 3 Doctors of science and more than 30 doctorate candidates. This experimental division is well-known worldwide with its scientific research. Many of its developments and achievements were applied into the practice. A.A. Godovikov becomes a deputy director of the Institute of geology and geophysics of Siberian Branch of USSR Academy of Science in 1974. The achievements in crystal synthesis gained under his leadership lead to creation of a special crystal growth technological design-engineering bureau in Siberian department of USSR Academy of Science in 1978. He was the organizer and the first head of the bureau and made a lot of efforts to develop it.

Research of the department of experimental mineralogy included following themes: 1) sulfide and chalcogenide systems with pyrosynthesis (construction of system diagrams, new compounds synthesis, investigation of growth conditions of mono crystals in dry systems) under atmospheric conditions and also in ones of high and ultra high pressure and temperature; 2) physical chemical properties of synthetic material and their natural analogues; 3) areas of stability of ore minerals, solubility of sulfides, transfer mode and forms of ore-forming elements by hydrothermal fluids depending on thermodynamic conditions; 4) physical chemical conditions of equilibrium of sulfides with oxides, native elements, wolframates and other compounds and also monocrystal growth in

hydrothermal fluids; 5) phase equilibrium in silicate systems, hydrothermal solutions, kinetics of hydrothermal reactions of silicate formation.

One can see from the department's topics of study that Godovikov had broad scientific interests. He participated not only in the statement of the problems which is a half of the successful problem solution but also saw into the details of difficulties encountered during experiments and interpretation of their results. These investigations were aimed to the main goal that Alexander Alexandrovich put against himself and the team he headed. He wanted to bring mineralogy to the point when it becomes a quantitative but not a descriptive science. He worked on theoretical problems of mineralogy in connection with this aim trying to create a unified mineral classification based on chemical, structural and genetic peculiarities of species. He paid particular attention to connection of properties of minerals with their chemistry and structure, development of study on chemical bonding in minerals, determination of common types of compounds by predominant type of their bonding. He proposed new techniques of assessment of donor-acceptor properties of elements, new arrangement of periodic system of elements of D.I. Mendeleev, geochemical classification of elements and cations. Results on the theoretical investigations of Godovikov are published in 7 monographs (Godovikov, 1972a, 1977a, b, 1979a, 1981, 1997 a, b) and they are the basis of natural structural-chemical systematic of minerals which represent a quintessence of his scientific life. Predominant type of chemical bond is taken as a leading attribute which determines the first higher rank of taxonomic units. There are five types of the higher rank which are common for all minerals:

1 Type: minerals predominantly with metallic and metal-covalent bond – native metals and semi-metals, intermetallic compounds and semi-metallic compounds;

2 Type: minerals with metal-covalent and ion-covalent bond rarely with residual bond – chalcogenides and native nonmetals from VI a group.

3 Type: minerals predominantly with ion-covalent bond and covalent-ion bond type – nonmetals of light (typical, centrosymmetrical) element of VIa group (O) – oxygen compounds;

4 Type: minerals with predominant covalent-ion and ion bond type – halogenide compounds;

5 Type: carbon and its compounds (excluding carbonates) and related to them compounds.

Lower taxons are determined on the base of the following: a) belonging of a mineral whether to isodesmic or anisodesmic compounds; b) type of anion, cation; c) coordinate number of main anion; d) value of force characteristic. The force characteristic was introduced by Godovikov and defines donor-acceptor (acidic-alkaline) properties of elements. The force characteristics (FC) can be calculated as the ratio of affinity to electron (in case of neutral atoms) or n -th potential of ionization (in case of cations) to orbital radius of atom or an ion; e) structural type (so structure is a secondary feature). The lowest taxon, a mineral specie is *"an individual chemical compound, an ultimate member of solid solutions; intermediate member of series of solid solutions with conventional limits of the composition"* (Godovikov, 1997a).

Godovikov tested his classification on a broad and very important for mineralogists exposition of minerals *"Structural chemical mineral systematic"* in the Mineralogical museum. He selected the most interesting samples for the exhibition in early 1990s with the help of museum's stuff. Then it contained 1895 mineral species. Collection replenishes since then with new minerals that the museum have not had yet and with new species that fit into the classification. There are 2917 mineral species in the exhibition by now.

Monograph *"Structural chemical systematic of minerals"* was published only after Alexander Alexandrovich passed away in 1997. It's second revised and corrected edition is just printed (Godovikov, Nenasheva, 2007a; Godovikov, Nenasheva, 2007b).

