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## ALEXANDER VLADIMIROVICH KUZNETSOV

Alexander Vladimirovich Kuznetsov, also known to the second generation of Soviet logicians as Sasha Kuznetsov, was born in Moscow on the 28<sup>th</sup> of October, 1926. He lived a short yet fruitful life and died of cancer<sup>1</sup> in Chişinău, Moldova, on the 24<sup>th</sup> of July, 1984.

Kuznetsov's father, Vladimir Kuznetsov, was an icon painter and Kuznetsov told me once that his father was acquainted with Mikhail V. Neseterov, a prominent Russian painter. Kuznetsov's mother, Lina Artem'evna Kuznetsova, was a custodian. She descended from a dissenter ("old believers"<sup>2</sup>) family in the town of Klintsy, Russia. From the late 1940s until 1962, Kuznetsov and his parents lived in the basement of an old wooden house near the Donskoy Monastery in Moscow, which was founded in 1591. The rooms of their apartment formed a circle so that one could walk through the whole apartment by going from one room into another. When Sasha got involved in mathematics research, he used to walk through the rooms making circles while thinking about a problem. His father died when Kuznetsov was still a young child. He and his mother lived in poverty. His mother could not read but knew the letters of the alphabet. Sasha learned the letters from her and

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<sup>1</sup>Actually, that end was predicted for him in 1979 by a gypsy woman on a shuttle train from the Domodedovo Airport, near Moscow, to Moscow, when he was coming back from the 15<sup>th</sup> All-Union Algebraic Conference held in Krasnoyarsk.

<sup>2</sup>The *Old Believers* (Russian: "starovery" or "staroobryadtsy") is a collective name for several groups of Russian Orthodox believers who left the hierarchy of the Russian Orthodox Church in 1666–1667 as a protest against church reforms introduced by Patriarch Nikon (1605–1681).

figured out how to form words by himself. Even before he started school at the age of seven, he was able to read.

Kuznetsov belonged to the first generation of Soviet people born after the Bolshevik Revolution and he passed away before the collapse of the Soviet Union. Although he was never a dissident against the Soviet regime, he remained critical of it throughout all of his adolescence. Part of this attitude was due to his intolerance to any form of administrative or bureaucratic authoritarianism, which penetrated all levels of Soviet society. A stubborn teenager, he was not very comfortable with figures of authority, especially when disagreements arose about scientific work in the field of mathematical logic and about mathematical logic itself.<sup>3</sup> His life was marked by confrontations with school authorities since the first grade of elementary school, when his behavior caused him to be suspended from school in the middle of the academic year. When he came back to school the next fall, he refused to stay in the first grade for another year to complete the program. The principal allowed him to start the second grade after Sasha promised to catch up on first grade material while taking second year classes. He kept his word and stayed in school until the sixth grade, during which he dropped out. Thus his documented education comprises a period between incomplete first and sixth grades.

Kuznetsov would never formally be a student again. But informally and, in part, illegitimately, he began attending classes at Moscow State University (MGU) in September of 1946, before his twentieth birthday in October.<sup>4</sup> As a non-matriculated student, he had the advantage of being able to choose classes, which was not allowed for ordinary students by the Soviet education system at that time. He began with introductory courses in mathematical logic, taught by Sof'ja A. Janovskaja (also Yanovskaya), and in algebra, taught by Alexander G. Kurosh. As he gained more knowledge and more learning experience, he attended Kurosh's *General Algebra* class, i.e. *universal algebra* as we call it today, and *Theory of Functions of Real Variables*, taught by Dmitri E. Menshov. Although Kuznetsov did not contribute to the

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<sup>3</sup>E.g., as the secretary of the seminar "Mathematical Logic and Philosophical Problems of Mathematics" (about this seminar see further in the text), he put his signature in the resolution of the seminar in defense of Boris A. Trakhtenbrot in the so-called "Penza Affair" of the latter's. (See B. A. Trakhtenbrot, "In Memory of S. A. Yanovskaya (1896–1966) on the Centenary of Her Birth", *Modern Logic*, vol. 7, no. 2, 1997, pp. 160–187.)

