Citations. That word strikes fear into the heart of the average academic. To deflate all but the most robust intellectual ego, it is only necessary to ask innocently, ‘How are you going in the Citation Indexes, mate?’ These Indexes, of which the Arts and Humanities Citation Index is the one relevant to philosophy, list under each author’s name all citations to his work in the current year, that is, all the papers that year which have cited his previous productions in a footnote. The purpose of the exercise is to allow research topics to be followed up: find an old paper on a topic and look it up in the Citation Indexes and you have a start on current research in the area. A by-product is that every academic can see how many people are taking notice of his work. Or not, as the case may be.

Another by-product is the possibility of tracking large-scale trends in academic fashion. A considerable study was made on the Arts and Humanities Citation Index for the period 1976 to 1983, and the results include a list of the works of the twentieth century most cited worldwide. The most cited author of the century was Lenin, which confirmed a number of right-wing suspicions about the humanities industry. But the most cited single book, on any subject, was Thomas Kuhn’s The Structure of Scientific Revolutions. Sir Karl Popper’s major works on the philosophy of science, The Logic of Scientific Discovery and Conjectures and Refutations, were both among the top fifty.

The naive observer might draw the conclusion that scholars in the humanities were at last taking an interest in science and were keen to understand it. Nothing could be further from the truth. Popper and
Kuhn do not explain science, scientific truth or the methods by which science reaches truth. They explain them away.

The main idea of Popper, the founder of the central school of twentieth-century philosophy of science, was that observations and experiments do not, as most people believe, support scientific theories. The ultimate virtue for theories, he said, is falsifiability: a good theory is one that sticks its neck out and makes definite predictions that can be checked. Falsifiable theories include ‘All ravens are black’ and Einstein’s theory of relativity. Popper had in mind as unfalsifiable the theories of Marx and Freud, which always seemed to have the ability to give some plausible explanation of any recalcitrant observation. The crucial point which Popper’s opponents objected to was his answer to the question: what should we think about a theory that has successfully withstood rigorous tests designed to falsify it? Is it then worthy of belief, or probable, or reliable as a basis for action? Popper’s answer was no. To admit otherwise would be to fall back into ‘inductivism’, the belief that observations do (probabilistically) support conclusions.

‘Inductivism’ here refers to the ancient ‘problem of induction’. How can one ever be sure of the truth of an ‘all’ statement like ‘All swans are white’, when the evidence for it can only be that all of the swans observed so far have been white? Surely, however many have been observed, the next one could be non-white? Undoubtedly, logicians in past centuries were excessively sanguine on the question, and Australia’s first contribution to world philosophy was its well-known criticism of the standard logicians’ example, ‘All swans are white.’ In a strategy that has been used on criticism from Australia more than once since, the logicians simply substituted ‘all ravens are black’, and carried on regardless.¹ But the ‘black swan of trespass’ of which Ern Malley speaks was on the wing, and it was only a matter of time before it came home to roost. John Stuart Mill wrote that the inference from the whiteness of European swans to the whiteness of all swans ‘cannot have been a good induction, since the conclusion turned out to be erroneous’.³ This is a remark so patently wrong as to suggest the depth of the underlying problem, which is that of conceiving of a logical argument that is worthwhile, although fallible. Mill’s extreme reaction was also that of Popper, in the Vienna where extreme reac-

¹ F. Burgersdijk (Burgersdicius), Institutionum logicarum, bk. 1, ch. 31 (Cambridge, 1666, p. 97).
tions were a way of life, and it became the orthodoxy of the turbulent and sceptical times that followed. Popper and his followers, believing there could be no such thing as a logic of probability, concluded from ‘observations can’t make you certain of a generalisation’ to ‘observations can’t give you any good reason at all for believing a generalisation.’

Sir Karl was showered with all the honours he could have wished for. Except a job in Australia. He applied for the chair in philosophy at the University of Queensland just before the Second World War but was not short-listed, the successful candidate possessing ‘the special advantages of long and responsible experience in this university and of experience in the service of the Queensland Department of Public Instruction.’\(^\text{4}\) Popper spent the War in New Zealand, and in 1945 was offered a position at Sydney University. His autobiography implied that he refused the offer as a result of anti-semitic sentiment in Sydney. It is true that a question was asked in Parliament complaining about his appointment because he was an alien, and the fuss prompted him to withdraw. John Anderson persuaded him to withdraw his withdrawal, but he soon received a better offer from the London School of Economics and went there instead.\(^\text{5}\) In 1950–1, he was considered for a chair at ANU, but lost out to Percy Partridge.\(^\text{6}\)

Kuhn agreed with Popper’s anti-inductivism, and added the notion of ‘incommensurability of paradigms’. According to this view, epochs of ‘normal science’ are punctuated by sudden changes of paradigm, such as the change from Ptolemy’s to Copernicus’ theory of the solar system. Paradigms cannot be rationally compared, since the very concepts involved in two different paradigms are quite different. Lakatos


applied these ideas to mathematics, the central bastion of scientific rationality. His presentation is notable for its continual use of scare quotes around words like ‘knowledge’, implying that what is normally taken to be ‘known’ or ‘proved’ is not really so. Feyerabend took this line of thought to its logical conclusion with his dictum, ‘Anything goes.’ Voodoo is as good as science, logically speaking. The essence of these thinkers’ views can best be appreciated from the caricature of them in David Stove’s Anything Goes, perhaps the best Australian work of philosophical polemic. As Stove explains, authors who do not think evidence can give us any rational confidence in theories must forever be undermining the ordinary words that attribute success to scientific endeavours:

