Open-Source Biotech: Science as a Tool for Social Justice

If you can't win the game, then change the rules. That could be the mantra of **CAMBIA,** an organization of scientific paradigm-shifters who have spent the better part of the last decade challenging the biological innovation status quo.

Turning their keen eye for social justice inequities first to the IP system, they developed what may well be the world's largest, free, full-text searchable database of life sciences patents. As part of this "Patent Lens", their vision is to make the opaque world of patents more "transparent", so that small and mid-sized enterprises and scientists in the developing world can more easily understand and penetrate complex patent thickets surrounding biotech innovation.

A self-described "public-good based scientist", CAMBIA founder Richard Jefferson, whose presentation closed the 2005 GE^{3}LS Symposium in Toronto, has little taste for patent practices as they currently stand."Transparency is our catchword in trying to make IP, which is clergy-ridden, opaque and, in my view, very unpalatable, into a more intuitive and navigable system that doesn't require as many interlocutors," said Jefferson, a molecular biologist who holds patents to the popular GUS gene reporter system and worked with the UN's Food and Agriculture Organization prior to founding CAMBIA in 1991. "It allows us to analyze the landscape of technology and distill the truth of what really is owned and controlled and what isn't. Armed with that dynamic information, we can cooperate to make tools that are not restricted and withheld only for personal or institutional wealth gain, but rather are forces for community wealth creation."

As if that weren't enough to cause a collective flinch on the part of patent lawyers everywhere, CAMBIA has used this "lens" to analyze the patent landscape and come up with alternatives to the transfer of genes to plants. Up to now, the only microbe considered capable of such transfer – *Agrobacterium tumefaciens* – was covered by complex patenting laws, preventing its use by many smaller organizations around the world.

CAMBIA's new *TransBacter* gene transfer system has not only neatly sidestepped its patent-riddled rival, earning the group a publication in *Nature*, it has now become a cornerstone technology of CAMBIA's new open-source "protected commons" for biological research, called BIOS, which stands for "Biological Innovation for an Open Society". These concepts have captured the imagination of the public and the press, with features in the *New York Times, The Economist, Newsweek* and scientific journals.

Developed in parallel with the open-source software movement, BIOS allows scientists to collectively invent and share new biological tools and technologies. Members can add, change, improve upon, and even use BIOS technologies as a basis for patentable products – so long as they agree to share their findings with other members. It's a virtual 'cone of silence' that levels the innovation playing field, giving smaller organizations and those from the developing world a leg up. Jefferson maintains that new and better technologies will emerge through distributed and collaborative innovation using Internet-based facilities such as BIOS' BioForge.net.

Although comparisons to Linus Torvalds or Richard Stallman, creators of the open-source GNU/Linux operating system, seem inevitable, Jefferson equally admires Brian Behlendorf, a super-hacker and co-founder of the collaborative, consensus-based Apache Software Foundation and the software development platform Collabnet, as well as fellow Australian Andrew "Tridge" Tridgell, the force behind the subversive Samba project.

What drove you to create CAMBIA?

CAMBIA emerged as a response to a great opportunity to bring many more people into the problem solving equation and focus on 'enabling technologies', the underlying tools of innovation. CAMBIA was not so much institution building, as concept building – that there should be a capability to invent methodology and distribute it so that it would fit the hands of the users who need to solve problems, and fit the problems themselves. And that this capability should be itself a dynamic and evolving one.

How did you come to that realization?

Much of what people are calling an "open-source biology" concept that we're promoting was shaped by my experiences since 1974 in wonderful laboratories that developed many key enabling technologies. These ideas were crystallized during the course of my own designing, inventing, distributing and troubleshooting an enabling technology – the GUS gene reporter system. Until we started distributing that system, many scientists were constrained by reductionist approaches to studying plant molecular biology – they'd chuck things in a blender and grind them up. Nobody knew where in cells things were happening, when they were happening, or how much was happening, simply because the tools weren't there yet.

GUS allowed you to see when, where and how much a gene was acting. Well before publication, I sent out tens of thousands of DNA samples and vectors around the world to many hundreds of labs. We sent it out without contracts, materials transfer agreements or licenses – just a thick user's manual where I had written every single bit of know-how and every trick that I could think of to make it work better, and a letter stating our goals and intentions.

