FEATURE INTERVIEW

"New coauthors bring new friends and travels"

Vladimir Sergeichuk Interviewed by Roger Horn[1]

R.H. - You were born in 1949 north of Kiev, near Ukraine's current border with Belarus. During your lifetime, Ukraine has experienced famine, population transfers, a nuclear reactor disaster, the dissolution of the Soviet Union, independence, several revolutions, the occupation of Crimea, and an ongoing armed insurgency in Eastern Ukraine. How did these events affect you, your family, and the scientific community in Ukraine?

V.S. - I was born 32 years after the October 1917 revolution led by the Bolshevik Party of Vladimir Lenin. These years were very hard for the population of the new country. Many events could have prevented me from being born:

My grandfather had a water mill. It was hard work; he had to raise sacks of grain to the top of his mill (which strengthened his health; he lived for 94 years). More than 1.8 million such "prosperous" peasants were deported, mainly to Siberia from 1930–1931, as part of the Soviet program of the collectivization of the agricultural sector. A third of them died from 1929 to 1933. My grandfather was not deported, just because he regularly fed and treated with moonshine the members of the collectivization commission and gave a bribe to its chairman.

My parents got married in 1940, when they studied at the Leningrad Agricultural Academy. My father was drafted into the army at the end of the year. After six months, Nazi Germany attacked the USSR. The Soviet army was not ready for war and only 36% of its soldiers survived the first four months of the war.

Vladimir Sergeichuk (left) with Roger Horn on the shore of Great Salt Lake, Utah, 2002

In the early days of war, the Soviet army retreated erratically. My father was a clerk at the headquarters of the regiment on the border with Germany. A car with staff documents could not pass over a destroyed bridge and was abandoned. The colonel who led the headquarters was shot for this. My father was arrested and also sentenced to be shot. By the third day, he did not care whether he was shot or not. An officer recruited sappers and my father was offered to become a sapper instead of execution. After that, he was not afraid of anything in the war. He believed that he would be killed sooner or later.

At the beginning of the war, my mother studied at the Leningrad Agricultural Academy. A stranger (with whom they later became friends) helped my mother get on the train and leave Leningrad. She saved my mom's life. The Siege of Leningrad (September 8, 1941 to January 27, 1944) resulted in the deaths of over a million Soviet soldiers and civilians. This is more than the loss of US and British troops throughout the war.

The economy of the USSR was developing rapidly until the 1960s, and then growth slowed. The negative trends intensified in 1985, when Gorbachev started reforms to restructure society and the economy, which led to the dissolution of the Soviet Union into 15 independent republics in 1991.

The economy of independent Ukraine was in deep depression until 1999; its gross domestic product had fallen to 40% of the 1991 level. My dentist told me that some of her patients broke their teeth in their sleep, which had not happened before. From 2000–2013, the economy of Ukraine grew every year, excluding its fall by 15% in 2008. My student Andrii Dmytryshyn reminded me recently that in 2007 I said in my lectures that students do not have to leave Ukraine since the quality of life increases each year.

But the economic situation worsened after the Euromaidan (Nov. 2013 – Feb. 2014). On the wave of patriotism, non-specialists came to the leadership of the country. In the first three years, more than half of commercial banks were liquidated; the national currency rate collapsed three times. Many factories were closed because of the embargo on trade

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with Russia. Many Ukrainians left the country. The number of labor migrants from Ukraine to Poland increased fivefold, from 320,000 in 2014 to about 1,500,000. During the years of independence, the number of scientists in Ukraine decreased by a factor of 5.

The first 30 years of the Soviet Union were terrible because of the Stalinist repressions. Nearly one million were executed or exiled from 1937–1938. However, one decision of Joseph Stalin dramatically increased the effectiveness of Soviet science. At the end of World War II, he summoned the Minister of Education and said, "Pay attention to the scientists. They are modest people and will not ask for themselves." He ordered a raise in the salary of scientists by 5–10 times. Academician Alexander Sheindlin wrote: "One fine morning, I woke up rich." Then the salary of scientists gradually decreased. My father headed a department in the Ukraine Ministry of Agriculture. In 1967, he defended his Ph.D. thesis and started to head a department at the Institute of Agriculture. His salary doubled exactly. The last Soviet president, Mikhail Gorbachev, resented that his salary was half the salary of the President of the Academy of Sciences.

