PLISKA
STUDIA MATHEMATICA

ПЛИСКА
МАТЕМАТИЧЕСКИ
СТУДИИ

Pliska Stud. Math. **24** (2015), 13–20

PLISKA
STUDIA MATHEMATICA

IN MEMORY OF N. A. DMITRIEV

Nikolay M. Yanev*

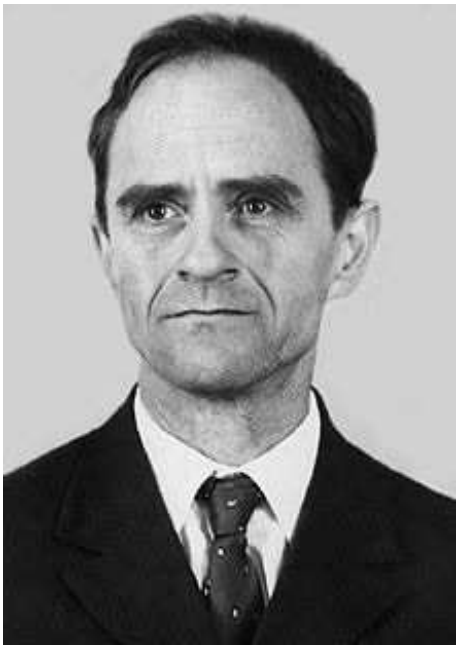
It is an unusual story for Nikolay A. Dmitriev (1924–2000) born in Moscow, whose father was from an eminent Bulgarian family. His grandfather has taken active part in the Bulgarian struggles for the liberation against the Ottoman Empire together with the national poet and hero Hristo Botev. Only 14 years old Nikolay became a winner in the Russian Mathematical Olympiad and the youngest student at Moscow State University. After that he was a PhD student of A. N. Kolmogorov in Steklov Mathematical Institute and the creator together with him of the modern theory of branching stochastic processes which could be interpreted as mathematical models of nuclear reactions and a lot of other real phenomena. N. A. Dmitriev has been working all his life as a researcher in a secret scientific organization and was one of the creators of the atomic and hydrogen bombs. He was a coauthor and collaborator with well-known mathematicians and physicists as Keldish, Gelfand, Dynkin, Zeldovich, Hariton, Kurchatov, Frank-Kameneckii, Saharov, Bogolubov, Tamm and others.

Recall that the term "branching processes" was introduced for the first time in the paper of *A.N. Kolmogorov and N. A. Dmitriev "Branching Random Processes", Dokl. Acad. Nauk SSSR, 56 (1), 1947, 7–10. (See, English transl., Selected works of A. N. Kolmogorov, vol. II: Probability theory and Mathematical Statistics, Kluwer, Dordrecht, 1992, paper No. 32).*

In fact, the modern theory of branching processes started with this paper, where the multitype Markov branching processes with discrete and continuous time were rigorously defined. The authors introduced appropriate multivariate probability generating functions and showed how this powerful mathematical tool

*The research was partially supported by the National Fund for Scientific Research at the Ministry of Education and Science of Bulgaria, grant No. NFSI I02/17.

Nikolai Aleksandrovich Dmitriev
(27.12.1924–23.09.2000)



can be successfully apply in obtaining well-known today functional and differential equations.

After the appearance of this seminal paper the name of N.A. Dmitriev was not possible to be found in the scientific literature and only after his death one could learn about his remarkable scientific and personal life story, see *Nikolai Aleksandrovich Dmitriev (Obituary). Uspekhi Mat. Nauk,56:2, 2001, 204–208. English transl., Russian Math. Surveys, 56:2, 403–408.*

Nikolai A. Dmitriev (1924–2000) was born in Moscow to a father from an eminent Bulgarian family. His grandfather Kostadin Dimitrov (1850–1907) was the eldest son (out of five children) in the family of Dimitar K. Dimitrov (1826–1864) and Penka D. Hristova (1826–1896), both from the town of Sliven, Bulgaria. The great-grandfather Dimitar was an Orthodox priest and took part in the Bulgarian National Revival in the end of the 19th Century. Kostadin began his education in Sliven. In 1872 he continued his studies in the Military School of Odessa, Russia. In 1876 he learned that the great Bulgarian poet and national hero Hristo Botev (1848-1876) was organizing an armed resistance against the

Ottoman Empire for the liberation of Bulgaria. Kostadin joined the rebels on May 8, 1976.

