The Finnish Society for Natural Philosophy 25 Years
K.V. Laurikainen Honorary Symposium 2013

Critical Remarks on K. V. Laurikainen's Natural Philosophy

Ilkka Niiniluoto
Department of Philosophy, History, Culture and Art Studies, University of Helsinki

Abstract. Besides his important achievements in physics, K. V. Laurikainen (1916-97) defined his "third mission" as the promotion of history and philosophy of science in the Faculty of Science. This project revitalized his earlier studies in theoretical philosophy with Eino Kaila. Laurikainen's proposal for combining science and religion, or even supporting the existence of an "irrational factor" or "free will" in nature by the statistical causality of quantum theory, did not impress most of his colleagues in physics. Lutheran theologians in Finland remained indifferent, and philosophers were provoked to present counterarguments. This paper summarizes my debates with Laurikainen in the early 1980s. His "third mission" is now carried forward by the Finnish Society for Natural Philosophy, established 25 years ago in 1988.

Laurikainen's three missions

Kalervo Vihtori Laurikainen (1916-97) was an energetic personality with clear aims and strong will. In his book on the "physicist's way" (see [11]), he has described the three great missions of his career.

Laurikainen started in 1934 his studies in mathematics at the University of Helsinki. He wrote in 1939 his Master thesis in topology for professor Rolf Nevanlinna, the famous function theorist. His other subjects included physics, astronomy, and chemistry. Laurikainen also followed in 1938 the lectures on logical empiricism by Eino Kaila, professor of theoretical philosophy, and finished in 1940 the highest grade laudatur in this subject.

During the Winter War 1939-40 and its continuation in 1941-44 Laurikainen served in the ballistic unit of the Finnish artillery. The plan to write a doctoral dissertation in philosophy for Kaila was changed to studies in theoretical physics. A scholarship arranged by Nevanlinna allowed Laurikainen to spend the summer of 1947 in Zürich, where he could follow lectures of Wolfgang Pauli. In 1950 Laurikainen defended his doctoral thesis on the gravitational energy of electro-magnetic fields.

Laurikainen, who was appointed associate professor of physics at the University of Turku in 1956 and professor of nuclear physics at Helsinki in 1960, defined his first mission as the

fight for the academic status of theoretical physics in Finland. His successful campaign in Helsinki, supported by Nevanlinna and Erkki Laurila, lead to the establishment of the chair of nuclear physics in 1958 and the Research Institute for Theoretical Physics (TFT) in 1964.

Laurikainen's second mission was to promote experimental particle physics in Finland. The Department of Physics had a small accelerator in Helsinki since 1956, and it was moved to an Accelerator Laboratory in Kumpula in 1982. Co-operation with CERN was started in 1968, and eventually Finland joined CERN in 1991. TFT was reorganized in 1996 as the Helsinki Institute of Physics (HIP), with the function of coordinating the CERN activities.

Laurikainen was not quite happy with the financial situation of particle physics in Helsinki in the late 1970s. After leaving in practice his teaching position 1976, which was soon renamed as professor of particle physics, he retired from the University at the end of 1978. During this time Laurikainen revitalized his earlier interest in philosophy, and started his third mission: the promotion of history and philosophy of science at the Faculty of Science.

Laurikainen had published textbooks in physics, such as *Atomistiikan aatemaailma* (*Ideas of Atomistic*, 1973), but now he started to write essays and books on the relations between science and religion, among them *Fysiikka ja usko* (*Physics and Belief*, 1978), *Todellisuus ja elämä* (*Reality and Life*, 1980), and *Luonto puhuu luojastaan* (*Nature speaks about its Creator*, 1983). These religious themes were related to the problem of interpreting quantum theory (see [10]), especially the issue about quantum indeterminism and statistical causality.

Oiva Ketonen, Kaila's successor as professor of theoretical philosophy, retired in September 1977. I was then associate professor of mathematics (logic and foundations), and chairman of the Philosophical Society of Finland, but I was asked to act after Ketonen as the professor of theoretical philosophy at the Faculty of Arts (until my appointment in this chair in 1981).

