Prof. Peter Dobson OBE

Interviewed by

Elisabetta Mori

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Via Zoom

Welcome to the Archives of Information Technology. It's 10th December 2021 and we are recording this interview on Zoom. I am Elisabetta Mori, an interviewer with Archives of IT. Today I'll be talking to Professor Peter James Dobson. I am in Italy, in Tuscany and Professor Dobson is in Oxford. Professor Peter James Dobson had a broad career covering a wide range of disciplines, from physics and chemistry to material science and engineering. He has worked in industry as well as academia and was responsible for creating and building the Begbroke Science Park for Oxford University. He has published over 190 papers and 32 patents. He spun off several companies, including Oxonica, specialising in making nanoparticles for a wide range of applications, Oxford Biosensors and Oxford NanoSystems. He is currently on the advisory board of several companies involved in nanomaterials, healthcare and energy. He is a chartered physicist, a Fellow of the Institute of Physics, a Fellow of the American Chemical Society, he was awarded MA from Oxford in 1988 and he is a Fellow of the Royal Society of Chemistry. He was awarded the OBE in 2013 in recognition of his contributions to science and engineering.

Welcome, Pete, thank you for being here today. So let's start with where and when were you born?

Oh, thank you very much for this invitation. I was born in Liskeard in Cornwall in 1942 and I grew up in Cornwall in fairly primitive conditions by our standards today. I lived in a house with no mains electricity, water, telephones, nothing, until I was fourteen years old. So I've seen what it's like to be in what we would call a zero carbon economy, or nearly zero carbon. And they were happy days, but I had to get all my homework done while it was daylight because at night we had no means of lighting to read by, so it was a hard, hard upbringing.

Can you describe your parents? What were their occupations?

Yeah, my father was a teacher in a small village school and my mother taught domestic science, cookery and things like that, part-time. And, you know, we had a happy childhood, my brother and I, and we really learned the value of learning and picking up as much science as we could at the time from our local library and our local schools.

So what was your family life like in this environment? So can you describe a little bit more your days as a kid?

Yeah, family life was fun in the sense that we had to plan everything meticulously. When the well ran dry we had to walk half a mile to collect water from a spring which was in a field full of cows, so it was quite an exciting life. And we had a little wind turbine back then and it was charging up a whole bank of old lead acid batteries which my dad had managed to find, I think they came out of a submarine somewhere, and they were really low-quality batteries by then, and we tried to use them to light the house. Heating was done from an old-fashioned Cornish stove which we heated using coal or coke, which we were able to buy from the local gas station in Newquay, which was about four miles away. It was an exciting life.

[00:04:32]
Who were the important influences on you in your early life?

Sorry, could you repeat that?

Yes. Who were the important influences on you in your early life?

Ooh, I think it was encouragement to learn as much science as possible. My dad was very keen on that because he'd been a navigator on a ship in the war. And when I got to the local grammar school, the secondary school, we had some truly brilliant teachers. They were very motivational, especially in physics, chemistry and maths, and the school itself backed on to the old gasworks, so we had practical demonstrations of chemistry actually in the gasworks. All of those things influenced me and even my art teacher influenced me because she was a brilliant artist and potter and she got us looking at the different minerals that went into pigments and glazes. So all of this added up together and gave us a very well-rounded sort of education. The physics teacher was quite remarkable, the way he encouraged us to do experiments and find things out. So I can't speak highly enough of the teaching that went on in those early days.

What did you do after high school?

Well, that was an interesting thing, because in Cornwall it was very difficult to get to university. We didn't have as many scholarships as other parts of the United Kingdom, so my physics teacher encouraged me to apply for an apprenticeship with what was called the General Post Office, which is now British Telecom. So I applied for one of those positions and I got it and it was the best decision I made in my life at that stage, because the scholarship I won was worth much more than the scholarships awarded by the state to get into university, but it had the added bonus that it provided a lot of extra training. So in my first year away from school I was trained in all aspects of telecommunications in both London and my local region and every vacation was spent working for the GPO, the Post Office. And at the time it seemed hard because I wasn't getting proper holidays, but looking back on it, I learnt so much more in those periods than I've ever done. And I guess it turned me into a bit of a workaholic, to be honest.

What year was that when you started your apprenticeship?

1961. Sixty-one.

So, what was the first impact you had when- can you describe your work environment and what changed?

Some of it was grim. I was put into accommodation in a very rough part of London and coming from a very rural part of Cornwall I found that quite a severe shock and I would try to get away at weekends back home to Cornwall as often as I could because I hated London at that time. I was working most at that time in the headquarters of the General Post Office in the City and it was really boring, horrible work in my view, I didn't enjoy it at all. It started to get much better during the winter when I was transferred to some of the research and development activities and one of the ones I enjoyed the most was in one of the most beautiful houses overlooking Regent's Park. The GPO had laboratories in the basement of Regent's Park Terraces and this was a really exciting period, these guys were all backroom boys left over from World War Two who were used to inventing things and in that basement I learned all about things like electrostatic spraying, ultrasonic cleaning, and then I went on to apply that in the factories that were run by the GPO, the Post Office. So in the factory in South Wales we applied the lessons of ultrasound, ultrasonic cleaning to cleaning up those old telephone dials. They used to dismantle them and brush them and put them back together, but we found we could just dunk them into a bath in an ultrasonic cleaner and they came out as good as new. So there were little things like that which made my life really exciting and I was all the time trying to learn more, it was the right environment for me.

[00:09:49]
Did you have any mentors at the time?

