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‘How can we know the dancer from the dance?’—William B. Yeats

To solve problems in the new millennium, society needs more, not less science

• by David McConnell

The natural sciences have often been regarded with concern and suspicion in the non-scientific world. This is by no means a new phenomenon. Galileo faced criticism for his statement that the Earth revolved around the Sun. Charles Darwin's *The Origin of Species* stirred up heavy criticisms from those who believed in a divine creation of man. Today, due to the larger influence of science on society, this problem is even greater, particularly regarding the extraordinary discoveries in the field of genetics. Society's disquiet about science is damaging to science itself and reduces the social, economic

In November 2000, I participated in the ‘Genetics and the Future of Europe’ conference, organised by Commissioner

accept that they and science should take most of the blame for many different problems, which, it is alleged, are caused by

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Busquin in Brussels. It was a valuable initiative, an attempt to start a public dialogue between life scientists and representatives of ‘society’. But instead of being elated and joyful about their

science. Moreover, there was a reluctance to turn the argument in the other direction, to speak more of the beauty of scientific knowledge rather than the horror, the value rather than the cost and the importance for society rather than the risk. Of course, there are faults within science, but I think we need to be clear that the main weaknesses relating to science lie in the general, non-scientific body politic. This is not a matter of apportioning blame, but rather of defining where the problems lie. The simple fact is that society requires a deeper understanding of science.

Society's disquiet about science is damaging to science itself and reduces the social, economic and cultural value of research

and cultural value of research. It has thus become necessary to find means to bring the natural sciences and the humanities together in order to overcome society's fears.

science, some of my colleagues appeared to have been wounded by the barrage of criticism. Indeed, I sensed a defensiveness among scientists who seemed ready to

There is much to be gained from allies outside the scientific camp, and if we listen to them, I believe we will discover

scientific methods, which were so successful on their home territory, could and should be applied everywhere to every-

discoveries. We have gained new insights concerning the origin of life, the electrochemical nature of biological machines, the origin of man and his place in the biological world, the nature of the person, the nature of consciousness and the complexity of the interactions between nature and nurture. With scientific explanations of many human qualities, with evidence accumulating that man is an extraordinary machine, a higher ape who can use complex language, we face immense problems when we seek to understand, explain or to guide man. Scientists, as much as humanists, are deeply puzzled, but at least scientists are better placed to

Isaiah Berlin wanted to defend the humanities, and society at large, from being distorted by an intrusive, colonialist science

better ways of helping society to accommodate science. The great student of the humanities, Isaiah Berlin, in his essay *The Pursuit of the Ideal* (1988), contrasted two factors that 'above all, have shaped human history in the twentieth century'. He wrote: 'One is the development of the natural sciences and technology, certainly the greatest success story of our time'. The other 'consists in the great ideological storms that have altered the lives of virtually all mankind'—the awful and terrifying ideological storms which, through war, laid waste huge parts of Europe and Asia during much of the 20th Century. In fact, Berlin was impressed by the achievements of science. He expected that, two or three centuries from now, our descendants would recognise these great movements of our time as 'the most demanding of explanation and analysis'. Otherwise, he believes in cultural and ethical pluralism—which, by the way, should help us in dealing with the ethical problems posed by science.

Berlin's essay has a strong message to scientists. The science of the 20th century has been remarkable and science is very important. But he rejects claims that the scientific method can and should be applied to all human endeavour. Earlier, in *The Divorce Between the Sciences and the Humanities* (1974), Berlin had already addressed in greater detail the problems posed by science. He was intensely conscious of the success of the natural sciences. But, while admiring them, he was also uneasy, perhaps because he did not really understand modern science enough to empathise with it in the same way that, for example, Popper did. Although Berlin had an immense capacity to accommodate diverse—even contradictory—ideas, and encapsulated this inclusiveness in his concept of pluralism, I wonder whether he ever truly felt comfortable with the natural sciences. What is clear is that he wanted to defend the humanities, and society at large, from being distorted by an intrusive, colonialist science; especially, he did not accept that

thing. Berlin cautions us about the 'ideal of a unified system of all the sciences, natural and humane', but he acknowledges that this programme has 'played a decisive role in the social, legal and technological organisation of our world'. Then he observes that 'this [programme] was perhaps bound sooner or later to provoke a reaction from those who felt that constructions of reason and science, of a single all-embracing system, whether it claimed to explain the nature of things, or to go further and dictate, in the light of this, what one should do and believe, were in some way constricting—an obstacle to their vision of the world, chains on their imagination or feeling or will, a barrier to spiritual or political liberty'. Berlin senses that science and technology may be taking too much from our society; they may be undermining rather than sustaining profound elements of our civilisation, they may be overpowering us, constraining our capacity for art, reducing the role of the imagination, limiting the range of valid ideas, and threatening our sense of personal freedom, individuality, civil liberty and social cohesion. It behoves us as scientists to pay careful attention to these sensitivities, and to find ways of allaying them.

