Hans Bachor:	00:02	Well, good morning. I'm Professor Hans Bachor, and today I'm going to interview TJ Higgins. The date is the 16th of November 2021. The location is Shine Dome in Canberra. This is a recording for the Conversations with Australian Scientists at the Australian Academy of Science. Good morning again, TJ.
TJ Higgins:	00:29	Hello Hans, delighted to be here.
Hans Bachor:	00:32	I'm really looking forward to learning a little bit more about your work and your life, TJ. May I start at the beginning? I mean, you had a very long and distinguished science career and you have contributed so much to improve food production, food security, even reduce poverty, benefits to society. Could it be that your upbringing right at the beginning played a role in that and set you on a positive path? Can you please describe your early life and how it influenced you?
TJ Higgins:	01:05	I was born in the West of Ireland in a rural area (County Roscommon), an area that is still relatively poor. My parents had a very small farm and they brought up six of us. I was the eldest of six. I was very fortunate in having such wonderful parents who worked hard to look after us. I had a very good and busy childhood growing up in that environment. My parents were subsistence farmers, so we produced most of our food. We had chickens, a pig, and cows to produce milk and butter. We grew our vegetables, including potatoes of course. Being Irish potatoes were still a big part of our diet even then in the late nineteen forties and early fifties.
Hans Bachor:	01:53	So obviously you had to go to school, and I assume that is local, and in many cases the teachers actually influence things. Did that happen to you?
TJ Higgins:	02:02	It did indeed. The local primary school had two rooms with two very good teachers. The school was small, probably less than 30 students and it was within walking distance of home. So, I walked there with other children from the area. Later I had to cycle a bit further to a secondary school in a town about ten kilometres away, called Elphin. This school was built with a bequest from an English Bishop, in the seventeenth century, I believe, but it was rebuilt several times. I was able to go there because my mother negotiated with the headmaster for me to be admitted without paying any fees, which my parents could not afford. So, I was very lucky in being able to go to that school

which had two-room with about 48 students in total. Again, I was very lucky in having two excellent teachers, particularly the headmaster who was a Canon in the Church of England, which was very unusual in that part of Ireland by that time. He was an inspiring teacher, and I think he influenced me to think about science in the future.

Hans Bachor: 03:45 So as you said, the choice of where you could learn, where you could study, was actually a little bit limited or driven by fees. Was that normal or just...?

TJ Higgins: 03:58 It probably was normal for the area where I grew up, where most of the people were, like us, very, very poor in monetary terms, but very enriched in a cultural sense. People, including my parents, worked very hard to bring us up, but certainly money was an issue. And I would not have gone on to secondary school if it hadn't been for the fact that the grammar school that I did attend, did not charge fees.

Hans Bachor: 04:34 So you obviously got a very comprehensive, sound education through the grammar school. I understand you're actually also studied in Gaelic, not just in English.

TJ Higgins: 04:45 Yes, Gaelic, particularly in parts of the west of Ireland, was still spoken. It has become much more widely spoken since then. It was government policy at the time for people to speak Gaelic. My maternal grandparents spoke Gaelic, and so I was conversant in the language. Because I spoke Gaelic, I was able to enrol, free of fees, at University College Galway, part of the National University of Ireland system.

Hans Bachor: 05:43 So you studied agriculture and sciences. Would that mean that it could explain agriculture to us in Gaelic?

TJ Higgins: 05:52 Yes, [greets Hans in Gaelic]. I studied agriculture, which was obviously an extension of my farming experience. As kids we all worked, before and after school. So, we had experience doing farm chores including milking cows, saving hay, or cutting peat for firewood. It was an obvious choice for me to enrol in agriculture.

Hans Bachor: 06:34 So, Dublin was the next stage, and then from there you actually picked a PhD project, and then there is this remarkable travel to California. How did that all come about?

