

MORE ON THE CAUSE-EFFECT SEQUENCE

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Abstract

Does every event have a cause? An answer is not simple. The notion of cause contains a particular being y acting on being x plus everything that may be called the boundary conditions. These may form necessary and sufficient conditions giving rise to a strong cause, or only necessary conditions, giving rise to a weak cause. These matters are discussed in this article with particular attention being paid to the argumentation of Thomas Aquinas known as *prima via*. *Prima via* is the analysis of a cause-effect sequence which leads (according to Thomas) to a First Cause (First Mover). It seems that the extrapolation of the cause-effect sequence to infinity is permissible from the logical point of view.

But the possibility of weak causes seems to destroy the cause-effect “line”. Here it is perhaps useful to “escape” to the metaphysical abstraction which looks at things *sub ratione entitatis*. If we ignore space and time (which is characteristic

of this abstraction) we are led to believe that the IS of cause is finally unavoidable, which means that from the vantage point of this abstraction, i.e. from the point of view of IS, all causes are strong.

1 Introduction

Must every event have a cause? In our life, in our activity, in our discussions and argumentations we take it for granted. Looking for causes constitutes an important aspect of our life. If something appears as an event without a cause we soon discover that it is an illusion. Sometimes we are inclined to propose a false cause in order to save our predisposition towards causality. Hence we have myths, superstitions, beliefs which may appear as naïve but which fulfill our need for the necessity of causes. As metaphysicians we say that any change, i.e. a transition from potency to act, needs an acting being. This being (we declare) is the cause of the change. Such a being may be this or that - easily identified - but can also be a set of circumstances which I am inclined to call boundary conditions. This being and these boundary conditions are responsible for the change which must occur, or perhaps they are only responsible for the probability that the change will occur. Hence, we may deal with a necessary and sufficient condition or only with a necessary condition. We may say that the former condition corresponds to a strong causality while the latter condition corresponds only to a weak causality. Weak causality is perhaps sufficient to save the order of the world.

But I must confess, that I feel a discomfort knowing that the Copenhagen interpretation of quantum mechanics forces us to resign from a belief in strong causality.

In this essay I would like to disregard time. Causes and effects shall be treated as timeless events. They shall be discussed *sub ratione entitatis*, which means that I shall operate in a frame of metaphysical abstraction which ignores all spatial and temporal aspects, based only upon consideration of IS. Contrary to this, physical abstraction is a basis for various models. One of them is the Copenhagen interpretation of quantum mechanics.

2 *Prima via* of Thomas Aquinas

The argumentation of Thomas Aquinas is based on a chain of effects and their causes which lead to a First Cause. In this argument motion is a synonym for change in general. The argument goes like this [1]:

“The first and most obvious way is based on change. Some things in the world are certainly in process of change: this we plainly see. Now anything in process of change is being changed by something else. This is so because it is characteristic of things in process of change that they do not yet have the perfection towards which they move, though able to have it ;where as it is characteristic of something causing change to have that perfection already. For to cause change is to bring into being what was previously only able to be, and this can only be done by something that already is {...} Now the same thing cannot at the same time be both actually x and potentially x , though it can be actually x and potentially y {...} Consequently, a thing in process of change cannot itself cause that same change; it cannot change itself. Of necessity therefore anything in process of change is being changed by something else. Moreover, this something else if in process of change is itself being changed by yet another thing; and this last by another. Now we must stop somewhere, otherwise there will be no first cause of the change, and, as a result, no subsequent causes. For it is only when acted upon by the first cause that the intermediate causes will produce the change {...} Hence one is bound to arrive at some first cause of change not itself being changed by anything, and this is what everybody understands by God.”¹

3 Infinite Set of Causes.

The argumentation of section 2 brings two problems to our attention: First, we find in the text a rejection of the possibility that the cause-effect sequence may be infinite, since the lack of its first element must lead to the lack of the others. (“We must stop somewhere, otherwise there will be no first cause of the change, and, as a result, no subsequent causes”). This argument is undermined by Kołakowski, for instance, as logically incorrect [2]. He writes: “There is nothing contrary to logic in the notion of infinite sequence of events; no logical rules force us to admit the first cause, whatever it could be”. His statement is clearly expressed by a logical formula: For everything x there is a thing y such that y causes a change in x . Or: It is not true that there is a thing x for which there is no thing y such that y

¹{...} denotes fragments of the text containing examples based on naïve medieval physics.

causes a change in x . As stated, both formulations show no necessity of interrupting the sequence.

