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The Origins And Becoming Of Non-Classical Logic In Russia
(XIX - the turn of XX century)

The work deals with the origins and early stage of becoming of non-classical logic in Russia. The special attention is paid to the intellectual legacy of N. A. Vasiliev and his imaginary logic.

Introduction

The path to modern non-classical logic was steep and toilsome. The starting point of this path can be seen in the pretty vague sensations related to the feeling of imperfection of the classical logic, any of Aristotelian logic law (principle) or the mode of reasoning due to corresponding norms and prescriptions. Fermentation of logical minds gradually created the milieu favorable for the birth of the new type of logic.

As for Russia and to large extent the rest of the world this birth in its perhaps most radical version took place at the Nicolai Vasiliev's works where he presented his imaginary logic. Surely Vasiliev is the most interesting and prominent figure in the history of non-classical logic in Russia. He is considered as a forerunner of paraconsistent and multi-valued logic's. I'll focus on his ideas a little bit later. First of all let inquire how the non-classical logic due to emerge in Russia? What circumstances made its construction favorable? What scientists may be considered as the predecessors of the first ever works on the field of non-classical logic? And at last but not least what heuristic prompts enabled Vasiliev to propose a radically novel system of logic?

The remote and nearest approaches. Prehistory of non-classical logic

Leaving out the standpoint that Aristotle could be considered as a forerunner of non-classical logic, we'll start with the fall of XIX century approaches to non-classical logic emergence.

Since the middle of XIX century classical logic developed both in old Aristotelian and, so to speak, mathematical logic tradition (though the latest one include algebraic and logistic style of reasoning). Nevertheless the basic principles of the classical logic - the laws of excluded middle and contradiction - were examined more and more thoroughly in the above mentioned trends and as well as dialectical tradition.

Since the fall of 1880-th C. S. Peirce was arguing about "non-Euclidean" and later non-Aristotelian logic in general, pointing out that three-valued logics are possible. In 1902 C. S. Peirce points out several situations and examples where the principles of the excluded middle and contradiction does not applied. Say, in the February of 1909 Peirce wrote:

> I have been long felt that it is a serious defect in existing logic that it takes no heed of the limit between two realms. I do not say that the Principle of Excluded Middle is ownright false: but I do say that in every field of thought whatsoever is

> an intermediate ground between positive assertion and positive negation which is just real as they. Mathematicians always recognize this [...] whereas metaphysicians and old-fashioned logicians - the sheep and goat separators - never recognize this. The recognition does not involve any denial of existing logic, but involves a great addition to it [...].[1]

In a letter to F. C. Russell on a "sundry" (as put it the Editor of the *Monist* P. Carus) topics of modern logic in 1910 C. S. Peirce says:

> Before I took up the general study of relatives, I made some investigation into the consequences of supposing the laws of logic to be different from what they are. It was a sort of non-Aristotelian logic, in the sense in which we speak of non-Euclidean geometry. Some of the developments were somewhat interesting, but not sufficiently so to induce me to publish them. The general idea was, of course, obvious to anybody of sufficient grasp of logical analysis to see that logic reposes upon certain positive facts, and is not mere formalism. Another writer afterward suggested such a false logic, as if it were the wildest lunacy, instead of being a plain and natural hypothesis worth looking into [...] However, I came to the conclusion that it was not worth my while to pursue that line of thought.[2]

Construction of non-Aristotelian logic Peirce bounded with the modification of transitivity law. P. Carus disagrees with C. S. Peirce approach towards non-Aristotelian logic nature and method of construction. He stressed that Peirce's treatment of Aristotelian (and non-Aristotelian) logic factually presupposes the different, rather then commonly excepted, understanding of logic and nature of non-classical logic.

Besides the transitivity law never have been included into the row of Aristotelian logic basic laws thus being far from it central principles. That's why in P. Carus account the modification (or even abandonment) of transitivity law cannot be consider as the starting point of non-Aristotelian logic build up.

Thus in the turn of XXth century Peirce was confident that non-Aristotelian logic is possible but not interesting enough to pursue that line of thought.

It is known for sure that the cited paper by C. S. Peirce was well enough known to Vasiliev - this issue of *Monist* is available in the Vasiliev's library and there is traces of his handwritings. Moreover, when Vasiliev was only 17 he concised C. S. Peirce's work on *The logic of relatives* published the same year (1897). In the surprisingly serious diary young Vasiliev paid much attention to making summaries of definite logical works.