TJ Higgins:	06:46	I moved from Galway to Dublin in order to complete a degree in agriculture. I had a very inspiring lecturer, a geneticist, who had trained in Scotland. He encouraged me to do post-graduate work and to apply to various places. I was particularly interested in going to the United States and I applied to Cornell University, the University of Illinois, and the University of California. I chose the University of California at Davis. It was well known for its agriculture.
Hans Bachor:	08:04	So that was both an adventure and further study, I assume?
TJ Higgins:	08:08	Yes, lots of adventure there and wonderful colleagues. There were lots of students from around the world, a lot of South Americans, a lot of Australians, which probably had an influence on me coming to Australia. I met many great postgraduate colleagues there from all around the world. It was wonderful place, and [where] I had my Major Professor as they were called, Bruce Bonner, was an absolute inspiration for me as a scientist.
Hans Bachor:	08:36	TJ, you worked in genetics in the 1960s and 70s. I'm a physical scientist, actually, I have almost no deep knowledge of genetics. What were the big questions at the time, in those days? Did you have any role models or were there famous people that motivated work in genetics?
TJ Higgins:	09:01	Yes. There were lots of them, in fact. [There were] big questions around that time, because the structure of DNA had been discovered in the fifties, which wasn't all that much earlier. There was a great deal of interest now in the role that modern genetics might play. Towards the end of my PhD, which was largely chemistry based, I was interested in a problem that Mendel had worked on. Mendel, the very famous geneticist, had worked on. He had used peas, tall and dwarf peas, in his work to study genetics and to study genes and their role. But I was also quite interested in the chemistry behind those genetics. One of the professors at Davis at that time had just discovered some new chemicals in plants. They were hormones, very much involved in plant growth and regulation, and one of these hormones caused dwarfism in plants. There were known hormones already in plants, gibberellins that caused plants to grow very tall. I spent most of my PhD trying to figure out the relationship between those two hormones in the control of the growth that Mendel had studied, you know, 150 years earlier

nearly. I started out with the chemistry focus and became more and more interested in the genetics behind that chemistry. How were these hormones, what were the genes involved in producing these hormones and how are they regulated? I was very fortunate in the colleagues I had at UC Davis in getting started in that area. And it was a very, as you alluded to, it was a very fruitful time in biological sciences because people were starting to understand genetics much better at a very detailed molecular level.

Hans Bachor: 11:12 And was technology part of that?

TJ Higgins: 11:13 Technology definitely was very much part of that. It soon became possible to sequence genes to get their primary structure. And of course, the human genome project, which came a bit later, was a massive expansion of that early technology. There were people like Fred Sanger at the University of Cambridge who developed methods for sequencing, not only the proteins, but sequencing RNA and DNA. And this opened up a whole new area for when I came to Australia, for instance.

Hans Bachor: 11:53 So there's the next big move. You were somehow attracted to Australia for people or through the reputation?

TJ Higgins: 12:02 Yes, again the reputation of people and advice from colleagues at the University of California. People whom I highly respected said, you know, there are very good people at the Australian National University and the Research School of Biological Sciences. You should go there for more training, different kinds of training to what you have been able to get here. So that's how I ended up coming to the Research School of Biological Sciences as it was called then at ANU. I came there in the early seventies, 1971, and worked with Professor Denis Carr and his research assistant Peter Goodwin. This was an excellent and fruitful time for me, again, having access to wonderful colleagues. Not just the Professor and his research assistant, but also other people at ANU and at CSIRO, which is just across the road. There were lots of collaborations, lots of contact. I was very fortunate.

Hans Bachor: 13:05 So, that was a great choice in terms of your research. TJ, you're still here in Australia, right? So, you migrated to the country and you continue to stay. Was that easy? Was it automatic?

