Preface
By David Papineau

The first edition of The Scientific Outlook was published in 1931, when Bertrand Russell was 59. By this stage of his life he was a prominent public figure. His brave stand against conscription during the First World War, and his consequent imprisonment, had made him famous, and through the 1920s he continued to court controversy through his support for progressive causes.

Russell's place in the public eye was maintained by a steady stream of writing for the general reader. He no longer held any academic position, and needed to support himself and his family by his pen. While he continued to do some technical work in philosophy, more of his energies were devoted to journalism and other popular writings. He was in great demand. His distinctive prose and dry wit enabled him to puncture the fusty assumptions of contemporary thinking, and his rationalist alternatives struck many readers as a liberating antidote to conventional morality.

Some of his best writing for a general readership lay in the realm of popular science. Then, as now, there was a large audience eager to understand the significance of new scientific developments. Russell's mathematical training and penetrating mind suited him eminently to this role. By 1931 he had already written The ABC of Atoms (1923) and The ABC of Relativity (1925), as well as Icarus or the Future of Science (1924), the last a pamphlet on the influence of science on modern civilization. In The Scientific Outlook he was able to develop his ideas about the significance of modern science at greater length.

The edition of The Scientific Outlook being republished here is the second edition of 1949, rather than the original 1931 edition. But apart from some half-dozen phrases altered to avoid anachronisms, and the Prefatory Note discussed below, the second edition is identical to the first.

There have been many changes in the seventy years since Russell wrote the book, both within science and without, and some of his claims would now need to be modified. Even so, it is striking how much of the book stands the test of time. The intervening years may have brought particular developments that Russell did not anticipate, but his general attitude to science contains many lasting insights.

The Scientific Outlook falls into three sections. The first and longest is on "Scientific Knowledge". It surveys the history and philosophy of science, and then considers what the findings of twentieth-century science might tell us about the underlying nature of reality. Russell's targets here include his eminent physicist-knight contemporaries Sir James Jeans and Sir Arthur Eddington, along with anybody else who takes the mysteries of modern physics to provide evidence for a Deity. The second section of the book covers "Scientific Technique". This is relatively brief, and mostly details various ways in which science has generated new technologies in the past. But it also contains predictions about future possibilities for scientific technique, especially in the human and social realm. These possibilities are developed further in the final section of the book, on "The Scientific Society".

This final section is the most remarkable part of the book. It paints a dystopic vision of future society. All aspects of life will come to be controlled within totalitarian states. Forms of democracy may be retained, but power will pass to a small group of scientific experts. The economy, along with education, reproduction, and entertainment, will be centrally regulated, with the help of scientific propaganda techniques. Most of the population will be sterilised, and propagation restricted to a small selected group. Sexual relations among the sterilized will become unrestricted. Children will be educated either to be governors or workers, with

especial care taken to ensure that the governors learn to value the State over any personal attachments.

These ideas have since become the staple of a hundred futuristic stories. But at the time they were not yet common currency. As Russell himself observes, in a Prefatory Note to the second edition of The Scientific Outlook in 1949

"The material of the last few chapter may now seem more familiar that at the time of the first edition, since it has been popularised in two widely read books, Huxley's Brave New World and Burnham's Managerial Revolution. I do not suggest that my book had any influence on either of these, but the parallels are interesting, and will, I hope, persuade my readers that my fears are more than an individual phantasy."

Aldous Huxley's Brave New World was written in four months and published in 1932, a year after the first appearance of The Scientific Outlook. Huxley's book mirrored Russell's prognostications on a number of points, from the divison of the population into Alphas, Betas and Epsilons, to the removal of sexual restrictions. There is no evidence that Huxley borrowed directly from Russell, but the two figures moved in overlapping circles, and one can imagine these conceits going the rounds of Bloomsbury dinner parties.

The other book Russell mentions is James Burnham's The Managerial Revolution. This was published in 1941 and is a rather more sober work of political analysis. Burnham, writing early in the Second World War, argued that the world would soon divide into two or three superstates. Within each a self-elected oligarchy would gain power and maintain a permanent readiness for war, using scientific techniques of surveillance and propaganda to keep the rest of the populace under control.

It is unclear whether Russell really inspired Burnham, but Burnham certainly influenced a yet futher dystopic vision. George Orwell not only read Burnham's book, but commented on it through the 1940s in a series of articles and pamphlets. Orwell's 1984 was published in 1949, too late for Russell to mention it along with Huxley and Burnham, but it would have been as clear a candidate. Orwell's vision may have been bleaker than his predecessors', and his antipathy to totalitarianism more heartfelt, but his masterpiece falls squarely in the same anti-utopian tradition.