<sup>4</sup>Kuznetsov told me once that, when he was a teenager, he liked going to popular science lectures that occurred in the Gorky Central Park in Moscow. Those lectures inspired him one day to head to MGU.

field of functions of real variables, later on in his fifties he named Menshov among the scientific figures that had a deep influence on him in his development as a mathematician. In the fall semester of 1950, Kuznetsov attended a course on algebra of logic, taught by Petr S. Novikov<sup>5</sup>, and, in 1955, he attended Novikov's course on constructive (i.e. intuitionistic) mathematical logic, which also had a long lasting impact on him.<sup>6</sup>

As for Kurosh's lecture on universal algebra, Kuznetsov tried to take it three times and only on the third try could he understand it to the most subtle detail. When the course was later published as a book, *Lectures on General Algebra*, his favorite question to pose to all his graduate students from the book was Fujiwara's First Theorem, where in the proof of the theorem the Axiom of Choice had to be applied twice though it was not mentioned at all by the author.

Kuznetsov preferred effective proofs, that is, when the Axiom of Choice could be eliminated, as well as constructive proofs, that is, when the double negation law could be eliminated. He thus infused his pupils with this preference. However, Kuznetsov was never a follower of constructive methods but regarded them as a possibility. He wrote in his address to the 17<sup>th</sup> International Congress of Mathematicians:

“One might also criticize the laws of intuitionistic logic—either from the standard point from the so-called “paradoxes of implication”, which lead to different logics of rigorous implication; or from the point of view of accounting for the peculiarities of quantum-mechanical problems (in this case one axiom is doubtful [...]); or in the light of immersion not in S4, but in weaker modal logic. Moreover, I am keeping to the view that none of fixed logic may be suitable in all the situations, for all the cases of life; therefore a general investigation of different large classes of nonclassical logics is useful.” (*Proceedings of the International Congress of Mathematicians*, Vancouver, 1974)

One might surmise that Kleene's *Introduction to Metamathematics* made

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<sup>5</sup>Petr Sergeevich Novikov was an eminent Soviet mathematician, a member of the Academy of Sciences of USSR. He set forth the Department of Mathematical Logic at the Steklov Mathematical Institute and was its first chairman. Kuznetsov, not far from his death, named Novikov first to me among his teachers.

<sup>6</sup>Kuznetsov's notes, along with others', were used while the course was prepared for publication as a book, *The Constructive Mathematical Logic From the Point of View of the Classical*, printed already after Novikov's death in 1977. Novikov's informal interpretation of the intuitionistic logic through process of weighing, discussed in class, which was not reflected in the book, inspired Kuznetsov to start his search, along with the author, for provability interpretation of the intuitionistic propositional logic.

a decisive impact on him, particularly in the respect of causing him to emphasize the distinction between constructive and non-constructive proofs. The book was published in Russian translation in 1957, and regarded as a logic bible in the Soviet logic community in the 1950s and 1960s. When Kuznetsov started his school of mathematical logic in the mid-1960s, he assigned this book to his graduate students for their doctorate qualification exam.

Returning to his education, one would hardly have a right to say that Kuznetsov was self-educated. In fact, he had a mentor—Janovskaja. Kuznetsov began attending her introductory logic class because the material did not require knowledge of mathematics beyond high school curriculum. Although he did not attend high school, he learned high school mathematics by reading mathematics books and doing exercises. The latter habit led to his acquaintance with Janovskaja.

As a student in Janovskaja's class on mathematical logic in 1946, Kuznetsov always did the assigned homework, though never turned it in. However, when nobody in the class could do a problem, he showed his solution on the board. Once, after class, Janovskaja asked him why he did not attend the seminar on mathematical logic. Sasha had to confess to Janovskaja that he was not a matriculated student. Since then, and for the rest of her life, Janovskaja took care of the talented young man.

The seminar on mathematical logic at MGU was formed when the Cabinet of the History of Mathematics was founded in 1944.<sup>7</sup> At that time, this seminar was named “Mathematical Logic and Philosophical Problems of Mathematics” and was run by Ivan I. Zhegalkin, Janovskaja and Petr S. Novikov. (The latter was undoubtedly the leading figure at the seminar.) It was the first seminar on mathematical logic in Moscow and, maybe, in the country.<sup>8</sup> In 1946, when Kuznetsov joined the seminar, it met in the apartment of Zhegalkin, who was already gravely ill.<sup>9</sup> This seminar became the environment which shaped Kuznetsov as a scientist.

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<sup>7</sup>Another possible year of the creation of the seminar is 1943—after the Faculty of Mathematics and Mechanics of MGU had returned to Moscow from evacuation.

