Oral History Interview with

Brian Randell

January 7, 2021

Via Zoom

Conducted by William Aspray

Charles Babbage Institute

Abstract:

Brian Randell tells about his upbringing and his work at English Electric, IBM, and Newcastle University. The primary topic of the interview is his work in the history of computing. He discusses his discovery of the Irish computer pioneer Percy Ludgate, the preparation of his edited volume *The Origins of Digital Computers*, various lectures he has given on the history of computing, his PhD supervision of Martin Campbell-Kelly, the Computer History Museum, his contribution to the second edition of *A Computer Perspective*, and his involvement in making public the World War 2 Bletchley Park Colossus code-breaking machines, among other topics. This interview is part of a series of interviews on the early history of the history of computing.

Keywords:

English Electric

IBM

Newcastle University

Bletchley Park

Martin Campbell-Kelly

Computer History Museum

Jim Horning

Gwen Bell

Gordon Bell

Enigma machine

Curta (calculating device)

Charles and Ray Eames

I. Bernard Cohen

Aspray: This is an interview on the 7th of January 2021 with Brian Randell. The interviewer is William Aspray. We're doing this interview via Zoom. Brian, could you briefly talk about when and where you were born, a little bit about your growing up and your interests during that time, all the way through your formal education?

Randell: Ok. I was born in 1936 in Cardiff, Wales. Went to school, high school, there. In retrospect, one of the things I missed out then was learning or being taught Welsh. I very much regret that, so for the past two or three years, I've been learning Welsh. Anyway, at the age of 18, I guess, I went to Imperial College in London to do mathematics. I'd done pretty well at maths in school, much less well at maths in college, but in my final year there I got to find out about computers. I got really turned on and I was the only one in the class who did. [At] Imperial College, there had been a project to build a computer, ICCE, Imperial College Computing Engine, ICCE-1. When I got there, there was, I believe, a non-working successor, ICCE-2. We were shown that, and I had a tutor who was one of the people who worked on that. That really intrigued me; and to the further detriment of my classes, I'm sure, I got really interested in that, and did a final year project on computing. At that time in Britain, there was still national service, conscription, but one of the things you could do other than go into the military was get a position that granted deferment. I got a position with the Atomic Power division of English Electric, a very big company which made all sorts of things, including computers. I was one of two people who went to English Electric from that class, and that was a class of about 30, I suppose, any and all of whom I've met since found themselves involved in computing. But I was the one who actually did it deliberately.

Aspray: Ok. Why don't you just lay out the rest of your career path while we're at it, as a way to get started?

Randell: Ok. I worked at English Electric, at a place called Whetstone, in the middle of England near Leicester. Initially, that was to work on nuclear applications. [I lodged] with a colleague who had also

gone there with me, who had got married and with whom I was a paying lodger as a way of helping them with their mortgage payments and [giving] me somewhere to sleep. He and I worked closely together on programing the English Electric DEUCE computer, a computer that is very, very directly descended from Alan Turing. We both brought a spirit of enjoyment and mischievousness and so on to a rather staid little department and started using the computer to play games. We soon decided that one of the best things you might do with a computer was [to] get it to help you do your programing. And so, we had an idea for a form of, not very high-level (but much higher level than the English Electric DEUCE [machine-code] programming [of the] computer called, Easicode. We nearly got fired over that, and we were banned from working on it for a year. A year to the day, we marched back into the boss' office and demanded to be allowed to go on with doing it. The first use of that system by one of the engineers saved more computer time than the entirety of all the time we'd spent on [developing] it. My colleague Mike Kelly, a brilliant programmer, went off to IBM. I was left there and became manager of a small Automatic Programming Section. English Electric was then starting to build the KDF9 computer, a very interesting and intriguing computer. It was agreed that I should lead an effort to help produce a compiler for it. Initially, we were arguing about what language to invent but went to a meeting at which Dijkstra spoke describing his early ALGOL compiler. In fact, [his was] the first ALGOL compiler, ALGOL 60 compiler that is. We got permission to seek his advice. We got his permission to base our work on his work, and - I'm now talking about myself and a colleague, Lawford Russell, - built an ALGOL compiler for the KDF9. While we were waiting for the KDF9 to be operational, we wrote a book on the compiler called *ALGOL 60 Implementation*. We thought there were several rival books being produced, so we did it in an intense effort. It turned out that there weren't any rivals being produced, but it meant that by 1964 we had published the first really detailed book on compilers. I was then wondering what to do next and had thought of the idea of spending some time in the States. Hadn't done much about that. An ex-colleague who had joined IBM heard that I had been interested in going to the States. I don't think he

