

**Oral History Interview with
Martin Campbell-Kelly**

January 19, 2021

Via Zoom

**Conducted by William Aspray
Charles Babbage Institute**

Abstract: This is an interview with Martin Campbell-Kelly, one of the leading early figures in the history of computing. The interview discusses his upbringing and higher education, including his PhD at Open University under the supervision of Brian Randell. The interview discusses his career at Sunderland Polytechnic and the University of Warwick. It goes into detail about the circumstances of his various major publications as well as his work as a public intellectual. The second half of the interview discusses his interactions with and impressions of the various individuals and institutions in the United Kingdom, United States, and Western Europe associated with the history of computing in its early years.

Keywords: Computer science, History of computing, Brian Randall, Sunderland Polytechnic, University of Warwick, Charles Babbage, Bletchley park

Aspray: This is the 19th of January 2021. An interview with Martin Campbell Kelly. The interviewer is William Aspray. This is being done over Zoom. Martin, would you start by telling me when and where you were born?

Campbell Kelly: Well, I was born in 1945 in North Wales, so I am Welsh. I was born in a small town called Johnstown, which is near Wrexham. My father had, since the 1930s, worked for the North Wales Power Company, which was an electricity supply company when the industry was still in private hands. After the war, all of the utility industries were nationalized, so electricity supply became the Central Electricity Generating Board, which had several different regional areas. My father was very ambitious. He came from a quite poor, but good background. His mother was a Salvation Army officer, and his father worked for the Salvation Army in a lay capacity. My father studied for a part-time degree at Manchester University. When he died a few years ago. I found the program from the degree ceremony. Amazingly, in the same program Jack Howlett, F.C. Williams and Arthur Porter were all awarded scholarships.

Aspray: Oh, my goodness!

Campbell Kelly: Of course, my dad never met any of them; and anyway, he was a part-time night-class student. He qualified in economics and statistics. After nationalization, he was offered a job as, I think, the chief statistician for the Merseyside and North Wales Electricity Board. That entailed moving to Liverpool, where the office was located. We moved to a town called Birkenhead, which is just across the River Mersey from Liverpool. So, he would go over on the ferry each day to Liverpool. It's a lovely way to go to work I might say, I did it myself for a few months. Because there was a massive housing shortage after the war, the only house my parents could find was in downtown Birkenhead, which is one of the most deprived areas in Europe. Very high-level unemployment and worse now, of course. It was a ship-building area, but that has mostly vanished now. It had been heavily bombed during the war. We ended up with rather a fine house in a downtown area; it was a three-story, semi-detached house with about seven bedrooms. It was enormous. Of course, we loved it as children. We had room for a chemistry lab in the attic. In fact, two chemistry labs—my brother had one too. I should say, by the way, there were four children in the family. The eldest was my sister Margaret. I had an elder brother, Adrian, who is now called Ben. I was number three, and then I had a younger sister Ruth. We got up to all sorts of mischief in this area because of the kids that we played with. Children played in the streets in those days. The local kids were a bit feral and quite impoverished. Of course, we joined in merrily. Because

there'd been so much bombing, there were lots of bomb sites, which were our playgrounds. One of my memories is of a derelict house that had received a direct hit during the war, to the extent that it had a big crater in the center of the house. In those days, there was very little anxiety about health and safety, so we just used to play in this house. It comes up in my dreams from time to time. We could walk up to the first floor as we would call it (you'd call it the second floor), walk around and look down this crater. It sounds lethal now, but it was quite exciting at the time. We were getting into all sorts of mischief—shoplifting, minor vandalism, and so on with these feral kids. We'd moved to Birkenhead, I think, in 1948. In 1956, there was a lot of housing construction. So, we moved to a new area in one of the suburbs of Birkenhead, which was called Prenton. We moved into a new house, which was rather small, probably half the size. It was a three-bedroom, semi-detached house. We were terribly excited about the move. We lived opposite the primary school that we attended, which again was brand new. There was a real feeling of a new world dawning although we didn't quite say it in those terms at the time. I liked the move to the suburbs, although I think perhaps, we all regretted moving to such a small house. And again, we all played in the street, but the children were middle-class and well behaved.

Aspray: Did your mother work?

Campbell Kelly: At first, no. She was a housewife. She had formerly been a secretary and shorthand-typist at North Wales Power. But she left when they married in 1937—women always retired on marriage in those days; it was a condition of their employment. And she remained a housewife, until probably 1959 or '60. Then she got a job as a secretary for a firm of accountants, which I think probably involved some bookkeeping as well. She was much happier then. She carried on working until she retired, I think mostly with the same firm.

Aspray: Okay. As a child, did you have particularly strong interest in this or that?

Campbell Kelly: I was interested in science. A lot of this I got from my brother, who was two years older. He went to secondary school a couple of years ahead of me. Of course, they had chemistry labs, so he built one for himself at home, and I copied him. This was in the old house. When we moved to the new house, there was no space for a chemistry lab, but my dad put up a shed in the back garden. That became his workshop and two chemistry labs, in a space about the size of the room I'm sitting in now. We had some quite eventful times, mainly involving explosives. There was still shrapnel around in those days, and you could find spent bullet casings. We used to make rockets. We would fill one of these

bullet cases with a mixture, I think it was sodium chlorate—which you could buy as weedkiller then—and iron filings, and other combustibles. Then we would tie that to a stick and ignite it with a Jettex fuse that you could buy from hobby shops in those days. Then with a bit of luck it would lift off, or sometimes it would just sit there fizzing away. Occasionally it would explode rather spectacularly. Another time - and this was my brother, not me - he had mixed a lot of explosive material which he kept in glass jam jars in the shed. One very hot day and the whole lot exploded. My father was quite alarmed, but he remained very liberal about our scientific experiments. I now think he was not completely aware of what was going on.

Aspray: Were you a good student before you went off to college?

Campbell Kelly: No, not at all. I think that's why I over-compensated later by becoming a professor. In those days we had what was called the eleven-plus exam for entry to a state secondary school. Secondary schools were divided into grammar schools, which had the potential for university entrance and secondary-modern schools. The funding formula for them was quite unfair. Funding per child in the grammar school was much, much higher than it would have been in a secondary-modern school. Also, the teachers would all be graduates. It was quite hard to get a teaching post in a grammar school, so they tended to be the cream of the teaching profession. I was a bit of a dunce within the family. I'm not sure why. I think I probably lacked concentration. I wasn't dyslexic or anything of that kind—just a bit lazy. Anyway, I was not expected to pass the eleven-plus. Margaret passed the eleven-plus, the elder sister, and my brother went to an independent school, a private fee-paying school, which was the third education sector. That was a big financial sacrifice but my parents, like most parents of that era, were very aware of education as being the ladder to success. I wasn't expected to pass the eleven-plus. In the event, I passed—to their surprise, and mine too I might say. So, I got into the Birkenhead Institute, which was one of the less-good grammar schools in the town. My younger sister, who was cleverest in the family, got into a private school, but with a state scholarship, so our parents didn't have to pay any fees. At the Birkenhead Institute I was placed in the A stream. There were two streams, A and B. I suppose my IQ was quite high, and we were streamed largely on that basis. I was lucky to get into the A stream, but I was not at all academic. So, for example, at some stage I dropped Latin and did woodwork instead, which frankly turned out to be a lot more useful. I dropped geography and did art instead. I dropped history for biology, which was a sensible choice, given my interest in science. At the age of 16 we were entered for the national examinations, known as ordinary levels, or O-levels. Again, I was not expected to do at all well. My parents came home from a parents evening at school wondering what to

make of me, but they remained encouraging. In the event, I did very well, surprising everybody. Then I moved into what was called the sixth form, for ages from 16 to 18. At the end of the sixth form there was another set of national examinations, the advanced-levels, or A-levels. I was quite strongly on the science side, but I was keen to take advanced-level woodwork. I had a chat with the woodwork teacher, and he explained that universities didn't count advanced level woodwork as being a valid subject and advised me to stick with the sciences. At that time, I wanted to be a dentist. So, I took maths, physics, chemistry, and biology. The biology was taught in another school because we didn't have a big enough cohort to justify it. This involved a trip across town, which was a bit of a chore. Also, I wasn't very good at biology. I dropped biology and focused on the other three A-levels. So, then my original ambition to be a dentist couldn't be fulfilled. But at that time, computers were in the air and I used to read *Scientific American*. My mother bought a subscription to *Scientific American* for me, which was characteristically thoughtful of her. Among the articles were adverts for computers. They looked very exciting—H.G. Wells's *Lord of the Dynamos* and all that. So, I decided I would try to make a career in computing, but first I had to get a degree. At that time, this is 1964, there was a guide called the UCCA Handbook—University Central Council on Admissions, I think it stood for. The handbook listed all the degree courses that you could apply for. There wasn't any course in computing. The nearest similar course of study I could find was electronic engineering. There were two courses, one at Southampton University and one at the University College of North Wales, Bangor. I was accepted by Bangor University, where I spent a year. While I was there, my younger sister was also applying for university and had the latest copy of the UCCA Handbook. When I came home in the Easter vacation, I was browsing through the handbook, and saw that Manchester University was offering a degree in computer science. I was too late to apply because I had missed the admissions deadline. So, out of the blue, I wrote to the Department of Computer Science at Manchester University. It was Frank Sumner who replied. I had no idea who he was at that time. And he asked me to attend for an interview. I think I probably arrived for the interview during the tea break and some of the staff had time on their hands. I was interviewed by Tom Kilburn, Dai Edwards, Frank Sumner, and two or three other people. They asked me why I wanted to do computing and why I would I want to waste a year of my life starting again to study computing. I can't remember the answer I gave, but I think it was something along the lines of "I just have to." Anyway, I didn't hear from them again. In the summer vacation I was back home, working as a railway porter. I'd still not heard anything from Manchester University by September. What had happened was that Frank Sumner, who was quite absent-minded really, had simply forgotten to write to me after the interview and I never had the gumption to follow it up. I wrote Sumner a letter saying, "What about me?" And he

replied, "Oh yes, of course you can come." It turned out, when I got there, there were 28 people on the course. I've often thought they might have let me in for reasons of parity, because the laboratory sessions were designed for student working in pairs. In those days, all university fees and accommodation were paid by the state; it was an extraordinarily generous time for students—quite different to today. I was entitled to a three-year grant from the government, but my dad agreed to fund the extra year I would now need. In the event the local educational authority gave me a grant for the full three years at Manchester. I was very fortunate. Having spent a lifetime in university teaching, I feel quite cross about the way students are treated nowadays and the debts that they end up with. We got our fees paid plus a living allowance of £300 a year. The grant was means tested, but it was very generous. We could also take on paid work in the vacations. We had no idea how lucky we were.

Aspray: Yes. Did you enjoy being in computer science?

Campbell Kelly: I loved it. Again, I wasn't a terrific student. I wasn't very good at electronics or computer engineering. I discovered I was a software type, which I found very easy.

Aspray: Are there people during your college days who were particularly influential on you?

Campbell Kelly: Not at the time. As a twenty-year-old, I was not very aware of what was going on. But F.C. Williams and Tom Kilburn were held in high esteem. I remember one day, I think in 1967, which would have been my second year, there was a departmental celebration because Tom Kilburn had received some award. I realize now he'd become a Fellow of the Royal Society. I didn't understand about such things at the time. And F.C. Williams, I'm not sure when he was knighted, it might've been around the same time. I'd not heard of Turing either—but I was very aware that I was in a charmed place. It had a reputation that went well beyond Manchester—and they weren't shy about telling us what a wonderful place we were in!

Aspray: Right. So, as you got close to being finished with your degree program, what plans did you have for your career?

Campbell Kelly: Well, I had applied for various jobs. I was offered a job at ICT as it was then called, which later became ICL. I was offered a job as a programmer. In the final year, they had what's called the "milk round," when employers would come along to the university and give a talk and encourage recruitment. I was keen to go to Elliott Brothers, but they turned me down. I'm not sure why, I think I

probably just didn't interview very well. ICL did offer me a job. I'm glad I didn't take it because I can think of three occasions now where I would have been made redundant. I quite liked the idea of teaching, college teaching. I applied for and accepted a job at what was then Alsager College of Further Education, which was not far from Manchester, and I accepted the job. That was what I was expecting to do in September after I'd graduated. However, I read an advert in the paper from Leicester Polytechnic, offering a research assistant job with six hours teaching a week, and the opportunity to register for a higher degree at the same time. Of course, this was exactly what I needed, but I'd already accepted another job. I had a friend then, by the name of John Kellett. We met one lunch time at a pub and I told him that I'd seen this fantastic job, but unfortunately I accepted the job at Alsager College. He said, "You must be mad, you must take this job. And anyway," he said, "Leicester is such an interesting place to go." I thought it seemed a very dishonorable thing to do to leave Alsager College in the lurch two weeks before I was due to show up. But John urged me to apply, anyway." I did apply and Leicester Polytechnic offered me the job. I then had a rather uncomfortable bit of letter writing to Alsager College to disengage. I think they were pretty cross with me, and I don't blame them. But anyway, that was what I did. So, then I went to Leicester Polytechnic—it's now De Montfort University. Actually, I have to go back a bit, it was called Leicester Regional College of Technology when I applied. It was sort of a trade school, really. They taught pharmacy, fashion, printing, and shoe manufacturing—the local industries. It became a Polytechnic in 1969, the second year I was there, and a degree-awarding institution. So, I was then on the track to becoming a proper academic. That was where I met my wife, Jane. She was a part-time student. It's quite interesting, because nowadays it would be quite frowned on—an academic consorting with students. What had happened was I took over an evening class halfway through, to cover for another lecturer. There were two girls and about a dozen boys in this evening class, on computer programming. I asked the class if I could borrow someone's lecture notes to see what the previous lecturer had covered. Girls usually have better handwriting than boys, so I borrowed Jane's notes, and then returned them the following week. After the lecture I invited her to the local pub. We got married a couple of years later.

Aspray: Okay. You stayed at Leicester for five years?

