The Necessity of Conceptual Skill Enhancement to Address Philosophical Challenges of New Science : Background and Implications

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Sensory extension and increasingly powerful computation underpinning emerging new science provides us with daunting conceptual challenges. It is here argued that because they are primarily philosophical in nature, high-level conceptual challenges are unique and different from those that help us refine outputs and achievements based on solving our technical and political problems. This paper explores the practical implications of such unique conceptual challenges and discusses the need for enhancement of conceptual skills. Such conceptual enhancement may provide us with a good opportunity to best respond to and benefit from these challenges.

1 Introduction

The use of information to achieve knowledge, derived from data originating with many sources, is essential to successful enterprise in any human effort. Indeed, we note that the derivation and use of knowledge is key to human advance in any field. This appears to be obvious, but the central argument provided in this paper is that the obviousness of this phenomenon that leads us through our processes of scientific discovery and advance may mask the emergence of unique conceptual challenges to our conceptual skill capacity defined by their philosophical nature, where such challenges are not at all obvious.

2 Background

To accomplish the derivation of scientific knowledge, we engage in two essential activities of science: [i] we continue to extend our senses to gather increasingly detailed, voluminous and complex data sets having to do with the very large and the very small, and the very complex and the very dynamic; and [ii], we apply many tools of analysis and synthesis to those data, and in the modern era we continue to develop and employ increasingly complex, networked, and very powerful advanced perceptual and computational tools for this purpose, especially those having to do with simulation, to assist us with and help us continue to develop and explore how to enhance theory and knowledge yields from these fundamental tasks. We create, develop, enhance and strengthen our perceptual and computational tools to the extent that, today, we are capable of deriving very useful and sometimes unexpected and exceptionally valuable information about extremely complex systems comprised of vast numbers of interacting components and agents [1]. This is important exploratory work that we could not accomplish, or even dream of accomplishing, only a relatively short time ago [2].

Prior to the advent of the current era where both highly advanced sensing devices coupled with very powerful computational machines continue to be developed, not much could be known about either the working intricacies of high dimensional complex systems, or of the extent and emergent nature of highly complex interactions among large numbers of high dimensional complex system variables and components. This meant that high levels of functional detail about complex systems might have been postulated, or how such systems behave might have been contemplated, but such detail or postulation was either inaccessible or undeveloped – with the exception, perhaps, of those blessed with a capacity for genius who, based on available early evidence, might be able to work out plausible hypotheses and develop new and useful mathematical models more effectively than others [3]; but even geniuses would not have privileged access to tools of extended perception and advanced computational capacities in advance of everyone else. Such characteristics and features of complex systems were hidden behind the limits to human perception, were postulated hypothetically by those who had the capacity to push to the edges of the hypothesis development envelope, and awaited discovery beyond a computational ceiling that could begin to be penetrated only by advanced mathematical modeling of plausible systems – but again, in relative terms, this ceiling was kept low by early generation computational capacities. Knowledge about what actually comprised such complex systems and their environments, as well as their behaviours – or even knowledge [not speculation] that such systems themselves existed – could not be accessed or perhaps not even surmised except in very special circumstances of hypothesis construction, and certainly not beyond rational conceptual limits which would relegate such thinking to the realm of fantasy.

Such complex systems, when rationally contemplated, could be dealt with only at relatively high levels of plausible abstraction, or, when available, in terms of their known components where, for example, limited principles of structure, logic and function might be explored mathematically and fundamental aspects of emergent theory might consequently be developed [4]. This meant that complexity theory – that is, any adequate theory building having to do with high dimensional, extremely complex systems with large numbers of variables – would initially be difficult in any scientifically meaningful fashion and could not be verified through experiment or simulation except in the most general terms, and therefore, almost exclusively, were known only in principle. For example, features and behaviours of complex systems such as ecologies, cortical columns, weather systems, genetic regulatory networks, quantum chemical interactions, dynamical activities among subatomic particles, energy and work networks of a cell, the Internet, or hitherto unknown dynamical astronomical objects could, in essence, be "sketched out" conceptually and perhaps mathematically modeled in some useful but limited fashion – and, all had in common the feature of residing in and perhaps even defining the archetypical "black box" [although of course as we well know, it is a very important step forward in knowledge generation when a black box is recognized where before none was perceived or even postulated!] [5].

Keeping these thoughts having to do with the advance of science as a backdrop to this paper, we note that, in the current era, based on the development and use of tools that extend our perceptual capabililty and provide advanced computation that together do such a good job at enhancing our productivity, creativity and problem solving capacities, we continue to explore, discover, invent and develop at a rapid pace. In other words, science continues to rapidly move forward on increasingly broad and comprehensive fronts and its valuable outputs proliferate. It is no surprise to note that part of this is taking place with regard to the very perceptual and computational tools we employ. Although I do not here address any details of the technical enhancement of computation and perception, a fundamental question with two related parts underpins what is addressed here: [i] what frameworks will allow us to best understand the components that allow us to make scientific advances; and [ii], if it is the case that we continue to develop our scientific capacities and knowledge, what is the extent and nature of challenges that present themselves as this development takes place, and how can we make best use of them? Let us explore where these formative questions lead us.