**HELPS TO YOUNG AUTHORS**

**NEUTRALISING SUCCESS WORDS, AFTER THE MANNER OF THE BEST AUTHORITIES**

**HOW TO REWRITE THE SENTENCE: COOK DISCOVERED COOK STRAIT.**

**Lakatos:** Cook ‘discovered’ Cook Strait.

**Popper:** Among an infinity of equally possible alternatives, one hypothesis which has been especially fruitful in suggesting problems for further research and critical discussion is the conjecture (first ‘confirmed’ by the work of Cook) that a strait separates northern from southern New Zealand.

**Kuhn:** It would of course be a gross anachronism to call the flat-earth paradigm in geography mistaken. It is simply incommensurable with later paradigms: as is evident from the fact that, for example, problems of antipodean geography could not even be posed under it. Under the Magellanic paradigm, however, one of the problems posed, and solved in

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the negative, was that of whether New Zealand is a single land mass. That this problem was solved by Cook is, however, a vulgar error of whig historians, utterly discredited by recent historiography. Discovery of the Strait would have been impossible, or at least would not have been science, but for the presence of the Royal Society on board, in the person of Sir Joseph Banks. Much more research by my graduate students into the current sociology of the geographical profession will be needed, however, before it will be known whether, under present paradigms, the problem of the existence of Cook Strait remains solved, or has become unsolved again, or an un-problem.

Feyerabend: Long before the constipated and bone-headed Cook, whose knowledge of the optics of his telescopes was minimal, rationally imposed, by means of tricks, jokes, and non-sequiturs, the myth of Cook Strait on the ‘educated’ world, Maori scientists not only ‘knew’ of the existence of the Strait, but often crossed it by turning themselves into birds. Now, however, not only this ability but the very knowledge of the ‘existence’ of the Strait has been lost forever. This is owing to the malignant influence exercised on education by authoritarian scientists and philosophers, especially the LSE critical rationalists, who have not accepted my criticisms and should be sacked. ‘No doubt this financial criticism of ideas would be more effective than ... intellectual criticism, and it should be used.’ (Boston Studies in the Philosophy of Science, Vol. LVIII, 1978, p. 144.)

A caricature, but the reality is only too close. The popular Australian textbook, Alan Chalmers’ *What is This Thing Called Science?* contained (in the first edition, though not the second) the Feyerabendian thought, ‘In medieval Europe, witches really inhabited the commonsense world while in modern times they do not.’

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Stove’s point is that the ‘four irrationalists’ are using a variety of underhand techniques to undermine the ability of science to come up with at least well-supported theories. Some are just tricks, like neutralising success words by enclosing them in inverted commas. More central is their ‘deductivism’, the thesis that all logic is strictly deductive, so that there can be no relations of partial support between evidence and hypothesis. This is true even of Popper, who at least claimed to be on the side of science and gave his work the comparatively upbeat title *The Logic of Scientific Discovery* — despite the fact that, according to the contents, there is no such thing as a logic of scientific discovery. It is, Stove says, ‘one kind of reaction to the disappointment of extreme expectations: that kind of reaction, namely, of which the best epitome is given in Aesop’s fable of the fox and the grapes. The parallel would be complete if the fox, having become convinced that neither he nor anyone else could ever succeed in tasting grapes, should nevertheless write many long books on the progress of viticulture.’


The reasons for Popper and Kuhn’s huge popularity among the Humanities Crowd are clear. They provide a science substitute, a ready-made theory about science which means never having to say you’re sorry about your ignorance of science itself. It licenses you to avoid studying any real science, while still allowing you to speak in a superior tone about the supposed objectivity of science and lacing your talk with the names of the scientific greats. The irrationalists’ success is a symptom of the uncomfortable position of philosophy astride the great fault line of the academic world, the one that separates the sciences and the humanities, the famous ‘Two Cultures’. Philosophy has been nurtured in the humanities, and has absorbed basic humanist ways of thinking and expressing itself. Nevertheless, one of its ambitions is to explain to scientists what they are really doing, and to make real contributions on matters like the logical structure of theories. Conflict between the scientific and philosophical points of view has been inevitable. Anderson was an example. Despite his avowed interest in the ‘ways of working’ of things in the world, he took virtually no interest in the natural sciences, while being free with his criticism of them:

The intellectual weakness of ‘science’ comes out particularly in the neglect of the true intellectual tradition (going back to the Greeks) of systematic philosophy and the amateurish substitution therefore of a mixture of professional devices (tricks of the trade) with philosophical odds and ends.