Campbell Kelly: That's right, yes. I became very interested in computer history while I was there, but also in programming and software technology. I became interested in macro processors, which were just coming out then, and I wrote a little monograph. I can't speak for the content, but I was quite good at writing, I discovered. The book came out in 1973, and on the strength of it, I tried to get a promotion at

Leicester Polytechnic. They didn't have a spot for me at that time, so I started looking around for a job elsewhere. The first that came up was at Sunderland Polytechnic, which was very similar to Leicester Polytechnic—another former trade school. It taught naval architecture and pharmacy, again typical of the local industries. Sunderland town had a reputation, even worse than Birkenhead, as a place of industrial decline. Jane said, "If you're applying to Sunderland, I'm coming up with you because I'm not prepared to live in Sunderland if it's as grim as it sounds." We stayed in a bed-and-breakfast hotel in a small town called Seaburn, which was a seaside resort about two miles from Sunderland. It was a spectacularly beautiful place with a wonderful beach and quite inexpensive housing. I had the interview and I decided it was such a nice place to live, I was going to take the job if they offered it to me. Which they did. Then I was wondering what to do next. Sunderland Polytechnic wanted to improve its academic credentials and offered a day off a week for study if a lecturer registered for a higher degree. I initially thought I would do research in software engineering, but I discovered there were countless other people doing that and it actually wasn't my forte. I had discovered by that time I didn't have the green thumbs to be a software engineer. But I had a latent interest in computer history. For example, when I was doing my final examinations, I had stumbled across Wilkes, Wheeler, and Gill, the first textbook on computer programming. I remember spending half an hour with this book and being absolutely fascinated because this early form of programming was like nothing I'd ever seen before. I remember putting it back on the shelf, thinking one day I'll pick that up again. When I'd been at Leicester Polytechnic, I'd written a teaching package for the National Computing Center, a module on computer history. And at Sunderland Polytechnic, I'd written an illustrated juvenile book on computer history called *The Computer Age*. So, I did have this interest in computer history and decided on a history of science PhD. One of our external examiners recommended I should get in touch with Brian Randell. I didn't know of him at the time, but he was at Newcastle University, which was just 15 miles away from Sunderland. He offered to contact Brian on my behalf. I waited and waited, and of course I never did hear because he had forgotten to contact Brian Randell. So, one day I phoned up Brian out of the blue, and got to his secretary, who put me through. I've now forgotten the name of the person who was supposed to make the introduction. I said, "I wonder, did so-and-so ever get in touch with you about me?" He said, "No, what was it about?" I said, "Well, it was because I wanted to register, for a higher degree, a PhD, in the history of computing." Brian said, "Oh, that's very interesting. Come along and have a chat." So that was that. That would be 1976. So, I came along and had a chat, and we decided I would do something on the history of software. We had quite a nice relationship. Brian, when he was appointed, was the youngest professor in computer science in the country. He had been

appointed, I think, at the age of about 31. He was born 1937, and I was born in 1945. So, he was only a little older than me, but extremely distinguished. I felt somewhat in awe of his success, but he was very unassuming and always put me at my ease. I registered with what was called the CNAA, the Council for National Academic Awards which awarded polytechnic degrees, rather than Newcastle University, because I was very strongly in favor of polytechnics and wanted to nail my colors to the mast. I was disappointed when polytechnics eventually became universities because they had such a wonderful function as trade schools. Brian recommended that I get another historian as co-supervisor, because he always used to say, and no doubt he's said it to you, that he's an amateur historian, which is his way of diffusing criticism, I suppose. I wrote to several history of science departments at other universities asking if they would be willing to co-supervise with Brian. The answers I got from all of them was that they had no expertise in computing and were typically more interested in the 19th century. The person who rescued me was Margaret Gowing at Oxford University, the eminent historian of atomic energy. I'm not quite sure how the contact was made now, but I went to see her at Oxford, and she was an extraordinarily nice, kind woman. She said, "It's a wonderful idea, what you're doing. It's just what needs to be done. And I can't think of anyone better than Brian Randell to supervise you. You don't need a second supervisor, and I won't be your second supervisor. But what I will do is this: if you ever need me to write a letter, I will do so." After I'd been registered for a year or two, the CNAA queried the quality of my supervision and recommended an additional supervisor. That was when I asked Margaret Gowing if she could write a letter. Of course, she was one of the most eminent, perhaps the most eminent, historian of science in the country. I never saw the letter she wrote to the CNAA, but I heard no more from them. I was eventually examined in 1980, by Maurice Wilkes and Brian Randell at Cambridge University. That was a very happy occasion because it was the day that Maurice Wilkes retired from the university, and they were having a celebration in his honor. He'd arranged for me to have my PhD examination on the same day. It took place in the early afternoon. It was only about 20 minutes or so, the examination. I'm sure that Maurice had read the dissertation or read the bits about the EDSAC anyway. I remember him saying, "Well, you're very thorough." He seemed quite happy and I passed the oral examination. Probably about seven o'clock, there was a banquet for Maurice, to which I was invited. There were many eminent computer scientists, including the people from Manchester University. Edsger Dijkstra was there, I remember. Peter Naur too, I think. Really quite a galaxy of rather famous computing people. So, I went back to Sunderland Polytechnic with my PhD.

Aspray: Let me ask you a couple of questions about your working with Brian. The first question is about the working relationship, how often did you see him? How did you interact with him, and so on?

Campbell Kelly: The rule of the CNA was that you must see your supervisor at least six times a year. Brian and I met twice each term. We have three terms in the year, so we met twice in the first term, twice in the second, and once in the third, for about half an hour. That was the only interaction we had. We never really knew each other terribly well. Over the four years I took to do the PhD, we must have had a total contact of not much more than 10 hours altogether. It was very businesslike. He was pretty busy, so we didn't linger. I was busy too, so we just had these nice half hours. Slightly fewer meetings than we were supposed to have, but I didn't tell that to Brian.

Aspray: Did he read materials that you prepared and critique them?

Campbell Kelly: Yes, he did. He was very good. He was quite penetrating. I was quite a good writer by that stage because I had already written two books. My research topic was the development of programming in the UK in the 10-year period, 1945 to 1955. I found studying programming texts quite difficult, and there really wasn't that much literature anyway. So, I hit on the idea of using a simulator to explore early programming texts. I remember Brian was somewhat lukewarm about that idea, but said, "Well, try it anyway." So, I did. Anybody who's ever developed a simulator will tell you it's quite a magical experience, when you suddenly revive software and it comes to life. I imagine it's what it must be like if you restore a player-piano and it suddenly plays a music roll. Once I had written the first simulator, I could see this was the way to go. It's a great way to study program texts because when you trace the actual flow of a program you study in a way that can't be done on paper. Also, it helped fill the time, because I didn't have enough to read, that was directly relevant. What I should have been reading about, of course, was the history of science. As a student, I should have deepened my history of science understanding. Studying for a doctorate in the UK is very different to America. Here, it's typically three years full time, or four- or five-years part time; and it involves little broad historical study. Things are a little better now, but the time constraints are the same. Simulator building came to be the heart of the thesis—restoring and exploring the original software libraries for those machines, describing the processes of invention, and the flow of knowledge. I took four years, so it was quite quick for a part-time PhD. One thing I found, and I always think it's a very good idea if you're studying for a doctorate, is that you need to do some teaching and have some other jobs, because the research will pall from time to time. I found, because I was teaching at the same time, I could put everything to one side, focus on

teaching, then come back to the research completely refreshed the day after. Brian and I have kept in touch. We've never been intimate because we've met so little. In fact, the first time I ever met his wife, Liz, was about three years ago, when I went up to Newcastle to give a seminar and was co-supervising one of their PhD students, Troy Astarte. I went out to a restaurant with Brian and Cliff Jones, and our respective wives. Brian's wife, Liz, is an absolute delight. They couldn't be more different. They're both Welsh, but she's very Welsh—funny, and wonderfully irreverent. Whereas Brian is quite strait-laced in a way. They complemented each other.

Aspray: So, you've finished your degree. It's about that time that you leave Sunderland and go to Warwick.

Campbell Kelly: Yes.

Aspray: Will you tell me that story?

Campbell Kelly: Yes. By that time, Jane and I had two children, and George, the eldest, would soon be starting school. He was four, I suppose. I hankered to be a proper academic in a good university. I was quite torn. I felt a strong affinity for the polytechnic and the job it did. But I was really drawn to doing much more computer history. I made a conscious choice, basically, to be a selfish scholar rather than a generous teacher. Once I got my PhD, I had to move then, that year, before George started school. So, I had to start in October 1980. There were four jobs advertised—this would have been around May time. I was interviewed by both Southampton and Warwick Universities. I was interviewed by David Barron at Southampton. We knew of each other because we both had written monographs in the same series. I didn't get the job. I think they wanted a much more technical person than me. He wrote very kindly after the interview, saying in effect "I wish we had been able to appoint you, but I was outvoted." He explained the reasons, so I was left feeling quite happy. The second interview was with Warwick University, which had a nice interview process. I gave a seminar, they took me out to lunch, and then had the formal interview in the afternoon. When I was interviewed, I was asked I what I proposed to do in terms of research. I said, "Computer history. I'm very happy to teach computer subjects, but it's not going to be my research interest." They agreed and honored that agreement. I was never once pressured to do something more mainstream. Much later, when I'd been in post a few years I learned I was appointed in preference to the other candidates, because the general consensus was that I'd be an

interesting person to have around. That would not happen today because universities are under so much pressure to generate research outputs.

Aspray: You ran a regular class on the history of computing. Did that start from the very beginning?

Campbell Kelly: Yes, it did. The department asked if I would teach a class. They were keen to have different options. The department has a nice system. In the third year, students take eight courses, of which six are optional courses. So, they had a huge range of options; and students didn't even have to take them in the department. You could take an economics course if you wanted to. So, I started teaching a course on history of computing as a third-year option. Later, Steve Russ joined the department. He was an historian of mathematics and taught the course with me for some years as well. We taught it more or less without interruption for about 30 years. It became the most popular option, at one point. I remember we had over 100 students, at its peak. It was very popular with students. Sometimes, people thought it was a soft option, but once they realized they had to write an essay as part of the assessment, some of them dropped out. They realized it wasn't altogether a soft option.

Aspray: Right. This was a very early instance of a course on computer history. Do you know of others from that time?

Campbell Kelly: No, I don't think there were any. In fact, there have been very few in Britain. Later, there was one at Portsmouth University, and another Manchester University in the 1990s. But there have been very, very few. This always surprised me because I'd expected the subject to be as popular as the history of maths. Not every maths department teaches a history of maths course, but many do. Warwick was somewhat exceptional. Computer scientists generally feel that there is no space in the computer science curriculum for anything other than computer science. You've probably experienced the same thing.

Aspray: Yes.

Campbell Kelly: It's hard to argue against because what would you leave out? And nobody wants to see their subject left out.

Aspray: Right. Tell me about what you taught in this course and how what you taught changed over time.

Campbell Kelly: The way I taught it at first was that every week I would give the students a handout—this was all before the web. So, I'd provide a physical document. It might be, for example, "Counting a Nation by Electricity", T.C. Martin's description of the Hollerith machine. There were 30 lectures in the course altogether. I thought of it in terms of 10 topics. So, one topic would be about the punched card machine industry. Another was about programming, when we would talk about how programming evolved through high level languages, operating systems, and so on. That complemented the courses on programming and operating systems quite nicely because the students got to know more of the deeper history. How I used to sell the course was to explain that students lived in a 10-year window—they were aware of the five years before they came in, and they would leave with some expectation of the five years to come. The aim of my course was to give them a hinterland of what happened before that 10-year window and to give them a much longer perspective. Early on, we stopped at System 360—this is going back to 1980—back to a time when the PC had barely arrived, and the students were still using punched cards on our computers at university. As time went on, we introduced the development of the personal computer and later the internet. That gave me the opportunity to talk about H.G. Wells's World Encyclopedia and Vannevar Bush's Memex as precursors of the web. When our book *Computer* came out, which was in 1996, I was able to use it as a textbook for the course. So, now I would just give them a single handout and then they would read the book as background. It's always quite awkward making your textbook required reading. So, I came to an arrangement with the publisher that they would let me have copies with an author's discount which we then sold to students. I made a slight personal loss on each one, so that should people ever complain that I was profiteering, my conscience would be completely clear. Making the textbook available cheaply made the course very attractive to students. What teaching had taught me was that students love to have a textbook because it gives them an anchor to the course.

Aspray: Tell me about graduate students you attracted to study with you.

Campbell Kelly: Actually, disappointingly few. The department of computer science was not a good environment, because students would be somewhat isolated. Unfortunately, Warwick University had no history of science department at that time which would have broadened their exposure. The two most successful students were Mary Croarken and Ross Hamilton. Mary started in 1982. She took a little while to get off the ground but then flowered and did very well. Her dissertation was turned into a book *Early Scientific Computing in Britain* and published by Oxford University Press. She won various fellowships, including one at the National Maritime Museum, Greenwich. She married and moved to

Norwich, which is a slightly remote city on the East coast of England, and not easy to get to London. So, she ended up getting a job with the National Health Service as a research manager. I think she had an ideal background—she understood the funding system having applied for lots of grants herself. She's been very successful. We still see one another from time to time. Ross Hamilton, another very strong student, wanted to study for a doctorate on the history computer games. This was in mid-1990s and I felt it was too early to study that topic. Perhaps I was wrong in that respect. But anyway, after we talked, he decided to write a history of the minicomputer industry in Britain. He wrote a fine dissertation. The UK had quite a big minicomputer industry, as did America. There were hundreds of firms in America, very few of which survived. There was a similar trajectory in Britain—there were perhaps a dozen minicomputer manufacturers, and most disappeared. What he wrote was effectively a business history. Rather like Mary, he married he married and moved into the countryside in East Anglia, and remote from any universities with an interest in computer history. The web was taking off at that time, and he set up a website development business. It has been very successful for him, and he has some major corporate clients.

Aspray: Okay. Are there other things that you want to tell me about Warwick and your time there?

Campbell Kelly: Warwick was a wonderfully liberal university when I went there. It had a curious reputation. There was quite a famous book called *Warwick University Ltd*, written by E.P. Thompson, who was a Marxist historian in the history department. The university was very tolerant of its dissidents. Our founding head of department was John Buxton, who was quite a maverick character. Cristopher Zeeman was the founding professor of mathematics and enormously respected. He was interested in the history of mathematics and appointed David Fowler, to teach and research the subject. So, it was an exciting institution to be in. It was a new university. The university was founded in 1965, when it had its first undergraduate students. It was not really a going concern until about 1970 when it had a full range of programs. I arrived almost as a second generation academic. Compared with what I was used to at a polytechnic, we had very little teaching. I only had to teach two courses, one of which was the history of computing. The university had quite a number of distinguished academics, including some Fellows of the Royal Society. The maths department was reckoned to be the third best in the country. When I arrived, Germaine Greer had just left the history department—she was rather typical of the Warwick University style, though more prominent than most. The founding Vice-Chancellor was Jack Butterworth, who had been bursar of one of the colleges at Oxford University and was a very good money manager. He persuaded firms like Rootes Motors, which was a major motor manufacturer at the time, and other

commercial entities to endow the university. He also pioneered the idea of using university accommodation to host conferences during the summer. He was an extraordinarily good money manager. E.P. Thompson's *Warwick University Ltd.* was a critique of this commercialization. Of course, these endowments paid great dividends later, when universities had setbacks in the 1990s. Warwick University was always, and still is, one of the most financially secure universities, excepting Oxford and Cambridge of course. Warwick University remains a very liberal organization. So, for example, when there was talk of having a satellite university in Singapore, many academics objected to Singapore's authoritarian regime and the project was cancelled. Another, much smaller, example, when I was there quite early on, one of the cleaners had been sacked for some minor pilfering. There was an academic protest and she was reinstated. It was a nice place to work for socially minded individuals.

Aspray: How did your being a professor in a computer science department rather than, say, a history department or a science and technology studies program shape the kind of research that you did?

Campbell Kelly: It's a good question because I did toy with the idea of trying to get into a history department. The main, but not the only reason, was that I didn't think I would get in. Academic posts in history are extremely competitive in the UK and I was somewhat on the fringe of history, as a historian of computing. Another factor, I now realize more in retrospect, is that my department and computer science departments generally are more convivial places than history departments. The saying that academics squabble because the prizes are so small, applies.

Aspray: Did you take on or not take on certain kinds of projects because of the environment in which you worked?

Campbell Kelly: No, not at all. I became very interested in business history and came to see myself primarily as a business historian with an interest in the computer industry. This paid dividends because I got to know people in the Warwick Business School, and we set up a joint degree in computer and business studies. Students took courses from the business school and the computer science department. Interestingly, we got a completely different mix of students. The computer science department got about 5 percent female applicants, whereas the computer and business studies degree got fifty percent, if not more, female participation. That was a big difference and a bit of an eye-opener for the department. We became much more conscious that we needed to up our game in attracting females.

Aspray: Now, I think to finish out this session, I'd like to talk about some of the other things that you've done. And, in particular, let's start by talking about you as a public intellectual. You've done a lot of writing for the newspapers. You've written for the professional computing journals. You've done things for television, and so on. Could you talk about how that happened, what your experiences were?

Campbell Kelly: Well, I've always been interested in public communication. I once applied to the *London Times* to be a science journalist, which never worked out. I was approached a couple of times by BBC Radio. The BBC had, and still has, a weekly program called "Last Word"—essentially spoken obituaries of people who've died in the last week. I remember I spoke for Pres Eckert when he died in the mid-nineties. I also wrote an obituary for *The Independent*. I had originally been approached by Tom Wilke the science editor of *The Independent* when I was writing my ICL history to write an article about the company. I then wrote obituaries of computer people for them, which I did for about 10 years. One of the tactics I decided, which I think was a good decision in retrospect, was not to pre-write obituaries but to treat each one as a surprise and do the best I could in the time available, which is usually the day before the copy is due. I decided this on the grounds that I would be tempted to revise and polish the obituary and waste a lot of time in the process. Over the years I've been approached by encyclopedias and popular science books for short pieces and enjoy writing them. Unfortunately, *The Independent* had a new obituary team which was much less interested in science and technology. Some of the team moved to the *Guardian* and they reconnected with me. Over the years, I've written probably 50 or 60 newspaper obituaries.

