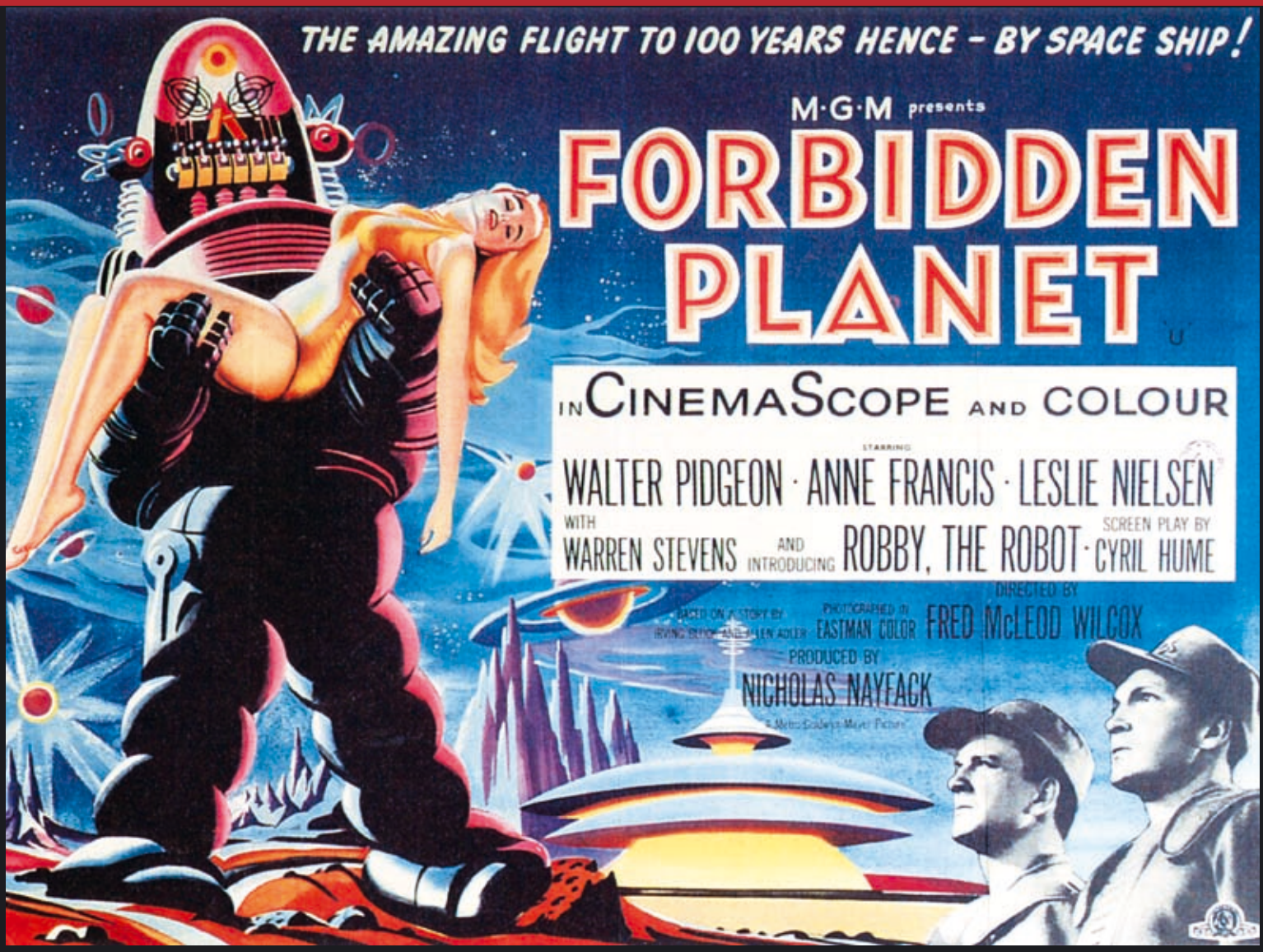

A NEW ERA OF RESPONSIBLE INNOVATION

Nanoscience could transform many aspects of our lives over the next century. But that promise doesn't come without risk. **Richard Owen** considers how we can ensure exciting new areas are explored responsibly.

In 1956 one of my favourite films hit the big screen: a classic piece of science fiction called *Forbidden Planet*. It tells the story of a mission in the 23rd century to a distant planet, to find out what has happened to an earlier scientific expedition. On arrival the crew encounter the sole survivors, Dr Morbius and his daughter: the rest of the expedition has mysteriously disappeared. Morbius lives in a world of dazzling technology, the like of which the crew have never seen.

He had discovered the remnants of a highly advanced civilisation, the Krell, and an astonishing machine they had developed, the Plastic Educator. This could radically enhance their intellect, allowing them to materialise any thought, to develop new and wondrous technologies. Morbius had done the same. But something terrible had happened to the Krell: not only did the Plastic Educator develop their intellect, it also unwittingly heightened the darker sides of their subconscious minds, 'Monsters from the Id'. In one night of savage destruction they were taken over by their own dark forces, leaving their advanced society extinct.