TJ Higgins:	13:18	It was very easy. There certainly has been a lot of Irish influence in Australia for a long time, starting with the convicts, perhaps. The culture in Australia was very easy for me to adapt to much, much easier probably than for many other people who came both before and after my time. It was very easy cultural transition for me, and I felt very comfortable here in talking to the people and interacting with them in general.
Hans Bachor:	13:51	So coming back to the research, what was the general opinion about the things you wanted to achieve? Were they difficult? Were they achievable? Where they regarded as impossible? And what timescales did people like you then look at, at the time? How long would it take to make real progress?
TJ Higgins:	14:10	I spent two years at ANU and then I moved across to CSIRO. Just across the road really and moved into a program that was very appealing to me. It was a program that was set up by former President of this Academy, Lloyd Evans. He was already at that stage - which was in the early seventies - becoming concerned about food security and the role of protein and calories, but protein particularly, in people's diets. He could see, and I think he was very prescient in the way in which he set up this program to look at food security, the timescales, of course, were long. We did anticipate that this would take time. Breeding new varieties of plants usually takes 15 years to come up with a new variety because of all of the work that needs to be done: the testing, the field testing, the proving of the plants in the field. It was not short-term work, but at that stage research and development was well-funded by the government. Not so much anymore, but definitely then, it was possible to undertake projects that were likely to take time. The new technologies that were coming available, I think, made it more attractive to a young person like myself. I could see that advances that were being made in protein chemistry, as well as in nucleic acid analysis, were going to be extremely helpful in what we wanted to do.
Hans Bachor:	15:49	So, were there particular skills that you brought to this personally, and what was the type of collaborators were you were seeking? Because this is probably all around teamwork.
TJ Higgins:	16:01	It certainly was all about teamwork. We have wonderful colleagues at CSIRO and ANU, and beyond during that time. My skills, I think were mostly energy...and interest. I had a

background in chemistry, biochemistry, and a little bit of protein chemistry, but I think my main contribution at that stage was a great deal of energy and enthusiasm to understand better the molecular biology of plants, how genes were controlled in plants. The technology greatly helped me in achieving some of those goals over the next several years. I spent a year on study leave at University of Washington in Seattle working in an animal laboratory, because I could see that animal science at that stage was ahead of plant science. It reversed very quickly, I might say. But I went there and spent a wonderful year in Seattle, which gave me new training in skills that I didn't have before that had been developed by colleagues there and at Stanford, just before I got there. I came back to Australia with a whole new range of skills that allowed me to do more molecular biology and perhaps less chemistry.

Hans Bachor: 17:29 So, you clearly brought new ideas, which were evolving around the word, brought them here. Another dimension of research is intuition. Does that play a big role in your line of research?

TJ Higgins: 17:43 Yes. Intuition is important there too. One of the things that did seem a dream but could possibly work, was the fact that we might be able to transfer genes. Not just by the birds and the bees as is normally done, by crossing or hybridisation as it's often called, but also using basic chemistry and biology to isolate genes and transfer them into species where they're not present at the moment. So that was, at that time, that seemed possible. It certainly looked like it was possible in mice. Could it be done in plants? And it turned out, in time, that it was possible to do this in plants and that became a major part of my career. From then on it was figuring out ways to transfer genetic material from one species to another, just using chemistry and biochemistry.

Hans Bachor: 18:52 So in the moment you're already sort of comparing what we know now or what we can do now and what it was like to do genetics in the 1980s. Was the development that you have experienced predictable, or were there big surprises?

TJ Higgins: 19:08 There were big surprises, first of all, that this was possible at all. There were many interesting discoveries along the way about how one could manipulate genes, make them do things that they didn't do before. The current President of this Academy, John Shine, did a lot of the early work in animals and in

microbes that I think gave us a lot of guidance in plant science about ways in which we could achieve things that were not possible to do using conventional plant breeding, for instance, but really advanced plant breeding so that now you could aim for changes in plant development and plant production that were not possible before.