I was 30 years younger than Laurikainen. But with my specialization in logic and philosophy of science, it was natural that he sought contact with me. We had long personal conversations in my office, and I gave lectures in his Thursday seminar at the Department of Physics, but we disagreed on almost all important philosophical issues (see Section 3 below). Sometimes I felt to be able to convince him on some point, but soon he stubbornly returned to his old position.

Laurikainen was disappointed that his fellow physicists were not impressed by his third mission, and I could not support it either. In February 1982 I wrote an assessment of Laurikainen's application to be appointed as "docent of history and philosophy of science (especially physics)" at the Faculty of Science, but did not find that his publications in these fields so far would correspond at least to two doctoral dissertations. I pointed out that some American and British universities had established new departments of "history and philosophy of science", but works in this field should be assessed by as strong scholarly standards as any other academic discipline. The other assessor, professor Anto Leikola, himself an expert in the history of biology, came to the same conclusion about Laurikainen's work in the history of science.

Laurikainen's frustration can be seen in the polemical remarks about academic

philosophy of science in his book *Tieteen giljotiini* (*The Quillotine of Science*, 1987). But his energy never failed. In the 1980s he was the main organizer of several international symposia on the foundations of modern physics in Joensuu (see [6, 7]), with many prominent participants, both physicists (like C. F. Weitzäcker, Max Jammer, Alain Aspect, David Bohm) and philosophers (Bas van Fraassen, Jeffrey Bub, Brian Skyrms). In current terms, Laurikainen had an admirable talent in networking. My relations with Laurikainen were polite: in 1986 I contributed an essay on Ernst Mach in the *Festschrift for Laurikainen's 70th birthday* (see [1]), and gave a lecture on scientific realism in the 1987 symposium in Joensuu (see [7]). In 1988 Laurikainen published a monograph on Wolfgang Pauli, *Beyond the Atom: The Physical Thought of Wolfgang Pauli* (see [12]. In the same year, Laurikainen with his friends founded the Finnish Society for Natural Philosophy.

Laurikainen thereafter continued his third mission with the concept of natural philosophy. In 1991 the Faculty of Science appointed a committee, chaired by professor Paul Fogelberg, which concluded that natural philosophy should be supported but not established as a new subject. Laurikainen also wrote letters to the Minister of Education and searched support for natural philosophy from the Academy of Finland in 1994. In 1994 he wrote *Kantista kvanttiin* (*From Kant to Quantum*), an introduction to philosophical problems of physics for a philosophy course in high schools. In 1997 he wrote a monograph about his views on "the ontological implications of quantum theory" (see [13]), and was prepared to defend it as a doctoral dissertation at the University of Oulu, but he died at the age of 81 just before the defense was supposed to take place.

What is natural philosophy?

Laurikainen's would-be dissertation in 1997 [13] was dedicated "To my great guides in natural philosophy: Eino Kaila, Rolf Nevanlinna, Wolfgang Pauli". It is probable that Laurikainen took the somewhat old-fashioned term 'natural philosophy' from his teacher Eino Kaila (1890-1958) who used the German word Naturphilosophie in his works still in the 1950s.

Philosophy of nature (with thinkers like Thales, Democritus, Heraclitus, and Empedocles) was the original theme of the pre-Socratic philosophy in the ancient Greece. Plato and Aristotle continued these a priori discussions about the ultimate constituents of reality; the latter's followers entitled this study as 'metaphysics'. In modern physics the term *philosophia naturalis* was still used in 1687 in the title of Isaac Newton's *Principia*, but lessons from the methodological reforms of the scientific revolution introduced a sharp contrast between natural philosophy (i.e. speculative approaches to nature) and natural science (i.e. the scientific study which combines quantitative theories with empirical observations and experimental tests). German idealism in the early 19th century (Goethe, Schelling, Hegel) reintroduced metaphysical Naturphilosophie. But modern philosophy of science in the early 20th century by the Vienna Circle (Schlick, Carnap) and the Berlin group (Reichenbach) rejected metaphysics as meaningless, and analyzed the language of science and the structure of theories by the tools of formal logic. Their work was developed in close co-operation with great physicists (Mach, Einstein, Bohr, Heisenberg). Today the term 'natural philosophy'

is not any more in fashion, but it may refer to those branches of the philosophy of science which are concerned with special disciplines of natural science (e.g. philosophy of physics, philosophy of chemistry, philosophy of biology) (see [18]).