3 The Challenge

I have argued elsewhere [6] that conceptual and philosophical challenges in the quantum mechanical and holonic enterprise fields illustrate a serious problem having to do with scientific advance; these two realms have a striking isomorphism with the fundamental two-part question outlined above. That is, given unfolding new knowledge about complex systems in many realms of science such as those mentioned earlier, and the improving tools we use to explore this diverse realm, we are faced with the challenge of developing a comprehensive conceptual foundation that would successfully account for this emerging “new science”, a foundation that goes beyond what I am here describing as the type of conceptual work necessary for spectacular technical scientific advance such as what was accomplished by the Manhattan Project and American moon landing teams, for example [7]. By this I mean that solving a vast array of technical, mathematical and physics problems having to do with complex systems as identified above, and coming up with novel solutions to those problems, does indeed take advanced conceptual skills of a particular kind rooted in and colored by the very technologies we develop [e.g., we need to think effectively about mathematical models and the engineering of new tool development to permit us to work in the particular complex systems realm of interest] – and clearly, we have to be very smart and well-trained to accomplish such tasks. However, we must at the same time be very cautious about assuming that our extensive technical [and even political] work that results in accumulations of good prescriptive knowledge [8] in the multiplicity of complex systems realms, some of which are identified above, will automatically result in some form of a solid conceptual foundation that permits us to stand confidently on a new epistemology of complex systems which in turn would be a specific example of the general case of the emergence of new science [see, for example, Kuhn (9), Nickles (10) and Suppe (11)].

The point here is that, from an epistemological perspective, there is a potentially serious danger of assuming that new propositional knowledge [8] derived from what is learned from vast amounts of new accumulated prescriptive knowledge that has originated from extended sense perception and computational capacity is the equivalent of an adequate conceptual foundation capable of supporting new epistemologies of new science [12]. Assuming that this is the case would amount to “masking” the authentic conceptual challenge of emerging new sciences of complexity, for example, which is what I have suggested elsewhere may also be taking place with regard to quantum physics and the holonic enterprise: in other words, new propositional knowledge about complex systems derived from extensive investigation and work in specific fields of inquiry can potentially be mistaken for the conceptual adequacy necessary to effectively deal with and account for new epistemologies of new science. This may be a state of misapprehension into which many contemporary scientists might easily fall, and I am among those ranks; it is, I think, natural to assume that if truly difficult scientific problems have been “cracked” and new emerging science has indeed been developed and advanced, especially problems having to do with complex systems on “the leading edge” that require advanced tools of perception and computation, that such advance is itself necessary and sufficient evidence to qualify as well-understood progress in the essential philosophical foundation of science [13]. However, I do not think that this is the case; in fact, I believe that this is a philosophical error that may be more common than we would like to think, and we are compelled to guard against falling victim to it. As I have stated elsewhere [6], “This type of conceptual slippage is of great concern in the emergence of new science for it speaks to the potential for making important conceptual errors that are generally not perceived, and this has great significance in the context of how we then actualize new science in our organizations and diffuse new science throughout our cultures.” In other words, if we do good work in a field of emerging science such as the complexity sciences, and if we become a part of a growing community of investigation and enterprise based on this field of emerging science and are rewarded in these pursuits, because of the above-mentioned conceptual slippage we may lose sight of the philosophical foundation of that science and therefore arrive at and commit to non-optimal decisions about how further investigation into that emerging field should be funded, supported, criticized, and, in the end, how that emerging field should be understood. It may be the case, in other words, that without careful consideration of the philosophical foundation of new emerging science, we may not think well enough about how to make good and effective use of that emerging science. This possibility has many scientific, economic and societal implications.

4 Conclusion

The challenges of scientific advance include how well we develop and make use of new tools of analysis and synthesis that permit us to explore new fields and derive new data that we can then reduce to new information about our objects of interest and investigation, whether they be cancer stem cells or micro-loan economies, plasma furnaces or climate models, stellar atmospheres or human consciousness, predator-prey relations or communication network dynamics. From these investigations we derive everything from methods to achieve economic advance and sustainability to new scientific paradigms. But the challenges of scientific advance also include our collective conceptual capacity to understand and shape an emerging epistemology of new science. I do not believe we can have one without the other; nor do I believe we can afford to be blind to the relationship between the two. It is our higher-level conceptual capacity to deal with issues of the epistemology of science, and especially our shared awareness of this capacity, that I suggest we need to refine and build in order to not slip into a state where we are compelled to be satisfied with the default outcomes of scientific advance, founded on fine technically-focused accomplishment coupled with the error of mistaking such accomplishment for philosophical clarity. To assume that this argument is unimportant, or that it is not necessary to think about and then make good use of enhanced understanding of the philosophy of science regardless of our fields of specialization, or that the philosophy of science is essentially a passive enterprise and will take care of itself without much thought are, I believe, components of a serious and in fact costly error. Good science proceeds and advances not only with creative investigation coupled with innovative and productive solutions to perplexing problems in many fields [as well as new interdisciplinary fields], it proceeds with a robust foundation of philosophical clarity about our higher-level conceptual skills [14], and, especially, clarity about how to use those skills to our best advantage. Placing the challenge of epistemological awareness in a more prominent place in our consideration of and actions taken to support scientific advance will, I believe, help us think with enhanced high-level conceptual clarity about our sciences in general and the full extent of scientific, economic and societal advances, outcomes and benefits we aim to achieve. Commencing with complexity sciences in this way may be a very good place to start.

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