

Synthetic biology

The potential ramifications go far beyond abstract objections to 'playing God'

Martin Ince, science journalist

IDEAS DON'T COME much bigger than synthetic biology. Its aim is to assemble living creatures to order from component parts, thereby going beyond the haphazard processes of natural selection to produce organisms to a precise specification. Professor Steve Yearley, director of the Genomics Forum, is one of a group of social scientists who are looking at the possible benefits and pitfalls of this massive concept.

As he sees it, synthetic biology raises a range of issues. One is simply the idea that it involves people 'playing God'. On a more practical level, it could lead to organisms that are unknown on the Earth today being released en masse to the environment. So despite its apparently revolutionary nature, synthetic biology raises the same issues as genetic manipulation, but this time in a more extreme form.

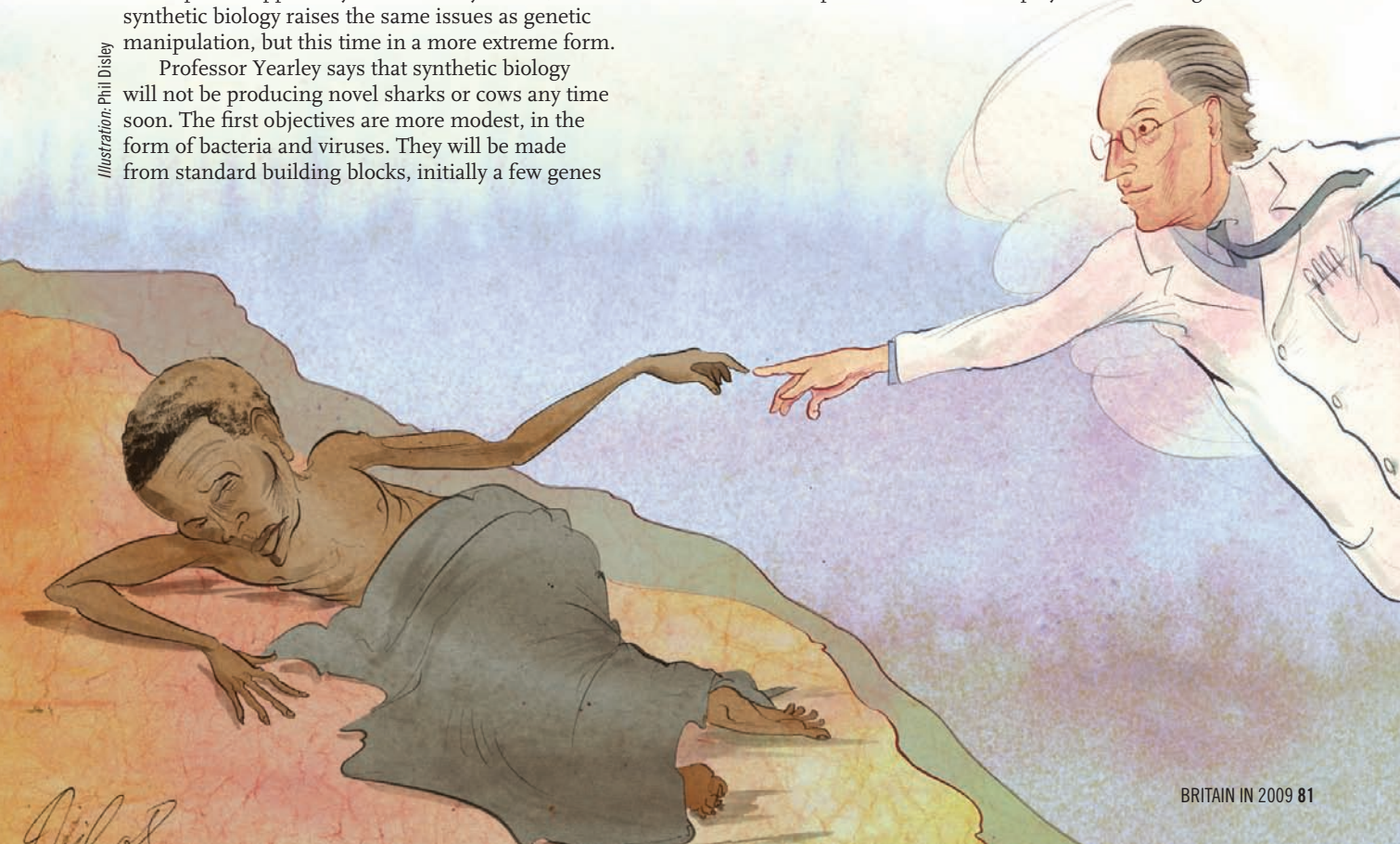
Professor Yearley says that synthetic biology will not be producing novel sharks or cows any time soon. The first objectives are more modest, in the form of bacteria and viruses. They will be made from standard building blocks, initially a few genes