Botev devised an ingenious plan for crossing Danube into the Empire without immediately alerting either the Romanian or the Ottoman authorities. The 200 rebels disguised as gardeners embarked in groups the Austro-Hungarian passenger steamship Radetzky at several Romanian ports. When the last group was taken on board at Bechet the rebels retrieved their concealed weapons and seized control of the ship. (This incident was later commemorated in a popular poem and song.) Botev confronted the captain Dagobert Englnder, stated his intent to reach the Ottoman side of the Danube and explained the political motivation behind his actions. Englnder was so moved by Botev's impassioned speech that he rendered full support and even later refused to cooperate with the Ottoman authorities who requested the use of his ship to pursue the rebel company. Botev disembarked near Kozloduy and together with every member of the company ritualistically kissed the soil of the Homeland.

Kostadin took part in all battles. Wounded, he was hiding in Sofia for three months. He was one of the few rebels who survived. Finally he successfully escaped in Russia via Istanbul with a forged passport. Changing his name to **Konstantin Dmitriev**, he graduated from the Military School in Odessa. Then he served as a military officer in the Russian Army and took part in the Russian-Japanize war as a staff officer. He married Maria P. Minkova, also from the town of Sliven, and they had two children: Alexander and Maria. Alexander Konstantinovich Dmitriev (1893–1941) was born in the town of Holm (today in Poland). He graduated from the Military School in Polotsk and after that from the Artillery Academy in St. Petersburg. He became a military officer and took part in the First World War. During the Russian Civil War he served in the White Army but was captured and forced to join the Red Army. After the demobilization in 1922, he was overseeing the Red Army arsenal in Kiev but soon was dismissed. In 1923 Alexander married the music teacher Valentina Markovna Gorkovaya (1897–1972) in the town of Taganrog. Soon after that the family moved to Moscow. On 27 December 1924 their first child Nikolai (Kolya) was born. Alexander and Valentina had three other children: Boris (1926), Elena (1931) and Alexey (1938).

In 1927 Kolya's father Alexander was arrested and exiled to the northern part of Tyumen Province (Siberia). The family was interned in the town of Tobolsk where Alexander joined them in 1930. It was there that the extraordinary abilities of Nikolai were discovered. He learned to read by himself from children's blocks before the age of four. At the age of six he already read and understood a num-

ber of popular science books that interested him. Before he turned nine, Kolya's parents had begun home-schooling him in mathematics, physics, languages, and other subjects. Friends of the father notified the provincial department of education about the abilities of his son. An education inspector from Ekaterinburg (Sverdlovsk during Soviet period) arranged for the family to move to Sverdlovsk after became convinced that Kolya was a highly gifted child. Soon Kolya was sent to Moscow, where he was examined by a committee chaired by the Commissar of Education (Minister) A. S. Bubnov and N. K. Krupskaya (the wife of V. I. Lenin). It became clear that Kolya already knew the entire middle school mathematics. Because of this, Kolya was enrolled in the fourth grade of the Radishchev experimental model school, where the lectures were delivered by eminent mathematicians such as Lusin, Kolmogorov and Berg among others. Individual studies were arranged for him in Mathematics and French, and he was given a generous scholarship (500 rubles, which was more than his father's salary). Kolya's family was assigned three rooms in a new five-room apartment in the center of town. The Moscow newspapers of the time wrote about Nikolai as a phenomenon that appears "once in a century". Kolya won the Russian Olympiad in Mathematics at the age of fourteen and became the youngest student in Moscow State University, the Department of Mechanics and Mathematics.

At the beginning of the Second World War his father Alexander went into the militia and perished without trace in the defense of Moscow. His mother and her young children were evacuated to Bashkir. Kolya was evacuated from Moscow together with the university, first to Kazan and then to Ashkhabad. There Kolya, a teenager suffering from malnutrition and from the unsettled state of his life, became seriously ill. He was saved from death by the vigorous actions of leaders of the university. In 1942 the university was moved to Sverdlovsk, and in 1943 it was returned to Moscow. In 1944 his mother and her young children came back to Moscow too.