Yes, there were mentors. In Dollis Hill we were assigned mentors and I think Tommy, that was when I first saw Tommy Flowers and I met him and talked to him for about ten minutes, and then I was assigned to one of his colleagues, a guy called Albert Lynch who was a very tall, commanding, eccentric individual. He had a monocle or one of those pince-nez spectacles, as I recall. But the thing I really admired about him most was he had a very old Rolls-Royce which he drove up to the laboratories, and we thought, wow, this is quite special. We also had a wonderful training officer there, and I can't remember his name, but occasionally he would ride on a horse around the North Circular up to the Dollis Hill laboratories. He came from Devon originally and was a delightful guy, very human. You know, he listened to us and he realised that as young people we were coming in from all parts of the country and we found London a bit intimidating, but he made us feel at home. So all of the people that I met in Dollis Hill and in Regent's Park Terrace were very, very nice human individuals and they, I cannot fault them, they were all great.

Can we go back to your meeting with Tommy Flowers? Can you describe him, what were your impressions?

Oh, at the time I just thought, well this is just the sort of person one would expect to be in a leading research laboratory. I knew very little at the time about Colossus, in fact nobody did, so he didn't talk about Colossus. And what, as I recall, was spoken to us was about the possibilities of using the technology that was used in computing machines, as he put it, to run a telephone exchange. And ultimately that did lead to the creation of the first electronic telephone exchange at Highgate. And one of the 20 of us apprentices actually did work on that first telephone exchange, which was not valves but transistors. I think everybody had realised that valves were too unreliable to really do a telephone exchange job properly and you'd have to get the smaller, less power-hungry transistors to do that. So it was a really interesting transition time when we were trying to get rid of valves, bring in transistors. But in Dollis Hill there was still a lot of activity in what we called special quality valves, because we didn't see how we could put transistors into repeater stations and the trans-oceanic cables. So I think it was in the fourth year of my apprenticeship I had a very nice time working on high quality, special quality valves which you could put into a repeater, pop it down on the seabed and it would last for 15 years. And this actually taught me a lot about surface science, especially surface physics and it led to me leaving the GPO and doing a PhD in that subject, with the long-term intention of coming back to the GPO or working closely with them.

[00:13:36]

So, tell us a little bit more about university. Which university did you go to and…

Yeah. I went to Southampton University and I picked it because it was close to the sea. I had a place to read physics at Imperial College, but by then I'd realised I didn't like living in London, so I switched and took the offer at Southampton. Southampton had a very high reputation in electronics and physics, so I was okay as regards the GPO, they were quite happy with that decision. At Southampton I messed about a lot, I played a lot of sport and things like that, got involved in the various music scenes, met my wife actually, met my future wife while I was there. And at the end of my undergraduate time when I was wondering whether to go and work on a cable ship for the GPO or do a PhD, the PhD won out because I was getting married and I wanted to stay on dry land rather than on a cable ship. And I did surface physics, partly with a view to trying to make radio valves more reliable. But I very quickly switched into growing semiconductors and metal films and that really dominated the next 20 years of my life, so… But it was the background training at the GPO that led me to do that work and after getting a PhD I got a lectureship at Imperial College, ironically [laughs], and I also got some funding for my first research students through the GPO, and I stayed in close contact with the GPO all the time I was at Imperial, for sixteen years as a lecturer, so there was a regular interchange of ideas and one or two studentships with them. So I kept up with them all the way through, it wasn't a complete break, it was following the new developments when they moved from Dollis Hill out to Martlesham.

Let's go back to Southampton, what was the title of your PhD?

Gosh, I can't remember. I think it was 'Epitaxial Growth of Thin Films of Metals'.

Okay.

Originally it was going to be semiconductors and we realised that it was tough. My supervisor wanted me to grow germanium and gallium arsenide films and at the time we had glass made vacuum systems which we built ourselves and we realised very early on that there would be contaminants coming from the glass and messing up the properties of the semiconductor. So we picked an easier job which was to look at the growth of metal films. And I did quite a lot of what we call epitaxy, growing a single crystal of a metal film on top of a single crystal. And I took that work with me from Southampton to Imperial College and I did a lot of electron diffraction of epitaxy, as we now call it. Still concentrating on metals, and it was over a period of that sixteen years that I got back into the semiconductor field. And it took that long, by the way, I mean even well-found laboratories such as Bell Labs and Philips and IBM found that the semiconductor growth needed to have much more sophisticated backing systems and technique we now call molecular beam epitaxy. So I got back into the semiconductor field in the early 1980s and it was while I was recuperating from a period of illness that a colleague at Philips said, you know, you understand electron diffraction, come and help us interpret these pictures. So I did and I found that we were able to study how a semiconductor crystal grew and formed a single crystal. I then transferred from Imperial to Philips. It was a tapered move, I'd had a year of sort of leave of absence, part leave of absence, then I moved completely and actually one or two other people from Imperial followed me. So I then became a permanent employee at Philips, and I have to say, that was partly due to the very early days of my apprenticeship because the director of the lab, the deputy director of the lab at the time at Philips was the person who was running the Maser, which was the detection system on the aerial at Goonhilly Down which was the earth station for Telstar. And he'd shown me how the Maser worked back in those days and remembered me from 1961. So in 1984 he offered me a job and it was a wonderful feeling actually. Working for Philips was terrific fun. They had a very, very flat structure. There was no pyramid hierarchical thing about it and you, everyone felt they could contribute to an invention or to what the company was doing. And I just found that really exciting and it's a thing which has stayed with me forever. When I became a director of the laboratory later on here in Oxford I made sure that I went round and met as many people in the facility as possible and really talked to them about what they were doing, why they were doing it and what they wanted to get out of the job. That was the sort of atmosphere that went on in Philips and it's stayed with me. Looking back on it, it was quite similar to Dollis Hill in many respects, but Philips took it much further because they're a commercial inventive company and I think that's how Philips invented so many things. They just allowed every worker to feel they were contributing to the good of the company.