But in the picture presented by a writer Blatty we find a vision of a cargo train in which every car is pulled by the preceding one. Blatty writes [3]: “No car could move of itself. Proceeding to infinity in cars would not give to any car what it lacked, which was motion”. I have quoted here the opinion of a writer as well as that of a philosopher, since I think that Blatty represents a point of view which cannot be easily rejected. In fact, Blatty’s approach is the same as that of Thomas Aquinas.

Seventy years ago J. Salamucha [7] presented an elegant analysis of Aquinas’ argumentation. His analysis is based on the achievements of formal logic and the mathematical theory of sets. Salamucha claims that Aquinas’ argumentation is generally correct. In Salamucha’s version, the ordering operator \mathcal{R} , as applied to sets, plays a fundamental role. For example, he considers the real numbers in an interval for which \mathcal{R} orders these numbers in such a way that each successive number is greater than the one before it. Such an ordering relation does not necessarily lead to a first element. For instance, the set of real numbers x belonging to $1 \leq x \leq 2$ possesses a first and last element, but the set $1 < x < 2$ does not. However, claims Salamucha, for \mathcal{R} formulated: “ y is the cause of a motion of x ”, the first element must exist. Salamucha presents a *reductio ad absurdum* proof, which as a matter of fact is the same as that of Aquinas: if no first element, then no succeeding ones.

Critiques of Aquinas’ argument based on extending the cause-effect sequence to infinity seem invalid, since even then (with \mathcal{R} formulated as above) a first element exists.

4 Does Physics Contain Events without Causes?

Let us recall that an important role in causing a change in microphysics – as described by quantum mechanics – is played by the so-called reduction of the wave packet, which, via a measurement, “offers” an actual IS to the change [4]. As we know, quantum mechanics describes perfectly well the probability of change, for instance, by means of the Schrödinger equation. But the act of the reduction

of the wave packet escapes the quantum mechanical calculations – it is beyond quantum mechanics and its occurrence cannot be foreseen, although when we repeat an experiment the distribution of “flashes” is in agreement with the probability calculated from the equations of quantum mechanics. A single act of the reduction of the wave packet seems to be without a cause. A charged particle “flying” through a Wilson chamber gives a trace of condensed fog in an unpredictable place and time. (In saying this I am for the time being ignoring my promise to consider things *sub racione entitatis*.)

Similarly nobody knows when an individual radium or uranium nucleus will undergo a disintegration - will it be soon or a thousand years from now? What is the cause of this “when”? (Here I am again not in agreement with a promise to consider matters *sub racione entitatis*, but we shall return to this in section 5.)

Similarly, an ion in a so-called magnetic trap possessing two energy levels with specific properties, may occupy one or the other level alternatively, but the moments of transitions cannot be foreseen. The transitional acts themselves seem to be without a cause.

5 Is the Lack of Cause Illusory?

The situation described in Section 4 suggesting that the events belonging to microphysics are without a cause, seems to destroy the value of the *prima via* argumentation of Section 2.

The state resulting from the reduction of the wave packet cannot in general be predicted with certainty. The power of this argument is great, but perhaps there is a “narrow escape”.

It must be stated that the reduction of the wave packet takes place against the “background” of the probability wave, which results from Schrödinger’s equation. This probability wave behaves in a causal fashion, providing definite probabilities for various states. We must go beyond this - to the reduction of the wave packet - to see the limitations of quantum mechanical calculations. However, the reduction of the wave packet occurs “in tempo” provided by the probability wave, which is a consequence of the wave function. Therefore there is no good analogy between the reduction of the wave packet and the throwing of dice. In throwing dice all possible outcomes are equally probable, whereas the acts of reduction obey the shape of the probability wave.

Heisenberg calls this a tendency [5], and he seems to believe that the notion of IS is not reserved to the actual IS only, but also to some degree to the tendency derived from the wave function. Hence, we might have degrees of being. The degree showing up in the tendency is fully causal. These ideas of Heisenberg seem to be coherent with those of Edith Stein [6]. Although interesting, they do not add much to a “defense” the of *prima via*.

Let us remember now that we want to discuss the problem of cause abstracted from time sub ratiōe entitatis. There is no reason to expect a cause to have an immediate effect.

