

Re: Physics & Philosophy

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From: Patrick Reany (*reany_at_asu.edu*)

Date: 06/14/04

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Bart Van Hove <bartvanhove@skynet.be> wrote in message
news:<pan.2004.06.10.18.47.01.849114@skynet.be>...

> *On Thu, 10 Jun 2004 15:55:43 +0200, willi wrote:*

>

> > *dans l'article 9gWxc.4538\$eu.2263@attbi_s02, Robert J. Kolker à*

> > *robert_kolker@hotmail.com a écrit le 10/06/04 11:57 :*

> >

> >>

> >>

> >> *jimp@specsol-spam-sux.com wrote:*

> >>

> >>> *Bart Van Hove <bartvanhove@skynet.be> wrote:*

> >>>

> >>>

> >>>> *My question is how philosophy relates to physics and science in general:*

> >>>>

> >>>>

> >>>> *It doesn't.*

It does! How Western science education has failed. If education in
science had done its job right, you'd know the answer to your question
already! Every high school graduate would.

> >>>>

> >>>

> >> *Not true. There are several good epistemological theses which describe*

> >> *how scientific theories differ from non-scientific theories.*

> >>>

> >> *See works by Peirce, Popper, Hempel, Samson. The big break away from*

> >> *metaphysics is due to David Hume (1711-1776).*

> >>>

> >> *In addition to all this, some philosophical contributions to science*

> >> *were made by scientists who also wore philosopher hats. For example*

> >> *Newton, Mach and Einstein. For a good review of method see Newton's*

> >> *-Principia Mathematica-, Book 3 and Newton's -Optiks-. Newton was very*

> >> *self aware about what he was doing and how it differed from all*

> >> *previous Natural Philosophy (that is what physical science used to be*

> >> *called). Newton who invented Modern Science version 1.0 and vanquished*

sci.physics: Re: Physics & Philosophy

- > > > *Aristotle invoked God within the corpus of –Principia Mathematica–.*
- > > > *Newton wrote twice as much on theology and scriptures than he did on*
- > > > *physics and his theology and science were entwined (or should we say*
- > > > *entangled).*
- > > >
- > > >
- > > > *Bob Kolker*
- > > >
- > > *Perhaps one should precise : "how GOOD philosophy relates to GOOD physics".*
- > > *But you have then to define good !*
- > > *I think that at least a part of Newton's theological works are highly*
- > > *questionable, especially his numerology. He certainly was upheld by his*
- > > *conceptions of God when he had to invoke far–ranged interaction and also*
- > > *vacuum ; it was a psychological help, not arguments.*
- > >
- > > *In science you use general principles (mostly hidden) which are metaphysical*
- > > *(not refutable) : on the use of logic, on causes, separability, existence of*
- > > *objects and so on.*

Not bad. But beyond their use, is the variety of viewpoints on what restrictions should be put on their use (in the form of physical models or concepts) and what specific criteria should be made explicit to enforce that use. These are also topics of the philosophy of physics. Philosophy gets used all over the place in physics. In the past it was explicitly recognized as such, but today, although it still gets used, it's hidden under a blanket of denial and/or indifference, mostly arising out of ignorance. The lack of specific use of philosophical terms in modern physics literature is partly the result of the majority of physicists not even knowing them, or if they do, their lack of courage to employ them in a mindset in which their use is at best superfluous. A failing of the ego philosophy of "not–invented–here" (NIH).

If the Establishment doesn't mandate the teaching of the philosophy of physics to physics students, it won't get learned.