[00:20:20]
Have you ever visited Philips' headquarters in Eindhoven?

Yeah. So we'd fly over to Eindhoven occasionally. That was also good really, because occasionally there were some questions of physics that we needed to sort out in a more practical semiconductor growth and we could collaborate with people in Eindhoven who'd had different and maybe better facilities, so we could do some pure physics experiments with our colleagues in Eindhoven either in a day, you know, it was possible to fly from Gatwick Airport to Eindhoven and back in a day and do quite a decent day's work, and sometimes we'd stay there for a whole week. But there was very close linkage collaboration between Eindhoven and the Philips laboratories at Redhill.

And so you joined Philips in 1984, and then, what happened?

Well, I moved into different areas in the laboratory. I felt that we'd solved all the semiconductor growth and I started to get interested in new devices, so I was, at first I just operated in a lab where I was making measurements for other people in the building who were growing layers for lasers. And while I was doing the characterisation I was able to experiment with things like modulators for light in semiconductors. It was a bit restricted because it had to be geared towards the business side of Philips and I wanted to diversify a little bit, I wanted to see if we could use light for computing, for example. I also wanted to see if we could use these laser diode structures made as simple light emitting diodes to emit light for lighting. But that was not really looked upon very favourably back then, it was quite amazing, we had a lighting division which was based in Croydon and there was very little interaction between the lighting division and the people working on semiconductors and I think that was probably a fault of the Philips management that they hadn't made that obvious connection. It was made later, and as you know, today Philips LED lighting is a major, major thing in the whole of Europe. But back then we could have had a jump on the whole of the world if we'd made that connection sooner. And I think that's one of my regrets that I didn't push that. But what it did do, it allowed us, as scientists in the lab, to think of things like that and to take those ideas and many of my colleagues, when the Philips semiconductor work broke up in the UK, they went into universities and they really made major advances wherever they went, they changed the way that the university they joined was thinking and working, and so colleagues who moved off to Nottingham and Manchester and Cambridge actually contributed to the way that semiconductor sciences moved on from there. So it wasn't a wasted opportunity, I think Philips played a very fair game and it gave us all a very good background to do the next career move.

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And what was your next career move?

Well, that was a bit disastrous at first. I turned up in Oxford and the…

What year?

… the department had forgotten I was coming and they wondered who I was and what was I doing there, and I was put in a really uncomfortable position of having no laboratory, no office and I had to give up on bringing all the optical equipment that I'd planned to bring from Philips into Oxford because there wasn't anywhere to put it. I believe one of my good friends and colleagues took it all off to Manchester. Lucky chap! [laughs] I didn't get any of it. So I was stuck wondering what to do and I decided to do two things. I decided to look at something called quantum dots, which are what happens if you shrink a semiconductor down in all three dimensions. When we made the lasers for the CD players and DVD players we effectively shrunk the dimensions down so there were very thin layers, quantum layers, and that's what the quantum well laser is all about. To this day they're very, very successful, they're in everybody's disc reader. Now, one of the things I wondered about was, could we do this by making tiny little particles of semiconductors and could we pump them and create light or lasing, and I wanted to do a different approach altogether, I wanted to use wet chemistry. Now, I'd done a little bit of this on a Friday afternoon down in Philips so I knew it was possible. In Oxford I set up a lab to do a lot of it and I started to grow semiconductor particles which showed really interesting light emitting properties. So that was one thread of work and I could do that in the most simple laboratory, I just needed a fume cupboard and a sink. Nothing more. But there was a really good thing that happened at the same time. A chemist called Professor Allen Hill was in my college and he saw that I had some of the skills that were needed to make biosensors and he got me interested in making enzyme directed biosensors. He'd already invented the glucose sensor which has transformed the lives of diabetics, and that was already coming on to the market through a company called MediSense, which he'd help set up, and I became a kind of unofficial consultant to them. But then Allen Hill and I started to make new types of sensors which would do other things, measure things like lactate, some of the compounds that give you an idea whether you were going to have a heart attack, cardiac risk analysing. And by nineteen eighty… no, 1995 we nearly formed a company, but we just couldn't get the cash together at the time, but later on, by the year 2000, we did form a company to do that. And in getting into the biosensing area I also was able to work on some of the early DNA sequencing machines with Professor Ed Southern in the Department of Biochemistry. So Oxford's inability to give me a laboratory from day one turned out to be an advantage because it got me collaborating with two really brilliant people in the bio area and I was able to think of what can you do with minimum facilities in the semiconductor area, and that's what led me to making quantum dots and nanoparticles. So all was not lost. I also at the time helped to set up a new joint course between the Materials Department and the Engineering Department and that produced some very good people, actually. It wasn't a big success in terms of numbers of people going through the course, but the ones who went through it went on to achieve a lot of important things.

[00:28:31]

Can you name some of these people?

Yes. One of them would have been Mark Graves who went - he was originally a vacation student at Philips – he went on to set up a company which was developing, I think it was called Bone Scan originally, it would pick up very tiny fragments of bone in meat on a conveyor belt in a packing plant. And he took that idea to commercialisation, sold it on and then with the money he got from that he took over an electronics company down in Paignton in Devon. And, you know, that's quite a lot for a very young man, still under thirty by the time he'd done that. I've kept up with him, he's now a consultant, and together we do a few interesting jobs helping out companies with patents and so forth. So that was one of those people. Another one went on to become a very good patent attorney, operating in the Midlands and North of England. And some of the others were engaged in some of the start-up activities that I got involved with later on when I formed a company called Opsys, and then later on Oxonica.

Can you tell us a bit about Opsys?