Nikolai A. Dmitriev graduated from the university in 1945 and was enrolled as a postgraduate student. He wrote his first research paper, jointly with E. B. Dynkin, on the characteristic roots of stochastic matrices. He was then transferred to the postgraduate program at the Steklov Institute of Mathematics, where his advisor was A. N. Kolmogorov.

In 1946 Kolmogorov created a special seminar on Branching Processes in Moscow State University where after the first paper by Kolmogorov and Dmitriev, two other fundamental papers of Kolmogorov–Sevastyanov (1947) and Yaglom (1947) appeared. B. A. Sevastyanov (1923–2013) and A. M. Yaglom (1921–2007) were also Ph. D. students of Kolmogorov. This famous seminar worked many

years after that under the leadership of Sevastyanov and played an important role in the development of the theory of branching processes.

Branching processes can be interpreted as mathematical models of division and multiplication of different objects (particles) in Physics, Chemistry, Biology, Demography, Economics and Finances, Technologies, and so on. The nature of the objects can be quite different: elementary particles, photons, electrons, atoms, molecules, gens, cells, viruses, bacteria, animals, people, some kind of information, finances, and etc.

In fact the attention of Kolmogorov was attracted by possible applications of branching processes in modeling of nuclear reactions.

In 1946, at the age of 22, N. Dmitriev was recruited as a research assistant in the uranium project, and was transferred to Zeldovichs group at the Institute of Chemical Physics. In 1948 this group was moved from Moscow to the secret town of Sarov, to Design Bureau no. 11 (KB-11) in Laboratory no. 2 of the Academy of Sciences. Eventually KB-11 became the Russian Federal Nuclear Centre: VNII'EF, where Soviet atomic and hydrogen weapons were created. Here, surrounded by the most prominent scientists such as Yu. B. Khariton, Ya. B. Zeldovich, A. D. Sakharov, D. A. Frank-Kamenetskii, E. I. Zababakhin, N. N. Bogolyubov, and I. E. Tamm, the brilliant talent and broad knowledge of Dmitriev was further developed and applied. He became one of the main creators of formidable nuclear weapons developing and applying branching processes. In their evaluations the leaders of KB-11 praised Dmitriev as one of the most gifted, qualified, and valuable scientists in KB-11. The unique analytical computations performed by Dmitriev were important for the success, in the absence of computers, of the first atomic bomb tests. For example, he worked out a perturbation theory for critical assemblies; he developed a theory of incomplete atomic explosions (together with Zeldovich and Frank-Kamenetskii); for the first time here it was shown that the density of neutrons at the interface of two media has a logarithmic singularity; he developed , using the method of delayed coincidences, a theory for directly determining, under laboratory conditions on the reactor, the quantity lambda that is fundamental for the development of a nuclear explosion. This outstanding idea became a breakthrough event in the scientific life of the institute. A special team led by Khariton and consisting theoreticians and experimentalists (Zeldovich, G. N. Flerov, Frank-Kamenetskii, V. Yu. Gavrilov, D. P. Shirshov, and A. I. Veretennikov) was elected to measure the effect. The participants of the tests was most surprised that the results of the measurements fell precisely on the curves predicted by Dmitriev.

In 1952 N. Dmitriev developed methods for computing solution critical sys-

tems, which were proposed by Flerov in order to economize on scarce fissionable materials. Dmitriev took part in the first tests with such systems, carried out personally by Kurchatov and Flerov. These tests served as a basis for the creation of impulse nuclear reactors, which are still used. In the same year Dmitriev together with Yu. A. Trutnev studied the inverse Compton Effect in elastic scattering of quanta on electrons in a plasma. The results of this work were important for a more complete understanding of the physics of thermonuclear explosions.

In 1955 N. Dmitriev was appointed Head of the Mathematics Branch. His ideas and projects during this period played an essential role in the further development of nuclear weapons and in the emergence of modern computational mathematics. The work of the mathematicians was carried out in close contact with the Applied Mathematics Branch of the Steklov Institute of Mathematics, where there were such prominent mathematicians as V. S. Vladimirov, I. M. Gelfand, S. K. Godunov, A. A. Samarskii, A. N. Tikhonov, N. N. Yanenko, and the President of the Academy of Sciences M. V. Keldysh. These researchers showed great respect for the brilliant talent and work of Dmitriev. This was a period of rapid development of nuclear weapons in connection with the transition to a new binary scheme of nuclear charges and with the installation of the charges on intercontinental missiles and other carriers. It became urgent for mathematicians to carry out, before the nuclear testing moratorium, massive "emergency" computer calculations of problems specific for given types of charges and, first and foremost, for one-dimensional problems of gas dynamics with heat conduction that had to be solved for symmetrization of the operation of the secondary charge assembly.

