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DEDICATED TO THE MEMORY OF V. V. NALIMOV

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Professor Vassily Vassilievich Nalimov, Ph.D. of Technology and senior researcher in the Biological Department of Moscow State University, died on January 19, 1997, at the age of 87. He was a brilliant and original scholar who worked in the domains of philosophy, mathematics, physics, chemistry, and biology. He founded the Russian school of the mathematical theory of experiment and brought scientometrics to this country. He also made very important contributions to the probabilistic approach to language, thinking, and consciousness, biological evolutionism, the philosophy of culture, and the study of human nature.

Nalimov was born on November 4, 1910, in Moscow. As early as high school, he became acquainted with the ideas of Russian mystical anarchism based on non-violence and freedom from dogmas. He remained loyal to these ideas throughout his life. In 1929, Nalimov entered the mathematical section of the physical-mathematical department of Moscow State University, but left it one year later because of the first of a number of political conflicts. He was the only one to defend a student expelled from the university because of his "non-proletarian" origin. Having left the University, Nalimov started to work at the photoelectronic laboratory of the electro-vacuum section of the All-Union Institute of Electrotechnology. In 1933, in the *Journal of Technical Physics*, he published his first scientific paper (together with P. V. Timofeev) on the photoelectric effect. He then changed his place of work to the Institute of Measuring Devices where he participated in the creation of a photoelectronic laboratory. His first book, *Photoelements: A Guide* (in Russian) appeared in 1936 (Moscow, ONTI, 122 p.).

The scientific activities of Nalimov were interrupted by his arrest in October of 1936. He was convicted in accord with the notorious 58 clause (ii. 10, 11) of the Criminal Code of the Russian Federation for anti-Soviet propaganda and active participation in a counter-revolutionary anarcho-mystical organization. After a stay in the Butyrki prison in the summer of 1937, he was condemned to five years in a labor camp. Nalimov served his term in Kolyma where he worked as a woodcutter and in gold mines. Exhausted by hunger and back-breaking toil, he refused to work and proclaimed a hunger strike, for which he was to be shot. From the punishment cell, he wrote a declaration describing the nonhuman conditions in the camp responsible for the death of many prisoners, but it was the head of the camp who was shot, because the plan for gold extraction had not been fulfilled. As to Nalimov, he was accorded two months in a camp hospital and a nourishing diet. After this conflict, he continued to work as a woodcutter and in the gold mines until the end of his term. In October of 1941, a decree postponed the liberation of prisoners whose terms were over until the end of the war. At the same time, Nalimov found himself in the laboratory of the Orotukan plant of mining equipment (a few hundred kilometers from Magadan) where he started to work in the domains of chemistry, metallurgy, and metallurgical science, and where, in effect, he fulfilled the functions of the laboratory head.

In autumn, 1943, through the solicitation of the plant director, Nalimov was liberated, though without permission to leave Kolyma until the end of the war, and he was officially nominated

to be the head of the laboratory. In the summer of 1947, he succeeded in obtaining permission to leave Kolyma, and was first taken in by the geophysical group of the Geophysical Trust of the Middle Volga, and then by the Ust-Kamenogorsk affiliation of the Trust. At the beginning of 1949, he was summoned to Alma-Ata, arrested again, and condemned to perpetual exile in the town of Temirtau in the Karaganda region.

It is from this moment that Nalimov resumed active scientific research. He had a chance to be taken on as an engineer-researcher in the Central laboratory of the Kazakh metallurgical plant, where he started extensive research on the application of spectral analysis in metallurgy. Massive experimental data of spectral analyses were processed by original statistical methods, and the results were published in the Russian *Journal of Analytical Chemistry* and in *Industrial Laboratory*.

After Stalin's death in 1953, Nalimov was granted amnesty, and at the beginning of 1955, he arrived in Moscow and entered, as an editor, the department of optics of the Institute of Scientific Information (VINITI) of the Academy of Sciences. While there, he obtained his Ph.D. with an authorization from the All-Union Certifying Commission (since he did not have a university diploma); his thesis was devoted to the application of mathematical statistics in the study of errors of spectral and chemical analysis.

