Dani Davies: Hi, and welcome to Fab Gab. This is the International Journal for the Feminist Association of Bioethics brought to you by the Fab Network. My name is Dani Davies, and I'm a PhD student at the University of Otago in Dunedin, New Zealand. Each episode I'm joined by Dr. Emma Tumilty, an assistant professor at the University of Texas Medical Branch in Galveston, Texas.

On this podcast, we'll discuss papers from the journal and hear from authors about the work that they've completed. This episode, we're happy to welcome Professor Wendy Rogers, a distinguished professor from the Department of Philosophy at Macquarie University and a member of the Ethics and Agency Research Center. She'll be talking about her work with Jacqueline Dalziel that appeared in the journal in volume 16, issue two "What Feminist Bioethics Can Bring to Synthetic Biology."

Hi, Wendy.

Wendy Rogers: Good morning and thank you very much for talking with me today.

Dani Davies: Thank you. Wendy, what was the motivation behind researching this topic?

Wendy Rogers: Basically, because I'm on a big grant, and I had the money to do it. So I'm one of 19 chief investigators on a big project funded by the Australian Research Council, called the Australian Research Council Centre of Excellence in Synthetic Biology. And these are big flagship projects funded by the Australian Research Council and they're funded for seven years usually focusing on a particular topic or technique in this case synthetic biology.

And they're big multidisciplinary teams, and I was brought into the team as the ethics person. And one of the fabulous things about being part of this team is that it carried with it money for postdoc salary, and so Jacqueline Dalziel was my postdoc on the project when we did this work together. So, to be brutally honest, I didn't have a huge interest in synthetic technology before this opportunity came along.

But I think that's often the way in academia, you know, something happens, opportunity opens up. And, you know, it's a bit of a diversion because I normally work in biomedical ethics, you know, my original background is in medicine, so I've always worked, you know, quite closely to sort of clinical ethics, medical ethics, you know, philosophy of medicine all with a feminist slant, of course.

So this was an opportunity to go into a completely different field, and instead of dealing with, you know, doctors, I'm dealing with bench scientists who are manipulating things that you can't see and, you know, dealing with microbes instead of humans, or even, you know, creatures that we recognize as animals, like experimental animals and so forth.

So yeah, it was a, it was a bit of a step for me, but it's been really interesting.

Emma Tumilty: I really love projects where bioethicists are embedded and obviously, feminist bioethicists, all the better. But can you tell us … people in the audience might not know exactly what synthetic biology is. Can you give us a little bit of a rundown of what that is?

Wendy Rogers: Yes, it's a term that was coined in the early 2000s to cover a suite of technologies and techniques that are basically a form of genetic engineering. So there's this idea that engineers can make lots of things very precisely. You know, if you think about a box of screws, they're all exactly the same.

They can, they've got techniques and approaches and a way of thinking about things to standardize processes. In biology, the processes are somewhat chaotic or can, you know, seem a little bit chaotic, you know, you plant a packet of seeds and they don't all look the same when they grow. So these two fields, sort of biology, particularly sort of molecular biology, genomics and engineering, have come together with this kind of view, well maybe we can standardize biology, maybe we can create sort of little packets of genetic information, like the code for an enzyme. And maybe we can put those into organisms where they wouldn't normally have that enzyme pathway, and we can turn these organisms into little factories, like little cellular factories, which will create things that we want them to create. So, for example, drug production is one potential avenue, and that's one that we talk about in the paper.

Now you genetically modify the organism to create a molecule, a drug, that it wouldn't normally create. You can also genetically modify them, not to create, organisms, not to create something in particular, but perhaps to, be able to metabolize something. And there's a lot of work going on looking at bioremediation—can we genetically modify organisms to get out there and eat up all the plastic and oil and other pollutants and create harmless byproducts doing that? So there's a, so there's a, it's a, it's a complicated field and it encompasses a lot of genetic techniques, genetic engineering. We've got a whole team doing DNA origami, which is just what it sounds like—it's folding the DNA into various shapes that can then do things that it wouldn't otherwise be able to do. So, you can't see their work at all. It's like, it's all, you know, molecular level, kind of a nano level. Then there are people working with organisms where you can see like a plate of organisms and see whether they're growing or not and they can measure the things that they're producing, you know, you can make them flourish in the dark and kind of things that are actually visible to the human eye. And then in the long run, you can, you know, have them growing in a vat and producing things sort of process that's called biofermentation, where you've got the organisms that you've modified and they're pumping out the product that you want.