In this connection the computer programs developed essentially by Dmitriev contained all the basic principles for constructing modern complexes of computer programs: modularity, a language for describing the initial data, a language for describing the calculation results, a library of standard substances, a library of equations of state, boundary conditions, and so on. Also of importance for the success of the first thermonuclear bomb tests were Dmitriev's development of methods for numerically computing the equation of state of structural materials under extreme conditions of a nuclear explosion, methods for numerically solving neutron problems by the Monte Carlo method, and many other methods.

At the end of 1959 N. Dmitriev moved to the theoretical subdivision of the institute and worked first as a senior researcher, and then from 1967 to 1986 as the Head of the Theoretical Branch. His activities expanded in this period. Among the theoretical physicists and mathematicians of all ranks he began to function more frequently as a consultant. These contacts stimulated much new

and fundamental research work at the institute. For instance, an interesting result was Dmitriev's exact formula for determining the cold pressure in a crystal directly from the wave functions of a stationary state of the system. An exact solution is a rare event in the big science. This result is undoubtedly classical in the realm of statistical physics.

One is struck by the breadth of Dmitriev's scientific interests and by the ease with which he mastered branches of knowledge that were new for him: gas dynamics, nuclear physics, quantum mechanics, thermodynamics, computational mathematics, and many others.

In the Obituary (published in UMN) one can find the list of 27 publications, most of them are joint works with well-known scientists in the field of Mathematics and Physics. Note that N. A. Dmitriev published also more than 80 papers, which are classified.

For his selfless work and his great creative contribution to the foundation of nuclear and thermonuclear charges N. A. Dmitriev was awarded several prestigious State Orders and State Prizes.

He loved his family very much. He usually spent his holidays with family members outdoors in the nature, on walking tours in remote places or canoe trips along small rivers.

In his life N. Dmitriev was very modest, unselfish, and upright human being. He distinguished himself in his political positions by his high principles. For "politically incorrect" opinions he received three serious reprimands, which were later withdrawn because his political foresight turned out in time to be true. But the most important for him were the relations of the colleagues and Dmitriev was highly respected by them. Zeldovich said: "Kolya was blessed by God". Frank-Kamenetskii called him "the source of wisdom". Gamov wrote: "The base of his ethics was the aspiration to the truth. It was not possible to be declined from the discovered by him truth".

Unfortunately, with the exception of the 1948's paper, Dmitriev's works on branching processes and their applications are not available to the public. However, even this single paper is sufficient to reserve his place among the founders of the Theory of Branching Processes.

REFERENCES

[1] A. N. Kolmogorov, N. A. Dmitriev. Branching Random Processes. *Dokl. Acad. Nauk SSSR*, **56 (1)** (1947), 7–10. (See, English transl., Selected

works of A. N. Kolmogorov, vol. II: Probability theory and Mathematical Statistics, Kluwer, Dordrecht, 1992)

[2] N. A. Dmitriev. Nikolai Aleksandrovich Dmitriev (Obituary). *Uspekhi Mat. Nauk*, **56:2** (2001), 403–408.

[3] A. N. Kolmogorov, B. A. Sevastyanov. The calculation of final probabilities for the branching random processes. *Dokl. Acad. Nauk SSSR*, **56(8)** (1947), 783–786. (See, English transl., Selected works of A. N. Kolmogorov, vol. II: Probability theory and Mathematical Statistics, Kluwer, Dordrecht, 1992)

[4] A. M. Yaglom Certain limit theorem of the theory of branching random processes. *Dokl. Acad. Nauk SSSR*, **56(8)** (1947), 795–798. (in Russian).

Nikolay M. Yanev
Department of Operations Research, Probability and Statistics
Institute of Mathematics and Informatics
Bulgarian Academy of Sciences
1113 Sofia, Bulgaria
e-mail: yanev@math.bas