Somewhat later, Nalimov became interested in the ideas of cybernetics. In 1959 (with G. E. Vladuts and N. I. Styazhkin), he published "Scientific and Technological Information as a Problem of Cybernetics" in *Advances in Physical Science* (in Russian). The research in mathematical statistics was later continued in his work on the mathematical theory of experiment, and the ideas of cybernetics were used in chemical cybernetics and scientometrics.

In the fall of 1959, Nalimov obtained a position in the State Institute of Rare Metals (Giredmet). Six months later, he was rehabilitated for failure to prove a charge against him. At the same time, his monograph, *Application of Mathematical Statistics to the Analysis of Substance* (in Russian) (Moscow, Fizmatgiz, 1960, 430 p.) was published, and several years later it was re-edited and published in the USA and Great Britain. In Giredmet, Nalimov organized a group for mathematical research of chemical and metallurgical processes, and started to develop a new scientific theory, unknown yet in our country, namely, the mathematical theory of experiment. He prepared and published a review ("Statistical Methods of Searching for Optimal Conditions for Chemical Processes," *Advances in Chemistry* (in Russian), 1960, V. 29, No. 11, pp. 1363-1387) and a booklet, *Statistical Methods of Describing Chemical and Metallurgical Processes* (in Russian) (Moscow, Metallurgizdat, 1963, 60 p.). In this period, his activities acquired a wide scope, thanks to lectures and consultations given to many organizations, as well as because Nalimov was head of the section of chemical cybernetics of the Scientific Council of Cybernetics attached to the presidium of the USSR Academy of Sciences. He also actively participated in the work of the new department, Mathematical Methods of Research, in the journal *Industrial Laboratory* (in Russian).

In 1963, in the Mendeleev All-Union Research Institute of Metrology, Nalimov successfully defended his doctoral thesis entitled "Metrological Aspects of Chemical Cybernetics." Two years later, his monograph (with N. A. Chernova) *Statistical Methods of Surface Experimental Design* (in Russian) (Moscow, Nauka, 1965, 340 p., later re-edited in Poland) greatly promoted research in experimental design in our country.

In 1965, academician A. N. Kolmogorov proposed for Nalimov a position as head of the section of experimental design in the new Intrafaculty Laboratory of Statistical Methods at Moscow State University. Later, Nalimov would often mention that the creative atmosphere in the laboratory greatly enhanced his research in experimental design, scientometrics, philosophy of science, and other domains. Continuing his activities in experimental design,

he now turned to scientometrics. He published the paper "Quantitative Methods of Studying the Evolution of Science" in *Problems of Philosophy* (in Russian)(1966, No. 12, pp. 38-47) where a broad spectrum of problems was examined concerning the application of quantitative methods to the study of science, and where he first introduced the term "naukometriya" (scientometrics) later used as the title for the international journal, *Scientometrics*.

During that period, research in scientometrics and in the science-of-science in our country was only in the bud. Nalimov was the president of the workshop on scientometrics at the Institute of the History of Natural Sciences and Technology of the Academy of Sciences; he proposed an informational model of science evolution and supported research connected with the application of his model to chemistry, experimental design, and other domains. Together with 11 other researchers, he published a paper devoted to the study of scientific journals as channels of communication and the evaluation of contributions made by different countries to the world-wide information flow of science (in *Scientific-Technological Information*, 1967, Ser. 2, No. 12, pp. 3-11)(in Russian); he also wrote (with Z. M. Mul'chenko) the book *Scientometrics* (Moscow, Nauka, 1969, 192 p., later re-published in Poland and Hungary)—the first monograph in the world concerning quantitative methods of studying the evolution of science.

