It's Not Given Us to Foretell How Our Words Will Echo Through the Ages: The Reception of Novel Ideas by Scientific Community

Valentin Bazhanov
Ulyanovsk State University

Abstract. The paper reveals some mostly unnoticed and unexpected trends in reception of novel ideas in science. The author formulates certain principles of the reception of these ideas by scientific communities and justifies them by examples from modern mathematics and non-classical logic.

Keywords: Scientific community, reception of novel ideas, creativity, non-classical logics, N. A. Vasiliev, N. C. A. Da Costa.

It's not given us to foretell
how our words will echo through the ages,
but sympathy is given us
as grace is given us.
Fyodor Tjutchev, Russian poet (1803–1873)
Translated from Russian by F. Jude

The reception of novel ideas by scientific community and its comprehension may be treated as psychological processes or, more precisely as the element of scientific oeuvre (creativity) and thus it is difficult to reconstruct in rational terms. These processes are very complex in their nature and every case might be viewed as close to unique. Nevertheless thorough analysis of these processes shows that they have some common features which enable us to notice and manifest certain principles which govern of novel ideas reception by the scientific communities.

Why some outstanding, epoch making inventions are embraced by scientific community almost without any resistance, their essence seems to be transparent to everybody while other waiting for the adoption for the long period and only time reveals their deep essence and immense value? The explanation of this phenomenon may be found within the analysis of proximate, current interests as well as expectations of the scientific communities.

1. History of science provide quite weighty arguments for the judgment that the *more unexpected discovery and more it tends to the periphery of interests and academic*

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inattention of the scientists, the greater the chance it will be adopted by the scientific community without a hitch. On the other hand: the more this discovery is disposed to central, most pressing problems, and the more actively discussed by the community, then the more likely it is to be rejected or at best remain unshared by the scientific community and the more difficult it will be to comprehension of its value and obtaining the status of a universally valid item (Principle 1).

For example, being unknown outside of Vienna, K. Gödel in September of 1930 at the meeting with elderly colleagues in Königsberg made a presentation and in early of 1931 published the paper with his famous, pioneering, incompleteness theorem in so compendious a form that he promised to deliver later the details of the proof. Nevertheless he never did deliver the promised detailed proof, because almost no one contested his proof, even though his proof was, for some time not adequately understood by such thinkers as B. Russell, E. Zermelo or L. Wittgenstein. Gödel's presentation was not even mentioned in the review of this meeting made by R. Carnap (cf. Dawson, Jr. 1991).

The understanding of Gödel's discovery and its assimilation was almost painless despite, say, the discovery of L. Löwenheim (1915) which awaited recognition not for one decade (Peckhaus 1994, 63).

2. Rather illustrative in the sense of comprehension, interpretation and reception the fate of Nicolai A. Vasiliev's imaginary logic, proposed by him in 1910–1914. The particularities of its reception were imposed not only by premature character of N. A. Vasiliev's discovery and the fact that his works were written in Russian and published in Russia and thus were not accessible to the Western colleagues, but additionally by the fact that under the cover of Aristotelian paradigm he put forward ideas — as the author persistently stressed — which were non-Aristotelian in its nature and in its construction presented radically novel formal system. The form in which N. A. Vasiliev presented his imaginary logic seriously impeded its evaluation as revolutionary and its reception by the logicians both by those who followed the traditional Aristotelian line or by those who developed mathematical logic (both either in algebraic form as had Boole, Schröder, and Peirce, or in quantification-theoretic form, as had Peano, Frege, or Russell).

N. A. Vasiliev happened to be the precursor of new non-classical logical systems but one does not find in his works the starting point of the evolution of these systems. The *scientific community easily, nearly with a sticky finger, adopts ideas which are expressed within familiar language and in commonly accepted forms that are natural for the current paradigm and standards of proof* (Principle 2).

To some extent something similar happened in the history of logic in the case of Ivan E. Orlov, who considered now as forerunner of relevant logic, as happened in the case of N. A. Vasiliev n the history of logic happened with. One does not find in Orlov's work, published in 1928, the cradle of the idea of relevance. The work of I. E. Orlov was discovered when relevant logic was already a matured field of research.

3. *History of science shows that novel ideas are more likely to emerge and become validated not in traditional and top-ranked centers of research with stable academic schools or places with consecutive generations of scholars, but in those places where they were not yet formed but already began attracting young talented and well-educated scientists many graduated from respected universities or/and trained by renowned persons* (Principle 3). For instance, Gauss and N. I. Lobachevsky, who is considered the founder on non-Euclidian geometry, had had in common a teacher, M. Bartels, who himself was a well-known mathematician. Kazan University where N. I. Lobachevsky worked, had just been established in 1804 and remained the most remote, easternmost, university in the Russian Empire until late XIXth century. There were no stable schools or traditions, but skilful and promising lecturers were invited from the Western Europe (mainly Germany) by Ministry of Higher Education to teach in these schools. M. Bartels was among those who were invited as lecturers to Kazan University.

