Sir Frederick Crawford

Interviewed by

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Welcome to the Archives of Information Technology. It is Monday the 24th of February 2020, and we are in the City of London, at the headquarters of the British Computer Society. In the Archives we capture the past and inspire the future. My name's Richard Sharpe, and I have been writing and researching about the IT industry since the early 1970s.

[00:26]

To use a colloquialism I suppose, many of the people who have contributed to the Archives have been what we would call the great and the good. But it's very hard to find someone as great or as good as Sir Frederick Crawford, who is making his contribution to the Archives today. He has been a researcher in in industry, he has been a researcher in academia, he has been a teacher in academia, he has been a lecturer and administrator in academia, he has been a consultant, he has been a senior academic executive, as in the vice-chancellor of a very important technical university, and he has been a visiting professor on at least three continents. And that's not the end of his CV at all.

[01:13]

Sir Frederick, before you embark on this glittering career, you must have been born, and you were born in 1931.

That's right.

Where was that?

In Birmingham.

You seem to have a lot of roots in Birmingham.

Well, I was born there, and brought up there, but I left when I was 21, and apart from a few years when I went back there, I've really had nothing much to do actually with Birmingham.

What was the background of your parents?

My father ran a small printing, family printing firm. My mother was just, a housewife, as, as women were mainly in those days. It was before the war; not so many women worked of course as during the war and afterwards. So she was, she was intelligent, and, I think in modern times she would have been to a university, but that was not the, the way things worked in those days. And as a matter of fact, even when I became a student, which was 1948, only about three per cent of the population took any form of university studies.

[02:37]
And you were, a single child, or, you had other siblings?

No I was, I was one of four.

Four.

I was actually the fourth in a family of three, with a gap of eight years. So I was either an afterthought or no thought at all.

What do you think that you actually got, apart from life, from your parents? When you look at Sir Frederick Crawford now, what would you see as your parents giving you?

I think it was very little that they encouraged me to do, but they supported me in anything I chose to do.

You didn't decide to go into the family firm, the printing firm.

No no. No no. My father retired, sold it, and, that simply wasn't an option when I, when I reached, say, 20 or 21.

[03:28]
You presumably went to a primary school, somewhere in Birmingham?

Yes. In Birmingham, about, 150 yards from where I was born.

What were your favourite subjects in primary school?

I have absolutely no recollection of anything that happened in the primary school.

[laughs] That's fair enough. You went to the George Dixon Grammar School. So you passed the equivalent then of the Eleven Plus.

That's right, I did rather well in the, in the Eleven Plus, in fact I was one of the top in the whole of Birmingham. And I had an offer from the top grammar school in Birmingham at that time, and it was a couple of bus rides away, and the second best grammar school was only 20 minutes' walk away, so that's where I went.

And, did you enjoy academia even then?

No, no I don't think I did actually. I think I was clever enough to get away with very little work. And I played on that until I had left school. And it was only really a day or two, or a week or two after I had left school that I realised how much time I had wasted, and that it was going to be quite difficult to catch up with my colleagues, who were either already in universities or they were waiting for an extra year or so in the sixth form, to get, to get to Oxbridge.

So you probably didn't have a sense of what you wished to do?

I had no idea what I wanted to do, and I certainly didn't have any idea of going to university.

[05:05]
So how did you get to university?

Well, I was advised that there were some apprenticeships going in industry. Birmingham is a big, or was at that time, big industrial city, and there were quite a lot of firms that had, by modern standards, extremely good apprenticeships and, educational offerings for the people who came in at, say, seventeen or eighteen. And

I took advantage of one of those. I went to Joseph Lucas, which was a big firm at that time, manufacturing bits and pieces for cars. And they had a research department which had a very good training and educational programme. They expected you to take an external degree from the University of London. And that's precisely what I did.

So you were a research trainee at Lucas. And this was, pre-electronics. This was electrical stuff, wiring and, components for cars.

It wasn't quite as bad as that, because, I was in the, what was called the engineering and designs department, which is really a research department, and, they were actually pursuing the most modern electronics that existed at that time, far in advance of it actually being used in cars. So, it was a laboratory, for example, where a lot of solid state physics was going on. And you have to remember that I am talking about, well 1948 to '52, and the transistor was not invented till 1947. So, I was in at the beginning of some, some very interesting things.

You hadn't met a computer yet, I imagine. Or did they have analogue computers?

No, I think, if I had had a computer at that time, it would have been beads on wires to slide along. [both laugh]

A Chinese comp-

But there were, but there were machines where you turned a handle, and, and they would do addition and subtraction, and…

PSK Pharma I believe was one of the main labels.

Well, the ones I used were all Swiss, and I've forgotten, I've forgotten the name now, but they were beautifully made instruments.

[07:31]

And so, in parallel to your industrial work, you took this degree at the University of London.

That's right. London at that time had either has many or possibly slightly more external students reading for degrees than it had internal students.

Right.

And although at that time only about three per cent of the population graduated, nevertheless, the contribution from London University was very well-supported, they had about 24,000 external students when I was, when I was reading.

And, was this distance learning, or did you come to London for this?

Because I was studying engineering, and that's an interesting point, because I was studying engineering, I had to do a lot of laboratory work. The London University degree made no concessions. So I spent quite a lot of time at what was then called the Birmingham Central Technical College. Then it became the Birmingham College of Technology. Then it became the College of Advanced Technology. And then it became Aston University.

In 1966.

And I came back to that at a much later stage in my career.

You do, and we'll, yes, we'll discuss that. So this was your BSc. It took you three years?

Four.

Four years.

Four, because there was ar too much experimental work, and, the discipline was essentially to get up at 5.30 every morning for a couple of hours, go to work, come

back at, 5 or, have dinner at about 6, and then work till 10. And, maybe thirteen hours on Saturday, and all Sunday.

Did you enjoy that?

[hesitates] I realised that it was the cost of having wasted my time in school, and that my friends from school were going all, going off to cushier university posts. But if I was going to catch up, that's what I had to do.