Eino Kaila was connected with the Vienna Circle (see [19]). He admired its exact philosophical method, but emphasized the "synthetic" task of philosophy in constructing a comprehensive world outlook by critically analyzing the contents of the best current theories in science, such as quantum mechanics, relativity theory, evolution theory, and Gestalt psychology.

Laurikainen's studied philosophy of science with Kaila. He was also familiar with the new results on formal logic by Kaila's student Oiva Ketonen. In 1941 Laurikainen published in Ajatus, the yearbook of the Philosophical Society of Finland, an essay on the nature of mathematical knowledge, "Matematiikan analyyttisyydestä", and in 1942 an essay on physical space and time, "Minkowskin neliulotteisesta maailmankuvasta". The latter paper shows influences from Rolf Nevanlinna as well. During the war Kaila suggested to Laurikainen isomorphism as a theme of doctoral dissertation, but then their contacts seem to have been lost. Kaila devoted much of his time after 1943 to the philosophical study of quantum mechanics. His criticism of Bohr is recognized by Jammer (see [2], p. 165). For a recent reappraisal of Kaila's philosophy of nature, see [22]. Even though Laurikainen later mentions Kaila as his teacher, and in particular refers to the notion of invariance in Kaila's work *Inhimillinen tieto* (*Human Knowledge*, 1939; for an English translation published in 2014, see [3]), no discussion of Kaila's critique of the Copenhagen interpretation of quantum mechanics is given.

Laurikainen was firmly convinced of the correctness of the Copenhagen interpretation of quantum mechanics. His great heroes included Niels Bohr, Werner Heisenberg, and Wolfgang Pauli. Indeed, he claimed that "Pauli's competence in philosophical questions concerning the foundations of physics was greater than that of any scientist of the 20th century" ([6], p. 276). Laurikainen's exposition always started with the double-slit experiment which illuminates complementarity and statistical causality. He argued against the idea of a "detached observer": quantum mechanics cannot study an "independent reality", as measurements disturb atomic objects. The observer has to be included in our picture of the world: "quantum mechanics does not reach the microworld but only describes our knowledge of this world" ([13], p. 3). This leads to an epistemic or psychic interpretation of the state function: "a matter wave can be characterized as a symbolic shape (gestalt) in the consciousness" ([13], p. 37). Both Cartesian dualism and materialistic philosophy have to be replaced by Pauli's "unus mundus" which admits that the complementary reality is both rational and irrational. In his later work, Laurikainen appealed also to Bernard d'Espagnat's notion of a "veiled reality", where a veil stands between the rational (empirical) and irrational reality.

In my view, Laurikainen's arguments for the "crisis of materialism" are not convincing. He does not seriously examine various realist interpretations of quantum mechanics, such as Popper's propensity view of the psi-function, Kaila's terminal causality, Bohm's holism, or Healey's interactive realism (cf. my discussion in [17]). Quantum theory does not support the

antirealist view that the microworld is mind-involving or mind-dependent. In particular, the speculative theses about "the free will" are based on a mistake: to give justice to quantum indeterminism, one needs a more realistic approach to scientific theories than Laurikainen's narrowly empiricist methodological view allows (see below Section 3).

Laurikainen's willingness to discuss the interpretation of quantum mechanics can be seen as following Kaila's project of natural philosophy. But his tendency of mixing religion to the world view is sharply in contrast with Kaila's skepticism towards religious and metaphysical doctrines. In this respect, Laurikainen is a representative of the old tradition of natural theology. When Hume and Kant in the 18th century rejected the teleological proof of God's existence, William Paley's Natural Theology (1802) attempted to find a new defense of the argument from design. When Darwin's theory of evolution in 1859 refuted the design argument, by showing how the functionality and complexity of biological organisms can be explained by variation and natural selection without appealing to supernatural agents, different versions of creationism and intelligent design have been proposed (for criticism, see [21]). Laurikainen rejected in 1980 the U.S. creationist campaign to use the Bible as a textbook of science. But in the next year in a newspaper article he protested against the teaching of the Big Bang in schools. His main line, against what he labeled as "scientistic" materialism, was the compatibility of science and religion which leaves room for God's providence. The "invisible" and "irrational" factor of reality is revealed only by faith or personal religious experience ([9], p. 183). But in Paley's spirit Laurikainen also kept repeating that "nature tells about its creator". Inspired by Pauli's attraction to Jung's mysticism, he went further to urge that statistical causality opens the way to irrationality in nature.