<sup>8</sup>Later, in the 1960s, when other seminars on mathematical logic were formed in different scientific organizations of Moscow, it was unofficially known as the “Main Seminar”.

<sup>9</sup>Ivan Ivanovich Zhegalkin was a professor of the Department of Theory of Functions at MGU at that time and interested in mathematical logic. His 1907 book *Transfinite Numbers* was the first Russian book on set theory; he is best known in the history of mathematical logic for *Zhegalkin polynomial*, the formulation of Boolean algebra as the ring of integers mod 2. (Originally, this notion was introduced in: I. I. Zhegalkin, “On the Technique of Calculating Propositions in Symbolic Logic”, *Matematicheskii Sbornik*, vol. 43, 1927, pp. 9–28.)

After Zhegalkin's death in 1947, the seminar began meeting on the MGU campus. Earlier, when Kuznetsov started attending the seminar, Janovskaja invited him to become the seminar's scientific secretary. As such, his duty was to take notes on the discussions that were held. He often stayed late, until one or two o'clock in the morning, to work on the notes after a seminar session.<sup>10</sup> When the Department of Mathematical Logic was founded in 1959, the seminar became one of the most important places for Soviet logicians to announce and discuss brilliant results in the field. Following the establishment of that Department, and with the encouragement of Janovskaja, Kuznetsov applied for a senior researcher position with the hope of obtaining one of junior researcher. He was granted the former, though without pay.

In the spring of 1948, Kuznetsov delivered his first scientific lecture at the seminar. The results of this lecture were published in 1950 in the *Soviet Mathematics Doklady*—the most prestigious Soviet (and now with a slight change of name—Russian) mathematical journal for short communications.

Lacking any type of educational diploma, it was hard for Kuznetsov to find a job related to science. At that time, his career was not progressing well and he did not have a permanent occupation until the age of thirty-two. In 1958, as a result of the efforts of his fellow colleagues and friends, including Vladimir A. Uspensky<sup>11</sup>, he began his vocational career at the Laboratory of Electronic Modeling at the Academy of Sciences of USSR (AN SSSR),<sup>12</sup> first as an assistant and then as a junior researcher. He worked in the Sector of Semiotics, whose members were logicians (e.g. Uspensky, Victor K. Finn, Nadezhda M. Ermolaeva) and linguists (e.g. Elena V. Paducheva). Kuznetsov did not have any special responsibilities; he mostly helped to his colleagues on various issues of mathematical logic. He remained at this job until 1965, when he moved to Chişinău (Kishinev at that time), the capital of Moldova. Moldova was a former Soviet republic which is now an independent

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<sup>10</sup>The transcripts taken by Kuznetsov were used essentially by Janovskaja (chief author) and other co-authors while working on the survey "Mathematical Logic and Foundations of Mathematics" in *Mathematics in the USSR for Forty Years*, Moscow, 1959 (in the Russian). These notes constitute a main part of the Kuznetsov's archive currently situated in Chişinău, Moldova. The transcripts are part of the documented history of the development of mathematical logic in the USSR and perhaps someday they will be available to public. (See further in the text about the participation of Kuznetsov in the survey.)

<sup>11</sup>Vladimir Andreevich Uspensky is currently (2008) the chairman of the Department of Mathematical Logic and Theory of Algorithms at MGU; he is also one of the co-directors of Main Seminar on mathematical logic.

<sup>12</sup>Later on, this laboratory had been transferred to the All-Union Institute of Scientific and Technical Information at AN SSSR.



Some of the participants of Main Seminar on Mathematical Logic at MGU in 1955, including Alexander V. Kuznetsov, Alexander S. Yesenin-Volpin, Sergei I. Adian, Vladimir A. Uspensky (top row starting from fourth from left to right), Sergei V. Yablonsky, Yuri I. Yanov, Boris Y. Falevich, Nadezhda M. Ermolaeva, Albert A. Muchnik (second row first, second, third, fourth and last from left to right), Berta Y. Pilchak, Vladimir I. Shestakov, Petr S. Novikov, Sof'ja A. Janovskaja, Dmitri A. Bochvar, Evgeni A. Shchegolkov (front row from left to right)

state. There, at the Institute of Mathematics and the Computer Center of the Moldavian Academy of Sciences, Kuznetsov established his school of mathematical logic and remained its head until his death.

