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Estonian Studies in the History and Philosophy of Science, Rein Vihalemm, ed. – Dordrecht–Boston–London: Kluwer Academic Publishers, 2001. – XIV, 304 p. – (Boston studies in the philosophy of science. Vol. 219).

Reviewed by **Leo Näpinen and Ülo Kaevats**

Tallinn Technical University

The publishing of the collection "Estonian Studies in the History and Philosophy of Science" in the famous series "Boston Studies in the Philosophy of Science" is unquestionably an important event in the history of Estonian science studies. The editor of the book — Associate Professor of Philosophy of Science Rein Vihalemm — has made an essential contribution in bringing Estonian studies in the history and philosophy of science to the academic readers of the English-language world. The book consists of 22 articles by 24 authors and is divided into four parts. The clear and informative introduction was written by Rein Vihalemm himself.

In part I "Studies in the History and Policy of Science in Estonia", researches in the history of science in Estonia and the formation and present-day state of science policy in Estonia are considered. In their article "Newton's *Principia* in the Curricula of the University of Tartu (Dorpat) in the Early 1690s", Ülo Lumiste and Helmut Piirimäe suggest that Tartu University of *Academia Gustavo-Carolina* (1690–1710) could have been the first in the whole world to start teaching Newton's theory on the basis of his *Philosophiae naturalis principia mathematica* (1687). This was done starting from the academic year 1693/94 by Sven Dimberg, a young professor of mathematics at *Academia Gustavo-Carolina*. Historian of science Hain Tankler writes in his paper "A University Between Two Cultures: On the Development of Tartu/Dorpat University in the 19th and Early 20th Centuries" about the development of natural sciences (astronomy, physics, chemistry, geology, botany, zoology) and medicine at the German-language *Universitas Dorpatensis*.

The chemist Vello Past's article, "The Emergence of Physical Chemistry: The Contribution of the University of Tartu", tackles the role of Tartu University in the shaping of physical chemistry. This discipline was developed especially by Wilhelm Friedrich Ostwald and Gustav Heinrich Johann Apollon Tammann. The former's Tartu period (1875–1881; from 1872–1875 Ostwald was a student of

chemistry at Tartu University) yielded 12 published articles (mainly on the problem of chemical affinity); Tammann's Tartu period (1885–1902) resulted in 68 scientific articles and one monograph. "In Tartu, W. Ostwald took the first steps to create a fixed system of substances for physico-chemical experiments." (p. 43)

In their paper, "In Political Draughts Between Science and the Humanities: Geography at the University of Tartu Between the 17th–20th Centuries", human geographer Ott Kurs and historian of science Erki Tammiksaar examine the development of geography in the history of the University of Tartu.

Science policy specialist Helle Martinson's article "Formation of R&D Policy in a Small Country in a Changing World", and President of the Estonian Academy of Sciences Jüri Engelbrecht's paper "Science and Society – Faculties Close or Apart?" consider the contemporary problems of science and its perspectives in Estonia as a very small country. Engelbrecht explains "how things are in Estonia, first in science and second, in society." (p. 77) Summing up, Jüri Engelbrecht begins with the statement "All starts from attempts to understand." (p. 85) and finishes with the paragraph:

"Open dialogue is the only way to encourage the stable development … The main point is that science and society are naturally close allies." (p. 87)

As the book is published in the series *Boston Studies in the Philosophy of Science*, parts II–IV have been devoted to philosophy of science.

Part IV is titled "Studies in the Methodology and Philosophy of Special Fields of Research".

Philosophical articles by Bruno Mölder, "Inter-Level Explanation and the Category-Mistake", Jaan Kivistik, "On the Raising of a Hand" and Valdar Parve, "Value-Neutral Paternalism" follow the analytical approach. Mölder summarises his analysis as follows: "the first condition for building a category-mistake-free theory is that its theoretical concepts should have overlapping ranges of application. The second condition is to avoid the use of causally efficient intra-level constructs in inter-level explanations. The explanation of conscious contents by non-conscious contents could avoid category-mistake only if one naturalises consciousness, that is, if one modifies the range of application of "consciousness" in a way that one establishes a link between sub-personal and personal level." (p. 292) Kivistik considers the contemporary discourse about action analysis on the basis of Donald Davidson's articles. Parve makes an attempt to give a non-traditional analysis of paternalism. If traditionally paternalism is viewed as an ethical conception, then Valdar Parve analyses paternalism as a value-neutral conception.

