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MYKHAILO KRAVCHUK - PRIDE AND GLORY OF UKRAINIAN SCIENCE (27.09.1892 - 9.03.1942)

27 вересня 2017 року виповнилося 125 років від дня народження видатного українського математика, громадського діяча, академіка Михайла Кравчука. Висвітлено життєвий та творчий шлях всесвітньо відомого вченого, життя якого було трагічно обірване сталінським режимом. Повернення з небуття імені талановитого українського математика Михайла Кравчука є справою честі сучасної України.

On September 27, 2017 we celebrated the 125th anniversary of Mikhaïlo Kravchuk, a prominent Ukrainian mathematician, academician, and public figure. The article is about his life and scientific work which was ruined by Stalin's regime. It's the matter of honor for modern Ukraine to rehabilitate the name of a gifted Ukrainian mathematician M. Kravchuk.



"My love is Ukraine and mathematics"
M.P.Kravchuk

"Your name has been written
on the tablets of math history forever"
Zh. Adamar

1. Introduction. Mykhailo Pylypovych Kravchuk (1892-1942) is one of the most outstanding Ukrainian mathematicians of the 20th century. He is a widely known scientist, educator, civic leader, academician of the Nationwide Ukrainian Academy of Sciences. His life experience had transited from Volyn to Kolyma. Mykhailo Pylypovych Kravchuk was born on the 27th of September, 1892 in the village of Chovnytsa, Kivertsi county on Volyn, in the family of surveyor. The future scientist had spent his childhood in the picturesque village on the bank of the Konopelka river.

2. Family. His father, Pylyp Yosypovych Kravchuk, the son of a shoemaker, had graduated from Petrovsk - Rozymovsky Academy in Moscow (today Moscow K. Timiryazev Agricultural Academy). His mother, Frederika, had a Polish origin, and was a very educated woman; she was fluent in Polish, French, and German and played the piano. Frederika came from a poor family. She worked as a governess in Rafalivka, where she had met Pylyp Kravchuk.

Mykhailo was the third child in the family after Constantine and Victoria, and the fourth one was Eva. The mother was mostly engaged in the children's upbringing and



preparing them for the gymnasium because the father's work of the land surveyor took a lot of time. The family members spoke Ukrainian, although mother also taught them Polish, French and German. Mykhailo studied willingly, and demonstrated diligence and perfection from early childhood. When he was in the primary school, he sometimes got B marks. Later, while studying in the gymnasium, Mykhailo got only A marks for all subjects and behavior.

3. Education. Mykhailo Kravchuk had graduated from the gymnasium of Lutsk in 1910 with a gold medal and entered the mathematical department of the Faculty of Physics and Mathematics of the St. Volodymyr Imperial University in the city of Kyiv. Such prominent scientists as V. P. Ermakov (1845-1922), D. O. Grave (1863-1939), H. V. Pfeiffer (1872-1946), B. Ya. Bukreyev (1859-1962) were his first teachers at the university. The creative atmosphere of the scientific seminars on the theory of groups and the theory of elliptic functions under the direction of professor D. O. Grave encouraged the development of his mathematical abilities, woke up his interest to something new, influenced on his choice of directions for the first scientific searches and

researches.

During his years of study Mykhailo Kravchuk published his first independent research on the theory of commutative matrices. The research was published in 1914 in "The Notes of the Kharkov Mathematical Society". In this work he generalized the well-known theorem of the German mathematician Schur about the upper limit of the number of linear independent matrices of the n th order of the residual group, specifying on the types of matrices corresponding to the above generalization.

After graduation from the University in 1914, on the request of professors D.O. Grave and B. Ya. Bukreyev, Mykhailo Kravchuk stayed at the university for preparation for a professor's rank.

4. The beginning of scientific work. Because of the evacuation of the university to the east due to the approach of the military actions and closure of the university library, M. Kravchuk had to move to another university in the winter of 1915-1916. In the winter of 1915, Mykhailo Kravchuk arrived to Moscow, where he met many leading mathematicians, attended scientific seminars, in particular a seminar on the theory of functions of professor D. F. Egorov, listened to the lecture series of professors M. M. Luzin, B. K. Mlodzeyevsky and others.

After returning to Kiev Mykhailo Kravchuk successfully passed master's exams, and on September 5, 1917 Mykhailo Kravchuk had conducted his first so-called test lecture on the subject of pure mathematics "On the functions that prove the theorem addition". Later, he had conducted his first lecture on the theory of sets and had won the title of private assistant professor. Since then, the intense titanic work of M. Kravchuk, devoted to the development of Ukrainian science and education, had begun. He taught mathematical disciplines at the Ukrainian National University, Polytechnic, Architectural, Veterinary-Zoological and Agricultural Institutes and in the first and second Ukrainian gymnasias.

