

Newton's Flaming Laser Sword  
Or:  
Why Mathematicians and Scientists don't like  
Philosophy but do it anyway.

by

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As a mathematician, I take care not to be caught doing philosophy. When I buy my copy of *Philosophy Now*, I ask the newsagent to wrap it up in a brown paper bag in the hope that it will be mistaken for a girly-mag.

I am not alone in this, most scientists and mathematicians regard philosophy as somewhere between sociology and literary criticism, both ranking well below, say, kissing slugs on the list of healthy activities in which one might indulge before dinner. Why is this? Are we not clever enough to understand it, too rigid in our thinking to find it stimulating? Too shallow to grasp fundamental issues? Or have we worked it all out and gone past it? I shall try to explain why scientists and mathematicians are inclined to be dismissive of the subject. And why we are in fact still doing it, and that the name has been changed, no doubt to protect the innocent.

When I was a child, of nine or ten years of age, a particularly sadistic schoolteacher posed the question: 'What would happen if an irresistible force acted on an immovable object?' My first response was that if the force was irresistible, then the object must move. 'Ah,' said the teacher, who had been here before, 'but the object is immovable.'

I thought about this for three days with brief periods out for sleeping. Eventually I concluded that language was bigger than the universe, that it was possible to talk about things in the same sentence which could not both be found in the real world. The real world might conceivably contain some object which had never so far been moved, and it might contain a force that had never successfully been resisted, but the question of whether the object was really immovable could only be known if all possible forces had been tried on it and left it unmoved. So the matter could be resolved by trying out the hitherto irresistible force on the hitherto immovable object to see what happened. Either the object would move or it wouldn't, which would tell us only that

either the hitherto immovable object was not in fact immovable, or that the hitherto irresistible force was in fact resistible.

From which you will infer that even at an early age I was destined for Science and not for Philosophy.

The scientist's perception of philosophy is that all too much of it is a variation on the above theme, that a philosophical analysis is a sterile word game played in a state of mental muddle. When you ask of a scientist if we have free will, or only think we have, he would ask in turn: 'What measurements or observations would, in your view, settle the matter?' If your reply is 'Thinking deeply about it', he will smile pityingly and pass you by. He would be unwilling to join you in playing what he sees as a rather silly game.

Many years after my first brush with philosophy, I was working in my room at the University of Western Australia writing computer programs. A timid knock at my door interrupted me, but I opened it to find a small man standing shyly outside. I invited him in and asked what I could do for him. He was, it transpired, from the Philosophy department. He asked if it was true, as he had been told, that I was working on Artificial Intelligence, and I said that I was in fact working on Artificial Neural Nets which purported to simulate brain functioning, in particular they could be taught to recognise patterns. So I was investigating them to see if it led to any understanding of how brains learn. 'Well I have come to tell you that you are wasting your time,' he told me politely. I asked him why he thought so and he explained:

'There is a fundamental difference between human beings and machines, one that you can never get around. People can make mistakes, Machines cannot.'

He delivered this with an air of triumph.

'My programs make mistakes,' I told him patiently. 'I have trained a neural net to recognise the digit 3 written on an array. It frequently tells me that a 5 is a 3. If I correct its response often enough, it then tells me that a 3 is a 5. If I train it on 3's and 5's alternately it eventually gets them right but by then it thinks everything is either a 3 or a 5. I haven't had the patience to make sure it gets every digit correct, but given the time and possibly a bigger network, I am confident it would get all the digits right. Until then, it will make mistakes.'

‘Ah,’ he said with the air of a man delivering certain knowledge, ‘but they are not *real* mistakes. *Really* it is doing what it has to do because you programmed it.’

For reasons which every scientist but not all philosophers will understand I was getting a little impatient.

‘First,’ I told him, ‘there is every reason to believe that a human brain is a machine, and so the "mistakes" that it makes are of the same sort as my neural net. We call them mistakes because the machine isn't working the way we think it should. But it is following the program which it has acquired from genetics and learning, in just the same causal way that my neural net behaves. And second, you are doing what Bertrand Russell called reasoning about properties of the world from the language used to describe it. This is not a reliable way of finding out how the world actually behaves. Which is why we have Science.’

The argument carried on for some hours, but eventually my impatience evaporated.

‘Look,’ I told him, ‘it seems to me that you are trying to legislate for language. You want me to call the mistakes I make *real mistakes*, and the mistakes my program makes *simulated mistakes*, the reason being that you feel that I am abusing the language. But people use language metaphorically all the time. It is as if you objected to someone calling the leg of a table a leg, because it is a different kind of thing from my leg. As if there is a serious risk of someone being afraid to scratch it in case he got splinters. The plain fact is that philosophers have no particular status here: people will go on saying that tables have legs and not take a blind bit of notice of philosopher's rulings to the contrary. And the same goes for mistakes.’