In the beginning of the '70s, Nalimov continued his research in experimental design and scientometrics. His activities in experimental design were especially impressive. He actively participated in organizing workshops and All-Union conferences in various regions of the country, and he composed a course of lectures entitled "Statistical Methods in Chemistry," approved by the Ministry of Higher Education. An important contribution was made to the theory of experimental design. It was possible to demonstrate the practical applicability of mathematically valid optimality designs for polynomial models and to construct designs satisfying a family of criteria (the paper written with T. I. Golikova and N. G. Mikeshina, "On the Practical Use of the Concept of D-optimality," *Technometrics*, 1970, No. 12, pp. 799-812). He also published the monograph *Theory of Experiment* (in Russian) (Moscow, Nauka, 1971, 208 p.)—an indispensable guide to the ideas of mathematical statistics and experimental design. Nalimov's scientific and organizational efforts in this direction resulted in the creation of a Russian school of experimental design that united experts in the mathematical theory of experiment and researchers applying these methods in various branches of science, technology, and the national economy. The school greatly contributed to the development of this scientific discipline in our country, which was later demonstrated by scientometric data. In scientometrics, several papers were written on the comparison of two systems, science and the biosphere (with Z. M. Mul'chenko), on the geographical distribution of scientific information (with I. V. Kordon and A. Ya. Korneeva), as well as on the change in the demand for intellectuals, based on employment advertisements in British journals and newspapers (with G. A. Batulova and A. V. Yarkho).

In the same period, Nalimov became interested in logico-methodological problems of science related to the use of mathematics for a probabilistic description of the world. This interest resulted in his writing two preprinted papers on the logical foundations of applied mathematics and experimental design (the latter with T. I. Golikova), and several articles on the history of cybernetics (with Z. B. Barinova), on the logico-linguistic analysis of the language of science (with Z. N. Mul'chenko), on the language of abstract painting (with P. F. Andrukovich, V. S. Gribkov, V. P. Kozyrev, and A. T. Teryokhin), and on the logical analysis of the problem of ecology. Certain results were later reflected in the monograph *Probabilistic Model of Language* (Moscow, Nauka, 1974, 272 p., re-edited and published in Poland, 1976; a second, extended version published by Nauka in Moscow in 1979 was re-edited in the USA in 1981). This monograph demonstrates a single view of everyday language, the languages of science, of mathematics, of abstract painting, of the biological code, and of ancient Asian cultures. The probabilistic model of language allowed for

establishing the sufficiency of contemporary language for the presentation of probabilistic concepts.

In the mid-'70s, the scientific life of Nalimov was witness to another turning point. The Intrafaculty Laboratory of Statistical Methods did not have the status of a problem laboratory, and according to the administrative conventions established by the Ministry of Higher Education it could no longer exist. The laboratory therefore ceased to exist and the section of experimental design was transferred to the Biological Department of Moscow State University and transformed into the Laboratory of the Mathematical Theory of Experiment. In the Biological Department, Nalimov was engaged in teaching biometrics and computer science to students, post-graduates, and colleagues of the department, as well as other biological departments and agricultural institutes. He also continued his research on the theory of experiment, scientometrics, and philosophy of science, often putting together the results obtained in these different domains. His interest moved more and more towards the problems of philosophy of science, human philosophy, and a probabilistic approach to the nature of consciousness. In the late '70s, Nalimov published a number of papers on the philosophy of science: the structure of science and logic of accepting hypotheses; scientific creativity as a manifestation of intellectual rebellion; the language of probabilistic notions; fighting against complexity in the scientific description of the world; the humanization of knowledge; and the problem of man in modern science. A small monograph, *Language and Thinking: Discontinuity vs. Continuity* (in Russian), was published in Tbilisi (Tbilisi University Publishing House, 1978, 84 p.). The author formulates a hypothesis there on the principal impossibility of a dialogue between man and computer by means of formal logic.

A monograph on experimental design (written with T. I. Golikova) came out in 1976, *Logical Foundations of Experimental Design* (in Russian)(Moscow, Metallurgia, 128 p; a second extended edition, 151 p., was published in 1981 by the same publishing house). The book examines the relationships among various optimality criteria. An article was published on the analysis of difficulties arising in the construction of non-linear models with respect to parameters. In 1980, Nalimov accepted a position as a Consulting Editor for the international journal, *Scientometrics*.