in size and later approaching the scale of a whole chromosome, some of which will be available to order off the net.

Synthetic biology's most noted coup to date has been the work of a group of Californian scientists who have used the method to alter the bacterium *Escherichia coli* to produce artemisinin, an existing anti-malarial drug. This is a valuable incremental step, but hardly a breakthrough.

Professor Yearley says: "Supporters of synthetic biology such as Craig Venter [one of the leading lights of the human genome programme] say that it will be used to create new energy sources and for other mass applications. That means that the products would be deployed over too large an area ►

Illustration: Phil Disley



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► to be contained. In addition, we know that bacteria are good at exchanging genes." So artificial gene sequences may get into existing bacteria.

As Professor Yearley warns: "Humans have already altered the world a lot, but introducing new life forms takes things to a new level. In the past we have failed to spot the effects of our interventions in the natural world in advance, and there is no reason to suppose things will be different here. So public unease about humanity having this power is understandable."

He says: "Natural selection has produced a wide range of subtle organisms and the idea of recombining them is obviously tempting. It might be possible to make self-replenishing photocells that would produce electricity, or medicines and fine chemicals, or perhaps to make custom-built organisms to remove pollutants. But it is obvious that we need ways of thinking about the ethics of synthetic biology from the start."

Professor Yearley believes that the answer lies in a proper independent agency that can shape the ethical process for synthetic biology, but adds that the UK currently lacks this sort of technology review body. It would work in an iterative way and take stock of this fast-changing area every few years. There would also need to be global understanding to prevent standards diverging too far. As he points

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out, the debate on topics such as 'where life starts' is very different in Asia from the form it takes in Europe or the United States.

Dr Paul Martin of the Centre for Social and Economic Research on Innovation in Genomics at the University of Nottingham agrees with Professor Yearley that synthetic biology is not so much a complete novelty as a continuation of previous trends such as genetic modification. The difference, says Dr Martin, is that we are now gaining the ability to use robots to synthesise large stretches of DNA. That means new potential but also new hazards, especially to the environment.

One pressure driving synthetic biology is that it might allow new drug manufacturing pathways to be developed, as has already happened with artemisinin. As Professor Joyce Tait explains (page 84), today's ways of developing drugs take too long and cost too much. But Dr Martin says that it is not clear what synthetic biology has to offer in this sphere. It is more likely to produce new drug manufacturing technology than actual new drugs. As he says: "Science that looks promising in the lab does not always work in real life. Even if it does, the governance structures for medicines are bound to take a cautious approach to anything produced by such a novel and non-natural route."

Despite these issues, Dr Martin believes that

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we will be hearing a lot more about synthetic biology. He says: "The term has become attached to something of a bandwagon, a little like nanotechnology. But we know that you need these re-badging ideas if you are going to mobilise resources for a promising new area of science. And after all, the idea of being able to synthesise anything you want from DNA is a powerful one."

Professor Yearley and Dr Martin are both aware of one major fear about synthetic biology: its possible use to create new weapons. Dr Martin says that governments would be more likely to use synthetic biology than freelance terrorists are. There is a big difference, he says, between making a small but frightening amount of some new biological agent and turning it into a practical weapon. He adds that the methods of synthetic biology might be used to produce new detectors for chemical and biological weapons, helping to reduce their threat.

Professor Yearley warns: "Terrorists or the malicious could in principle use synthetic biology by playing with infectious viruses or bacteria. Even the fear of such a development would be highly disruptive to contemporary societies. The entry costs would be low and the technology is a lot easier than handling plutonium." ■

<http://www.genomicsnetwork.ac.uk/forum>