He objected that he was not trying to legislate for language use at all, that he was trying to get at the truth using philosophical methods.

‘Philosophical methods of the sort you are using have been obsolete for at least three centuries,’ I told him. ‘Their failure to provide truth has been demonstrated repeatedly. Now kindly buzz off because I have serious work to do and this discussion cannot be productive of anything except raising my blood pressure.’

This wasn't polite, but then wantonly wasting my time on frivolity wasn't very polite either. Of course, he was being impolite out of ignorance or folly rather than malice, but the universe has a harsh way with ignorance and folly, and why should I be kinder than the universe?

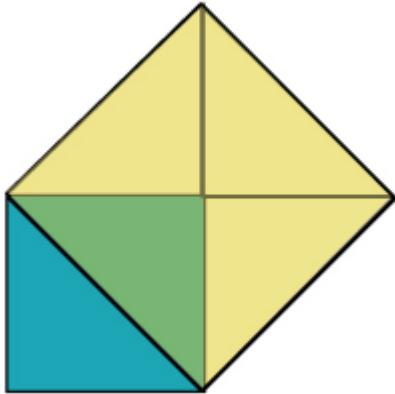
The argument about mistakes, please notice, was not in fact original with my little philosopher: it may be found in page 77 of the Notebooks of Samuel Butler, the author of *Erewhon*. I preferred the advertisement: 'Mrs Smith having cast off clothing of every description invites inspection.' It is marginally more frivolous.

My little visitor was not the only platonist to take on the people who try to write intelligent programs, the philosopher Searle has written arguments (about chinese rooms) to the same end, and been treated with comparable disrespect by mathematicians, scientists and the *soi disant* artificial intelligentsia. To such people, the way to find out if it is possible to write intelligent programs is to try and see what happens. As to whether such a program could 'really' be intelligent or thinking, or only able to simulate it, the scientist asks 'What procedures would you use for distinguishing these cases?' Again, the answer 'Thinking hard' would earn a tired smile and a quick exit.

So far I have presented the orthodox position of scientists: truth about how the universe works cannot generally be arrived at by pure reason. The only thing reason can do is to allow us to deduce some truth from other truths. And since we haven't got many truths to start out from, only provisional hypotheses and a necessarily finite set of observations, we cannot arrive at secure beliefs by thought alone. Most scientists are essentially Popperian positivists, they take the view that their professional life consists of finite observations, universal general hypotheses from which deductions can be made, and that it is essential to test the deductions by further observations because even though the deductions are performed by strict logic (well, mathematics usually), there is no guarantee of their correctness. The idea that one can arrive at reliable truths by pure reason is simply obsolete. Plato believed it, but Plato was wrong. Such is the conventional wisdom among scientists, and it would be wrong of me to attempt to conceal that this is, broadly, my position too.

How did it come about that anyone could imagine that pure reason, to use Kant's term, could inevitably lead to truth about the world? The answer lies in the overpowering effect of Greek mathematics on Greek philosophers, particularly Plato. In one of Plato's Socratic dialogues, Socrates gets a slave to

prove the result that says that if you take a square and draw a diagonal, and then make the diagonal one side of a larger square, then the area of the second (yellow) square is twice that of the first (blue).



Socrates does not actually give a proof, he draws one out of the slave by asking questions (and if you want to see if you have the mathematical skills of an Attic slave, you can scrutinise the diagram and see if you can prove it). When the slave triumphantly concludes the argument, Socrates tells him that he must have known it all along, because all Socrates has done is to ask questions of him. So the knowledge of this particular truth was inside the slave's mind already but needed to be exposed. The act of thinking of

the answers to Socrates questions brought it from the depths to the light of day, a process not unlike the practice of certain psycho-analysts of a Rogetian persuasion. It is fundamental to Plato's thinking that truths can be obtained by the mind reaching out and grabbing them. The 'truth' about the relative areas of the two squares is just one rather unimportant example of this process. One can also expect to work out the right answer to ethical dilemmas, engineering problems and aesthetic judgments by the same process. In fact Plato wrote to Archimedes, scolding him about messing around with real levers and ropes when any gentleman would have stayed in his study or possibly, in Archimedes case, his bath. Archimedes who was a real mathematician and about twenty times as smart as Plato was probably much too busy to answer such silliness.

If you read Euclid's Elements (now available on the internet, there is a nice site at: <http://aleph0.clarku.edu/~djoyce/java/elements/elements.html>) and follow the remorseless deduction of mathematical propositions from a ridiculously small number of axioms, you cannot help but be impressed by what can be done by persistent and careful thought. In the days when the results were still relatively fresh, impressionable minds could easily have supposed that there is no limit to what can be obtained by these methods.