And you were motivated to catch up?

Oh yes.

Why?

Well I've no idea. It was only really after I had left school that I realised that I had wasted that time, and now I had to catch up with these people, who were no smarter than I was, but, at Oxford, Cambridge, London, and so on.

[09:57]
And you got a First Class degree.

Yes.

What was your particular interest, in that First Class degree that you got, BSc Engineering, at the University of London, what was your particular interest then?

Well I was always interested in mathematics. In fact, when I went into industry, the head of the department said to me, 'Now, you've come here; you'll no doubt want to take a degree.' And I said, 'Yes, I would like to graduate in mathematics.' And he said, '*Mathematics*? *Mathematics*?' [laughs] He said, 'It's an *engineering* research lab. You will graduate in engineering.' And that's how I came to graduate in engineering. It was another 50 years before I got a mathematics degree.

[laughs] Right. Did you go on and do an MSc?

No. I went straight to PhD. As soon as I had finished my apprenticeship and the bachelor's degree, I found a research, well, research studentship, or fellowship, at Liverpool University. And it was related to work that I was doing in industry, because I was interested in sparks igniting petrol mixtures, petrol-air mixtures. So that was important to Lucas's, because they provided the sparks. And so I went to a laboratory in Liverpool that did gas discharges and sparks and things. So I, I turned that into my PhD area.

And, who was your supervisor for this?

It was the head of department, who was called Professor Meek, who delegated most of the work to another person who was a reader when I went there, but later became a professor, Professor Reynolds. And so, I did three years there. And, one of the things that, that was odd about that period was that I realised that I had missed all of the benefits, the social benefits of an undergraduate education at a university. So, I did displace by a few years all of the things that I would have done if I had been to university. I got interested in university politics, I was President of the Student Body. I did a number of things, as a Vice-President of the National Union of Students, and so on. So I caught up at the PhD level with all the things that I would have done as an undergraduate had I gone directly to university.

And this was the late Fifties.

'52 to '56 I was… Or, '52 to '55 I did my PhD. And then, because I was President of the Student Body, I stayed on one extra year for a Diploma in Education.

Right. And then you were NHS[sic] Vice-President and Treasurer, '57 to '59, I believe, the dates were?

The… The NUS Treasurer?

Yes.

Yes, that's right. I was… I failed by two votes to be President of the NUS.

[13:18]
What drove you to be interested in student politics in that period?

I was never interested in student politics. And I would have not made a, a very good president for the, for the NUS. But I did get on very well with people, and I was a very good organiser at that time. And so, for that reason I was Treasurer of the NUS and so on, and did things. But I wouldn't have been a good president. And in the end, it was, it was the best thing that ever happened to me, that I would fail by two votes to be President of the NUS. Because I had one other option. I had left Liverpool by then, and I was doing an MSc in mathematics at Birkbeck College in London, about a couple of hundred yards from where I was working, and I was working in the research department of the National Coal Board. In fact, that, that in itself was an interesting facet, because the National Coal Board had bought up the old British Lion film studios, where *The Third Man* was made, and my office was Orson Welles' lavatory. It was just a tiny room off the main star's dressing room, which was my instrumentation laboratory, and I had this tiny room with the remains of the plumbing visible on the, on the walls. So I started off in the seat of the mighty at, at Isleworth.

[14:56]
The mighty Orson Welles. You were also very interested in debating I believe.

Ah. Well that… I was coming to that, because the… I continued the mathematics at Birkbeck College, and one day an Indian student came up to me and said, 'I hear that you, you like debating. Would you like to debate with me?' And I said, 'Well, what do you mean?' He said, 'Well,' he said, 'there's a National Student Debating Tournament, and we need teams of two. Would you like to debate with me?' So I said, 'Well, I don't mind.' And so we started this. And we ended up winning the National Debating Tournament. And that gave me the option of spending two months with Ernest, two months touring American universities debating against them. And we were doing all of the universities west of the Mississippi, and one or two on the

East Coast, Connecticut. And so, that was what I did. And it was while I was at Stanford University for a debate that I talked my way into a job, a postdoctoral fellowship.

[16:18]
This must have opened your eyes, America opened your eyes, did it, to a significantly different type of culture. Here you are, from the, in the late Fifties, Birmingham boy, London and Liverpool. You have those experiences. But suddenly, you're out in the western United States, in a significantly different culture. How did that feel?

It was just marvellous. It was creative, it was wonderful. There were thirteen Nobel Prize winners at Stanford. It was… It is now… It would have been classed in the top four universities in the world at that time. Today it's the top university in the world. And I was there while it was in its wonderful rise to the eminence that it, it now has. And it was just an extraordinary place to be, let alone being in a wonderful climate and… But it was the intellectual climate, the, the fact that everybody was, everybody was smarter than I was, and everybody felt the same. [laughs] I loved that. And it was, it was seething with knowledge and excitement and, it was just wonderful.

Did you tend to win the debates, you and your partner?

Well when we debated in America, it was a disaster for the first few debates, because they insisted we should debate against them. And American debating at that time was such that you would, you would really be talking to somebody on the Supreme Court, it would be that sort of thing, where you had to convince judges that your arguments were sound and, and accurate. There would be no humour associated with it. And every university in the country for an entire year would debate the same motion.

Oh.

It would be a domestic one one year, and it would be international. And the year we went it had a very slick and, slick title, it was, that in the best interests of international peace, the testing of atomic weapons should be outlawed by international agreement. So that's… So we went there, and because we were British, we, [laughs] we don't

want to do the same thing over and over again, that's something… We'll give you nineteen other subjects, and you can choose then whether to debate your motion or ours. And in the end we did the national motion seven times. And we had got a list of things which would have gone down very well in Britain, which puzzled them. For example, the first motion that we suggested to them was, it would been better if the Plymouth Rock had landed on the Pilgrim Fathers. [both laugh] And they just said, 'Well, what do you mean?' And we said, 'Well, it was about the timing of the erection of, of the discovery of America, and, development, and what difference would it have made and so on. So, they didn't see it. But, nevertheless, we, we gave them nineteen other motions. The one that they enjoyed most, and we debated most, at several places, was that, the sun has set on the British Empire.

