THIS WEEK

EDITORIALS

PHOTOSYNTHESIS Enzyme upgrade helps plants grow faster **p.280**

WORLD VIEW Research can bolster new UN world goals **p.281**

FOSSIL Ancient spiral-toothed shark went for soft centres **p.282**

Diversity challenge

There is growing evidence that embracing diversity — in all its senses — is key to doing good science. But there is still work to be done to ensure that inclusivity is the default, not the exception.

Earlier this year, Tom Welton, a chemistry professor at Imperial College London, wrote about the prejudice he experiences as a gay scientist. Intolerant peers jump to conclusions, insult him and make assumptions about his beliefs and behaviour. It is better, Welton wrote, to hide behind a lie: "I often find it easier to say 'I'm a teacher'."

Scientist colleagues had no problem with him being gay. But he found that people in the lesbian, gay, bisexual and transgender community seemed to have a problem with him being a scientist. "Most scientists, medics and engineers know that unless they have a stethoscope around their neck they aren't valued," he wrote.

As we explore in a Feature on page 297, others may have a different experience. Scientists, of course, should not be judged by their sexuality. The principles of research — reliance on data, rigorous experimentation and respect for evidence — do not cluster by any of the ways that humans choose to define themselves and each other. Gender, race, ethnic background, social status, wealth, nationality, age, skin colour and sexuality are as irrelevant to doing science as a person's musical taste or dietary preference. Or are they?

There is no place in science (or outside it) for prejudice. But there must be a place for diversity, and there is growing evidence that such variety is a key ingredient for doing good science. Much of that evidence is discussed this week in a joint special issue of *Nature* and our sister publication *Scientific American*.

Diversity is a vague word. The special-issue content (available at nature.com/diversity) is wide-ranging and covers much ground. It can be usefully tied together by a working definition: diversity means an inclusive approach, both to the science itself and the make-up of the groups of people who carry out the research.

Diversity is a topic too often discussed in the negative, through stories of discrimination and bias against select communities. Science has its problems here just like most of society, and *Nature* has long spoken out, for example, against the under-representation of women. Much of the special-issue content frames the subject in a different way, and examines the benefits of an inclusive approach.

Attention, busy scientists: if diversity sounds like a worthy topic but one better left to your university's human-resources department, then turn to page 305, where Richard Freeman and Wei Huang explain how it might boost your citation rate. Their analysis of the surnames of US-based authors on some 2.5 million research papers suggests that scientists who tend to stick with their own kind publish less-cited work, and in lower-impact journals.

Why published collaborations with a greater mixture of surnames perform better is unknown. What is clearer is that a mixture of people (mixed across whatever divisions you care to mention) will be able to consider and to enable a wider range of possible solutions to a problem. If the problem is scientific, then the result of that diversity can be better science. On page 301, for example, Esteban Burchard describes how his ethnic background and experiences with a variety of cultures have helped him to study the genetics of asthma in Latino Americans. On page 304, Mónica Ruiz-Casares highlights how the results of mental-health research based on adult, Western populations might not apply to other cultures and communities.

DIVERSITY
A *Nature* and *Scientific American* special issue **nature.com/diversity**

"There is a place for positive discrimination to address specific imbalances."

But collaboration that spans vast personal differences can raise problems. On page 303, Wenzel Geissler and Ferdinand Okwaro discuss the sometimes-fraught scenarios that arise when researchers from very different economic backgrounds work closely together. To draw attention to this inequality can be awkward, say the duo, but that is better than the destructive ways it can surface if ignored.

Science has already been through one revolution in diversity. Traditional academic silos that held subjects as distinct disciplines have crumbled. Interdisciplinary research now sets the agenda in many fields, especially those with a direct impact on society, such as climate-change research. That shift, although beneficial, was not entirely spontaneous. It was managed and encouraged by senior scientists and funders, who saw the pay-off. To fully develop the benefits of diversity, to ensure that science becomes fully inclusive, similar intervention is necessary — even if it is as simple as a busy lab head stopping to consider the issue for the first time.

As a telling graphic in the special issue of *Scientific American* illustrates, 51% of the science and engineering workforce in the United States is white and male. There is a place for positive discrimination to address specific imbalances. But diversity is not just a case of championing minority interests — the benefits of diversity go to the majority. ■

A worthy ambition

Finalizing the European Research Area is still a vibrant and relevant goal.

The completion of the European Research Area remains a "gradual process", admits the European Commission rather forlornly, at the conclusion of a report it published earlier this week on progress towards an entity within which European researchers and their ideas can circulate freely.

The European Research Area (ERA) was originally due to be finalized by the end of this year. The notion that this could happen, set

in train only two years ago by Máire Geoghegan-Quinn — who will depart as research commissioner of the European Union (EU) this autumn — was always as fanciful as it was beside the point.

That is because the ERA is a process, not an event. The project will never end. Anyone who imagines that it might do so only has to look at the United States. There, despite a genuinely single market and decades of federal incentives, huge disparities persist in 'research excellence' — however it is measured — between, say, Massachusetts and Montana.

That the problem is difficult does not mean that it should not be addressed. Optimists will note the remarkable progress that has been made in European research collaboration over the past 50 years and, in particular, over the past 15. Huge EU research programmes have forged active collaboration involving tens of thousands of scientists. Academic mobility between nation states is visibly increasing, everywhere you look.