The big four ‘irrationalists’ took very little notice of the shouting from distant Australia. When one of Stove’s articles attacking him appeared in a leading English journal, Popper did send a brief not-for-publication letter to the editor along the lines of ‘more in sorrow than in anger … sad that a journal such as yours …’, but did not reply publicly. The one Australian attack that did provoke a response was an article on Feyerabend by the Sydney Marxist philosophers Jean Curthoys and Wal Suchting, well-remembered for their role in the

Sydney split. Feyerabend, they said, was still ‘immersed in the empiricist problematic’, and was no better than a liberal, that is, virtually a class enemy:

In the hands of class-peripheral, parasitic intellectuals, liberalism becomes stripped to its bare constituent atom, the single individual, posturing about in despair or self-congratulation (or different mixtures of both), often spouting *enfant-terrible*-ish pseudo-radical rhetoric the while.\(^\text{14}\)

Persistent criticism of Feyerabend on the grounds that his views were not true had washed off him like water off a duck’s back, but being accused of ethico-political deviation was hitting where it hurt. He replied with an article, ‘Marxist fairytales from Australia’:

Sydney has one opera house, one Arts centre, one zoo, one harbour, but two philosophy departments. The reason for this abundance is not any overwhelming demand for philosophy among the antipodes but the fact that philosophy has party lines ... our two southern rhapsodists have studied the Marxist vocabulary well. They are not too original and there are certainly better stylists even among contemporary Marxists. Still, they know the right words and they know how to put them together. But Marxism is not just an inventory of phrases, it is a *philosophy* and it demands from its practitioners a little more than a pure heart, strong lungs, and a good memory ... No doubt they first made up their mind that I was a no-good, big-mouthed liberal-empiricist bum and then adapted their mental reactions to this image. But I am astonished to find two philosophers so unfamiliar with elementary principles of the art of argumentation.\(^\text{15}\)

Behind this smokescreen of vocabularies in collision is a recognition by the Old Left of the grave danger to themselves in the migration of leftist intellectuals into regions like scientific irrationalism, idealism and post-modernism. If the point is not to examine the world but to change it, as Marx has it, then it helps to believe the world is there, and that one’s plans might have a real impact on it.


Popper, Kuhn and company, and the issues they considered, are now regarded as more than a little passé. Needless to say, that does not mean that the rationality of science is now orthodoxy among philosophers. On the contrary, the ‘social construction of science’ movement that is now all the rage maintains that science is now even more irrational than previously thought. A descendant of Kuhn’s talk of the non-rational conflict of paradigms, it maintains that science is a yarn got up to reflect the needs of the scientists’ society or his patrons. The overseas leaders of this field, such as Bruno Latour, recommended a host of sociological studies that would actually show how the content of scientific theories does reflect the interests of their proponents. One attempt to carry through this program was in Melbourne. Four philosophers led by Max Charlesworth lived with a group at the Walter and Eliza Hall Institute that worked on malaria vaccine and observed their behaviour from an anthropological point of view. The resulting book, Life Among the Scientists, did not work out quite according to plan. Some of the group thought the scientists were engaged in exactly the construction of fictions expected, but others came away with the impression that the researchers were actually discovering things about immunology and malaria. The book had to go to print with a disappointingly non-committal conclusion.¹⁶

There were soon educationists keen to share these new insights with the young, especially science students who might be acquiring reactionary opinions in class. The Victorian educationist Noel Gough, writing in the Australian Science Teachers Journal, took Latour and Charlesworth to have established that there is no special or rational method to science. It follows that school laboratories are ‘mythic spaces’ promoting the politically objectionable fantasy that chemicals and solutions are really there and have the properties science claims they do. He recommended that schools stop what they are doing at once and replace it with ‘the kinds of activities through which learners might come to understand science as “politics continued by other means”’.¹⁷ And a Sydney University mathematics educa-

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tion ‘expert’ recommended various changes in the way mathematics is taught on the basis that it is ‘now generally accepted by researchers’ that ‘Coming to know is an adaptive process that organizes one’s experiential world; one does not discover an independent, pre-existing world outside the mind of the knower.’

By this stage, we know where we are. The wheel has turned full circle and we have come round to idealism again.

While the education system has not actually capitulated yet, thanks to a reservoir of good sense in that much maligned profession, school-teaching, there is obviously a need to do something about the problem. One rational response is to say that there is no point in arguing with people who do not accept the rationality of logic. As Stove said about all authors who say things so bizarre even they must know to be false, they are ‘beneath philosophical notice and unlikely to benefit from it.’ Unfortunately, ignoring the blight does not make it go away. Somebody ought to explain clearly what has gone wrong. It’s a dirty job, but somebody’s got to do it, and as usual there is an Australian at the front line. Peter Slezak, of the University of New South Wales, observes that a lack of respect for finding the truth does mean that anything goes, including some very unpleasant items. To put it bluntly, ‘for educators the grounds for concern are seen clearly enough by reflecting on the fact that the sociology of scientific knowledge could have offered no principled objection to teaching the racial theories of Mein Kampf when they were believed by a majority.’ Those kind of regimes are in a position to give you the

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19 Stove, Plato Cult, p. 30.

choice of having your compliance extracted, or your teeth. In Australia, though, it is more likely that minority science would assert its right to a fair go. Helen Verran of Melbourne, praised by Latour as the world leader in 'symmetric anthropology', argues that Aboriginal science which lacks numbers and the concept of prediction is something we ought to learn a lot from.21

Slezak adds an interesting anti-idealist argument, arising from the fact that there are computer programs that can do a certain amount of science, such as finding laws in data. Since computer programs are not members of society, at least not yet, they show that the content of science can be independent of society. Since the laws that the programs discover are the same as the ones humans discover, there is good reason to believe that humans too are applying discovery methods that are not mere reflections of society’s wants.22

While disputes over the ability of science to reach the truth give rise to entertaining polemics in the style of a Punch and Judy show, there is perhaps more genuine interest in the investigations of philosophers on what kinds of truths exactly science has arrived at, and what kinds of entities science has discovered.