Hans Bachor: 20:05 Now you have been with CSIRO since 1973, and you are still working there. That's a really remarkably long time. Was that clear to you from the beginning? What kept you there? What was the motivation to stay and push from one location in this big globe?

TJ Higgins: 20:26 Yes, it was very important. I joined CSIRO on that project that was overseen by Lloyd Evans, basically as a three-year appointment at the beginning. But when I arrived there – when I worked with colleagues like Paul Whitfeld, and Don Spencer, John Jacobson - I realised that this was a wonderful environment in which to work, and I could see that it would be possible to do much more than I had done before because of the research environment that was there. The colleagues that I worked with were extremely important to me and in my deciding to stay on in Australia. At the end of my three years, I was very fortunate to have my appointment made permanent. Something that doesn't happen all that much these days, but it was very important to me, of course, and my career, because it meant that I had some continuity and that I could, in fact, take on projects that were likely to take quite a bit of time and effort. So, I've been very fortunate. This has really been kind of a vocation or a hobby for me, very closely related to my background growing up in Ireland, of course, when my interests were always in thinking about ways in which it might be possible to improve farming so that it was less labour intensive and more productive.

Hans Bachor: 22:08 Now at the same time you were at CSIRO you also supervised PhD students. I assume that the vicinity to University was useful, ANU next door to Plant Industry. Did that play a role?

TJ Higgins: 22:20 Yes, that was very important. Having access to the University so that we could helped train students. They would frequently spend most of their time at CSIRO, because of the facilities that were there may not have been the same sort of facilities...we had a lot of facilities that were downstream, you might say.

		Universities are very important in educating new students, but sometimes facilities at CSIRO were complimentary to what they needed to complete their degrees. I was involved in the training of many PhD students, and post-docs in collaboration with universities. ANU mostly, but other universities like the Queensland University of Technology, University of Melbourne, Latrobe University, Monash University, University of Western Australia. I've been very fortunate in having many wonderful colleagues in the university system, as well as in CSIRO. So collaboration - I think you can get the message that collaboration is something that I see as being very, very important in achieving what are sometimes complex projects and taking them through to fruition
Hans Bachor:	23:42	Are you still able to stay in touch with some of your ex PhD students?
TJ Higgins:	23:47	Yes, definitely. Some of them are even starting to retire from their positions around the world now, but I do still maintain contact with them. I'm very proud of what they have actually achieved, and they sometimes say thank you as well, to me. I'm joking, of course, they have been very appreciative. I've greatly enjoyed working with young people. I still do now that I'm retired.
Hans Bachor:	24:16	I guess that's what keeps you young?
TJ Higgins:	24:18	Absolutely.
Hans Bachor:	24:20	Now, genetic modification technology has been immensely successful, but it also has been controversial. What were the big intellectual and technical advances? Let's start there...
TJ Higgins:	24:32	Well, the technical and intellectual advances were that it was possible now in the early eighties to transfer genetic material from one species to another. I was certainly involved in that, but my main interest was improving the quality of protein in food legumes. Legumes are an important group of plants that I greatly appreciate because they fix nitrogen from the atmosphere, allowing a farmer to reduce the application of chemical fertilizers. So that's something that I think is very important in sustainable food production. I've always worked on food legumes. Initially on legumes that were very important in Australia from an agriculture perspective, like peas, and

chickpeas and lupins. I spent most of my career working on using gene technology to improve protein composition, but that, of course, involved genetic modification or genetic engineering, which became a highly contested area and controversial. People for some reason, became very worried about this aspect of genetics.

25:52 I saw it as an extension of what Mendel was doing. Many people did not see it in that way, and I can understand [that] it is different. This certainly occupied me, not only doing the research work, but also in educating decision makers, and the community in general, about gene technology. How we did it, the technical aspects that were involved. So that people understood it better, but that wasn't enough. People wanted to also take it much further and became concerned about the role of multinational corporations in the technology. And it's true that multinational technologies had the funding to take this technology to the field. Whereas public research institutions like my own CSIRO, or the university system, didn't have the funding to take the technology to the farmers directly largely because of the regulatory costs, which are quite high. This raised suspicions in the minds of the community, the community became concerned that the multinational corporations would control the food system all the way from seeds, through to the food.