Ah.

They liked that

[19:50]
Yes. What did you learn from debating?

[pause] Nothing, really. It was because, I knew a lot of things. Now I'm talking about a lot of things that I did the debating. And, we weren't in it… We… When we did the first few debates, we found that these debaters only debated in front of judges, had never had an audience. Then we insisted on being one on each side, so that we could do it our way, and with British humour and sarcasm and all the rest of it, and they could do it, do it their way. So, we didn't learn a lot out of it. We had a lot of fun, it was, it was just wonderful, that, for example at Berkeley, when we devoted – we debated, the sun has set on the British Empire, we had 1,000 in the audience. So…

What side were you on for that one?

Didn't matter. We, we… For many of them… I was brought up in London University debating, at Birkbeck, to the idea that you knew in advance what the

motion was, but you didn't know which side you were, or whether you were proposing or seconding, until ten minutes before the debate.

Ten minutes. That is excellent. I was, until recently when I retired, I was teaching at a university, the University of East London, not Stanford or, one of those.

That's the old polytechnic…

The old North East London Poly.

North East London. Yes. It used to be very political in my day.

It… Yes, it is quite political now. And I was a little horrified to know, to realise, that, a large number of those students coming into university had never debated anything.

No. No.

There just wasn't a culture of it. It seems, there wasn't a culture developed in secondary education of debating.

Well, it was there very strongly in all the American universities, but it was run through the speech department.

Oh right.

You wouldn't just be any old student wanting to have a debate and, and wading in, in the way you would at a British university. You would, you would go to the speech department, and you would learn very very formal debating of the sort that was just right for the Supreme Court, but was not the knockabout stuff that we were used to.

Right.

And the use of illogical arguments to, to get a laugh and, and so on, that's…

[22:28]
Did you do National Service?

No. When I, when I went on to the National Coal Board, that was, they were so short of scientists in the research department that it counted instead of military service. And I never actually had to do any military service.

Now the National Coal Board was '56 to '57?

That's right. And, and at that time I became 25, and when you were 25 National Service, if you hadn't done it, you didn't have to do it.

[23:03]
Your next step after that was, at the College of Advanced Technology?

Yes. They offered me a senior lectureship, and I was very flattered about that. And so, I took it. But then I realised it was a mistake afterwards, that I should have…

What was the subject?

Electrical engineering.

And, this was… It had been turned into the College of Advanced Technology…

That's right.

…in Birmingham, in Aston in fact.

That's right.

Why was it a mistake?

To go there? Well I could have, I could have gone to some university to, some established university, to go, or I might even have gone to America earlier too.

And you did go to America.

That's right.

You parlayed your way to Stanford, did you?

I talked my way to Stanford during the debating tour.

Right.

And, I had a one-year appointment, and stayed for 20.

So what was your role there?

Well I started off as a researcher, and I did that for about five years. And, there was a hierarchy of researchers, and when you read, when you reached the most senior level, you could behave like a professor, you could have contracts of your own, you didn't have to work on anybody else's work, contracts. And so when I did that for two or three years, then they put me on the faculty as a professor. Because, they were using me to teach anyway, as well as doing my research, so, he might as well be a professor. So I…

And you had tenure, did you?

Not for two years, but that never worried me. If you were worried about tenure, you shouldn't be in the university.

And, what were you teaching?

Electrical engineering.

Still electrical engineering.

More towards applied physics, but… Because, I always had at the back of my mind that, I liked mathematics better than other things.

And what type of external research work were you doing then?

[pause] What… At Stanford?

Yes.

None. I wasn't doing anything outside the university at that time.

Oh, OK.

No no no.

OK. What type of research inside?

Well it was in an area called plasma physics. The Greeks would have recognised it, because they used to talk about earth, air, water and fire, and, very hot gases of plasmas. And so they were onto the fact that, well, they weren't onto the fact that, they didn't know that 99 per cent of the universe was plasma. But, that's what it is.

You started to publish about then, didn't you?

I published two or three things with my supervisor on my PhD thesis, and then, when I started working in plasma physics at Stanford, then it was normal to publish, and I published quite a lot.

[26:03]
And who of the notable people in Stanford were you rubbing shoulders with?

Well, there were, there were Nobel Prize winners left, right and centre there, mainly in physics, but, for example, there was, Shockley was one of my, one of my colleagues in the same department. And he invented the transistor.

He had come from the East Coast.

He had come from the East Coast, Shockley. He had set up a firm in Silicon Valley. Another one was Arthur Schawlow, who had invented the laser and had the Nobel Prize for it. One of my personal friends was Robert Hofstadter, who had got a Nobel Prize for the, for theoretical – for, for, oh, accelerator physics. And…

Shockley was, said to be a very difficult man to work with.

Well… [pause] He was very successful in the things that, that he did. But, what people knew most about him was that he was talking about the, a correlation between intelligence and race.

Yes.

And that made him extremely unpopular. It was a subject that no one in their right mind would, would approach; you know, to try to prove that blacks were smarter, or, than yellow or white or, [laughs] brown, any other colour, thing, was really a very difficult area to work in. And, the one big secret of the, of the academic world is that, you don't have academic freedom. You can't just work on anything under the Sun. You can't, you can annoy people, and you can cause sit-ins and marches on your laboratory and all the rest of it, which is what happened to Shockley. But as a person, I got on fine with, with Shockley.

And presumably at the time as well, he was working with people like Noyce and Gordon Moore.

Well, people knew of Moore, but I, I never came across him, but… But Stanford of course was the nucleus of, of Silicon Valley; it all spread out, with, with Stanford professors. We had a linear accelerator which was two miles long, and because we had a sixteen square mile campus, you could, you could build something that was two miles long. So it, it was very famous for the, for the pioneering work it did in, in accelerator physics and all the rest of it. And it, it, it involved… It attracted people

like, as I say, Stanford, who – to Stanford, people like Schawlow, who had invented the laser, invented it in the east.