Opsys was an interesting company, it was jointly with the Chemistry Department. My postdoc was a Russian who was working on quantum dots and the chemist was somebody working with rare earth compounds which emitted light. And it was a sort of competition, which is the best technology: the rare earth compound or the quantum dot. And we, even to this day I'm not sure which is the best. But these two guys got together, rather than fight each other, and they said let's go and see what we can do with the rare earth, so they were certainly easier to make in terms of getting the three important colours, you know, the red, green and blue. And we were able to synthesise a range of these compounds and they emitted light at the corners of the chromaticity diagram, so they gave a very good, sharp, crisp image when the light was combined.

Now, the thing they did was they found they could make these compounds so that you could put them down using wet chemistry, or you could go into what they call vacuum chemistry and evaporate them. And I was really amazed at the crispness of the colours they were achieving from these, so I didn't want to get too involved in running the company and I let the two postdocs form the company. But I did get involved later on because I provided facilities first of all in my lab and then later on when I became the director at Begbroke, I was able to give them space where they could develop the idea. And everything looked pretty good, they were making displays, full colour displays of mobile phone sizes back then in 2002, that sort of period, but then the investor they had, a company called 3i's, pulled out of investing in them and they had to find some money quickly. Well, they were bought by our big rivals in Cambridge, Cambridge Display Technology. And although Cambridge Display Technology promised to keep the company going, that promise was quickly broken and the entire Opsys technology was lost and broken up. It's a great shame. But I think you can see how successful it was because a lot of those ideas were taken over to Korea and ended up in places like Samsung and LG, so we had employed quite a lot of Koreans, I have to say, in the early stage. That was partly because we couldn't find any homegrown skilled technologists to make the things and this is a problem here today. Lots of the great ideas coming out of British universities we don't have enough people at the highly skilled technician level to turn these into commercial reality. So it's a lesson that Britain hasn't learnt, but we were seeing that, it was tragic really. And it still is. I think we could have had a really powerful display industry if we'd managed to keep that company alive.

[00:33:36]
So in 1999 you also contributed to the firm Oxonica.

Yeah.

Can you tell us a little bit more about Oxonica?

Yeah. We thought we could make nanoparticles of anything. We had a very skilled team at the time and we'd given up a little bit on the semiconductors that we knew and loved, but we could make any oxides which are halfway between semiconductors and ionic materials, and we were really going very well in that respect and I thought just having this ability to turn any material into a nanoparticle, there must be so many applications out there waiting for us that we would have very easy time in the market. Turned out not to be true. We made some particles for display industry, we trialled them with companies like Motorola and Sony and others, and they came back and said well, they're not all that good. [laughs] A little bit better, perhaps, than we thought, but we would only be interested in the complete system. And we didn't have sufficient funds to provide them with a complete screen, for example. But then we had a lucky break because we'd made some titanium dioxide for another application and it turned out to be very good for a sunscreen because it blocked ultraviolet light. But this particular stuff that we'd made to conduct electricity also acted as a very good scavenger of free radicals, which are the things that cause all the skin damage with sun creams. So Boots the chemist's got to hear about it, trialled it, found out that we were telling the truth and we had a really good ultraviolet blocker, which also protected us against free radical damage, and it protected the sun cream against free radical damage. So the sun cream stayed active for six hours on the skin. And that idea got on to the shelves really quickly, in two or three years we were getting it on to the shelves in the shops. So it was kind of breaking the rules of innovation, we were, normally innovation takes ten to fifteen years, we had actually got something out there in three or four years. So that was one thing which was flowing through and working really well and fast. And about the same time we had another compound which we'd been making which became much wanted, it was a rare earth, it was cerium oxide, no doping in it, it was just cerium oxide. And this material is quite plentiful and it's used as an abrasive material in polishing glass and things like that. And we'd met this inventor who said that he'd added cerium oxide to diesel fuel in his car and it seemed to eliminate the smoke coming out of the tailpipe. But the bad news was, it was abrading the engine, because it's an abrasive material it was wearing out the engine. So a team of our people in Oxonica developed nano cerium oxide and we found a way of making the one which was a really good catalyst to help burn all the oil in the engine during the exposure. So when your diesel engine compresses the diesel you get the bang and you get complete combustion if you put our stuff in there. So we didn't get any smoke coming out the tailpipe, but we got more efficiency. And this was trialled in buses in Hong Kong back in, I think it was 2003, and it was a great success. And the bus companies liked it because it gave them better fuel efficiency.

They weren't all that worried about blue smoke coming out the back of a bus, they were worried about fuel consumption and everybody was happy. Now then Stagecoach bought the Hong Kong bus company and trialled it in the UK, first of all in Scotland and then later in London. And again, it worked. It was not quite as good as the results in Hong Kong, that was because the buses here in the UK were newer, they were a much newer design of diesel engine. So for many years we had an exclusive contract with Stagecoach and this lasted until about two years ago when the diesel engines of the latest variety are so good in terms of their efficiency, they're not improved by putting in our additive. So no, a lot of inventions are like that, they get a window of opportunity of about 15 years and then it goes off. But those two products were very successful and to this day, I think we did the right thing. But it taught us one really important thing, and that is the importance of market pull. We had got something that people wanted to buy and we knew how to make it and get its quality in the form that it satisfied the customer. So that was a really important set of lessons. And we had quite a few others like that coming along in Oxonica, but I'm afraid they lost their way as a company and they ended up satisfying their shareholders by downsizing, selling off lots of stuff and the story kind of ended there. The fuel additive carried on as a separate company that was bought out. The sun cream has just survived on royalties and the patent ran out last year, so we're now looking for new things there, really.

