Well Beyond Uncertainty, Uncomputability, and Unpredictability

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The ideal of learning about the world and understanding it, which has accompanied mankind, perhaps from the time we started to deserve such characterization, has undergone various dramatic downgradings, for at least a couple of centuries. Relatively soon after the advent of what we nowadays regard as the era of dominance of the scientific world view, we were forced to accept that such ideal was to be taken, not really as a goal to be reached, but just as a direction in which, should we decide to walk towards, we were likely to be rewarded with practical, as well as intellectually, satisfying prizes.

The observation by G. Bruno that the stars we saw at night were likely to be objects similar to our own sun, but simply far too distant, so that they look as points, made it clear that the task of knowing everything was completely unpracticable. We should then be contented, perhaps, with just understanding the basic rules governing our world, and those of mathematics and logic. So, that acknowledgment of an, in-practice, unescapable level of ignorance was not so traumatic. That is, we had to accept we would be unable to ever know everything that was going on in the universe, and, in particular, in those incredibly distant regions where other suns ruled the skies. The effective unreachability of faraway regions was complemented, through the advent of Botltzman's account of thermodynamics by based on atoms and molecules, Einstein's confirmation through his analysis of Brownian motion, with the realization of the incredibly large number of elementary components that even a small volume of simple gas contained. Thus knowing everything about the state of a simple piece of matter became, again, an accepted impossibility. In fact, the development of disciplines such as statistical mechanics managed to make good use of the recognition of such practical limitations. There were simply many things of which we would forever remain uncertain both about the present and even about the past. Some level of uncertainty about facts and figures, was going to be with us forever. Predictability, as envisioned by Maxwell with his mischievous Demon, suffered also, due to the uncovering of the ubiquity of chaotic behavior, even in rather simple systems. That was, however, not so confidence shattering since the problem could be taken to be, in a way, analogous to the one we discussed initially, i.e. the fact that we did not in practice have access to infinitely precise initial data about everything, resulted in a limitation of our ability to make forecasts. On the other hand, there was the realm of knowledge that seemed to be independent of the contingent details of our world: the laws of nature themselves, among which those of physics seemed to enjoy a particularly dominant position, as well the laws governing mathematics and logic. Regarding the latter we were forced to accept a further dramatic increase to the limitation of knowledge when Gdel showed us that, even in the most pristine of the realms, that which is untouched by the "dirty business" of dealing with the enormously large details pertaining the physical world, we were bound to encounter undecidable prepositions. These were simply unavoidable both in math and logic, i.e. statements whose level of truth we were never going to be able to ascertain. Let us note here in passing, that the notion of uncomputability is intimately linked with that undecidability as shown by A. Turing. We, nevertheless, held on to the conviction, that even in such dire circumstances, where we were unable to establish what the correct answer is, each meaningful statement was either true or false: The Principle of the Excluded Middle. The situations where this did not seem to occur were, in turn, regarded, as places which we should consider simply as bifurcation points in the development of our ideas: we could add a new axiom or its negation, and have now two branches or lines of research: Euclidean and Non-Euclidean geometry. An example of more current relevance is provided by the axiom of choice: there are mathematicians that use it without a second thought, and there are those who aim to focus only of the questions whose proofs do not rely on its use. Another interesting case, which at this point (as far as I know) is not generally considered as beeing of axiomatic nature, concerns the continuum hypothesis. If it turned out that such hypothesis could be shown not to have a truth value under the mathematical system under consideration, one could then choose to work under the assumption of the continuum hypothesis, or under the assumption of its negation. So, uncertainty, unpredictability and undecidability (or uncomputability) were all, in a sense, readily incorporated, even if sometimes reluctantly, into our way of thinking.

Of course the story does not end there. A further issue arose with the rise of Quantum Mechanics. An issue that, in my view, is so dramatic that we continue to describe it in terms of words that do not seem truly appropriate. I am referring here to the so called "quantum mechanical uncertainties", which according to the standard account of the theory (as well as some modified versions thereof), should not be viewed at all as real analogous to the first kind of uncertainties we have encountered.