Special attention was paid to the pressure of a gas phase and water vapor during studying of sulfide systems under supervision of Godovikov. It enabled to determine a range of important regularities which are to be considered at mineral synthesis and applying experimental data to understand natural processes. They also were essential at growing mono crystals of semiconductors and active optical material. Methods of chalcogenic glasses produc-

tion with composition As_2S_3 , As_2S_5 , $As_{20}S_{80}$, and monocrystals of α -arsenic sulfide (orpiment) were developed. The glasses possessed optical quality and lack gas, solid inclusions and structural thermal tension. They are widely used in semiconductor industry, infrared optics, acoustic optics; arsenic crystals that are used in optical information recording devices (holograms etc.).

Studies of sulfide minerals were in the basis for original conclusions made on origin of many sulfides and sulfosalts, developing their systematic and prognosis of their synthesis conditions. The techniques of growing proustite, pyrargyrite, silver thiogallate, bromellite, chrysoberyl (alexandrite) and paratellurite crystals were developed under supervision of Godovikov. They were the first to visualize infrared image on proustite monocrystals in our country. Paratellurite crystals can be light-sound conductors and are used in production of single-channel and multiplex modulators, beam splitters, deflectors, radio frequency spectrum analyzers and other elements in optoelectronics.

The work on emerald growing from melt solution and on its hydrothermal growth on crystal seed were carried out successfully. Not only large crystals of emerald of any shades of color were grown but also other varieties: bluish aquamarine, yellow heliodor, and crimson morganite.

Techniques and hardware for quality control of crystals during their growth were developed. They allow determining photo-goniometric orientation of crystals, evaluating their resolution power, visualizing micro block structure and mechanical tensions not detectible with light microscopy, measuring block size and grain-boundary angles. These methods allowed assessing quality of grown crystals and swiftly considering these data to develop conditions of the growth of monocrystals of high perfection and select the best ones for quantum electronics investigations.

Handling of this work would be impossible without connection with theoretical studies on thermodynamics, kinetics and mechanisms of reactions in the relevant systems. They enabled the switching to common theoretical works that brought to light questions on conditions under which some elements form compounds with certain crystal structure and properties.

Consequently it led to basics of scientific prognosis and design of compounds with predetermined properties. Results of the work were published in three monographs (Godovikov, 1979b, 1989; Belov, Godovikov, Bakakin, 1982).

Tasks on high pressure petrology and development of instruments for investigations in conditions of 200–300 thousand atmospheres, cubic multi hob press instrument with maximum pressure up to 1 million atmospheres are very important even now. This gave an opportunity to study phase transition in conditions of ultrahigh pressures. Conductor-insulator transition was obtained in iron oxide under 650 thousand atm., in diamond under 700 thousand atm., in pyrophyllite under 750 thousand atm. This gave possibility to answer major questions in petrology and geophysics of high pressures and depths, modeling of new super hard materials and products and big diamond crystals.

Alexander Alexandrovich was talented professor and gave lectures on a whole mineralogical course and after *"Introductory mineralogy"*, *"Crystal chemistry"*, *"Genetic mineralogy"* at geological-, geophysical department of Novosibirsk state University from 1963. For the students and wide audience he published books *"Introduction in mineralogy"* (Godovikov, 1976b), *"Mineralogy"* (Godovikov, 1975), and later revised and edited edition of the last one (Godovikov, 1983). He trained experimental mineralogists developing original independent investigations, organizing and heading students' academic and field practices, in different expeditions to Urals, Khibiny, Khakassia, Altai putting a lot of effort and initiative to pedagogical work.

A.A. Godovikov contributed a large mineral collection counted of more than 4000 samples to Fersman Mineralogical museum. He gathered the collection in numerous expeditions at various regions of the USSR and trips abroad: USA, Czechoslovakia, Bulgaria, Rumania, Mongolia, England and Japan. Many samples from the collection are shown on different expositions. Representative agate collection including specimens from its various genetic types: from basic effusives (basalts and andesites), from acidic effusives (rhyolites), in cavities formed from burned out vegetation remnants, in solution cavities of sedimentary

rocks. Agate studies concerned many questions of their formation: cause and mechanics of cavity formation in basic volcanic rock, what part of lava flow confined cavities, coalescence of gas bubbles, their shape, gas composition in gas cavities, composition of minerals that formed agates, compositions of lava icicles and build-ups in gas bubbles, mechanics of cavity formation in rhyolite lithophysa and so on. These investigations were published in monograph *"Agates"* with O.I. Ripinen and S.G. Motorin as coauthors and are displayed in the exhibition *"Agates"* in the Mineralogical museum (A.A. Godovikov, M.B. Chistyakova).