[00:40:00]
So around early 2000 something else happened, so you succeeded Professor Cantor as Academic Director of the Oxford University Begbroke Science Park. So can you tell us what was the vision and what were your major achievements during…

Well, Brian Cantor was, he wasn't really the director, he was the head of the division. He helped the university acquire the site and they bought the site of Johnson-Matthey and Cookson's. I think the company Cookson's actually owned the site. So that would have been in 2001. Brian then decided to leave Oxford and go to York to become vice-chancellor in 2002 and they advertised for two posts: one was of course to replace Brian as the division head, and the other was to run the Science Park. I got the job of running the Science Park and it was, it was a risk on my part because I was still keen on research and teaching, but I thought, well, there's not many other people in the university who are qualified to do this, because I'd seen companies grow and, well, at the time I hadn't seen them die. All the companies I had up till then were growing and growing very successfully. So I got the job in 2002, I had to relinquish my teaching fellowship in Queen's and also all of the teaching that I did in the department. So from then on my teaching load dropped quite a lot and I was just doing graduate teaching on several specialised courses. So my role then was to try and raise the money to develop the site. And it was quite tricky. At first I think the vice-chancellor and the team at the top of the university liked the idea but didn't have a clue how to grow the site. I knew how to grow it, but didn't know how to get the permissions and the money and I learned how to form relationships with local politicians at both the city and the county level and then at the bigger regional, south-east regional level, we got quite generous support from the South East England Development Agency and we were able to get money together to build buildings. And as soon as that started to happen, then the university saw the merit of this and started putting extra money in to actually equip the buildings and furnish them. And I had a sort of, I wouldn't say it was a production line, but it was a planned development of building after building on the site. And along with that I had a very small team, I gave up any idea of having a secretary or a PA and decided that any money for that should go into a general office to help me run the site. And we did that, I had a team which was really good. They, it was a very lean team: we had a site manager who looked after all the maintenance, we gave him an assistant; I had an administrator working alongside of me who looked after all of the contractual issues and so on. We kept the team very very lean, and because we kept it so lean it was very easy to operate. And at the same time, I kept a kind of open door policy for academics in the university who wanted to come and talk to me about spinning off, and I also kept our open door policy for all the companies that were moving on to the site and wanted advice. And it just worked. I think it was helped a little bit by having the Materials Department characterisation service sited on the place, so we had electron microscopes and lots of analytical gear onsite which small companies could hire or rent time on and that worked really well. And again, you know, it was one of those, I think there was an element of luck about it, but you've also got to go and put effort into making sure that the luck works for you, and that's what I did. It was, it was almost like a very enjoyable hobby, but it consumed huge hours of time. I mean I would be on the site at seven in the morning and leave just before seven in the evening, and my wife was probably going mad about this, but you know, you kept everything running by doing that, being there just to unload a lorry or to ensure that the chiller on the roof of the supercomputer was still working, that type of thing. But, yeah, it worked.

[00:45:14]
Can you describe your wife?

Yeah, she's a very patient person. She's just come home from shopping. [laughs] I was hoping she wouldn't come charging in and tell you… My wife was a student at Southampton who did maths, but she didn't enjoy the maths very much and she got into computing at a very early stage. So she worked on the Pegasus computer at Southampton and then when the Pegasus was decommissioned she worked on one of the early ICL machines and then the later ICL machines. So she's worked in computing.

Mrs Dobson: Someone's talking about me!

PD: This is my wife.

Mrs Dobson: How do you do?

PD: We're being recorded.

Mrs Dobson: Sorry.

PD: [laughs] That was unexpected. [laughs] So…

That was nice. Lovely to meet her.

So if it hadn't been for my wife I wouldn't have done a PhD, because she supported me financially while I did the PhD. And she was at the time a computer programmer assistant engineer in Southampton. In those early days she was like a lecturer in computer science but they didn't call them that then, they called them research assistants. And she carried on that career after she had kids and she worked for ICL, which was later bought by Fujitsu, and she was one of the pioneers of the homeworking schemes that ICL developed. They realised there were lots of these women who'd had families, were really tied a little bit to home, so as soon as the technology permitted, ICL started to install computer terminals. In the early days it would be with a Texas Silent Writer terminal at home, later on it would have a video monitor. But she at one time had a team of homeworkers who were kind of under her direction, all doing the programming work from home. And she enjoyed that and she carried on with that kind of activity until two years ago and retired, not from ICL but from another company two years ago, having been in computer support, doing the work from home.

Do you have any kids?

We've got two kids, so both daughters, both did science degrees. One did maths at Nottingham University, the other one did engineering at Southampton University. The mathematician taught for a while, but she's just a teaching assistant nowadays and her kids have gone through, are going through university right now. One has left and has become a fulltime systems engineer in AI, working for the defence industry. The other one's doing a degree in Cambridge in natural sciences, so… My other daughter went off to do lots of different engineering jobs, but she interspersed them with social jobs. So her first job after leaving Southampton was with the steel industry and at one point she ended up with a new steel rolling mill in South Africa, then I think she moved to Linz in Austria with another steel company and realised that life wasn't for her, so she had a break and set up- oh no, she went as a PA consultant for a brief period, then she had the break and set up a community centre in London, a complete break. Then got back into engineering through KPMG and another similar company, got bored with that a year or two ago and has decided to retrain as an occupational therapist, which she's doing right now at her own expense. So, you know, she's been in and out of engineering and, yeah, they never leave you, you know, there are always problems. [laughs]

[00:49:46]

Sounds great. So, let's go back to, so we were talking about Begbroke Science Park. So you were there until 2013, but in 2012 you also set up a new company, Oxford NanoSystems. Can you tell us a little bit more about this company?

