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**DISCUSSIONS WITH
K. V. LAURIKAINEN (KVL)**
“Science has its limits”

K. Kurki-Suonio (KKS), prof. emer.
University of Helsinki.
Department of Physics

2 (2) Two Missions

1967 The first discussion

Description 26 years later:

“... A young boy was once invited to the home of an authoritative scientist. He wanted to discuss something I had written about knowledge and faith. ... He explained that he was thinking in a different way. He declared himself as a freethinker and atheist, indicating that his world view was materialistic. Some years later, when I encountered again his thoughts, I was surprised to realize that they had changed. ...”

=> Common interest: knowledge <=> faith
the effect of modern physics on our worldview.

KVL: natural philosophy as the mission of life.

KKS: “didactical physics”,
physics teacher education

3 (3) Theory and Empiry

Much in common

Differences related to the roles of theory and empiry

KKS: the weak position of empiry in school physics
the main problem. "Formula disease"

KVL accepted:

* empiry as the primary basis of knowledge

* intuitive nature of concepts as gestalts,

* inseparable intertwining of empiry and theory:

- All empiry is theory-laden.

- All theory is empiry-laden.

- The empiry is primary.

- The empirical core meaning is perceived intuitively
and is preserved in all developments.

KVL:

argumentation often started from theory.

4 (3.1) Die and Electron.

KVL:

** The die is a macroscopic body and, hence, a classical object.*

Classical mechanics makes possible accurate prediction of its motion.

** Electron is a quantum mechanical object.*

Quantum mechanics allows only probabilistic predictions of its behavior.

KKS:

classical / quantum mechanical \Leftrightarrow

theoretical models instead of the “real” die and electron.

* The classical mechanics does not make possible “accurate prediction”

* Limitation to probabilistic predictions is not a consequence of QM.

It is an empirical fact \Rightarrow “empirical compulsion”
development of QM.

5 (3.2) The Double-slit Experiment.

KVL: QM requires a radical change of our conceptions of reality.

KKS: The necessity to change views does not come from QM but from the empiry which made the development of QM necessary.

KVL: One-slit experiment is sufficient, because it already produces a diffraction pattern.

KKS: In a one slit experiment, interpretation of the intensity distribution as a diffraction pattern is theory. It is concluded from the successful mathematical modeling of the phenomenon as linear superposition of monochromatic waves.

No empirical evidence of wave-particle dualism **without the second slit** => 3-phase experiment A–B–AB:

The patterns consist of “hits”, like particle impacts. But **the pattern AB is not A + B.**

The empirical evidence is not the pattern itself but its **non-additivity** $I_{AB} \neq I_A + I_B$, + its **accumulation** of local and instantaneous **events**.

Measurement => interpretation of AB, in terms of an **additive “field-quantity”** ψ , as a superposition of two waves. Assumption: The intensity is proportional to the square of the field quantity.

$$I_A \sim |\psi_A|^2, I_B \sim |\psi_B|^2 \Rightarrow I_{AB} \sim |\psi_A + \psi_B|^2$$

There is no observable field quantity.

ψ is just a mathematical abstraction, which makes the interpretation possible.

The “diffraction pattern” is nothing but an empirical probabilistic law of the “hits”.

6 (3.3) Ontological notes.

KVL: probabilistic nature of atomic phenomena,
complementarity:

*“Different experimental results can give incompatible results
(complementary to each other)*

“Objects of the micro world are contradictory to themselves”.

\Leftrightarrow both particles and waves are “valid models”.

Both natures occur simultaneously in the double-slit
experiment \Rightarrow

experiment and nature of objects internally incompatible.

KKS: *Empiry concerns only events and their distribution.*

* No indication of continual existence of particles

* No observable field quantity to support the wave model.

\Rightarrow Both models invalid, to be rejected

\Rightarrow the nature of electrons and photons??

No incompatibilities are left, if

* *the electrons and photons have no continual existence.*

* *realized only in instantaneous and local events of
interaction.*

\Rightarrow *The concept of path meaningless.*

No individual identity; only “species identity”.

KVL: probabilistic nature of atomic phenomena \Rightarrow

QM a representation of information not of “the reality”, \Rightarrow

Psycho-physical problem of the mind and the reality, \Rightarrow

science \Leftrightarrow religion.

KKS: OK, but the other conclusions are equally important.

Losses of continual existence and individual identity!

\Rightarrow the identity of particles, second quantization, fermions
and bosons.

\Rightarrow intelligible explanation of the particle and wave
observations.

7 (4) The Human Dimension

Consideration of theory \Leftrightarrow empiry not sufficient.

The human aspect cannot be neglected, neither the individual nor the social one.

The interaction of theory and empiry is the driving force of science.

