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VASILIJ VASILEVICH NALIMOV WHINS THE 1987 DEREK JOHN DE SOLLA PRICE AWARD

The Editorial and Advisory Board and the Publishers of *Scientometrics* have awarded V. V. *Nalimov* (Lomonosov State University, Moscow, USSR) the 1987 Derek John de Solla Price Award for his distinguised contributions to the field of scientometrics.

Professor V. V. *Nalimov* with the 1987 Price Medal at the awarding ceremony held at the Institute of History of Natural Sciences and Technology of the USSR Academy of Sciences (Moscow).

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COMMENTS ON V. V. NALIMOV RECIPIENT OF THE 1987 DEREK DE SOLLA PRICE AWARD

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I have been acquainted with V. V. *Nalimov* for about 30 years. In 1960 being on the staff at the research institute of rare metals I learned we had a new colleague. He was going to give a course on how the experiments must be carried out and their results treated. That was V. V. *Nalimov.* I was much impressed both by the lectures and the lecturer's personality, and I began to get interested in the problems of experimental design. In 1965 we were both in a group of lecturers who were to deliver lectures on experimental design in the institutes of the Kola affiliation of the USSR Academy of Sciences. There, in an unofficial situation, a broad exchange of opinions took place on scientific and other problems. Nalimov's judgements on each problem were unusually profound and non-trivial. I felt then that he would soon carry out research whose results would become well-known and would affect many scientific trends. At that time V. V. Nalimov was known only among a narrow circle of professionals. Now we may say with great certainty that my prediction was fully correct.

V. V. *Nalimov* began his career in 1931 in the All-Union electrotechnological institute with the research in experimental physics. Two years later he published his first paper on photoelectrical effect. In the 40ies and 50ies V. V. *Nalimov* studied the problems of applying methods of mathematical statistics in chemical analysis (to the extent he was able to do it, since between 1936 and 1953 he was in prison, in a Kolyma labour camp and in exile). After 1953 the work was carried out on large scale, about 30 papers were published. A landmark in his work became the monograph issued in Moscow in 1960 and later re-published abroad; V. V. NALIMOV: *The Application of Mathematical Statistics to Chemical Analysis,* New York, Addison-Wesley, 1963, 294 pp. In the period between 1965 and 1986 the *SCI* registered more than 800 citations to it.

This monograph already demonstrated the urge of *Nalimov* to choose non-traditional roads. The traditional approach rejected the possibility of applying the probability theory to physical-chemical research. This book was an essential

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contribution to the probabilistic paradigm which *Nalimov* started to form at that time and which was based on the application of probabilistic approach to the description and interpretation of experimental data.

At the beginning of the 60ies, *Nalimov* started work at the research institute of rare metals and developed two directions of research: experimental design and scientometrics. The beginning of experimental design was quite modest: it started with a few examples of applying the procedures of response surface design to chemistry and metallurgy. The first papers appeared in the journal *Industrial Laboratory* in 1963. Then the research in experimental design in the USSR acquired speed. It was greatly promoted by *Nalimov*. He gave lectures, organized seminars and conferences, published many articles, a booklet (1963) and two monographs (1965, 1971). As soon as five years later the USSR had a large invisible college embracing representatives of quite different institutions. The college carried out research in theory and practice of experimental design methods in almost all branches of natural sciences.

The elaboration of this trend met powerful resistance. How can response surface problems be studied without studying the mechanism of the process and the properties of the substance? This approach is not scientific – this is a popular objection of "classical" naturalists concerning the application of methods of multifactorial experimental design. One of these traditional chemists once confessed to me that after reading the book by *Nalimov* [*Teoriya eksperimenta,* (Theory of experiment), Moscow, Nauka Publishers, 1971, 208 pp] he spent a sleepless night, so much was he sent off the rails by its unusual ideas.

The development of experimental design was another step towards establishing probabilistic outlook. But to make this step *Nalimov* and his school had to spend a lot of efforts.

The research in experimental design went side by side with that in scientometrics. The first paper was published in 1959 [G. E. VLADUTS, V. V. NALIMOV, N. I. STYAZHKIN, Nauchnaya i tekhnicheskaya informatsiya kak odna is zadach kibernitiki (Scientific and technological information as a problem of cybernetics), *Uspekhi fizicheskikh nauk,* 19 (1959), No. 1, 13–56]. The paper analyzed the models of the growth of science suggested by *Price.*

In 1965 *Nalimov* entered the staff of Moscow State University and became head of the section of mathematical theory of experiment in the interfaculty laboratory of statistical methods (headed by academician A. N. *Kolmogorov*). Later *Nalimov* said that the atmosphere within the laboratory with its freedom of scientific research greatly promoted the research in scientometrics and other branches of science.

