

RICHARD JEFFERSON believes that biotechnology can be used to benefit the poor and disenfranchised, but only if the R&D process is democratized so that everyone has access to critical scientific tools and technologies.



RICHARD JEFFERSON IS the founder and CEO of Cambia, a Brisbane, Australia-based nonprofit that is trying to transform the way that we create new crops, drugs, and other biologically based products. Today, the biotechnology revolution is dominated by large multinational corporations, such as Monsanto, that use patents, access to capital, and other means to control critical technologies. As a result, the products that are developed are largely ones that maximize profits, not solve pressing social problems.

For the past two decades Cambia has been trying to upend that dominant model. Cambia is developing new scientific tools and processes for controlling and manipulating genes, and making them available to all organizations on a progressive pricing model: Large corporations pay a lot, whereas small shops pay little. Cambia's approach

makes it more likely that new drugs will be developed for otherwise ignored diseases, and that new crops will be developed that are more environmentally sustainable.

In this interview with *Stanford Social Innovation Review* Academic Editor Johanna Mair, Jefferson explains why the current patent process used for biological discovery inhibits innovation, why an open source approach is the answer, and what Cambia is doing to get scientific discovery moving in the right direction.

Johanna Mair: In the early 1990s you started Cambia as a nonprofit organization focused on biological innovation. Why did you do so?

Richard Jefferson: The vision of Cambia dated back to the late 1980s when I was a postdoc at the Plant Breeding Institute in Cambridge, England. While there, I began

to realize that the ways in which science was used to solve problems and the types of solutions that were created, were shaped and influenced by who controlled the design and use of new scientific tools. This was during the dawn of biotechnology in agriculture. I sensed that it was necessary to dramatically democratize the process and involve a more diverse group of people in using these powerful new approaches to solve localized and scaled-down problems.

At the time, however, the apparent successes of the biotech industry had convinced many people that the blockbuster mentality would deliver the goods, and that a rent-seeking model was a viable way forward. In that model, you invent a new process, find a drug target, or discover a new gene, then wrap it up in intellectual property protection and try to sell it to the highest bidder. That bidder then has to try to as-

semble the puzzle into something actually useful. It's a slow, expensive, and cumbersome process that requires so much capital that the only targets worth shooting for are the blockbuster products. It was not widely perceived how dysfunctional this process could end up making biological innovation.

What is wrong with that model?

When I started, genetic engineering was not yet considered to be the pariah it is today in some circles. It was generally thought that since so much crop development was done in the public sector, it would continue to be a public resource—a commons. I remember talking to directors of Greenpeace International who were quite excited about how biotechnology could eliminate our dependence on chemical agriculture and could be an enabling environment for agriculture to become sustainable.

A few years later it was a very different world. By that time, the control of innovation—including control of the actual toolkits necessary to put biotechnology to work—had been vertically integrated through acquisitions, mergers, and a skein of cross-licenses, to make it a no-go zone for small and medium enterprises. There are now thousands of patents covering almost every stage of the research and development process that could give the holders the rights to stop others in their tracks. That makes for a pretty constipated ecology.

As a result, we have vast acreage of a few crops, controlled by a few industry players, engineered for arguably higher performance in an industrial agriculture paradigm, as well as a public that generally doesn't like it. Many people and small enterprises were cut out of the process—those who could have brought real creativity and perspective to bear—and local-scale solutions never make it onto the drawing board.

You keep using the word “tool.” What do you mean by that?

In software, tools are databases, web browsers, or programming languages—all methods for manipulating information. In life sciences they are methods or techniques for manipulating or understanding living systems, including genes. While I was in grad school, and then later when I was at the

Plant Breeding Institute, I developed GUS, a widely used genetic technique—or tool—that allows you to monitor when, where, and how much a gene acts inside a cell. I distributed it freely to hundreds of laboratories before patenting it or even publishing a paper on it. When I did that I discovered something utterly fascinating—GUS changed the entire field in less than a year, and enabled real progress both scientifically and commercially.

That was very gratifying because it confirmed my premise that a tool, if properly designed and shared, can change the direction and pace of innovation. It led me to think, why couldn't we have an institution that designed and shared tools for people who are currently outside the loop and used in a way to engage truly holistic problem solving?

The Rockefeller Foundation was a strong supporter of Cambia for many years. How did that happen?

Cambia's first paying gig was funded by the Rockefeller Foundation, thanks to the visionary leader of the agriculture program, Gary Toenniessen. This only happened after four years of pounding on their door, loitering in their offices, and just not going away. In 1992 they gave us \$100,000 and sent us off for a year to troubleshoot their rice program throughout Asia, with a nod and a wink. They knew that what we really wanted to do was to invent a new way of cooperative problem solving, sort of a biological open source, but as long as we did our work in troubleshooting their rice program that was fine. We went back after one year and they were pretty happy with our progress, so they ended up funding us for the next 15 or so years.

Our job was to visit every laboratory that did rice biotechnology in the world, to learn, evaluate, teach, help, invent, and support new technologies that would overcome the barriers these laboratories experienced. Our vectors [the DNA tools that are shuttles for genes] are in use in all those labs almost two decades later, and the people we worked with now run major institutions and companies in Asia, Africa, and Latin America. For us, that work was a great learning exercise because we also became experts in intellectual property and observers and strategists of the culture of the public sector.

Which led to your initiative, the Patent Lens.