Everett Collection/Rex Features

Now I'm not going to tell you how it ends; you'll have to watch the film yourself. And it would be fanciful to say that we are heading for the same fate as the Krell. But it is fair to say that our relationship with innovation can at times be troublesome, with consequences that can on occasion be global in nature.

You may have heard, for example, of a clever financial innovation, called 'securitisation': you may also know that this has helped leave a legacy of toxic debt that all of us will play a part in cleaning up. This is dwarfed by the legacy that our relationship with fossil-fuel burning technology will leave not only for our children, but also for their grandchildren. These examples show that it is important that we innovate, to drive our economy, to improve our lifestyles and well-being, to find solutions to the big issues we face – but it is critical that we innovate responsibly. And public demands to be responsible, to avoid excessive risks, go beyond banks: they also apply to research.

In his inaugural speech in January, Barack Obama called for a 'new era of responsibility'. I want to know what this new era will look like. For a number of years I worked for a regulator, the Environment Agency. I discovered that regulation is an incredibly powerful tool to promote responsible innovation, and there is no doubt that it will continue to play an important role. Development of policies and regulation, for new technologies for example, tends to be 'evidence based' – that is evidence is acquired to make the case for amending or bringing in new legislation, and here the research councils play an important role.

It's small stuff, but big business.

I'm fascinated by how this process works. Take for example nanotechnology, which has been described as the first industrial revolution of the 21st century. It's small stuff, but big business, taking advantage of the fact that materials at the nanoscale (a billionth of a metre) can have fundamentally different properties compared to other (perhaps larger) forms of the same material. So while carbon nanotubes resemble tiny rolled-up sheets of graphite, they behave very differently – indeed, they have been called 'the hottest thing in physics'.

Nanotechnology has a projected market value of many billions of pounds, potentially providing important solutions for renewable energy for healthcare, and for the environment. But if these nanomaterials behave so differently, do they present greater risks, to the environment or to human health[1]? If so, do they need to be regulated differently? How do we balance economic growth with preventing harm to people and the environment?

In 2004 the Royal Society and Royal Academy of Engineering published an important report that showed the huge economic potential of nanotechnology, but also the great risks and uncertainties, particularly where the natural environment was concerned[2]. Soon after this I was asked to help write the Government's research strategy to help address these uncertainties. I recognised that to understand these risks better, many of the questions we needed to answer were those of fundamental science: environmental fate and behaviour, nanoecotoxicology, detection.

In 2005 I worked closely with NERC, Defra and the Environment Agency to set up the Environmental Nanoscience Initiative (ENI), which was launched the following year. The first job was to build capacity, as there were only a few researchers working on the environmental behaviour and effects of manufactured nanoparticles in the UK. Two calls for research proposals and 17 grant awards later I feel we have made good progress in developing a strong community of scientists; my hope is that more will join them.

Building on this, the ENI has recently launched a second, and much larger phase, one that brings the existing partners together with the Engineering and Physical Sciences Research Council (EPSRC) and US Environmental Protection Agency to develop and validate models of exposure and bioavailability for key nanoparticles, drawing together complementary strengths from across the Atlantic.

I believe that collaborative programmes like the ENI are good models for funders to work together and are important ways of providing the evidence base on which policies and regulation can be developed. But what I have learnt from this process is that it naturally takes time. In the meantime innovation marches on, beyond nanoparticles, beyond nanotechnology. This means there will inevitably be long lags between innovation and the development of evidence-based regulation. That worries me, and it also worries the Royal Commission on Environmental Pollution, as they explained in their recent report on novel materials[3]. Regulation alone is not enough – we need to look for other, complementary ways to embed responsibility into the innovation process. This is what I am working on now[4].

In the spring of this year EPSRC asked me to work with Richard Jones at Sheffield on their third nanotechnologies grand challenge call, which will be on the novel contribution nanotechnology can make for carbon capture and utilisation.

It's an exciting area. They told me that in trying to solve one environmental problem they didn't want to cause another. I proposed that, for the first time, they asked applicants to provide a brief 'risk register' in their proposals: one that asks them to consider any environmental, health or societal impacts and the level of associated risks for their proposed research. I hope this will help them think early on about the wider implications of their research, about any risks and uncertainties, which can then be managed in a timely way. This could perhaps be through targeted research, working across councils through collaborative programmes such as the ENI.

I'm convinced there is a way to link innovation with responsibility more efficiently, to make it more anticipatory. And I've been struck by how willing and open the people I have worked with at NERC, EPSRC and ESRC have been to consider these approaches. Maybe there is a silver lining in the black cloud of the recent financial chaos; maybe we are learning that responsible innovation is sustainable innovation, that it's a good thing, and that a commitment to it will help build resilient and responsible economies. Maybe Barack Obama was right, maybe we are about to enter a new era of responsibility. I hope so. ❖

MORE INFORMATION

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Further reading

1. Owen R. and Handy R. (2007) Formulating the problems for environmental risk assessment of nanomaterials. *Environmental Science and Technology* 41 (16): 5582-5588
2. www.nanotec.org.uk/finalReport.htm
3. www.rcep.org.uk/novelmaterials.htm
4. Owen et al (2009) Beyond regulation: risk pricing and responsible innovation: *in press, Environmental Science and Technology.*