Geographer Hill Kulu's "Knowledge, Human Interests and Migration Studies" pays attention to the importance of Richard Rorty's pragmatism for his speciality. Kulu sees the need to bring migration studies into the context of today's social scientific thought. Relying upon the recent history of the methodology of social science and the philosophy of science (the ideas of Richard Rorty, Thomas Kuhn, Jürgen Habermas, and others), the author reaches the conclusion that the

researchers of migration "have become conscious of the dependence of the goals and approaches of migration studies on the predominant traditions and social practice." (p. 270) The researchers "are aware of the diversity of goals and approaches and of the state of human knowledge." (p. 270) Accepting this means "that choices regarding the goals of migration studies also denote ethical choices." (p. 270)

Part III is titled "Studies in the Philosophy of Physics". Physicist Anto Unt's article "The Copenhagen Interpretation of Quantum Mechanics and Common Sense" also belongs to analytical metaphysics. The author emphasises that his "only claim is that something being weird from the viewpoint of classical physics does not imply its being something extraordinary in an everyday context." (p. 248) And in the end of his writing he stresses that his "aim was to outline the basic logic of propositional attitudes and deontic concepts." (p. 260) Unt gives as an example a hyper-intensional object. (p. 260) He points out that "only its existence as an abstract object allows us to use logical connectives with it – the possibility we take advantage of every day." (p. 260)

Physicists Madis Kõiv (also a writer and former Professor of Liberal Arts at the University of Tartu (1994)) and Piret Kuusk in their article "What is Time?" apply the analytical method of research. The authors themselves write that they abandon the Heideggerian approach. (p. 233) They also notice that they "don't use the time operator in Prigogine's sense." (p. 238) The article by Piret Kuusk, "Physical Reality, Theoretical Physics, and Mathematics", focuses on the relations between physics and mathematics. Kuusk asks the question: "what is the physical reality investigated by the methods of modern physics, and what is the role of mathematical language?" (p. 203) The author gives the following answer: "All reality contains everything, whatever this means; physical reality concerns only phenomena which are already defined and named." (p. 204) Piret Kuusk distinguishes two types of mathematical reasoning in the practice of theoretical physics.

"In the phenomenological approach, observational and experimental results are the primary data which are always kept in mind while constructing and improving the equations of a theory.

In the mathematical approach, the fundamental equations of a theory are postulated from some general physical principles and/or on the basis of some experimental facts, and their solutions are considered to describe physical reality (with possible rare exceptions in the declaration of some solutions to be non-physical)." (p. 206)

About the lastly mentioned exceptions speaks philosopher Jüri Eintalu in his "Outsolutions in Physical Theories. Physical Considerations". He demonstrates how a mathematically correct solution to a mathematical equation is sometimes excluded from a physical theory. The author claims: "… in case of outsolutions we find that "physical considerations" prescribe laws to nature." (p. 218) Eintalu thinks "that to accept … a formula as a natural law is a kind of value judgement. The improbable is turned into the impossible due to "physical considerations."

These serve as a legislative power, as a basis of evaluation." (p. 223) The author states: "The physicist's *a priori*, unconscious, predominant conviction that he knows what the world is like even without experiment, manifests itself in these considerations." (p. 226) Jüri Eintalu points out that "the physical considerations" can also be called "philosophical considerations". "In the philosophy of science these considerations are often used unconsciously rather than investigated." (p. 228)

About part II the editor Rein Vihalemm himself writes the following:

"The bulkiest section of the book is part II, which discusses the issues of the general methodology of science. In a nutshell, the main theme here is the classical question *what is science?*" (Introduction, p. xii) Next, we are going to dwell on this part.

