Abstractions

REVIEW AUTHOR
Drew Endy draws a distinction between bioengineering and engineering biology. Bioengineering, he says, has been about applying engineering principles to biology, to aid scientific discovery for clinical applications such as tissue transplants, or to build machines for diagnostics or data analysis. Engineering biology, also known as synthetic biology, involves imbuing biological forms with new functions, or creating new forms from existing biological components. His review article (see page 449) makes the case for standardizing technologies and methods in synthetic biology so that scientists can build new functions and applications from others' work. *Nature* caught up with Endy to discuss this growing field.

You start your review with a sort of synthetic-biology quiz. Why this approach?
For most types of engineering, these example problems would be fairly simple to solve. But for synthetic biology, they are incredibly challenging. The examples are designed to illustrate how inept we are at engineering biology. We can program computers but we can't easily programme new DNA functions.

Nanotechnology became a buzzword that some say was really just a trendy rebranding of chemistry. Can the same be said of synthetic biology?
Synthetic biology is not new in terms of inspiration or aspiration. In putting this review together, I came across an article published 27 years ago that talked about synthetic biology. And people have always wanted to manipulate cells. The question is how come we're still not able to do it reliably?

Why the need for a review article now?
Most people working in bioengineering are helping to discover life processes, they're not manipulating life. We hope the article will help inspire and motivate people to do the work.

What ethical concerns does this field face?
Laurie Zoloth, a bioethicist at the Center for Genetic Medicine at Northwestern University in Illinois has done a great job collecting those. She's been giving some very interesting talks on the ethics of synthetic biology — and they are webcast (see www.syntheticbiology.org).

What problems in public acceptance do you anticipate?
We have three relationships with the natural world: the pre-darwinian view that the natural world doesn't change; the darwinian view that the natural world changes under certain rules; and, under synthetic biology, the view that theoretically, we can change the world. People in some places are still having problems with the second one. ■

MAKING THE PAPER

Ann Holbourn

Unearthing records of past climates from deep beneath the sea.

Geoscientists have long been puzzled by the middle Miocene epoch — a time that stretched from 16 million to 12 million years ago, and that saw some of the most dramatic changes to life on Earth. "We went from greenhouse conditions to ice-house conditions," says Ann Holbourn, a geoscientist at Christian Albrechts University in Kiel, Germany. "It seemed impossible to know how long it took for this change to occur and what mechanisms triggered these changes."

What has made it so difficult to find out, says Holbourn, is the lack of clear geological evidence. Core samples obtained by drilling into the sea floor weren't long enough to cover a large enough chunk of the Miocene, and the sediment within them was often too disturbed to present a clear picture.

But for their latest work (see page 483), Holbourn and her colleagues were able to reap the benefits of advances in drilling technology developed by the Ocean Drilling Program. The group obtained passage on the *JOIDES Resolution*, a ship designed to take samples from the deep-ocean floor. The ship was equipped with a new kind of corer, which Holbourn thought wouldn't disturb the ancient sediment. And by drilling several holes at different depths but in close proximity, the team hoped to recreate a solid 'splice' of the Miocene.

Once out in the Pacific Ocean, the success of the drilling approach exceeded their expectations. "It was very exciting to be on the ship and see those cores coming up," Holbourn says. "We recovered amazing sedimentary archives."

Earlier sampling techniques typically recovered cores 10 metres long and resulted in gaps in the record. But Holbourn and her colleagues' approach allowed them to drill a few hundred metres into the sea floor, which itself lay up to 3,000 metres below sea level. The *JOIDES* team spliced together samples to construct a core several hundred metres long — big enough to capture a significant chunk of the Miocene. The excitement on board the ship was infectious, Holbourn says. "You're working with a whole party of specialists in geology. There's so much effort, so much energy."

Once back on shore, besides examining the nearly continuous core, her group selected tiny pieces of marine organisms scattered throughout it. They used mass spectrometry to monitor stable oxygen and carbon isotopes to track the course of climate change over the middle Miocene.

Holbourn and her team found drastic changes in both oxygen and carbon isotopes indicating shifts in deep-water temperatures, ice volume and carbon dioxide. "It was an unusual time of low seasonal contrast on Earth," Holbourn says. Her group's interdisciplinary approach helped draw this picture, with Wolfgang Kuhnt, at Christian Albrechts University, helping with the palaeontology, Michael Schulz, of the University of Bremen in Germany, conducting modelling and statistical analysis, and Helmut Erlenkeuser running the mass spectrometry lab at Christian-Albrechts. This approach allowed Holbourn and her group to ask bigger questions of the data. Next her group plans to peer more closely into the 'greenhouse world' of the Miocene and look for analogous present-day warming conditions. ■

QUANTIFIED **KENYA**

A numerical perspective on *Nature* authors.
Robert Snow, head of the Malaria Public Health & Epidemiology Group (MPHEG) at the KEMRI-Wellcome Trust Research Programme in Nairobi, Kenya, works on the consequences of malaria for global health, international development and national health policy. Snow has been conducting malaria research and control in Africa for more than 20 years, and says that the depth and breadth of his current programme results from his long-term commitment to working in Africa, with African institutions and researchers. He plans to stay in Kenya for the next decade to help make tropical public health a discipline driven from the tropics.

Some of Snow's more recent work with US- and UK-based health-systems providers and scientists examines malaria infection rates in African children (see page 492).

9 people work in Snow's group at MPHEG, including three postdocs, four junior scientists starting their doctoral programmes, and two senior scientists from overseas institutions.

2 submissions to *Nature* during 2005 have come from scientists based in Kenya

6 *Nature* papers published in 2005 have been on malaria epidemiology and control.

1,416 is the average number of visitors based in Kenya who visit www.nature.com each month.

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