Yet his scientific life in the period between 1950 and 1965 had been full of extraordinary, and often dramatic, events. The lack of a higher education diploma, or even a high school diploma, prevented him from commencing a Ph.D. program. However, though short of a graduate education, Kuznetsov had achieved a number of first-class results. The diversity of his interests, even just in the scope of logic, is astonishing. Indeed, after his first paper, "On primitive recursive functions of big extensions", these publications followed: "Investigation of partial recursive operators by means of the theory of the space of Baire" (jointly with Trakhtenbrot, 1955), "On the problems of identity and functional completeness for algebraic systems" (1956),



“Some questions of the mathematical theory of switching circuits” (1957), and “Completeness of the axiomatic system of arithmetic with the rule of constructive-infinite induction” (1957). It is no wonder that in 1957 he was elected a member of the Moscow Mathematical Society. About that time he was commissioned to write five articles on logic for the Soviet *Philosophical Encyclopedia*. Thus his reputation as a mature researcher and even an expert on certain issues of mathematical logic had been well established.

When the number of Kuznetsov’s published results was found to be more than enough, two academicians of the Soviet Academy of Sciences, Anatoli I. Maltsev and then Novikov, appealed to the Highest Attestation Commission (VAK), seeking to grant Kuznetsov a Ph.D. in mathematics without a dissertation. VAK was a Soviet organization that had the final word on awarding Ph.D.’s and D.S.’s.<sup>13</sup> The practice of awarding a doctorate without the defense of dissertation was common until the mid-1930s, but ceased to exist by the late 1950s. In response, VAK, taking into account Kuznetsov’s achievements, allowed him to take qualification exams, which, at the time, for the specialty of mathematical logic, included exams in mathematical logic, foreign language, and the philosophy of dialectic materialism.

None of the qualification exams actually occurred for Kuznetsov. The story goes that he did not show up for the last two exams, but the marks were generated even without his presence. The presentations that he had delivered at the seminar on mathematical logic at MGU were counted as his first exam. His performance there was assigned the highest possible mark.

Sergei I. Adian<sup>14</sup> became, metaphorically speaking, a major engine in organizing the qualification exams for Kuznetsov and his defense. He was also the first (principle) proponent for the dissertation. Although there was no dissertation text except for a 16-page brochure entitled “Recursive Functions and Undecidability of Some Problems for Propositional Calculi”, which contained the description of Kuznetsov’s results in his three published papers<sup>15</sup>, the Dissertation Council at the Steklov Mathematical Institute

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<sup>13</sup>The Commission remains functional today (2008). It is currently under the jurisdiction of the Ministry of Higher Education of the Russian Federation.

<sup>14</sup>Sergei Ivanovich Adian is a member of the Russian Academy of Sciences (RAN) and is currently (2008) the chairman of Department of Mathematical Logic at the Steklov Mathematical Institute of RAN; also, he is one of the co-directors of Main Seminar on mathematical logic at MGU.

<sup>15</sup>Those papers were his first published paper on recursive functions of big extensions (mentioned above), his joint paper with Trakhtenbrot (also mentioned above), and “On undecidability of the general problems of completeness, solvability and equivalence for



Some of the participants of the International Congress of Mathematicians in 1966, Moscow, including Alexander V. Kuznetsov, Sof'ja A. Janovskaja, Boris A. Trakhtenbrot, Vladimir V. Donchenko (front row from left to right), Igor D. Zaslavsky (back row third from left)

appointed two proponents in accordance to the requirements.<sup>16</sup> The defense took place in March 1965, at the Steklov Mathematical Institute, and was a success.

Janovskaja and Kuznetsov had been close enough that she consulted him occasionally on details of particular issues in mathematical logic, since her own expertise was mainly in the history and philosophy of logic and mathematics.<sup>17</sup> In the survey mentioned in Footnote 10, Janovskaja com-

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propositional calculi", *Algebra and Logic*, Seminar, vol. 2, 1963, no. 4, pp. 47–66 (in the Russian).

<sup>16</sup>It is worth noting that according to the Soviet higher education requirements, such a description was merely one of the materials, which was to be submitted by the candidate to a Ph.D. dissertation council for the defense of his or her dissertation.