If the final futuristic section of The Scientific Outlook is the most sensational, the first section, on "Scientific Knowledge", is closest to Russell's own area of philosophical expertise. Many of the issues he discusses are still matters of active philosophical debate. The philosophy of science has been through many changes since Russell wrote this book. But not all these changes have been advances, and on a number of points Russell scores rather better than his successors.

For example, in the chapter on scientific method he emphasizes the importance of both approximate truth and Bayesian inference, two topics that have only emerged into prominence in the last couple of decades. Russell does not describe the issues in quite these words, since "approximate truth" and "Bayesianism" are both recent terms of art, but he is quite clear on the substantial points.

On approximate truth, he explains at some length that no serious scientist will ever hold that some current scientific theory is exactly true. Still, it does not follow that existing theories are downright wrong. After all, when Einstein's relativity theory replaced Newton's classical physics, Newton was not totally rejected, but rather shown to be less than fully accurate. Similarly, future theories will show our current theories, not to be totally mistaken, but rather to be approximately right.

Russell is similarly insistent on the basic Bayesian point that the best-supported scientific theories are those that predict surprising results. When Eddington observed in 1919 that light rays bend as they pass the sun, this was widely regarded as overwhelming evidence for Einstein's relativity theory, precisely because it had never previously crossed anybody's mind that light rays would do such a thing. Russell draws the general moral on p. 70: "In all good inductions, the facts accounted for by the hypothesis are such as would be antecedently improbable, and the more improbable they would be, the greater becomes the probability of the hypothesis which accounts for them." Russell does not invoke the modern jargon of "prior" and "posterior probabilities", nor does he refer his readers to the underlying theorem of the probability calculus proved by the eighteenth-century parson Thomas Bayes, but the point he is making lies at the centre of much modern methodology of science.

The first section of the book also contains Russell's discussion of the connection between science and metaphysics. Much that he says here will also have direct interest for modern readers. When he addresses the views of Lloyd Morgan, author of Emergent Evolution (1923) and Life, Mind and Spirit (1926), he dismisses the suggestion that living beings are imbued with some mysterious vital spirit, by retorting that "the progress of scientific investigation [does not] afford any evidence that the behaviour of living matter is governed by anything other than the laws of physics and chemistry" (p. 128). This latter claim will be familiar to contemporary philosophers as the "causal completeness of physics", and is precisely the basis on which many philosophers in the second half of the twentieth century have argued against non-physical realms of reality. Russell, however, unlike more recent writers, does not take this physicalist principle for granted. Even if the "causal completeness of physics" now seems like the merest scientific common sense, it was not so in Russell's time, and so he spends some pages detailing the recent scientific investigations he takes to support it, including work on digestion, fertilization and Mendelian heredity.

What about consciousness? Is not the conscious mind something additional to the purely physical brain? To many, both now and then, it seems clear that our conscious feelings, if nothing else, constitute a non-physical realm of reality. Yet the argument from the causal completeness of physics bites here too, and threatens to render any independent conscious realm causally impotent. Russell puts the point with characteristic succinctness: "It seems to introspection as though there were something called the will which causes those movements we call voluntary. It is, however, quite possible that such movements have a complete chain of physical causes to which the will (whatever it may be) is a mere concomitant" (p. 131).

This conundrum still bedevils modern philosophy of mind. Some philosophers, myself included, argue that the only way in which we can respect the causal efficacy of the will and other conscious phenomena is to identify them with features of the physical brain. Others find this brute materialism impossible to stomach, and insist that the conscious mind must be separate from the brain, even if this implies that the mind is causally impotent, a mere epiphenomenal concomitant to the physical processes determining our choices. But perhaps there is a third way. In the passage immediately following the last quotation, Russell points out that modern science only identifies physical entities via their causes and effects. Science gives us "the causal skeleton of the world", while "leaving out all the colour and variety and individuality of the things that compose the world". So perhaps, suggests Russell, our conscious experience connects us immediately with the very same reality that physical science identifies in terms of causes and effects. Russell is here seeking to break down the traditional dualism of mind and body, by suggesting that consciousness gives us direct access to a realm that that physics picks out only indirectly. This is an intriguing thought, and it has been revived in the last few years by philosophers of consciousness, like Michael Lockwood and David Chalmers, who are impatient with the restricted choice between materialism and epiphenomenalism.