Due to pretty tight ties with the Western Europe Universities Russian scholars knew well enough the state and trends in logic which influenced the current thought. However the Russian logical thought developed to large extent along with original lines.

Pretty important steps towards construction of non-classical logic made by A. Meinong (1907) due to idea of contradictory objects and J. Lukasiewicz (1910) due to the reassessment of the principle of the contradiction in Aristotelian logic and L. E. J. Brouwer (1908) rejection of the principle of excluded middle didn't have had any direct impact on Russian scientists. They expressed some ideas and conjectures related to the

[1] Eisele, New Elements, p. 116.
[2] Carus, Nature, p. 45.

non-classical logic emergence dealing with various subjects - either logical or mathematical. For instance, already in 1901 - 1902 S. O. Shatunovskii from Odessa proclaimed the law of excluded middle is not valid for the infinite sets [Bakhmutskaya, 1965, p. 208]. He argued that the law of excluded middle is valid only for objects that may be considered as constant in relation to some other object. Thus the validity testing of the law of excluded is required every time we inclined to implement it.

Father Paul Florenskii in the theological book *The Pillar and Affirmation of Truth* (1914) discuss the idea of probabilistic treatment of judgments in the historical sciences. He introduced the "ladder" of moral expectations related to the firmness of our faith. Gaining a foothold in S. Jevon's works Florenskii proposed the table of the degree of faith ranging, generally speaking, from $+\infty$ to $-\infty$.[3] Thus, Florensky was close to the idea of probabilistically comprehended truth values in mathematical logic, he was well acquainted with.[4]

E. A. Sidorenko has found even some implicit traces of paraconsistency idea and non-monotonous logic in Florenskii's doctrine of Holy Writ.[5] Florenskii justify contradictory premises while reasoning about the Higher spiritual cognition and the inconsistency of Holy Writ in the aspect of confirming its divine origin.[6]

Some gleam of non-classical ideas, claim B. V. Biryukov and B. M. Shuranov, may be detected in the works of A. I. Vvedenskii and N. O. Losskii.[7]

If not jump into the philosophical discussion what conditions and bulk of contribution enables us to assess somebody as a forerunner of novel constructions (I mean in this case just mentioned names, ideas and content of quoted articles), to the debate the details of, so to speak, the prehistory of non-classical logic in Russia, than the true history of non-classical logic in this country starts with the works of N. A. Vasiliev, the only indisputable creator of the alternative to classical logical system.

Social and cultural prerequisites

Vasiliev was Kazan University privat-dozent (1910) and later Professor (1918). His crucial works belong to pretty short period of 1910–1914 (until the scholar was drafted to the Army as a physician). Why namely Kazan in the Russian history became the birthplace of sizable number of, so to speak, heretical intellectual constructions?
Say, in Kazan University the first ever idea of non-Euclidean geometry was proposed by N. I. Lobachevskii. In Kazan the non-classical, imaginary style poetry was created by Velemir Khlebnikov (1908–1922) and early the non-classical style of linguistics was developed by Baudouin de Courteney (1880). Even the "heretical" ideas of V. I. Lenin emerged when he was who for three months enrolled as a student of Kazan University. If recall this facts, this row of heretics then the question is legitimate - why namely Kazan in greater number of compared in respect of relatively small size of the city and University staff with Moscow or St.-Petersburg gave life for sufficiently many non-classical ideas and theories?

Not going into details we could argue that Kazan in XIX century was on the periphery of European thought only in spatial sense. Until 1888 Kazan University was

[3] Florenskii, , Pillar, p. 547.
[4] Florenskii, , Pillar, pp. 519–529, 600–603.
[5] Florenskii, Pillar, pp. 500–505.
[6] Sidorenko, Florenskii's ideas, p. 295.
[7] Biryukov, Shuranov, Russian neokantians, p. 125.

the easternmost University in Europe. Nevertheless its faculty included the brilliant scholars, like, say, M. Bartels, mathematician, the teacher of Gauss and later of Lobachevskii or I.Littrow, the astronomer. Being on outskirts of European and even Russian academic activity and along with this possessing profound thinkers and skillful teachers, who didn't created stable firm academic schools, Kazan University offers a plenty of academic freedom in the sense of choosing the subject of research and mode of reasoning. Nobody had been sufficed over the novel and even radically sound ideas promoting their free development under the conditions of no rivalry persistence of firm scientific community available, say, in St.-Petersburg or Moscow. Hence, the probability to survive in Kazan of suchlike revolutionary ideas was higher than elsewhere in Russia.