Among the more abstract disputes that true philosophers love are those on what kinds of things exist. Are there gods, or not? Is there such a thing as moral worth? Are there minds over and above brains? Even if we keep to the purely scientific world, there is a lot of doubt about which of the various items mentioned in scientific writings should be interpreted literally as referring to real things. At a general level, realism confronts ‘instrumentalism’, the theory that the unobservable entities of science, like electrons, force fields, and so on are not to be taken as literally existing, but are only mental ‘instruments’ that help us in inferring from one observed state of the world to another. Obviously, instrumentalism is essentially the same thought as


idealism, but applied in a piecemeal way: idealism denies the reality of everything outside the mind, while one may be instrumentalist about just this or that kind of entity. Since Jack Smart’s commitment to the realist position in the 1950s, Australians have been in the forefront in defending realism about scientific entities against the instrumentalism prevalent in, especially, the universities in the eastern United States. Michael Devitt summarises the argument for realism:

The basic argument for the unobservable entities is simple. By supposing they exist, we can give good explanations of the behaviour and characteristics of observed entities, behaviour and characteristics which would otherwise remain completely inexplicable. Furthermore, such a supposition leads to predictions about observables which are well confirmed; the supposition is ‘observationally successful’.

That is not to say one should be excessively fundamentalist about scientists’ language, since scientists explicitly use certain language, such as complicated pieces of mathematics like the Hilbert spaces of quantum mechanics, as devices for calculation, not as names of proposed entities. Scientific realism must be selective. Therefore, some

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of the most interesting questions concern the existence of particular sorts of entities. What about forces, for example? Are they just ways of talking about accelerations, or are they real entities that cause movement and that we experience directly when we feel pressure or push something? What about space? It is easy to suppose that there are physical things and distances between them, but no actual thing or stuff, ‘space’. But modern physics speaks of the curvature of space, which has causal effects related to gravity, and talks of empty space supporting gravitational and electrical fields. It is a big job for something that doesn’t exist, and one may be tempted by the opposite theory, that space is more like a stuff or ether. This is the view ably defended in The Shape of Space, by the Adelaide philosopher Graham Nerlich. There is also the problem of the structure of space at the sub-microscopic level — on present scientific theory, it is uncertain whether space is continuous (infinitely divisible) or discrete (that is, atomic, so that a cubic metre of space would consist of a finite though large number of points). It is hard to believe the question makes sense for something that does not really exist. Then there are the ‘secondary qualities’, like colour and taste. Even if physical things really have shape and size, perhaps colour and taste are in the eye, or mind, of the beholder? Even here, Australian philosophers have been more prepared than most to defend a realist position.


For those who think of themselves as ‘philosophers’ philosophers’, the central question of the ‘What exists?’ family is the problem of universals. According to both common sense and advanced science — in agreement for once — physical things act in virtue of the properties they have. A table looks as it does because of the colour and shape it has. A sun attracts a planet because of the mass it has. Another table with the same colour and shape (and texture: whatever properties contribute to looks) would look the same; another body with the same mass would attract the planet in the same way. It is these repeatable properties like blue, being cubic, and having a mass of one kilogram, traditionally called ‘universals’, whose existence is in question. Should we say that the colours, shapes and so on really exist, or only the things that have them?\(^{31}\)

David Armstrong’s defence of the realist position on universals is one of the high points of Australian philosophy. In a series of books over the last twenty-five years,\(^{32}\) he argues that the opposite ‘nominal-


ist’ position, which holds that universals are mere names or concepts, is unable to give an account of laws of nature. What is the difference between a true law of nature, like ‘all bodies attract one another’ and a mere cosmic coincidence?\(^{33}\) Surely the reason that the law supports predictions — that two new bodies would also attract — is that there is some real connection in things between having mass and attracting other bodies. That ‘real connection’ is a law of nature, and the aspect of things, such as mass, that it connects must also be real.\(^{33}\)

While making sense of science is Armstrong’s main basis for realism about universals, he also has some sympathy for the more classical route to universals via the meaning of words.\(^{35}\) Do we not all come to agree on the meaning of ‘yellow’ because all yellow things have some character in common which affects different observers’ vision in the same way? Armstrong insists, however, that universals are not something ‘postulated’ for the purpose of giving words meaning, much less somehow created by language or thought. It is for science, not linguistics, to discover what universals there are. The word ‘lightning’ has a different meaning to the phrase ‘electrical discharge in the clouds’, but scientific investigation shows they are the same thing.


Armstrong calls his realism ‘scientific’ because it leaves to science all such questions as which universals exist, which differently described universals are actually the same, which are basic and what the laws connecting them actually are. Philosophical investigation does, however, establish certain more general truths. For example, it finds that the basic furniture of the world is ‘states of affairs’ — a particular thing’s having a certain universal, such as this table’s being square.
These are the basic objects that act on one another causally, and that act on us in that particular causal process, perception.