In the article "Some Fundamental Criteria of the Scientific Method and the Internal Structure of Science", Viktor Palm argues for the classical, positivist tradition — for the subject-free objectivity (definite objective knowledge) in science. He makes an attempt to show that several principles (model's *adequacy* to reality, verification (falsification), reproducibility of observations, logical and mathematical correctness, specification of the object of science, etc.) and the realisation of methodological requirements are available for granting the real manifestation of the normative methodological requirements. This specific scientific approach, the author notices, is limited in two cases: (1) if the observational data are unique (unique aspects of historical events), and (2) if the results of observations are irreproducible in principle (for example, the case of the quantum mechanical uncertainty relation, where "only the distributions of the frequencies of corresponding events are reproducibly observable," and therefore "the *interpretative* models are limited to the prognosis on the probability level, only"). (p. 107)

Undo Uus, former astrophysicist and present methodologist of science, argues in his paper "The Glory and Misery of Modern Science", contrary to Viktor Palm, that scientists must abandon the conventional objective methodology of scientific research. The author claims "that it is utterly unreasonable to ignore the subjective empirical facts, for they supply information about the world of a kind, which cannot in principle be provided by any objective facts." (p. 111) Uus reaches the following conclusion. "Modern science disparages qualitative intuiting by degrading its conclusions to the status of deceptive feelings, harmful for the scientific purpose." (p. 121) He makes a straightforward confession: "… the present-day humankind has deliberately blinded itself intellectually in respect to the rich content of conscious experiences, because from this content it is evident that the clear but primitive modern scientific world view, in which most of the educated people want to believe, is erroneous." (p.122)

The paper of Ülo Matjus, historian of philosophy, "Edmund Husserl Pursuing the Paths of Descartes: *The Paris Lectures* on Philosophy as a Universal Science", considers the relation between science and philosophy in the context of the history of phenomenology. Matjus argues that "… Husserl's philosophy as a philosophy

of transcendental subjectivity … can be considered the philosophical expression of the era of modern technology … Edmund Husserl's philosophy is a remarkable philosophical expression of the era that has forgotten existence … Husserl only said that since Descartes, the forgetting of existence (*Seinsvergessenheit*) had even become deeper than before." (p. 136) The author also stresses that if Husserl's interpretation of the existence is formal-logical, then Martin Heidegger understands the existence as the basic feature of reality. (p. 137, note 4)

In her article "Herman Boerhaave – *Communis Europae Praeceptor*: Internal vs. External in the History of Science", philosopher Endla Lõhkivi discusses the new ideas about the relations between the internal and the external in the methodology of the history of science. The author restricts her topic to Hermann Boerhaave's (1668–1738) chemistry. The main issue of her study concerns some meta-level historiographical questions. Lõhkivi denotes that "Boerhaave applied Newtonian mechanics and its extension, the theory of affinity to a new area of research — chemistry, whereas chemistry itself remained secondary or an assistant science in comparison to physics." (pp. 148–149)

Philosopher Leo Näpinen's article, "The Problem of the Relationship Between Human and Physical Realities in Ilya Prigogine's Paradigm of Self-Organisation", explains Ilya Prigogine's non-classical conception of science. The author demonstrates how a science in Ilya Prigogine's interpretation is restoring the contact with human everyday experience and natural-historical reality. Some characteristic quotations are as follows. "For Prigogine, the "pure" physical universe does not exist any more; he includes in the physical world the partly rehabilitated Aristotelian cosmos." (p. 159) "The natural-historical character of the synergetic theories of Prigogine and others lies in the fact that they use schemes from biology as a discipline describing living, historically developing nature." (p. 160) "Now, as mathematical natural science adds to physical description human everyday experience as well (which cannot be expressed by mathematics but by natural language), it also captures the real, historical time, at least in a minimum way." (p. 158) Leo Näpinen draws the following conclusion: "If traditional mathematical natural science excluded chance from science…, then Prigogine's paradigm of self-organisation, through irreversibility, includes chance as well." (p. 162) This paradigm acknowledges the necessity of understanding the reality as a whole (which would also include humans). (p. 162)

Philosopher Peeter Müürsepp's paper, "Science and Magic: Causality", also observes the problems of non-classical science but, differently from Leo Näpinen's article, he proceeds from the ideas of René Thom. The author makes an attempt "to analyze, when and why is science really scientific, and when does it tend towards magic." (p. 165) Basing his "inquiry on the notion of causality and the role of this concept in modern science," (p. 165) and considering René Thom's *salient* and *pregnant forms* and other concepts, the author reaches the following conclusion: "On the one hand, modern natural science seems to strive for unity and wholeness in a magical manner. On the other hand, there is clearly no need for a timeless organizing center any more. On the contrary, natural science today is

strongly time dependent … The experimenter enters the same reality he is studying. Like the classical scientist, he is still interested in predicting the future development of the process under study. But he knows that he cannot repeat his experiments. He has to act differently." (pp. 176–177)

