Answers to Five Questions

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Question 1. Why were you initially drawn to the philosophy of logic?

Well, in the first place, I was drawn to logic. I was trained as a mathematician. My doctorate was in mathematical logic, and so I engaged with some of the great results of logic of the first half of the 20th Century, such as Goedel's incompleteness theorems. This made me reflect on some of the philosophical puzzles and paradoxes in the neighbourhood of these. In this way, I was drawn into philosophical logic. I wanted to see what was going on under the mathematics.

Mathematical constructions and results are often beautiful and important in their own right, but professionally I suppose that I have rarely been interested in them for their own sake. Mathematics is important for me when it engages with philosophical issues. (Thus, I gave up reading the *Journal of Symbolic Logic* a long time ago. I have no problem with those who have interests in such areas; but any connection which the papers in this journal have with philosophical issues largely disappeared a long time ago.) In particular, "classical logic", that is the logical theory invented by Frege and Russell and co-travellers, is a superb logical tool. So much better than any logical theory that came before. But every logician is aware that it faces philosophical problems – though some might think that they can be made to disappear with appropriate manoeuvering. It seems to me that, in many cases, this is not so. It must be possible to do better. Much of my work in logic has been directed to seeing how.

Question 2. What are your main contributions to the philosophy of logic?

For the part of my work in question, I find it hard to disentangle the philosophy of logic from logic itself, the philosophy of language, and metaphysics. I suppose that most people who know of my work will associate it with dialetheism, that is, the view that some contradictions are true. I think that in the first place, this is a view in metaphysics. Thus, Aristotle defends the Principle of Non-Contradiction in his *Metaphysics*, not his *Analytics*. Since Leibniz, however, the Principle has been taken to be a part of logic. I have advocated dialetheism on many grounds, concerning the paradoxes of self-reference, motion, inconsistencies in law, contradictions that arise at the boundaries of what can be said/thought – and most recently in connection with aspects of Buddhist philosophy.

Of course, since dialetheism is such a contentious view, much of what has to be done in advocating it is defending it against objections. Of these, the first that comes to mind to most philsophers nowadays is the thought that everything follows from a contradiction (Explosion); so dialetheism lapses into trivialism. This is, in fact, a very superficial objection, since any dialetheist who is not a trivialist will take Explosion

not to be truth-preserving and so not to be valid. What is not superficial, however, is framing a robust account of validity which shows how and why Explosion fails. Logics which invalidate Explosion are called paraconsistent logics. They were invented by various people before I came on the scene (Jaskowski, Da Costa, Anderson and Belnap), but I formulated one in ignorance of their work (the so called Logic of Paradox), and much of my work since has been connected with developing various paraconsistent logics, especially (though not exclusively) in connection with relevant logics. I have also been engaged in looking at the application of such logics to truth, sets, arithmetic, and exploring the interesting philosophical and mathematical possibilities that arise there.

Another objection that is often made against dialetheism is that one can suppose that some things of the form *A&~A* are true only by changing the meaning of negation. This is another superficial objection because, as anyone who knows much about the history of logic will know, there have been many different theories about how negation works, and what properties it has. To assert, baldly, that the account given in "classical" logic is correct is simply to beg the question. However, it is beholden on a dialetheist to give an account of the meaning of negation. This, though, is relatively easy, given that an appropriate semantics of paraconsistent logic is under control.

Of course, there are many other possible objections to both paraconsistency and dialetheism (distinct from objections to the application of it to any *particular* area). These concern denial, rationality, belief revision, and a variety of other notions. The objections engage with issues in technical logic, the philosophy of language, epistemology, and other areas. I have discussed all these things, though this is not, I think, the place to go into matters.

When I started to advocate dialetheism, most people refused to take it seriously, and were therefore content with very superficial objections. Thinking philosophers now know that if it is to be refuted, a much more sophisticated discussion will be required. This is now starting to happen, and where it will lead, time will tell. However, as a result of this discussion, even if dialetheism were to turn out to be incorrect, we will learn much about logic, truth, negation, rationality, and many other notions in the process. Indeed, how could it be otherwise? Aristotle effectively manage to close down debate about the Principle of Non-Contradiction in Western philosophy. You cannot make philosophical progress in some area by stopping thinking about it.