Aspray: You were a columnist for *Communications of the ACM* for a while. Could you talk about that experience?

Campbell Kelly: Yes. That was quite fun. That was a blank sheet, and it was quite nice to opine about a little piece of history. It was a way of writing about history and trying to make it interesting and relevant to current practitioners.

Aspray: Okay. Can you talk to me about your work on being an advisor, an expert witness, for legal and IP activities?

Campbell Kelly: This happened mostly after the publication of my book, *From Airline Reservations to Sonic the Hedgehog: A History of the Software Industry* in 2003—a terribly ponderous title, but I could never come up with a better one. I was approached by a number of software companies and legal

entities, either as a consultant or an expert witness. The first case came quite out of the blue. It concerned Peter Norton, who created Norton Software. He was a most interesting character, with a most interesting life story. He was a Buddhist monk at one time. Later he married and built up the business of Norton Software with his wife and were trying to reach a divorce settlement when I was involved. It's an extraordinary story. They started off on a kitchen table, copying disks and putting them into envelopes. The business boomed and they eventually sold the business for out for a hundred million dollars. I was acting for Peter Norton's lawyers. I made a deposition about the growth of firms in the software industry, explaining about network effects and so on.

Aspray: I think that we should stop for today.

**Oral History Interview with
Martin Campbell-Kelly**

February 9, 2021

Via Zoom

**Conducted by William Aspray
Charles Babbage Institute**

Abstract: This is an interview with Martin Campbell-Kelly, one of the leading early figures in the history of computing. The interview discusses his upbringing and higher education, including his PhD at Open University under the supervision of Brian Randell. The interview discusses his career at Sunderland Polytechnic and the University of Warwick. It goes into detail about the circumstances of his various major publications as well as his work as a public intellectual. The second half of the interview discusses his interactions with and impressions of the various individuals and institutions in the United Kingdom, United States, and Western Europe associated with the history of computing in its early years.

Keywords: Computer science, History of computing, Brian Randall, Sunderland Polytechnic, University of Warwick, Charles Babbage, Bletchley park

Aspray: This is the second interview with Martin Campbell-Kelly. The date is the 9th of February 2021. The interviewer is William Aspray. We're doing the interview over Zoom. In the last interview, we were talking about legal and intellectual property activities. I wanted to start today by asking you if there are other things you wanted to talk about with regard to that topic.

Campbell-Kelly: I got very interested in legal matters. When I'd written my book on the software industry, I was contacted by a firm called LECG—Legal and Economic Consulting Group I think it stands for. They were one of the organizations that Microsoft dealt with on legal matters. They were interested in my historical approach and asked if I would be interested in taking an interest in IP matters on issues such as open-source and bring a historical perspective to them. That was very much my cup of tea—something I find very interesting.

Aspray: Were there some particular cases or episodes that you feel that you can talk about and that you want to talk about?

Campbell-Kelly: I found the whole area of the patenting of software very interesting. It coincided, when I was taking an interest, with the rise of the open-source movement. This movement was very hostile to patents and still is, to some extent. There were a lot of exaggerated fears about the impact of software patents. It's always been a bit contentious as to whether software patents should be permissible because patenting algorithms is not permissible. Is software an algorithm? There are some philosophical arguments about that.

What I found was, you actually can't really draw a line between other technologies and software. For example, people argued that many software patents were trivial, and in a sense that was true. But when you look at patent history—and I looked particularly at the punch card machine industry and the typewriter industry as being forerunners of information technology—what you found was there are lots and lots of apparently trivial inventions. People were also anxious about what was called a “patent thicket”: that you would not be able to write any software at all because everything would have been patented, and you could not write a line of code without infringing somebody's patent. Again, when you looked at it, and it's more than 10 years since I did this work, nothing has emerged that's given that fear any foundation.

Aspray: Many of the patent issues, legal issues in the United States have had to do in recent years with Microsoft. You said that Microsoft was connected with this firm that contacted you. Did you have direct contact with Microsoft on one side or the other in these legal issues?

Campbell-Kelly: It was mostly indirect, but in 2007 they called me as a witness for the European Commission suit against Microsoft. My evidence was concerned with Microsoft's unwillingness to make server protocols available to the open-source community—effectively so that one could insert an open-source server into a Microsoft network. The argument of the open-source side was that the protocols were essentially trivial, and Microsoft was simply not disclosing them. I went over to Microsoft in Seattle and interviewed the people who developed the protocols, and what I found was very, very interesting. It was an eye opener for me because it was an aspect of the software industry, I wasn't familiar with. How they derived the protocols was very much an empirical process. They tried different things. Some worked, some didn't. It wasn't simply a question of writing down standards. It was much more like the development of the internet, for example, first developing running code and then using that to define the standard. That was the argument I brought up at the European Court of Justice. It was quite a nerve-racking experience, I must say. And, of course, Microsoft lost the case because all big American companies tend to lose their cases in Europe. They got fined a few billion euros and a rap across the knuckles. I think that's the way it works, really. It's a signal that you're being watched as much as anything. So, although the EU tends to win antitrust cases and impose substantial penalties, they tend not to change the firm's behavior very much. But it reins them in, I think.

Aspray: Okay. Are there any other things you care to say about this topic?

Campbell-Kelly: Well, I had a very interesting interaction, not connected with LECD or the other firms, but with Nominet, the internet domain names authority in the UK. My involvement was as one of a panel advising on allowing or disallowing contested domain names. This is going back to the early 2000s. There were quite a lot of people speculatively registering domain names in the names of prominent firms. So, for example, they might register the name of a firm such as "Mars" and make the spurious claims that it was pure coincidence that this happened to be the name of a major firm. Their idea was to obtain the registration and then sell it to the firm. I think some were successful. My task was to decide whether a particular case was reasonable. I almost always argued in favor of the complainant—it was usually a firm that was effectively being held to ransom.

Aspray: Yes. That was a big issue for a small number of years and then sort of died out over time. Anything else about IP or legal issues?

Campbell-Kelly: Well, I also got very interested in open-source. I was involved with IBM at the time it was being sued by SCO, The Santa Cruz Organization, for whom I was acting. That was interesting. Historically, software had been open source in the 1950s, when it had no commercial value. Then software becomes a closed source in the 1960s because firms want to monetize it. The development of APIs was a way of overcoming the need for source code disclosure. I think it's not always realized that APIs are about intellectual property as well as providing clean interfaces. Then, IBM became open source again for some aspects of its operation in the 1990s, which made open source much more nuanced than people had thought. IBM embraces open source for some aspects of its operations and closed source for others. In the case of IBM at the time I was looking in about 2006, I think they had a few hundred developers on open source, but several thousand on proprietary software. So, you really can mix open source and closed source software. It's a much less black-and-white situation that people commonly think.

Aspray: Okay, what I'd like to do now is to talk about several activities or institutions that had a connection to computing history in one way or another. I'd like you to not only talk about your own role, but to talk about these institutions, to give the readers an understanding of them. The first one I'd like to talk about is the Charles Babbage Institute reprint series. Could you tell me about that?

Campbell-Kelly: Yes. I first knew of the Charles Babbage Institute, I think, in 1980, when I'd just finished my PhD. I first visited in May 1981, which was when we first met, Bill. For me, the Charles Babbage Institute was enormously helpful because I was one of the very, very few—possibly just two—people who were actively interested in computer history in the UK. So, the fact that this organization had started in the USA was extremely helpful to me. I got quite friendly with Erwin Tomash, who was a very approachable person. We had a conversation—it probably was in May 1981—that the CBI was thinking of reprinting a series of books. I think the plan at the time was to reprint some large numbers of books. I thought a better approach would be to produce a set of seminal works. I was thinking of the famous five-foot shelf – but it would be more like a two-foot shelf for computer history. Many of the seminal works were very difficult to obtain and not always easy to interpret. So, what we did in the series was to commission very long introductions that set the each book in context. I wrote the first introduction to establish that pattern—that was for Wilkes, Wheeler, and Gill, *The Preparation of Programs for an*

Electronic Digital Computer. Allan Bromley edited the second volume, *Babbage's Calculating Engines*. So, we had two good examples to start us off. Altogether, there were 16 volumes. At that point we felt we had probably got an optimal selection any more volumes would have diluted the quality of the series and probably would have made it unaffordable. A library could reasonably buy 16 volumes of a series, but if the series went on forever, that would no longer be the case.

Aspray: Was it indeed libraries that were the main purchasers of these books?

Campbell-Kelly: Oh yes, they were expensive. I've no way of knowing for certain, but I believe a lot of libraries routinely bought them. University libraries particularly would buy them, but not generally public libraries. Individuals would buy one or two from the series. So, for example, *Babbage's Calculating Engines* was very popular with people who were interested in Babbage. So that sold quite well. One of the books was Alan Turing's *ACE Report of 1946* which sold very well and was reprinted at one stage. Some of the books definitely struck a chord.

Aspray: My recollection is that originally Erwin Tomash formed his own publishing operation and started the publishing, but then they co-branded with MIT Press. Is that correct?

Campbell-Kelly: That's exactly what happened. The problem I think was that Erwin didn't have the marketing capability, and he was very aware of marketing. The other problem was that everything was subcontracted so it was difficult to exercise quality control. So, certainly in Wilkes, Wheeler, and Gill there were a few typographical errors, which I'm afraid are still there. I'm not sure how he made the arrangement with MIT Press. Of course, they were already publishing computer history books at that time, so they co-branded it. The series did a great deal better after that because new books in the series would be featured in their quarterly catalogs where there would always be a mention of the Charles Babbage Institute series.

Aspray: Do I remember correctly that Mike Williams was also involved in the editing of this series?

Campbell-Kelly: No, not directly, but he did edit the famous *Handbook of the Napier Tercentenary Celebration*. We also jointly edited *The Moore School Lectures* and *The Early British Computer Conferences*.

Aspray: Okay. Looking back on this, do you think that this was a valuable venture to undertake?

Campbell-Kelly: I think it served two purposes. The primary and most useful purpose was it moved computer history more into the mainstream than it had been. The fact that there was an institution for computer history and that they were publishing books, was a real lift for the whole computer history movement. The fact people were able to get the books was secondary, but helpful. It would have been quite hard to undertake serious historical studies without some of the books. For example, one of the volumes was the Manual of Operation for the Harvard Mark I, which was a foundation of computer history and was almost unobtainable even in major libraries. The reprint series made it widely available.

Aspray: Can you tell me why Erwin Tomash was particularly interested in this series?

Campbell-Kelly: Well, Erwin was a real bibliophile, and he was a book collector. He spent a small fortune on books and had a very fine collection. Mike Williams and I once visited him at his home in South Rockingham Avenue in Los Angeles. He had a personal library, which I remember Mike Williams being stunned by because he was a book lover too. I think that that was one of the main reasons for Tomash Publishers—he would enjoy the process and create a legacy too.

Aspray: I don't know [whether] this is true, but I've speculated that also he was particularly interested in seeing the availability of the Engineering Research Associates early book.

Campbell-Kelly: Yes, that was High-Speed Computing Devices. It had a very good forward written for it by Arnold Cohen who was a Senior Fellow at the CBI. It was a book Erwin was very, very keen to see. And again, it was a book that was almost unobtainable outside of the series. One thing I should say about Erwin and the series was that he was extremely supportive. He didn't just get it going and then cut me adrift. We had many phone calls at a time when international phone calls were expensive. He said, just pick up the phone any time you want to talk about things. He would call me from time to time. We had many phone conversations. Certainly half a dozen times a year we would speak on the phone about how the series was going. Another nice gesture was he occasionally got a better edition of one of the books he owned and would pass the less good copy to me. I particularly treasure a copy of J.A.V. Turck's *Origins of Calculating Machines* he gave me.

Aspray: Oh, nice. Yes, he was a very generous man.

Campbell-Kelly: He was a very nice man. He came to Britain not often, but often enough. We would meet up and have dinner. I think always with Adele.

Aspray: Yeah. His wife. Anything else you want to say about that before I move on to the next topic? I have whole series of these.

Campbell-Kelly: Just that I have very, very warm feelings for the Charles Babbage Institute. I feel in a way we grew up together.

Aspray: Yes. The next thing I wanted to ask you about was the Dictionary of National Biography. I understand that you were the computer science editor for this series, for this book.

Campbell-Kelly: The DNB. Yes. Well, how that happened was John Leech, who was a professor at Glasgow University and one of the pioneers on the EDSAC, was the computer science editor for many years. Because I had written a few entries for them— for Strachey and some others—when John got too old, he recommended me as his replacement. I've probably been doing it over 20 years. It's quite interesting how the process works. Every year they send me a list of computer people who've died and have had obituaries written or otherwise they've heard about. I normally add one or two names that they haven't noticed. Then I categorize them from A to E. A is essential to include. B means the dictionary would be diminished if this person was not included. Very British. Next, C means should be included if space permits. And then, D and E are not worthy of inclusion. So, I always think people need to treat me well, because I'm the final gatekeeper on their possibility of being in the Dictionary of National Biography!

Aspray: How many computing people would appear on average each year?

Campbell-Kelly: Oh, less than 10. Because it's only British citizens, of course. Rarely more than five. And who would write the entries? I would write some of them. Quite often, I'd have written an obituary for one of the newspapers so I would have the background. Otherwise, I would recommend somebody who I thought would do a good job, who knew the individual and had some historical insight.

Aspray: Were these typically authoritative?

Campbell-Kelly: Oh, absolutely. The Dictionary of National Biography is an extraordinarily rigorous publication. For example, it will always obtain marriage and birth certificates to be quite certain that they have the right details of where a person was born, when they got married, and so forth. So, very rigorous in that sense. They produce a complete list of sources. You won't see all that on the web

version of the Dictionary of National Biography, although you can click through to it. That will tell you the sources that were used, if there are any portraits in the National Portrait Gallery, and so on. The DNB makes an interesting contrast with Wikipedia. As you know, the principle of Wikipedia is that authors only use secondary sources and include no original research. Whereas the Dictionary of National Biography is completely the opposite. It uses both original research and secondary sources. I've always been a bit troubled by that aspect of the Wikipedia in the sense that it is, by definition, totally derivative. Again, if you take something like the Encyclopedia Britannica, they will commission articles from single authors who often have their own point of view. Wikipedia is quite different—it doesn't have the opinions of a sole author.

Aspray: Okay. How about the Annals of the History of Computing, could you talk about that?

Campbell-Kelly: Well, again, the Annals has been enormously helpful to me. We've grown up together too. When it started in 1979, it came at exactly the right moment for me. I was able to publish four chapters of my dissertation in the Annals over a two-year period. It was very helpful to me to get some peer-reviewed publications, because at that time, the early eighties, it was quite difficult to get computer history published. The history of computing was too new for the history of science and history of technology journals. There was no tradition for publishing the history of computing. As for computer science journals, there was too much pressure on space to be able to take computer history. So, the Annals was extraordinarily important to me. Most of my early refereed publications appeared in the Annals. Later, towards the end of the 1980s, when the history of computing had wider acceptance, I would often try first with a conventional journal of high standing to see if I could get in. And sometimes I did. And sometimes I didn't, in which case I would submit them to the Annals. It sounds unchivalrous but obviously if my entire oeuvre had been published in the Annals of the History of Computing, it would not have looked good.

Aspray: How did your colleagues feel about your publishing in Annals?

Campbell-Kelly: There were no problems at all. It had the imprimatur of AFIPS when it first started, and later Springer, and then IEEE. So, it always had a good pedigree. We had, starting in the 1990s in Britain, what's called the Research Evaluation Framework [REF] to evaluate university research nationally. I found that typically people on the panel were sympathetic to computer history and took it seriously, for which I was very grateful. There were some doubts in the department as to whether to include my

publications, but in fact they were highly rated. And it probably helped that Brian Randell was one of the bigger names on the REF committee for computer science.