As soon as one admits the existence of properties, a host of questions crowd in. Perhaps what really exists is not just ‘blue’ in the abstract, but the individual bluenesses of this and that? If things have properties, how many do they have? Is a physical thing just the ‘bundle’ of its properties (as Bertrand Russell thought); if not, what is there to it other than its properties? What about relations? ‘Being two metres apart’ is a repeatable, but applies to two things, rather than being a property in either one. What should be said about tendencies or dispositions, like solubility? Are they a different kind of universal and one of the fundamental kinds of things in the world, or are they eliminable in favour of laws? What about active dispositions — powers? What about higher-order universals, such as the resemblance between ordinary universals such as red and orange, or the ratio of two kilograms to one kilogram?

One question much studied is the notion of cause. If laws of nature are interpreted realistically, then causality can be explained in terms of the operation of universals. But there remain many issues needing treatment, such as when to infer a cause from co-occurrences, and what connection cause has with the pushes and pulls one experiences directly. Another question concerns what science has actually shown

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about the nature of causality, given that it is conceived of in realist terms. In defending the theory that science has found that causality essentially involves transfers of energy, Phil Dowe pulled off one of the rarest of philosophical successes. He expressed his theory in terms of criticism of the reigning account of the American philosopher Wesley Salmon. In philosophy, even more than in other disciplines, the young are always out to make their name by attacking those in power; but in this case, the result was altogether unexpected. The great man not only admitted Dowe’s criticisms were right, but changed his own theory completely to agree with Dowe’s.42

The problem of universals was central to scholastic philosophy in the middle ages, but was commonly treated as a pseudo-problem thereafter. The Australian Catholic scholastics, as we saw, believed that a realist theory of universals was essential to the defence of objective morality. Anderson was one of the few other philosophers of the early or mid-century to have the question on the agenda. What Anderson’s view on the matter was is controversial, with writers of differing views attributing their own opinions to him. In his only substantial treatment of the subject, Anderson was emphatically against universals, but meant by this only that they should not be thought of as things in their own right, somehow separate from what they are characters of. On the other hand, he admitted a kind of propositional structure to reality: the subject-predicate structure of sentences is not merely a fact about language, but reflects how reality is: ‘the subject is the region within which the occurrence takes place, the predicate is the sort of occurrence it is.’43 This is why logic was so


central to Anderson’s system: his logic was a theory of reality as much as a theory of reasoning or language. So Anderson was certainly also against nominalism, the theory that universals are ‘mere names’ (or mere concepts), imposed by us on the world. According to A.D. Hope,

He [Anderson] stopped my attempt to write a thesis on the theories of William Occam by declaring that there was nothing worth while in the whole of medieval philosophy. I was amazed for it seemed to me that Occam had anticipated Anderson’s own objections to the modern nominalist schools he so brilliantly combated. I even ventured to ask, ‘Have you read any medieval philosophers?’ ‘No’, he said, ...

To confuse the situation further, G.F. Stout, the eminent English psychologist and father of Alan Stout, accompanied his son to Sydney and brought yet another opinion. His theory was that it is primarily the individual characters of things — this rock’s whiteness — that exist. He attributed this theory to Anderson, though apparently wrongly. And David Armstrong credits Anderson as the source of his own realist theory of universals.

Among more strictly scientific topics, a favourite among philosophers is quantum mechanics. The German founders of this theory had studied rather too much idealist philosophy, and imposed a philosophical gloss on the equations with vague talk of ‘the observer’, in a way that has led to widespread anti-realist talk in Humanities Departments along the line of ‘Even science now admits that reality depends on the observer.’ As one would expect, Australians have been among those arguing for more realist interpretations; they include Peter Forrest and the Melbourne Jesuit John Honner.

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of the realist authors note, there may be certain costs in realism about quantum mechanics, possibly including causation backwards in time.\textsuperscript{46} But that is still much cheaper than idealism, which costs the earth. Sceptical outsiders hold the opinion that quantum mechanics is in such a conceptual mess that there is no point in a philosopher touching it until the scientists sort it out. The case of quantum mechanics provides a good answer to the question John Passmore asks: ‘Why bother with philosophy of science, and not just let the scientists get on with the real science?’\textsuperscript{49} Taking that position will result in the scientists doing the philosophy instead, but badly, and possibly without even realising it is philosophy they are doing.

Evolution is another old favourite. It is the perfect scientific theory for philosophers: it is a brilliant idea on how to explain a great deal with very little. Using only natural selection on random mutations, one can explain everything from why people look like apes to why gentlemen prefer blondes. Or so it would seem; give any philosopher a phenomenon of living things to explain, and he will construct an evolutionary scenario for it within seconds. It allows plenty of in-principle chat and conceptual distinctions, without needing too much attention to details. It is an infinitely flexible tool for adding a ‘scientific’ ‘foundation’ to speculations on literature, women, social planning, nature versus nurture, the liberation of science from theology, and a host of similar topics.\textsuperscript{50} Surely such a good idea must be right?