Yes, yes. I was, this is a really interesting story. During the period I was running Begbroke I did a lot of external work for the business school here and other places as well. But after one teaching session in the business school, the other teacher and I were having coffee together, we'd been training MBA students how to read and understand a term sheet when they were setting up a business. And we'd had a really exhausting two days. We were sat in my office talking about the two days that had just gone past and he said to me, do you think we could start up a company, you know, a real company, just off an idea that we have here sitting talking. This person, a friend of mine, Mark Evans, he was accountant, so he was an accountant. So we looked at some copper structures that were sitting on my bookcase and he said, what are those for? And I said, well, they could be used for heat exchangers if we could make the surface in the right way. So he said, well that's okay, let's put them in an MBA proposal for a team of students to convert a copper sheet into a heat exchanger. It was a realty wacky idea. We did this and we got a team who put the idea forward in the business plan competition and they actually won. And some bloke in the audience came up with £300,000, which really surprised me, because it was, there was no experimental data at that point to say that it could be done and all four of the team were non-scientists. So I was scratching my head and thinking, wow, what are we going to do here. Anyway, we decided to risk it, it wasn't our money after all, it was an investor [laughs], but I had a stroke of luck. A friend of mine rang me up and said I've got a son who's just married a lady who's going to work in Oxford, can you find him a job? And I'd met the son once, very briefly, and he was a physicist from Brunel University. I thought well, yeah, I'll… so I said, yes, there's a job for him here as a chief technical officer of a company that doesn't really exist yet, but if he works at it, maybe it'll work. He came and very quickly we lost the four MBAs, except for one, three of them just dropped out, they didn't know enough about engineering science to really cope with day-to-day conversations. But this young man, Alex Reip, he really got it. He found a way of treating surfaces of anything and turning them into very efficient heat exchangers. Now this was 2012/2013 and already we could see that if you were going to solve climate change in the long run you're going to have to make things like heat transfer much more efficient. So we thought this could be a bandwagon that will roll and roll forever. So we started to get money in to grow the company. The investor didn't want to put any more money in. In fact, he was a bit naughty, he wanted to take his money out and walk away with three times as much. But we stuck at it, we got a lot of the government grants and kept the company alive and growing during that period, and after about four years, five years, we really were certain that we had created a surface which improved heat exchange by a factor of between three and five. Then came the crunch, can we apply that to a real system, a heat pump, a refrigerator, heat pipes and things like that. And that's where the progress has slowed down, because when you start taking these things out of the lab and putting them into real systems, the improvements are nowhere near as big as the ones you measured under ideal conditions. And that's where we're at now. We're running out of time, we're running out of money, to be honest, but… and Brexit hasn't helped, because all of our partners are from Europe and I don't think they're very keen in Europe on signing any contractual deal with any British company right now. I may be wrong but that's the impression I've received from five or six other friends. So, what are we doing? Well, we've suddenly found this, these surfaces are brilliant as electrolysers to generate hydrogen and one of my students, one young man working in the company, he's Italian actually, he has shown with his assistant that these same surfaces we were using for heat exchangers are brilliant at creating hydrogen in electrolysers. So right now we're doing what the MBA people term 'pivot', we're pivoting into a different application. And it's a pretty exciting period, because hydrogen is in great demand, again, for net zero. I think that the only sensible way of storing energy at the moment from excess wind or a solar energy is by converting it into hydrogen and then storing it in tanks or underground, I don't think batteries will ever satisfy that. So we're sitting on two possible applications and we really need much more capital investment than we can get easily at the moment. So we're in a country where we have a Prime Minister who boasts about world beating that and world breaking that, and yet they're not prepared to put their hand in their pocket and help the companies that are trying to do it and we're feeling very frustrated. So that's Oxford NanoSystems, current snapshot of events. We're really desperately trying to make this work and keep it going.

[00:56:49]

In 2013 you were awarded an OBE for services to science and engineering. Did you expect it?

No, it was…

And what do you remember of the day you were awarded that?

I remember the day very well, because it was the day I was told I had to leave. So I opened the letter in the morning from David Cameron to say that I'd got an OBE and in the afternoon my division head was telling me that I had to leave in September, so it was a very strange period. I wasn't allowed to tell my division head that I'd just got an OBE because the news was embargoed for about three weeks, so it was a very strange period for me.

And what do you remember of the ceremony?

Oh, wonderful. I went to Windsor Castle and it was Princess Anne, who's, I have to say, my favourite royal. And she was great, really nice. And the other thing that I remember about the ceremony was all the people there, we were queuing up to go in, we were all chatting amongst ourselves, we all realised we'd had very similar experiences and we had the same 'can do' attitude. It was a really nice thing to be amongst people that were just doing it because they could do it and help others. And I just thought this is the first time I've been in such a gathering where there's so many unselfish people around, it really inspired me.

So in 2013, as we said, you had to leave Begbroke Science Park, so what activities have you been pursuing since then?

Well, again, my wife is the one who helped. She went to a garden party in September and met someone and said my husband's being kicked out of his job in the weekend, I don't know what he's going to do next. And this chap said, well, he ought to come to Warwick Manufacturing Group because we like to have people like that. So I arranged to go to Warwick Manufacturing Group on the Monday and by the Tuesday