The approach sub ratiōe entitatis (metaphysical abstraction) ignores all individual aspects except the aspect of being (IS). In this essay we concentrate on change (motion) and we observe it via two pictures of the situation the changed one and the unchanged one the time being ignored. Also we should ignore words connected with time. We just compare the two pictures *tota simul*. However, in common speech as well as in scientific language, words connected with time cannot be avoided; words such as immediately, once, finally, etc. When we use them we should remember that they are not adequate to the approach sub ratiōe entitatis .

Let us consider a radioactive nucleus, whose half-life is, say 1000 years. The probability that this nucleus will decay in 1 year is relatively small. The probability that it will decay in 100 years is of course greater. And so on. The probability that it will decay in 10000 years is still greater, as a matter of fact it is near 1. When we go to infinity with time, this probability approaches 1. In infinity we reach the certainty that it will have decayed, although we do not know when.

Hence, if something is in *potentia* with respect to a change, we know that this change will occur, although not immediately after the cause. Thus when considering things sub ratiōe entitatis, we have a necessity of change i.e. a strong causality. Therefore *prima via* does not suffer from an interruption.

Here I declare that abstraction from time is achieved by integration over time, further integration over other coordinates leading to an isolation of the “IS” aspect.

References

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- [3] William Peter Blatty *Legion* Pocket books, New York 1983, p. 94.
- [4] G. Greenstein and A. G. Zajonc *The quantum challenge* Jones and Bartlett Publishers, Boston, London, Singapore 1997.
- [5] Werner Heisenberg *Physics and Philosophy* Prometheus Books, Amherst, New York 1999, p. 41.
- [6] Edith Stein *Endliches und ewiges Sein* Herder, Freiburg – Basel – Wien 1986, p. 33.
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Comment by

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Consider for a moment one of the early warning signs faced by Bohr and the other founders that things might not go so well in the micro world: An atom makes a transition from an initial to a final state and in the process emits a quantum of energy of an amount equal to the difference in energy between the initial and the final state. Now, if this is a temporal process, the quantum must be emitted *after* the atom leaves the initial state but *before* the atom arrives in the final state (which surely signifies the end of the emission process). But

how can it be that the energy of the emitted quantum is determined by the energy of a state that lies in the future?

Again, consider what happens if we have the equipment to reduce the intensity of a light beam to arbitrarily low levels and watch the build-up of a photographic portrait of someone on a series of developed negatives, each containing more photon encounters than the previous through an increase in exposure time. We see at first the small areas of development caused by the arrival and registration of a handful of photons. The positions of the developed emulsion appear random, but as we increase the exposure time, a fuzzy image begins to emerge until finally we have an “ordinary” portrait of a person when millions of photons are allowed through the lens. Now, what is the nature of the connection, if any, between a particular photon arriving at the emulsion and the final image?

An essential aspect of Bohr’s thinking about such puzzles was the insight that when we try to carry over our classical notions of space and time, causality, and continuity to atomic physics we are going to be confronted from the outset with conceptual problems and existential mysteries which arise precisely because we are dealing with an entirely new set of phenomena.

At one point in the history of Einstein’s and Bohr’s discussions, Einstein believed all would be well if quantum mechanics were understood to be a purely statistical theory in the spirit of classical statistical mechanics. Bohr, however, emphasized over and over that this was wrong; that one was dealing in atomic physics with *individual* events of a new order of epistemological complexity.

One can perhaps say that fundamental problems in quantum mechanics seem to contain an odd mixture of physics and epistemology, as if the way we come to know a thing is somehow connected to its very existence. Whether or not metaphysics is also part of this mixture depends first of all on whether a metaphysics of physics is possible; if so, just what form should it take?

Having made these preliminary remarks, let me now briefly lay out what I believe to be the essential content of Professor Janik’s argument for a “narrow escape” from the apparent lack of causality for the events of atomic physics.

He first makes a distinction between “strong” and “weak” causes, which seems to be equivalent to the difference between necessary and

sufficient conditions and merely necessary conditions. We are then reminded of Thomas Aquinas' argument (based on Aristotle's) that there must be a first cause of any cause-effect sequence and that these causes are presumably all "strong," although from a purely logical point of view one need not arrive at a first cause, making the sequence unlimited. However, whether limited or not, "the possibility of weak causes seems to destroy the cause-effect 'line.'" The phrase *sub ratione entitatis* is introduced as a metaphysical abstraction, ignoring all space and time aspects, and based only on consideration of IS. In contrast to this, the Copenhagen interpretation of quantum mechanics is relegated to one of various models based on physical abstraction. Professor Janik then reconsiders and finally rejects the logical possibility that Aquinas' cause-effect sequence has no beginning, no first cause. Finally, in the last two sections, he comes to the question of whether or not physics contains events without causes and whether or not any apparent lack of causation is illusory.