Russell also comments on the relevance of the new quantum mechanics to the problem of free will. Sir Arthur Eddington had argued in The Nature of the Physical World (1928) that quantum mechanics explains how free will is possible. As Eddington told the story, the indeterminism of quantum mechanics makes room for an autonomous mind to influence the otherwise uncaused movement of atoms in the brain. This is how our volitions can influence our actions. Russell responds that it is by no means sure that the physical world is indetermimistic. The quantum mechanical "Principle of Indeterminacy" may place limits on what can be "determined" in the sense of measured; but it does not follow that anything fails to be "determined" in the sense of inevitably caused.

Russell was writing at the start of the great debate between Einstein and Niels Bohr about the proper interpretation of quantum mechanics. The view he takes is in line with Einstein's advocacy of a "hidden variable" theory incorporating causal determinism. Later work, and in particular the experimental confirmation that quantum events can be instantaneously coordinated across space, has placed obstacles in the way of such hidden variable theories. But a significant number of philosophers of science still believe that these obstacles can be overcome. The current enthusiasm for David Bohm's interpretation of quantum mechanics testifies to the continuing attraction of Russell's initial reaction to quantum mechanical indeterminism.

On the question of free will itself, it is perhaps surprising that Russell does not observe that, even if quantum mechanics does undermine causal determinism, this offers no real help to free will. Suppose, along with Eddington, that the movement of certain atoms in the brain is indeed not physically determined, but occurs at random, in the way that it is random whether a coin falls head or tails. As plenty of later philosophers have observed, this is scarcely a good model for the free determination of the will. When I act freely, I want to control my action, not to have it decided by some quantum mechanical analogue of a coin spin.

From this perspective, it seems that free will is threatened not only by determinism, but equally by indeterminism. No doubt Russell missed this point because the underlying probabilistic nature of quantum mechanics was not yet clearly articulated. It is one thing to recognise that quantum mechanics loosens the straitjacket of universal Newtonian determinism. But it is another to recognize that the replacement is an equally precise and mind-independent system of probabilistic laws, and at the time Russell wrote this realization was not widespread.

Russell also spends some time on the second law of thermodyanamics. This is the principle that disorder always increases, or, as Russell characteristically puts it, "things left to themselves tend to get into a muddle and do not tidy themselves up again". The obvious implication is that at some finite time in the past the universe started off in a state of maximal order, and has been getting steadily messier ever since. Russell quotes Eddington as unwilling to accept the implication that the universe had a beginning in time: "As a scientist I simply do not believe that the present order of things started off with a bang; unscientifically I feel equally unwilling to accept the implied discontinuity in the Divine nature" (quoted on p. 121). From Russell's point of view, Eddington is here being scientifically faint-hearted. If the scientific evidence points strongly to a temporal beginning to the universe, then we should provisionally accept this conclusion. Not that Russell takes any supernatural Deity to follow from such a temporal origin. There is no reason why the universe should not have begun spontaneously. Moreover, if you do insist on positing God, because the universe must have a cause, there is then the question of what caused Him, a point which Russell reminds his readers is familiar from centuries of theological debate.

Modern readers may be tempted to read these points as directed at the "Big Bang Theory", according to which the universe started in a space-time singularity and has been expanding ever since. But despite Eddington's terminology ("things started off with a bang") this is not

what he and Russell have in mind. The first paper positing the modern Big Bang Theory was published in Nature in the same year that Russell was writing, and Edwin Hubble's painstakingly gathered evidence correlating star distance and recession speed was only announced the following year. For Russell and Eddington, the issue was not the relativistic origins of space and time, but classical thermodyamics and the dissipation of order. Even so, Russell's substantial points apply equally to the later debate. The Big Bang does not imply a Deity, any more than does the existence of thermodynamic order. The universe could still have occurred without a cause, and the thesis that everything must have a cause only pushes the problem back a stage.

A rather different way in which later developments have overtaken Russell is in his treatment, or rather lack of treatment, of Darwinism. Russell does mention Darwin, along with Galileo, Newton and Pavlov, in his first chapter on "Examples of Scientific Method". However, in Russell's view, Darwin is noteworthy more for his cultural significance than for any scientific contribution. Darwin forced people to acknowledge the evolutionary descent of humans. But Darwin's specific hypothesis about the mechanism of evolution, natural selection, "is less in favour among biologists", Russell tells us, "than it used to be" (p. 42).

