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HYLE Book Review

Vladimir I. Kurashov: *History and Philosophy of Chemistry* (in Russian), Moscow: KDU, 2009, 608 pp., ISBN 978-5-98227-563-9

***by Vitaly Gorokhov**[*]*

The book under review is, as noted in its foreword, at the same time a scientific monograph and a textbook. This fact makes my review of Professor V. Kurashov's book especially difficult. First of all, I would like to make some remarks about the curriculum in history and philosophy of science in Russia. Some years ago, a new examination for 'Candidates of Sciences' (*kandidat nauk*) in history and philosophy of science for postgraduate students of all disciplines was introduced in Russia. The academic degree Candidate of Science is the first level which officially endows the academic status; the next and highest academic degree is the Doctor of Science. The main curriculum leading to the Candidate of Sciences degree is the *Aspirantura* in universities and scientific research institutions of the Russian Federation, which is intended to impart in-depth theoretical, technical, and social education and training. The duration of full- or part-time postgraduate studies is three and four years, respectively. Educational programs in the *Aspirantura* include both postgraduate courses and research. In the first year of this curriculum, a course on the philosophy of science is offered, requiring a library-research report on the history of a particular, narrowly-limited field of science, which the doctoral student (called an aspirant) investigates as a future researcher. The course consists of lectures on the philosophy of science and seminars on the history of science, with presentation of the report on the history of the respective field of scientific research from the philosophical point of view. The holder of the academic degree is officially designated not simply as Candidate of Science, but as Candidate of Technical Science, Candidate of Physicomathematical Science, *etc.* The lectures and seminars in the courses on philosophy of science consist of general and special levels. The special level is oriented on philosophy of physics for physicists, philosophy of technology for engineers, and so on. For that reason, the author wrote: "If we have books on philosophy of physics and on philosophy of technology, we also have to have a special textbook on philosophy of chemistry for postgraduate chemistry students."

But this work is not exclusively concerned with the philosophy of chemistry. V. Kurashov's text has general and special sections. The former treats among others the followings topics: "What is science? The conceptions of science, scientific knowledge, and the methodology of science", "The nature of the experimental methods of natural science", "Recognition of the limits to the

cognition of nature", "The course of global natural history", "The origin of the Universe, the concept of evolution, and the problem of the origin of life", "The interdisciplinary unity of scientific knowledge".

The special section is concerned with the history and philosophy of chemistry. This part of the book involves the following topics: "The natural world and the phenomenon of technology from the point of view of the historical and philosophical analysis of chemistry", "Fundamentals or the essence of chemical method", "The mathematization of chemical knowledge: historical and methodological aspects", "The heart of chemistry: organic synthesis (the origin of the concept of chemical structure and organic synthesis, the objectives of organic synthesis, chemical synthesis as a method of cognition, strategy and tactics of synthesis)", "Supramolecular chemistry, spin chemistry, and nanochemistry", "On the structure of chemistry's modern foundations". The author emphasizes that chemistry has much in common with mathematics and physics on the one hand, and with biology and geology on the other. In particular, he analyses in his book the historical relationship of chemistry to these various scientific disciplines, such as the development of physical chemistry, mineralogical and biological models in chemistry, the application of chemical methods in biology, and of mathematical methods in chemistry. He also investigates the origin of the atom-molecule concept and its most important ramifications in 19th-century science and in quantum chemistry in the 20th century.

The book's next special topic is a description of the language of chemistry: chemical terminology, symbols, and nomenclature, the professional dialects of chemists (from the real life of chemists in the various chemical laboratories) and the technical language of natural scientists and technologists.

As noted above, we in Russia have an examination for the mandatory course on the history and philosophy of science for postgraduate students of all disciplines. A prerequisite for this examination is a treatise on the history of a special branch of (for instance) chemistry, which is the dissertation. For that reason, this book's Appendix presents an educational program for a subject, "The history and philosophy of science", subdivision "Philosophical problems of chemistry". I am certain that many chemists will read this book simply to learn what the philosophy of chemistry is, and to prepare for the examination on the history and philosophy of science in the chemical faculties of the different universities and research institutes of the Russian Academy of Sciences.