I'd been offered a job to work as much or as little as I liked. It was Lord Bhattacharyya, he ran the Warwick Manufacturing Group, and he gave me a completely open-ended deal. I didn't want to go there five days a week, but one or two days a week would be fine for me. And that just opened up so many doors. I was already talking to people in other places and as soon as I got the Warwick Manufacturing Group offer I got a visiting professorship at UCL in chemical engineering, I got a visiting professorship in King's, in physics, which later on translated into engineering. I also taught at Bristol and Bristol made me head of their Industrial Advisory Board, which is taking place today actually in Bristol, I've handed that job over. But those positions, along with another one in Birmingham, which was to chair their facility for nanotechnology in the environment, they really filled my days and more. I mean, again, some days were quite bizarre: I'd be going to a different town each day of the week. And it was beginning to get quite tough until I realised that I could actually pull back on this. I gave up going to Cambridge, I think in 2015 I was teaching on a doctoral training course there and it was getting a bit much because travelling from Oxford to Cambridge should only take an hour and three-quarters, but early in the morning you could take an hour and three-quarters to do that last three miles, so it's not a lot of fun. So I think I've kept up this level of activity, plus all the other stuff, meeting students with ideas that they want to commercialise, and because I've had quite a few what I call failures, some of the students will come to me and say well, what went wrong and how do we stop that happening to us, and I think I know the answers in some of those cases. So I've been in fairly high demand for advice, and I don't charge for it. If a student comes to me for that kind of advice, it costs them absolutely nothing, I don't expect to be paid a fee, I just want to see it work, and that's the way I operate. On the other hand, if a big company comes to me for advice and I know they've got cash in the hand, I will charge. But for small growing companies I don't, and I feel it's my duty to pass on what I know.

[01:02:10]

So looking at your career, and your life, what do you think were the key decisions, positive but also negative, that you made and what difference did they make?

Well, I think one of… there were decision points all the way along my career, to be honest. I mean the first big one was probably in as early as 1956/7 when we heard an announcement on the radio that the Harwell scientists had cracked the problem of nuclear fusion, and my father said to me, there you go, he said, you've got to go and be a physicist because they will need people like you to design the fusion reactors. But of course nuclear fusion still hasn't happened, not in the lab anyway. And that was a decision point where I really thought, yeah, he's right, I've got to go and concentrate on science. So that was one decision point out the way. [laughs] And then another one was taking the apprenticeship with the GPO and getting to meet all those fantastic people in my apprenticeship. I mean that was really an amazing period. It opened my eyes up to the way that science, as taught at advanced level in schools, is applied in the real world, so that was a very important period. I can't say highly enough of how good that apprenticeship was with the GPO, it was brilliant. Another decision point would have been to go into research at the end of my first degree and I quickly realised that I was quite good at teaching and putting across the research to an audience and, you know, what mattered in terms of the science, so I became a kind of natural to be a university lecturer. I know it sounds arrogant, but I was quite good at it and I got a lectureship in the third year of my PhD studies, which was unheard of. So I really did have the way of putting stuff across. And I think then the next big turning point for me was joining Philips and seeing what you can do in a well-run company in terms of invention and, you know, some of the Philips inventions have been really remarkable over the years and, again, to me that taught me a lot about not being selfish and worrying about your own personal career, but worrying more about the social implications of what you and your team were doing and how to get it out there for the benefit of everyone. So that was a, that thing really cemented in my mind that the best thing in life is to help others, and that's my guiding thing from then onwards.

[1:05:15]
Great. Is there anything you would do differently if you had your time again?

Well, I've always thought that I'd like to be a professional surfer or a fisherman. [laughs] But quite seriously, I was in tears the day I left Cornwall to go to the apprenticeship because I was so accustomed to surfing every day and to working on a fishing boat, albeit a very small one, and I just loved that kind of life and it broke my heart to leave that behind. And even to this day, I switch on the webcam to see what the surf is like on the beaches back home. [laughs] But realistically I might not be alive today if I'd gone down that route.

Okay. So what were the most positive and most negative financial outcomes that you experienced as an entrepreneur?

Well, I've lost money on two companies, I won't name them, but I've lost a lot of money on companies where I've put my own money in, and I've never been highly paid as an academic, even when I was director of the Science Park, I didn't have a pay rise in eight years. So I was just very frugal, I saved money and I put some of it into companies and in one case I lost a lot, and another one I'm not so sure at the moment what will happen. So I have lost money on my entrepreneurial activities. A lot of people here in Oxford who've been successful have made a lot of money, millions in some cases, but in my case it's worked the other way around. I'd do the same again, to be honest, because I believed in what I was doing and I still do. The only thing I would have done differently, I think, is perhaps tried to stay on the decision making board. I've never wanted to be on boards of companies and I really hate the job, but when you see them make silly mistakes you think, well if only I'd been in the room and talked to them, they wouldn't have made that mistake. That's the kind of 'if only' view everyone has about everything in life, but I've certainly had that happen. In terms of the best things, I think taking the decision to leave a really comfortable existence in my college and department and run, and build and run the Science Park, that was a big risk but very, very satisfying when it worked out. The only thing that's upset me about that is the sort of way that the university ended it by just kicking me out without a thank you, I thought that was horrible and I won't forgive Oxford University to this day. I think the people at the top behaved despicably and I've got absolutely no time for them at all. It just was wrong to do what they did.

[1:08:43]

So, what do you think is and should be the relationship between academia and the industry in research and innovation?