It is not news that throughout the history there have been scientists who are at the same time deeply religious. Freedom of thought allows this possibility. But Laurikainen's steps in finding a positive link from science (quantum theory) to religion did not impress most of his colleagues in physics. (In [13] Laurikainen gives replies to criticisms by Stig Stenholm, Mats Roos, and Raimo Lehti.) Also the Lutheran theologians in Finland, who typically favor the peaceful independence and co-existence of science and religion, remained indifferent to Laurikainen's programme. Among the philosophers, Oiva Ketonen was perhaps the first to point out already in 1976 against Laurikainen that the appeal to the Creator as the cause of existence is "to explain the unexplained by the unexplained" ([4], p. 75).

My debates with Laurikainen

During the years 1980-84 I published several open letters and critical short articles about Laurikainen's arguments in the Finnish journals Vartija, Kanava, and Tiedepolitiikka. Laurikainen, who of course wrote his replies (cf. [5]), was obviously annoyed by the fact that a young philosopher opposes him. I tried in vain to convince him that philosophers have not neglected the notion of probabilistic causality: a lively discussion about objective probability and indeterminism was going on between philosophers of science, among them Karl Popper and many followers of Hans Reichenbach like Carl G. Hempel, Wesley Salmon

and Patrick Suppes. Probability had been the focus of my own studies in mathematics and philosophy.

The summary of these debates from my part was given as a chapter of my collection of essays *Tiede, filosofia ja maailmankatsomus* (1984) with the title "The Laws of Quantum Mechanics do not presuppose God" (see [15]).

My counterargument starts from the common premise of scientific indeterminism: particular event are governed by probabilistic laws without hidden variables, so that they do not have complete determining causes. Laurikainen's jump to the conclusion that particular events involve an additional supernatural cause ("chance", "free will", "irrational factor"), which guides world events as if behind a veil, is therefore based on a kind of metaphysical determinism. As Laurikainen stated, "Only God knows what happens in particular cases, human knowledge is at best probable" ([8], p. 31). So this was my main point: from nothingness (i.e. non-existence of determining causes) one cannot infer a positive existence claim about God's guidance or an irrational factor unknown to science.

Further discussion on this theme was given in my review of the book *Todellisuus ja kuvajainen* (1990) by K. V. Laurikainen and Kullervo Rainio (see [14] and [16]). Rainio – also a student of Kaila - is a pioneer of applying probabilistic or stochastic models in social psychology, so that for him Laurikainen's "irrational" equals "stochastic". It seemed to me that Laurikainen had misled Rainio to speak about the "free choices" of atomic particles. Their positions about the psychophysical problem remained unclear, and the authors did not tell how quantum indeterminism could prove that we humans have a free will. As an epilogue, Rainio published in 2010 a good and fair summary of my debates with Laurikainen (see [20]). He accepts my basic counterargument, but points out that Laurikainen could avoid the charge of metaphysical determinism by admitting that the "irrational factor" effects some single events sometimes. But then he undermines this proposal by referring to Laurikainen's statement that "God is present here and now" and "in his hands is everything what happens". Rainio concludes that our scientific world view has to take seriously the ideas of "active information" and "information field". This leads the debate back to Bohm's version of quantum mechanism – which Laurikainen always rejected as inconsistent with the Copenhagen interpretation.