Aspray: Did you serve on the Annals editorial board?

Campbell-Kelly: Yes, from very early on, in 1980. Apart from Brian Randell, I think I might be the longest serving member just about.

Aspray: I see you're still on the editorial board.

Campbell-Kelly: Yes. Surprisingly.

Aspray: Do you want to talk about the differences in the kinds of materials that were published, how it changed over time, and the editors in chief and how the nature of them changed over time?

Campbell-Kelly: Yes. The editors' background changed only slowly over time. At first, they were typically computer science academics. That has changed over the last 20 years. Nathan Ensmenger and Lars Heide were both in history departments.

Aspray: Con Diaz also.

Campbell-Kelly: Yes, of course. The Annals had quite a computer science ethos to begin with, but it has gradually it broadened. You may have seen the controversy that I've had with Donald Knuth.

Aspray: Yes, I have.

Campbell-Kelly: In 2007 I wrote an article "The History of the History of Software" discussing how history of software writing had changed over the years. It had started off as a highly technical genre, including my own publications. It had gradually moved on to the software industry and applications, which I thought was a good thing. Donald Knuth felt it was dumbing down—he has a point of view that there are other people who can write that kind of history, but people who know about computing really ought to write about computer science. I think of this as a spirited academic debate. We remain on very cordial terms.

Aspray: Right. So, let me interject for a moment just to tell you a little piece of the story you might not know. You, of course, do know about the article that Tom Haigh wrote for Communications of the ACM about this controversy.

Campbell-Kelly: The "Tears of Donald Knuth."

Aspray: Yes, "The Tears of Donald Knuth". And you might not know that that had more than a hundred thousand downloads.

Campbell-Kelly: Really? No, I didn't know.

Aspray: The most recent part of this story is that it was very recently revisited in the Communications of the ACM with an abbreviated version of Knuth's talk. I'm currently the chairman of the IEEE Computer Society History Committee, and the president of the Computer Society asked me about this controversy just last week, and if there was some position the computer society should be taking about this issue. So, I explained the background to him, and he said, "Okay, that's fine. We don't need to do anything," but it continues.

Campbell-Kelly: It's strange, isn't it? It shows what a towering figure in computer science Donald Knuth has been and remains.

Aspray: Yes, absolutely. I think you told this because it was illustrating the nature and influence of the Annals. Do you want to say more about Annals?

Campbell-Kelly: Certainly. It has broadened over the years. So, in any particular issue you will find a mixture of technical and business articles; it's much more business oriented than it used to be. It's still not very strong on social history, I would say.

Aspray: Right.

Campbell-Kelly: One of the problems, I think, with the Annals, is that it's positioned as a magazine rather than as a scholarly journal. I've always been slightly ambivalent about that. A good aspect is that I believe it gets the highest checkoff of subscriptions among IEEE publications. The magazine format makes this possible, so it has a broader readership than the more technical journals. If it became a scholarly journal it would lose an awful lot of its readership. It would maintain the readership within the

history of computing community, but we would lose the broad readership and tolerance for computer history in the wider computer science community. I think that's similar to the way that the *Communications of the ACM* has a history viewpoint, which I always read, and it's always very good. They're nice short articles of three or four pages. Tom Haigh is writing these now. He's a particularly insightful historian.

Aspray: Yes. Annals also, because of the magazine format, had a fairly strict 8,000-word limit on its articles. I suppose that means that you can't fully explore certain kinds of topics.

Campbell-Kelly: Yes. I think that's right. On the other hand, it gives you the opportunity to write at length for one journal and more briefly for Annals. It also contains the anecdotes section, which makes it a rather readable magazine.

Aspray: Okay. The next thing I wanted to ask you about was the Springer series in history of computing.

Campbell-Kelly: The original suggestion came from Professor John Tucker, at Swansea University. I was external examiner at Swansea for several years, and John is a very good friend. He was already an editor for Springer, and they'd come up with the idea of having a computer history series. He didn't feel he had sufficient background and asked if I would be willing to assemble an editorial board, which, of course, included John, and we went from there. I realized the new series would be competitive with, for example, MIT Press, which has always been very good to me, but I also thought, it would be good for computer history. The more outlets, the better. The series turned out to have some rather interesting aspects. It came out at the time that electronic publishing was beginning to take off, which many other publishers hadn't caught up with. The Springer books were somewhat overpriced and did not sell in big numbers, generally in the low hundreds. But the downloads, were phenomenal. For example, Simon Lavington's book *Moving Targets*, a history of computing at Elliot Automation, sold about 300 copies, which doesn't sound very exciting, but the downloads of individual chapters were in the thousands. So, it's a very different publishing model and it has been quite successful. Another decision we made was that we were going to have a fast-track refereeing process so that we made a decision in a month or so and got to market quickly.

Aspray: Yeah. The production schedule was very quick, with Springer.

Campbell-Kelly: Of course, this led to some shortcomings. In order to conform to Springer's normal scientific publications, the citation style was not ideal for a historical book. They varied a little from book to book, in the interests of speed and given relatively inexpert editors in the history field.

Aspray: You mentioned the MIT Press series. How did the Springer series compare to the MIT Press series?

Campbell-Kelly: That's a good question. The MIT Press series has a good reputation. My impression is that university libraries buy all the books or many of the books in the MIT series; they are relatively inexpensive, and MIT promotes them very effectively. I had a counterexample. The first book I wrote with Daniel Garcia-Swartz was with Harvard University Press, and neither the sales nor the marketing were particularly good. For our new book on mobile telephony, we've gone with the MIT Press.

Aspray: Mm-hmm (affirmative). Are you still actively involved with the Springer series?

Campbell-Kelly: Well, I'm still on the editorial board. So, yes.

Aspray: But you're not the editor in chief any longer.

Campbell-Kelly: Indeed, no. Gerard Alberts is the editor in chief now. He's very effective and follows the policy of getting books out quickly.

Aspray: Nice. Okay. Let's talk about The National Museum of Computing. Tell me the story of it, both your involvement and the larger story of the institution, please.

Campbell-Kelly: Starting with the larger story of the institution, it began about 10 years ago, and it was founded by Tony Sale, who was a delightful and slightly eccentric person. He had worked with MI5 in the 1950s. So, he had security clearance and all that. He was also a software entrepreneur, not wildly successful, but successful enough. I believe he got interested in the history of computing and codebreaking following Brian Randell's revelations in the late 1960s, and Frederick Winterbotham's *Ultra Secret* and similar books in the 1970s. He came up with the idea of building a replica of the Colossus. He did this at Bletchley Park, the home of the wartime Colossus. Bletchley Park had been owned by British Telecom, which wanted to develop it as a business park. Tony Sale was among the people who were instrumental in getting the site to be protected as a heritage site. Tony, who actually was quite an awkward character,

eventually fell out with some of the people over policy decisions about Bletchley Park and decided to start his own computer history museum on the Bletchley Park campus. And that's where he created the Colossus replica, which works rather wonderfully, by the way. It's a great exhibit. The museum, therefore, inhabits the World War II huts that are still standing, and heritage listed, which you can imagine is a maintenance nightmare. It is also the worst possible museum layout because the original construction had narrow corridors and relatively small workrooms. In the time of the current pandemic, we have had to create a one-way system. There's, maybe, 20 workrooms, and they're quite good for galleries because they restrict the size. I was asked to become a trustee by one of the other founders, Kevin Murrell, who is an independent software vendor in the health industry and very interested in computer history. I've been involved for about five years now. My role has been as the academic authority on how to operate an archive, checking on the historical accuracy of the website and exhibits, and so forth. Each of the trustees has a specific role—I'm the history expert. The chairman is Andrew Herbert, who used to be director of Microsoft Research in Europe and is an extremely effective manager. We have another person who is a human resources manager for Unisys, and he's very good at handling personnel issues. Another trustee is a lawyer, and she's very good at dealing with the legal issues of intellectual property rights, dealing with the charity commission, and so on. So, we don't have many trustees, but between us we have the expertise to keep going.

Aspray: How much traffic do both the museum itself and its website get? Are these very popular?

Campbell-Kelly: There have been some interesting developments in the pandemic era. The museum has a turnover of about half a million pounds a year. And there are of the order of five full-time employees, and close to a hundred volunteers. So, it's a very volunteer-driven museum, which you can imagine creates all sorts of tensions. What we found in the pandemic was that—and I've heard the same is true in America—that the national museums are fine because they are government-funded, and they will survive whether they're open or shut. The voluntary sector museums like us are doing okay because we have relatively small overheads and a small staff. It's the ones in the middle, the independent museums that are not government funded, but with payrolls of perhaps 30, 40, 50 people, that are struggling the most. Financially, we're doing fine in this pandemic. People are frustrated that they can't visit the museum in person while it's physically locked down, but there's all kinds of Zoom activity going on. This was an eye-opener for me because I had always thought it would be nicer if the museum had more money and more professionals involved. Now I see that's not without risk.

Aspray: Right. Could you talk about the National Archive for the History of Computing at Manchester?

Campbell-Kelly: How that started, and it's also how my book about ICL started, was that, in 1984, the company secretary of ICL, David Marwood, was on the point of retiring and was very interested in computer history. He had written a long article "Crisis and Swift Recovery" in the journal Long Range Planning, about ICL's recent problems. He wanted you to form a national museum or archive for computer history. As a result of that initiative, a group of people, organized partly by Jack Howlett—who was editor of the ICL Technical Journal and knew many people who were active in computer history—came together to take the idea forward. My original hope was to set up an archive at King's College, University of London, with the help of John Buxton. Buxton, who was the founding professor of computer science at Warwick University, had recently become the head of department at King's College. He was a distinguished software engineer and had co-edited one of the NATO software conferences with Brian Randell. So, we cooked up a plan that we would have the national archive at King's College in London. Sadly, for us, the Centre for the History of Science, Technology and Medicine at Manchester University had exactly the same idea. The head of the center, John Pickstone, was a very energetic department builder. And, in the event, Manchester made a better offer than King's College was able to, so the National Archive for the History of Computing went there. This enabled ICL to get rid of its technical archive that was in a warehouse in Letchworth, and it was divided between the London Science Museum and the National Archive for the History of Computing at Manchester University. The Manchester archive has not thrived as well as it could because it has always been dependent on having a lecturer in computer history in the department who was enthusiastic about it. The first incumbent, Geoff Tweedale, did a fantastic job and cataloged it completely. Since then, the archive has been taken over by the university archive, and it is now housed in the Rylands Library.

Aspray: Does Manchester still have a lecture in computing history?

Campbell-Kelly: Yes—the present incumbent is James Sumner.

Aspray: Okay. The next institution I wanted to talk about was the ACM History Committee.

Campbell-Kelly: Yes, I believe I replaced you on the history committee.

Aspray: It's quite possible.

Campbell-Kelly: I enjoyed being on the ACM History Committee very much. We have something similar for the British Computer Society, the Computer Conservation Society – the CCS. That was formed by Doron Swade in 1990. Doron, was curator in computing at the time but rose to become assistant director of the Science Museum. Tony Sale was instrumental as well. The CCS publishes a quarterly magazine *Resurrection* and has a regular lecture program in London. It is a very successful organization, with the order of a thousand members. The lecture program is now conducted over Zoom, which has had the interesting effect that, whereas we would get an attendance of 50 to a hundred people in London, now, on Zoom, there can be upwards of 200 participants. That's the new Zoom life we're getting used to. Anyway, getting back to the ACM committee. The idea as I understood it, was to diffuse history into the wider ACM community, make people aware of their heritage, and better able to preserve their records. For example, one of the initiatives, which I think may have come from me, was to organize an archives workshop in 2014. We invited people from all over the world, and there was certainly somebody from Italy and a couple from Britain. The idea was to introduce people who had never heard of or who had never used an archive to good practice. It was held at the Charles Babbage Institute, and the university archivist Arvid Nelsen led the workshop. I think people found it very helpful in enabling special interest groups to set about preserving their history. The format proved very successful, and three or four years later we had an oral history workshop. That, again, that was well attended. We had an authority on oral history giving a series of lectures for the workshop and attendees practiced doing oral histories with one another. To a historian, that sounds pretty mundane, but if you've never done an oral history before, you may lack confidence or not know how to prepare—for example by preparing a set of questions in advance. It's not obvious.

Aspray: Yes.

Campbell-Kelly: When I wrote the history of ICL, I conducted a lot of interviews. I discovered that, very commonly, people want to talk about some urgent topics, and it can make the whole interview quite incoherent. So, at the beginning of an interview, I would always say, "I've got to do this chronologically, and I'd like to start with your school days. We will work our way through chronologically. So, don't be anxious that I'm not going to cover something, just bring it up at the appropriate chronological point."

Aspray: Let's talk about some other organizations, the computing activities of the Science Museum of London.

Campbell-Kelly: That's quite an interesting story. The museum set up a new gallery in 1975, Computing Then and Now. It was largely curated by Oliver Strimple, who in the 1980s left to join the Computer Museum in Boston, which Gordon and Gwen Bell had recently started. He was eventually replaced as curator of computing by Doron Swade. Doron is a very interesting character. He trained as an engineer and is extremely sympathetic to engineering. It was his idea to create the Computer Conservation Society, and its main mission at that time was restoring machines to working order, which is not something you would expect a museum curator to be so interested in. In truth this has skewed the mission of the Computer Conservation Society, but it is held together by the lecture program that appeals to everybody. The computer exhibit at the Science Museum languished for many years, and they made some classic errors. For example, they presented time-sharing as being the latest word in computing, and never quite got round to rewriting the labels. By the 1990s timesharing was dead, and the exhibit generally was very out of date. Doron did what he could, but in the absence of funding there was little he could do. However, he did manage to get funding to build the replica of Babbage's Difference Engine. This created terrific publicity for the museum, and for Doron personally. He ended up as assistant director, which is just about the second highest you can get in the British museum world. The current curator of computing is a woman called Tilly Blyth, and with a better funding situation she has created a new computing and communications Information Age gallery. Curation in museums has got gradually less and less important compared with designing the exhibits, but I sense that Tilly Blyth will go far.

Aspray: Was there connection between historians of computing in England and the historians of mathematics? There was a group of historians and mathematics at the Open University, Jeremy Gray and some other people, for example. Did they have any role in the overall ecology of history of computing in your country?

Campbell-Kelly: Yes, very much so. The British Society of the History of Mathematics started in 1971. A leading light was Ivor Grattan-Guinness. The history of mathematics has a long tradition, and for Brian Randell, myself and others starting out in the history of computing, the BSHM was a community of like-minded scholars. I was a member from the mid-1970s and served on the committee for a few years. I still go to their seminars in Oxford. There is no professional history of computing community in the UK.

The Computer Conservation Society is very popular, but there are only two or three professional historians in the membership. I had always supposed that there would, in time, be a British Society for the History of Computing, but there never was. What I realized, and it's the same in the United States, I think, is that the history of mathematics is quite a siloed community. If you don't speak maths, it's difficult to join in. That's less and less true, now—there are lots of schoolteachers and lay people in the society, so I shouldn't overstate the case. With the history of computing, I was expecting more specialist journals to emerge, but they didn't. What happened was that the history of computing field broadened and was absorbed by the other history of technology and science disciplines. I remember when this dawned on me. In the mid '90s I was attending a SHOT Conference: in virtually every session somebody was talking about computing within their particular specialism. It's rather pleasing that the history of computing has gone that way. I would say that the history of computing is not in the least siloed. There's great interest from social historians too.

Aspray: Right. Can you tell me about the growth of people holding faculty positions in England who are interested in computing history and how that changed over time?

Campbell-Kelly: When I joined the department of computer science at Warwick University, they were happy to employ a person whose special interest was the history of computing and for me to pursue that. I think my case is almost unique. There were probably one or two other examples, but very few. A lot of the reason for that is the REF that I mentioned earlier, the Research Evaluation Framework. A central government operation monitors the research in universities, and it apportions grants on the basis of the overall research activity of the university. Because of that financial incentive, universities have become very unadventurous about who they employ. I think the chances of being an historian of computing full-time in a university are very few. However, the chances of being a person who is interested in history of computing within the university sector are quite high. For example, people like Brian Randell, and John Tucker, who I have mentioned, are deeply interested in the history of computing and both have small archives and museums in their department. But it is not primary research interest for them and cannot be.