Yes.

At Bell Labs I think. And, similarly with, with Shockley, he had been, he did his work in the east.

Yes.

But when he founded an additional firm, he founded it in Silicon Valley, and moved out to it.

[29:33]
Yes. Why can't the United Kingdom build a Stanford?

Well, I think you could argue that Oxford and Cambridge were very similar in their standing in relation to the country, that Harvard and Stanford had in the United States. So they can do it. And it is, there is a positive feedback effect with it. The stronger it gets, the more attractive it is to the very best people.

Yes.

And when you toss in the fact that, Stanford was very good at fundraising, and that Americans are very generous with fundraising, I think probably for the last ten or twelve years Stanford has raised more money than any university in the world. It's typically over a billion a year in gifts.

[30:35]
When did you meet your first computer, I mean a digital one?

Well, people were working on computers there, primitive computers. And, I was working in a subject where the mathematical equations were too difficult to, to work out on paper, and so, I got drawn into the computersphere, not because I knew

anything about computers, but that I *used* computers and was, and my, my students used the, the computers to solve the trickier problems that we could tackle with computers. But it was a time when for example the complexity of the programs, which is as nothing now for the, for the modern computer, the complexity was such that my students would leave at 10 o'clock in the evening for their three hours on the computers, until 1 o'clock in the morning.

What computers did you have there at Stanford?

I can't remember the names now. There were, there were a couple of quite big ones that, twins, that were back-to-back, and they, they produced something that you would now put in your pocket, but nevertheless, those days, I had, my first computers were derisory. They were 64 kilobytes. Now, you want 64 gigabytes, which are a million times [laughs], before you even get started, you know. And so, they were very primitive. But, we were much more ingenious about the way we used them.

Less profligate.

And, I can remember going to the Sierra mountains with, with a small computer with about 30 kilobytes, and I would leave it to do problems while I went for a walk with my wife, and when I would come back there would be 20 feet of paper that was lying on the floor that it had spewed out in that time.

[32:45]
Are you an advocate of technology?

I don't talk to anybody who is not already converted. I think… I've certainly enjoyed working with technology. I consider myself to be more a, more a user and proselyte for technology, than actually being a specialist *in* the technology itself. I've never designed a computer or anything like that. But whatever level they had reached, I found some way of using them that was beneficial to the research I was doing.

Some people are very concerned, not everybody by any means, but some people are very concerned today about the rise and development and implementation of artificial intelligence. Are you?

Well, that's, that's very interesting. I've lived through three phases of artificial intelligence. When I was first at Stanford, artificial intelligence was a big thing. And it was being done with very primitive, very low power computers. And so, the, the typical jibe was that artificial intelligence was just about equal to genuine stupidity. [RS laughs] And as the power and the storage possibilities went up and into smaller and smaller modules, it was only then, there was and eclipse, and for a period of about, probably ten years, nobody used the words artificial intelligence. It became knowledge-based computing, and knowledge-based computing it was, until they became more and more powerful, and the words artificial intelligence came back. But there was probably a fifteen, or, something of the order of fifteen or 20 years when you didn't use the words artificial intelligence.

No, a lot of companies lost a lot of money. There was a famous trek through the Rockies, wasn't there, where some pioneers all got killed in the winter, and they called that, that was the winter of artificial intelligence, that year.

Yes.

What… Tim Berners-Lee considers perhaps that now the Internet has become a digital dystopia, and is proposing regulations and ideas, global action plan, to tackle a misuse of the Internet. Are you with him on that, or do you see…?

Well, it's too far really from my interest to, to even have a, a comment. But the… He certainly spawned the machines and the programs and that that, that did this, and it's perfectly reasonable in almost any domain that you can mention to find there are good uses and bad uses. And, unfortunately, it's so easy to, to find bad uses for computers, or ways of disrupting computers and so on. So…

[36:02]
Do you enjoy teaching? Did you enjoy teaching?

Well, I did very little teaching. I think… I remember there was a thirteen-year period when I taught in only seven years, and never more than one course of two or three lectures a week. Stanford, a normal, a normal lecturing schedule was, was one subject, three lectures a week, and you were expected to do research. And because I ran a research group with about two dozen people in it, PhD students, almost all my time was supervising research. And, I think I taught one or two undergraduate courses, because I felt I ought to do it, and that was only for one or two years. All my teaching was postgraduate teaching apart from that, and not much of that, no more than one course a year.

Are you a good manager?

I'm a very good manager, but… [laughs] I, I… In fact I like managing things, I like organising. I'm a very good organiser.

Of people?

Of people.

Why? How?

Don't know. Just… I understand how organisations work, and I've put together some, some… For example, one of the things that I did towards the end of my career, I set up a commission on, on miscarriage of justice, which worked extremely well, and, we did six and a half thousand cases, criminal cases, in seven years. It was… So, it, it was just what they needed in the, in the field of law where people are not good managers and didn't know quite how to make these things work.

Is this because you're a man of methods, methodical?

Well, I suppose I'm… Yes, I'm very analytical, I know exactly what I want to do, why I want to do it, before I actually do it. And that's, that's it.

Your debating would have helped you hone those skills.

Well I suppose so, but, debating, when you are, when you are just as ready to speak against and for the same motion, it… The training there is, it makes you really look thoroughly at the subject.

Yes.

Whatever it may be, whether you have a sentimental feeling for one side or another was, is beside the point. What is the… It's… It's what lawyers do actually, because, they start with the assumption, if they're defence, that their client is innocent, and the question is, how can I debate what are all the best arguments for his innocence? If they're prosecuting counsel, they do the opposite. Where… And it's exactly the opposite of the mindset of a, of a scientist. The scientist takes a pile of intellectual debris and tries to make sense of it, and puts it into patterns, and then, sees what wonderful patterns come out. In, in the legal mode of thought, you know what the answer is that you want to achieve, and the question is, how can you, how can you get there with the material you've got available?