That's why to my mind Kazan happened to be a birthplace of various non-classical conceptions, non-classical logic proposed by N. A. Vasiliev among them.
The conjecture related to Kazan form a social milieu argument. Another conjecture may be put forward in respect of lucky circumstances that served as certain kind of heuristic prompts cleared way to new logic.

Heuristic prerequisites

What vague, uncertain and barely formulated analogies fed Vasiliev's pioneer work? They can be specified due to the new findings: 1) C. S. Peirce's logic of relatives, which Vasiliev learned when he was only a teenager; 2) the symbolist poetry that paid a great deal of attention to the subject of another world; 3) the special psychological standpoint, used for the critical analysis of Aristotelian logic; 4) Charles Darwin's ideas on the evolution of life; 5) the analogy with non-Euclidean geometry construction and method.

We may argue that in C. S. Peirce's logic of relatives (mid and late 1890-s) Vasiliev perceived the evidence of Aristotelian logic imperfection, the narrowness of traditional theory of judgments and it elements, he realized the principal possibility of different ways of logical reasoning, the non-absolute character of classical logic and its basic laws.

As a symbolist poet Vasiliev spoke not only about "another worlds" but endowed - unlike the rest of Russian symbolists - these worlds with contradictory features.[8]

Vasiliev's psychologism helped to propose radically new - paraconsistent in essence - system of logic. In our world, Vasiliev affirmed, only "positive" sensations are possible, by which we can distinguish only contrary qualities . This is the basis of qualitatively different types of judgments - affirmative and negative. If one imagines a world in which not only positive but negative sensations are possible, then such a world will indeed require a different logic. and the introduction of supplementary qualitative judgments. As the imaginary world becomes more complex, logic becomes more complex too, and perhaps will be not of two dimensions (as Aristotelian logic), but, generally speaking, of any number of dimensions.

According to Sigwart Darwin's ideas emerged revolution in logic. Vasiliev claims that his ideas has direct impact to the foundations of logic. Aristotelian logic implicitly was based on ontological assumption of invariability of the world and

[8] Bazhanov, Vasiliev, pp. 44–57.

concepts. Darwin has shacked this conviction and opened the way to the new worldview.[9] Vasiliev stated:

> Imaginary logic is constructed by imaginary geometry method [...] In order to implement this method I have learned the non-Euclidean geometry [...] From all non-Euclidean geometry systems I have had more intently studied the geometry of Lobachevsky, which I learned from his original works.[10]

Non-Euclidean geometry gave a powerful impetus to the imaginary logic construction.[11]

Vasiliev's idea of the plurality of logical systems has been realized. "I am very well aware of the fact, - wrote Vasiliev in 1912, - that my idea of new logic contradicts the millennial conviction of mankind [...]" Half a century had to pass before the ideas of imaginary logic revived like Phoenix from the ashes.

Intellectual climate prior to Vasiliev's works

The notion of non-Aristotelian logic at the turn of the XX century was pretty vague and contained only the idea of abstract possibility of its construction: "Aristotelian logic is incomplete and ineffective, though no mistakes are not yet founded in it", - Carus stated, manifesting the opinion of radically disposed member of scientific community towards Aristotelian logic.[12] In favor of his standpoint, by P. Carus have been cited C. S. Peirce's letters, dealt with question at the point.

The analogy with non-Euclidean geometry had suggested the thought of a possible non-Aristotelian logic. "If there is a geometry of curved space, why can't there be a special kind of "curved logic", P. Carus reflected in 1910. And again:

> The world has seen many new inventions. We can talk over the telephone at almost unlimited distances, and some of our contemporaries fly like birds through the air. Radium has been discovered which is often assumed, with a certain show of plausibility, to upset the laws of physics; but the invention of non-Aristotelian logic would cap the climax'.[13]

However the image of such logic, at that time, was vague, only its possibility was recognized.

We may judge that N. A. Vasiliev was the person who cap the climax of all mentioned achievements.