Berlin saw these concerns 25 years ago and I wonder how he would view matters today. When he wrote his first essay in 1974, Sanger and Gilbert had not yet pub-

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evaluate the scientific evidence. It is not that philosophers have not pondered on such questions for centuries, but now the material evidence is closing in, reducing the room for manoeuvre. Genetics touches us all in the most intimate and personal of ways. Whether we like it or not, the sciences and the humanities are coming towards each other again in a most exciting but disturbing way, as we understand more about ourselves.

There are truly extraordinary prospects, but if genetics is to have a large positive effect on how we understand life and how we improve the conditions of life in the 21st Century, it must be allowed to do so. I am concerned that an 'ideological storm' is brewing, and it is being exacerb-

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lished their revolutionary methods of DNA sequencing. By the time of the second essay in 1988 we were on the brink of formally starting the Human Genome Project, which led to the publication of a draft DNA sequence in 2001. During the last 40 years, genetics has presented scientists and non-scientists alike with a series of astonishing and wonderful

ated by the latent and sometimes overt tensions between the humanities and the sciences. This storm may prevent science—especially genetics—from being able to contribute fully to our understanding and welfare of man. It is just possible that this ideological storm may be as damaging to society in this century as the ideological storms referred to by Berlin

were in the last. The stakes are certainly high—the viability of civilised society.

Here I turn to another humanist and essayist, Wolfgang Fruhwald, distinguished literary historian, formerly the President of the Deutsche Forschungsgemeinschaft, and now the head of the von Humboldt Foundation. In *Science and Technology: On Research and the Universities of Europe* (1993), he discussed the ‘science anxiety’ which was sweeping Germany and indeed Europe in the early 1990s. Fruhwald describes what he calls ‘a fundamentalist anti-science’, which has come ‘into existence in many parts of the world (and) could finally destroy the basis for human life’. He feared that a new ideological storm based on anti-science could have catastrophic consequences for mankind: ‘The undercurrent of science anxiety which accompanies the development of science can become dangerous to our very existence; the problems of our world—growing waste dumps, the poisoning of the air, soil and water, the social and economic misery of two-thirds of the world population, poverty, migration and distribution wars—can only be reduced by more, not less, science’.

It is plain that we must have more science, but it must come in a way that affects the very essence of our society. Somehow we have to reduce, if not break down, the barrier between the sciences and the humanities. Somehow we have to change the place of science in the general psyche of our citizens in order to allow people to embrace science and technology as part of their being. Elsewhere, I have written that ‘I am interested in looking behind the obvious and asking how people might relate to scientific knowledge of the natural world at a deep level, and how science might be allied with the humanities in forging a new basis for living. I am interested in bridging the gap between the two cultures, in reducing the distrust between the arts and the sciences and in finding common ground. I sense that there is a wonderful opportunity for science to pervade culture in a way which might enrich people’s lives and help them to feel more at home in this extraordinary but perplexing world.’ (McConnell, 2001).

The key question is whether science can ‘pervade culture’ in such a way that people, especially those who consider themselves to be educated and who are influential in forming public opinion, are knowledgeable about science. How

different it would be if there were a wide appreciation about how scientific research is carried out, about how the scientific community reaches consensus, and what are the main current explanations of the natural world. We would all have a sense of the qualities and weaknesses of science, and the meaning of authority within science. Thoughtful citizens would be able to consider and discuss science in the same way as well-educated people are able to discuss economics or art or music or politics. They would be able to distinguish between science and technology. Above all they would be less likely to fear science itself or to distrust scientists simply because they are scientists.

The fact is that too few people have this sense of science because too few people study science. In 2001, 58 388 students in Ireland took the Leaving Certificate—the final state examination for secondary school students; only 17% took higher mathematics, 9.5% took physics and 9% took chemistry, and most of these would have been the same students. Essentially 80–90% of Irish students left school this year without a sound understanding of the hard sciences. More Irish students (25%) took biology, but in my opinion that particular course is not a good basis for understanding science.

I personally would like to see a course on the ‘History of Ideas’, and I am sure that there are examples in other countries. Such a course would include material from the sciences and the humanities, and teach the scientific method, the history of science and the main ideas that underlie our current understanding of the natural world. It would help all students, particularly those with an aptitude for the humanities, to develop a reasonable understanding of science and thereby underpin a society in which culture would embrace science. That is my touchstone—that science will be as much part of our culture as are the humanities. This is a political objective and the ultimate responsibility lies with the scientists, the politicians and the political parties to lead public debate on this matter. It is important for us as scientists to say to our politicians over and over again, with the support of thoughtful humanists, that science is important and not just for the sake of jobs. If our world does not become scientific—in the deep sense that I have outlined—it runs the risk of being

undermined by an ideological storm based on anti-science or perhaps I should say counter-science, to recall another ideological storm of an earlier century in Europe.

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All this has led me to the conclusion that the main task is the creation of a scientifically literate society, which must start in schools. It will be a long haul, and it will take at least two generations to achieve. If we are to develop this sense of science we must ensure that science, including its history and philosophy, is well taught at school but with, and not at the expense of the humanities. This means that we must have outstanding teachers of science and it means that there must be outstanding teachers of science teachers. We need to break with George Bernard Shaw: ‘Them that can, become teachers, and them that can teach, teach teachers’.

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