

CAREERS

AGRICULTURE Raising a new generation of seed breeders **p.545**

POSTDOC ISSUES Finding funding as a US visa holder **go.nature.com/2eom84q**

NATUREJOBS For the latest career listings and advice **www.naturejobs.com**

ADAPTED FROM ERHUI1979/GETTY

DAVID GREENKY



Agents of change

Three advocates explain how their groups are trying to improve junior researchers' experiences.

The career progression of many junior researchers is hamstrung by a global postdoc glut, ultra-tight funding and microscopic chances for tenure-track posts. We asked Gary McDowell, Chris Pickett and Jessica Polka how they intend to transform the scientific enterprise to repair some of the dysfunction that chokes researchers' careers and forces young people to choose between quality of life and a chance of advancement.

McDowell's interest began when he was a postdoc at Tufts University in Boston, Massachusetts. With Polka and others, he formed Future of Research (FoR) in San Francisco, which seeks to give junior researchers a voice for their concerns and to help them develop solutions. As executive director of the organization, he aims to empower postdocs and other junior

scientists with information on career options, postdoc classification and compensation.

Pickett was in the middle of a postdoc at Washington University in St. Louis, Missouri, when he realized that he wanted to pursue politics and policy as a way to change the culture of science. A policy fellowship at the American Society for Biochemistry and Molecular Biology (ASBMB) in Rockville, Maryland, turned into an analyst post there, and that led to his current position as director of Rescuing Biomedical Research in Washington DC. He and the group — founded by thought leaders

including Shirley Tilghman, former president of Princeton University in New Jersey, and Harold Varmus, former director of the US National Cancer Institute in Bethesda, Maryland — seek to tackle the problems that stop junior researchers from launching sustainable careers in biomedical research.

As a PhD student at University of California, San Francisco (UCSF), and postdoc at Harvard Medical School in Boston, Polka saw the biomedical enterprise as a vast system of moving parts that does not always function optimally. Active in the development of both FoR and Rescuing Biomedical Research, she has most recently seized on using biology preprints to accelerate the pace of knowledge transfer and to promote career development in a venture dubbed ASAPbio, based at the UCSF.



GARY MCDOWELL

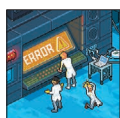
Progress through power

Executive director of Future of Research

I got into science to work on really big problems. After witnessing colleagues' frustrations with unequal pay, stymied career development, lack of diversity and other issues, I realized that the biggest problem could be systemic to academia.

FoR aims to involve junior scientists in making the scientific enterprise more sustainable, and a crucial part of that is getting them to come together and share experiences and data. Transparency is key. Junior scientists need to know what they are getting into. Postdocs, for example, are dealt with haphazardly at the department level, with differing salaries and benefits at the same institution.

Early-career scientists often hear platitudes, such as 'More PhDs make America smarter'. That sounds great, but we haven't been using good science to see whether that argument stands up. We don't track anything to see whether the United States is in fact smarter. It's hard to push back on a romantic ideal. I go to conferences and ask questions. Recently, for example, I asked for data on the number of ▶



YOUNG SCIENTISTS
A Nature special issue
nature.com/youngscientists

► available jobs in non-academic careers, how competitive those jobs are and whether anyone has modelled the future labour market for new PhD students. Of course, there are no such data or models. People say nobody asks those questions. I find that strange. As a scientist, I want to see the data that test those underlying assumptions.

A generational divide was clear during a discussion about scientific staff positions held at the ASBMB Sustainability Summit in February. A senior scientist asked, incredulously, who would want a second-tier career position. I argued that these are desirable positions, especially after seeing the many difficulties faced by new principal investigators.

People seem to agree that early-career scientists have legitimate concerns, but it's also popular to call them young and entitled. There's a sense that 'everyone has to go through what I did'. I don't think junior researchers should have to martyr themselves for science.

This year, however, the conversation has increasingly involved graduate students. It is also a big year for US postdocs because they will attain employee rights. On 1 December, the Fair Labor Standards Act (FLSA) will update the threshold at which salaried workers are exempted from overtime payments for working more than 40 hours per week — from US\$ 23,660 to

\$47,476. In some instances, salaries will need to double to keep the postdocs on. Institutions are panicking because if they can't double those wages, employees may lose jobs. People think it's just about asking for more funding, but it's not. It's about sustainable funding. Funding booms and busts caused the problems we're facing now.

By 2020, I hope that people pursuing scientific research careers are as informed as those who are currently in the medical-school system. Graduate students need to know how they will be supported and trained in particular programmes, and by particular principal investigators. All who are trying to maximize their passion for science need to know what they are getting into.