During this period, M. Kravchuk had published his course on geometry lectures and his



first translation of the famous textbook on the geometry of Kiselev into Ukrainian. Together with academician Fyodor Kalinovich he had composed and published a three-volume Ukrainian mathematical dictionary.

In the difficult years of the civil war, M. P. Kravchuk left Kyiv with his young wife Esfira Yosypivna (1894 - 1957), whom he married in 1918, for the village of Sawarka, Boguslav district. There, Mykhailo Kravchuk had been working as a school principal and mathematics teacher from 1919 till 1921. The new teacher radically changed teaching methods and awakened students' interest in science and independent creativity. One of his students at this school was Arkhip Lyulka. In a while Arkhip Mykhailovych Lyulka (1908-1984) had become a world known famous scientist, academician, general designer of aviation engines, the creator of the world's first turbo-compressor and turbo-jet engines.

5. Return to Kyiv and getting Ph.D. degree. After returning to the university, Mykhailo Kravchuk had plunged into the scientific activity. During the early 20s he had obtained fundamental results in the theory of variable matrices, the theory of bilinear forms and linear transformations, which he had used as the foundation of his dissertation on mathematics for the degree of Ph.D., which was successfully defended on December 14, 1924. It was the very first dissertation, defended in Ukrainian SSR. Subsequently, M. P. Kravchuk became interested in the questions of generalized interpolation.

In 1925 M. P. Kravchuk was awarded the

title of professor.

6. Kravchuk's international relations.

The mathematical interests of the scientist were expanding, his works were marked with the originality of ideas and non-standard approaches to mathematical problems. In September 1928, Mykhailo Kravchuk participated in the International Mathematical Congress in Italy (Bologna). On his way to Italy, he spoke at a meeting of the Mathematical Society in Paris. At the congress, the young Ukrainian professor established friendly relations with famous scientists from France, Italy, and Germany: J. Adamar, R. Kurant, F. Tricomi, T. Levi-Civita, D. Hilbert and others.

Here is an extract from the letter of the well-known French mathematician Jacques Hadamard (1865-1963) to M. Kravchuk, "Dear friend, I finally got your promised scientific works. Both ones pleasantly impressed me with their novelty. Such complex problems and such simple solutions! Only the genius could manage doing it! Can't guess how long you will live, but what is for sure is that your name is already written forever on the tablets of mathematical science ... ". Mykhailo Kravchuk was the first Ukrainian to successfully present domestic mathematics on international level. He also participated at the mathematical congress in Zurich in 1932, where he made a presentation on the problems of moments.

7. Kravchuk gets a rank of academician. In 1929, more than 30 organizations nominated M. Kravchuk as a valid member of the Ukrainian Academy of Sciences, and at the Academic Council's meeting he was unanimously elected as an academician. At the age of 37, he became the youngest academician of NASU (National Academy of Sciences of Ukraine). Besides him, D. Yavornytsky, P. Tychyna, A. Leontovich, E. Paton, M. Vavilov, O. Bogomolets, O. Paladin, and many other well-known scientists and cultural figures of Ukraine were given the title of academician at that meeting.

The next eight years were the most fruitful in the work of M. Kravchuk.

The largest (by number of works) part of the scientific heritage of Mykhailo Kravchuk



is devoted to the theory of differential and integral equations. This topic was traditional for the Kyiv mathematicians of the 20-30s.

It's enough to recall the studies of M. M. Krylov, M. M. Bogolyubov, G. V. Pfeiffer and others. Mykhailo Kravchuk had made a great contribution to this section of mathematics. He successfully developed the method of least squares in the theory of approximate integration of differential and integral equations.

Professor Kravchuk investigated the least squares method in two directions; namely, in the direction of reducing the error of approximate solutions and in the direction of proving the convergence of derivatives from these approximations under the corresponding boundary conditions and the corresponding set of functions from which the approximate solution is formed. M. Kravchuk reported about the results of these investigations at the International Mathematical Congress in Bologna in 1928.

The vast majority of Kravchuk's works on the theory of approximate integration is devoted to the development and application of the method of moments to the approximate solving of ordinary linear differential equations, linear equations of mathematical physics, differential equations with partial derivatives and integral equations. The basic idea of the method of moments is to define the function on this interval through moments on the same interval, that is, through integrals

$$\int_a^b f(x)\varphi_i(x)dx, \quad i = 1, 2, \dots,$$

where specified functions are $\varphi_i(x)$.