Aspray: And that's true also in history of science and technology programs in the UK?

Campbell-Kelly: Yes, but not because of the REF, but because few history of science departments have the history of computing as a priority area. James Sumner is perhaps the only person who is employed

as a historian of computing—at Manchester University and associated with the National Archive for the History of Computing. Jon Agar is professor in STS at University College, London. He began as a computer historian though he has broader interests than computer history.

Aspray: Okay. You mentioned the Computer History Museum and the Bells, do you want to talk about that?

Campbell-Kelly: Yes, they were a very interesting couple. I stayed with them once and they lived out in the wilds somewhere. I found them quite overpowering, I must say. I couldn't get out in the evenings because they got back at six and then left early in the morning. I didn't stay with them very long. We always got on perfectly well. Gordon Bell was a very driven individual. Gwen was a good deal calmer, but slightly of the same temperament. When I first visited the computer museum, it was located near DEC in Maynard, Massachusetts. In the '80s it moved to Central Boston, next to The Children's Museum.

Aspray: Yes.

Campbell-Kelly: I think the idea was that the move would help to increase the footfall. People would visit the Children's Museum and perhaps visit both or visit the Computer Museum on another day. It was a quite good museum. This was the time that Oliver Strimpel took over as director. The museum subsequently got dumbed down somewhat. I remember on a later visit, probably at the end of the '80s, they'd installed a huge keyboard that kids could jump up and down on. What they were doing would no longer have interested a computer professional.

Aspray: Yes.

Campbell-Kelly: And then of course the Silicon Valley phenomenon really took off with the personal computer and the whole center of gravity of computing, which had been Route 68, moved to the other side of the country. I think that the museum became unsustainable, died and then was eventually resurrected again in Mountain View.

Aspray: Did you have much activity, much involvement with the computer museum after it moved to Silicon Valley?

Campbell-Kelly: Some. I was a paid consultant. I wrote a review of the proposed galleries. Doran Swade was very actively involved. He was there for several months. I think the present gallery layout is still much as Doran planned it at the beginning. I have visited on a number of occasions. It could hardly be more different to The National Computer Museum of Computing. Our computer museum is very low budget and in insalubrious buildings. And the whole focus is on working exhibits. While the Computer History Museum in Mountain View does have some working exhibits, it has more emphasis on the aesthetics. I think they do a very good job. It shows what you can do with a multi-million-dollar budget versus what you can do with a very small budget.

Aspray: You alluded earlier in today's session to our meeting in 1981. I believe that was at a AFIPS Pioneer Day.

Campbell-Kelly: It was.

Aspray: Do you want to talk about Pioneer Day and about AFIPS?

Campbell-Kelly: At the time, the only thing I knew about AFIPS was their annual conference proceedings. These were very notable publications over here. I think they started about 1964, and we had the full set at my university. They were an important source for me personally because I was researching the history of computer software at that time. And then, of course, I discovered AFIPS was also the publisher of the Annals of the History of Computing. The annual conference we attended in May 1981 was in Chicago. I remember I was quite alarmed by Chicago—this was my first trip to the United States. It's had its ups and downs as a city. It seemed quite unsafe in 1981. I think we were probably at the same hotel—I forget the name, but I remember it had a high security fence around it. I found that disconcerting. One day I took a shortcut across some wasteland and a person came up to me and advised me I was walking in a very unsafe place. After the conference, I had two or three days before my plane back to the UK. Feeling oppressed by Chicago, I took a bus out to place called Niles which looked suburban and safe, and stayed in a Motel 6. It was an interesting experience.

Aspray: What do you remember about the program of the Pioneer Day?

Campbell-Kelly: I recall that you, Paul Ceruzzi and I shared a one-and-a-half-hour session. I believe that Paul Armer—who was the first director of the CBI—chaired the session. I had prepared a set of 35 mm slides for the presentation, so I was well prepared.

Aspray: Well, let's move to another institution. Are there things that you want to talk about both in terms of your connection or in terms of your perspectives on the Smithsonian either at National Museum of American History or Air and Space Museum?

Campbell-Kelly: I was a Visiting Research Fellow at NMAH in 1988. The leader of the computing and mathematics division was Arthur Mollela, who was very welcoming. He was celebrated, I was told, for being the only person in Washington who didn't have air conditioning in his apartment. Other people around I recall were Peggy Kidwell, John Eklund, and Uta Mertzbach—all very helpful and friendly. I have found the experience very useful since I become involved with the computer museum in the UK. At the time the NMAH was planning a computing gallery and, of course, that was partly why I was there. The project was run by David Allison, who probably quite rightly at the time, took a somewhat nonconsensual approach. I didn't find this terribly helpful myself and it rather limited what I felt I could contribute. The exhibit, which was called the Information Age, included television and broadcast media as well as computers. I thought the result was a bit of a mish-mash lacking focus. But in other respects, I thought the exhibit was very good. While I was at the NMAH I started to understand much more about what the modern mission of the museum was. I remember, for example, going down to see the typewriter exhibit because one of my interests was the history of the typewriter. I'm probably embroidering this, but my recollection is that there was a large number of typewriters, each of which was subtly different to its predecessor. Even a typewriter enthusiast like me could see this was dull. The sociology of the office should have led to a much more interesting exhibit. That was very enlightening, and I took that lesson away.

Aspray: My recollection is that that information age exhibit was supposed to have two separate strands of computing and communications that came together at some point. And the curator for the communication side was Bernard Finn, Barney Finn.

Campbell-Kelly: Yes, it was, yes.

Aspray: Did you have something to say about either the communication part or about Barney?

Campbell-Kelly: Barney was likeable. I think he found it difficult to work with David Allison. I had the feeling that showed in the final result, in that it wasn't terribly well integrated. The most diplomatic person there was John Eklund, who was an extraordinarily nice man. So, I think he mediated a little between those two, but I wasn't in the room when that was happening. My family came over to join me

around Easter time when the kids were off school and John Eklund and his wife put on a barbecue for us, which was a very nice thing to do and they were wonderful hosts,. He died really quite young didn't he, John Eklund?

Aspray: Yes. He was a historian.

Campbell-Kelly: His memory lingers on.

Aspray: He was a historian of chemistry who I guess had gotten interested in minicomputers and microcomputers. Changing continents for a moment but talking still about museums. Do you have things to say about the Deutsches Museum and its activities in computing?

Campbell-Kelly: The Deutsches Museum I only visited once in Munich. It was very good. It was rather like the older British museums, I thought at the time. It didn't have a very good social dimension in the exhibits. I was much more familiar with the Heinz Nixdorf Museum in Paderborn, that I have visited several times.

Aspray: I was going to go to the Nixdorf in just a minute, but before we do that, there was a very fine scholar of the history of computing at the Deutsches Museum in the early days in Hartmut Petzold. Did you have much interaction with him?

Campbell-Kelly: A little. His English was quite limited, so we found it a struggle to communicate to any depth. His research was quite Germanic, compared with what was going on in Britain. He'd written a book on calculating machines that was quite exhaustive and somewhat catalog-like. Of course, it was in German so I can't give a fair appraisal of it. But it is probably symptomatic that no English language publisher took it up. I doubt that it would have sold that well in the UK.

Aspray: Okay. So, let's talk about the Nixdorf Museum in Paderborn. Can you tell me about your experiences?

Campbell-Kelly: It's a museum like no other, I would say. It was very well funded, so they weren't scratching around for money like most museums. For most museums, money is their number one issue, I would say. When I first visited, it was quite Germanic and would be perceived as rather old fashioned; there were many objects with relatively little interpretation. Architecturally it was very nicely done. I

had quite regular interactions with the first director Norbert Ryska about this, that or the other issue in history. The current director Jochen Viehoff has come over and given talks at the Computer Conservation Society. Again, he has a different tone to a British curator, who would be much more interested in social history, I would say.

Aspray: Are there things that you want to say about the place of the museum or the creation of the exhibits there? In particular, the head curator who was responsible for pulling together all of the exhibits was Ulf Hashagen. And he later went to the Deutsches Museum. He's now the head of research at the Deutsches Museum.

Campbell-Kelly: Yes. It wasn't a great fit for Ulf, the Paderborn museum. I would say that he didn't have a popular touch. The Paderborn didn't make much, for example, of computer games, which would attract visitors. I think he escaped when he got the opportunity, he was much more of a research scholar than a museum person. I'm not quite sure why he didn't become an academic. Perhaps like in Britain, it's hard to get an academic job in our particular specialty.

Aspray: He was offered two very good jobs in the United States. He was offered the Babbage directorship at one point. And he was also offered the head curator of the instrument museum at Harvard and he turned both down. I think he didn't want to live in the United States. Anyway, the museum was right next door to the University of Paderborn and the chair in computer science was Reinhard Kiel-Slawic. Did you have interactions with Reinhard who was interested in software history, for example.

Campbell-Kelly: Yes, I did. You'll recall we were on the program committee for a conference on the history of software held at Paderborn in 2001. Reinhard, Ulf, and Arthur Norberg produced an edited proceeding published by Springer the following year.

Aspray: Okay. I'm now ready to turn to asking for comments about individual people, as opposed to institutions. Could you talk about Steve Russ?

Campbell-Kelly: He is an interesting person. He came to Warwick University initially as an administrator, and then joined the lecturing staff. He had been a schoolteacher and had fairly recently completed a PhD in the history of mathematics at the Open University. We taught our history of computing course together for many years. In the mid-1990s he was president of the British Society for the History of

Mathematics. Steve is a very kind, sociable person—a thoroughly nice person, and wonderful with students. He retired from the University of Warwick quite recently— he's about two years younger than me. He has a long-standing interest in the mathematician Bernard Bolzano, so he has become quite fluent in German. He has collaborated on Bolzano's collected works which amount some 50 volumes and has produced annotated editions of his works. What he's planning to do now is a master's degree on the social aspects of the history of science, which he thought would get him out of the silo, I think. We had lunch together very recently, taking advantage of the government's "Eat Out to Help Out" initiative. Just a historical note in the middle of the pandemic in Britain!

Aspray: How about Maurice Wilkes.

Campbell-Kelly: We got on really quite well, so far as anybody got on well with Maurice Wilkes. He was quite prickly, but he was always quite lavish with praise where he thought it was due. When I was doing my PhD and researching programming for the EDSAC, I interviewed several individuals and asked if I could interview him. He declined to be interviewed in a way that was slightly cutting. I wrote a draft of my first article about the EDSAC and sent it to everybody at Cambridge, including Wilkes, whereupon he completely turned round and said, he'd be delighted to have a long conversation with me. And, of course, he was very interested in the history of computing, and had written some articles about Babbage. He always sent me a copy and asked me to review it before he submitted. We built up quite a file of email and correspondence between us over the years. He retired, I think I told you, the day I was awarded my PhD, so I've only ever known him as very close to retirement, and in retirement.

Aspray: Mm-hmm (affirmative). Okay.

Campbell-Kelly: We quite liked one another. I remember once ... I've forgotten the occasion was, but it was probably when he was about 80 and there was a dinner in his honor at his college. He invited me back to his rooms in St. John's College and we had a nice fireside chat and he fell asleep. I just didn't know what to do. I thought, "Should I just leave quietly? Perhaps he'll forget." I think I made some coughing noises after he'd slept quarter of an hour and woke him up. It was late and probably past his normal bedtime.

Aspray: Did you have anything to do with his memoirs that were published by MIT Press?

Campbell-Kelly: Well, I must say I ought to put this on the record, just to be honest. I'd always thought I'd quite like to write his biography at some point. When his memoirs were sent out to me for review by MIT Press, I advised against publication. Obviously, I was overruled, I presume by I. Bernard Cohen. I think he was your co-editor, wasn't he? I thought it was a wrong decision for two reasons. First, and selfishly, I'd quite like to have written his biography, but that wasn't the fundamental reason. It was that half of the book was about his wartime experience, which was rather unexceptional. The book needed a strong editor. The computing history in the book is valuable, but and the rest of it is a bit anecdotal.

Aspray: As the junior editor-in-chief of the series, I was given the job by Bernard of anonymously going through and striking or suggesting striking out, all kinds of irrelevancies. And it resulted in being reduced by about 30% in length. And he resisted every single change!

Campbell-Kelly: I can imagine. Did you think MIT Press should have published it?

Aspray: Oh, I thought that he was important enough to have his recollections. On the other hand, I thought that it didn't really get to the penetrating analysis of computing that I wished it had done.

Campbell-Kelly: I think I would have done a better job!

Aspray: I think you would have done a much better job.

Campbell-Kelly: I did write his memoir for the Royal Society, by which time his papers had been given to St John's College—his private, personal papers. There wasn't much about the war there, incidentally. So I think without the MIT Press memoirs, I would have been hard put to fill in some of the details.

Aspray: Tell me about David Wheeler.

Campbell-Kelly: David Wheeler is an actual genius. I've not met many in my life. Less than a handful. David Wheeler was also tactful and kind, the polar opposite of Wilkes. They were yin-and-yang of the Computer Laboratory at Cambridge. One would go to Wilkes for decisions, I think, and David Wheeler for empathy. I got quite friendly with his wife, Joyce Wheeler, who's in her nineties now. When David died in 2005, I attended the memorial meeting and said a few words. Joyce was very anxious about the Royal Society memoir, because Wilkes wanted to write it. As I was going to my car after the service, she implored me "Please will you write it, because I don't want Maurice to. He's never understood David

and held him back." She was quite angry with Wilkes. Whereas I thought Wilkes had been extraordinary generous to David Wheeler. He must be the only Fellow of the Royal Society with only about 12 publications to his name. He was unconventional in academic terms; he was particularly unproductive in terms of publications. It wasn't how he kept the score, but as I said, he was an actual genius. You just have to look at his work, for example, on programming the EDSAC. Interestingly, we were recently looking at one of the programs he wrote in 1949 for the EDSAC in connection with the replica that's being built at the National Museum of Computing. It was the one of first demonstration programs that printed prime numbers. Andrew Herbert, who is leading the replica project, and I and several others, tried to figure out Wheeler's algorithm. None of us could quite work out how it worked. Andrew eventually resolved the problem. It was a unique piece of mathematics we didn't know about. That was very typical, and bear in mind he was only 20 or 21 when he wrote the program.

Aspray: Could you tell me about I. Bernard Cohen?

Campbell-Kelly: Oh, we got on very well. I've often found I have got along well with Americans who have a reputation for prickliness. I could mention, for example, Jean Sammet and Uta Merzbach at the Smithsonian, that people found crotchety. I got along with both very well. I remember Jean Sammet invited me to her home to have a look at her filing cabinets of historic programming materials and took me out to dinner. Uta Merzbach took me out to dinner on my last day at the Smithsonian. We quite often lunched together, the two of us. We got on famously. I. Bernard Cohen was rather the same. When I was a visiting research fellow at the Dibner institute, and Jane and the family were visiting, he invited us round to his family home. We met his new wife, Susan, who was just a wonderful woman. They so complimented each other. She was quite irreverent, funny, quite different to Bernard. Bernard Cohen was first married to a rather distinguished journalist Frances Davis who was a war correspondent in the Spanish Civil War. She was permanently in poor health afterwards and died in the early eighties. Years later, when Bernard was moving house, he asked me if I would like a copy of her memoirs. I confess I had never read but I did so recently during the pandemic lockdown. If you've not read it, I really recommend it—the title is *A Fearful Innocence*. It's a deeply moving book and it shows a picture of Bernard Cohen that will surprise you—what he was like as a young man. He came to England from time to time. We had dinner at the Athenaeum once. He enjoyed a reputation as a bon vivant in academic circles. I don't know how he came to be a member of the Athenaeum Club, but I'm sure I wouldn't qualify. We met on a number of occasions. He was always enjoyable, slightly pompous company. There's

an American actor Monty Wooley, who played crotchety roles. Bernard always reminded me slightly of him.