Some graduate students and postdocs are not as free as others to leave the lab to pursue career-development opportunities or training, let alone for advocacy. This can make progress difficult for our group and others, because there is only a very small number of people who can advocate for change. Still, I've been pleasantly surprised by the level of engagement. There were about 20 people involved in our first meeting in 2014, and today, we have roughly 100 active volunteers in the United States and abroad who are engaged and in regular contact.

I have left the bench — and I don't know if I'll go back. I feel no sadness whatsoever. My

research was interesting, but I hadn't yet figured out that I enjoy doing things that effect some kind of change. It's very liberating not having to worry about all the issues that I now spend my time trying to alleviate for others.



CHRIS PICKETT

Change the culture

Director of Rescuing Biomedical Research

The biggest challenge that academia faces is the need for a culture change. My motivation was seeing junior scientists buy into the idea that scientific success means attaining a faculty position.

Helping early-career scientists to get information about the skills needed for a variety of careers, and encouraging universities to recognize postdocs and improve their pay and benefits — both these goals require people to change their minds about how things have been done since the inception of the biomedical research enterprise.

There will always be pockets of resistance. But more people are addressing these issues now, by offering career training for junior researchers and improving the funding outlook, for example. While I was a science-policy analyst, I compared 9 reports and consolidated 250 suggestions into 8 recommendations. Two of those suggestions are to broaden training for graduate students and postdocs to prepare them for a variety of careers, and to add more staff-scientist positions at universities (C. L. Pickett *et al. Proc. Natl Acad. Sci. USA* 112, 10832–10836; 2015).

Some of the recommendations in US reports from the National Academies of Science in the mid-1990s were the same as those in my report. I fear that if I hadn't written this paper, a lot of these reports would continue to sit on shelves collecting dust. People have been talking about solving these problems for a long time, but there hasn't been enough popular support in the scientific community. And that's not helped by resistance to change in government and at universities.

We now have long-time advocates who are active at the same time as broad grass-roots efforts. It's a potent mix for achieving real change. We can't let that momentum go.

We want to improve the environment for biomedical researchers at all career stages. Take postdocs, for example. The 2014 US National

Postdoctoral Association's *Institutional Policy Report* showed that there are 37 titles for the single job of postdoc. This hinders the ability to introduce a unified pay or benefits scheme. We're pushing for institutions to harmonize postdoc categories into one central group with the same funding and tax codes. For postdocs to be compensated in a single, uniform way would bring about a huge shift in the science community.

Our next step is to encourage research institutes, universities and governmental agencies to pilot some of these recommendations. The biggest barrier to change is that the system we have now works, even if inefficiently, and we don't know what will happen if we change it. The only way around that is to experiment with small-scale pilot programmes.

Just as at the bench, successes and failures tell you important things that help to move the conversation forward. In a few years, I want to be able to take my paper and cross off the recommendations that have been tried, and know whether they worked or failed. The first pilot I'd like to see would involve universities collecting and publishing data on the eventual careers of their PhD alumni. If we can aggregate that at the national level, it will be a huge benefit to undergraduates, graduate students and biomedical departments across the country.



JESSICA POLKA

Promote the preprint

Director of ASAPbio

In 2014, when I was a postdoc, I attended a meeting to discuss the future of the research enterprise. Shortly afterwards, I met Gary McDowell at a meeting of the Boston Postdoctoral Association. The FoR advocacy group emerged from all of this. In the same year, I met Shirley Tilghman, then president of the American Society for Cell Biology, while I was co-chairing the society's new student and postdoc committee. She invited me to join the steering committee of Rescuing Biomedical Research.

When I read Pickett's paper and subsequent blogposts for the American Society for Biochemistry and Molecular Biology, his framing of these issues in terms of sustainability brought home the need for fundamental change. Publication is the currency through which scientists obtain credit and recognition, and falls at the centre of a lot of the

LAWRENCE GREEN

RICK GROLEAU

problems in research. Ron Vale, a molecular pharmacologist at the UCSE, really put the issue of increasing time to publication on the table (R. D. Vale *Proc. Natl Acad. Sci. USA* **112**, 13439–13446; 2015) and organized the rest of us to launch ASAPbio as an independent spin-off group last year. My volunteering with policy groups and experience in organizing meetings and conducting outreach helped to soften my transition to director of ASAPbio in August.

