

FROM THE DESK OF ...

How an undergraduate education in philosophy has helped me in physics

A. J. LEGGETT¹

¹ 2003 Nobel Laureate in Physics

Department of Physics, University of Illinois at Urbana-Champaign, USA

Address for Correspondence: Prof A. J. Leggett, Department of Physics, University of Illinois at Urbana-Champaign, USA. Email: aleggett@illinois.edu

Recommended citation:

Leggett, A. J. (2014). How an undergraduate education in philosophy has helped me in physics?. *Journal of the NUS Teaching Academy*, 4(1), 6-10.

<https://doi.org/10.24112/ajsotl.43299>

How an undergraduate education in philosophy has helped me in physics

Unlike most of my colleagues in physics, I did not study the subject from my earliest high-school days. In fact, my education between the ages of 9 and 17 was concentrated in the area of classical languages (Latin and Greek), with essentially no exposure to any science subject; and when I entered university (Oxford) I followed what at least in those days was the path of least resistance, by studying for a degree in *Literae Humaniores* (“Greats”). This involved spending the first five trimesters on a continuing study of Latin and Greek languages and literature, then the last seven on an equal mix of “ancient” (Greek and Roman) history and philosophy, the philosophy side being much like what one would get were one to major the subject at a typical university in the English-speaking world (such as the National University of Singapore, except for the emphasis in the latter on Asian philosophy).

The Oxford Greats course was a very exciting experience, and I particularly enjoyed the philosophy side of the second part of the course. It was completely different from my subsequent experience in my second undergraduate course in physics, which was again I suspect rather typical of what one would get at NUS or elsewhere, in that at the undergraduate level one is absorbing the mostly cumulative wisdom of 400-odd years of thought, without in most cases realistically being able to approach the frontiers of current research or being able actively to question what one is learning. By contrast, in my undergraduate study of philosophy I would typically be set some essay topic by my tutor and would go to the library and skim the latest issues of journals such as *Mind* or the *Proceedings of the Aristotelian Society* to see if they had anything relevant to say about it, and moreover would be able to argue currently “hot” issues with my tutor on equal terms. This cut and thrust of debate is something which I suspect is unique to the “analytic” mode of doing philosophy which has evolved in the English-speaking world over the last couple of centuries and particularly since the nineteen-thirties; it seems to me quite different in spirit to the more declaration-centred ethos which I tend to associate with most of the “continental” schools.

I will not repeat here the rather convoluted thought process by which, towards the end of my third year in the Greats course, I gradually came to realise that I wanted to make an academic career in physics (of which at the time I actually knew very little) rather than in philosophy; if you are interested, you can find an account of that process in the [autobiographical note](#) which I wrote for the Nobel Foundation. Suffice it to say that with the help of many people I was able

to enrol for a second undergraduate degree in physics, and thereafter to pursue much the same career path as most of my present colleagues (D.Phil., postdocs, faculty positions etc.). However, one point which is relevant in the present context is that as a result of having spent four years in the Greats course my career was retarded relative to theirs (for example, I got my doctorate at the age of ²⁶ rather than the ²³ which was in those days normal for British candidates). Nevertheless, it has never for one minute occurred to me to regret the four years I spent on Greats, and in particular the part of the time spent on philosophy.

So, how exactly has my undergraduate training in philosophy been helpful to me in my career in physics? Well, the first point is that philosophers are by the nature of their profession sceptical and iconoclastic people; they are continually asking “what do you mean?” and “how do you know?” So I think that even at the level of the everyday practice of technical physics I am probably more prone to ask such questions than many of my colleagues. Here is a mundane example: you will find many experimental papers in condensed matter physics whose titles start “Direct observation of ...” or “Direct evidence for ...” or something similar. In reality, almost no experiment in physics – certainly none in the highly complex web that modern condensed matter physics has become – provides “direct” evidence for anything; there is always a huge background of implicit postulates, and while many of these postulates may be so widely shared as to be almost never questioned, it is as well to be aware of their existence. Indeed, one of the things I find refreshing when I go, as I frequently do, to workshops whose attendees are split between physicists and philosophers, is the way in which the latter group challenges us professional physicists to justify some of the unthinking assumptions we make about the physical world. (One overarching example is that we simply take for granted the idea that the past can cause the present and the present the future, but that no causal influences can propagate “backward” from the outcomes of our experiments to their preparation).