As Russell sees it, Darwin's weakness was that he did not understand the mechanism of heredity. Darwin was committed to a continuous medium of inheritance, in which parental contributions blend together in the offspring. However, as Russell explains, this view had been discredited by Mendel's work, which ascribes inheritance to the discontinuous action of genes, expressing themselves according to the principles of dominance and recession.

Russell's complaint here might seem puzzling to contemporary readers. Nowadays we do not see Mendelism as a problem for Darwin. Indeed the theory of natural selection works far better when combined with Mendel's discontinuous genetics than with Darwin's own continuous theory. For Darwin's model of continuous inheritance makes it very difficult to see how natural selection can work at all, because it means that any beneficial mutations will be diluted by the repeated blending of parental contributions.

However, Russell did not yet have the benefit of the "new synthesis" of Mendelian population genetics and natural selection theory that was at the time being forged by Ronald Fisher, J.B.S. Haldane and Sewall Wright. Instead he shared the widespread perception that natural selection and continuous inheritance were tied together in one Darwinian package, which was thus flawed twice over, since the continuous inheritance was in tension with natural selection, and was is any case quite mistaken.

These early twentieth-century doubts about Darwin meant that biology then seemed far less relevant to human affairs than it does today. In recent decades there has been an explosion of ideas about ways in which humans have been shaped by their evolutionary heritage. And popular science writers, from Desmond Morris and Konrad Lorentz to Richard Dawkins and Stephen Jay Gould, have made these issues the staple of popular debate about the human significance of science. What is the relative importance of nurture and nature? Are all genetic traits "adaptations" which have been naturally selected because they provide some good? And good for whom? Does natural selection work for the benefit of human groups, or individuals, or indeed only for "selfish genes"?

One can imagine that, if Russell were writing The Scientific Outlook today, he would have plenty to say on these topics. But these issues lay in the future. Russell did have high expectations for the scientific understanding of human beings. But his hopes lay with Pavlov, not Darwin. Advances would come from the laws of conditioning, not from the biological basis of human nature. Russell was a thoroughgoing empiricist. He viewed the human mind as a blank slate, waiting to be filled by whatever connections are impressed on it by accumulated experience. Here he was at one with the "behaviourism" which dominated

academic psychology through most of the twentieth-century, but whose influence has now waned.

Russell's strong empiricism also colours his assessment of the possibility of ultimate knowledge of reality. Despite his enthusiasm for scientific investigation, Russell doubts that science can uncover the essential nature of things. Scientific theories are no more able to penetrate the inner qualities of reality than they can demonstrate the existence of a Deity. This is because any firm knowledge of reality must derive from the data of sensory experience. Yet science itself argues that reality is very different from the way it appears to our sense organs. In place of the stable world of medium-sized physical objects, modern physics describes a colourless shifting realm of ephemeral microscopic waves. Given this, we can no longer believe in the world of appearances. However, science give us little to put in its place. Since the posits of modern physics are inferred, not experienced, they are only given to us as items in a possible causal structure. So at most science tells us that the world is arranged in a certain way, but cannot show us what it is made of.

Despite these sceptical doubts about theoretical knowledge, Russell has every confidence in science as a provider of practical power. Russell distinguishes sharply between science as a source of metaphysical insight, and science as a generator of techniques for manipulating the world. It may be limited in the former role, but in Russell's view there are few bounds to what it can achieve in the latter.

Russell discusses science as a source of power in the second and third sections of the book. At first he seems relatively optimistic about the possibilities. When he discusses "scientific technique", he reminds us about advances already achieved: irrigation and smelting, steam and electricity, medicine and fertilizers. Moreover, he looks forward to yet further possibilities: synthetic food and rubber, climatic improvement, systematic agricultural breeding, not to mention chemical intervention in embryological development, and educational practices rigorously grounded in psychological principles.

Modern readers are likely to be struck by Russell's insouciance about any unwanted side-effects of such technological innovations. While there are occasional sideswipes at the pursuit of power for power's sake, especially on the part of industrial capitalists, and unease about power's corrosive effect on moral values, there is nothing to suggest that nature will prove too intractable to control by scientific techniques. Russell makes no mention of pollution, or global warming, or destruction of environments. On this level, Russell has no doubts about the possibilities of scientific progress. Science can be used for evil and well as good, and is more likely not to be used at all, especially by ignorant politicians. But, even so, Russell is confident that, in the hands of right-thinking people, scientific knowledge provides the high road to the solution of practical problems.