N. A. Vasiliev as a forerunner of modern non-classical logic

Assessing the movement in XIX century logic that resulted in eventual drastic changes, Vasiliev names its following landmarks: Hegel's dialectical logic, Mill's inductive logic and his critical approach towards Aristotelian syllogistic, Sigwart's critique of the classical doctrine of modal judgements and, at last, the development of mathematical

[9] Bazhanov, Presequisites., Bazhanov, The heuristic impact.
[10] Vasiliev, Report, pp. 20–21.
[11] Bazhanov, Imaginary Geometry.
[12] Carus, Nature, p.44.
[13] Carus, Nature, p.45.

logic by Boole, Schroder, Poretsky, Peano, Frege, Russell.[14] Worthy to note that Vasiliev specially stressed "subjective" character of his choice. In his pivotal work *Logic and Metalogic* Vasiliev points that B.Erdmann insist in the relativity of logical laws and presupposes the possibility of the logic, different from Aristotelian one.

The break through the horizon of traditional logic have been taking place in several points. First of all, one of the cornerstone laws of Aristotelian logic - the law of contradiction, according to which the existence of judgment (A) and its negation (non-A) in the reasoning is intolerable, i.e. the system should be consistent, - was severely criticized by the philosopher's assigned themselves to dialectical trend. They were seeking in the world realized contradiction and its reflection in the human consciousness (Cusanus, Hamann, Hegel, Bahnsen, Meinong).[15]

In his "imaginary" logic he attempted to discard fundamental law of Aristotelian logic - the law of contradiction and to propose system free of this law. Moreover he argued that the law of excluded middle ought to be completely removed from the "canons of the laws of thought". Meanwhile, he proved that these laws possess deep sense as empirical generalizations and preserve their force in "telluric" things. In our world, Vasiliev affirmed, only "positive" sensations are possible, by which we can distinguish only contrary qualities, serve as basis of affirmative and negative judgments. If one imagines a world in which not only positive sensations are possible, then such a world will indeed require different - non-Aristotelian - logic, the introduction of supplementary qualitative judgments, truth values and new types of negations. However, in any logic there are laws enabling the reasoning. The minimum of such laws (the law of non-selfcontradiction, according to Vasiliev, among them) constitute a metalogic - the science of structures valid for every logical system.

Imaginary logic of Vasiliev and imaginary geometry of Lobachevsky

One of the main heuristic prompts, the sort of incentive to non-Aristotelian logic of Vasiliev was the discovery of non-Euclidean geometry by Lobachevsky.
The possibility of "another" logic, distinct from Aristotelian convince us, according to Vasiliev, the existence of another, non-Euclidean geometry. Not only the fact of existence of another geometry inspired the scholar. In geometry itself he has found more than mere prompt. Vasiliev stated

> Imaginary logic is constructed by imaginary geometry method [...] In order to implement this method I have learned the non-Euclidean geometry [...] From all non-Euclidean geometry systems I have had more intently studied the geometry of Lobachevsky, which I learned from his original works.[16]

In analogy of his logic and Lobachevsky geometry enables Vasiliev explored some inward analogies for the logical identity of their creation methods.[17] Similar to Lobachevsky geometry starting point was the rejection of attempts to proof the famous V-th postulate and construction of geometry, free of that postulate, the starting point of Vasiliev logic is the abandoning of crucial Aristotelian logic laws - the laws of

[14] Vasiliev, Imaginary Logic 1912a, Logic and Metalogic, Imaginary Logic 1924.
[15] Vasiliev, Logic and Metalogic, pp.57, 70.
[16] Vasiliev, Report, pp.20 f.
[17] Vasiliev, Imaginary Logic 1912a, p. 208.

contradiction and excluded middle - and the construction of logic, free of these laws. Exactly in the bottom unity of methods lies "the striking analogies between non-Euclidean geometry and [...] imaginary (non-Aristotelian) logic".[18]

Both non-Euclidean geometry and non-Aristotelian logic, put it Vasiliev, are sound systems, possible after the giving up of their pivotal statement, both are consistent, both disturbs the common sense and our intuition.

In Euclidean geometry the strict lines on plane surface are either intersect or remain parallel. In Lobachevsky geometry the strict lines on surface are either intersect, or not intersect, or parallel. In Aristotelian logic we have two different - in relation to their quality - types of judgments, which characterize the subject-predicate relation - affirmative and negative judgments. In Vasiliev logic there are three classes of judgments, - affirmative, negative and so called "indifferent". Thus "the dichotomy of "telluric" logic and geometry transits to trichotomy of imaginary sciences".[19]

After almost half of century the existence of Lobachevsky geometry its interpretation on surfaces called pseudosphere was discovered. Imaginary logic, Vasiliev wrote, valid not only in certain imaginary world with two different types of "sensations"; it may be interpreted in "terrestrial" world, in the logic of concepts, which not the same as the "telluric" things logic. Vasiliev demonstrated that in the latter the laws of contradiction and excluded middle are valid, while in logic of concepts we are to adopt the laws of, as he called one, the law of non-selfcontradiction and excluded forth.