ASAPbio is trying to promote the most productive use of preprints in biology. We see preprinting in other fields — physics, computer science and maths — as a way to address problems that early-career researchers experience most acutely. Having a long time to publication strains early careers, limits feedback on work through a closed peer-review process and slows the pace of science.

Transmission of knowledge is the foundation on which all major discoveries are built. We want to accelerate that process. Preprints are not widely used in biology. There's a general lack of awareness about them and they're not part of our culture. We're trying to encourage scientists to have conversations about preprints.

I hear two main concerns about preprints. The first is that they will disqualify authors from publication in top-tier journals. That's not true. There's been a remarkable trend of acceptance of these practices at journals in the past few years.

The second is that preprint users will get scooped. This is a valid concern, but one that will be easily remedied as more and more people use them.

In other fields, preprints are cited, and treated as a first-class research product. If we want this in biology, we need to create the infrastructure, including the introduction of standards.

The rise of social media has enabled people to compare their experiences and to coordinate themselves better. In the past, this was possible only through more formal channels. As people debate the more conservative and radical positions on preprints in the public arena of Twitter, anyone can read them and take part in the discussion. People are also starting to share their first preprints with the hashtag #ASAPbio.

I would like to see more than 100,000 biology preprints posted each year by 2020. That would represent 10% of the volume of manuscripts that appear on PubMed annually. It would roughly equal the number in physics, too. This is an ambitious number, so I'll consider any increase a win. ■

INTERVIEWS BY VIRGINIA GEWIN

These interviews have been edited for length and clarity.

TURNING POINT

Cream of the crop

William Tracy is one of only two sweetcorn breeders left in the US public sector. He describes how he is helping to grow a new generation of seed specialists as endowed chair at the University of Wisconsin–Madison — the first such position in the United States to focus on organic seed breeding.

What is your mission?

Public plant breeders do things companies don't, such as incorporating a range of genetic diversity. I develop new crop lines that companies can use to make hybrid varieties, and I use exotic corn from the tropics to give traits such as flavour, tenderness and appearance. Companies tend to focus on production qualities such as yield and disease resistance.

How do your cultivars get to farmers?

I've released around ten inbred lines, which companies have used to make dozens of different hybrid seeds. My lines are cost-free for research, but the companies return a royalty if they use one in a commercial cultivar. All the big seed companies have used my material. I calculated once that my lines have generated hundreds of millions of dollars in products.

How is public plant breeding today different from when you started your career?

When I was a PhD student in plant breeding in the 1980s, there were around 30 public-sector sweetcorn breeders, maybe 10 of them developing cultivars. Ten years later, there were around six or seven producing cultivars. Now, I'm basically it. Fifteen years ago, budgets were being cut and I was bemoaning the future of the discipline. It's better now, but the land-grant universities, where most public plant breeding took place, are being severely downsized. People aren't being replaced as they retire.

What are the knock-on impacts?

There are fewer training opportunities. The big seed companies realized that their training pipeline was drying up, and that is one reason things have got a bit better recently. Monsanto, DuPont and others started donating money to land-grant universities to fund graduate-student training. But that shouldn't be the sole reason to have public plant breeding. We need to encourage a food supply based on genetic diversity.

Have your trainees got jobs at public universities?

None has gone to a public institution; some 40 have been hired by private companies.



SHAWN LINEHAN

Is public crop breeding misunderstood?

The biggest misconception is that plant geneticists breed new cultivars. Molecular genetics and genomics produce a lot of papers but don't necessarily do anything to improve plant diversity on the farm — and that's where the crisis is.

Besides funding, what's your greatest problem?

For those of us developing cultivars, it's increasingly difficult to get access to seed. Given the concerns about biopiracy — the use of seeds or knowledge for profit without a nation's consent — it can be almost impossible to collect seed in some countries. Despite international agreements meant to facilitate access to seeds and encourage equitable profit-sharing from their use, some countries still don't share, which can affect public- and private-sector breeding efforts.

What is the significance of the new endowed chair, funded by Clif Bar and Organic Valley?

It shines a light on the need for organic plant breeding. Organic farms require crop varieties that are adapted to different soil environments, nutrient uptake strategies and microbial communities. But there hasn't been much breeding focused solely on organic crops. When these big companies fund not only the chair but also PhD-level fellowships, it generates interest from prospective students.

What is your hope for the future?

I'd really like to see the field move towards a greater understanding of the idea that classical plant breeding is a powerful means of developing new genetic diversity in crops. All of life's diversity is based on evolution, and plant breeding is really just human-directed evolution. ■

INTERVIEW BY VIRGINIA GEWIN

This interview has been edited for length and clarity.