This message is not always well-received nowadays, but on the underlying issue Russell is surely right. Today we are quite rightly worried about the dangers of over-precipitate technological intervention in nature. But the remedy is not to turn against science as an instrument of progress. After all, we need science itself to assess the dangers of technology and decide what to do about them. As for the thought that we would be better off not to meddle in nature at all, who seriously wants to return to a world before vaccinations, antibiotics, or indeed agriculture? A blanket Luddism may seem attractive at first sight, but a moment's thought shows that it is not a serious alternative to Russell's progressive faith in scientific technique.[*]

[*] Readers may find it less easy to forgive a rather different transgression of political correctness on Russell's part, when he twice nonchalantly lets slip the view that "negroes" are of inherently lower intelligence, and so will be best suited to whatever manual tasks survive into the future scientific age.

Russell's commitment to scientific progress is still in evidence at the start of the final section of the book, on "The Scientific Society". This section, as I explained earlier, develops an anti-utopian vision of an inhuman world regulated by an oligarchy of scientific experts. But in the earlier parts of this final section it is not yet clear what Russell is up to. There is no immediate sign that he his anything but optimistic about the scientific future. He writes with enthusiasm about communal child-rearing, economic planning in place of capitalism, and the formation of a world government. In these passages it is possible still to read him as the radical scourge of conventional thinking, pointing out rational alternatives to the status quo visited on society by conservative stupidity and capitalist greed.

However, as Russell develops his theme, it metamorphoses into something much darker. The communitarian idyll turns inexorably into 1984. Dissent is suppressed, workers are forcibly sterilized, individuals are tortured in the name of scientific research. By this stage Russell's underlying moral has become quite clear. "The scientific society" contains the potential to undermine all human values. Power corrupts. In particular, the greatly enhanced power resulting from scientific advance threatens to eclipse the very human ends to which it should properly be devoted.

Russell's hopes for a solution lie, somewhat surprisingly, in a return to tradition. The danger is leaders who have no sense of history. "The government of the world . . . has been allowed to fall into the hands of men ignorant of the past, without tenderness to what is traditional, without understanding of what they are destroying" (p. 277). Russell looks forward to a future in which those who wield power have acquired a proper reverence for humanity from the study of history.

As a whole, The Scientific Outlook is rather more pessimistic about the achievements of science than are many people today. As we have seen, two of Russell's themes were, first, that science cannot deliver full knowledge of reality, and, second, that it is likely to lead to totalitarianism. Russell may have been writing as a friend of science, but on these points he is at one with its enemies.

However, neither of Russell's worries remains as prominent at the beginning of the twenty-first century as it did seventy years ago. For a start, scepticism about the very possibility of scientific theorising is far less central to contemporary philosophy than it was in Russell's time. For Russell, the arch empiricist, we could not know anything about the world except via the directly acquaintance of sense-perception, and theoretical science failed this test. But sense-perception no longer plays this central role in the theory of knowledge, and philosophers now allow that there may be other routes to genuine knowledge, including theoretical inferences in science.

As to Russell's other main worry, the threat of totalitarianism has now thankfully receded, at least for the time being, over large areas of the globe. When Russell was writing, Stalin's inhuman "great experiment" was under way, and the Nazi party was beginning its rise. In return, capitalism could only offer the brutalities of industrialization and the growing threat of mass unemployment. It is scarcely surprising that Russell, along with many others, underestimated the resilience of liberal democracy.

Still, even if Russell now seems unduly pessimistic on these specific issues, the underlying contention of his book still holds good. Russell's most basic commitment was to the eradication of superstition and prejudice. For him, science was first and foremost the instrument of enlightened knowledge, the means to the elimination of dogma. If sometimes the scientific argument leads to less than rosy conclusions, then this is the price we must pay for our dedication to knowledge. We cannot pick and choose the truth as it suits us. Once we have chosen the scientific way, then we must follow this higher path where it leads.

Russell had no doubt that the choice of science is the right one. He concludes his discussion of scientific knowledge with these words. "Science is in essence nothing but the systematic pursuit of knowledge, and knowledge, whatever ill-uses bad men may make of it, is in its essence good. To lose faith in knowledge is to lose faith in the best of man's capacities; and therefore I repeat unhesitatingly that the unyielding rationalist has a better faith and a more unbending optimism than any of the timid seekers after the childish comforts of a less adult age."