Were people shocked that you freely distributed your invention?

The people in the private sector were certainly pleasantly surprised. The people in the public sector were pleased, but most took it as a matter of course. The ones who were truly shocked were in the developing world because they got them at the same time as anybody in, say, Berkeley got them … instead of the usual cliquey distribution of technology and capabilities in science, which is a really powerful tool for reinforcing the 'old boys' club and the status quo.

What happened next?

Within a year or so, everything in the field had changed. Papers were being published all the time on cell and developmental biology, and new crops could be transformed, which had been very difficult until the ability to visualize gene action was in hand. For instance, the first genetic engineering of soybean, which is of no small interest to Canada, was done because GUS had been distributed for free to all these companies and institutes.

I learned that methodology or 'enabling tools' – properly designed and distributed – can change the direction of an entire field. And that when treated with respect, businesses by and large would respond respectfully, with only a few exceptions.

Apart from methodological issues, what other issues inspired CAMBIA?

There were also scientific and sociological issues coming to a head. When I was developing the GUS technology, reductionism was ruling the roost. Almost all of plant molecular biology evolved in laboratories by laboratory scientists, and so unfortunately did the questions being posed. They came out to be extraordinarily simplistic questions, not about field biology or, god forbid, field agro-ecology, but about the subset of questions that could be reformulated or redrafted into lab-level experiments.
What was also horrifying for me was that virtually none of the agronomists, physiologists, plant breeders or of course farmers – people who understood field biology and field performance – were well integrated into the question formulation. It was a massive untapped opportunity.

And finally, virtually all of my colleagues, post-docs and grad students, were from the developing or less wealthy world: Kenya, China, India, Mexico, Poland. This is another huge untapped resource of creative people who have high motivation to solve problems, but we were not engaged in crafting any of the methodology to work within their operating constraints. We weren't extending an inclusionary hand to say, 'come on, help design the science'. Just fellowships to say 'come do our pipetting, get a paper and go home'.

BIOS was launched in February 2005. What have been some of the early results?

It's extraordinarily gratifying the number of people who are excited about working together for a change. Most scientists are fed up with the current system, with the idea that you've got to patent, you've got to own, you've got to squabble like rats in a bag instead of sharing what we know and watching society – and economies – flourish.