Professor Kravchuk outlined the most significant results of his work on the theory of moments in his fundamental two-volume monograph "Application of the method of moments to the solution of linear differential and integral equations" (1936).

The first volume is a study of the method of moments in its application to the approximate solving of ordinary linear differential equations and systems of these differential equations. The linear equations with partial derivatives of mathematical physics are considered in the second volume.

Mykhailo Kravchuk had close relations with Scientific Society named by Taras Shevchenko (SSS) which was the first unofficial Ukrainian National Academy of Science. He kept correspondence with Volodymyr Levytsky, the chief of the math-natural section of SSS. Kravchuk and Levytsky worked together on Stirling formula.

Till 1931 M. Kravchuk had published his 8 works in the first Ukrainian scientific magazine founded by SSS. In 1929, M. Kravchuk published his "Report on the Trip to the World Math Congress in Bologna and Paris" in that magazine. Unfortunately, Kravchuk's co-work with SSS stopped in 1930s because of Stalin's punitive measures.



Yevhen (1925 - 1991)
Kravchuk's son



Natalia (1930 - 1983)
Kravchuk's daughter

8. Kravchuk's contribution to the invention of the first electronic computer. In 2001, Kravchuk's two-volume monograph "Applying the method of moments to the solution of linear differential and integral equations" in English was found by



the researcher of M. Kravchuk's works, Ivan Kachanovsky (USA), in the archives of the Smithsonian Museum of American History in Washington DC and the University of Iowa in Ames. The monograph was translated by John Vincent Atanasoff, American mathematician and physicist, inventor of the first electronic computer. In 1937, in a letter to academician M. Kravchuk, J. Atanasoff wrote that the publications of the Ukrainian mathematician appeared to be very useful in his work, and he would like to have copies of all the scholar's works published in Ukrainian magazines.

It's likely that M. Kravchuk was not able to learn about this recognition and the application of his scientific work because he had already begun his "path" to Kolyma, where he died in four years. As J. Atanasoff had not received the response from Kravchuk, on November 16, 1937 he sent another letter to Kyiv to the Association of Cultural Relations with Foreign Countries. He asked whether M. Kravchuk got the letter, and why he didn't answer. At the same time, John Atanasoff informed that their library had ordered all the books by M. Kravchuk through agents in

Germany and asked Kravchuk to send him his two monographs. I. Kachanovsky believed that the monograph, which J. Atanasoff translated into English, was received through German agents. Scientists J. Atanasoff and K. Berry worked fruitfully and in November 1939 the first outlines of the computer ABC (first letters Atanasoff - Berry Computer) appeared. From the end of 1939 to the middle of 1942 they were developing and designing the computer. The machine was designed for the sole purpose of solving large systems of linear algebraic equations. Atanasoff failed to obtain a patent for his ABC and there is the opinion that J. V. Atanasoff didn't claim copyright because he considered M. Kravchuk as a co-author. As an honest and thorough scientist, he admitted that the mathematical basis of the computer ABC was built on the ideas borrowed from M. Kravchuk.

An American scientist Ivan Kachanovsky, a native of Volyn, claimed that the world did not only learn Ukraine through Mykhailo Kravchuk, but also owed him a great step towards progress.

9. Stalin's punitive measures. A difficult time of trial came to M. P. Kravchuk in 1937.

The personal tragedy of the scientist was a consequence of a number of events that took place in Ukraine, in particular, at NASU. The Academy of Sciences had opposed to politicization for a long time, and the tension in the relations between NASU and the state had grown. Selfless work of M. P. Kravchuk in the name of building up Ukrainian science and his authority could not remain unnoticed by the authorities of the totalitarian regime. In autumn of 1929 arrests in the case of the Union of Liberation of Ukraine (ULU) began.

Among the arrested there were many friends of M. P. Kravchuk, people with whom he had scientific and friendly relations. The newly elected academician was offered the infamous role of the "public prosecutor" in the process of ULU. M. Kravchuk, refused to accuse the vice-president of NASU Sergey Yefremov and other scientists. It was clear that because of this refusal his career was over.