I am happy that I studied and became a mathematician in the post-Stalin era, when life in the USSR was most quiet and comfortable. The quality of life of the Soviet people by the 1980s was comparable to that of the Americans. (André Weil said that the Soviet Union and the USA were quantitative civilizations.) The country was socially oriented: free medicine, the best school education system in the world, scholarships for university students, there were no homeless. Full employment, no fear of not being able to provide for the family. Public safety, I was not afraid to walk in Kiev at night. People helped each other. However, labor productivity was low. Heart surgeon Nikolai Amosov believed that socialism contradicts human nature. He wrote that a person is lazy by nature; most people need both positive and negative incentives to work hard, but socialism does not give negative incentives.

R.H. - As a young man, you were interested in relativity and physics. How and when did you get seriously interested in mathematics? What made you decide to become a mathematician?

When I was 12 and 13 years old, I did not do school homework because I went to the chess club every day. I did the right thing. Playing chess, and especially solving chess problems, is almost abstract algebra; they are more useful for the future mathematician than the primitive mathematics which is taught for teens of this age. I played in a qualifying tournament, won first place, and left chess since science is more interesting.

It was the time of the first space flights; interest in science was very high. I read several popular books on the special and general theory of relativity. It was very unlike the physics that was taught in school. I read a textbook on physics for technical engineering and I was amazed at how effectively derivatives and integrals work in mechanics.

At that time, it was difficult to enter Kiev State University. When I entered the mathematics department, only one of seven applicants became a student. They were selected by the results of exams in mathematics and physics that were difficult. For more than a year, I was prepared for the examinations in mathematics by Yuri Prizva, who was a Ph.D. student in the mathematics department and the son of my father's friend. Under Yuri's influence, I entered the mathematics department of the university.

R.H. - You were a student of the great algebraist Andrei Vladimirovich Roiter, who was a student of Dimitry Konstantinovich Faddeev. Roiter had 13 Ph.D. students; please tell us something about how he worked with them, and his influence on your career. Did you have any memorable experiences participating in Roiter's seminar?

I am very happy that I started to work with Roiter when I was a student. Andrei Roiter and his wife Liudmila Nazarova graduated from Leningrad State University in 1960 and began their Ph.D. studies under the direction of Dmitry Faddeev. When Roiter wrote his doctoral dissertation on integral representations of rings, he solved many problems about reduction of matrices, which he considered as secondary. However, after defending his thesis, his opinion completely changed. He started to develop the theory of matrix problems. He is one of the founders of the modern theory of representations of finite dimensional algebras, which is in fact the theory of systems of linear mappings satisfying some polynomial relations; a part of linear algebra.

Crucial to me was Roiter's seminar on representation theory at the Institute of Mathematics in Kiev. Professor Claus Ringel from Bielefeld University called it fantastic. Modern representation theory had just been created and every week the seminar participants told about their new results. It was very instructive to learn from Roiter about his research, the research of other mathematicians, and about his interpretation of new mathematical results. Roiter developed a new direction in mathematics, and so he always had many problems. He generously shared them. In the summer, we all went outside of town to play volleyball. Roiter was a very honest and principled man.

R.H. - Your published work has more than 40 coauthors so far. What do you think of George Mackey's comment that "the advancement of pure mathematics very effectively combines extensive cooperation with rugged individualism"?

I agree with Mackey's justification of his comments: "research in pure mathematics is a very cooperative activity in which everyone builds on the work of someone else and in turn has his own work built upon. On the other hand, mathematicians tend to work alone (and occasionally in pairs) and to be intensely individualistic." Every mathematician solves problems by his own methods. I could not solve some problems without my collaborators. I learn from each of them. Without them, my life would be much duller. New coauthors bring new friends and travels. Immediately after the collapse of the USSR, I was three times in Zurich thanks to collaboration with Peter Gabriel. (He introduced quiver representations. As my supervisor A.V. Roiter said, definitions are more important than theorems.) I lived for about a year in Salt Lake City in Roger Horn's house. (I am grateful to Roger and Susan Horn for their fantastic hospitality.) I was six times in Beer-Sheva, Israel due to Genrich Belitskii. I lived for more than a year in Al Ain (UAE) due to Victor Bovdi. Now I am in São Paulo until May 2020 due to Vyacheslav Futorny. By his invitation, I have been living in São Paulo for more than three years during several visits. I really like São Paulo for its wonderful weather, fruits, and people.

I am also very grateful to my students and coauthors Lena Klimenko, Nadya Shvai (Zharko), Tatiana Gerasimova, Andrii Dmyryshun, and Tatiana Klymchuk. They activate me and add new colors to my life.

R.H. - Camille Jordan's canonical form is a standard textbook topic. The canonical form of his Czech contemporary Eduard Weyr is less well known, but you played a role in its rediscovery and use. Tell us something about that. What are the relative advantages of these two canonical forms?