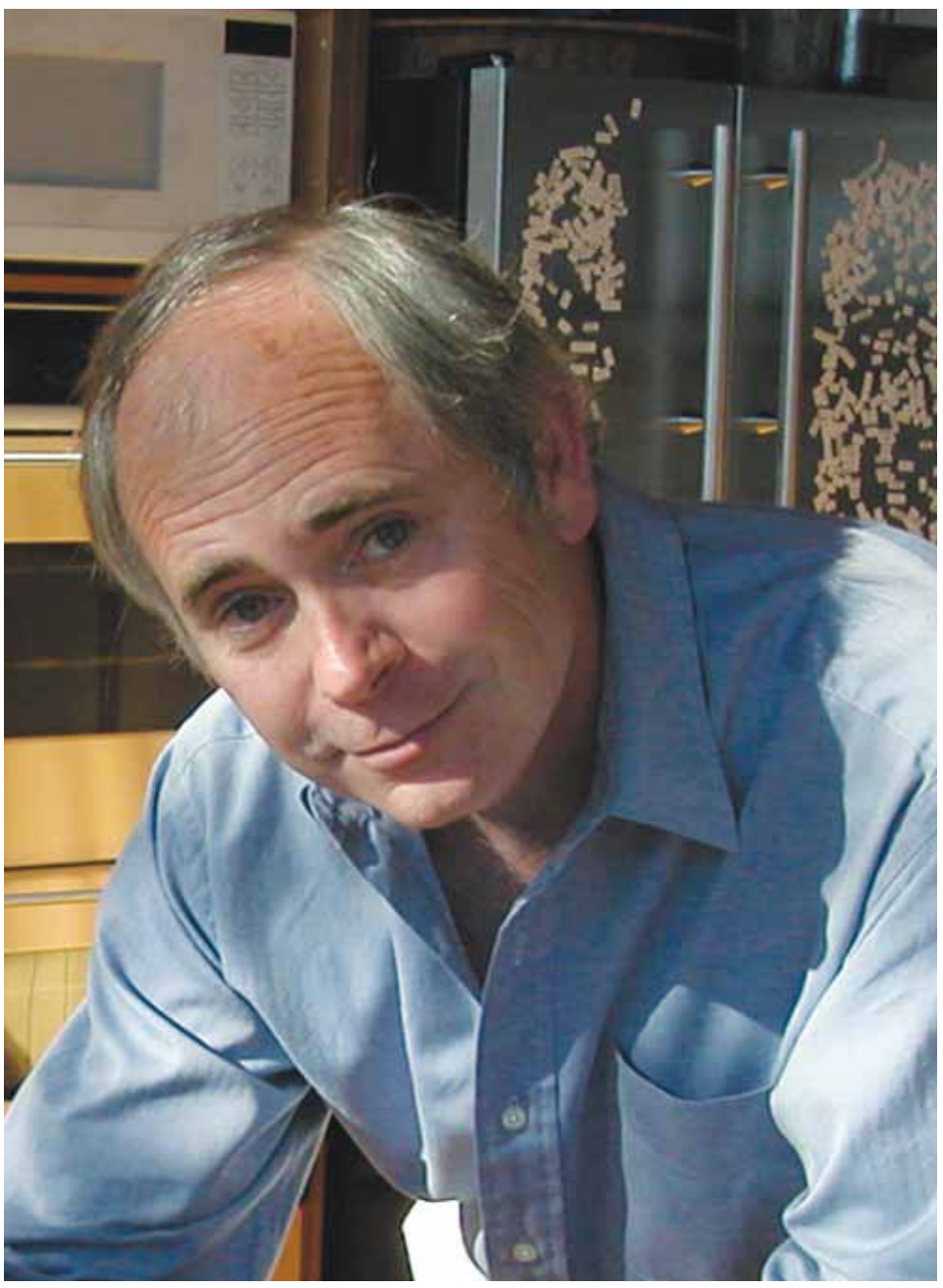
Most people talk about patents as incentives to inventors. That is simplistic and usually wrong. Every inventor I have ever known would invent in a vacuum, they would invent in a cave. It's impossible to hold them down, impossible to keep them from talking. Really inventive people thrive on the performance of invention. You couldn't pay them enough NOT to invent! The incentive – the limited monopoly of a patent grant – is captured by 'owners' of invention. In the private sector and indeed most of the public sector, the inventor assigns entire right and title to the employer.

Patents are more cogently argued as being needed to stimulate all the capital recruitment that is needed downstream to turn an invention into a real deliverable innovation, but they're certainly not required to stimulate most invention per se. But we lose sight of the self-reinforcing barriers to entry this provides. Those who can use patents as tools to recruit financial capital (through exclusion of competitors) have little incentive themselves to make that value chain more affordable to others. Real competition and transparency is often suppressed, and only the 'low hanging fruit' of high-margins or large markets become priorities – leading to very unfortunate social alienation from innovation.

Have you been accused of promoting genetic engineering and GMOs?

Not really. We're not actually promoting genetic engineering, just promoting options and honesty. Genetic engineering is a modest approach to solving a lot of the important problems we have in world agriculture and nutrition, especially with current technology. *TransBacter* is not about promoting GMOs at all, it's about promoting cooperative activity to help get rid of the fear, uncertainty and doubt, what IT people call "FUD", that confuses everybody into thinking we can't solve problems by using science where science works well. *TransBacter* may lay the groundwork for collectively evolving much more context-sensitive, socially responsive toolkits. Then decisions about GMOs, or no GMOs, can be unpacked from the emotive, and trenchant, criticisms of industry domination and can be viewed as an option for social, environmental and economic interventions to be chosen or not, but based on it being 'ours' not 'theirs'.

We're neither railing against the machine nor being apologists for science and techno-fixes. We're trying to creating alternative paradigms using modern communications, modern informatics and the life sciences as an opportunity to unleash creativity and reconsider how we look at the world. ❖



Richard Jefferson