contacted me, I think he spoke directly to the Director of Computer Science at the IBM Research Labs in Yorktown Heights, who contacted me and asked if I'd like to join them. I wrote back and said, "No, thanks." I was quite frightened at the idea of joining anything as big and overwhelming as IBM. To my surprise, I got another letter backing, saying essentially, "We quite understand, but why not come out and see us in any case?" I was very surprised at that. I wrote a letter back, which tried to make sure they understood I was requiring travel money without actually asking for that. They of course were assuming they would be paying for the traveling. And so, I made a trip out there, but I combined it with visits to two other places: General Electric—I've forgotten the other one for the moment. I was hosted for several days at Yorktown Heights. John Cocke, later the Turing Award winner, was the one who took me under his wing. He took me up to Poughkeepsie to see the computer assembly line there, and then I saw how really different IBM was. English Electric was able to produce one KDF9 in several months. IBM was producing at least equal-size machines, I think several in parallel, coming off the line, probably every few weeks. It was massive, but I was overwhelmed by the friendliness, their hospitality, and their perhaps naïve assumption that I was good enough for them – because I did not regard myself as a researcher. We had been developing a compiler because it was needed. But you're around all these people with PhDs regarding me as someone appropriate to join them, and it took me at least six months to get used to that. I'd been invited to join what was called Project Y, a very secret project inside IBM to produce a supercomputer, to get the supercomputer lead back from CDC. After a year, our research project became a development project. Twelve of us moved out to the West Coast. I was involved in designing the instruction set and things to do with machine architecture. I got involved there with work on instruction scheduling. Got really very, very excited by that work. And also got out of love with the way the project was going, technically. I wrote a notorious memo called "Clean Machine Design," which said something along the lines of, "If you take a set of architecture decisions independently of each other, and validate each one separately, what you might end up with is something of a pig's breakfast." Not

sure I used that phrase in the memo. Within a number of months, I was back at Yorktown Heights having told the people at this—by now 100, 150-person – development project ACS, Advanced Computer Systems, that I would make two predictions: you are going to be forced to abandon your special-purpose machine instruction design and set, as you'll be forced to transfer your ideas to the 360, and you will then be killed. That was the biggest "I told you so," of my life, as within two years it had all come true. One of the people I was working on was a young graduate student—no—a young masters graduate, I suppose, who I had completely forgotten about. Years later, I found out that this master's graduate who I had remembered as writing a simulator for us was the person who became famous as Lynn Conway.

Aspray: Oh!

Randell: She had disappeared. I had no contact with her after my time there. She was somebody who incredibly bravely went through transition, had to rebuild her career from scratch, got to Xerox Palo Alto (PARC), did wonderful work there on VLSI design, and a few years later revealed her story. I had learned all this from somebody who had been researching Project Y and ACS. He contacted me saying, "Are you the Randell that worked at ACS?" I said yes. And he said, "Well, I'm very interested in dynamic instruction scheduling," which was something, essentially, I had felt I was never allowed to talk about, that remained very secret all this time. He didn't reveal to me Lynn Conway's name. What was strange is the name he was talking about on the dynamic instruction schedule memo, did not match that on the copy that I kept.

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Randell: When he contacted me, I told him I had my own copy of this memo, and was told that he regarded it as very important because he said we had invented superscalar architecture 20 years before it had existed. I got completely confused because there was a name in the set of four authors on this

memo and all of the names were male and he had been talking about somebody with a female name. And about a year or so later, Lynn Conway revealed her transition. I had lots of contact with her. I wrote all this up for the Annals. We had a wonderful one-day seminar at the Computer History Museum, a reunion of the ACS project. That [project] was what I did for my second year at IBM. I then went back to IBM Research and worked for three years on operating systems, multiprocessors, systems design methodology. My wife and I had always said we were going to the States for just two years. All our American friends were saying, "You'll never go home." Our youngest child was just coming up to going into school, we decided that's when we wanted to get back to Britain. I heard about there being a professorial tenure-track chair at Newcastle University coming up. I applied and got that job.

Aspray: And you've been there—

Randell: I've been here ever since, much to my surprise. I had no idea whatsoever that I would never move again. But using a wonderful phrase from John Buxton, "I found I'd left the ivory towers of industry for the sordid commercial reality of a university computing lab," and got myself involved in all sorts of interesting projects. Really, I've concentrated on system development [and] dependability ever since, influenced by my involvement in the first and second NATO software engineering conferences. I'd been invited to edit the report of the first of them with Peter Naur. Before I joined IBM, I had been invited to join the ALGOL committee. English Electric was not willing to fund that. To my surprise, IBM very definitely was, even though I was doing nothing to do with ALGOL. When I joined IBM, I specified that I was not willing to work on compilers, I was going there to work on something different. But essentially, I moved to IBM, I moved into the international computing world with membership on the ALGOL committee and the like. That lead to things like the software engineering work and various other activities.