Dani Davies: So, you wrote in the paper that there's a part to synthetic biology, perhaps quite a large part that, there's a lot of promises that it entails and whether it can bring those to fruition might be a different story. So bearing that in mind or not, depending on how you want to approach this question, how might synthetic bio change life as we know it?

Wendy Rogers: Yes, it is a promissory science sort of at the moment, given that we've had the field for 15 to 20 years and there are not a lot of major wins on the board yet. If it works, it could be, you know, extraordinarily transformative. It could affect health care, it could be able to bioengineer organisms that will produce drugs for people, perhaps based on the person's own DNA. So you've got very personalized treatments. You've got the possibility for production of

products that without the harmful side effects of production that we have at the moment, so what they call a circular green bio-economy. So there are people working on recycling plastic in a way that is sustainable, that kind of gives you virgin plastic over and over again, because at the moment when you recycle plastic, it's a horrid color and it hasn't got necessarily exactly the same properties. But, there's a team working in Canberra on trying to break down, you know, using microorganisms to break down the plastics so that they can be used, you know, as if it was brand new petrochemical material. So if that, if that process works and can be taken up at scale, then you've got the potential to have no more plastic production and just your water bottles will just be endlessly recycled.

There's, you know, challenges, people are trying to, for example, engineer microorganisms to photosynthesize that wouldn't ordinarily photosynthesize so kind of like harnessing solar power in different ways. At the moment, you know, trees can do all this cool stuff, you know, and grow just from, you know, with using the energy from the sun. And if we could engineer microorganisms to do that, well, that gives us a lot of power to create, for example, foodstuffs without the energy needs that the current mechanisms have. There's lots of potential applications. It could really, you know, in the really futuristic imaginings, you'll have your microorganisms, and you'll sort of be able to dial up what you want them to, you can combine the synthetic biology with the 3D printing and be able to sort of dial up your dinner. The microorganisms will produce the protein and then you'll, you know, get it printed into, you know, your favorite shape, a slice of tofu or a piece of chicken or something that looks like a martian because you're having fun, you know, so, so that, you know, it could be, it could be wildly impactful. Or not.

Emma Tumilty: What struck me reading the paper was just how much synthetic biology seems a lot like a lot of the other tech innovation spaces. Like I've read quite a bit on sort of things happening in Silicon Valley with other promises. There's lots of hype and then they kind of deflate or the thing that they deliver is a lot less impactful, but maybe also just terrible, doesn't do the thing and warps the world in some other kind of way. And the cases that you chose to apply the sort of feminist approach to, again, seem to parallel other things. So, can you tell us a bit about the feminist analysis that you applied to synthetic bio and what you think it sort of added in an analysis of these kinds of activities that other things might not?

Wendy Rogers: Yes, we looked at two, we used two case studies in the paper. Okay. So, one is the case study of the creation of Semi-synthetic Artemisinin, which was probably the first and perhaps most famous application of synthetic biology. And this involved the Bill and Melinda Gates Foundation funding a group of scientists at the University of California to use synthetic biology techniques to create a drug called Artemisinin, which is used for treating malaria. Malaria is a significant health problem for a large portion of the world's population and so the team got the money, you know, in the vicinity of 50 million US dollars, and they worked away, and it took them a long time, and a lot of complicated and a lot of technical challenges which they managed to overcome. And in the end, they got close, they, they got, an organism that was able to create something that's called Semi-synthetic Artemisinin because it needs a chemical conversion to make it into Artemisinin. And this is seen as a success, and there are undoubtedly, you know, major, major scientific knowledge gains in the process. It's considered one of the founding projects of synthetic biology. But the original brief was to make a, you know, a synthetic drug that would help treat people with malaria, because Artemisinin that we use in

medications at the moment comes from a plant, sweet wormwood artemisia plant, and it's farmed in, you know, what to Western eyes might seem slightly haphazard ways. It's smallholding farmers, or it's wild harvesting in various parts of Asia, in India and Pakistan, and also in Southeast Asia. And the supply to market can be unpredictable. It's dependent on the weather, it's dependent on other cash crops that people might have put in instead and so forth.

So the idea was that this project would help, would provide, you know, a steady supply of Artemisinin that could kind of fill the gaps when the natural harvest failed. But it didn't do that. It's never been commercially viable. It was too expensive. It's never made it onto market and it's hard to find out what's actually happening at the moment because a lot of stuff is 'commercial in confidence' behind the company that currently owns the patent.