Nalimov continued to expand his research on the philosophy of science and on the probabilistic approach to the nature of consciousness. He prepared a new book, *Faces of Science* (ISI Press, Philadelphia, PA, 1981, 297 p.) containing articles he published earlier that treated the structure of science, the logic of accepting hypotheses, etc., as well as scientometric papers (a comparison of science and the biosphere; the geographic distribution of scientific information; and the change in the demand for intellectuals). A year later, another monograph developing the probabilistic approach to the concept of the unconscious appeared from the same publishing house, *Realms of the Unconscious: The Enchanted Frontier* (ISI Press, Philadelphia, PA, 1982, 320 p.). It concluded the cycle of books devoted to the probabilistic model of language and the image of science. The book was first published in our country only in the mid-'90s, with some amendments and specifications, as *Reality of the Unreal: Probabilistic Model of the Unconscious* (with J. A. Drogalina) (in Russian) (Moscow, Mir idei, AO AKRON, 1995, 432 p.; it was re-edited and published in France in 1996). The conception was based on the use of probabilistic logic, notions borrowed from many scientific domains (mathematics, physics, psychology, etc.), original experimental data, and a metaphoric approach. The book examines the language of the probabilistic vision of the world, studies certain problems insoluble in an ordinary language, and gives attention to the problem of psychological time proper and the notion of time as a grammar of the Texts of the World. Another philosophically flavored book by Nalimov, *Space, Time, and Life: The Probabilistic Pathways of Evolution*, was published in 1985 (ISI Press, Philadelphia, PA, 110 p.). It proposed a new approach to the problem of evolutionism that did not use the idea of natural selection dominant in biology for almost 150 years.

During this period, Nalimov continued his research on experimental design and ecology. He was editor for the reference book, *Tables of Experimental Designs for Factorial and Polynomial Models* (in Russian) (with V. Z. Brodsky, L. I. Brodsky, et al., Moscow, Metallurgia, 1982, 752 p.). A review of the situation in the research on experimental design in the USSR was published in an anniversary volume of the International Statistical Institute, "Experimental Design in Russian Practice," in *A Celebration of Statistics* (ISI Centenary Volume, Ch. 21, NY, Springer-Verlag, 1985, pp. 475-496). A new approach to ecological forecasts was considered in the paper "Analysis of the Foundations of Ecological Forecasting" (in Russian) that appeared in *Problems of Philosophy* (1983, No. 1, pp. 108-112).

The second half of the '80s was witness to a few more remarkable events in the life of Nalimov. For his contribution to scientometrics, he was awarded the Derek de Solla Price medal given annually by the editorial advisory board of the journal *Scientometrics*. In 1988, he was first authorized to travel abroad—to the International Congress, *Spirituality and Nature*, in Hanover. As Nalimov said later, during this trip and those that followed, he acquired many friends—warm, intelligent, and endowed with spirituality.

It was in these years, also, that Nalimov first became acquainted with transpersonal psychology, a new philosophical-psychological trend engaged in the study of human nature and the integrity of human consciousness beyond its personal manifestations. This trend aroused great interest on the part of Nalimov. By the end of this period, he published the monograph *Spontaneity of Consciousness: Probabilistic Theory of Meanings and Semantic Architectonics of Personality* (in Russian) (Moscow, Prometei, 1989, 288 p.). It completed the cycle devoted to the application of the language of probabilistic concepts, scientometrics and the solution of certain philosophical problems, semantics of everyday language, philosophy of science, nature of the unconscious, and biological evolutionism. The book is devoted to the development of a probabilistically oriented philosophy. Proceeding from certain concepts of philosophy, transpersonal psychology, psychiatry and other domains of science, the book reveals the nature of meanings, and constructs a probabilistic model of personality. It also considers such problems as the relationship between the semantic world and the physical one, the nature of understanding, creativity, multidimensionality of personality, human dignity, and the meaning of life and the meaning of the Universe. A new category is introduced, that of Spontaneity, of openness to the universal potential and the capacity to get into resonance with it.