The university where Professor Vladimir I. Kurashov has held the chair of the department of philosophy since 1995 is not a classical, but a technological university in Kazan, the capital of the Russian Republic of Tatarstan – Kazan State Technological University. Professor Vladimir I. Kurashov's department offers courses in Philosophy and Concepts of Modern Natural Science for undergraduates of all curricula; courses on the Philosophy of Science, the History and Methodology of Science for graduate students, and courses in the History and Philosophy of Science for postgraduate students of all of these postgraduate and postdoctoral curricula. Accordingly, we find in his book several chapters on artifacts and technology, technological education and technology as one of the bases of social life and of society's view of the world. But Kurashov's deliberations on the philosophy of technology are too rudimentary. He reflects on the different approaches to the definition of

technology (on only 5 pages), but does not analyze the specific structure of the engineering sciences. The more interesting aspect of his thought on technology are his reflections on advances in chemical engineering (nanotubes and fullerenes, 'intelligent materials', membrane technology, *etc.*); biotechnology, the systems of biophysical and chemical knowledge, of biomolecules in nanotechnology, molecular electronics, and 'DNA-computers'. While most of the older engineering disciplines only dealt with various physical processes (electrical, mechanical, hydraulic, *etc.*), they today also include chemical processes, or any natural processes in general, when the theoretical principles of chemical engineering are concerned. There is, for example, the fabrication of a programmable microfluidic device similar to an electronic computer. Professor Kurashov notes that a characteristic feature of modern chemistry is the interdisciplinary approach in scientific research and technological decision-making.

The author stresses above all that chemistry is rich in interfaces to other scientific disciplines, because chemistry overlaps with mathematics and physics on the one hand, and biology and geology on the other. We can therefore find very different cognitive models in chemistry: physical, mathematical, mineralogical, and biological models, and the corresponding scientific strategies and intrascientific systems of thought (methodological guidelines). For example, the expansion of the 'mathematical ideology' and mathematical methods in chemistry was always connected with the intermediary role of physics, and in the initial stages, with mechanics. M. Lomonossow, in his work, *The Elements of Mathematical Chemistry* wrote that chemistry is the science of the mixture of substances, the change of the mixtures results from motion; the science of motion is mechanics, and chemistry therefore has its foundations in the mathematical apparatus of mechanics. It is interesting to note that, in this work by Lomonossow, you can find neither concrete chemical experiments, nor concrete mathematical reasoning. It is rather a methodological discourse. Later, physical methods were applied in chemistry more as a means of research on various chemical structures. Quantum chemistry originated, from the Kurashov point of view, not as applied quantum mechanics, but as a new scientific discipline which inherently integrated quantum-mechanical theory (physical knowledge) and the theory of the chemical constitution of matter (chemical knowledge). The author criticizes much more exhaustively (pp. 291-392) the reduction of chemistry to physical-mathematical knowledge. In this regard, he is in agreement with the positions of the Russian philosophers of chemistry, B. Kedrov (*The Subject and Interrelations of the Natural Sciences*, Moscow 1973), V. Kusnetsov (*The Dialectics of Chemistry*, Moscow 1973) and others, who underpinned their views with quotes from Friedrich Engels. But Kurashov's analysis of this problem is made more from the methodological than from the ideological point of view. Concerning biological models in chemistry, it is very important to remember that, at the same time, chemical models are being developed in biology – for instance, the metaphor of the living cell as a chemical factory in biotechnology. The author sees the development of the interaction between geology and chemistry in the Vernadsky conception of the integration of the two disciplines in historical geochemistry ('history of terrestrial atoms').

An obvious omission of this textbook is the complete neglect of ethical problems in science and technology. The fundamental ethical problems of science and technology have been coming to the fore increasingly in connection with consciousness of the scientist's, engineer's, and designer's social

responsibility in modern society: The ultimate goal of technology is to serve people without harming others and the environment. Many current manufacturing processes in the mass production of food, drugs, agricultural products, and the like are known to be harmful to man and to nature. For this reason, scientists and engineers play an increasingly important role in modern technocience and in society in solving the problems of scientific, technological, and business ethics, or of social responsibility in general. It is also important to have social structures in society and in social institutions which support the well-directed and moral orientation of scientists and engineers. There is, as yet, no sustainable science and engineering, there are no special ethics courses in scientific and engineering education, and unfortunately, there is a lack of the necessary institutional support in Russia. We propose the elaboration of an, in effect, new paradigm of scientific and technological development: The production of scientific knowledge cannot be separated from its application, and both of these cannot be divorced from the ethical responsibilities of scientists or engineers.

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