Professor Janik's paper thus depends centrally on the meaning of a medieval Latin phrase, *sub ratione entitatis*, which he avoids (perhaps wisely) to offer us in English. This is not to say that he doesn't give us plenty of opportunity during his discussion to acquire a sort of familiarity with just what it is that he means by the phrase, for it appears eight times in the article. For example, "The approach *sub ratione entitatis* (metaphysical abstraction) ignores all individual aspects except the aspect of being (IS)." In the abstract, after noting that "weak" causes seem to destroy Aquinas' cause and effect line, he finds an "escape" to the "metaphysical abstraction which looks at things *sub ratione entitatis*. If we ignore space and time (which is characteristic for this abstraction), we are inclined to believe that the IS of cause is finally unavoidable, which means that in this degree of abstraction, i.e. from the point of view of IS, all causes are strong." Again, in section 1 he confesses a discomfort with the Copenhagen interpretation which "forces us to resign from a belief that cause is a must." In section 4 he apologizes twice for temporarily abandoning considerations *sub ratione entitatis*. In the final section, he mentions the phrase four more times and reaches the following conclusion: "Hence, if something is in potentia with respect to a change, we know that this change will occur, although not immediately after the cause. Thus when considering things *sub ratione entitatis*, we

have a necessity of change i.e. a strong causality. Therefore prima via does not suffer from an interruption.”

After downloading a Latin dictionary, *Latin Words for Mac OS X*, I find that *sub* can take either the accusative or the ablative case and that *ratione* is the ablative singular of the feminine noun *ratio*, while *entitatis* is the genitive singular of another feminine noun, *entitas*. If I push things a little, I can, not without some uneasiness, arrive at a tentative translation of *sub ratione entitatis*: A method of reasoning under which one takes into account only the character of the being of those things under discussion.

The point I'm trying to make is that the translation of the phrase that I arrived at doesn't seem to be quite the same as Professor Janik's view of the phrase. He wants to abstract all individual aspects of things except their being, while what I have in mind is that while it is possible to abstract the accidental qualities of things (whether they are brown, or small, or furry, etc.), there are still certain characteristics of things which are bound up in the very nature of their being. For example, are they animate or inanimate; material or immaterial? What is the difference between a mouse and a diamond *sub ratione entitatis*? Does not Thomas imply in another of his "Ways to God" that a mouse has being superior to a diamond through its possession of life?

Again, I have trouble with the notion of "weak causes." I *think* what Professor Janik means by a weak cause is a condition that might *possibly* cause an event to occur, such as a rise in temperature in avalanche country. He then says that "weak causality is perhaps sufficient to save the order of the world," a sentence I simply do not understand. In any event, it does not seem to me likely that any philosophical effort would ever succeed in reducing the concepts of cause and effect to an aspect of the rules of formal logic (necessity and sufficiency). Suppose we observe two events that have always occurred together; that is, we have never experienced one without the other. From whence do we arrive at the concept that one of these events must out of *necessity* always accompany the other, from which we arrive at the concept that one is the *cause* of the other. I am enough of a Kantian to agree with the notion of cause being inseparable from the concept of necessity and that this concept does not come to us through experience no matter how often we witness

a pair of events but, rather, is categorical in nature; i.e., one of those concepts without which we could have no integrated experience of the world at all. From the Kantian point of view, the concept of the *necessary* connection is transcendently connected to the very possibility of experience.

The introduction of a metaphysical abstraction to save the validity of Aquinas' *prima via* in the micro world of atomic events reminds me somewhat of Einstein's attempt to remove from quantum theory any consideration of the individual atomic events that actually occur in time and space. We cannot visualize these happenings in our minds through the usual categories of experience. However, in the case considered by Professor Janik of the radioactive decay of nuclei, the events marking the unpredictable "when" of individual decays seem to define the whole process as one that takes place essentially in time. It seems difficult to see how the removal from the decay process of this essential aspect, time, can restore cause and effect back into a phenomenon that now, with time removed, seems essentially empty.