Euclid starts by defining, rather inadequately, points and lines. It is important to notice that these, as the name Geometry itself suggests, were abstractions from the Egyptian habit of doing their surveying by driving pegs into the fairly

flat banks of the Nile and joining them by ropes pulled tight. This was necessary because the Nile had the habit of washing away all the previous markers telling people where their fields were, so they had to be reconstructed afresh every year. Now pegs and ropes in a field are not very complicated things in this context, they have only a few significant properties, and these properties could readily be abstracted to properties of points and lines in a plane. And when written down, they became the axioms of plane geometry. So there is a definite connection with the real world, but only a few important properties have been selected for further consideration.

To many of the Greeks, the connection with reality was too tenuous to be worth bothering about. Axioms were regarded as 'self-evident truths', dredged by pure thought from reality, and the philosophers didn't believe the axioms could be other than they were. Believing that they were abstracted from real things like pegs and ropes was far too mundane. So Plato came to articulate the idea that all the important truths about the world could either be known to the inner eye directly, or deduced from them by pure reason. A more conservative man might have concluded that there were mathematical truths which could be derived from just about any set of rules, and observational truths about reality, and that the two were not in general the same. But intoxicated by 'Greek Magic' as mathematics has been called, Plato went the whole hog.

Most people, no doubt, decided that this might be true in principle, but if you wanted to know which horse could run faster, it was a lot cheaper, quicker and less intellectually taxing to race them than to sit and think about it an awful lot. Those people who had lost all their money betting on horses and also had a disposition to think, felt it was a better to solve the problem by pure thought, and looked down on those who owned the horses or bet on them. This habit has continued to the present time.

There are two basic reasons why mathematicians and scientists generally reject platonist methods. One comes from Euclidean geometry. The axiom of the parallels was given by Euclid and asserts that through a point, parallel to a given line, one line and only one can be drawn. A great many people felt unhappy about this axiom. It didn't seem to them to come under the heading of a proper axiom, because they didn't find it self-evident. So they tried to deduce it from the other axioms. Huge numbers of man-hours and even some woman-hours have been spent trying to deduce the statement from the rest of Euclid's axioms, or to append a really self-evident axiom from which it could be deduced. All of them failed, although an Italian mathematician thought he had

done it by assuming that the statement was false and trying to deduce a contradiction. He didn't get any contradictions, but he deduced a lot of results which he felt were sufficiently bizarre to allow all fair minded men to accept the axiom of parallels.

Until the mathematicians Bolyai, Lobachevsky, and Riemann came along. Bolyai tried to deduce a contradiction, assuming that through a point, parallel to a given line, many lines could be drawn. He deduced away like crazy but failed to get a contradiction, and eventually realised that he had invented a new geometry, different from Euclid's but just as respectable. Riemann went the other way. He assumed that through a point, parallel to a given line, no line could be drawn. He realised that he too had invented another geometry, in fact the geometry of great circles on a sphere.

This pretty much does for platonism as far as mathematicians are concerned. Axioms stopped being self-evident truths as soon as the work was read and understood. Instead they were simply postulates, and they might be interpreted as true statements about the world, perhaps in several different ways. Or they might not be interpreted at all. Platonism died for mathematicians some centuries ago, and simply looks silly. Mathematics doesn't give truths, it gives consequences. The axiom of parallels is merely the postulate that the space in which we are working is flat. This tells us nothing about whether the space we live in really *is* flat, maybe it is and maybe it isn't. We would need to find out by observation, and Gauss, who grasped the point immediately suggested putting three telescopes on different mountain peaks and measuring the sum of the angles of the triangle so formed. If it came to 180 degrees, space was flat, at least up to the limits of accuracy of the measurements. If more, we lived in Riemannian space, if less then in a Lobachevskian space. Reason alone couldn't possibly tell us which.

I said there were two reasons why mathematicians and scientists rejected platonist methods. The second one was the revolution in philosophy made by Newton. You can see what it amounted to by reading *De Rerum Naturae* by Lucretius, a gentleman who wrote a long lyrical poem about science (as he conceived it) which discussed among other things the question of whether we see things by something coming off the objects we see and coming into our eyes, or whether our eyes reached out in some way to touch the objects and grapple with them. Compare this with Newton's *Opticks*, and you notice some substantive differences. Lucretius was a philosopher, old style. Newton was undoubtedly a philosopher, but he had a different and non-platonist method.

He wrote *Hypotheses non fingo*, which translates literally as ‘I do not frame hypotheses’, but of course he did; The latin fingo is related to fiction (fingo, fingere, fictum) and it might be better to translate it as ‘I do not engage in untestable speculation.’

Newton made his philosophical method quite clear. If Newton made a statement, it was always going to be something which could be tested, either directly or by examining its logical consequences and testing them. If there was no way of deciding on the truth of a proposition except by interminable argument and then only to the satisfaction of the arguer, then he wasn't going to devote any time to it. In order to derive logical consequences that could be tested, it was necessary to frame his statements with a very high degree of clarity, preferably in algebra, and failing that Latin. Nowadays we drop the Latin option.