The period of cooperation with Mineralogical museum was the years of productive and hard work in his life as well as in the museums history. His "outstanding" (by the words of academician A.A. Trofimuk) organizing abilities appeared then. The reconstruction and renovation of the museum which were gone for 8 years were finished under his leadership in a short time. Old expositions were restored and new ones created. New exhibition floor space was acquired in joined building which used to belong to Paleontology museum. This allowed to increase the number of expositions with vacating floor space from cases with funds of mineral deposit collection which were moved to the fund storage arranged in former exposition hall of Paleontology museum. New electric geological map instead of old cumbersome one was created by N.I. Zardiashvili. This made possible to widen the exposition and lighten the museum better. Alexander Alexandrovich engaged unusual mineralogist V.I. Stepanov and young enthusiastic mineralogists D.A. Romanov, D.V. Abramov and A.B. Nikiforov to the restoration of the museum. M.A. Smirnova who was a chief museum custodian then admitted that the job was a *"big challenge not only for the entire museum's stuff but also the mineralogists from the other institutes in Moscow, Novosibirsk, Kiev, amateur mineralogists, and the museum's stuff family members and their friends who were inspired with enthusiasm of A.A. Godovikov and his example"*. The restorations were finished and the museum was opened by 27th Session of international geological congress which took place in Moscow in August of 1984.

New expositions were created and old ones were remodeled during the years of work in the museum under supervision and often with personal participation of A.A. Godovikov. New



Alexander A. Godovikov with colleagues in the expedition to Mongolia, 1988.

original exposition "*Forms of occurrence of minerals in nature*" was created by A.A. Godovikov, V.I. Stepanov and M.A. Smirnova. The book "*Natural Mineral Forms*" was published with A.A. Godovikov's and V.I. Stepanov's text on the material of the exposition in 2003. The book is exceptionally illustrated with photos of samples selected by looking through the entire museum collection. It shows gradual evolution in perfection of crystal shape from almost ideal to such a defective that they can be called whether individual crystals or aggregates depending on forming conditions.

The original exhibitions "*Mineral Systematic*" (by A.A. Godovikov, M.A. Smirnova), "*Karst caves*" which is a part of "*Forms of occurrence of minerals in nature*" exposition (by A.A. Godovikov, V.I. Stepanov and M.A. Smirnova), "*Minerals of Moscow region*" (by V.I. Stepanov) were created in the same period of museum's reconstruction. The exhibitions "*Precious and ornamental stones*" (by M.B. Chistyakova, L.V. Bulgak and M.A. Smirnova), "*Skarns*" (by O.L. Sveshnikova), "*Sources of mineral coloration*" (by A.N. Platonov, T.M. Pavlova, L.A. Kudinova) were renovated. Work on new exposition "*Diversity of mineral species*" also started then and continued by the

staff members of the museum even after A.A. Godovikov has been passed away.

As we noted above A.A. Godovikov, V.I. Stepanov, M.A. Smirnova and other staff members of the museum looked through entire collection of the museum during preparation for the museums reopening. The idea of sorting the samples by quality, their genetic exemplary significance into three collections appeared during the work. Collection "A" was supposed to have unique specimens which have to stay untouched. Collection "B" was considered to contain samples which can provide matter for investigations. Samples from collection "C" should be packed and put away to give space to newly acquired samples. The idea was endorsed by A.A. Godovikov and being materialized by efforts of B.B. Shkurskiy, D.V. Abramov, T.I. Matrosova who looked through tourmaline, zeolite, beryl, pyrite, marcasite samples.

Alexander Alexandrovich invited mineralogist D.I. Belakovskiy create the creating computer database of the collection. Fersman Mineralogical museum of the RAS was the first museum in Russia to have a computer database on exhibits.

Godovikov started showing the museums exhibitions abroad in 1986. The first temporary

thematic exhibition took place in Hungary. After that the exhibitions took place in Czechoslovakia (Prague), France (in Paris), Finland (Helsinki), Germany (Munich), USA (Houston) and Japan (Tokyo). These expositions followed it with a great success and had lots of visitors. It was on those trips with exhibitions abroad when Alexander Alexandrovich took chances to get acquainted with mineralogical collections of different museums in those countries. He photographed unique, showing most illustratively their genetic peculiarities or beautiful samples to acquaint scientists of the museum and also the wide mineralogical public with the well-known mineralogical collections on returning from the trips. He also popularized mineralogy and the Fersman Mineralogical museum itself by giving lectures on its collections and history, showing color slides of the most interesting museums specimens.