Do you see patterns quite quickly, where others don't?

Well I don't know about that, but I, I do see patterns. And I enjoy both types of, of argument, the analytical argument of the scientist, and the constructive argument of, [laughs] with intellectual debris from a lawyer.

[40:05]
How long were you at Stanford then?

Twenty years.

Twenty years.

And I, I kept a group there for an additional four years, and I, just finishing my PhD students and tapering them out. So I went backwards and forwards every term for, three or four years.

Then where did you move to?

Well, then I was… Let's see, when I came back I was… I came back as Vice-Chancellor of Aston University.

Right. Now this was established '51, College of Technology in Birmingham; '56, College of Advanced Technology; '66, there had been a Robbins Report in the early Sixties: what are we going to do with these baby boomers? We had better build some more, new, universities, some of them were called plate glass universities. And so we had…

Well, that, that came out of an earlier, earlier thing, the Bruce Truscot book that was called *Red Brick University*.

Right.

And they needed a new name, so they were called, steel, glass.

And, and so, for instance in 1966, the University of Kent was formed, and also, this…

There were seven completely new ones, and over thirteen universities altogether.

And Aston was established as a technology university, in '66.

Technological… Technological. There were…

Technological.

There were about a dozen of those, including Scotland.

[41:38]
Right. Let me ask you about the current position of undergraduate work in science, technology, engineering and mathematics, which is a term that is used is it not? STEM.

STEM, yeah.

Well, which, Aston is clearly one of the leading universities in the UK in the areas of STEM. Are we any, are we good, are we better at it than we were, in training undergraduates, or educating undergraduates in STEM?

There is one way in which I, I like to think that we are better. When I was student age, there was a hierarchy of establishments. Stratospherically above everything else was Oxford and Cambridge, and then maybe University College London, Imperial College, LSE, and then, the major provincial universities, Liverpool, Sheffield, Manchester and all the rest of it. And then there were the, then there were colleges. In fact it was stratified into universities, polytechnics, or technical colleges as they were, college of advanced technology, and then further education. There were three levels in those days. And, what has changed is that instead of looking at it as a hierarchical thing, in which the best was up there, and, that was down here, people now see it as, as they should, as the spectrum of institutions, each one of which can be excellent. It doesn't matter what you do, once you have established your niche, you can be either good in it or bad in it or excellent in it. And there's a better understanding of that now. But that was always understood, in my contact with America, people understood that there were marvellous liberal arts colleges that had no research whatsoever. Whereas in Britain, you would have written off any university that hadn't done research. So how valuable was it that they had to have some research. And the Americans were much better in the, in the development of hierarchic-, of, of a spectral view of it, rather than hierarchical view.

[44:06]
What did you think of the aim to get 50 per cent of the age group into university?

Well, it's a meaningless, absolutely meaningless statement. The best way to deal with it is to turn it round and say, what percentage of, of people after the age of seventeen or eighteen should never receive any more education? And everyone would, well nobody. There shouldn't be anybody. And once you have turned it round and got them thinking, everybody should be growing at whatever they do, whether they're a technician, whether they're a, an engineer, whether they are a theoretical physicist, they can all be growing, all, all of their lives. And, it's much better to think of it as a spectrum in which everybody is, is doing the right sort of education to improve themselves, and there is a way of, of producing excellence for a technician just as much as there is as a theoretical astrophysicist or something like that. And slowly we're coming to that. But the Americans were there first.

[45:20]
You were Vice-Chancellor of Aston from 1980 to '96. Sixteen years.

Yes.

I guess, I can do mathematics. [laughs] Easy stuff anyway. One, that's a very long time, for such a pressurised job, is it not?

Well, it wasn't so long in those days, but it's tended to be five to ten years now. But my job was to take a wreck of a university…

A what of the university?

A wreck of a university.

It was a wreck ?

Yes. It was in the bottom three or four of the university league. It had had a, a vice-chancellor who simply didn't bother with doing… In fact one of his public statements, 'Well I treat the university like any of my small businesses.' And, I think, a university is rather tricky compared with some businesses. So my job was to approve it. And when I got there, it was in the bottom three or four; when I left it was

at the top of the middle third, or bottom of the top third. I had moved it up from, I don't know, I think we were about, I think there were probably about 50 organisations when I got there that looked like universities, and when I finished, more like 100. But, it had moved up to the top third.

What was the most difficult thing that you faced in achieving that progress for Aston?

[exhales] Well, it's an extremely simple thing to conceptualise, but quite difficult to do. And, I started from the, from the extremely practical view that all human problems are best solved with money. If you have a university in which there are, at least two-thirds who should not be there, you buy them out. So I spent £13 million, which I didn't have, I had spent £13 million to buy out the bottom half. Very selectively, nobody from the top half could be, could take the money and run. But all of the rest of them could and did. And once you have removed the bottom half, then what's left raises you up in the league. But very very roughly, the top half do about four times as much productive work as the bottom half. So it's worth your while to give them two years' salary, or whatever it took, two and a, two and a half years' salary was what I found would work. And, you just keep using all the money you've got to buy them out; that allows you to save their salaries and their overheads, and then you buy the next lot of people out. And that way I got rid of more than half of Aston's staff, academic and non-academic, in my first four years.

[48:36]
To be a good manager, some people say you have to be a good butcher. Are you a good butcher?

I don't call myself a butcher. I don't think of myself as a butcher, because those people were in the wrong places. And a lot of them, when I had bought them out, relaxed into some other sort of job, maybe at a lower level, they maybe did consulting instead of trying to teach, or do research. And, no one ever came back, of the two or three hundred people I got rid of, not one came back and said they were annoyed. Mostly people, they all said how much better it was that they were doing this, and doing this, and really enjoying life. And it was, it was by buying out the bottom half,

so the half that was four times as good as [laughs], as they were, represented the university, that I moved Aston up the league.