But it's certainly not on the market in a big way and it never has been. I think the most it ever did was supply 10% of the world's supply of Artemisinin whereas they were aiming for around 30%. So, you know, if we look at, you know, standard consequentialist benefits and harms, you know, you could argue, and it has, it is strongly argued by the scientists involved, that it was beneficial. It created all this knowledge and information, the techniques have been applied in other areas, you know, it was a resounding success. Certainly was for the scientists who got lots of papers in very prestigious journals. But if we look at it from the point of view of the people who it was meant to help, the people with malaria, it was, it was a resounding failure, you know, and it didn't really do anything to help them. In fact, the price became more unstable in the, you know, as the project went on. Reach completion for reasons I don't fully understand, including, you know, bad weather and things that were out of people's control. But I think there was also a fear that this was coming and so it wouldn't be worth planting a crop because there would be chemical version on the market.

It wasn't a project that succeeded, to my mind, in really achieving its aims, and I think the operation of power was quite worrying to me. I mean, I don't have insights into how the Bill and Melinda Gates Foundation operates. There's very little that's publicly available when you trawl their websites. But there were voices at the time arguing that this was the wrong project if you wanted to address malaria in the target populations. This was the wrong project. NGOs like Oxfam were outspoken on this at the time, but that didn't seem to have any effect. And so I sort of think, well, you know, the power was all with, you know, the Bill and Melinda Gates Foundation. They had the money. And then I'm not sure how they met up with Jay Keasling who led the project. But, you know, I think a lot of things go on in airport lounges and in business class and first class that we don't know about. You know, it was, it wasn't advertised. It wasn't run like a research project that was funded by governments and so on. I mean, that's the privilege of, you know, foundations like that - they've got the money, they can do what they want with it. But it seemed to me, I don't, it seemed uncomfortable to claim that it was a philanthropic project to help with this particular problem of malaria when there were credible voices in the field saying this is the wrong project, if that's what you want to do, and when, and those voices turned out to be right, those critical voices, but then the people in charge of the project were able to kind of bin it to say, wow, it's this amazing success, we've kind of invented synthetic biology, you know, shame about the malaria.

So it's, it's, yeah, that's what I felt, that just looking at the benefits and harms wouldn't really capture how that power operated and look at the sort of the justice and equity, you know, the beneficiaries were a Western pharmaceutical company and Western scientists, the beneficiaries were not people who, you know, significantly impacted by morbidity and mortality from malaria.

Emma Tumilty: And that issue of power was also key in the second case as well, right?

Wendy Rogers: That's right. So, the second case is a kind of a feminist reflection on a qualitative project that Jac Dalziel and I did. Jac did the interviews for this and that paper's published as well, looking at how synthetic biologists in this project think about the ethical issues and kind of what motivated them and so forth.

I was particularly struck by the motivations that people wanted to do the science for the public good construed as improving human well-being, improving human health, you know, achieving planetary security, addressing the ecosystem horrors and disasters that we're walking into, addressing climate change. But then there was a big disjunct between that and the work that they actually did, because the people that do the work, like Jac herself, the people in these, in, in these big projects are the postdocs. And postdocs are on precarious salary funding, it's three years funding here, three years funding there, so they have to do projects that will get them another job. They'll have to do projects that will lead to publications, that will lead to scientific outcomes that are recognized as valuable in the short-term. So that's one sort of set of pressures which skews their research agenda, and another set of pressures comes from the imperative to develop partnerships with commercial ventures.

So the ARC, the Australian Research Council, funds this centre very generously, but it's on the proviso that funding is also secured from industrial partners. And that's the same, I think, in a lot of countries around the world these days. But commercial partners don't necessarily want to save the world and fix climate change or make, you know, new medicines available, you know, to cure problems in the Global South. You know, they often want to turn a profit. And so synthetic biology has turned out to be quite good at doing what I see as somewhat kind of gimmicky things like creating artificial flavors and fragrances and colors and so forth. And beers, you know, new yeasts for beers and so forth. And it's, you know, it just seems to me, again, you know, a mismatch. The powers that are influencing the research agenda are not the ones that are necessarily out in the open, and they're not the ones that we might want to be operating in this space, particularly when, you know, a lot of the research training is all publicly funded, and the people doing this are all people with PhDs that come through the university system, in which they, you know, at undergrad level, there's a lot of self-funding, because we have, as you do in the United States and the UK and a lot of other countries, you have to pay for your degree these days. And then if you're lucky, you get a scholarship to do your PhD, but that's on the public purse. And then, you know, the intellectual labor kind of gets hoovered up by industry and that's problematic.