In 1984, I published an algorithm for reducing a square complex matrix to canonical form under transformations of unitary similarity. From Helene Shapiro's survey [5], I learned that Dudley Littlewood published this algorithm in 1953. I tried unsuccessfully to construct a similar algorithm for a pair of matrices under similarity. Then I found it in Genrich Belitskii's paper [1] published in 1983 in the collection of works of the Kharkov Institute of Low Temperatures. Belitskii's algorithm reduces each matrix pair by simultaneous similarity transformations to a "canonical" pair such that two pairs are simultaneously similar if and only if their canonical pairs coincide. In his algorithm, Belitskii uses a "modified Jordan matrix"; it is permutation similar to a Jordan matrix and has the following property: The set of matrices commuting with it consists of all block triangular matrices, with fixed partition into blocks, in which some blocks must be zero or must be equal.

During 1988–1992, P. Gabriel, L.A. Nazarova, A.V. Roiter, D. Vossieck and I proved the geometric form of Yuriy Drozd's "Tame-Wild Theorem." (I never worked so hard!) It was published in [2]. Still working on the proof of this statement, I began to think about a new proof based on Belitskii's algorithm. I published it in [4]. Presenting Belitskii's algorithm, I used the term "Weyr matrices" instead of Belitskii's "modified Jordan matrices," since their partition into blocks is determined by Weyr characteristics. My article is very complicated; I worked on it for many years. I twice e-mailed preliminary versions of my article to Helene Shapiro and she found these matrices in Eduard Weyr's articles.

R.H. - Please tell us about some of your results that you like best.

My supervisor Andrei Roiter taught me how to reduce matrices. Almost all my articles are on the reduction of matrices or sets of matrices to canonical or simple forms with respect to some set of admissible transformations.

I am proud of the method that was developed by Andrei Roiter and me. It reduces the problem of classifying systems of linear mappings and bilinear or sesquilinear forms to the problem of classifying systems of linear mappings. I applied it to many classification problems, including the canonical form problems for bilinear and sesquilinear forms, pairs of symmetric or skew-symmetric forms, pairs of Hermitian forms, and isometric or self-adjoint operators on a space with indefinite scalar product. In [3], I solved them over any field of characteristic not 2 up to classification of Hermitian forms over finite extensions of the field. Roger Horn and I gave simple canonical forms of real, complex, and quaternion matrices under congruence and $*$-congruence.

I like my articles in which Belitskii's and Littlewood's algorithms are generalized to representations of quivers and unitary representations of quivers; that is, to finite sets of vector spaces or inner product spaces and linear mappings between them. I study canonical forms of their matrices.

I also like the articles in which my coauthors and I construct miniversal deformations of matrix pencils, contragredient matrix pencils, and matrices under congruence and $*$-congruence.

R.H. - What suggestions do you have for young mathematicians beginning their careers?

Actively seek a good supervisor. Choose among those who are actively engaged in research and have articles in leading journals.

Limit yourself. The first chief designer of the Soviet space program, Sergei Korolev, wrote, "Do only the most important, otherwise the secondary will fill your life, take away all your energy, and you will never proceed to the main."

Work hard while you are young. The best age for doing math is under 30; then you can relax. G. H. Hardy wrote, "No mathematician should ever allow himself to forget that mathematics, more than any other art or science, is a young man's game."

Have an exercise-related hobby such as sports or dancing. You need positive emotions when you work hard on a difficult problem for a long time.

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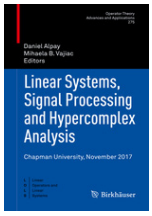

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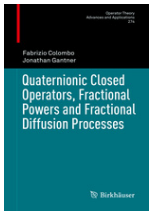

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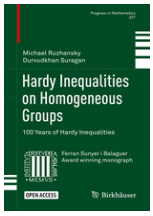

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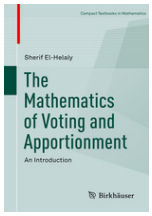

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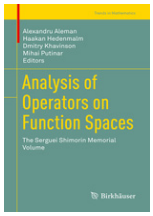

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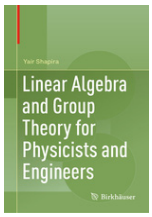

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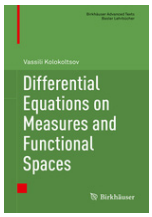

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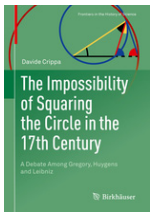

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