Alexander Alexandrovich worked a lot on classification of minerals and on wrote the chapter of new book "*Mineralogy*" in his after period of life. The book was intended to contain description of all known mineral species by that time and to characterize their formation conditions. That monograph had to be the most comprehensive contemporary book on mineralogy. Godovikov had wonderful efficiency. He never had rested on weekends nor had vacations. He usually worked on a next coming book or an article during his vacations implementing his plans. He did plan a lot of things to do. For instance he wanted to write a monograph on inorganic chemistry which would contain all known inorganic compounds and he collected materials for this book and monitored new discoveries in natural sciences: chemistry, physics and biology. Also he planned to write the book on mineralogical collections from various museums of the world. He took color slides of samples from different museums gathering illustrations for this book.

One can imagine from written above that Alexander Alexandrovich devoted all his life to work. He actually possessed real humanness. He loved a lot his mother Elena Alexandrovna, his children and grand children. He helped his elder children to adjust to the new realities of life in 1990s and spent a lot of time educating the youngest son. Alexander Alexandrovich liked to spend his time in the bosom of his family in rare two or three weeks when he was out

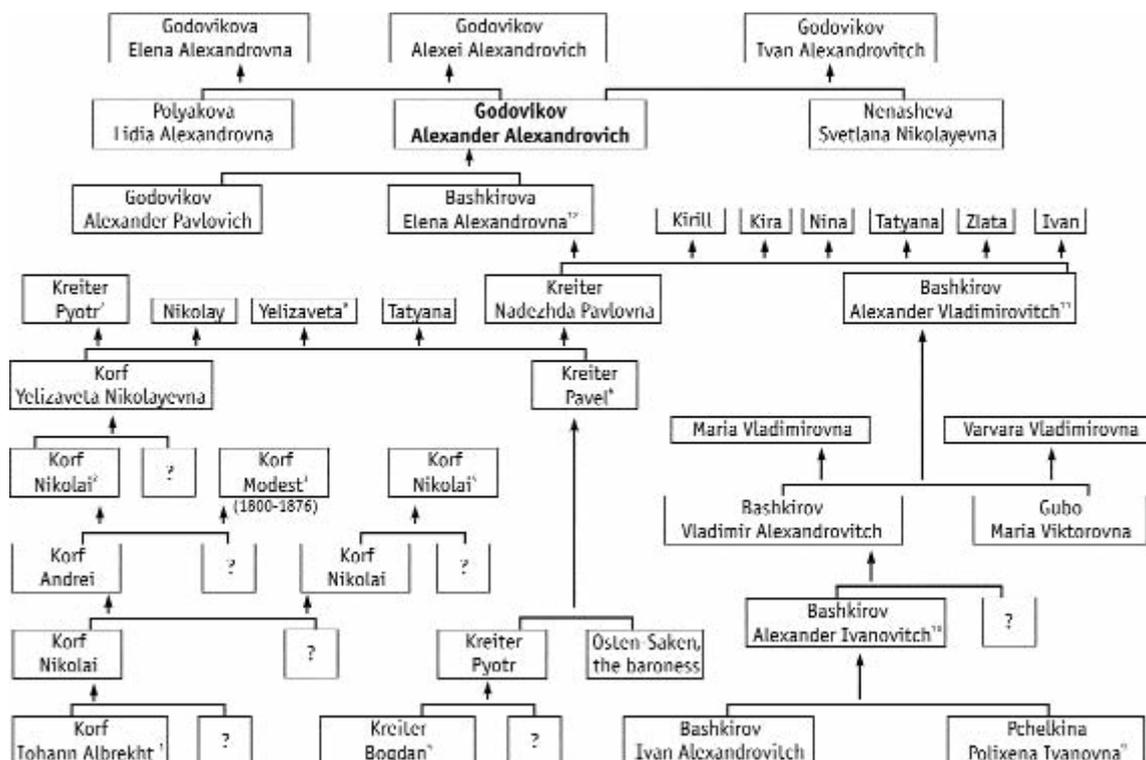
of Moscow on vacation. It means only time after 2 pm because he always worked in the mornings. He liked picking up mushrooms; sprawling out in the sun on a beach, swimming, simply walking in a forest, watching birds, butterflies and insects. He was a man of action and could not spend a minute doing nothing. He always found something to make good for surrounding people: to repair something, to fix, to go buy food. In spite of his very full employment, he had time to do renovation of his apartment by himself and even used to make decent furniture by himself. He was skilful and accurate in doing everything and did everything with gusto. He told his children that it is necessary to do with pleasure. In this case result will well and you yourself will receive pleasure from this result.