Emma Tumilty: Yeah, I was going to say what's particularly problematic is if the resourcing and infrastructure comes from the promise of affecting life in these massive ways around climate change, around malaria, and actually all we're getting is better flavored beer, which I'm not going to point my nose at, but that's not quite the, it's not quite the same thing.

Wendy Rogers: Yes, it's a mismatch between, you know, the alleged power of the technique to do these incredible, to achieve these incredible manufacturing processes and so forth that are going to change our lives and then the reality so far. And fields take a long time to mature. So, you know, we may, you know, I hope to be eating my words in another five to ten years, but we're not there yet.

Dani Davies: Yeah, the insights that this feminist lens lends to this are fantastic. And I know from my own experience looking at these kind of technologies, previously I've looked at things like pharmacogenetics, and there's links with syn-bio for that, it's not always readily apparent how a feminist bioethics lens, what they will produce and how they will make sense of it. So, I found it really, really helpful reading through this paper and seeing all the different angles that you can approach these kinds of issues with. And a question or a point rather that really stuck with me was in going back to your first case study with the foundation, what defines success? That's not a question that I've often asked myself when looking at these kind of examples. So that, that really stuck with me.

What were some of the challenges that you encountered with your research or the writing of this paper?

Wendy Rogers: Time. Ask any academic and they'll say time. Look, I actually really enjoyed writing this paper. I was writing it at the time when we'd just finished editing the Routledge Handbook of Feminist Bioethics, and so, you know, I'd read more feminist bioethics in the last six months than probably in my whole life put together and, you know, work by fabulous scholars who I cite in the paper, and so that, you know, all of that, all of their intellectual work was very fresh in my mind, and I thought, yeah, look, you know, what Agamoni has to say, what Arianna has to say, what Carrie has to say, and, you know, it was just fabulous working on this just after having worked on that big project. So that, that was very interesting. And I think what's a challenge is communicating with the scientists in the project who are, you know, individually, you know, generally lovely people working super hard doing their science. And it's hard for them to kind of see these ethical issues because they, they see themselves as compartmentalized. They're working on an enzyme pathway. They're working on trying to culture these organisms that have been genetically modified that aren't growing as well as you want them to, or once they start creating a certain amount of the product you want, then it all goes pear-shaped because there's some kind of toxicity you haven't anticipated.

So they're very focused on the immediate problems at the bottom of their test tube or microscope or Petri dish. They often don't have the time and the mental space to really reflect on what they're doing. And I think also they, they can't see where they could intervene in the process anyway. And so, you know, if you're asking people questions, which in a way can emphasize their powerlessness, they don't really want to talk to you. So it's hard to find ways to navigate the field, you know, in a productive way, because I'm not here just to say, you know, you shouldn't be doing this, you should be doing that, or, you know, you're not thinking about this. It's like, well, how we've got this system that they're within a system that was already preset, you know, it was a condition of funding that you have industry partners.

You know, is there a way of making it work better than it might otherwise work? But that's what I try and do, and I wouldn't, I wouldn't say I'm there yet. I would say I'm a long way off!

Emma Tumilty: Yeah, I did wonder how the research, you know, I mean, one of the questions that we like to ask people is, what do you want listeners or readers to take away from your paper, but here also, I mean, what did the larger research group take away from your analysis in the end about things like relationships and power?

Wendy Rogers: I don't know. I'm not sure that they've actually read it! But what I did do based on the back of the interview study was we made a five-minute video or a six-minute video called The Values Microbiome, which if you Google you will find. And it's trying to illustrate how the fact that you have to think about values and they affect the context in which you're working, you know, is, is similar to how you have to think about the various factors that make your microculture flourish or not. So we sort of use the microbiome as a metaphor for the flux of values in which people are doing their work.

And, you know, people said they enjoyed it and we did like a post viewing survey and people said they could understand the values and they were important ones in their work. But does that change anything? I'm not sure.

Emma Tumilty: Oh, don't say that, Wendy!

Dani Davies: Thank you, Wendy, for such a fantastic conversation. There's a lot that we've taken away from this. I wasn't overly familiar with Synbio myself, so it was a lovely read, and I'm sure that our audience will very much enjoy listening to this.

Wendy Rogers: Thank you very much for interviewing me. And it's great to talk through these things because it is a dense topic, but hopefully we've made it a bit more accessible through the podcast and I'd love it if people read the paper.

Dani Davies: Lovely. Thank you so much.

Thanks so much for listening to this episode of Fab Gab. You can find the paper we discussed linked in this episode's notes, along with the transcript. You can find out other episodes on Spotify. This has been your hosts, Emma Tumilty and Dani Davies. Once again, thanks for listening. Bye.