Aspray: Can you talk about his influence on the history of computing in the early years?

Campbell-Kelly: He really helped to legitimate the field. There's no question about it. He did a great job with *A Computer Perspective*, one of the finest early books on the history of computing. It accompanied an IBM exhibition for which Bernard consulted, and he wrote a short introduction. The book was quite a formative influence on me. I have a strong visual sense and I thought it was a fabulous book. I eventually got a copy for myself, secondhand. The first edition, not the reprint. He was on the editorial board of the *Annals of the History of Computing* and was on my editorial board of *Charles Babbage Institute Reprint Series*. He was a great promoter of both. He was very interested in and a good friend of Howard Aiken, and eventually wrote his biography. As a scholar in the history of computing, he didn't write so much, but his influence was above anyone, I would suggest.

Aspray: Tell me about JoAnne Yates.

Campbell-Kelly: How did we meet? This goes back to when we started writing our book *Computer*, the history of the information machine. There was a gap in the literature about what I later termed Victorian data processing. In the course of researching that topic, I encountered JoAnne's book, *Control Through Communication*. It turned that we'd been paddling independently in very similar streams. She was telling the American story. I was focused on Britain which has a period of non-mechanized information processing, unlike America. Our studies were parallel but very similar. Mine a bit earlier, hers a bit later. We had quite a correspondence. She came over to England from time to time and we would meet. I don't recall we ever collaborated on a paper. I think she may have been influential in my being awarded a Dibner Fellowship at the Sloan School. We got to know each other, and I've been a house guest with her and her husband Craig. And she has visit us in Coventry as well. We kept in touch, though this lapsed somewhat as she became much busier as chair of her department. The last time we met was at a meeting at the London School of Economics. Ships that pass in the night and then meet again.

Aspray: Later in her career, well, after the *Control Through Communications* book, she did two other studies that might not seem necessarily that they're exactly about computing, but I found them remarkably valuable. One is the study about the insurance industry and automation in the insurance

industry. And the other was her more recent work, two books, one with her husband on standards and the standards practices. Have you had any connection with those studies?

Campbell-Kelly: Daniel Garcia-Swaertz and I used and cited the standards book in our forthcoming book and mobile telephony. I am very familiar with *Structuring the Information Age*, because of course I've a long-standing interest in the insurance industry and I've written about it, and Babbage's connection with life insurance as well. Her book also describes the use of information technology equipment in the insurance industry. Sadly the book came out after I'd written my ICL book, but I would have found it very useful if I'd had it.. Neither of us has been particularly prolific in terms of single-author books. But her books have been path breaking.

Aspray: Actually, I would say that you have been prolific. I can tick off four or five books right away and that's well over the quota.

Campbell-Kelly: Well, let's say compared with James Cortada, I'm a minor scholar!

**Oral History Interview with
Martin Campbell-Kelly**

February 25, 2021

Via Zoom

**Conducted by William Aspray
Charles Babbage Institute**

Abstract: This is an interview with Martin Campbell-Kelly, one of the leading early figures in the history of computing. The interview discusses his upbringing and higher education, including his PhD at Open University under the supervision of Brian Randell. The interview discusses his career at Sunderland Polytechnic and the University of Warwick. It goes into detail about the circumstances of his various major publications as well as his work as a public intellectual. The second half of the interview discusses his interactions with and impressions of the various individuals and institutions in the United Kingdom, United States, and Western Europe associated with the history of computing in its early years.

Keywords: Computer science, History of computing, Brian Randall, Sunderland Polytechnic, University of Warwick, Charles Babbage, Bletchley park

Aspray: Okay. It is the 25th of February 2021. This is the third session in an oral history interview with Martin Campbell-Kelly. The interviewer is William Aspray. We're doing the interview over Zoom. The last time, we ended by my asking you to give me reactions to a number of people. I started with people in the UK first, and then we moved to the US. I still have a few US people. I want to talk about Europeans, and then we'll go on and talk about your research. Could you tell me about how you got to know, your interactions with, your reflections upon these people? Arthur Norberg is the first.

Campbell-Kelly: I only knew Arthur from when he started at the Charles Babbage Institute. He was very supportive. When he started at the CBI, I had just begun my history of ICL. Arthur Humphreys, who was a former deputy chairman of ICL, was a friend of Erwin Tomash, and also a member of the CBI board. I'll tell you an interesting story. I had a message, which came from both Erwin and from Norberg. Arthur Humphreys had said to them, "I think Campbell-Kelly is undercharging ICL for writing this book. They can afford to pay more." Evidently, he also hinted it wouldn't be a bad idea for them to tell him, but he couldn't do so himself. So, they both said, "We've be told if you were to renegotiate your contract with ICL, it would be looked upon favorably." It worked out very well, and they quadrupled my fee!

Aspray: Good.

Campbell-Kelly: Arthur was helpful when we were trying to start the National Archive for the History of Computing at Manchester University. The CBI was effectively a role model, the kind of organization that we hoping to emulate. It never quite worked out as well as we hoped. The scale of funding in the UK never quite matches that of America. As Arthur and I got to know one another better we would have dinner at a restaurant when I visited the Institute. And if Arthur was in London, we would have lunch at the Cheshire Cheese, which is just the sort of pub that he liked.

Aspray: Arthur shared a strong interest with you in business history.

Campbell-Kelly: Yes, he did. Of course, he was at least as interested in institutional history. He wrote a fine book with Judy O'Neill focusing on IPTO. He later wrote another book Computers and Commerce. He sent me copies of both books as they appeared, the latter with a generous inscription thanking me for my help.

Aspray: Right. Okay. Bernie Galler.

Campbell-Kelly: My memory of Bernie Galler is not terribly strong. I only really met him perhaps three times, all quite early in my career. He was very encouraging. I guess it was Bernie who invited me to join the editorial board of the Annals of the History of Computing in 1980. At that time, I had just finished my PhD and begun at Warwick University. It was very useful to me career-wise, because it gave me a little prestige.

Aspray: Do you have any other comments about his role in shaping the Annals of the History of Computing?

Campbell-Kelly: That's a good question. I don't think I understood the institutional background at the time. The Annals was heavily involved with AFIPS, which was an organization little known in the UK. We had the AFIPS annual conference proceedings in the library, but that was about all I knew of it. He was in the University of Michigan, and I don't think he visited Britain particularly often. He visited continental Europe more, I believe. I suppose Bernie made most of the editorial decisions that shaped the Annals. It was nicely done. For example, the anecdotes section—which is still there—meant that anybody could contribute, whatever their level of expertise. A learned article would be judged by normal scholarly standards, whereas an anecdote would be judged on its merits. I supposed that idea must have come from Bernie. It's one of the ways that makes the Annals accessible to different communities, not just scholars.

Aspray: Okay. What about J.A.N. Lee?

Campbell-Kelly: Well, J.A.N.'s interesting. I don't know if you know, he was born and grew up in Coventry, which is where I have lived since I came to Warwick University. So, we had quite a connection in a way. When he came over to see his parents, who were still alive then (this would be going back to the eighties) we would get to get together—usually in a pub. He was an enthusiastic amateur historian and would not have thought himself as being more than that. I believe he saw himself a cheerleader for computer history, and very happy for other people to come along. He was always very encouraging to me personally.

Aspray: He worked at institution-buildings activities. Not only being editor of Annals, but his dictionary of computing figures was sort of a reference tool that people used for a while.

Campbell-Kelly: Yes. I have his *Computer Pioneers* and use it from time to time. It was a sort of dictionary of computer biography.

Aspray: Yes. Are there other people from the US or Canada that you want to mention?

Campbell-Kelly: Well, when you mentioned J.A.N. Lee, it made me think of Tim Bergin. He and Carolyn stayed with us in Coventry, several years ago. Another time we stayed with them in their holiday cottage in Fenwick Island, Delaware. Once they retired both J.A.N. and Tim dropped out of the field entirely. Not like we dyed-in-the-wool historians—we will carry on into our dotage.

Aspray: Tim was the last of the people from the technical side that became editors of *Annals*.

Campbell-Kelly: Yes. JAN and Tim were also heavily involved with editing the HOPL II and HOPL III proceedings [the second and third ACM History of Programming Languages Conferences, 1978 and 1993]. Another person I worked with a lot was Mike Williams at Calgary University. He too was on the technical side but completely focused on the history of computing. He got a visiting fellowship for me to work at his university in the summer of 1983. We did a house-swap with one of his colleagues and so the whole family—me, Jane and our three boys—came over. Mike and I were working on the Moore School Lectures for the CBI Reprint Series. In May of that year, we interviewed some of the participants—among them Pres Eckert, J.G. Brainerd and the remarkable Perry Crawford. It was one of the most satisfying pieces of work I ever did, crowned by a memorable summer.

Aspray: Anybody from the Computer History Museum you want to speak about?

Campbell-Kelly: Well, I got to know Len Shustek quite late in my career. He's a remarkable character. We were both on the ACM History Committee for a several years, so I got to know him quite well. Two or three years ago, he and his wife Donna [Dubinsky] visited the National Museum of Computing in Bletchley Park. Donna was phenomenal. She's a remarkable businesswoman and she bowled everybody over, she was so full of ideas. I remember her saying, "You've got all this space on the campus. You should put a hotel here and attract visitors to the museum." We thought, "What a fantastic idea." Of course, when the whirlwind left, we came down to earth. Another person associated with the Computer History Museum is Burt Grad who founded the Software history Center with Luanne James. I think of Burt as something of a role model—his is now over 90 still remarkably active. Jane and I have visited Burt and Carol Anne several times and get on famously well.

Aspray: Let's talk about other people from Europe. How about Gerard Alberts?

Campbell-Kelly: Well, Gerard Alberts and I go back a long way. He's been very supportive of me, and I've supported him. He had a technical background, but very early on tried to become a mainstream historian. Not many years go by without us meeting up. He has stayed with us a few times when he's been at a conference in the Midlands [of England]. He and Jane get on particularly well. He always brings us a present when he visits. Last time he visited, he bought us a beautiful tulip vase. If you know the Dutch-style tulip vase, which has many outlets and you put one tulip in each slot.

Aspray: Oh, right. Yes.

Campbell-Kelly: That comes out every spring and occasionally we send him a photograph if the tulips are looking particularly fine. We stayed with him and Marja quite recently. He came to visit one time when we had our local "open gardens"—people open their private gardens, and you can wander round. It's quite an event every year. He told us they had the same in Amsterdam. We went over and stayed with them for their open gardens. They had just acquired a municipal cottage in the outskirts of Amsterdam. It's rather like the British allotment system, except that they have small cottages where you can sleep over during the six light months of the year. They were absolutely delighted with it because they'd been on the waiting list for several years. Now they had got to the end of the queue and it had come just at the right time for them. When I was the founding editor of the Springer Series in the History of Computing. I asked Gerard to join the editorial board. When I retired, I asked if he would take over as editor-in-chief. He gets things done, Gerard. He's very effective.

Aspray: Pierre Mounier-Kuhn?

Campbell-Kelly: Again, we've known each other for such a long time. He's another of my occasional dining partners in the Cheshire Cheese pub in London. He's given a couple of lectures to the Computer Conservation Society—we have invited him to give a talk when he's had a new book coming out. Our paths have crossed in business history. He has written about Machines Bull which of course was the French equivalent of the British Tabulating Machine Company. I disappointed him once, because when I'd finished my history of ICL I recycled all the photocopies of company records I had made. Everything was in the archive and it wasn't material that I could put in the public domain, anyway. Sadly, when he started his work on Machines Bull, ICL had been taken over by Fujitsu and they closed the archive from public access. As a result, he had to make do with my book to get the British punched-card story. Pierre

translated my book on the history of software for the French edition, for which I owe him an enormous debt of gratitude.

Aspray: He's been quite an organizer of events in the French History of Computing.

Campbell-Kelly: He has. He's very good at organizing conferences, usually in association with CNAM [Conservatoire national des arts et métiers]. He's a real internationalist and has almost single-handedly made France quite prominent on the computer history scene. We've been lucky that we've had individuals in Italy, Germany, France, and Holland always keen to reach out to the UK and the USA.

Aspray: What about people in Germany? Ulf Hashagen, Norbert Ryska, any of those people?

Campbell-Kelly: Well, Ulf I know best. He found it quite tiring speaking English. After about 45 minutes of conversation he would suddenly fade. I don't speak any German at all so this is not a criticism—I just found it an interesting phenomenon. Ulf asked me to be a consultant to the Heinz Nixdorf Museum when they were setting up, but really, I was just another voice to add to the conversation. Norbert Ryska was the first director of the museum. He is a rather delightful character. Every now and again, he would send me an email asking, "What do you know about X?" I always reply as best I can. I suspect he sends the same email to several people! He's quite business-like.

Aspray: Are there other Europeans you want to mention?

Campbell-Kelly: I must mention Corrado Bonifante. Corrado's background was in the Italian software industry. He became very interested in computer history and I think concerned at the lack of Italy's presence. The Italian academy generally was pretty uninterested in the history of computing. He organized a number of international meetings. One particularly memorable event was held in Sienna I think in 1994, with many of our international colleagues attending.

Aspray: What about the Scandinavians?

Campbell-Kelly: Well, the main person I know is Lars Heide, in Denmark. We had quite a lot in common, because he was writing about the Danish punch card machine industry. He was editor of the Annals the History of Computing for a period. I think it proved to be quite hard to manage from such a distance. He organized a conference in Copenhagen that I attended. He was a wonderful host and organizer. As an

aside, overseas conferences have been one of the delights of my academic life. I hope they will come back when this pandemic is over. In a similar vein, I'm ambivalent about digitizing archives. One of the nicest things about being a historian is that you get to travel abroad visiting different archives, and in any case, there is nothing like the tactile experience of actually handling physical documents. But I think I'm fighting a losing battle.

Aspray: Okay. Let me turn our discussion to your scholarship. We'd already talked in a previous session about the Tomash reprint series. Let's start by talking about your work as the editor on the Works of Charles Babbage.

Campbell-Kelly: I was first approached to edit the Works of Babbage by Roger Gaskell, the managing editor of Pickering & Chatto publishers in London. Pickering & Chatto was a very old publishing name, that had been revived by William Rees-Mogg. He was Sir William Rees-Mogg then and he became Lord Rees-Mogg shortly after we met. He was a former editor of the London Times and very High Tory. He lived in Smith Square, a stone's throw from the Conservative Party's HQ. His son, Jacob Rees-Mogg, is currently a right-wing MP and prominent Brexiteer. I'm well to the left politically, so I was intrigued to see how we could get along. Of course, he was perfectly charming. He had recently acquired the name of Pickering & Chatto, which had been established in the early 1800s but had faded away. They decided to specialize in collected works. I think Babbage was probably about their third or fourth production. Later they produced the edited correspondence of H.G. Wells, which I managed to acquire and treasure. They had also approached Anthony Hyman to edit the Works of Babbage and he must have had a similar discussion with him. In the event I was appointed. Anthony Hyman never forgave me. We had been on quite good terms up till then, but he went into a sulk and when he had the opportunity, he would write something negative about my work. He's the only enemy I ever made in computer history.

Aspray: This was primarily because he was very proprietary about Babbage, I take it?

Campbell-Kelly: Yes. Also, he was a freelance historian. Pickering & Chatto paid quite well to do the editing, and I think he probably minded about the money as well as the prestige.

Aspray: Tell me about the decisions, about what went into the series, both in individual volumes and in the collection of the 11 volumes overall.