That's a really good deep question. I think the thing that I've learned over the years is that the way it works best is when you have transfer of people. So when I took the chance at Imperial to go to my head of department and say would you mind if I work at Philips for two or three days a week for the next couple of years, and he said yes, I think that was an amazing point in life, really. I, he said that without really knowing much about me either, but it did work out and just by me going down to Philips and finding out what they really wanted from academics was useful in the extreme. One or two people from Imperial followed me then and they were people working in the elementary particle physics groups with CERN and so on, they suddenly realised that that wasn't really ever going to be applied to everyday life, so they switched to semiconductors, followed me in Philips and well, one of them set up a couple of companies, so, you know, it's changed their lives and it's enriched the students' lives they teach, talk to. So I think the way that academia and industry should work is much more with a partnership where there's more sharing of people. Bringing people from industry into the university in some way, in some capacity to help, but also having the facility where you can go out and work in a company for a short period. Maybe not, I don't think it works very well if you're six months out and then six months back, I think it's much better to be able to do it two or three days a week, but that's, geographically that's not always possible. But if possible, the short periods is the best because you can get a freshness for the information transfer when you're going from the company back into the university and vice-versa, there's this immediacy with it. The ability of doing some of that with modern communications and internet of course has helped, so if you were transferred to a company for six months you could keep in touch with colleagues, it would be much easier nowadays through email and whatnot than you could when I did it. But- and I've seen it happen and it's worked really well. So it's the interchange of people, I'd say is the way to manage this. And I don't think going through research contracts offices and so on, administrators, is a great way of improving things. You can have all of these business development managers, transfer offices, that isn't necessarily going to help, it's the interaction between the people in industry and the people in the academic side which is where you make real difference. And these other folk, you invent titles, business development, they just get in the way and they're useless usually, I've not met a good business development manager yet.

[1:12:26]
How do you see the future for nanotechnologies and biosensors?

Well, I thought when I relinquished the decision for EPS in 2013 I thought we'd done it, I really did, I thought we've gone as far as we can, we've awarded lots and lots of grants to academics and it's all going to happen. I was wrong. There was still a lot of work to be done to convince people in industry that there was merit in doing more with nanotechnology and there was also merit in getting people from the academic side to see it much more closely from the industrial side. I got that bit misjudged, I suppose I was too much at the sharp end myself and I didn't look at it through the lens of other people. I think that there's an enormous amount of money in Europe has been wasted – and I mean really wasted – on nanotechnology. They're obsessed with nanotechnology safety, and quite frankly, they've made up most of the danger aspects, there's no danger – well, there is some – but there is no huge dangers in nanotechnology as a technology. But the European Union has funded more grants on nano safety than it has on nano innovation, and I think that's shameful. If you look at America it's completely different. If you look at China it's completely different. And both of those countries are forging ahead, applying nanotechnology to just about everything. In Europe we're lagging behind because this obsession all the time with nano safety. And I, you know, it's sad to see that happen, but I've sat in nano safety meetings where people are generating nanoparticles for their experiments in a way that industry would never in a million years think of doing. And the folk doing these nano safety experiments aren't even going to the big players like MERC and BASF and Chemours and others, and saying can we try your nanoparticles for our toxicity tests. They're not doing that and it's terrible.

[1:14:55]
What about the future of healthcare?

Well, healthcare's very closely linked to the safety issue. In healthcare what you're trying to do very often is get nanoparticles into the body. [laughs] The safety people say, ooh, they get in all the time. They don't. It's quite hard to target a nanoparticle into the body in the right place at the right time. If you can do it, it has tremendous effects. You reduce the drug loading so you'd reduce a lot of side effects if you can target a nanoparticle containing a drug into the right part of the body, or if you can get the nano diagnostic to improve the sharpness of an MRI image, you know, everybody's benefiting. So there's a lot of work to be done and I'm really heartened by the work that's been done by the vaccine companies, some from Oxford – you wouldn't expect me to say this – but Moderna and Pfizer-BioNTech are using liposome, nanoliposome technology to deliver their MRNA drug. Now, in my lectures until about two years ago, I was saying this is still quite a long way off before we routinely use this, but it's been used, tried and found very, very successful and already we're beginning to ask the questions of, is this liposome encapsulation going to be useful for lots of other things, other diseases and so on. So nanotechnology's really going to play a very important role in treating disease and everything from grain right down to mitochondrial diseases in humans. So I think the sky's the limit at the moment for applying nanotechnology to healthcare and medicine. I've got a really good project with University College and my good friend and colleague, Rachel McKendry leads the i-sense infectious disease sensing programme, which is a joint one with UCL and Imperial, and some of the work that they're doing there is really showing the way to future infectious disease detection, both for microbes and viruses. And it's, one of the great pleasures of my life – you say what did you like most – one of the things I've liked most is working with those who, people, Molly Stevens at Imperial and Rachel McKendry at UCL on that fantastic programme they've got to detect viral infections. And it started way before Covid, it was being geared up for HIV and ebola, with flu, in there is another on the wish list, and it's in the right place at the right time. One of the things I know Molly at Imperial's got a new lateral flow sensor idea. At UCL Rachel's got an idea for improving the sensitivity of the lateral flow, I'd say by a hundred thousand times, and right now I'm trying to help develop that as a commercialising idea. So yeah, in healthcare some of the diagnostics that we're developing are really going to transform it.

[01:18:24]

What advice would you give to someone willing to pursue your career today?

I would say never… never be worried about when you get to a decision point, just go with your best instinct and do what you think is right, and usually that means something which is going to make you satisfied and happy. I think a lot of young postdocs especially get worried about this, they come to me and they say what do you think I should do next and which journal should I publish in to get the highest impact. I don't like that, I think that's all wrong. I think what they should be doing is thinking of the broader issues of what makes them really happy and follow their gut instinct, because that's going to give them much more satisfaction in the long run. And I think there's far too much manipulation of data going on in people's CVs. When I'm on interview panels I'm afraid I'm the panellist from hell for these people. [laughs] So that's why I'm not on many interview panels any more. [laughs] I want to find out what makes people really tick and how they're going to become good citizens in the future and that's why I say people should think of doing things from a gut instinct, when they've got a decision to make, make it from the point of view of the big scheme of things and not just your personal selfish attitude.

So, is there anything I haven't asked you today that you would like to talk about?

I think you've done a good job. But I think you've done a good job, I don't think I've got much to add and I don't want to… no.

Okay. So thank you, Pete, it's been a real pleasure talking to you.

[1:20:32 recording ends]