27:17 This is a concern, quite a legitimate concern in many ways. However, it was not the intention of the multinational corporations to take over the food supply for all the crops. They were interested in some of them of course, crops where they could take money, but this is a small proportion of the total number of probably 3000 different crops around the world that people use for food. The multinational corporations were interested initially in probably three, out of that 3000. And eventually they became interested in probably up to 10, but never very much more than that. But it was still a legitimate concern that people had. This has reduced a little with time and the public sector is now starting to take some of their research crops through the system, to the farmer's field. I'm involved in one of those myself now.

Hans Bachor: 28:19 So let's have a look at the practicalities. In all the three releases of GMO – Australia, Africa and I believe Bangladesh, am I right with that?

TJ Higgins: 28:30 Bangladesh and India, yes.

Hans Bachor: 28:33 So what was the motivation for these campaigns? What was achieved and, you know, was it similar or very different in their nature? In the plants, and the farmers that were using it?

TJ Higgins: 28:49 So the outcome of my earlier research on a better understanding of how proteins were made in plants, particularly in the seeds of legumes, led to me, working on, particularly on lupins. Lupins are a very important crop, especially in Western Australia as a source of protein, particularly for sheep and you will recall that sheep were very important in Australia's agriculture, particularly in the more recent past. They're slightly less important now, but I was very interested in improving the protein composition for feeding ruminant animals like sheep. We developed lupins using gene technology that had an improvement in their protein composition, such that it led to an increase in wool production, more efficient production of wool. We published all of that work and had taken it very close to commercial release, except for the fact that there was so much opposition to the import of lupins into Europe, because Europe was particularly antagonistic towards GMOs, and project had to be shelved.

30:09 I continued working on using that same technology in peas and chickpeas and branched out away from just working on protein composition and improvement of protein composition, to improving those crops in the field from the point of view of insects. Frequently the plant breeders, while they appreciated improvements in composition, they were also very interested in improving the protection of the plants in the field. And insects are usually the first line of offense in the field. There are many other offenses as well, but insects are a major problem. So I used that same sort of technology to develop peas that were resistant to a major problem in Australia. A bruchus called the pea weevil and we developed again, pees that were resistant to this particular insect pest. But again, we became stymied by public reactions to this where we did lots of field trials, but in the end, we were not able to commercialize these peas and they're still on the shelf here in Canberra. But the technology was also applicable to other crops.

31:27 You alluded to chickpeas in India, too. I have colleagues that I worked with in India to protect chickpeas against another insect

pest and those crops are currently in the pipeline for possible commercialization in India and Bangladesh as well. I also became interested in another crop in Africa. Cowpeas or black-eyed peas. I have spent really the last 20 years working on that. Taking some of the technology that we developed in the early eighties for legumes like lupins, peas and chickpeas for cowpea. Cowpea is a very important staple and food source for probably 200 to 300 million people, particularly in west Africa. This crop is of course also subject to all kinds of insect damage, but particularly a lepidopteran or a moth species called a pod borer. So, I had a request from colleagues there. This is part of the internationalization of science, one is always talking to colleagues around the world. They approached me and my colleagues at CSIRO to adapt some of the technologies that had been developed for the food legumes of importance here, and in Asia.

Hans Bachor: 32:57 You were invited to a conference in, I think it was Nigeria? And you reported your research findings because people had heard about your work. And it was largely about improving food for sheep, and they were not so impressed, but I guess that's changed with time?