A rather different, though related point is that many of the really fundamental issues in physics long predate what most of us would call “modern” (i.e. post-16th century) science; many of these questions, such as the nature of time, have long been the province of philosophers, and many remain unresolved by modern advances in physics and cosmology. This was brought home to me in a striking way a few years ago, when the philosophy department at my home university, UIUC, organised a workshop on Plato’s famous dialogue, the *Timaeus*, and asked me to contribute a lecture on connections with modern physics and cosmology. When I went back to the original text of the dialogue to refresh my memory of its contents, what struck me forcefully was that while most of Plato’s conjectures concerning the nature of the physical world are pretty much orthogonal to what modern science would suggest, the “questions” he raises have not changed

much in over two thousand years. A typical example would be the question of how far the form of the laws of physics are a priori necessary; e.g. is the fact that our best description right now is in terms of Lagrangian field theory in any sense determined by some deeper principle? Could it have been otherwise? (and what exactly does the “could” mean?). Again, is the observation that were the constants of nature different by even a very small amount from their actual values we would not be here to ask the question (the “anthropic” principle) an “explanation” of the values they in fact have? Even today, these questions are right on the borderline between what we would conventionally call “physics” and “philosophy”. In this context, it is interesting to consider the statement made, I believe by Paul Davies, roughly to the effect that “ten years of radio astronomy have taught us more about the structure of the Universe than two thousand years of philosophical speculation”. While this statement may be true in the most obvious sense, I believe it ignores the fact that the most interesting questions are (almost by definition!) precisely those which *cannot* be answered by standard known techniques such as radio-astronomy, and these are (again almost by definition) the province of philosophy as much as of physics. It is consideration of this type of question, particularly in the context of the quantum measurement problem (where for example people argue furiously over whether “decoherence” constitutes a solution to the conceptual issue), which has inspired much of the work of which I am most proud over my career.

There are, of course, specific areas of modern physics which raise questions right on the borderline of physics and philosophy; in particular, the theory of irreversibility and issues concerning Bell’s theorem and related matters. In the first case, while given an initially ordered state it is not too difficult to describe the transition to a less ordered one, the question of why the initial (rather than the final) state has a tendency to be ordered is not at all a simple one, and (contrary to an impression given in some of the popular literature) is not trivially solved by appeal to cosmology. Moreover, there are some very delicate questions concerning the relation of the common-sense “arrow of time” to our everyday notions about causality; these have been the province of philosophers for over two thousand years, and it is not entirely clear (at least to me!) that modern physics has done much to clarify them. In the Bell’s theorem area, I would personally regard the most important question as being not what the formalism of quantum mechanics tells us about the world (after all, we have to remember that quantum mechanics may itself someday turn out to be limited in scope), but rather what existing experiments tell us. In particular, must we automatically sacrifice the idea, central to the special theory of relativity, that no causal influences can propagate faster than the speed of light, or could we avoid this conclusion by relaxing our common-sense prejudice that counterfactual statements (“had I got up ten minutes earlier, I would have caught the bus”) are definitely true or

false? Debates about this question, or related ones, seem to attract the attention equally of physicists and philosophers.

When I was doing the “Greats” degree at Oxford in the late fifties, very few of the professional philosophers there had any interest in science, let alone in fundamental physics, and the few that did were mostly interested in rather abstract and generic problems such as the nature of scientific method; few if any would have been able to argue toe-to-toe with professional physicists about e.g. the issues raised by Bell’s theorem. Moreover, it was impossible to major jointly in physics and philosophy. That situation has changed radically over the last fifty years; not only does Oxford now have a very lively joint major, but there and elsewhere in the English-speaking world there has grown up a distinguished cadre of people who while trained in analytic philosophy acquired a deep enough understanding of fundamental physics to make very nontrivial contributions to the subject. I hope very much that this happy situation will be perpetuated in the future.

Sir Anthony James Leggett, KBE, FRS, Oxford University (Balliol & Merton Colleges) is a world authority on low-temperature physics. Professor Leggett was conferred the ²⁰⁰³ Nobel Prize in Physics in recognition of his pioneering work on superfluidity. He has shaped our current understanding of superfluid helium liquids and strongly coupled superfluids. At the University of Illinois, Urbana-Champaign, Professor Leggett is still actively setting directions for research on the foundations of quantum mechanics, quantum physics of macroscopic dissipative systems, as well as the further use of condensed systems to test the foundations of quantum physics.