Yes, which in turn led to our passion for innovation cartography. The patent system exploded during the biotechnology revolution. It reached such a point of complexity and opacity that almost no one really knew what was going on or who had what rights. The Rockefeller Foundation and Cambia were concerned that there was too much opportunistic and shortsighted use of the patent system by the universities that Rockefeller was funding, and too much consolidation by the multinationals that even then were coming to dominate the landscape. The foundation was funding universities around the world to contribute toward solutions of problems in plant sciences. But most of those universities were filing patents on their work and restricting distribution of their materials, all ostensibly to maximize their financial upside, although few did profit. This was never Rockefeller's intention. They wanted these technologies to be widely available so that new options could be created that would benefit rice farmers and, of course, poor rice consumers.

So Rockefeller asked us to start shedding light upon the extent of patent coverage globally in agriculture. That work became the Patent Lens. It was the first and still the only nonprofit involved in integrated worldwide patent search. We set out to show who controls what patent rights and share that as public information that could be a basis for community response.

By doing that work we learned a lot about intellectual property. Cambia invented a number of technologies, filed a lot of patents, and did a lot of licensing. Almost every company in agriculture has paid to license our technology. We learned how to do tiered licensing so that it could be equitable with access guaranteed to anyone. We used the revenue stream from those who benefited a lot from the technology, like Monsanto, to help those who otherwise would have had very little access to the technology. This use of tiered pricing to fund a public-good activity was our foray into social enterprise, long before I'd ever heard of that term.

One of Cambia's early initiatives was called Biological Open Source. Why did you think that open source was the way forward?

We mapped the thickets around the first

step of making genetically modified plants, dominated then and now by Monsanto and its ilk, and devised a new method that we reasoned would not infringe these patents. We published it in *Nature*, sent it out to thousands of labs, filed patents, and licensed it to hundreds of players in dozens of countries. The licensees agreed to share improvements to that technology, but still retain full rights to their own use of the tools. The problem was that it was too little, too late. By that time the industry was intensely consolidated in a few hands, and the public had already lost any confidence that their interests were being promoted and protected by a capable public sector.

My work happened more or less in parallel with the develop-



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ment of the free software movement that later morphed into open source. We knew nothing about what was going on in information technology at the time, and we didn't develop our ideas modeled on open source. We developed our ideas modeled on what we perceived as a terrific opportunity for a general approach to enabling innovation in a field that we knew a lot about.

It's interesting that what is called open source in software engineering was anticipated by several thousand years of plant and animal domestication that underpinned all of agriculture. We've actually had thousands of years of developing the norms and innovation models of open source. For millennia, new varieties of crops were selected or bred by farmers themselves. They were freely available to anyone who could collect the seeds, cuttings, or seedlings. It was impossible to stop seeds from getting out, so the focus was on producing something of value, and accepting that others would use your seeds to make better ones. Of course, that is now dramatically changing in the agricultural industry, since the advent of hybrids—crops whose seeds don't breed true—and now transgenic crops, heavily controlled by contracts and licenses.

What has been your biggest disappointment since Cambia began?

That would have to be the public sector's discouraging performance. I've felt for a long time that the public sector, in particular universities and national laboratories, has been very ineffective and inefficient as agents of public good. The feature that makes them public is generally the source of their funding, but sadly not the development and disposition of their work.

Right now the metrics they cleave to are things like monetization, spin-offs, publication, and career advancement. None of them have a direct correlation with social value. The metrics of career advancement are not aligned with the metrics of delivering benefits to society.

The metrics of monetization of intellectual property are not aligned with the metrics of using intellectual property to create a new crop or medicine.

Tell me about the Initiative for Open Innovation.

It's the culmination of our lessons from the last two decades. The Initiative for Open Innovation, or IOI, was designed to be a truly open global initiative to change how problem solving is done and by whom.

Let me explain it with a metaphor. In the first several thousand years of human economic development, almost all progress was made by moving physical material from one place to another. Global trade drove the development of civilization. The big problem with moving stuff across space is the space. The biggest risk was that you would hit a reef and lose your ship, or run across a hostile tribe and lose your caravan. So the single biggest tool for risk mitigation that made economics work was the map.

Cartography, the ability to map our physical environment, was the single most important breakthrough in economic development. In the 1400s and 1500s, the great maritime empires of Portugal and Spain

dominated global trade because they dominated mapmaking. No one else knew how to make the long-distance passages. The Portuguese and Spanish kept it as a trade secret. In the biggest act of open access guerrilla warfare ever done, in 1596 a Dutchman named Jan Huygen van Linschoten stole all the Portolan charts and navigation directions from the Portuguese and published them in Amsterdam. Within a few years the Dutch East India Company and the British East India Company were formed, and the entire landscape of commerce changed. It is unthinkable now that we would have trade in the absence of maps as global public goods.

Yet that is the situation we face in today's information economy, the lack of publicly available maps.

Indeed. And that is exactly the transition we now have to make in the world of ideas. Today it's not about moving stuff from one place to another; it's about converting information through thought processes and creative innovation into new value. It's the world of ideas rather than the world of things. But we have the same challenge of cartography. We need to create publicly available maps that can help us navigate this new world of information. We need to create as global public goods, a risk mitigation tool so that decisions that are aligned with self-interest and ambition can be made with as little avoidable risk as possible. Right now, the greatest risks are associated with intellectual property, regulatory compliance, and, of course, ignorance. Those can be reduced.

The vision of IOI is to create an ecology in which virtually anyone with ambition and a good idea can enter into the process with as small an entry barrier as possible. Five years ago it would have been considered unrealistic, even impossible. But today, by harnessing such trends as cloud computing, social software, and the trajectories of freedom of government information, there's no reason we can't anticipate that within the next few years we will have true innovation cartography that is shaped for diverse people as a decision support tool, just as maps are taken for granted in global trade. That's our vision, and I think that making this happen will have a massive transformational change in global equity and economics. ■