TJ Higgins: 33:16 Yes, that conference was in Senegal, Dakar. The people who invited me there clearly had an ulterior motive. They were very interested in adapting the techniques that we had used in lupins and peas and chickpeas to cowpea. They were very persuasive, and I visited many farmers in that area, particularly in Nigeria, but also in Burkina Faso, and in Ghana. Visited lots of farmers and scientists, African scientists. They convinced me that it was worthwhile trying to use the technology for cowpea as well. It took us a few years to do that, but we did succeed in developing ways of getting new genetic information into cowpeas. That work has led to a whole new series of collaborations around the world, particularly with African scientists, entomologists, agronomists, plant breeders, wonderful colleagues. This was an opportunity for me to share technology that had been developed in the west and could be adapted in developing countries.

34:32 Frequently African scientists say, there's wonderful technology, but we never get access to it. Well, this was one case where I could see there was a way of transferring the technology from Australia to Africa. This has taken time. Of course, like you said

earlier, these projects do take time. This project has taken about 15 years, but we now have transferred genetic information into cowpeas that protects them against the pod borer, this devastating pest. It means that the farmers do not have to spray so much. They do spray to control these insects because the crop is so important in their diet, they want to be able to grow it. They don't get very much yield if they don't spray. Chemical insecticides have become cheaper over time and are imported from China, but they don't like spraying, just like farmers everywhere. They don't want to spray, if possible. They would prefer a biological inbuilt protection, and that's what this is. They started growing cowpeas with pod borer resistance, and instead of spraying seven to ten times a season, they can get away with spraying, say twice a season. This makes a huge impact both financially and health wise as they don't like spraying because of the risk of the insecticide, but also it's much cheaper of course.

Hans Bachor: 36:01 I understand that it means you're not just sending seeds to Africa. You're actually also building up the ability to do the gene technology eventually within Africa? In collaboration with other scientists?

TJ Higgins: 36:16 Yes, that's absolutely true. We share the technology with them and where possible try to have them do as much of the technology as possible, and in fact, they do a large proportion of the work now. I'm very proud to say, and very pleased to say that they are my real collaborators on a daily basis. I have fortnightly meetings with them. In the current climate, it's not possible for me to go there, but it is possible to share the technology and they are more and more competent, and I can stand back from the technology more and more. There are still things that I can do and am doing and look forward to doing into the future, but I also feel that they are very well trained and prepared.

Hans Bachor: 37:11 So that's quite an alternative to huge companies like Monsanto or, you know, Bayer. Who have big research labs and large resources. You see it as a feasible alternative to the company funded research?

TJ Higgins: 37:27 Well, certainly this case of the pod borer resistant cowpea in Africa is an example, and it's only one example now I might say, of the technology being done completely in the public system

with funding from public sources. The funding in this case has been very important - from USAID, from the Rockefeller Foundation, from CSIRO, from the Crawford Fund in Australia, and from ACIA, the Australian Center for International Agricultural Research. These are all public funds that have made this possible. The companies are still of course doing this sort of work, but now the public sector is doing it as well, and I'm very pleased that this is the case. The large companies are not interested in crops like cowpea, of course. They're not a way of easily making large amounts of money and we're not interested, of course, either in making money. We are much more interested in being able to give these seeds to the farmers, small holder farmers in Africa. Small holder farmers are even smaller than the farm that I grew up on. I grew up on probably a 20-hectare farm. These farms in west Africa are probably one to two hectares.

Hans Bachor: 38:54 So, the pressure is still on from the regulatory sides for GMO. Do you think that the current status of the framework of the regulation is appropriate in regard to safety oversight approvals? Or would you like to see changes?

TJ Higgins: 39:14 On the one hand I would like to see changes of course, to see that the regulatory arrangements were more proportional to the risk, but at the moment they're disproportionate. I also am very respectful of the regulatory system because it helps reassure the public and the community that everything is being done according to safety guidelines for health and for the environment. It's very costly, but I think it's still needed, shall we say. It is very expensive and could be changed, and the regulatory systems around the world are attempting to change to be more proportionate, but there are legal constraints, legislative constraints that makes it difficult to change. So, on one hand I find it difficult, because it is expensive. On the other hand, I feel reassured that the public are assured that it is a safe technology.