The same story happened with the birth and development of paraconsistent logic. Newton Da Costa received a good education and put forward the idea of a logic tolerant to contradiction in Brazil where, as far as I know, at that moment there were no steady logical community capable to oppose to his ideas and reject it in a straightway manner as a type of heresy. N. A. Vasiliev's ideas happened to be premature and expressed in the form not favorable for the acceptance by mathematical logicians. Newton Da Costa independently advanced the concept of paraconsistency and expressed them in the form adoptable for the contemporary logical community.[1]

The latest did not treated Newton Da Costa as impudent stirrer-up of trouble for he was at that moment outside the key centers of logical thought. Time, Da Costa's vigorous efforts, and perspective works enabled logical community to accept his ideas. The probability to born and pull through for the revolutionary ideas in newly established scientific centers with no dominance of certain paradigm is higher then in the centers densely populated with traditional mode of thinking persons.

4. Conceptual richness of imaginary logic of N. A. Vasiliev, non-Aristotelian par excellence by its nature and spirit, was exposed steadily, step-by-step. If N. N. Luzin in 1927 noticed in the imaginary logic only those elements (first of all the abandonment of the law of excluded middle) which were consonant to intuitionism and effectivism (developed by N. N. Luzin himself) (cf. Bazhanov 1987) then in the mid of 1960's it was treated as the source of multi-valued logic (A. I. Malt'sev; cf. Bazhanov 2007).

After the Newton Da Costa's works in paraconsistency the most radical element of N. A. Vasiliev's logic was at last behold — his reassessment and abandonment of the law of contradiction.

In 1990's V. A. Smirnov tended to regard imaginary logic of N. A. Vasiliev as a system more relevant to the ideas of so called multi-measured logic than were even to paraconsistency ideas (Smirnov 1992). We see that almost every new generation of logicians rationally reconstructed imaginary logic due to the fact it was expressed in informal, Aristotelian style and exhausted it due to the current interests and goals. Hence, we can claim the connection between the moment of scientific discovery, its place within the space of total research realm, and the nature of discovery: *informal ideas are interpreted by new generations of scholars along with it conceptual tools, goals and under the angle of their interests* (Principle 4).

5. In the case of I. E. Orlov (cf. Bazhanov 2003) one feature comes to the surface: sometimes beyond the dense ideological mantle are hidden valuable for the future research novel ideas and theories. From this point of view we can sum up the only strictly logical and quite modest in its size but revolutionary in its nature his 1928 paper "The Calculus of Compatibility Propositions" (Orlov 1928). In this paper I. E. Orlov proposed the first ever axiomatization of relevant logic (R) and even to certain degree foresaw paraconsistency (cf. Alves 1992; see also Da Costa et al. 1995) and substructural logics (cf. Došen 1992).

In a logic inspired to construct the special logic of natural sciences which would coincide with the Marxists theory of knowledge and dialectics, I. E. Orlov did his best to overcome the paradox of material implication and establish antecedent and consequent in a dependence of meaning. This would have signified a passage from the "logic of extent" — extensional logic — to the "logic of content" — intensional logic.

Thanks to I. E. Orlov, the logic of natural sciences could pose broader problems for itself than does traditional logic. This new logic is obliged to pose the problem of the nature and limits of intuition. It must estimate the reliability of the initial assumptions and methods by which science arrives at its discoveries. Thus it should be an *ars inveniendi*, that is, when it serves as a means of discovering new methods of experimentation and the formation of hypotheses.

According to K. Došen "the axiomatization of relevant logic arose at the same time that an axiomatization of intuitionistic logic was proposed. ... But this is not Orlov's only achievement. He also anticipates the modal imbedding of systems with intuitionistic negation into systems of type S4 with classical negation (a modal imbedding is an imbedding that places the necessity operator before subformulas of nonmodal formulas). ... Orlov went as far as the construction of S4 systems, but added the corresponding postulates to relevant logic rather than classical logic." (Došen 1992, 339–40)

In this way Orlov anticipated Gödel's 1933 paper and, most importantly, O. Becker's 1930 paper, which in particular is credited with the construction of an S4 system (Došen 1992, 349).

A quite natural comprehension of Orlov's ideas and their origin is provided within the scope of substructural logics, for they reject or restrict some of Gentzen's structural rules. The so called Thinning rule, rejected in relevant logic, stands apart from other structural rules (like Expansion, Cut, or Permutation), and that is the reason, perhaps, why relevant logic appeared earlier than substructural logics (cf. Došen 1993).