- > >
- > > *20th century science have shown that many epistemological postulates are*
- > > *false or useless and even counter–productive: those above, those on space*
- > > *and time and even the very old and quasi–ineradicable concept of essence or*
- > > *substance.*
- > >
- > > *I would sum up :*
- > > *1) the scientific discoveries put limits on theories, even in philosophy.*
- > > *2) philosophy is welcomed in science if it brings creative ideas but should*
- > > *be put aside when it pretends to impose concepts or limits.*
- > > *3) hidden presuppositions in science should be tracked down.*
- >
- > *I agree with that, still: having put these limits on the use of*
- > *philosophy, doesn't it boil down to plain creative thinking? Ofcourse this*
- > *is a step in the scientific process of explaining some occuring effect.*

- >
- > *Some philosophy-enthusiasts I know claim it's the source of science, I'm*
- > *not eager to give philosophy that much credit (I agree with Uncle Al that*
- > *"real" in-depth philosophy doesn't produce any actual results).*

Then you believe that someday all new physics could be done by computers and not have people involved in it at all? How much is being purposely unanalyzed by that key word "Creativity" that is philosophical? Einstein and Heisenberg were creative thinkers, but their creativity was strongly influenced by their personal philosophical formal points of view. They didn't just sit down in a lotus position and wait for God to tell them the "truth" of deep reality. They proactively developed a formal point of view on how to proceed, and on top of that foundation they constructed theories to do the job, as they saw fit.

You need to learn a lot more philosophy before you make such claims about philosophy and physics. The problem with physics is often that one has too many possibilities to make choices from. One needs to impose a formal point of view, as Einstein said:

In order to construct a theory, it is not enough to have a clear conception of the goal. One must also have a FORMAL POINT OF VIEW which will sufficiently restrict the unlimited variety of possibilities.

— Einstein, Ideas and Opinion, The fundamentals of theoretical physics, p. 328 (emphasis my own)

- >
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Philosophy is NOT in competition against physics to explain the world! Philosophy investigates (among many other things) the logical structure of science. And it helps to provide criteria to choose a personal formal point of view, as claimed by Einstein. In his 1916 paper on GR, Einstein wrote this:

In classical mechanics, and no less in the special theory of relativity, there is an inherent epistemological defect which was, perhaps for the first time, clearly pointed out by Ernst Mach.....No answer can be admitted as epistemologically satisfactory, unless the reason given is an observable fact of experience.

--- Found in: The foundation of the general theory of relativity, A. Einstein, Dover Books, 1916, reprinted,

pp112–113.

In other words, motion with respect to invisible absolute space did not fulfill Einstein's personal view of a justifiable claim to physical knowledge——that's the epistemological defect of Newton's mechanics and SR, as Einstein saw it. Was he right? That's not a question that physics or philosophy can answer. But we can say that Einstein himself gave this FPOV credit for moving his thoughts in a direction that eventually produced GR, a theory that works.

One aspect to philosophy is to make us aware of the ultimate limitations on human knowledge. Heisenberg understood this. You should read his book *Physics and Philosophy*. You should also read Einstein's book, *Ideas and Opinions*, a collection of his essays on physics and other issues.

If we consider that part of the theory of relativity which may nowadays in a sense be regarded as bona fide scientific knowledge, we note two aspects which have a major bearing on this theory. The whole development of the theory turns on the question of whether there are physically preferred states of motion in Nature (physical relativity problem). Also, concepts and distinctions are admissible to the extent that observable facts can be assigned to them without ambiguity (stipulation that concepts and distinctions should have meaning). This postulate, pertaining to epistemology, proves to be of fundamental importance.

—— Found in: *Fundamental Ideas and Problems of the Theory of Relativity*, A. Einstein, Albert Einstein's *Theory of General Relativity*, G. Tauber, Crown Press, p51.

This paragraph of Einstein's is hard to understand to most physicists today because they are not trained in philosophy, even in the philosophy of science, which would do them some good. However, the physicists of Einstein's time were much more knowledgeable of the philosophy of physics than those of today. They understood, no doubt, what he meant: He meant that, based on the known empirical facts of his time, there was no "meaning" to the assumption of the existence of a preferred frame of inertial reference, as Lorentz's theory of electrodynamics supposed! Not having such a "meaning" based on empiricism, there was no justification to Einstein in claiming a legitimate "distinction" should be posited between any two inertial frames of reference. Einstein proposed what I call the "pure principle of relativity" (not to be confused with the much weaker Lorentz covariance principle) on this basis:

There is no empirical grounds to formulate any kind of distinction of any inertial frame of reference

over any other inertial frame for all theoretical purposes.