Hans Bachor: 40:18 You are a person who has worked with organizations that advocate strong regulations like Greenpeace. Is that a positive experience? Constructive experience?

TJ Higgins: 40:31 It has been. I've certainly enjoyed the possibility of being able to talk to people in Greenpeace and Friends of the Earth and other organizations. I've spent a lot of my time, time that I should

have probably been spending on doing research, but spent talking to people, educating them about the technology. It hasn't been entirely easy, but it has been respectful, I have to say.

Hans Bachor: 41:02 So TJ, how would you advise a young scientist now in regard to the balance between basic research commercial R&D and work with communities and NGOs? Can and should an individual person do all of these? You're basically an example for that, or should an individual person focus on just one or two of these?

TJ Higgins: 41:33 This is a very good question. I think it is very important for a young scientist starting out to definitely build up their credibility as scientists and to spend time working at what I would call the bench, or in the lab. This is very important, but it should not be to the exclusion of communicating that science to the community and to decision-makers. This is also very important. It's time consuming, but it is also extremely important. I encourage young scientists just to do some of the things that I've done. That is to talk to the community about your research and talk to decision makers in the government about the research. Show how this research is improving lives in the community. This is difficult to do, but I think it's extremely important. [To] science communicators that I've worked with, and there are many of them and they are excellent, this is a very important aspect of science. Probably much more so than I realized when I started out, as you would know too, very well.

Hans Bachor: 42:55 So there are choices. That's what you're saying, depending on who you are and where you are in your career? You can focus, but then still contribute to all of these areas?

TJ Higgins: 43:07 Well, I think so, yes, but it does need to be taken in a stepwise manner. I think it is important to develop credibility in science, but it is then also very important to start moving that science forward towards an end goal that is going to benefit the community in the longer term.

Hans Bachor: 43:30 I think that gets us seamlessly to the Academy. TJ, you have made major contributions to this Academy as a member of Council and for many years as Vice-President. How did you get involved and what was the best experience?

TJ Higgins:	43:47	The best experience was being elected a Fellow of the Academy, of course, totally. I felt totally unjustified in my case, but this was a great experience. The Academy has been an important part of my life as well. It has been part of some of the issues that you've just raised...talking about science to the community, to the public and to decision-makers in government. The Academy has given me opportunities to talk to them from a platform where they are likely to pay attention because of the reputation of my other colleagues in the Academy. The Academy has a very high standing in Australia and around the world, I might say, but it is a great platform, to talk to the community and decision makers about the role of science in our future. I have enjoyed making a contribution as well, because of the great benefits that I have received from being a Fellow of the Australian Academy of Science.
Hans Bachor:	45:02	So surely there have been some challenges too?
TJ Higgins:	45:06	In the Academy?
Hans Bachor:	45:07	Yup.
TJ Higgins:	45:09	Yes. There have been challenges. We have fought very hard for funding, for R&D, and for decision-makers particularly in the government recognising the value of investment in research and development for the future. This is an ongoing activity we have with my colleagues in the Academy, more so than I directly, have also made major contributions in convincing first of all, the community from an education perspective, but also from a policy perspective. The Academy provides all kinds of advice to the government and to the community about the value of science, and this is something that I have made a small contribution towards, but many of my other colleagues, fellow members of the Academy have made huge contributions in those areas. It is a challenge and was much easier when I started out, [when] the government did invest much more money in research and development.
	46:19	It's not doing that now, but I hope...I'm hoping that our information pleas to the government, particularly after….I think the government probably recognised the importance of science during the COVID pandemic. This has been an immediate way in which the government can see past investments made in medical research and development, but other aspects too I

might say, how important that has been for Australia's quite rapid recovery. So, I'm hoping that there will be changes in the future.