And then, presumably you were able to recruit.

Oh yes. The more you, the more you get rid of dead meat, the more attractive your, your university becomes. And what I did was, I was extremely tight on appointments, and everyone who came in, I don't think I ever appointed anybody who hadn't got a First. They were in their twenties, and that's all that you had got to show for what they had done so far. And they were extremely good, and in no time at all a lot of them were grabbed for readership here or professorship there, and then when one or two of them went to London University, or even to Oxford or Cambridge, Cambridge first, when people I had dragged up from nowhere, didn't know anything, you know, weren't established, that were absolutely brilliant in my opinion, and then they turned up as head of department at Cambridge four or five years, then the others would flock in. So, it's a, it's a, it's a positive feedback effect. The more you do it, the better you, the better the people you can attract. You don't… It's not the end of your career to go to Aston; this is a place where the vacancy occurred because the guy went to Cambridge.

[50:57]
It's almost like Hewett-Packard when they used to interview people and ask them in their interview, 'Where will you be when you leave Hewlett-Packard?'

Yeah. Well I've met both Hewlett and Packard. They used to wander around the lab when I was at Stanford, and they were…

What were they like?

Well I didn't know them *very* well, but I mean, they were, they were quite different as, as people. One was a businessman, one was more engineering-oriented. But they both knew how to run a firm, and to get people working. They had the advantage that Stanford had this sixteen square mile campus; they set aside 900 acres for an industrial park, and they allowed, very selectively, Varian's, and, what became

Hewlett-Packard, and a lot of other small firms in, which grew. And then, they lived on the, on the university knowledge. They would be in the lab one minute, and in some sort of instrument or application. Whereas normally with the transfer time from university research to application is, between five and ten years, it can be almost instant if you've got them on the campus. So you've got the industrial park growing. It was never called a science park, it was the industrial park. And these people coming in, and consulting and talking, and having graduated from Stanford as Hewlett and Packard did, that's it.

[52:30]

1981, Aston Science Park was established.

It was the first science park in Britain.

You must have had a big hand in that, to say the least.

Well, nobody knew what a science park was. I persuaded Lloyds Bank to give me a million pounds. Lloyds was, was founded in Birmingham, and it had, it had strong links to Birmingham. And I played on that. And they, they actually put up a million for me to, to get my science park going. The fact that a lot of the ground north of the campus was derelict, with dead factories, allowed me to build this science park there, [laughs] right in the middle of town. When Warwick tried to do it, they, they had to use the countryside around Warwick. I could take the centre of Birmingham and use it to develop the science park. So, so that was, that was a really interesting situation. And I got the science park going, I think probably… Well, it was founded in January of my second year. I went to, I went to Aston in July, and then eighteen months later I got the science park going, with this initial, initial sort of, research fund from, from Lloyds.

Who were your first tenants on the park?

[exhales] We, we… Well a lot of small… We, we had, I think after about two years I had got something like, something between 50 and 100 small firms, two people, four

people, that sort of thing. And, the total people, number of employees, was probably 1400 or something like that. So, it took off. It was an idea whose time had come. And of course from that, Warwick, which was a much better university in the sense that it was better founded, it was started from nothing, it didn't have to get rid of dead meat, you just avoid appointing them in Warwick, and you've got beautiful countryside around. And a lot of encouragement from Government. So, they had a fairly… And they had a very good vice-chancellor. He was a lawyer, what was his name? It began with a B. Anyway, he was, he was… Butterworth, Jack Butterworth. He was very very good. And he got, he got Warwick going. But they had a much easier job to, to do.

I remember visiting Warwick, and was struck by the fact that the buildings were in the countryside, and there was a lot of mud between them. And I went back to my university, University of Kent, and I asked the registrar, Eric Fox, 'What's this about, why have you packed your buildings on the top of this hill so close?' And he said, 'Richard, the money will soon run out, and they will just be left with muddy paths, and we won't.' [laughs]

Yeah. And it runs downhill from the roof. [laughs]

Yes. Yup, yes.

Yes. Well Kent was, was good. It was around the seven foundations of what, '63, '64, something like that.

[56:02]
You became a visiting professor as well at a number of universities, in Japan, in Paris, and Australia.

Yeah. Well they were sort of, they were really sort of, sabbatical, leave. The concept of sabbatical leave didn't exist over here, but in America it did. And, I wanted to get around universities, and, I got, I got a letter once which said, 'We have decided that you are a distinguished American educator, and we are paying, we want you to visit these 20 universities in Japan.' So that was, well that was the Japan Society for the

Promotion of Science. And it all stemmed from the fact that I had had a very good Japanese PhD student, and when he went back home, his, his father had got a lot of leverage, and, they managed to persuade the Japanese to make me a, a distinguished American… I said, 'I'm not distinguished, and I'm not an American, and I'm not an educator. I'm a researcher.' [laughs] So… Never mind. So I did one or two. I went to France also. We, I speak French, and my wife is, is French, so, if I ever get a word in edgeways, it's in French, at home. And, that came out of spending a year in the French atomic energy authority.

I want to come back to that in a moment. But, I also Australia I understand.

Yes. I, I did a lot of travelling in Australia. I had a fellowship from the, from the National Science Foundation or some other body, American Association for the Advancement of Science, something like that. I had that. And I, I travelled round Australia and took in New Zealand. It's 1,000 miles away. People think that it's just next door, but… But I did New Zealand, and I visited just about every university in those two countries.

[58:22]
Can you do a compare and contrast then? Stanford, UK, Japan, France, Australia.