It's obvious that this is not a metaphysical statement per se, though it was based on one; but rather, it is a theoretical design principle that restricts the kinds of theories one can make under its purview. In other words, it was part of his formal point of view which he adopted to build special relativity upon. That's a clear example of philosophy preceding physics! Uncle Al will give you no evidence that his claim is true, but I gave you evidence that his claim is false.

Einstein claimed that this principle was in conformance with his doctrine that one should not be making positive knowledge claims about physical concepts which have insufficient "meaning" in a physical theory. Of course, one can agree with Einstein that one must have meaningful concepts before one can claim to have legitimate knowledge claims made about them, and yet strongly disagree with Einstein about what the criteria ought to be accepted to justify 'meaning' in a theory. In fact, there are three primary ways to do this, corresponding to how the instrumentalists, positivists, and scientific realists formulate these criteria.

To the positivists, meaning requires strong operationalism (verificationism): meaning is restricted to those concepts which can be directly and unambiguously correlated to sets of physical operations by which the concept is either identified or measured in physicality.

To the instrumentalists, meaning requires weak operationalism: meaning is restricted to 1) those concepts which can be directly and unambiguously correlated to sets of physical operations by which the concept is either identified or measured in physicality, or 2) to "paper and pencil" operations (Bridgman) by which concepts find their meaning implicitly by their relationship to the entire theory.

To the scientific realists, meaning is either 1) immediately apparent by the concept's obvious correspondence to something visual or tangible, or 2) intuitively justified.

To scientific realists, science can be used to justify the "approximate existence" of things which correspond to physical models employed by successful theories. They're out to use science to find deep reality! Scientific realists are hostile to any theory which purports to describe the physical world using arbitrarily invented concepts, especially what they call "mathematical theories." To them, that stikes out against the primary purpose of science — the claimed search for TRUTH. "What is the true nature of the world?" is their battle cry against human ignorance. Naturally, they tend to be very hostile toward Copenhagen quantum mechanics and relativity. Scientific realists are by their demanding philosophical choices the least free to adopt the principle of logical economy in their formal points of

view.

To instrumentalists, science is a means of predicting physical events (through physical laws) within successful theories. Physical concepts and models are free creations of the human mind which serve as "instruments of thought" for the invention/construction of theories that work. They adopt weak operationalism. In the pursuit of these "instruments of thought," guessing, conjuring, or intuition are all equally valid as means toward their production. Science is neutral to finding deep reality! Science is NOT about reverse-engineering deep reality. To instrumentalists, Copenhagen quantum mechanics and relativity are not particularly "weird" at all. In fact, the "weird" theory that works is worth a million "commonsense" theories that don't. Instrumentalists are by their relaxed philosophical choices the most free to adopt the principle of logical economy in their formal points of view. For the record, I'm an instrumentalist.

To the positivists, science is a means of making positive statements about the physical realm. To protect the purity of those positive statements, they have removed from science anything iffy, and that includes all those "paper and pencil" concepts, like fields, potentials, wave functions, and atomic and subatomic particles. There is no distinction between science and natural philosophy to a positivist. This is known as "scientism."

There are few positivists today. Most are instrumentalists, but there are a large number of scientific realists, especially among the so-called "cranks." There are even physicists who adhere to this viewpoint as well. It's both interesting and sad to me that most physicists today know so little about the philosophy of physics that they couldn't even begin to accurately characterize themselves as to which of these three views they adhered to the most, if any.

What Einstein was telling us is close to the philosophy espoused by the positivist movement — a philosophical movement that had begun with August Comte and had found a champion in Mach who further refined it, and later in the Logical Positivists who stressed the nature of language as the bearer of knowledge, which was taken for granted in science before they made a detailed study of the issue. In their view, for sentences to be meaningful the words they contain must be meaningful first. Although that sounds commonsensical, it turned out that the physicists of their time had not adhered to that dictum and so physics models were constantly being introduced into physics which had no particular "meaning" in terms of manifest physical operations or phenomena. Whether this is a good or bad thing depends on your personal philosophy about it.