* This dynamics is embedded in the *social process of "negotiation about meanings"*.

* And the whole process originates from the *intuitive perception* of empirical meanings.

The *intuitive basis* and the *social character* of all knowledge essential

* in the natural philosophy of KVL,

* in didactical physics of KKS

8 (4.1) Knowledge and Belief

Plato: *“Knowledge is justified true belief.”*

There are no unjustified beliefs! =>

The key question: *What kind of justification makes beliefs knowledge?*

Threefold justification needed; empirical, theoretical and social.

* *Empirical justification*: observation.

- Science: repeatable controlled experiments.

- In general: *all experiences are empiry.*

strong and convincing. Cf. planning of the daily life.

* *Theoretical justification* <=> structure of knowledge.

Pieces of knowledge fit consistently together.

* *Social justification*: similar experiences of others, perceived common meanings.

“Private beliefs” are no knowledge.

Common approval of some society.

Knowledge: Beliefs with threefold conviction:

1. *empirical*: **all** relevant empiry support it.

2. *theoretical*: **consistent** structure of knowledge.

3. *social*: **conviction of the “knowledge society”** of the **sufficiency** of **“all”** and **“consistent”**.

This includes the essence why even the “scientific knowledge” has the nature of *belief* and is basically *intuitive*.

9 (4.2) The Problem of an individual.

Individual: \Leftrightarrow personal conviction
 \Leftrightarrow subjective.

Science: \Leftrightarrow aims at objectivity
 \Leftrightarrow independent of the opinions.
 \Leftrightarrow everybody's conviction about the validity of its justification.

Unattainable utopia.

- A priori truths don't exist.
- Scientific grounds far beyond the reach of "everybody".

Everyone decides himself:

- * what empirical and theoretical grounds he finds convincing,
- * the conviction of what kind of society he can share
- * what beliefs he can adopt as his own knowledge.

Everyone is alone in his thinking.

Everyone regards himself as the best thinker.

No one can escape the responsibility of thinking himself!

10 (4.3) The Problem of Science.

Knowledge is born in the interaction of the “mind” and the “nature”.

- (1) **“Meanings first”** and
- (2) **“Ask nature”**.

The “mind” perceives meanings through observations offered by the nature.

Meanings cannot be derived or founded by anything but the perception.

This is ***the intuitive core of empiry,***
the origin of the empirical justification.

Knowledge is created by ***conceptualization of meanings.***

Concepts are adopted for representation of the meanings.

=> structural order

=> *theoretical justification.*

Definite order.

1. *Empirical justification.* <= perception of meanings.

2. *Theoretical justification.* Couples empirical meanings together.

3. *Social justification.* Agreement about sufficiency and validity of both.

11 (4.3) The Problem of Science (cont.)

“Science has proved.”

“It cannot be proved scientifically.”

\Leftrightarrow solved definitively.

Science does not PROVE anything!

Scientific knowledge is the best possible.

- still basically belief.
- intuitive perception process.

Science is intuitive, not logical.

Results presented in form of a final rational structure.

Pretended logic is *the white lie of science*.

The problem of science:

***Tension between intuition and logics,
between rational and irrational.***

KVL: *“the irrationality of reality”*

\Leftrightarrow *“the rationality of science”*.

Conclusion following from the QM.

KKS: *“the ultimate irrationality of science as a whole”*.

Theories of physics as rational conceptual structures.

They represent empirical meanings, intuitive, irrational.

Without empirical meanings theories are no physics.

\Rightarrow *Physics is irrational.*

12 (4.4) The Problem of Atheism

“Discussions with KVL” defective without God and religion.

The basic belief of the atheism: *“There is no God”*.
Knowledge? Threefold justification??

3. Social: Shared convinced about the sufficiency of the empirical and theoretical justification. What are they?

2. Theoretical: *“The non-existence of God”* fits without contradictions in the structure of knowledge, called “scientific world view”.

OK. Science is based on *“methodical atheism”*.

Investigating internal causal relationships of nature,
laws of nature.

Causes = cause-phenomena, the laws can be investigated.

God is not a cause-phenomenon obeying laws to be investigated.

God is excluded at the outset.

1. Empirical: lacking!

Sometimes non-existing things are observed, but *observation of a non-existence* does not make sense.
Lack of experiences does not prove anything.

The impossibility of empirical justification is replaced by two ideas, interpreted as the empirical evidence.

1. *“Negative justification.”* The mankind possesses consistent experiences, divine dispensation, the world of spirits etc.
Invalidation of this recurring and accumulating empirical basis is an endless task.

2. *“God of the gaps”*: Accumulation of scientific knowledge leaves God less and less space.