Unfortunately, not only the career, but the life itself. . . Since then, they began to collect false evidence of Kravchuk's "spying" and "counter-revolutionary" activities. On September 14, 1937, the newspaper "Communist" published an article "Academician Kravchuk Advertising Enemies", signed by D. Grave, the director of the Institute of Mathematics of the Academy of Sciences of Ukraine, and K. Brus, the scientific secretary of the institute, where it was reported that M. Kravchuk positively evaluated the works of mathematicians who were arrested as "enemies of the nation", in particular his student V. Mozhar, by the NKVD. There appeared different hostile articles in press; shameful meetings to blame Kravchuk took place in the walls of Kyiv Polytechnic Institute and Kyiv University; his former colleagues and students betrayed him. His mathematical achievements were put under the question; he was named a hidden nationalist who tried to participate in anti-Soviet actions.

Only a few people had enough civic courage to stand for the scientist. Among such courageous people were J. Pogrebinsky, Y. Sokolov, O. Smogorzhevsky, M. Chebotaryov, P. Bondarenko and V. Zmorovich.

On February 21, 1938, the leadership of the NKVD of the Ukrainian SSR signed an order №1699 on the arrest of M. P. Kravchuk. On February 21, Mykhailo Kravchuk was arrested; on the same day NKVD carried out a thorough search in the apartment of his family in Kyiv by the address of Engels Street (now Lutheran Street), 21. Two days later, on February 23, 1938, the Presidium of the Academy of Sciences of the Ukrainian SSR,

headed by the President of the Academy of Sciences, O. Bogomolets, decided to withdraw M. Kravchuk, the member of many foreign mathematical societies, from the members of the Academy of Sciences of the USSR.

In the verdict, M. P. Kravchuk was recognized as an active participant and leader of a nationalist organization. As a result, the verdict of the "outgoing session" of the Military Collegium of the Supreme Court of the USSR said 20 years of imprisonment and 5 years of deprivation of political rights. Mykhailo Kravchuk filed two complaints, explaining that he was under moral and physical pressure, but there were no answers to the complaints. He was sent 10 thousand kilometers from Kiev to Vladivostok, and from there in the hold of the dry cargo vessel "Juma" to Magadan, and then to the sinister Kolyma mines, where the prisoners were kept in inhuman conditions: the freezing temperatures reached 60 degrees below zero and the daily rate for mining was a half of ton. Mykhailo Kravchuk could not stand in the slaughter for a long time as he had a sick heart. Tortured by severe conditions, illnesses, having got disability, M. Kravchuk sent the third complaint to Moscow - to the Chairman of the Supreme Court and the Prosecutor General of the USSR. But he didn't receive the answer to his complaint.

Even in those inhuman conditions M. Kravchuk managed to continue his scientific researches in mathematics. He handed his notes on researches and discoveries to the chief of the camp. All those notes had disappeared. "I have made a great mathematical discovery, on which I have been working for 20 years", wrote M. Kravchuk in a letter to his wife (investigatory case №817, volume 2).

According to the political prisoner Mykola Popov, who was lucky to survive, "In these terrible conditions in 1942 in Maldak, I met the Ukrainian academician, the famous mathematician Mykhailo Kravchuk. He was probably fifty years old. Returning from the mine, he used to sit near the iron furnace; he took his papers and made records - some mathematical calculations. I remember well that he periodically handed his work to the

camp chief - only under such conditions he managed to obtain the permission to work ... His place on the bunk was below mine. One morning, from the call of the chief of the camp, "Get up!" Kravchuk did not jump up, as it always had been before. The chief hit him with a stick called the "alarm clock", but the academician did not move - he lay dead ... "

The great academician died on March 9, 1942. Thus, the talented Ukrainian scientist, who had worked until his last breath, passed away. He remained in the permafrost of Kolyma forever...

10. Scientific researches and world's recognition. The scientific works of the Ukrainian mathematician M. P. Kravchuk (over 180 works) refer to different sections of mathematics: algebra and number theory, mathematical analysis and the theory of differential and integral equations, probability theory and mathematical statistics, mathematics history. His scientific works entered the treasury of world science and became a model for imitation.

Scientific achievements of the outstanding Ukrainian scientist are used in various sections of theoretical and applied mathematics:

- symmetric Kravchuk's matrices;
- martingales, Kravchuk's polynomials and multinomial distributions;
- Li's algebras and Kravchuk's polynomials;
- Li's groups, Kravchuk's matrix and group elements;
- quantum probability and tensor algebra, Kravchuk's matrices as their own vectors;
- Clebsch-Gordan's coefficients and Kravchuk's polynomials;
- Kravchuk's transformation;
- Kravchuk's polynomials as hypergeometric functions;
- Gauss's quadratures. Zero polynomials of Kravchuk, Gauss-Kravchuk's summing up;
- theory of coding.