Question 3. What is the proper role of philosophy of logic in relation to other disciplines, and to other branches of philosophy?

For most *X*s there is a philosophy of *X*: philosophy of biology, philosophy of mathematics, philosophy of history, philosophy of mind, philosophy of language, philosophy of art. Any topic of sufficient generality will throw up numerous philosophical questions. And the philosophy of *X* is the domain in which these things are pursued. So it is with logic. Logic is the study of what follows from what, and

why. The 'why' is already a big philosophical question, and answering it forces one to engage with questions about truth, meaning, probability, rationality, as well as many more local questions, such as the nature of truth-bearers, logical constants, and so on. Digesting such questions is necessary to establish a theory of logic as well-grounded and philosophically defensible.

To the extent that logic is relevant to other disciplines, then, so is the philosophy of logic. Of course, all disciplines argue. So the correct canons of argumentation are going to be relevant to all disciplines. However, logic, and so its philosophy, has a particularly intimate connection to several disciplines: mathematics, computer science, and linguistics, in particular. Logic is informed by the application of mathematical tools; and, in reverse, throws up new structures for mathematics to analyse. (To give just one example: mathematical structures based on non-classical logics.) Logic provided the foundations of computation theory; and in reverse, the development of AI and computer-reasoning have provided fertile ground for new developments in logic. (To give just one example: non-monotonic logics.) Logic has provided the basis for various theories of linguistics; and in reverse, linguistics has provided impetus for the study of novel parts of logic. (To give just one example: various sub-structural logics.)

The relation of logic and its philosophy to philosophy in general is a particularly close one. Of course, philosophers argue, and so logic is relevant there. As I have also indicated, issues in philosophical logic relate to questions in the philosophy of language, epistemology, and metaphysics. However, I think that the connection between logic and philosophy goes even deeper than this. Time and again in the history of philosophy, we have seen logic deployed as the ground of metaphysics: it is the tectonic of Kant's *Critique of Pure Reason;* Hegel has a pan-logical metaphysics; in the *Tractatus*; Wittgenstein reads off his account of reality from Frege-Russell logic; Dumment shapes his philosophy of language on the verificationism of intuitionist logic; Kripke reads of his philosophy of language and metaphysics from his semantics for modal logic. There is something wildly over-optimistic about all these projects. However, they illustrate an important point. There is a sense in which logic provides the framework, the ground rules, for any metaphysical project. This does not mean that it determines an answer to the project, but it does put boundaries on how one can proceed. To give one simple, but obvious, further example: can we develop metaphysical theories which allow objects to behave in a contradictory fashion? The frame of an explosive logic says 'no'; the frame of a paraconsistent logic says 'yes'. In this way, then, logic is relevant to metaphysics. And behind most systems of ethics (or of values more generally), there is a usually a metaphysics. So the relevance of logic to all philosophy is there. Maybe at a distance; but it is there.

Question 4. What have been the most significant advances in the philosophy of logic?

Wow! In two and a half thousand years of logic, East and West? There is no way that I can answer that question here, so let me just stick to the last 140 years in the West –

roughly from the rise of modern logic. I will break this up (notionally) into three periods. Again it is difficult to divorce advances in the philosophy of logic from advances in logic itself, the philosophy of language, and so on.

I suppose that the most significant advances in the philosophy of logic in the first generation of logicians in question were in establishing the autonomy of logic from psychology, the analysis of the nature of quantifiers, and clearly framing the distinction between systems of proof and semantics (and so posing the question of how these things should be related).

These advances made possible the great results in metmathematics of the next generation of logicians, most notably in this context, the standard incompleteness results: Goedel's theorems, the unaxiomatizability of second order logic, the Skolem-Loewenheim theorem. There was enough material here to keep philosophers busy with questions about the philosophical implications of these results for a long time. In many ways, these debates are still going on. The amount of consensus on all of these matters – at least since the dismantling of the influence of Quine – is, distinctly limited. I think that most of us would agree that these results are profound. Wherein lies their profundity is, however, still contested.