In the last paragraph the author claims:

"Thus, science and magic have significant intersections during their parallel development … What we really need today, most of all, is probably as scientific magic as possible." (p. 177)

Philosopher Jüri Tammaru's paper "Symmetry and Rationality" considers the formulation of historical types of standards of rationality by means of the concept of symmetry. The author concludes that the standard of rationality "is applicable wherever systems are tackled whose transformation is irreversible (i.e. the vector of time is present) and which are in motion towards the state of equilibrium." (p. 182) Tammaru also notices "that the trend developed by I. Prigogine and his school renounces" the Leibniz principle of sufficient reason (and accordingly the Curie symmetry principle) "assuming, as a result of changes and development, the formation of systems, more asymmetric than their predecessors." (p. 182) The author also denotes that in non-linear thermodynamics the principle of sufficient reason is not universally valid and the effect can be more asymmetric than the cause (p. 183, the table).

Rein Vihalemm sums up his own article as follows. "The article by Rein Vihalemm … "Chemistry as an Interesting Subject for the Philosophy of Science" is founded on the philosophy of chemistry. He argues in favour of the narrow view of science (as an idealised physics-like science, proposed to be called *φ-science*), showing that one should not broaden the notion of science but understand clearly that the scientific treatment has certain premises and limits within the framework of which it is effective, but it cannot pretend to have the status of ideal cognition and knowledge in general." (Introduction, p. xiii) Vihalemm emphasises the role of chemistry in understanding the peculiarity and limits of idealised physics-like science. The author demonstrates how chemistry (like the natural sciences in general) is "moving from artificial world to real nature, from constructed and organised phenomena towards self-organising and behaving phenomena." (p. 196) Rein Vihalemm states:

"The most essential example of the theory of self-organisation in chemistry is the theory of non-linear, non-equilibrium thermodynamics of chemical reactions presented by Prigogine and his co-workers." (p. 195) In connection with this theory he stresses: "In principle, a self-organising system cannot be constructed, since its organisation and behaviour cannot be prescribed and created by an external source. It emerges autonomously in certain conditions (which cannot be prescribed either). The task of the researcher is to investigate in what kind of systems and under what kind of conditions self-organisation emerges." (p. 195) Following Aleksandr Pechenkin, a Russian philosopher of science, Rein Vihalemm agrees that we can speak about *paradigm change* in physics, undertaken by Ilya Prigogine. But he also adds that this paradigm change "is

actually very extensive and would need a separate thoroughgoing analysis." (p. 195) Vihalemm warns: "However, Prigogine's optimism can also be misleading as so we can neglect the specific character of science as a way of cognition and a type of knowledge…." (p. 198, note 18) Rein Vihalemm finishes the body of the paper with the paragraph:

"The natural world of complex processes is not the predictable and invariant world of φ-science. Knowledge about the natural world "in its naturality" cannot be obtained within the framework of the constructive-hypothetico-deductive approach, but requires classifying-historico-descriptive type of inquiry as a starting point." (p. 196)

Summing up, the reviewers point out that the *Collection* gives an interesting picture about the present science studies of Estonian researchers. The different conceptions of science and its changes have been described from different positions. The reviewers tried to bring forward the more interesting places from the texts of this book and deliberately avoided any critical evaluations. The penetration into problems discussed in the collection needs much more time, and the reader can do this himself. Good luck with this.

Addresses:
Leo Näpinen
Chair of Philosophy
Tallinn Technical University
J. Sütiste tee 21, room 300
13419 Tallinn, Estonia
Phone: +372-6202661
Fax: +372-6202665
E-mail: napinen@edu.ttu.ee
Ülo Kaevats
Chair of Philosophy
Tallinn Technical University
J. Sütiste tee 21, room 300
13419 Tallinn, Estonia
Phone: +372-6202660
Fax: +372-6202665
E-mail: kaevats@edu.ttu.ee