Almost all major facilities are now planned on the basis of pan-European collaboration. Earlier this month, ground was broken on the latest of these: the European Spallation Source near Lund in Sweden, paid for by 17 European nations. (It is worth noting that the United States has not managed to start work on a billion-dollar-scale research facility for more than a decade.)

Most importantly, a cohesiveness and mutual understanding has emerged between senior European scientists that most parts of the world can only look upon with envy. Compared with the situation in east Asia in particular, the level of everyday dialogue and collaboration that exists in Europe in several major disciplines, such as particle physics and molecular biology, is singularly impressive.

This process had been going on for decades, before the formal concept of the ERA was endorsed by EU heads of state at a summit meeting in Lisbon in 2000.

The idea of taking specific administrative steps to improve researcher mobility was mainly theoretical at first, but has steadily gained impetus. And the decision was taken in 2012 for the European Commission to report annually on ERA progress, with the aim of cajoling more action out of member states.

At the same time, the political context for the ERA initiative has changed for the worse. The ERA was conceived when the EU had just experienced a period of rapid convergence — in particular, economic convergence between living standards in the north and south.

Since 2008, however, the health of Europe's national economies has been diverging. Today, in research and innovation, as in other spheres, the wealthier regions are moving rapidly ahead, with the poorer ones falling behind. On the face of it, this makes the ERA's objectives more elusive than ever.

"With the rapid growth of the Internet, genuine global research collaboration has become almost routine."

Perhaps with this in mind, the commission's latest progress report pulls some of its punches. Earlier talk of 'naming and shaming' those member states that are slowest to implement ERA actions has been reined in.

These actions include steps to improve the portability of researchers' pensions and to address the gender gap in research. Women now obtain around half of Europe's PhDs, but will receive less than a quarter of this year's grants from the prestigious European Research Council. This is a major problem that both universities and research agencies prefer to overlook; its vigorous pursuit is a worthwhile goal for the commission.

Another change that has intruded on the ERA since 2000 is the accelerated emergence of a de facto global research area among elite researchers in most disciplines. Since 2000, with the rapid growth of the Internet, genuine global research collaboration has become almost routine, rendering 'local' collaboration less significant.

Still, Geoghegan-Quinn's successor as research commissioner — the current nominee is Portugal's Carlos Moedas — should pursue the goals of the ERA with as much vigour as possible. There will doubtless be renewed debate in the new European Parliament about the need for a fresh EU directive to force member states' hands over the ERA. In the meantime, it is up to the member states and their institutions to do more.

The 2014 deadline may be about to pass, but the project must endure. Ultimately, its fate rests in the hands of every department, institution and research agency in Europe — to build the ERA, one step at a time. ■

Amped-up plants

Bacterial enzyme supercharges photosynthesis, promising increased yields for crops.

The catalytic conversion of carbon dioxide and water to sugar and oxygen is arguably the most important chemical reaction in the world, and one of the oldest. It is so old, in fact, that it evolved when the world's atmosphere was much lower in oxygen than it is today. So, in a way, photosynthesis is its own worst enemy. Thousands of millions of years later, most modern plants struggle to photosynthesize because of all the darned oxygen in the air — oxygen that they helped to put there. These plants simply cannot distinguish between molecules of carbon dioxide and molecules of oxygen, so they waste their time and energy grabbing both.

Some plants can do better — for example, plenty of weeds (ever wondered why they grow so fast?) have evolved ways to concentrate carbon dioxide inside their leaves, to supercharge their photosynthesis. Cyanobacteria can do this too. But the majority of plants, including most of the crops we rely on for food, have developed a blunter strategy: produce lots and lots of the enzyme that drives the reaction. That enzyme, Rubisco, is thus among the most abundant proteins on the planet.

A significant amount of Rubisco still wastes its time grabbing useless oxygen — reducing the overall efficiency of global photosynthesis by almost one-third. When they discuss ways to boost the world's food supplies, plenty of plant scientists see leaves' wasted photosynthesis capacity as, well, low-hanging fruit.

What if crops could borrow the faster-acting Rubisco system of weeds and cyanobacteria? In theory, this would dramatically boost their growth rate and so their yield, all without needing any extra farmland. The appeal of such a strategy is obvious, particularly in the face of the often-quoted United Nations demand for global food production to double by 2050.

In practice, replacing the enzyme has proved difficult. But there is encouraging news: on *Nature*'s website, researchers report that they have made tobacco plants that use the Rubisco from a cyanobacterium (M. T. Lin *et al. Nature* http://dx.doi.org/10.1038/nature13776; 2014). Sure enough, the transformed plants photosynthesize faster and have higher rates of CO_2 turnover than their conventional counterparts. Faster-growing tobacco plants might not sound like a boon for global welfare, but they do demonstrate what might be possible in future. (Tobacco is a common model organism for genetic-engineering research.)

As biologists Dean Price and Susan Howitt write in an accompanying News & Views (G. D. Price and S. M. Howitt *Nature* http://dx.doi.org/10.1038/nature13749; 2014): "The work is a milestone on the road to boosting plant efficiency. The advance can be likened to having a new engine block in place in a high-performance car engine — now we just need the turbocharger fitted and tuned." Available in any colour you like, as long as it's green. ■

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