<sup>17</sup>Sof'ja Alexandrovna Janovskaja was an active political worker in the early 1920s and served as a political commissar in the Red Army in 1919. She graduated from the Institute of Red Professors. Thus her education penetrated with Marxist ideology, as well as her pro-Bolshevik political activity in the past, allowed her at the Stalin time to set forth for defense of mathematical logic as a unique and valuable discipline, which had often character of a struggle on behalf of participants of the development of mathematical logic



missioned him to write Section 13, *Algebra of logic and its generalizations*, and I believe he was consulted about the other sections of the survey where his results were mentioned.

Among Janovskaja's numerous students, there were non-mathematics as well as mathematics majors. They often consulted Kuznetsov on mathematical logic. Lacking a formal education diploma at that time, he was probably proud of showing his generosity in sharing the knowledge he possessed. In the beginning of the 1960s, a newcomer from Moldavia appeared among Janovskaja's students. Her name was Elena Alexandrovna Pavlova. She enrolled as a Ph.D. student in mathematical logic. Pavlova completed an undergraduate program with honors at Kishinev State University and went to Moscow pursuing higher academic goals. Actually, she received her "seat" on the Ph.D. program at MGU from the Moldavian Ministry of Higher Education, which was a practice in Soviet times.<sup>18</sup> According to the rule, she was required to return to Moldavia after receiving her doctorate. As Pavlova's research was being conducted, Kuznetsov advised the Ph.D. candidate more and more (in full agreement with Janovskaja) and, in fact, became her actual scientific advisor. In the course of this relationship they became close friends. Janovskaja knew about this and wished for them to get married someday. So it happened in 1964. And in 1963, Pavlova defended her Ph.D. dissertation at the Council of Moscow State Pedagogical Institute and soon returned to Moldavia.

Kuznetsov received confirmation of his doctoral degree from VAK in 1965 and joined his wife, Elena Pavlova, the same year. Heading to Chişinău, he believed that he would stay there for one or two years. But, as it turned out, he remained in Moldavia for the rest of his life and there became an eminent representative of science. He was offered a position of senior researcher at the newly founded Institute of Mathematics at the Moldavian Academy of Sciences.

At the Institute of Mathematics in Chişinău, Kuznetsov had no academic, i.e. teaching, responsibilities. He was a senior researcher just like many others who had a Ph.D. However, the founder of the Institute and its first director, Vladimir A. Andrunakievich, asked him to form a mathematical logic research group. The group always consisted of Kuznetsov's pupils who were either current or former graduate students under his supervision.

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in the USSR at that time. (A remarkable example of this is described by Trakhtenbrot in: B. A. Trakhtenbrot, *Ibid.*)

<sup>18</sup>In the Soviet education system such a seat was called "tselevoe" (purposeful).

The projects of the group were in a current plan of the algebraic department where Kuznetsov and his pupils resided, so that the mathematical logic group's activity reports were included in the department's reports without any formal recognition of Kuznetsov's leading role. What made Kuznetsov's logic group special within the Institute and beyond it, at least in the landscape of Soviet mathematical logic, was Kuznetsov's research seminar that met once a week with vacation breaks mostly in summer. The talks at the seminar were delivered in full detail under the thorough eye of the chairman, Kuznetsov, so that some of them took months to be completed and one, presented by Anna Danil'chenko, a graduate student of Kuznetsov who in fact worked in an another department of the Institute, lasted more than a year. Exception was granted only to guest speakers from other cities. Guest speakers began appearing rather often in the late 1970s, when the Dissertation (Ph.D.) Council, one of five in the former USSR, was established at the Institute. The Council accepted Ph.D. dissertations for consideration and conducted their defense. The specialties included algebra and mathematical logic. Kuznetsov was invited to take a seat on the Council from the very beginning of its existence. For a long time, he was only one of a dozen of the Council's members who represented mathematical logic. All dissertations on mathematical logic submitted to the Council were to be approved at Kuznetsov's seminar.

Proper academic teaching occurred during just two short periods in Kuznetsov's life. To the best of my knowledge, he taught a course on the algebra of logic at MGU in the Fall 1957 semester, where he introduced a general approach to the completeness problem in many-valued logic, and a graduate course on mathematical logic at Kishinev State University in the 1970s, which was a disaster, since he only reached the completeness theorem for classical propositional logic in the curriculum. Classroom teaching was not his strong point. Rather, his work with his pupils, mostly one-on-one, was intense and rich for the exploration of new approaches to a problem. This work might have occasionally become too exhausting, both physically and emotionally, for the pupil and the teacher, so much so that sometimes the relationship between them found itself on the verge of a dramatic conflict. Nevertheless, it also gave rise to the maturity of the younger party and could, from time to time, eventually lead to a balanced and fruitful collaboration.