The special relativity theory resulted in appreciable advances. It reconciled mechanics and electrodynamics.

It reduced the number of logically independent hypotheses regarding the latter. It enforced the need for a clarification of the fundamental concepts in epistemological terms.

---- Found in: Fundamental Ideas and Problems of the Theory of Relativity, A. Einstein, Albert Einstein's Theory of General Relativity, G. Tauber, Crown Press, p54.

Epistemology is basically the study of the justification for all knowledge claims. Apparently, Einstein's formal point of view about how to proceed to deconstruct the preeminence of the inertial system concept in the foundation to physics was strongly influenced by his personal notions of causality and its foundation in epistemology. Look at that thought experiment which Einstein setup in his 1916 GR paper. He described two mutually rotating massive orbs, one a perfect sphere, the other distorted. He asked a simple question (which I will put into my own words):

If one is to attempt to provide a causal explanation of the physical distinctions between the two orbs, how does one justify the knowledge claim: "I know what is the ultimate seat of causation for this distinction?"

Obviously, the distinction could not rest in an explanation of their relative motion. Einstein was well aware of Newton's answer to this. Newton had no causal explanation in terms of how this happens, though he assumed the existence of an absolute space (the equivalent to the absolute status of the inertial motion concept) by which acceleration is meaningful locally. Einstein's personal philosophy was that this absolute space of Newton's in which absolute accelerations lives is "ghostly." It was not only not detectible or visual, it was that way in particular because it was unaffected by the presence of matter altogether. Thus it failed in reciprocity: it could affect the behavior of matter, but was not, in turn, affected in any way by matter. Einstein's solution was to posit that the ultimate seat of causation for this difference between the "at rest" orb and the accelerated (i.e., rotated) orb was the set of visible background stars providing an observation frame for comparison, and thereby providing a "meaning" to the claim that the distorted orb was rotating, while the spherical orb was not, a view first held by Mach.

Finally, was Einstein a positivist? I don't think so. Einstein was a long-time believer in the existence of the atom and he would not have given away his right to make theories that used the atom concept, which was demanded by Machian positivism. Einstein accepted some, but not all, doctrines of positivism.

We read in Einstein's essay 'Reply to Critics' (in P.A. Schilpp, ed. Einstein: Philosopher-Scientist, La Salle, IL, Open Court, pages 683-4, published in 1949, a few years before his death in 1955) his

own eclectic instrumentalist philosophy, which sums up his philosophy as a reaction against the positivists who would have placed his mind in a cage:

The reciprocal relationship of epistemology and science is of noteworthy kind. They are dependent on each other. Epistemology without contact with science becomes an empty scheme. Science without epistemology is --- insofar as it is thinkable at all --- primitive and muddled. However, no sooner has the epistemologist, who is seeking a clear system, fought his way through to such a system, than he is inclined to interpret the thought-content of science in the sense of his system and to reject whatever does not fit into his system. The scientist, however, cannot afford to carry his striving for epistemological systematic that far. He accepts gratefully the epistemological conceptual analysis; but the external conditions, which are set for him by the facts of experience, do not permit him to let himself be too much restricted in the construction of his conceptual world by the adherence to an epistemological system. He therefore must appear to the systemic epistemologist as a type of unscrupulous opportunist; he appears as a realist insofar as he seeks to describe a world independent of the acts of perception; as IDEALIST insofar as he looks upon the concepts and theories as free inventions of the human spirit (not logically derivable from what is empirically given); as positivist insofar as he considers his concepts and theories justified only to the extent to which they furnish a logical representation of relations among sensory experiences. He may even appear as Platonist or Pythagorean insofar as he considers the viewpoint of logical simplicity as an indispensable and effect tool of his research.

[---emphasis mine]

Obviously, Einstein had taken from positivism its "best" without accepting its anti-metaphysical aspects. Einstein wrote all over the place about his philosophical views, but without distinguishing which of those views are "scientific" per se and which are just those of his personal natural philosophy. And that fact can make him appear self-inconsistent.

Patrick