COLLIDING FIELDS: BRINGING PHILOSOPHY INTO SCIENTIFIC RESEARCH

BY MARLEY OTTOMAN

To most people today, the work of a scientist and the work of a philosopher could not be more different. The scientist toils to gather data empirically, analyze it, and decipher the results, with each discovery, or often lack thereof, still adding to the collective wealth of human knowledge. In contrast, the modern philosopher works largely within the realm of the abstract, pondering fundamentally complex questions, and seemingly getting little in return. As a result, the study of philosophy is now seen by many as almost a relic, especially within the scientific community. Nobel laureate physicist Stephen Hawking claimed the discipline was dead in his 2010 book, *The Grand Design*.[1] Seeping further into the public consciousness, prominent science educators Neil deGrasse Tyson and Bill Nye have both called philosophy a waste of time. But, these claims ignore the possibility that there could be areas of scientific research where applying some philosophical analysis would be beneficial, and indeed there are a few. They are areas of science that face problems closely resembling those that philosophers have dealt with for centuries. Fields such as cognitive science, artificial intelligence, and stem cell biology routinely confront more abstract and poorly understood problems and could theoretically benefit from philosophical analysis. By examining a handful of philosophically based research projects within these fields, we can catch a glimpse into how such a seemingly unorthodox intellectual partnership could contribute to impactful discoveries.

In "Why Science Needs Philosophy," Laplane et al. present a compelling, though opinion-driven, argument for the necessity of philosophical thinking in science.[2] They begin with a quote from Albert Einstein: "This independence created by philosophical insight is—in my opinion—the mark of distinction between a mere artisan or specialist and a real seeker after truth."[3] Here, Einstein is stressing the importance of young scientists having a solid footing in philosophy, so that they may analyze beyond their biases and have a more comprehensive understanding of their work. This was indeed true for Einstein himself; he famously used simple thought experiments to conceptualize aspects of the theory of relativity, providing himself with a foundation to later solve the mathematics behind it.[4] Laplane and company argue that philosophers use the same fundamental methods to approach problems that scientists do, differing from scientific experimentalists in the degrees of thoroughness, freedom, and theoretical abstraction that they can use.[2] These differences have strengthened scientific research; in the past 40 years, for instance, cognitive scientists have begun employing a decades old philosophical theory to provide a better framework for understanding the notoriously enigmatic human mind.

Enter, emergence theory (ET). At its most basic level, it posits that a system composed of many individual yet interdependent "sub-units" can have properties that a single, lone "sub-unit" could not.[5] A fitting biological example is the neuron. A lone neuron is almost practically useless, but amass billions of them, precisely interconnected, and you have a system that allows for all the

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▶ ***Figure 1. The opening to a Saharan silver ant nest.*** *When conceptualizing Emergence Theory, think of ants. On their own, they're tiny insects with often miniscule lifespan. Working together, albeit under a monarchy, they can build massive underground structures. Image licensed under CC BY-SA 4.0.*

complexities of the human experience. A 2010 paper by Stanford psychology professor J. L. McClelland attempts to flesh out how the growing adoption of ET (in favor of the then-held theory that the mind largely utilized symbolic processes) could shed light on many areas of current cognitive science research such as linguistics, decision making, cognitive architecture, and (perhaps most interesting and elusive) consciousness.[6] The questions surrounding human consciousness are numerous, profound, and as old as the phenomenon itself, making it the ideal realm in which to tinker with philosophical analysis. Consider all the factors that impact one's conscious decisions: projected outcomes, past experiences, subconscious influences, and others. These factors all overlap, influencing each other and suppressing less likely choices, and out of this emerges a final decision. Many scientists, including McClelland, contend that human consciousness as a whole can be described in the same vein, as an emergent phenomenon. It must be noted, however, that this is still mostly untestable and merely provides cognitive scientists with a better framework for understanding human intelligence. But nevertheless, some scientists have tried to extend McClelland's work, attempting to explain, in great detail, all of consciousness.