Our world and sensational abilities are arranged in such a manner that all immediate sensations are positive. "Negative" sensations actually are not negative; they are secondary if compared to positive one, and appear when one feature replaces another, incompatible with the first one. In the world with two kinds of sensations of living beings the non-Aristotelian logic surely reins. To put it in another way the logical laws and principles for the first hand are determine by nature of cognitive objects and experience, open to subject, i.e. they are *Empirical*. Arguing the dependence of logical laws origin from some sort of imaginary reality, Vasiliev persistently stressed the primacy of ontological aspect of logic, the thought that material conditions make up various kinds of logic. Changing the ontology, combining the reality features, we can get different imaginary logic's for the imaginary logic method opens the possibility to experiment in logic, to give up certain logical principles and to see what we get of this rejection. This method resembles the "natural sciences experimental methods".[20] Thus, Vasiliev was the evident proponent of psychologistic approach to logic.

Most supporters of psychologism were opposed to the mathematisation of logic. However N.A.Vasiliev on the contrary declared that this process enables to open new horizons of the development of logic. Though he didn't used the methods of mathematical logic (being acquainted with them at least in general terms), his psychologism helped to propose radically new - non-classical in essence - systems of logic, supposed to formalization by means of mathematical logic.

Following D. Hilbert, who devoted his fundamental work to the foundation of geometry, Vasiliev stressed the importance of studies in the foundations of logic.

Due to prolonged neglect of Vasiliev's ideas the critical review of his work by N. N. Luzin, an outstanding mathematician, was all the more significant. In 1927 he wrote:

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[18] Vasiliev, Imaginary Logic 1912b, p. 5.
[19] Vasiliev, Imaginary Logic 1912a, p. 233; compare: Vasiliev, Report, p. 21.
[20] Vasiliev, Logic and Metalogic, p. 78.

> Vasiliev's works on logic are of great importance in connection with investigations of the principles of thought as a whole, but [...] on account of the new tendencies in mathematics [intuitionism and effectivism are meant - V.B.] Vasiliev's ideas coincide remarkably with the latest efforts to which mathematicians resort by force of facts.[21]

In 1925 the last work by N.A.Vasiliev and the only one in English was published in Naples in the collection of Naples Philosophical Congress papers.[22] There were only two works by Russians. The second one was by N. A. Vasiliev's father - prominent mathematician, organizer of science and education in Russia, noticeable public figure A. V. Vasiliev [Bazhanov, Yushkevich, 1992]. The work by N.A.Vasiliev was very concise and contained no fresh ideas (if compared with works appeared a decade earlier).

In 1940 N.A.Vasiliev died in the mental hospital where he spent his last almost twenty years and thus survived communist purges.

In 1925 A. N. Kolmogorov published his well known work related to the law of excluded middle *The principle tertium non datur* and in 1927 I. E. Orlov, the representative of new generation of "dialectical logicians", former engineer, published the cornerstone work *The calculus of compatibility of propositions* that fostered the birth and development of relevant logic.

The period of advancing of novel non-classical ideas in Russia was over. Some ideas (like Vasiliev's) were premature, far ahead of its time, another gave rise to extensive movements (like ideas related to the law of excluded middle and the actual infinity led to the constructivist style logic of A. A. Markov and his followers). Only Kolmogorov was pretty lucky to see his ideas flourished in the scientific community. Vasiliev spent his last two decades in the mental hospital; Orlov's (born in 1886) fate in unknown, likely he was purged. Logic in the Universities almost seized to exist - at least as a taught subject.[23] The development of logic in Soviet Russia since mid 1920's was bounded to the research in mathematics (I. I. Zhegalkin, V. I. Glivenko, and D. A. Bochvar). The revival of logic in the USSR began in pretty unfavorable milieu soon after the World War II.

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[21] Luzin, Review.
[22] Vasiliev, Imaginary Logic 1925.
[23] Bazhanov, Interrupted flight.

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