$\forall \epsilon > 0 \exists N \in \mathbb{Z}^+ \dots$



In choosing to exclude all propositions which could be argued about but not decided by a combination of logic and observation, Newton changed, quite deliberately, the rules of the game. An argument about, for example, whether cats or rocks have rights, the same as people do, would not be entered into until some clarification has been obtained. The first question the newtonian philosopher asks is: What set of observations do you consider would establish



the truth of your claim? If the answer consists of some definite set of observations and these are in fact made and produce the results required, the next step is to demand that the logical connections between the observations and the claim be provided. In the case of debate about the rights of cats or rocks, nobody would have troubled to ask what observable data would have confirmed the claim, on the not unreasonable grounds that arguments about it cannot give a definitive answer because we have not yet defined the term 'right' with sufficient precision. Anyone who thinks he knows exactly what a 'right' is, is invited to define it in algebra. Until someone does, newtonian philosophers have declared it unfit for serious consideration.

All good principles should have sexy names, so I shall call this one *Newton's Laser Sword* on the grounds that it is much sharper and more dangerous than Occam's Razor. In its weakest form it says that we should not dispute propositions unless they can be shown by precise logic and/or mathematics to have observable consequences. In its strongest form it demands a list of observable consequences and a formal demonstration that they are indeed consequences of the proposition claimed. This does not, of course, establish the truth of the proposition, but it does provide supporting evidence.

There are, of course, a lot of pre-newtonian philosophers around. People like Searle and my little visitor would no doubt accuse us newtonians of neglecting the study of vitally important matters such as ethics and the nature of mind. Newtonians simply reply that we have little constructive to say about these matters because we don't understand them, so we shut up. We are working on both. Ethics may be approachable through a study of evolution and repeated games theory. Some of us are trying to write computer programs which do some form of cognitive processing at a very simple level. Those who want the grand over-arching explanation are not satisfied with this approach, but it has paid big dividends in Physics and Chemistry, although it is mostly slow, technical and requires some competence at mathematics. (This is not a commercial, it just comes out that way.)

Such then is the view of a majority of practising scientists. I suppose you could say that we believe we have taken philosophy to new heights, incorporating mathematics and reasoning to levels far past anything Plato mastered, so the best you can hope for from us is an acknowledgment that Plato was alright for his day, but that his day is long past. We are indisputably still trying to understand the universe, and a lot of thought goes into it, and we are therefore doing (natural) philosophy. But we don't call it that these days for fear of being

mistaken for the sort of philosopher who is prepared to settle hard problems about minds and brains and computer programs with only the most tenuous knowledge of how computers or brains actually work.

You might, just possibly, have been able to detect a touch of intellectual snobbery in this view of philosophy. In Plato's day, an educated gentleman of a literary cast of mind could be expected to at least follow a mathematical argument which was at the frontier of research. Now nobody can be familiar with all aspects of current research, there's too much of the damned stuff. So there is the possibility that some of those posing as newtonian philosophers may not be philosophers at all, merely technicians who are good at doing hard sums. This is a suspicion not without supporting evidence. Much mathematics and science teaching, and many texts, have the characteristic dreariness that goes with a total lack of reflection on larger issues.

It must also be said that, although one might much admire a genuine newtonian philosopher if such could be found, it would be unwise to invite one to a dinner party. Unwilling to discuss anything unless he understood it to a depth that most people never attain on anything, he would be a notably poor conversationalist. We can safely say that he would have no opinions on religion or politics, and his views on sex would tend either to the very theoretical or to the decidedly empirical, thus more or less ruling out discussion on anything of general interest. Not even Newton was a complete newtonian, and it may be doubted if life generally offers the luxury of not having an opinion on anything that cannot be reduced to predicate calculus plus certified observation statements. While the newtonian insistence on ensuring that any statement is testable by observation (or has logical consequences which are so testable) undoubtedly cuts out the crap, it also seems to cut out almost everything else as well. *Newton's Laser Sword* should therefore be used very cautiously. On the other hand, when used appropriately, it transforms philosophy into something where problems can be solved, and definite and often surprising conclusions drawn. A platonist who purports, for example, to deduce from principles which he has wrested from a universe of ideals by pure thought that euthanasia or abortion is always wrong, is doing something quite different.

It seems to me fair game to use the flaming sword on philosophers who meddle in science which they do not understand. When he asks questions and is willing to learn, I have no quarrel with him. When he is merely trying to lure you into a word game which has no prospect of leading anywhere, you really have to decide if you like playing that sort of game. Mathematicians and

scientists feel that they have found a more difficult but much more satisfying game to play. Newton's Flaming Laser Sword is one of the rules of that game.