A.A. Godovikov was a very exacting person, did not suffer laxity, an indiscipline, and the negligent attitude to work. With the scientists unfairly concerning work, Alexander Alexandrovich did not wish to have anything general and they, accordingly considered him with hostility. But he considered accurate diligent members of collective with respect and warm. He always came with aid to the friends in any complex situations. He helped if he could: advice, the petitions in public organizations in different occasions, the organization of the rest, treatment.

Alexander Alexandrovich believed, that each researcher has the right to the point of view on any question and consequently very attentively listened to other treatment of each fact, other hypotheses opposed with the reasons, easy tried to convince the correctness and if it was not possible, concerned it with understanding, thought of, whether he was mistaken. Never tried to press, somehow to pursue the person for other ideas, was not vindictive, very quickly forgot the offences and if he saw, that the person can benefit business, he employed him, despite disagreements in any questions.

Last years A.A. Godovikov considered above ways of development of mineralogy as science. The monograph "The brief sketch on history of mineralogy" was written, but the publication also could not be seen by the author. Much from conceived Alexander Alexandrovich had not time to make, many materials collected by him remained not used. This stresses that he was not ordinary person, the person with a big potential,

The genealogy of Alexander Alexandrovich Godovikov by the Maternal Line



Korf family

1 Johan Albrecht Korf came to Russia in 1730 in the encirclement of Tsarina Anna Ioanovna. A baron, a Kurland knight. Had a brilliant education. An atheist, a bibliophile and an alchemist. Was the President of the Academy of Sciences. Organized the "Russian Assembly" attached to the Academy where Russian philologists were studying themselves the Russian language and consequently they composed the "Explanatory Dictionary of Russian Language". The task of J.A. Korf's activity was to educate young Russian scientists. So talented young people were sent to foreign Universities for their education; among them — M.V. Lomonosov, D.I. Vinogradov, G.V. Rikhman. Korf supported V.K. Trediakovsky (a bashful, but talented poet). After the duel Johan Albrecht became an ambassador. There is written about him in V. Pikul's book "Word and dead" from Anna Ioanovna's time.

2 Nikolay Andreyevich Korf (1834–1883) — a notable Russian teacher and methodologist, a progress-minded worker of public education. There is an article about him in BSE.

3 Modest Andreyevich Korf (1800–1876) — a historian. In Brokgauz and Efron's Dictionary is written that a work about Decembrists' revolt belongs to his pen. In 1834 — State Secretary. In 1864–1872 — chairman of the department of law of the State Council. There is an article about him in BSE.

4 Nikolay Nikolayevich Korf (organizer of schools in the countryside of Russia).

Kreiter family

5 Bogdan Kreiter came to Russia in 1730 in the encirclement of Tsarina Anna Ioanovna.

6 Pavel Petrovich Kreiter — an ambassador in Italy, then in France.

7 Pyotr Pavlovich Kreiter was married Tatyana Mikhaylovna Puschina, daughter of colonel Mikhail Nikolayevich Puschin (1846–1877) who was killed in the war. His father Nikolay Nikolayevich was the cousin of Ivan Ivanovich Puschin, a Decembrist. They were both grandsons of admiral Pyotr Ivanovich Puschin.

8 Yelizaveta Pavlovna Kreiter was married doctor Yevgeniy Mikhaylovich Ivanov.

Bashkirov family

9 Polyxena Ivanovna Pchelkina, maid of honour in the Tsarina Yelizaveta's encirclement. Voluntary governess of Ioann Antonovich (son of Tsarina Anna Leopoldovna, granddaughter of Tsar Ivan V, brother of Emperor Peter the Great). There is written about Pchelkina in V. Danilevsky's novel "Mirovich".

10 Alexander Ivanovich Bashkirov — marshal of nobility of Tulskeya province. His photo is exhibited in the Orel Museum of Regional Studies. Was married Varvara Alexandrovna Yevreinova. Had got 16 children.

11 Alexander Vladimirovich Bashkirov — a translator from French. Translated a book about the Inquisition.

12 Elena Alexandrovna Bashkirova was married Alexander Pavlovich Godovikov, a worker of the higher level of skill — a gauger.

BSE — Bol'shaya Sovetskaya Entsiklopediya (Grand Soviet Encyclopaedia). M.: Sovetskaya Entsiklopediya, 1969–1978.

profound knowledge, inquisitive mind and the person of huge working capacity.

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