In a 2014 paper, "Integrated Information Theory of Consciousness 3.0" (IIT), Oizumi et al. propose that consciousness is not only definable, but also measurable. They even put forward a mathematical model, derived from their philosophical framework of the mind, that outputs a value (Φ^{Max}) for how "conscious" a system is.[7] While a description of the mathematical details of the model would be incalculably far outside the scope of this article, (not as incalculable though as finding Φ^{Max} for even some simple systems) IIT is relevant here because of the criticisms it has received from many scientists and philosophers in the field. In a 2019 open letter to the Brain Research through Advancing Innovative Neurotechnologies Initiative, a diverse group of cognitive science researchers expressed their dissatisfaction with the credence IIT had been receiving despite its flaws and fundamental untestability.[8] Machine learning researcher Max Tegmark pointed out one of these flaws by demonstrating how the exponential growth in processing power required to simulate even the simplest of conscious systems defined by IIT makes it impossible to run such a simulation on any current computer.[9] In fact, some scientists feel IIT is better interpreted as describing a hypothetical proto-consciousness rather than as a theory attempting to describe human consciousness.10 Ultimately, IIT can serve to illustrate the limitations on philosophy-based approaches. Bold philosophical ideas are exciting and interesting, but if they are not fundamentally testable then their practical utility is extremely limited.

Still, if philosophy is going to persist within science, it should be useful. In the aforementioned 2019 paper on why science needs philosophy, Laplane et al. discuss how philosophy has helped further our understanding of cancer stem cells.[2] The very same Laplane also explored this topic in depth in a 2016 monograph. By taking the generalized umbrella term used to describe stem cells, "stemness", and applying some philosophical analysis, Dr. Laplane redefined stemness through four key sub-properties: categorical, dispositional, relational, and systemic.[11,12] These helped to better define common stem cell behaviors despite the effects that internal and external factors can have. This helped elucidate some semantic and conceptual hurdles in both oncological and stem cell research.[13] While Laplane's model is one of several trying to untangle this difficult term, it is research-ready and testable, bringing it out of abstraction and making it useful for the scientific community. By providing new ways of understanding and interpreting stemness, theories like these can provide oncologists with new ways to approach the treatment of difficult or poorly understood cancers.[14,15]

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The flexibility in thinking that philosophy offers gives it real potential within scientific work. At its simplest, it can be invaluable for getting mechanistic thinkers to embrace the unorthodox and approach problems differently. At more complex levels, philosophical analysis can allow scientists to construct models of intractable problems in pursuit of gaining a deeper understanding. No doubt there is value in being able to pluck a difficult idea out of a world of limiting certainties, and place it into a realm of flexible possibilities. Moreover, seeing as how we currently have no shortage of complex problems to solve, it may be premature to begin removing tools from our collective toolbox.

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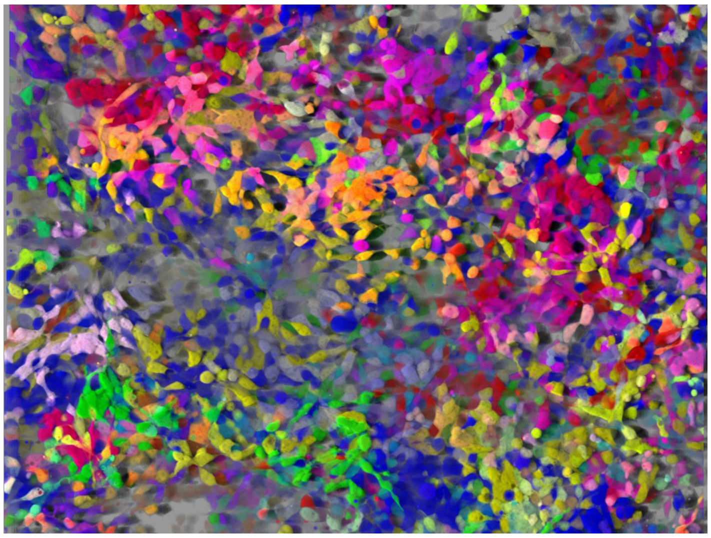

Figure 2. Dyed clonal stem cell tracking. *A 3D rendering of a live culture of stem cells, dyed to track movement and behavior. Image licensed under CC BY-NC-ND 3.0.*

IMAGE REFERENCES

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