

sciences is as rapid and substantial as it has been elsewhere then China's impact on gene and protein research will be profound.

An obvious word of warning needs to be made here: quantity is not the same as quality. Measuring the volume of China's scientific output is clearly both valuable and surprising but it doesn't tell us whether that research was any good. For that we turn to a useful proxy: China's scientific collaboration with other countries better known for the high quality of their science. The results here, too, are eye-opening.

China is not doing science behind closed doors; its international collaborations are growing. Nearly 9 per cent of papers originating from Chinese institutions have a US-based co-author. Japanese and British co-authorship is also growing. Collaboration with South Korea and Singapore almost trebled between 2004 and 2008 and collaboration with Australia expanded too – signs, perhaps, of an emerging Asia-Pacific regional network.

So what does this all mean? Firstly, China's emergence as a scientific superpower can no longer be denied, and it is a question of when rather than if it will become the world's most prolific producer of scientific knowledge. Perhaps more importantly, China's expanding regional collaborations show that Asia-Pacific nations no longer rely on links to the European and American institutions that have traditionally led the science world.

The question for the EU and the US as we enter the new decade is no longer about whether we should collaborate with China, but what we can bring to the table to ensure that China wants to collaborate with us. ■

Jonathan Adams is director of research evaluation at Thomson Reuters in London. He is co-author of *Global Research Report: China*

## One minute with... Frank Drake

The founder of Project Ozma kick-started the search for intelligent extraterrestrial life just 50 years ago

### What gave you the inspiration to set up Project Ozma?

In 1957 I was studying the Pleiades star cluster at Harvard University's radio observatory. On one occasion we saw an added feature in the data. It turned out to be an amateur radio enthusiast near the observatory, but at the time I thought we had detected clear evidence of another civilisation. You feel a very strong emotion that you never feel otherwise. It's a combination of elation and excitement and the sense that everything we know is going to change.

### How optimistic were you when it all began?

In 1960, when Ozma started, every star in the sky could have been radiating signals, for all we knew. There was a chance we'd succeed almost immediately. But we knew so little of the universe that one could not seriously speculate.

### You kept Project Ozma secret: was that because your peers would be sceptical?

Back in 1960 it was taboo to think about extraterrestrial life; it was something done by bad scientists. However, we were fearless. We did not feel we should be embarrassed in any way.

### Fifty years on, do you think we should have heard something?

Over the years, I've gotten more realistic. The equation I devised [the Drake equation] says that we're going to have to look at 10 million stars before we find one that might host life. Even then there's no guarantee they're transmitting, or on the frequency we're looking at. We've done a lot of searching to date but it doesn't add up to 10 million stars. In a way what we've been doing until now is buying a ticket in the lottery. There's no reason to think we should have succeeded yet.

### Should we start broadcasting in a coordinated way?

Frankly, no. A civilisation not much more advanced than ours could build a telescope that could detect the signals we already transmit, such as television. For us to spend our resources adding



### PROFILE

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one more signal to that cacophony would be frosting on the cake.

### There is also an argument that broadcasting could elicit an invasion.

Yes, and if that happens it might be my fault! Back in 1974 I broadcast a signal from the Arecibo Observatory in Puerto Rico, which is still the strongest signal ever sent. That stimulated a major outburst from the Astronomer Royal at the time. He was very concerned.

### What do you think an alien would look like?

Our physiology and morphology are certainly not unique. Humans are basically a good design: it's good to stand upright, because it frees our hands to manipulate tools, for instance. It's best to have the head on top, so you can see prey. Our two arms are arguably not optimum, however, as anyone who has tried to carry groceries from their car to their house will find! So my hypothetical ET looks a lot like us but has four arms. Then again, who knows what evolution will lead to elsewhere?

**Interview by Richard Fisher**