In the recent years there appeared a number of scientific publications in the field of applied mathematics and computer sciences in which the ideas of M. Kravchuk were used. In 2003, the researchers from the University of Malaya (Malaysia) proposed a new method

for image processing and reconstruction where Kravchuk's moments were used. In 2006, Greek scientists reported on three-dimensional search algorithms for the processing of three-dimensional images built on three-dimensional moments of Kravchuk. In 2009, a group of scientists from France, the United States, and Germany demonstrated the effectiveness of using Kravchuk's weighty three-dimensional moments as a data analysis tool to recognize the nature of tumors. The use of polynomials and the Kravchuk's transformation in the theory of coding, which began in the 70s of the 20th century, continues to this day.

The nation will have a future if it remembers and honors its great sons.



The foundations of the Ukrainian revival of science were based on the achievements of the great citizen, the prominent scientist, and mathematician M. Kravchuk. His life became a legend for the present and future generations.

Ukrainian nation, the nation without its own state, had been constantly losing its gene pool in the times of the Soviet Union. Hiding behind the ideology of bizarre illusion, the Soviet government mercilessly killed the best citizens who were the undesirable witnesses of its own misery. This explains the long silence, even after rehabilitation, of the glory of the genius scientist Mykhailo Kravchuk, the man whose name is a pride of our Ukraine.

How difficult it was to raise the name of the repressed scientist from oblivion and collect information about his life and work!

After all, the measure of punishment of M. Kravchuk (it became known from declassified documents), was personally approved by such tyrants as Stalin, Molotov and Zhdanov. Thanks to the efforts of many scientists including the scientists from the United States and Australia the name of Mykhailo Kravchuk had returned to the Ukrainian scientific pantheon. Doctor of Physics and Mathematics, professor of the National Technical University of Ukraine "Kyiv Polytechnic Institute named after Igor Sikorsky" Nina Virchenko has devoted almost 50 years of her life to study the way of life and scientific creativity of the Ukrainian scientist Mykhailo Kravchuk. It's not possible to fully appreciate her contribution to the commemoration of his memory! Streets and gymnasia named after M. Kravchuk, documentary about him, monuments and memorial plaques, publication of his work and books about his life, eighteen international academic conferences named after academician M. P. Kravchuk - all these great things were made thanks to the kind heart of Nina Virchenko.

"Looking back at my life, the credo of which was my life is Ukraine and mathematics, now I add another - Mykhailo Kravchuk and students", said Nina Virchenko. The scientific ideas of Mykhailo Kravchuk will be studied, deepened and developed, because his geni-

us had been far ahead of his time. His scientific work was used by the American and Japanese scientists in the design of television equipment. "Only in 2001 the works of Kravchuk were used in 15 scientific articles in the USA", says I. Kachanovsky. In 1992, UNESCO added the name of M. Kravchuk to the list of the most prominent persons.

REFERENCES

1. My Love is Ukraine and Mathematics. – Anniversary session of the General meeting of the National Academy of Sciences of Ukraine, devoted to the 120th anniversary of Academician M. Kravchuk. – Herald of the National Academy of Sciences of Ukraine. – 2013. – №1. – P. 25-28.
2. *Virchenko N. O.* The Giant of Ukrainian Mathematics. – Kyiv. – Zadruga. – 2007. – 80 pp
3. *Mykhailo Kravchuk* Selected Works. – History and Methods of Mathematics. – Kyiv. – 2014. – 250 pp.
4. *Virchenko N. O.* Mykhailo Kravchuk. – Documentary Works. – Kyiv – 2000. – 218 pp.
5. *Kachanovsky I.* Ukrainian Mathematician M. Kravchuk and the Invention of the First Electronics Computer. – Materials of the IX International Conference named after M. Kravchuk. – Kyiv. – NTUU KPI. – 2002. – P. 6.
6. *Zaderei N. M., Nefodova G. D.* Academician Mykhailo Kravchuk - the Star of Ukrainian Mathematics of the Twentieth Century. – Problems of Perfection of Fundamental Education. – Materials of the XVIII International Scientific-Methodical Conference. – September 23-27. – 2013. – Sevastopol. – P.45-48.
7. *Zaderei N. M., Nefodova G. D.* Mykhailo Kravchuk – Ingenious Ukrainian Mathematician. – XVII International Scientific Conference named after Academician M. Kravchuk". – May 19-20. – 2016. – Kyiv. – Materials of the conference. – P.225-232.