Mistake: *God would have an unlimited freedom to act without the slightest possibility to be observed.*

13 (5) *Unus mundus*

KVL / W. Pauli, a kind of *final summary*.

All aspects of the mind:

conscious and unconscious, knowledge and intuition,
physics and psyche, rational and irrational,
science and religion etc.

constitute an undividable **“one world”**,
united into an inseparable whole.

KKS: “unifying dualism”

intertwining of opposing counterparts.

Primarily *theory* \Leftrightarrow *empiry*.

→ Ultimately *mind* \Leftrightarrow *reality*.

Starting points:

KVL: QM, unpredictability, probabilistic nature of
atomic phenomena, complementarity,

KKS: *empiry* \Leftrightarrow *theory*

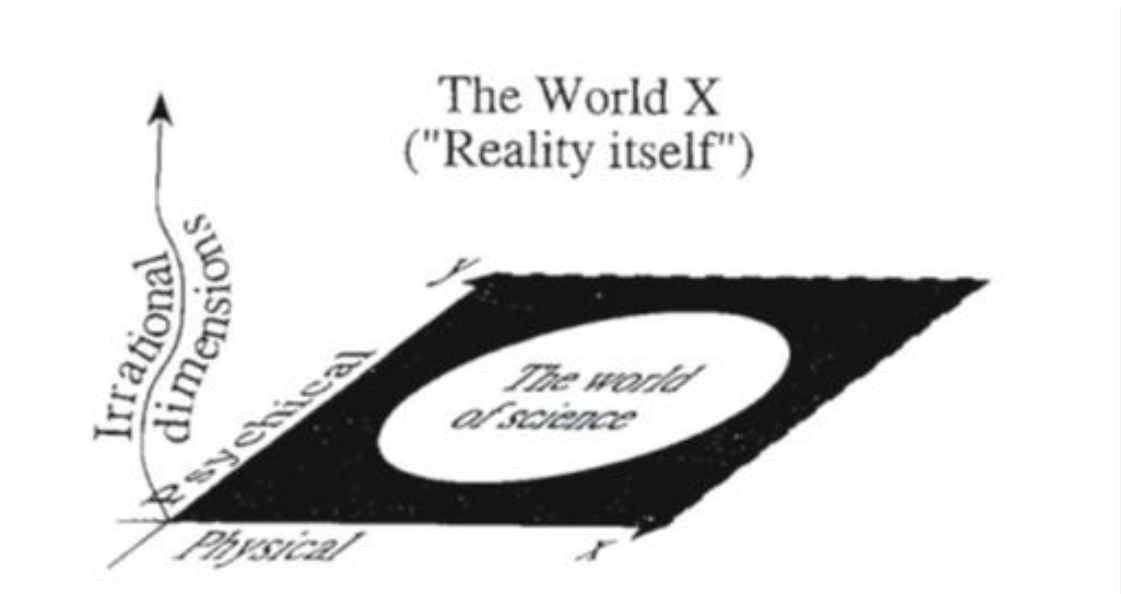
“meanings first” \Leftrightarrow *intuitive basis of knowledge*

QM one theory among the others.

→ ***parallel views*** about the relations of science,
reality and God.

Comparison:

14 KVL:n unus mundus



Pauli's "World X"

"The 'reality itself ... contains irrational dimensions nondescribable by science. In Figure the 'reality itself, or Pauli's 'World X', is the three-dimensional space. The rational world of science is just a two-dimensional cut of reality. The irrationalities – or better: the irrational dimensions – are reachable only by faith."

*My personal image of God: God is the same as reality itself, the basis of existence unreachable by reason.
"In him we live, and move, and have our being."*

15 Unus mundus of KKS

All elements within each other, (rational, irrational, God).

“The whole reality” = ***“God’s reality”***,
(without rejection of the cited Acts 17:28.)

Consciousness of God “fills the reality”.

***Mathematical metaphor:
continuum of numbers \Leftrightarrow geometrical line.***

* ***“God’s reality” \Leftrightarrow the infinite continuum of the line.***

* ***The possibilities of scientific knowledge*** (the rational of KVL)
 \Leftrightarrow The infinite enumerable set of the points of rational numbers.
- Fills densely the whole continuum and every part of it.

* ***The actual scientific knowledge***
 \Leftrightarrow a finite subset of rational points.
- extends up to some finite distance,
- decreases in density with the distance.
- spreading further and getting denser with the progress of science.

The measure, the “combined length”,
of the enumerable set of points is zero!

The length of any segment of it is due to the irrational numbers.

Similarly:

The measure of “God’s reality” is infinite.

The measure of the rational reality of science is ZERO.

I encounter in my life some finite part of “God’s reality.”
Its finite measure is due to the irrational.

“Science has its limits.” God has no limits.

SDG!