Kuznetsov's life in the 1970–1980s was relatively modest and transparent. He left Chişinău only when he went for conferences and never for vacation. He had unofficial permission to not come to the Institute on working days if

he so pleased, unlike other researchers. Kuznetsov usually worked at night-time. He told me once that his most productive hours were after midnight. His research work and his seminar became his only passions. I recall him doing a presentation at the seminar when he had a high fever. Also, in his fifties, he was a brilliant seminar speaker and it was a pleasure to observe how his thoughts materialized during a talk. He did not have many friends but did not feel lonely either. It seemed that his research and scientific interests absorbed all his attention and thirst for life.

I have deliberately left out any concrete achievement of Kuznetsov in the fields of mathematical logic and algebra. This is simply because I do not feel competent in giving such an expository picture of his results, even the most important ones, in the areas to which he contributed. However, these areas can be named. They are *Theory of Recursive Functions*, *Theory of Boolean Functions*, *Intermediate and Modal Logics*, *Expressibility in Propositional and Predicate Logic*, and *Universal Algebra* (concrete algebras).

As a culmination to Kuznetsov's recognition for his contribution to mathematical logic, he was invited to deliver a plenary lecture at the 17th International Congress of Mathematicians, held in 1974 in Vancouver, Canada.<sup>19</sup> In 1984, he received an invitation from Hiroakira Ono and Andrzej Wroński, the editors of an issue of *Studia Logica* devoted to intermediate logics, to submit a paper for the issue. He was gravely ill at the time. That paper (jointly composed with me) was his last publication. The issue came out in 1986, after his death, and was dedicated to his memory.

If we put aside all of Kuznetsov's achievements in science, that is, what he accomplished in the fields of mathematical logic and algebra—that is, all the impressive theorems he proved, like *Kuznetsov's Criterion* for determining completeness in many-valued logics or his (joint with Vladimir Ja. Gerčiu) example of a finitely axiomatizable superintuitionistic logic without the finite model property, and the results of the 1960s and 1970s, that still have influence on researchers even today, as well as the less interesting observations of his, either published or left in the developmental stage in the scratch papers that he had merely sketched; if we lay all this aside and ask the question, “What kind of person was he?”, we would probably hear different, often controversial, opinions coming from those who had ever encountered him. Some praise him as a man of the extraordinary, a prodigy who rose himself

<sup>19</sup>His name was proposed by Adian to Andrzej Mostowski who was on the Program Committee of the Congress at the time. Kuznetsov could not participate at the Congress for medical reasons. His talk, published in the Proceedings of the Congress, was read by Yuri L. Ershov.

up in mathematical logic by his own efforts to the highest level; others see him as “a narrow fanatic, [...] very naïve and very respectable person” like *Luzhin*, a character in Nabokov’s novel *The Defense*; there have also been those who remember him simply as a talented and kind man and even others who refuse to assign him the last quality. The truth, perhaps, is that he possessed, at least to some extent, each of these characteristics. Whatever it is, the branches of mathematical logic in which he was engaged exist in their present-day form essentially because of his efforts.

*The list of the pupils of A. V. Kuznetsov, to whom a Ph.D. was granted under his direction:*

- Pavlova, Elena A., “On densities of sets of natural numbers”  
(Formally, E. A. Pavlova began her Ph.D. studies and research under the supervision of Janovskaja. However, little by little, Kuznetsov became her actual advisor.)
- Ratsa, Metodie F., “Questions of functional completeness in the logic corresponding to the first matrix of Jaśkowski” (1968)
- Gerčiu, Vladimir Ja., “Questions of finite approximability of superintuitionistic propositional logics” (1973)
- Danil’chenko, Anna F., “Questions of parametric expressibility of functions of three-valued logic” (1979)
- Negru, Ion S., “On the totality of primitive propositional logics with a single variable” (1979)
- Citkin, Alexander I., “The rules of inference admissible in superintuitionistic logics” (1979)
- Muravitsky, Alexei Y., “Provability logic and proof-intuitionistic logic” (1985)
- Simonova, Irina G., “Proof-intuitionistic logic and its extensions” (1992)  
(joint direction with A. Muravitsky)

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