K. V. Laurikainen deserves credit for his Kaila-based insistence that it is important to carry forward conversation about the philosophical implications of the best scientific theories to our world views. This critical multidisciplinary discussion, which belongs to all of us, will not come to closed conclusions as long as science and philosophy are alive. Laurikainen's third mission is now continued by the Finnish Society for Natural Philosophy which I congratulate for its 25th anniversary.

References

[1] Hämäläinen, Rauno and Lahti, Pekka (eds.), *Essays in Honour of Kalervo Vihtori Laurikainen on the Occasion of His Seventieth Birthday*, Annales Academiae Scientiarum Fennicae, A VI, Physica, **431**, Helsinki.

[2] Jammer, Max, *The Philosophy of Quantum Mechanics*, John Wiley, New York, (1974).

[3] Kaila, Eino, *The Human Knowledge – A Classic Statement of Logical Empiricism*, translated by Anssi Korhonen, edited by Juha Manninen, Ilkka Niiniluoto, and George A. Reisch, Open Court, Chicago, 2014.
[4] Ketonen, Oiva, *Se pyörii sittenkin: Tieteenfilosofian peruskysymyksiä*, WSOY, Porvoo, (1976).
[5] Lahti, Pekka and Mansikka, Kauko (eds.), *Tieteen todellisuuskuva*, Department of Physical Sciences, University of Turku, Turku, (1984).
[6] Lahti, Pekka and Mittelstaedt, Peter (eds.), *Symposium on the Foundations of Modern Physics: 50 Years of the Einstein-Podolsky-Rosen Gedankenexperiment*, World Scientific, Singapore, (1985).
[7] Lahti, Pekka and Mittelstaedt, Peter (eds.), *Symposium on the Foundations of Modern Physics 1987*, World Scientific, Singapore, (1987).
[8] Laurikainen, K. V., *Fysiikka ja usko*, WSOY, Porvoo, (1978).
[9] Laurikainen, K. V., *Todellisuus ja elämä*, WSOY, Porvoo, (1980).
[10] Laurikainen, K V., *Quantum Theory and the Openness of the Scientific World View*, Report Series in Physics, University of Helsinki, Helsinki, (1980).
[11] Laurikainen, K. V., *Fyysikon tie*, Matemaattisten aineiden opettajien liitto, Hyvinkää, (1982).
[12] Laurikainen, K. V., *Beyond the Atom: The Philosophical Thought of Wolfgang Pauli*, Springer, Berlin, (1988).
[13] Laurikainen, K. V., *Science has its Limits: Ontological Implications of Quantum Theory*, Report Series in Physical Sciences 8, University of Oulu, Oulu, (1997).
[14] Laurikainen, K, V. and Rainio, Kullervo, *Todellisuus ja kuvajainen*, WSOY, Porvoo, (1990).
[15] Niiniluoto, Ilkka, *"Kvanttimekaniikan lait eivät edellytä Jumalaa"*, in *Tiede, filosofia ja maailmankatsomus*, Otava, Helsinki, (1984), 113-131.
[16] Niiniluoto, Ilkka, *"Satunnaista luonnonfilosofiaa"*, Psykologia **5** (1990), 410-412
[17] Niiniluoto, Ilkka, *Critical Scientific Realism*, Oxford University Press, Oxford, (1999).
[18] Niiniluoto, Ilkka, *"Tarvitaanko vielä luonnonfilosofiaa?"*, in H. Rydenfelt and H. A. Kovalainen (eds.), *Mitä on filosofia?*, Gaudeamus, Helsinki, (2010), 137-147.
[19] Niiniluoto, Ilkka and Pihlström, Sami (eds.), *Reappraisals of Eino Kaila's Philosophy*, Acta Philosophica Fennica 89, Philosophical Society of Finland, Helsinki, (2012).
[20] Rainio, Kullervo, *"Muuan keskustelu Jumalasta ja kvanttifysiikasta"*, Vartija **2** (2010), 50-55.
[21] Sarkar, Sahotra, *Doubting Darwin? Creationist Designs on Evolution*, Blackwell, Oxford, (2007).
[22] Stöltzner, Michael, *"Terminal Causality, Atomic Dynamics and the Tradition of Formal Teleology"*, in Niiniluoto and Pihlström (2012), 163-194.