Later, Nalimov continued his research on the methodology of the mathematization of biological knowledge and on the conception of probabilistically oriented philosophy. Several papers on biological subjects were published at the beginning of the '90s in the journal *The Way*. The principal idea of these papers is that prevention of ecological catastrophe is only possible after a radical change of value orientations, which is tantamount to the emergence of a new culture. He examined certain philosophical problems in the monograph *In Search of Other Meanings* (in Russian) (Moscow, Progress Publishers, 1993, 280 p.). Two thirds of this book is devoted to the problems that Nalimov had approached earlier: the irreducibility of meanings to their rigid definitions; ways of revealing meanings; the conception of multiple worlds of different spirituality and wanderings through worlds and ages; forms of the manifestation of consciousness; and the spiritual necessity of individual and social inner growth. The rest of the book exposes Nalimov's views on the problems of the philosophy of culture. Nalimov started to study these problems in his later years. He paid special attention to the critical state of modern culture, to the search for a new culture and a different civilization, to the danger of charging culture with ideology, and the danger which grows as culture becomes richer and more complicated.

Nalimov discussed these and other problems of the philosophy of culture in a philosophical essay, (with the participation of J. A. Drogalina) *At the Threshold of the Third Millennium:*

What we Have Grasped on Approaching the XXIst Century (in Russian) (Moscow, Labyrinth, 1994, 74 p.). Here Nalimov comes back to the fundamental problem: the unavoidable transmutation of the modern culture which has become dilapidated and can no longer support ethics according to the demands of the period. Nalimov believes that the basic principle for the development of a new culture must be comprehension of the dilemma—*life/death*—via examining another opposition, that of *consciousness/matter*.

At the same time, Nalimov published several papers (in the periodicals, *Put* [Way], and *Chelovek* [Journal of a Human Being]) about his life experiences. They all appeared in his book of memoirs, *The Rope-dancer* (in Russian) (Moscow, Progress Publishers, 1994, 456 p.). These are fragments of a family chronicle saturated with philosophical and historical speculations. In this book, as well, Nalimov recorded such manifestations of modern culture as the bureaucratization of society, the increased violation of the individual, the fight against the destruction of nature, and methodological violations in science. In 1992, Nalimov became a member of the editorial board of the Chinese journal, *Science of Science and Management of S.T.*, and in 1996, he was elected an honorary member of the Russian Academy of Natural Sciences and awarded an honorary badge of the RANS for his “service in the development of science and economics.”

In his book, *The Rope-dancer*, Nalimov quotes Maeterlinck: “Human greatness is measured by the greatness of mysteries that preoccupy him” (p. 362). Nalimov himself passed on from the problems of a probabilistic approach in substance analysis, experimental design, and scientometrics to constructing a probabilistic theory of consciousness, to bridging the gap between consciousness and the physical world in order to create a hyper-field theory, to solving the problems of the meaning of the Universe and human life.

Nalimov’s conceptions, exposed in almost 200 papers and 18 books, do not all share the same destiny. According to the Institute of Scientific Information (USA), two of his monographs, *Application of Mathematical Statistics to the Analysis of Substance* and *Statistical Methods of Surface Experimental Design* have become “classics of citation.” His books on scientometrics and the probabilistic model of the language have also become widely known and very popular. His philosophical books, however, include notions from many disciplines and are therefore rather difficult to comprehend. In addition, they violate established paradigmatic boundaries among sciences. According to the foreign press, they cannot be said to belong either to philosophy or to any other domain of science. One reviewer calls Nalimov’s perspective a “hyperscience” which will be developed in the XXIst Century. It is difficult to say now in what way Nalimov’s ideas will be “unpacked” in the years to come.

Nalimov’s attitude toward science, his original and profound thinking, and his interest in modern culture have had a great impact on his disciples and members of “invisible collectives” guided by him. He was an affable and easy-going person, always ready to discuss scientific problems as well as other subjects. He supported all manifestations of creativity, and was happy for the progress of his students though never afraid to criticize their errors or neglect of their duties.

Everyone who has been privileged to know Vassily Nalimov closely will remember him forever.