Stanford…

Up there. Right up there. Perhaps…

Japan was, was very very interesting, because, one of the subjects that I learnt a lot about and lectured on in Japan and Australia and New Zealand was student unrest. I knew a lot about student unrest, because we had had three years of it on the Stanford campus, and I, I did help a lot to understand first of all how you can create student unrest, if you want to, and how you can, how you can reduce it if that's what you need to do. So, I had a lot of things that I could teach people around the world who… Because, there as a wave from about 1968, started in France, the event, *Les Événements de Mai*, which started in April, in April 1968, and I happened to be there, in Paris. And they, they spread around the world, fed I think by one particular feature,

and that was, it was the first time, round about 1968, that you had international reporting on television. So that the students, who were waiting, watching what was happening in Japan, could see it on television, they could see what was happening at LSE in London, and, when there were disputes around, steel gates at LSE and so on, they could do all of that. And, it spread around the world. So I went round discussing how, how you actually create unrest, if that's what you want to do, and what countermeasures are that you should take if you want to avoid it, avoid… And, that was quite interesting. So that was why I visited a lot of these, I was invited, or, I got one or two fellowships to visit the universities in Australia, or… I never got one in New Zealand, but I just went there anyway, and, visited most of their universities.

What do you think were, are, or were, the main cultural differences?

Well, the cultural differences of course were, primarily between, or, the extremes were primarily between America, the Stanfords and places like that, and the, places like the National University in, in Canberra in, in Australia, where you were still Prof, and where this mysterious pyramid of one professor, two readers, and research, and, senior lecturers, and, five lecturers, and then the, the little people for doing research posts and things, and the… But in America, I remember when I went to America, the first thing that struck me was, here is a physics department. It's one of the top university physics departments, and it's got three Nobel Prizes in it, but they're all full professors. Where are the assistants, where are the tiny little assistants? It's because they were all so good, and when they had been there a few years, just got promoted. And here we were, believing that one in seven should become a professor, and there should be two or three of the others, and they would fall foul. And it was, it was absurd.

You don't like hierarchies very much, do you?

I don't mind. If they, if they are natural, they are… I, I want what does the job well. And clearly, clearly people, people have to be led, so, they do differ, but they have… They… When I like is, is an organisation which has functions in it, which are not viewed as hierarchy. There's somebody who knows ow to do this, there's somebody who organises that, and somebody who does this. But it doesn't look like that.

It doesn't look like a pyramid.

And when you start drawing plans and things, that's, that's not always a very wise thing to do, and it's sometimes better to put them upside-down rather than the conventional way.

[1:03:05]
You were asked by the French Atomic Energy Commission to do some work with them. Where did this come and what was it?

Oh well, I was… I was at Stanford at the time, it would be about 1961, and, the French atomic energy authority approached Stanford and said, 'We have someone here who would like to spend a year at Stanford. Is there anybody in your area who would like to spend a year in France?' And, I thought that would be rather interesting. I had only been in America two or three years, I hadn't made up my mind whether I wanted to stay there for a long time. So I thought, right, I'll, I'll go and… And so I had a year in France at the, the French atomic energy authority. And I wrote to them in advance, and I said, 'Look, I know it's extremely dangerous for me to come to France, because, all of you speak English, and I don't know any more than the five years of French that I did at school. So I'm telling you in advance that I'm not going to speak one single word of English for a year, or at least, I'll speak English on the 23rd of April.' And they said, 'OK.' And I had worked out that St George's Day was a Sunday, and therefore I wouldn't be in the lab. So, I, I did just that. And, they were very kind to me, they put up with me, they didn't try to bully me. I gave talks and lectures in French after the first few weeks. They were terrible. I mean they were… But they said they would rather listen to my bad French, than have me speak with perfect English that they couldn't understand. So they, it suited them too. And, so that was my French experience. There was, there was a… I was in the division of applied physics, and there was a hierarchy there. The physicists on pedestals, they were all very, you know, very important, stuff. And so they had their own restaurant. And we used to go to this restaurant. And, the only person who was allowed there who was not a scientist was the administrator. And she, she had graduated in German, and she was, she would come to lunch. And, she tyrannised me

over my vocabulary, my grammar, my syntax, my logic, which was not French logic, and, and so on. And, I had a wonderful time, a wonderful time. In fact a year later I went back and married her. So that… [both laugh] And fifty-six years later we're still, we're still arguing. So… So that was the contribution from France.

[1:06:07]
What's the biggest mistake you've made in your career?

[exhales] Oh dear. [pause] The trouble is that, a lot of things that you do that are positive are actually mistakes. You may take a job out of two, you may do well at it, but the other one might have been much better. So, I'm not sure that I'll ever know what the biggest… There are very few things I regret. I think, characteristically I make the best of a bad job. So if I, if I have a non-ideal situation, I try to turn it round, and, and that's it, and move on to something else, if that's necessary. But, I mean I, I… In 1963 I had offers, unsolicited offers, from both Oxford and Cambridge of jobs, and I turned them both down. And I turned them down because I was enjoying myself at Stanford. And, it was pretty clear, if I didn't accept them, Oxford and Cambridge were closed to me thereafter.

Mhm.

They don't take, expect noes from some nobody like this. And, I had not been a student there, I hadn't even been to university to, to study. And, so…

But you don't regret that, you are saying?

I don't regret it, one little bit, but it might have been a big mistake, I might have ended up running something at Cambridge. They came back around a half a dozen, or, or… No, I think it was seven offers of headships of colleges, all at, round about the late Eighties, and, and it was laughable, I just thought, why on earth would somebody give me such a silly job? They're non-jobs, but to them, they're really important and… Stanford straightens you out on, on hierarchies and things like that.

What, you didn't want to sit at the high table, looking down onto the well of...

Not a bit. It would be good for a week, but I… It would drive me mad.

But they've got very good cellars you know.

But I did do two sabbatical years in Oxford, so I knew what it was like.

Oh you knew what it was like.

I knew exactly what it was like.

OK.

I went to University College in Oxford and, just to see what they were, they were like, and, the myths just dissolved away, that's…

[1:08:41]
While there have been some big companies coming out of Oxbridge, and particularly out of Cambridge, well, Autonomy was one for example, another one was really ARM, still, it is enormous rocks or very small pieces of sand, it seems to me, from Oxbridge.

Mm.

Whereas, Stanford, MIT, there's a whole gradation of sizes of organisations that have been sprung out and been successful in the private sector. Why does that happen in Oxbridge, and they can't get that gradation?