Campbell-Kelly: We decided that we would publish everything in print that Babbage had produced, but not manuscripts. Babbage was not a particularly prolific writer and didn't give the best accounts of his own work. For example, there's the famous Lovelace Analytical Engine article of 1843. We included that. There were about a dozen items that were not written by Babbage but were recognized as being the best accounts of his work. These were almost entirely in the volumes on the calculating engines. The 11 volumes were more or less chronological. We started with a volume on mathematics, when he was in his twenties, and we finished with the autobiography written when he was in his seventies. That was *Passages from The Life of a Philosopher*. I set up a small editorial board to guide me. I'm not a very strong economist so I invited Maxine Berg the leading Babbage economist—by a complete coincidence she happened to be in the history department at Warwick University. Also, we had Allan Bromley, who was very strong on the engines and John Dubbey, who later became vice chancellor of the University of Malawi and had written on Babbage's mathematics and education. I was also greatly helped by Jim Roberts who was an independent scholar. The other volumes were primarily oddities like the Ninth Bridgewater Treatise which, had it not been Babbage, wouldn't have been included. But there's a lot to be said for including everything in the Works. The editing was fairly light. We standardized the text and located all the references that Babbage made, which were often quite obscure. The only part where we dramatically changed things was in the mathematics volume where we decided to standardize the notation. Babbage's lifespan covered a period when mathematical notation changed considerably, not least from Isaac Newton's calculus notation to that of Gauss. Early on Babbage used a lot of compound fractions where you would get a fraction, under a fraction, under a fraction. That style had died out by the middle of the century. The printer for the Works was not a specialist mathematics compositor and the results were absolutely dreadful. So that one volume was typeset by Cambridge University Press, where we had a really good mathematics editor. We also standardized on the spelling and punctuation throughout. Again, Babbage lived at a time when the English language was being Frenchified as we call it. So, for example, a word like "catalog" would be spelled in what is now the American way, in the 1820s. But when Babbage was writing in the 1860s, he would write "catalogue" ending O-G-U-E. That taught me quite a lot of about why American spelling is different to British, incidentally. American English and English-English developed separately after the time of the Mayflower. So, a word like "gotten," which is used in America, is archaic in England. Also, Babbage also would spell a word like magnetized with the ending I-Z-E-D in the 1820s but ending I-S-E-D in the 1850s. I found these orthographic details surprisingly interesting.

Aspray: Did you have to do a lot of research to be able to handle this editing task?

Campbell-Kelly: Yes, I suppose I did. Mostly I read the standard histories of science and economics of the period. When the Works came out, I remember talking to somebody about writing a Babbage biography, and saying, "The really interesting thing about Babbage, that modern authors miss, is the matter of religion and the church." For example, Darwin's theory of evolution was replacing creationism in the middle of Babbage's life. It's very hard as a 20th century writer to know whether Babbage was agnostic, an atheist, or a believer. This would be completely beyond my scope. But I did think if I ever did write his biography, which I had thought I might do when I was retired, I would need to understand much more about religious history. Needless to say, I decided not to write his biography when I retired. I felt I didn't have enough interest in or affection for him. I'm not sure whether that's necessary in a biography, but I think you should care.

Aspray: What were the reactions to the Works? How was it received, the series, how was it received?

Campbell-Kelly: Better than I expected really. I think all the reviews, probably apart from Hyman's, were quite positive. Several Babbage scholars have told me how very useful it was to have everything on one shelf. And I think that was fair, because getting all the materials together was quite a challenge. Babbage wrote pamphlets that were difficult to locate besides the books and journal articles. The only bad thing that came out of the Works—do you remember Herman Berg?

Aspray: Yes, I do.

Campbell-Kelly: Well, Herman Berg had discovered the 1837 letter from Babbage to Quetelet, in which he described his first ideas on the Analytical Engine. Jim Roberts had discovered the same letter entirely independently in the Quetelet Collection in the Belgian national library in Brussels, which was the source we used. Berg wrote letters accusing me of plagiarism to everyone he could think of—I remember he sent letters to Prince Phillip, the Archbishop of Canterbury, and to my vice-chancellor Brian Follett among others. Brian sent me a note saying, "I've got this extraordinary letter. Come along, have a chat, and you can tell me about it." He told me about his experience as a vice-president of the Royal Society, when he was shown a cupboardful of correspondence about perpetual motion machines. He was very familiar with cranks. We got on quite well after that, which proved useful. On one occasion Aston University had inherited the mathematical tables collection of L.J. Comrie from the Scientific Computing Service and were proposing to get rid of them. So, I got in touch with Brian and said, "Next time you see

the vice-chancellor Aston University, please tell him these are rather important, and they should look after them."

Aspray: Did your work on this series have some shaping influence on your own research? For example, maybe on your Victorian data processing work.

Campbell-Kelly: Curiously not, but it taught me quite a lot about insurance. Babbage had written a book about life insurance, so I researched the insurance industry. That enabled me to edit that volume and I became quite knowledgeable about the insurance industry in so doing. The idea of the Victorian data processing really came about as one of the missing untold stories that we wanted to cover in our book *Computer*.

Aspray: Interesting. Let me jump back in time. Do you want to say anything about the two books that you published prior to getting your PhD?

Campbell-Kelly: They are mildly embarrassing really, perhaps best forgotten. The first book was called, *An Introduction to Macros*. I wrote it when I was working at Leicester Polytechnic. There was very little published on computing at the time, but there was a series known as the McDonald monographs. They were mostly quite short and pithy. I particularly admired David Barron's books, because they were succinct, and witty in their way. So, I thought I would write one on macroprocessors, which interested me at the time. They were an alternative technology to a compiler. Rather like gas fridges versus electric fridges, there was a shaping process going on that was social as well as technological. I realized this only in retrospect. But computer programming could have taken another path. Anyway, my book was not sufficient to change the path. But it did okay. There was a Russian translation, which produced a surprise £500 royalty.

Aspray: Okay, and what about the *Computer Age*?

Campbell-Kelly: This book appeared in a series of illustrated books for younger readers. There were two main publishers I approached—Batsford was one, and Wayland the other, who accepted my proposal. The books were written for children in the middle years of secondary school. There were books on the Egyptians, steam engines, Tudor buildings, and so on. The *Computer Age* did reasonably well, it was reprinted and there was Japanese translation. Later I felt mildly embarrassed by its naivety. Hank Tropp

wrote a kindly review of it for the Annals and I think he felt that while it was not a masterpiece it was good of its kind.

Aspray: Could you talk about your dissertation, and in particular about the notion of building simulators?

Campbell-Kelly: My doctoral program was to write about the early development of programming in the UK. I quickly discovered there was a dearth literature to work with, and I came to the feeling, "Well I've read that, and I've read that, and there's nothing really else to read." So, developing simulators was partly to compensate for the lack of written sources. I first wrote a simulator for the EDSAC, and it proved to be quite a revelation. I was very surprised by the power of this approach. Studying programs is largely about studying texts, but it's quite hard to study programming texts, because text is static whereas programs are dynamic. Studying the dynamic behavior of programs was a very different experience. When I wrote a program and found find something that doesn't work, the process of discovering the reason deepened my understanding and my admiration for these early programmers. There was an archival dimension as well in recovering the software. There were a lot of programs dotted about in the literature, and in archives, and so forth. I simulated three computers—the EDSAC, the Manchester Mark I, and the Pilot ACE. I managed to recover perhaps 80 percent of the system software for these machines, and that became the basis of the study. Once I'd got the simulation idea, I never really looked back, and just plowed on. I took four years to complete the dissertation and I enjoyed the process immensely. I think research should be like that. If it isn't, you're probably in the wrong job. It needs to be all-consuming.

Aspray: Did you find other people that followed your lead in building simulators?

Campbell-Kelly: I couldn't claim to have influenced the writing of simulators generally. If you look on the web there are simulators for virtually every machine that's ever been built. I don't think people always come to it from a historical angle so much as nostalgia. There's lots of interest in replicating game consoles and PCs so that one can run early computer games on them.

Aspray: Can you think of examples of serious historians, who have used simulators as a tool in doing their research?

Campbell-Kelly: One person who comes to mind David Link in Germany has done some wonderful work simulating the Manchester Mark I. Interestingly he presents his work as an art installation. He managed to get Christopher Strachey's checkers program of 1951 working, which was real tour-de-force.

Aspray: What I'm planning on doing in the next part of the interview, is to go through chronologically, and I'm focused on your books, not on your articles. But if there are important articles, I would appreciate it if you'd just bring them up at the appropriate time as we move forward.

Campbell-Kelly: I think I should mention the Strachey article, because that predates my books. How that came about was through Margaret Gowing, I mentioned earlier, who was a professor of history science at Oxford. She was an advisor to the National Cataloguing Unit for the Archives of Contemporary Scientists, which was also at Oxford and was run by Jeannine Alton. She contacted me one day and said, "Oh, I've got some papers here by Christopher Strachey, and Margaret thought you might find them interesting." This would be mid-1978. The cataloguing was not yet finished, but she fished out the those relating to Strachey's work on the Manchester Mark I computer, which was useful in completing my dissertation. When I came down to Warwick University, I was looking for another modest project while I was finding my feet. There was a tremendous volume of material in the Strachey archive—the catalog was nearly 200 pages; he was an absolute pack rat. And of course, Oxford is very near to Warwick, so it was very easy traveling. Jeannine was extremely helpful about letting me photocopy things, and not putting any bureaucratic obstacles in the way. She put me in touch with Strachey's sister Barbara Halpern, who also lived in Oxford. I interviewed Barbara and other people from each stage of Strachey's life. I interviewed one of his school friends, another person who had worked with him during the war, about a dozen people altogether. The Strachey article was one of the most enjoyable things I've done, and it took me into doing many more biographical pieces. In 2016 there was a conference at Oxford celebrating Strachey's centenary. I gave a biographical talk and I felt my academic life had come full circle.

Aspray: Tell me the story about how the ICL book came about, what your experiences were like researching it, and its reception.

Campbell-Kelly: How the book came to be written was that the company secretary of ICL, David Marwood, invited me to see the ICL archive in London. It was a very substantial archive, but all contained in one medium-sized room, so it was not overwhelming in volume. So, I made him an offer—

would ICL like me to write a company history? Surprisingly they agreed. They were probably quite naive. If they had really wanted a business history, there were lots of people better qualified than me. I already had a passable knowledge of ICL, so I wrote an outline over the following weekend: ICL accepted the outline and I never had cause to change it. I've always found that getting a firm structure before starting to write a book works best for me. One of the challenges of the ICL story was that it was formed by a government-led merger. As a result of the merger, all of the data processing companies in the UK became one; there were about nine companies altogether. For me, a business history is rather like a biography of a company. When one writes the biography of an individual, you have decisions to make: Which relatives and friends do you include? Who is significant, and which of the ancestors do you trace back to the beginning? I decided that I would make the British Tabulating Machine Company— which was the original product line that came out of Hollerith and was ICL's direct ancestor—the spine of the story. Then I would introduce the other companies as they folded into the ICL story. I interviewed about 30 people altogether. They came from both the punch card and mainframe eras. When I was writing the book in the late 1980s, there were many people from before the war who were still employed by ICL. One of the most interesting interviews concerned the code-breaking equipment that BTM developed for Bletchley Park during the war. The Bletchley Park story was just starting to come out. There'd been *The Ultra Secret* by Frederick Winterbottom, and Brian Randell had unraveled more of the story. So, I needed to learn something of BTM's side of the story. In the company minutes there was almost nothing at all, because it was so secret. There were references to a CANTAB machine, which was the code name for the Bombe code-breaking machine (Cantab is a Latin reference to Cambridge). The only concrete fact I discovered was that BTM had made 200 of these machines. This figure had never appeared in the literature at that time, and I was astounded by it. To try and learn a bit more, I asked the company secretary Gordon Bates to ask through the pensioner's newsletter, if there was anybody who had been involved at all with the machines, who would be willing to be interviewed. A very nice man called Norman Hedges came forward, and we had lunch in the ICL canteen in London. I explained, "I've never actually seen one of these machines, these Bombes. Could you draw one for me?" So, I opened my notebook in which I was taking notes on the interview, and he drew a rough sketch. I got an artist at Oxford University Press to produce a cleaned-up version of the sketch. The ICL history came out in 1989, and I think that was the first published image of the Bombe. Of course, there's been lots of photos published since then. Hedges' sketch was remarkably accurate—very recently someone contacted me explain which particular variant it was. The book came out in 1989, but I should say there was a moment of doubt. When I got to know people in the business history world, I began to hear stories of people who

had written business histories that were not published because they were suppressed by the company. My agreement with ICL allowed for this eventuality, of course. This was big risk for me, because 5 years work might not see the light of day. So, I made an arrangement with Jack Howlett who was a very good friend and the editor of the ICL Technical Journal. I wrote the book in four parts. When I'd written a part, I would put anything that was controversial in it into an article for the ICL Technical Journal and Jack would publish it. So, if, at the end of the day, ICL did not want a particular fact published I could say, "Well, it's already in the public domain." As the book was about to go to the press, I was called in by Peter Bonfield, ICL's chairman and chief executive. He is now Sir Peter Bonfield, and eventually became chairman of British Telecom. Bonfield is a genuinely nice man and had a family connection with ICL because his father had worked for the British Tabulating Machine Company. I looked at the notes of our meeting recently and he said: "This last section of yours ... you write as though ICL has a death wish." I had written that ICL had had a near death experience about every 10 or 15 years. I thought the company would survive on the grounds that most hundred-year-old companies do, but it would be a roller-coaster ride into the future. Bonfield told me I would have to remove this last section of the last chapter. Of course, I didn't have an option. But anyway, he said, "Well, if you'll agree to that, I won't read any of the rest of the book. I'll trust in the company secretary to have done due diligence." So that was what happened. Consequently, the end of the book is rather anodyne.

Aspray: And was it during this period of time that the Japanese came in?

Campbell-Kelly: Yes, that had already happened. Rob Wilmott, who was the managing director before Peter Bonfield, came from Texas Instruments UK and was very knowledgeable about the semiconductor industry. When he arrived, ICL was still making its own chips. He realized that wasn't going to be the way of the future. So, he hooked up with Fujitsu who made very high-end, very fast chips. The main computer line, the 2900 series, then became Series 39, which had the same architecture, but all based on Fujitsu technology. It saved the company because it enabled them to vastly reduce their manufacturing costs and yet retain compatibility with the existing range of computers. Not long after the book came out, within a year ICL had been acquired by Fujitsu. I think perhaps Peter Bonfield knew that this was on the cards but could not tell me at the time and wanted to save me and ICL embarrassment, but I don't know.

Aspray: What was the reception of the book?

Campbell-Kelly: It was well-received. When it was published Gordon Bates, ICL's company secretary who succeeded David Marwood, organized a press launch and several of the former managing directors and top management showed up. I got some pleasant letters from former employees saying how much they had enjoyed the book. I got a particularly nice letter from the widow of Terrence Maxwell, who was chairman of the company in the 1950s. He died shortly after the book came out, but she wrote me a letter saying how much he had enjoyed reading it. I was very touched. The book won the Wadsworth Prize from the Business Archives Council. I already had quite good links with business schools, but this made me much more confident.

Aspray: How had you learned about business history?

Campbell-Kelly: Compared with computer history, business history was relatively mature. There were two respected journals and regular conferences. The Harvard Business Review had been going I think since the 1920s, and there was a British journal Business History, which I think started in the 1950s. This maturity was very welcome to me. I was also much influenced by Alfred Chandler's Visible Hand. That came out in 1973, won a Pulitzer Prize, and was still very current. I got to know Al Chandler slightly through the Business History Conference, and he was very encouraging and told me had plans to write about the computer industry himself one day. He did eventually produce a book Inventing the Electronic Century about the computer and electronics industries. I read a lot of economics. I was very interested in the interwar period—the Great Depression and all that, which struck England in many ways as badly as America. I read about the general business and political environment. The merger that resulted in ICL was inspired by Harold Wilson's Labour government. Reorganizing the motor industry and the computer industry were the two main initiatives. The whole process was quite secretive, and at first, I had little to go on until I had a lucky find in the ICL archive. There was a set of box files labeled Tehran—as in the capital of Iran. I had assumed these were papers about overseas sales. But when I opened one, I realized they were the government and ICL papers about the merger. "Tehran" was a code name to maintain secrecy. There were several similar box files full of detail—fortnightly or monthly reports of the machinations that had been going on between the different companies. It was fascinating stuff. One of the ways in which the ICL was tremendously helpful, somewhat unwittingly I suppose, was they didn't know how archives were supposed to work. They would let me take materials off-site to read and photocopy at leisure. Not the board minutes of course, but they would photocopy anything I needed. A couple of times I drove down on a Sunday to London, parked in the front of the building, and loaded up the boot of the car with documents to study. Then I'd come back three months later and take another

lot. No conventional archive would allow you to do this, but you can imagine the countless hours that saved me.