When a system is in a quantum state, which is not an eigenstate of a quantity A, we say the system has a level of uncertainty in its A value. But that leads to the erroneous notion, at least as far as standard version of quantum theory is concerned, that the quantity has a value, although we simply do not know what that value is. That is not at all what is going on. Under those conditions, and for the system in question, the quantity A simply does not have a value. It is true that the corresponding uncertainty is a reflection of the range of values that we would obtain if and when we decide to measure the quantity A. Again, according to the standard theory, before such measurement takes place, there is simply no fact to the matter regarding the value of A for our system. This represents a much deeper limitation, in comparison to the previously discussed ones, as it does not refer to our state of knowledge regarding the system, but somehow about the properties of the system itself. I.e., it is not an epistemic limitation but an ontological barrier. Of course, the consideration of this question with some depth takes us to confront all sorts of issues: the measurement problem, the ontology of the theory, etc. I do not want to enter into those delicate issues at this point. My main observation here is that the issue deserves to be referred to by an appropriate term, that does not lead to the confusion that arises from talking about it by using the word "uncertainty". Heisenbergs "uncertainty principle", ought not to be taken (at least not without some modification of the theory, such as that embodied in the de-Broglie-Bohn proposal) as characterizing an epistemic limitation. It is a surprising fact that a large number of physicists and practitioners of related disciplines (such as cosmology) continue to do so. The word "indefiniteness" comes to mind as a good alternative to the word "uncertainty" in this regard. Needless is to say that, tied to the issue of measurement, there is also the usual probabilistic character of the standard version of quantum theory. That feature is even present in alternative evolution laws that are considered in some of the modifications of the theory, which have been built to deal with the measurement problem, such as the so called spontaneous collapse theories.

The question I want to raise here is whether this is all we must confront regarding limitations to our description of the world: Uncertainty Uncomputability, Unpredictability and Indefiniteness? (UUU&I)

The fact is that even after having had to digested all of the above limitations, we seem to remain fully committed to the existence of fundamental laws of physics. We might view them metaphysically either as governing laws, or, in the Humean sense, as the maximal synthetization of acquired knowledge about nature. However in any event, these are laws: Unshakable, everlasting, fundamental, truths about the physical world. We do not know them all " but there they are".

The possibility I would like to briefly contemplate here, one that seems particularly appropriate if one adopts the Humean approach, is that no such things exists. No absolute, exception free, everlasting laws. We might regard this as the next possible step in the lessons we have to endure so far, represented by the now generally accepted UUU&I (a steep that, we must admit, has just an inductive type of motivation). Yes, there are of course some regularities in the world, and we as humans have managed to explicitly describe many of them and use them to our benefit in a very large variety of ways. Nevertheless, we keep looking for that ultimate law with a seemingly undaunted determination. That theory of everything that would, among other accomplishments, unify in a smooth manner some version of quantum mechanics free of its already mentioned problems, i.e. a version of the theory without a measurement problem and a completely clear ontology, with our currently most successful theory of gravitation, General Relativity.

What, besides inductive arguments, leads us to be so convinced that such a theory ought to exist? What would be wrong in adopting the view that, yes there are indeed regularities in the world, in fact surprisingly large number of regularities, but there is simply no way to encode them all into a single unified coherent picture, because a picture, made out of postulates and formulas is after all, what our theories about the world are. There is a world out there, I am convinced, but why should it be susceptible to such characterization?

It is certainly a bleak picture for people like us, who have devoted a big part of our lives, in various ways, to an endeavor that has, as ultimate goal such a complete theory of the physical nature of our world. Were one to adopt such view, one might rightfully be accused of defeatist, no doubt about that. It is, nonetheless, a logical alternative that we might want to at least contemplate: if there is no way to win, the only rational option is to be a defeatist. In order to contemplate the possibility, we should start by giving it a name: My proposal: untheoretizability. That is, such position would contemplate the ultimate untheoretizability of nature.

At this point I do not have much to add, but I think it would be worthwhile if the issue was studied, and some arguments against it or in its favor were brought up by people in the community

So, there we have it, beyond Uncertainty, Uncomputability, and Unpredictability, there is Indefiniteness, and well beyond that there might be Untheoretizability.