[exhales] They love tradition. You can have a, you can have traditions that bind you when they, when you want to be free. And I… There's something special about… Don't believe for one moment for example that the educational system that you've got in California is anything like Harvard and MIT in the east. They're actually very different. I turned MIT… They came and offered me a professorship at MIT, and I, I wouldn't have dreamt of going there.

Because?

Because it was so stiff, and, I didn't have the liberty that I would have had at, at Stanford. And they, they believed in Ivy, and things like that, you know. We didn't have any Ivy, we, in Stanford. So…

They really are Ivy League.

They really are Ivy League. There really was a… Not so much at MIT, but certainly… And, they had got personalities of, of their own, which, I wouldn't have fitted in. But they offered me, they came along and offered me a job, and I said, 'No.'

[1:10:41]
Sir Frederick, you have spent an awful lot of your time turning down offers, haven't you?

No, not a lot of time. But I've turned offers down that a lot of people would have been pleased to have.

But then you… Is your vice-chancellorship of Aston the real crown of, the real jewel I mean, in your crown, would you…?

It's something I'm very proud of, because I, I wanted to show things, something to the world: not to the world, to, English, educational areas, that, American universities are managed, and British universities are administered. And there is an enormous difference between just doing the administration for something, and actually leading it, and getting the best out of it, and building it, and shaping it, and creating it. And I like that. And I don't like that.

You like the management, you don't like the administration.

I don't mind *doing* the administration, but, but if, if you just think a vice-chancellor's job is to administer a university, then get rid of the vice-chancellor. Get one who knows… It's all summed up… [laughs] Somebody once said to me that, they said,

you know, 'What maxim have you got for someone who is, you know, who goes to, to a university to run it, or to be a vice-chancellor?' And I said, 'Well never be seen moving.' It's as simple as that. Never be seen moving. You must have a strategy, you must have a plan. You must carry the people with you. But, you can only do it incrementally. Do it like, like the sweeper in curling, where you scrape away the ice in such a way that the stone goes where *you* want it to go. And you never touch the stone. And those are the, those are the aspects of university management that, that, they're fighting each other, and they just, have got so much going on. You can shove the whole lot of them a little bit at a time, and you can shape the institution, but you've got to do it incrementally, and never be seen moving.

Never be seen moving?

Never be seen moving.

That's a very interesting philosophy. How would you apply it more generally, apart from academic management?

Oh, well, the academic world is really… I mean, in the hierarchy of managerial complexity, health services are right at the top.

Yes.

Universities are next. And then, after that come, simple things like running a, running a, you know, let's say a, a manufacturing company or something like that. Service organisations are generally pretty tricky, because they, they involve people more evidently than machines, and, it's very often simple to say what is optimum in a service. Take health for example. Do you want to have, is prevention the thing that you aim at, or is it cure? And to me, you both, because, you know, you do, of course you do. But, it's not as evident as when you are working on, some component, some, something you are making by mass-production, and you make it a little bit better here, you do a little bit of Japanese kaizen on it, make it a bit faster, make it a little bit better, and that sort of thing. It's not like that in the, in the service industries, or service activities. So they are, they are much more tricky. And one of the most

complicated service areas to run is, is a university. But beyond that, above that, is health service.

[1:14:38]
Sir Frederick, seemingly outside the area of information technology, or academia, you led the Criminal Cases Review Commission. You were recruited by the then Home Secretary to do that I understand. Why and what was your brief?

Well, I did already know him. He was, he had been a, he had toured America as a debater. And so we had a certain amount of common ground on that. He had gone from Oxford or Cambridge. And, I had gone because we had won the national tournament. So there was, there was therefore common ground.

This was Michael Howard?

Michael Howard. To organise a legal commission to look at miscarriages of justice. The last person you would want to, or the last qualification you would want, is, is someone with a legal background. Because, what is needed for it is, is a managerial approach, which allows you to analyse cases in large numbers. We used to get 1,000 cases a year. We did six and a half thousand cases in the seven years that I was running it. And it was, the way we would deal with it, the way we would analyse it, and the way we would write it down, the way we would do the work, and it was the process and the organisation that I could contribute, I never had anything to do with a single case in, in all that time, but my job was to appoint the right people with the right skills, and create methods of, methods of treating the cases, and dealing with them which was appropriate. And that was easier to do with, from my background, than it would have been if I had been a, simply been a practising lawyer.

You used quite a bit of information technology to make that run smoothly.

Absolutely. That's what information technology is for. It's a servant. I'm not in the business of working on information technology; I'm in the business of using it to, to simplify life .
How did you use it, how did you use it?

Well, when case material came in, even, if I was in, in one particular case, I can remember, it was 94 completely full lever-arch files. They were scanned immediately into the, into the computer so that immediately they could be called up, and can be edited and treated, with very little effort. And, and also took up very little space.

I believe the then Home Secretary had a question for you about, what would be success.

Well, what I said to him at the time was, if at the end of my five years, and I actually did seven, at the end of my five years there was no one in England, or in Britain, who knew my name, that would be a success. And nobody did.

Ann Widdecombe famously said of him, there was 'something of the night' about him.

Well, I, I didn't feel that way at all. We got on very well. And he had the same student debating background that I had got, and, we got on fine.

[1:18:04]
Since you retired, you, I don't think you really retired, you carried on with your academic work, your own personal academic work, have you not?

Very little, but, I have been working on some papers that came out of, of an MSc thesis that I wrote on mathematics.

How old were you when you wrote your MSc thesis in mathematics?

Oh let's see. It would be, 2015; I suppose I'd be, I'd be, 84.

That's quite an inspiration. So Sir Frederick Crawford, I never expected anybody to say, who is part of the extreme international great and good as you are, that their mantra of management would be, never be seen to be moving. But you have moved me today, and thank you for your contribution to the Archives.

That should be put in a, sealed in a special can, not to be opened for 100 years.

[End of Interview]