In 1966 he published a paper [V. V. NALIMOV, Kolichestvennye metody issledovaniya protsessa razvitiya nauki (Quantitative methods of research of scientific evolution), *Voprosy filosofii,* (1966), No 12, 38–47] which touched on a broad circle

of problems related to the application of quantitative methods to science studies. It seems that the first occurence of the term "scientometrics" later used as a title of this international journal, can be found in that paper. The article was published in the period when scientometric research began in our country. The research was carried out within the framework of the informational model of science proposed by V. V. *Nalimov*. Within this model publications are regarded as carriers of information, journals – as communication channels, and citations – as a specific language of scientific information showing the effect of the papers cited on the evolution of information flows. Scientometric research was applied to chemistry (I. M. *Orient*, P. F. *Vasiliev*, and the present author); to experimental design (Yu. P. *Adler*, Z. M. *Mul'chenko*, G. P. *Preobrazhenskaya*) and to other fields of science. A large team carried out the study of journals as communication channels and the evaluation of contributions made by several countries to the world information flow. A Moscow Seminar of Scientometrics began to function at the Institute of History of Natural Sciences and Technology, of the USSR Academy of Sciences. This period was summed up by issuing for the first time in the world a complete monograph on quantitative methods of research on the evolution of science (V. V. NALIMOV, Z. M. MUL'CHENKO, *Naukometriya, Izuchenie nauki kak informatsionnogo protsessa*, Moscow, Nauka Publishers, 1969, 192 pp. Translated into English: *Scientometrics. The study of the Development of Science as an Information Process*, Washington, Translation Div. 13 Oct. 1971, a microfilm).

Twenty years have passed since then, but the book still remains timely. However, in the USSR scientometric methods still have to force their way. The idea itself to study science as a self-organizing system governed by its information flows seems absurd to many researchers. Indeed, it is inefficient to study science guided by the deterministic attitude (and this attitude is shared by the majority of researchers). Besides, scientometrics is capable of discovering drawbacks in the management of science: efforts spent on the development of science may prove to be disproportionate to its efficiency, the scientific information service may be poorly organized – and that hampers the diffusion of the ideas through communication channels, etc. All that requires decision-making, and this is always difficult.

Experimental design and scientometrics are two scientific trends that solve from different directions the principal problem of science-of-science – that of increasing the efficiency of scientific research. *Nalimov* successfully applied them together. In his scientometric papers he used the ideas of experimental design and in the work on experimental design – the scientometric ideas. After the monograph was issued, *Nalimov* made a personal acquaintance with D. Price – that was in 1971, in Moscow, during the International Congress of the History of Science. On Nalimov's request

Price gave a report about his research at the Chemistry Department of Moscow State University.

Scientometric research was continued in the 70ies as well. E.g. there was written the paper (in co-authorship) where two systems were compared: science and biosphere. It gave an acute formulation of the study of dead-end or non-conflict trends which render science lifeless. Another article was concerned with the geographical distribution of scientific information. It showed the non-uniform nature of information distribution among scientific centers. There also appeared a paper examining the need for intellectual workers on the basis of the analysis of advertisements in British journals and newspapers.

Further Nalimov became more and more interested in the logicomethodological problems of science, the problems of applying mathematics to non-mathematical fields and those of grounding the applicability of probabilistic-statistical approach. Hence his urge to find a language that would adequately express probabilistic outlook. In 1974 the monograph devoted to this subject came out (V. V. NALIMOV, *Veroyatnostnaya model yazyka,* Moscow, Nauka Publishers, 1974, 272 pp.) The second, expanded edition of this book appeared in 1979, and in 1981 it was re-published in the USA (V. V. NALIMOV, *In the Labyrinths of Language: A Mathematician's Journey,* ISI Press, Philadelphia, 1981, 246 pp.). It examines from a single stand the everyday language, the languages of science, of mathematics, of abstract painting, of biological code, the languages of ancient Oriental cultures. According to *Nalimov,* the existing scientific language allows people to express probabilistic concepts of the world sufficiently well and therefore there is no need to create a new language for this purpose. The probabilistic model of language reveals the specific trait of human thinking – its continual nature irreducible to the discrete verbal forms.

Also in the 70ies *Nalimov* published a series of papers on philosophy of science. These are works on the structure of science and logic of accepting hypotheses, on scientific creativity as a manifestation of intellectual rebellion, on the use of probabilistic concepts for the description of the phenomena of the external world. This represents only part of publications on the subject. Later they, together with the scientometric papers, entered a monograph issued in 1981 (V. V. NALIMOV, *Faces of Science,* ISI Press, Philadelphia, 1981, 297 pp.).

Proceeding from the system of Bayesian notions *Nalimov* managed to strengthen the assertions of *Kuhn* and the role of paradigms in science. According to *Nalimov,* paradigm is a stabilizing selection, a kind of a defense mechanism on a certain stage guarding the scientific trend from spreading into fruitless fields, and on another stage hampering the emergence of new trends. Therefore, if the optimal way of scientific evolution is to be found, organizational forms are necessary that would allow us to preserve the mobile equilibrium between stability and changeability.