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On the other hand, evolution is a theory logically rather distant from the evidence on which it rests, and subject to a large number of qualifications, extensions and excuses. So it suits the purely logical inquiries that sceptical philosophers revel in. Two of the best anti-Darwinian books have come from Sydney, Michael Denton’s *Evolution: A Theory in Crisis* and David Stove’s *Darwinian Fairytales*. Denton argues that evolutionary theory has not coped with the classic problems that have dogged it since the time of Darwin: the gaps in the fossil record, or ‘missing links’, the uselessness of incipient structures like half-wings, and the difficulty of a random search process producing the observed complexity in the time available. Stove’s objections are quite different. He claims that time and again evolutionists try to have their cake and eat it. Darwin’s theory, he argues, postulated a relentless struggle for life in all species, and then, to explain why humans were not observed struggling, had to postulate an unobserved Cave Man age when they did struggle. Dawkins’ *Selfish Gene*, the modern ‘sociobiological’ version of evolutionary theory, is falsified in its few predictions, such as that an animal will sacrifice itself for three siblings, but has an endless supply of logical patches to explain away its errors. Both old and new Darwinism, Stove says, offend logic as much as common decency, by picturing the life of humans and other species as either a constant struggle, or a struggle under a veneer of respectability.

Correspondingly, philosophers have generally not wanted to know about areas of science where the truth has been fully established. There is not enough to argue about. There are two such areas. One comprises disciplines like physiology and chemistry where there are well-established generalisations close to experience. No amount of juggling about the tentativeness of conceptual schemes or the underdetermination of theory by observation is going to make the theory of the circulation of the blood doubtful. As Sir Henry Harris magis-


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terially wrote, in a useful corrective to the one-sided diet of examples that feeds the stranger denizens of the philosophy of science zoo, ‘I do not believe that it will ever be shown that the blood of animals does not circulate; that anthrax is not caused by a bacterium; that proteins are not chains of amino acids. Human beings may indeed make mistakes, but I see no merit in the idea that they can make nothing but mistakes.’  

Harris, Regius Professor of Medicine at Oxford, had had the advantage of a dose of Andersonian realism in Sydney in the 1940s. The other area where scientific knowledge is secure is in mathematics and related sciences, where proof is available to back up claims to certainty. Philosophy of mathematics in the early twentieth century was inclined to explain away the certainty of mathematics as being about 'merely' logic, or some purely abstract entities like sets. Australians have been in the forefront of recent realist attempts to explain what genuine aspects of the world mathematics is about. The central idea is to revive the theory of the scholastics and Newton that numbers are essentially ratios, which are real repeatable properties. ‘Being double’ is a relation that really holds between certain pairs of weights, and also certain pairs of lengths; likewise, the same relation holds between a heap of four parrots and a heap of two parrots. For the same reason, there has been attention to the notion of measure-

54 J. Franklin & A. Daoud, Introduction to Proofs in Mathematics (Sydney, 1988).
A growing point in the philosophy of science concerns the ‘formal sciences’ or ‘mathematical sciences’ — subjects like operations research, control theory and computer science which have come to prominence, or even come into existence, only in the last sixty years. While they are outside mathematics proper, they rely on pure reasoning, but also apply to the world directly, by studying the interactions of parts of real complex systems like traffic flow, job allocation and scheduling, and network design. Theorists of science have almost ignored them, despite the remarkable fact that, if the practitioners are to be believed, they seem to have come upon the ‘philosophers’ stone’, a way of converting knowledge about the real world into certainty, merely by thinking. They cater well, too, for the word-oriented aspect of philosophy. If one aim of studying philosophy is to be able to speak plausibly on all subjects, as Descartes says, then the formal sciences can be of assistance. They supply a number of concepts, like ‘feedback’, ‘bottleneck’ and ‘self-organization’ which permit ‘in principle’ explanatory talk about complex phenomena, without demanding too much technical detail. It is just this feature of the theory of evolution that has provided a century of delight to philosophers, so the prospects for the formal sciences must be bright.

Do the social sciences, like sociology, economics and history, pose different problems to the natural sciences? It is often maintained that the fact that they deal with human creations makes them essentially different. As might be expected, sceptical attacks on knowledge that remain marginal in science are orthodoxy in the humanities. According to the feminist historian Ann Curthoys, ‘Most academics in the humanities and social sciences, and as far as I know in the physical and natural sciences as well, now reject positivist concepts of knowledge, the notion that one can objectively know the facts ... Many take this even further, and argue that knowledge is entirely an effect of power, that we can no longer have any concept of truth at all.’


number of Australian books, from Quentin Gibson’s *Logic of Social Inquiry* and Robert Brown’s *Rules and Laws in Sociology* to Keith Windschuttle’s *The Killing of History* and Behan McCullagh’s *Justifying Historical Descriptions*, have defended the social sciences as rational enterprises in which generalisations may be supported with good evidence in the same way as in other sciences. Any such attempt faces the difficulty that it is very hard to make people listen to defences of rationality. ‘Hero’s Feet Found Not Of Clay After All’: what kind of a headline is that? Compared to the fashionably shocking productions of the postmodernists, the profile of these books in the Citation Indexes is, in the old Australian metaphor, ‘lower than a black snake’s armpit’.

It is obvious from the above that the various defences of rational thinking in science depend on logic itself being accepted as sound. There is no point in scrabbling for the logical high ground if that itself is going to crumble under one’s feet.