A word should be said, in this context, about the philosophy of mathematics. Many of the logical and philosophical advances in the period in question were driven by attempts to develop a viable theory of the foundations of mathematics: logicism, intuitionism, formalism. By the end of this period, all of them were generally agreed to have failed. This is philosophical progress; which may well arise due to the fact that we know what does *not* work.

The third generation of advances in logic really belongs to the development of non-classical logics. Some of these had been developed from early in the second period. But as logicians became more aware of the various problems and limitations of Frege-Russell logic, this was the time when non-classical logics blossomed, bringing with them a whole new bunch of philosophical problems. We see (amongst other things):

- The rise of modal logics and their semantics. Which modal logic correspond to which notion of necessity; and what is one to make metaphysically of world-semantics? I don't think there is as yet much consensus on these questions. The waters have been made even murkier in last 30 years by the rise of theories of impossible worlds.
- Debates about metaphysical realism and anti-realism, based on the supposed forced choice between "classical logic" and "intuitionist logic". That debate is now pretty dead, but it has morphed into the more general one of whether one should prefer a truth-conditional account of meaning, or a proof-theoretic account of meaning, which debate is still going strong.
- Novel theories of conditionality. The material conditional of Frege-Russell logic was never really a very good candidate for an ordinary conditional, though logicians were pretty happy with it for a while. However, its

limitations eventually became clear. Hence we saw the invention of conditional logics, relevant logic, and the ensuing debates about whether these are any better. As far as I can tell, there is now little consensus about the conditional.

- New work on the logical paradoxes. Much of logic in the 20th Century was driven by the logical paradoxes. Theories thereof in the first half of the century tended to be based on Frege-Russell logic. In the period in question, we have witnessed the development of logics based, notably, on truth value gaps and/or gluts, and seen how they may or may not be applied to the paradoxes. These have added a whole new dimension to the debate; and as far as I can tell, there is absolutely no consensus over this.
- Debates on vagueness. Though sorites paradoxes have been known since Eubulides, it is notable that such paradoxes were not debated in Medieval logic, nor in the modern period until the last 40 years. Since then, we have seen much discussion of the nature of vagueness. Much of this has been in connection with non-classical logics, such as supervaluation logic, fuzzy logic, and paraconsistent logic.
- The establishment of the field of non-deductive logics. After a brief period of trying to develop these on the basis of probability theory, work in the last 40 years has focused on the development of non-monotonic logics, based on semantics with a priority ordering.
- Debates about logical pluralism. Traditionally, logicians have assume that there is one correct logic (at least, one correct deductive logic). The proliferation of different logical theories has caused some to wonder whether this is correct. Maybe some of these logical theories are right for some things; and some for others. That is a fairly recent debate, and we are still just feeling our way around it.

Question 5. What are the most important open problems in philosophy of logic, and what are the prospects for progress?

I don't think it profitable to concentrate on particular questions. There are just too many, and several of them are inter-connected. As I indicated in my answer to the last question, there are many whole areas of philosophical logic where there is no consensus. Any developments in these areas which helped produced such a consensus (even temporarily) would be welcome.

But in what does progress in philosophy consist? Not in reaching consensus (much less in finding definitive answers). It consists in deepening our understanding. We come to understand new questions to ask; to understand how to ask old questions better; to understand new answers that are possible; to understand why old answers don't work properly, and maybe how to improve them. I am not foolhardy enough to make predictions about what is going to happen in any of the areas I mentioned, or about what new areas of inquiry might emerge. But we now have at our disposal a wider range of mathematical tools than ever before for applying to matters in logic;

and people are feeling freer than ever to apply these tools. Perhaps this will just lead to a proliferation of theories, and even less consensus; but it is hard to see how this could not but deepen our understanding of many issues.