Aspray: In the later parts of your career, I think of you primarily as a business historian.

Campbell-Kelly: Yes. That's fair.

Aspray: I remember, this is probably the 1990s rather than the 1980s, having a number of conversations with you and Terry Gourvish at LSE and Richard Coopey at one of the Welsh universities. All of you had at least some interest in computer history or building computer history into the main lines of argument that were going on in business history at the time.

Campbell-Kelly: That right. Yes.

Aspray: Could you talk about that?

Campbell-Kelly: Yes. Well, when my ICL book came out, Terry Gourvish, who was the director of the Business History Unit at the London School of Economics, invited me to give a departmental seminar. He had a terrific network of people. The Business History Unit was very inclusive. There were lots of visitors, academics as well as businesspeople, and many part-time students. I was appointed to a visiting fellowship and we obtained a grant for a two-year research fellowship for Richard Coopey. We organized a conference on Information Technology Policy and Richard produced an edited volume with the same name—you and Arthur Norberg both attended and contributed papers I recall. We also organized a witness session on ICL. Arthur Humphreys was one of the attendees, and various other high-ups from ICL and other people with an interest in the subject. Another visitor to the unit was Sir Geoffrey Owen who was a former editor of the Financial Times. He was writing about the government's restructuring of the British motor industry, which paralleled the reorganization of the computer industry. We got along very well and had a number of conversations. Richard Coopey eventually obtained a post at Aberystwyth University, where he is now emeritus. Terry Gourvish has also retired. They were very interested in integrating computer history and business history. I think they were ahead of their time in that regard.

Aspray: Okay. The next topic I had in mind was this book called Computer that you had something to do with. But are there any articles prior to 1996 that you want to talk about?

Campbell-Kelly: The most significant article I wrote was about data communications at the National Physical Laboratory—the NPL. I was asked by the NPL if I would write an historical account of their work, which started in the mid-1960s. The project was led by Donald Davies who invented and gave a name to packet-switching. It's my most cited paper. I think an interesting aspect of it is that it was written in the mid-1980s before the internet took off, so it was not colored by that later history.

Aspray: So, tell me the story about Computer.

Campbell-Kelly: Well, for me this was a gift from heaven, the opportunity to write a book for the ordinary reader. I'd written *The Computer Age* beforehand, so I've always been interested in broad communication. Of course, it was you who got the grant from the Sloan Foundation—so I counted myself lucky when you asked me to join you. The book had a slightly troubled beginning. It was such a huge canvas, and we didn't quite know where to start. I remember we met in New York before we'd really got going and met Arthur Singer.

Aspray: Yes. He was the program officer.

Campbell-Kelly: He lived in a very grand style. I remember it being a wood-lined, gracious office he occupied. I recall he was wearing a blazer and looked like he'd just come off his yacht. A very dapper individual—sort of an ambassador figure. I can't recall what we said, but he was quite happy to let us go ahead. Then at the same time, so this is probably about '92 or '93, we met Susan Rabiner, who was the editor with Basic Books. She was wonderfully rude to us—effectively saying "Oh, nobody will read this rubbish." Of course, she was right—we were so used to writing for an academic audience. She gave us some great advice. I remember some of the things she said: that we had to tell the story without pictures, and that what people want to read about is people. So, the more biographical we could make it, the better a read it would be. I was quite chastened by that meeting. When I got back to the UK I wondered if the book was going to happen. I reflected on Susan's advice about telling the story without pictures. In Britain and in America there's a tradition for radio talks on the BBC and PBS, typically of 15 minutes. Roosevelt's fireside chats are the most famous example. So, I decided that was what I would do—I'd divide each chapter into a set of radio talks, and then I could not rely on pictures to carry the narrative. I even went to the point of dictating the talks using a Dictaphone and having them transcribed. Of course, I did a fair bit of editing afterwards. That was how the whole book was written

rather like a set of radio talks. Then you sort of walked away somewhat, is my recollection. So, tell me your side of the story.

Aspray: I guess I'd say that you had been teaching this subject for quite some time, and you had a much deeper and broader knowledge of this history than I did. I think that I embodied sort of the Steve Russ attitude about this, in the sense that I had this math and logic orientation, that was a lens on the history that was at least somewhat different from yours, and probably was less mainstream than yours. I also had a very different writing style than you had. I was somebody who wanted to put something down quickly on paper and then do innumerable redrafts. It didn't work very well with the dictation and clean up style that you had. So at some point after we'd had some really rather heated discussions, I decided that the right thing to do was to simply let you run with things, and I would be helpful how I could. I remember in particular that the Sloan had been very generous about letting us meet wherever we wanted, and just sort of give them not even very good receipts to get reimbursed. One of our trips had probably been, I don't remember, either into the Pennines or possibly it was a trip into Wales. I know we did both. But I remembered we were having a discussion and we were sitting on an old stone fence, and we had become so intense in our discussion that we didn't realize that all of these sheep had gathered around us. I was completely oblivious. But it was clear that we weren't going to make quick enough progress if we just kept hammering at each other over what would go in. You had a much better founding of it. You did most of the writing in the end, and you did the vast amount of the decisions about boundaries and topics and such. This really was your book with help from me in a kind of way. I think it's important that that's known. I think it was well known.

Campbell-Kelly: Yes, the reason I asked if we could be Campbell Kelly and Aspray rather than alphabetic ordering was essentially for promotion reasons. At my university I needed to make it clear that I was the principal author of the book.

Aspray: I had absolutely no problem with that, because it was clear that you were the principal author.

Campbell-Kelly: I'm just doing the same with the book I'm currently co-authoring on mobile telephony with Daniel Garcia-Swartz. I've asked him to be the lead author, because I've been very much the secondary author on this particular book.

Aspray: Why don't you talk about the reception of the book and the other editions of the book?

Campbell-Kelly: Well, it is not terribly known in Britain, and it certainly wasn't at the beginning. The original version was published by Basic Books, and they're not a particularly known publisher in the UK. It wasn't stocked by bookshops; you'd have had to order it. It got quite decent reviews, but not an enormous number. It was a trade book, so it didn't get many academic reviews. It surprised me how often it was cited. It sold well. We sold close to 20,000 copies of the first edition.

Aspray: If I may, I don't like interjecting myself in these interviews, but let me talk a little bit about the American side of things. Because I think it's complimentary. The book got reviewed in good places. It got reviewed in the Sunday New York Times book review, which is probably the best place in the US to get a serious book review. It also got reviewed in some of the major newspapers. I remember a review in the Chicago Tribune, which compared our book to another one. The other book was written by a couple of journalists, and the Chicago Tribune review said, "It's interesting that this book on computers was much more readable than the book that the journalists wrote." This was very nice praise. I remember when the book came out and the review appeared in the Sunday New York Times Book Review, I was working at the Computing Research Association at the time. I told the chairman of our board, a very distinguished computer scientist, David Patterson, about it. He lived in Berkeley. He got up early that morning and went out to the local newspaper shop to buy a copy before the New York Times was sold out so that he could see what our review looked like. The book has had very wide adoption for classes. It competes, of course, with Paul Ceruzzi's book. Paul's book has typically been used by engineering and computer science departments, whereas ours has been used more in the liberal arts and social science departments. Anyway, let me turn it back over to you. So, what about the later editions?

Campbell-Kelly: Well, the book was originally written as a trade book, so I was surprised that a second edition was offered. I had expected it to just to sink without a trace. Well, sink anyway. It got adopted as a class text and made its way to Westview Press. I assumed Basic Books had no interest in the textbook market.

Aspray: Westview was in the same family of publishers. They were owned by the same company as their textbook materials.

Campbell-Kelly: Oh, it that right? So, it morphed into a textbook. When we wrote it, we were quite careful about the scholarly apparatus so that we cited quotations and gave a bibliography. So, although you could read it uncluttered by footnotes and references, if you wanted to know where things came

from that was all there too. It was quite fortuitous—without the scholarly apparatus it wouldn't have cut it as a textbook at all. The second edition did not add very much apart from more discussion of the web. When we wrote the first edition, the web had only just emerged. Fortunately, we were able to write about it briefly it before the book went to press, but it must have been a matter of months. By the 2004 edition, the internet was firmly in the ascendant and we added much more. For the third edition in 2014, we brought in Jeff Yost and Nathan Ensmenger. I had become much more of a business historian and the book needed broadening out considerably. Nathan had done some very fine work on the professionalization of programming. So, we took out some sections that had lost their relevance and said much more about the programming profession, which we hadn't really covered at all in the first edition. Jeff did a lot of work on the broader context of networking. In our original edition, we had not adequately explained that the internet was only one of many networks that were happening at the same time. It was somewhat misleading to focus so much on the internet. Jeff introduced a section on Minitel which helped to Europeanize the book too. Jeff also wrote at length about social media that was just beginning to emerge.

Aspray: Okay. And this process continues. You should just mention that you've started work on the fourth edition.

Campbell-Kelly: Yes, we are. Whether we make a fifth edition, I have no idea. I never expected it to still be around 25 years after we first wrote it!

Aspray: Let's talk about Hedgehogs. So, could you tell me the story about From Airline Reservations to Sonic the Hedgehog?

Campbell-Kelly: Yes—the book was the result of a research grant I obtain in about 1998. It's very difficult to get research grants in the UK. The success rate is very different to the US where academics commonly pay for their salary in the summer months with a research grant. That situation does not exist in England. Something like 80% of research grant applications fail. I had a number of fails before succeeding with a proposal to write a history of software. The grant was for about £75,000, which paid for research associates for a couple of years, travel money, and that sort of thing. It wasn't a massive amount, but for career recognition within the university, you need to win a few research grants. I was talking earlier about how important it is for me to get the structure of a book right. Once I have, the book tends to write itself. I worked out the structure on a train journey to Edinburgh. Developing the

structure for the software book was particularly challenging. At that time, the railways in Britain were in a terrible state, following denationalization by the Thatcher government. I was about to attend a conference in Edinburgh and decided I would plan the structure of the book on this train journey, when I'd be free of all interruptions. On a good day, it was about a six-hour train journey to Coventry from Edinburgh. Well, the train broke down on the way, so the trip took much, much longer and I was still thinking about the structure on the return journey. However, by the time I got back to Coventry, I had decided what was going to be in each chapter and that never changed. The book was the story of how the software industry developed from being a programming service to a product and then becoming a consumer product. As I mention previously, Mary Croarken and Ross Hamilton helped me, Mary particularly on banking and back-office software, and Ross on computer games. I decided to make 1997 the cutoff date. There was a strong sense that the industry was changing rapidly with the rise of the internet. Software as a Service, or SaaS, was barely a known concept then, and certainly not a known acronym. I think I made the right cutoff point, as things have turned out. I feel that a second volume would be timely right now, but I think I'll leave it for somebody else. It would be a big challenge because there is so much to cover. History is like a bunch of flowers. It gets wider at the top, doesn't it? When I wrote my book, there was a beginning and an end-point that was quite containable in a book. I don't think that would be so easy now. With the rise of open source and many other phenomena it would be a much harder narrative to write, and not necessarily chronological.

Aspray: Okay. How was the book received?

Campbell-Kelly: It was very well received. It got reviewed in the business literature and the academic press. The Observer newspaper has a color magazine each Sunday where it got a prominent review. A student I'd shared lodgings with back in the sixties, who was then living in France, saw it and we reconnected after a gap of 20 or 30 years. As I mentioned earlier, another outcome was that I was approached by a number of firms and consultancies involved in the software industry wanting to use my expertise. So that got me in touch with LECG's computing consultancy that was run by David Evans at the time, and then into the area of software patents which I didn't know very much about before. I gave a couple of seminars to the industry. The seminars went down well because they were unfamiliar with the idea of taking a historical approach and having slides with pictures rather than text.

Aspray: I'd like to ask you to talk next about your collaborations with Daniel Garcia-Swartz. You've written now two books and some articles with him. Could you tell me about how you came to work together? What's the agenda of your research? And tell me about the two books.

Campbell-Kelly: Well, when I was consulting with LECG, they put me in touch their Chicago office with idea that my historical approach would dovetail with their economists and we could put together an article for the one of the legal journals. The principal in Chicago was Anne Layne-Farrar and Daniel Garcia-Swartz was a senior consultant at the time. Anne was very busy and could only join us to a limited extent, so Daniel and I generally worked just the two of us. He has an economics PhD from Chicago. He is a very strong economist of a quantitative kind. He was less knowledgeable about the computer field than me, so we blended quite well. He has a lot of confidence using economic data, which I would be much more cautious about because it's not my field. One of the papers we wrote was on the economics of the time-sharing industry. Time-sharing was known to be important, but rather lost to history. I always felt it didn't get due prominence. He dug around, collected all the data and it turned out that the computer time-sharing industry was 15% of the global computer industry at its peak. I think that was a very surprising finding. I had no idea time-sharing was so significant. So, we then wrote two books. One was *From Mainframes to Smartphones*. We felt there as a need for an international history of the computer industry. There are many national studies of the computer industry, but little international history. We aimed for a breadth-rather-than-depth coverage of the whole of the international computer industry, literally from mainframes in the 1950s to smartphones. I was knowledgeable about the western computer industry and Daniel was very good at teasing out data about the rest of the world. He comes at the industry from an economic perspective, whereas I'm more comfortable with industrial structure than raw economics. But together we cover the gaps fairly effectively. The book we've just sent off to the publishers, we are planning to call *Cellular: An Economic and Business History of the Mobile Phone Industry*. We found exactly the same problem as trying to study the international computer industry—that there are dozens of books that deal with the mobile phone industry in a particular country but no global coverage. So, we have tried to tell the international story. It's a very complex story. The result will be a single volume 50-year history of the mobile industry from many countries' perspectives. It is interesting that different countries entered at different times. For example, the last chapter of the book, which we've finished most recently, considers Africa. There was very little telephone infrastructure in Africa, so mobile phone became the dominant form of

communications from beginning. The book is not in any way a social history, but we discuss the phenomenon of the Arab Spring and the impact of mobile telephony.

Aspray: So, by the time that you started working with Daniel, you had already become quite an accomplished business historian. Had you done any economic history before this time?

Campbell-Kelly: No, not at all. And that's why I rely quite heavily on Daniel. The economists in my university were mostly mathematical economists, so I had few connections. The exception was Robert Skidelsky who wrote the acclaimed biography of Maynard Keynes—he was supportive of business history in the university. Of course, I read a lot of twentieth-century economics when I was writing the ICL history, so I was familiar with the main developments such as the Great Depression and monetarism.

Aspray: Yes. So, what are your current research projects? What do you have planned for your next career?

Campbell-Kelly: I retired from Warwick University in 2010, when I was 63. And before that I worked half-time for three years. The university has a rule that one could do consulting for one day per week, but I was starting to do more than this. Working half-time kept me within the rules, and besides I was greatly enjoying exploring behind the scenes in industry. I then taught just the history of computing and a few other bits and pieces. Being a trustee of The National Museum of Computing takes some of my time, and I've recently become a trustee of the Archives of IT. I'm also on the committee of the Computer Conservation Society and helping to set up a digital archive. I suppose this could be called computer history as a social activity. I've been reading more. I own many books that I have skimmed but never read properly. Doron Swade once told me "What you learn to do as a graduate student is to be able to file a book in three hours." And that's absolutely what I had done; now I'm making time to read books more thoroughly.

Aspray: Are there things that you want to talk about that we haven't talked about yet?

Campbell-Kelly: No, I think you've probably heard enough from me.

Aspray: Okay. Well, thank you so much for doing this.