Fortunately, there is a core of logic, developed by Frege and Russell based on Aristotle’s works, that has proved resistant to all attacks on it, and is accepted by everybody. Not so fortunately, the core is

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not nearly extensive enough to cover much of the serious arguing that one wishes to do. It is adequate, more or less, for proof in mathematics, but woefully insufficient to evaluate arguments in science, history, law or philosophy, not to mention in real life. Further, if one asks questions in the philosophy of logic, such as why logic works, what counts as logic and what not, whether logic has limits to its applicability, what exactly are the ‘propositions’ that logic discusses, and so on, one is again in uncharted, or at least disputed, territory.\textsuperscript{61}

One main source of the trouble is that the core of logic is deductive, whereas most real arguments are not. Consider, for example, the two arguments,

\begin{align*}
\text{All men are mortal} \\
\text{Socrates is a man} \\
\text{Therefore Socrates is mortal}
\end{align*}

and

\begin{align*}
\text{99 per cent of men are mortal} \\
\text{Socrates is a man} \\
\text{Therefore Socrates is mortal}
\end{align*}

The first is a part of core deductive logic, in that if the premises are true, the conclusion \textit{must} also be true. The second is not, despite its obvious close resemblance to the first. In the second argument, the premises \textit{could} be true but the conclusion false. The premises of the second give, at best, good though inconclusive reason for believing the conclusion. The question is, whether this good reason is a matter of pure logic, or whether it depends on some contingent feature of the world such as the laws of nature. Could the world be different in such a way that the information ‘99 per cent of men are mortal and Socrates is a man’ (just by itself and in the absence of further relevant evidence) was \textit{not} a good reason to believe ‘Socrates is mortal’?

The heat generated by this question is extraordinary, despite the fact that the issue is hardly ever joined directly. As we saw, it was a central plank in Popper’s system that there could be no probabilistic support of theory by observations, so the debate is crucial for the philosophy of science. But most logicians have regarded the matter as not on their turf, while unsympathetic philosophers of science have taken it to be a matter of logic that there can be no such thing as non-deductive logical support.

This brings us to the problem of induction. What is the bearing of ‘all observed ravens have been black’ on the theory ‘all ravens are black’? Generally, can one learn about the unobserved from the observed? Stove’s answer, based on an idea of the American philosopher Donald Williams, is to reduce inductive inference to the inference from proportions in a population described above. It is a purely mathematical fact that the great majority of large samples of a population are close to the population in composition. For example, in opinion polling on voting intentions, most of the large — say of 1000 people — samples that one could take from the whole population are representative of the population, in that the proportions of those voting for the various parties are very close to those of the whole population. The observed, in other words, is probably a fair sample of the unobserved. This applies equally in the case where the sample is of past observations, and the population includes future ones. The sample is probably still a fair one, and one can make a probable inference (unless, of course, one has further reason not to: probable inferences are always relative to the evidence at hand).

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One reason for believing that Stove was right in thinking induction is purely a matter of logic is that it works in mathematics. The decimal expansion of the number \( \pi \) begins:

\[
3.141592653589793238462643383279502884197169399375105820974944592 \ldots
\]

It can be seen that this sequence of digits is random, in the sense of lacking any patterns such as repetition of digits or predominance of one particular digit. It can be confirmed with statistical tests that the same is true for any longer part of the decimal expansion of \( \pi \) that has so far been calculated, though there is no proof that \( \pi \) must continue like this. But it would be extremely surprising if it did not: the inductive argument, ‘the first million digits of \( \pi \) are patternless, so the next million probably are too’ is a good one. But the digits of \( \pi \) are what they are in all worlds, irrespective of the laws of nature. It would seem, then, that inductive inference must be a matter of logic rather than depending on any assumptions about nature, since it works irrespective of any facts about one particular world.\(^{64}\)

The defence of rationality through the logic of probability does, however, have an Achilles heel. As we saw also, the chief arguments for realism, against both idealism in general and instrumentalism in science, required a particular kind of probabilistic argument: inference to the best explanation. The existence of an external world was said to be the best explanation of appearances, and that was taken to be a good reason for believing in its existence. Armstrong too notes that he relies crucially on such an argument, in saying that laws of nature are the best explanation of observed regularities.\(^{65}\) Such arguments are necessary also for inferring the existence of other minds.\(^{66}\) And inference to the best explanation, unfortunately, is one of the worst understood kinds of argument. It has so far proved impossible to say what makes one explanation better than another, or to measure how much better. Several authors have made progress in discussing whether one scientific theory is better than another by being simpler, or by explaining the behaviour of wholes in terms of the properties of parts, or by lacking \textit{ad hoc} twiddles and kludges,\(^{67}\) but even on those


more definite issues, a good deal of mystery remains. Simplicity might seem a simple enough concept, but there is no good way to measure it, in general, nor is there any convincing reason known why simpler theories are better than complex ones.

Non-deductive logic is far from the only area of logic that causes difficulties of principle. Within deductive logic itself, many problems concern, one way or another, ‘if’. ‘If’ is a word subject to extraordinary difficulties of interpretation, especially for its size. Some of them are explained by David Lewis. Lewis was an eminent American philosopher who regularly visited Australia to take in the realist air, and was known more widely for his conjecture that Ern Malley was named after the Austrian philosopher of the non-existent, Ernst Mally. The Australian flavour of his example is a tribute to his hosts. He analyses ‘If kangaroos had no tails, they would topple over’, to mean, ‘In all possible worlds close to the present one, in which the antecedent holds, the consequent also holds.’ There is more than in this analysis than meets the eye:

‘If kangaroos had no tails, they would topple over’ is true (or false, as the case may be) at our world, quite without regard to those possible worlds where kangaroos walk around on crutches, and stay upright that way. Those worlds are too far away from ours. What is meant by the counterfactual is that, things being pretty much as they are — the scarcity of crutches for kangaroos being pretty much as it actually is, the kangaroos’ inability to use crutches being pretty much as it actually is, and so on — if kangaroos had no tails they would topple over.