Hans Bachor: 46:55 So let me ask you, TJ, did the Academy influence you?

TJ Higgins: 47:00 The Academy did influence me. Even in the early days, I could see the investments that the Academy was making in awards, and in supporting science. I didn't benefit directly from it, but some of my colleagues did, and I could see how valuable that was. That the Academy does make a huge contribution to science in Australia, even more directly than the way in which it influences policy or has its policy advice, [which] is so important. The fact that it recognises science advances around Australia, this is extremely valuable as well, and had an influence on me when I could see people's careers getting recognised by medals and awards. These are very important as well.

Hans Bachor: 47:56 So looking into the future, TJ. Do you see it with optimism or with fear, in your own field or for the whole society?

TJ Higgins: 48:07 I do think about the future and, I do have some concerns. I think like you, I'm interested in population, the fact that we are overpopulated in the world and that we are doing a lot of environment damage, particularly in in the Western world. Our food production systems are not really sustainable. We are destroying too much of the environment in order to produce our food and we have to change that. We know that we are going to add another 2 billion people to the planet in the next, probably 25 to 50 years. This is something that I am still concerned about, and this comes back to my point that I was making about public investment in research and development. I think it is important that our governments do invest more in research and development for the future to deal with some of these very big issues.

49:19 I am concerned about that for the future, but I'm also optimistic about the future. I'm particularly optimistic about the way in which young people are working for a better environment for the future. They are thinking much more than I think my, our generation thought about such issues at the same age, for instance. We're now thinking about it, of course, but we didn't, I suspect, at that time. I'm also very optimistic about our future

in the role that women, especially young women now, are playing in STEM. That they're becoming much more interested in some of the areas of science and technology, mathematics, that are going to be very important for our future and their full participation in that is, I think something that makes me very optimistic about the future. So I'm not all doom and gloom about the future. I do have some concerns, but I do also feel very positive about the future as well. That we can do better than we have done in the past. That we will do that.

Hans Bachor: 50:33 Well, thank you, TJ for such positive, but you know, well-considered outlook. Now we talk all about your work, but it's important to balance work with life. Can you tell us a tiny little bit about what keeps you sane, what keeps you active? What allows you to have all of this energy that you show?

TJ Higgins: 50:54 So, work certainly has been important. My wife would probably say, maybe over a bit overdone, but work really has been more or less a vocation or a hobby for me. It is very important in my life, and I relate that back to growing up. You know, my family, my parents, hard work, they certainly...our culture was to work and to enjoy it. It hasn't been a burden to me, at all. I've enjoyed it so much, but I've also been very interested in the outdoors. We've done a lot of bushwalking, camping. We spent a lot of time at the beach as well. I've also been interested in cultural activities, particularly in music and dance, and particularly folk dancing because of my background in Ireland, I started out with social dancing, which we call ceilidh dancing.

51:56 I continue to do that when I came to Australia because bush dancing here is closely related to the kind of dancing that I used to do as a youth in Ireland. Dancing has always been an important part of my outside life. Mostly in more recent times Scottish country dancing. This is an activity that's practiced everywhere around the world. Everywhere you go, you can join a Scottish country dance club, anywhere, immediately. It's something that has also provided me with a bit of exercise and a great deal of community involvement, interactions with people who are not involved in science at all, which I think is also an important way to maintain balance.

Hans Bachor: 52:39 Oh, that's beautiful. I've always enjoyed the talks recently about the future of food [Food for Thought 2021]. Maybe in the future

		we can also enjoy some Scottish dancing here at the Shine Dome.
TJ Higgins:	52:50	Yes, yes.
Hans Bachor:	52:53	I would like to thank you for such a beautiful, elegant interview. I'm sure if I wish you all the best for the future you will do many more things in science and in your private life.
TJ Higgins:	53:05	Thank you. Thank you, greatly enjoyed this interview.