Discussing conceptions by *Popper* and *Kuhn* concerning the evolution of science, *Nalimov* says that these conceptions, like some metaphors, describe one and the same phenomenon. On a large time scale the evolution of science is regarded as ceaseless change, and on small time scales as a formation of closed colleges.

Some conclusions made by *Nalimov* seem paradoxical. He believes that concrete scientific achievements can hardly be regarded as a sign of progress. In the cognitive aspect, the results of science are nothing more as the mastery of nature, since the entire contemporary knowledge from the viewpoint of the future is but paradigmatically fixed ignorance. It is possible to speak of real progress only in thinking, the evolution of science expands thinking.

In the section of the book devoted to the logical analysis of large ecology the conclusion is formulated that the problem of large ecology is a logical completion of the whole system of the European outlook. The idea of human superiority over nature was deeply rooted into the consciousness of society and opened the way to the unbridled advance of technological civilization. The way to overcome the ecological crisis lies in the creation of a new culture, and the index of the quality of culture is boredom.

Thinking over the way of scientific evolution, *Nalimov* notices the tendency towards the humanitarization of knowledge. He feels this will bring us back the lost integrity, and lead us to indivisible knowledge. We come to comprehend that the entire scientific knowledge is connected with man, with the peculiarities of his thinking and his needs. The problem of man becomes central in science. According to *Nalimov,* science simulates the nature of man rather than that of the world man describes. Hence the study of the nature of science is primarily the way to understand man.

The two following monographs by *Nalimov* are devoted to the problem of man (V. V. NALIMOV, *Realms of the Unconscious: The Enchanted Frontier,* ISI Press, Philadelphia, 1982, 320 pp.; V. V. NALIMOV, *Space, Time, and Life: The Probabilistic Pathways of Evolution,* ISI Press, Philadelphia, 1985, 110 p.), These two books sum up the results of the research in a new field of knowledge which is known in the USA Transpersonal Psychology. According to *Nalimov,* this is an appendix ramification of contemporary psychology which examines human nature in all its completeness, which studies the integrity of human consciousness outside its personalized manifestations. This trend is developed via knowledge integration. It is being contributed to besides psychologists, by philosophers, mathematicians, physicists, biologists, physicians, linguists, psychiatrists, theologists, and sociologists.

Nalimov introduces into his speculations over semantics the concept of semantic field through which human consciousness interacts with itself and that of other people. That allows us to think over the entire variety of manifestations of human

consciousness: dreams, creative insights, intuition, etc. The probabilistic model of consciousness is constructed as a deductive system based on a number of postulates.

Nalimov remarks that the problem "mind-matter" up to now remains unsolved. Two different realities, the world of meanings and that of physical phenomena, can be regarded together within, as it seems, a single field theory that reduces physical and semantic phenomena to spatial changes. He believes that the change of meanings can be explained in the language of the change of metric of the corresponding semantically charged space. Within this conception new texts are semantic excitons, the excited state of space.

It is far from being by chance that *Nalimov* started the research in the scientific trend which, evolving, might change the entire outlook of contemporary science. *Nalimov,* too, does not exclude in this connection the possibility of "schizoid" splitting of culture, the emergence of two sciences: the science of man and the science of the rest.

If we pass now from the description of the content of Nalimov's works to quantitative estimations, they too prove impressive. By the year he was awarded the Derek de Solla Price medal he had published 12 monographs and 130 articles. According to *SCI,* in the period between 1955 and 1985 they received more than 2200 citations.

Nalimov's scientific activities coincided with the transition of science to the study of objects of the new type, namely, complicated diffuse systems. This required changes in many fundamental foundations of science. The probabilistic approach, as compared to the deterministic one, has proved to be more efficient in the study of diffuse systems. Nalimov's studies strengthen and expand the probabilistic paradigm.

In the philosophy of science the change of paradigms is interpreted as a scientific revolution; therefore Nalimov's studies have in many aspects a revolutionary character. That was noticeable in the resistance provoked by his publications in mathematical statistics, experimental design, or scientometrics.

The significance of his papers on the probabilistic approach to language and consciousness, the philosophy of science, transpersonal psychology is likely to be revealed only gradually, as the major principles of science change. But the importance of the tendencies in the evolution of contemporary science revealed by him – such as humanitization and cybernetization of knowledge – is undoubtful. The essential feature is that *Nalimov* in his studies has practically welded natural scientific and humanitarian knowledge. Their successful synthesis is hardly possible without solid knowledge of ancient and modern cultures, which interest *Nalimov* greatly.

Nalimov keeps working fruitfully, he is a consulting editor of *Scientometrics.* We wish him further achievements on this road.