We might think it best to confine our attention to worlds where kangaroos have no tails and everything else is as it actually is; but there are no such worlds. Are we to suppose that kangaroos have no tails but that their tracks in the sand are still as they actually are? Then we shall have to suppose that these tracks are produced in a way quite different to the actual way. Are we to suppose that kangaroos have no tails but that their genetic makeup is as it actually is? Then we shall have to suppose that


genes control growth in a way quite different from the actual way (or else that there is something, unlike anything there actually is, that removes the tails). And so it goes; respects of similarity and difference trade off. If we try too hard for exact similarity to the actual world in one respect, we will get excessive differences in some other respect.  

Frank Jackson confused library cataloguers everywhere by producing two books on the subject of ‘if’ with the same title, and plenty of others, from Anderson on, have tried their hand as well.

One approach to taming ‘if’ that has been popular in Australia is ‘relevant logic’, a project pursued by a group of logicians first collected in Armidale in the 1960s. It was admitted by the mathemati-
cal logicians who followed the standard formalism of Frege and Russell that explaining ‘if’ was one of the more awkward problems. The standard formalism has a surrogate for ‘if’, according to which ‘if \( p \) then \( q \)’ is true whenever \( p \) is false. This inconveniently makes ‘If the moon is made of green cheese then everything is permitted’ true, contrary to the usual requirement of English that in ‘if \( p \) then \( q \)’ there ought to be some connection between \( p \) and \( q \), or relevance of \( p \) to \( q \). This was one of Anderson’s objections to Russell’s logic, and it is one of the cases where Anderson’s ideas, regarded at his death as antediluvian, have proved more long-lived than those of his rivals. One of those to maintain Anderson’s ideas on the subject through the intervening period was Paul Foulkes, author of ‘Russell’s Wisdom of the West’. Relevant logicians have developed mathematical systems to overcome this difficulty, and the Automated Reasoning Project at ANU has developed software to implement the results and exhibit the power of relevant logics.

More alarmingly, a few hardy souls have gone much further in their divergence from the trodden paths of logic; indeed, have gone as far as it is possible to go. Graham Priest quotes Wittgenstein, ‘I predict a time when there will be mathematical investigations of calculi containing contradictions, and people will actually be proud of having emancipated themselves from consistency’, and joyfully fulfils that prediction, defending the thesis that some contradictions are true.


cslab.anu.edu.au/ar.

At least Australia can take the credit for some of the objections to this push.77

The concentration on logic as a fiercely technical science of relations between propositions tended to obscure the older view of logic as the art of reasoning correctly. Even in the heyday of mathematical logic, it was realised that informal reasoning, or the methodology of live argument, was a much wider subject that needs its own investigations.78 This view has been revived more fully in recent decades, thanks to the attempt by Artificial Intelligence to imitate human reasoning by computer. Or more exactly, by the failure of AI to succeed in that project. It looked easy, but it wasn’t, and the reasons why not involved a failure to understand how humans reason. If the way the mind does inference were really understood fully, it ought to be possible to program its secrets into a computer, and hence come up with, for example, computer systems for medical diagnosis that are as good as the best human experts. Having to program a working system is the severest possible critic of any fuzziness in one’s understanding, and will rigorously expose the smallest shortcoming. Once the early optimistic promises of Artificial Intelligence proved to be nowhere near what was achievable, it became clear that there were many basic logical issues still to be sorted out before it was possible to imitate human reasoning mechanically.

Once this was understood, the way was open for a close and productive relationship between science and philosophy.

One framework for solving some of these problems is the ‘belief revision’ promoted by the philosophers Brian Ellis and Peter Forrest.79

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One thinks of one’s beliefs as forming a network. The nodes are propositions, each labelled with one’s degree of belief in it. The connections represent the logical relations between them. The problem is to calculate how the degrees of belief should adjust when one comes to believe something new. If, for example, one learns something incompatible with one’s present beliefs, how do the adjustments to degrees of beliefs flow through the network to restore equilibrium? The problem is purely logical, but is much closer to implementations than purely formal logical investigations.

Perhaps the most hopeful approach, and one in which Australians have been leaders, is ‘machine learning’, or ‘inductive learning’, which concerns the automatic extraction of knowledge from large amounts of raw data. Given many results of suites of pathology tests, tagged with their correct diagnosis by experts, how can one extract rules for diagnosis which will generalise to new cases? Given second-by-second logs of how pilots use their controls to land planes, how can one use the data to train a computer to land a plane?

It is a project where the most abstract concepts of philosophy, logic, mathematics and computer science combine to attack the most practical problems. Artificial Intelligence, or any half-way reasonable imitation of it, is a goal worth achieving, considering the shortage of the natural article. The way to get it, if it is possible at all, lies in bridging the gap between philosophy and science.