Orlov's scholarly legacy included traits such as his striking breadth of interest (papers devoted to the philosophical analysis of mathematics and its foundations, philosophy of logic, relativistic physics, probability theory, and the inductive method, experiment, musical acoustics, chemistry and chemical engineering — potentiometry, titration, and others) and ideologizing (expressed in a striving to connect scientific and social problems, to approach scientific problems from an exclusively Marxist point of view that does not recognize any other approach).

Thus, we can formulate Principle 5: *in scientific (as well as poetical) oeuvre (creativity) "if only you knew what trash gives rise/ To verse, without a tinge of shame"* (A. Akhmatova, Russian poet, 1889–1966). *Novel discoveries may have quite unpredictable foundations, sources, and inspirations* (Principle 5).

6. Finally, history of science speaks for the fact that *worldwide recognition of revolutionary idea might (and might not) be accomplished by acknowledgement of its author. If this idea is natural in the sense it lies at the surface in a certain field but was not discerned by the scientific community, then the person who will attract attention to this idea and introduce it in the manner it become popular — this scholar might be granted world recognition in the case when he will present to the world another brilliant, valuable idea(s) or would be a pathfinder in some other field* (Principle 6).

In early 2001 mankind paid a final tribute to Professor Claude Shannon (born 1916). His death was announced in almost all leading newspapers and media. In 1987 Victor I. Shestakov (born 1907), Dozent (Associate Professor) of Moscow State University, almost unknown even to the historians of science quietly departed (Bazhanov 2007). No newspaper, local included, noticed this event. V. I. Shestakov had proposed a theory of electric switches based on Boolean logic a little bit earlier than Shannon, in 1934-35, but the first publication of Shestakov's result took place in 1941, after the publication of Shannon's idea (1938). This theory in fact forms the foundation of modern informational technologies and computers.

V. I. Shestakov for many years worked as an ordinary lecturer in the Department of Physics at Moscow State University and never got the rank of Full Professor, although his result was rather widely known and respected among his colleagues, many of whom considered discovery of Shestakov as natural and just escaped their attention. Moreover implicitly he was considered as classic alive. Nevertheless he was humble, shy person, who did his best to avoid any sort of publicity. Not even one Soviet biographical dictionary of mathematicians (or physicists) mentioned him. Even the introductory papers to the translations of foreign books on the subject containing historical sketches dealing with the theory of electric switches, and packed of foreign names, seldom paid any tribute to fellow-countryman — V. I. Shestakov. His discovery was popular and widespread; Shestakov himself was forgotten. All his life he developed the one idea broke upon him in the mid-1930s.

C. Shannon on the contrary decisively changed the fields of his researches and academic interests; everywhere he sown the seeds of novelty and genius, and left the novel ideas to be developed by his followers. He highly enriched the information theory, computer science, cryptography, economics, genetics, etc. He was an all-rounded genius, and got deserved fame while he was relatively young.

I think that different fate of V. I. Shestakov and C. Shannon (in the sense of international recognition) cannot be explained merely by reference to periphery place of Russian language publications in the flux of world's scientific media and by Shestakov's camouflage of logical in its essence ideas by algebraic terminology due to hostility of Stalin's regime to metaphysical mathematical logic (opposed to officially adopted Marxist-Leninist dialectics) but by the fact that V.I. Shestakov did not confirm his genial insight by any other discoveries (natural but failed to be seen by the community); as was done by C. Shannon.[2]

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VALENTIN A. BAZHANOV
P. O. Box 1602
Ulyanovsk-63
432063, Russia
vbazhanov@yandex.ru
http://staff.ulsu.ru/bazhanov

Resumo. Este artigo revela algumas tendências inesperadas e em sua maioria não percebidas na aceitação de ideias novas na ciência. O autor formula certos princípios da aceitação dessas idéias pelas comunidades científicas e as justifica por meio de exemplos da matemática moderna e da lógica não-clássica.

Palavras-chave: Comunidade científica, aceitação de ideias novas, criatividade, lógicas não-clássicas, N. A. Vasiliev, N. C. A. Da Costa..

Notes

[1] Professor Newton Da Costa told the author of this paper (Moscow, August 19, 1987) that he was almost thunderstruck when learned that a half century earlier the same ideas already were expressed by Russian scholar N. A. Vasiliev (in 1910). He asked his pupil Aida Arruda to probe deep into the matter of N. A. Vasiliev's imaginary logic.
[2] The work was partly supported by RFH grant. I'm grateful to Dr Irving Anellis (Purdue University) for improving my English.