Aspray: Do you want to round out any other things about your career before we turn the interview to history of computing issues?

Randell: Other than to say I notionally retired 20 years ago, but my retirement is entirely notional. Until the Coronavirus started up, I was going into work every day, attending my office there. I'm still involved there, gently, in work which is an outgrowth of work on system development and dependability, working particular on causality and system analysis, system failure analysis, and so on. But also, now and again, almost invariably reactively rather than proactively, I've taken up work on computer history as well. But I think that gets all of the non-computer history out of the way.

Aspray: I have two follow up questions for you that are actually both good transitions from our original topic to the new topic. The first one is—you mentioned the Turing legacy that was built into the DEUCE computer. Were you appreciative of that Turing connection at that time?

Randell: I'm not sure, I think so, but I don't know. Turing had died two or three years before I got involved in computing. I certainly—let me think—I'm sure I knew that the DEUCE was a commercialization of the Pilot ACE computer that that came from NPL [National Physical Laboratory]. I must've known a bit about that. As to when I learned how important Turing was, I just cannot remember.

Aspray: Ok. The other question is about when you're a child growing up. Did you have a particular interest in history during that time?

Randell: I think the simplest answer is no. I was put off history at school because the only sorts of history I can remember were something like ancient Egypt and probably 19th century politics or something, and that really didn't interest me at all. I have no idea! I was a voracious reader and certainly there were historical novels that I liked. Alexander Dumas, I remember. I was the only kid in my class who read the entirety of the *Cloister and the Hearth*. I always remembered it was 600 pages long,

and as far as I was concerned, that was great. Everyone else looked and gagged at that. So, I suppose I wasn't interested in history as a subject. At the age of 16, I suppose, I was probably planning to carry on in languages. But then I did the examination at 16 and did surprisingly well, surprising myself and everybody else, in mathematics.

Aspray: Oh.

Randell: Physics. I was persuaded to switch to that and Mathematics.

Aspray: Ok. So, let's turn to how you got interested in the history of mathematics and I'll just let you tell a story.

Randell: Well not history of mathematics, history of computing

Aspray: History of computing. I'm sorry. Excuse me.

Randell: I think, I'm pretty sure, one of the first books I read on computing was Bowden's *Faster than Thought.* That was almost the only book, if it was available, to buy in about '56 or '57, when I think I bought my first books. Another one was Ed Berkeley's *Giant Brains.* I didn't know about or at least didn't buy Wilkes, but I still have the Bowden's book, *Faster than Thought.* [It] was a series of chapters he edited, the essays, contributions on various British early computers. I think that was a 1956 book if I remember rightly. But he was very interested in history and in particular [in] Babbage. So, there was a lot about Babbage in that book. I think that must've been, that's what sort of got me actively interested because a third book that I remember buying was the Dover paperback on Babbage's engines. The one that reprinted Ada Lovelace's paper and so on. By the time I was working on—to get the years right – certainly by the time I got to Newcastle, I was well attuned to various bits of computing history. I found them very interesting, but I'd not actually done anything. What caused me to do something on the computer history was a pure accident. That was when I was writing my inaugural lecture.

Aspray: What is an inaugural lecture? What place does it play?

Randell: It was the case, probably in all universities, but it is no longer the case in Newcastle or I think elsewhere, that when somebody was invited, promoted or invited, to a chair, they had to give a full, typically one-hour, lecture; and that lecture would be to both, at the same time, the general public and their colleagues. It was meant to straddle [those two audiences]. And so, I arrived in Newcastle in 1969 to what was referred to as the second chair. In general, then, the various departments… the University was smaller—all universities were smaller then – at least at Newcastle I think it was the case that almost all departments had at most one full professor, who typically was head of the department as well. The notion of the second chair, at least at Newcastle, was one that was meant to concentrate on research, which was great as far as I was concerned. I got there in 1969, and I think it was in 1970 that I gave my inaugural lecture. The existing head of the department, the first professor [Ewan Page], he'd given his inaugural lecture about five or six years earlier, and his lecture was mainly an explanation of what computers were. Think back how little was known by the general public then. So, I decided that in my lecture, at least for the general public, what I'd need to do is explain what programming was. So, the first part of my lecture was explaining about programming. I did that first by talking a bit about Ada Lovelace and making some reference to the fairer sex; I went on to explain it was rather like knitting patterns. I explained how knitting patterns had loops and subroutines and so on, and how the printed knitting patterns were a comparatively high-level language for explaining how to knit without actually telling you how to move your fingers around. Then continuing that sort of light-hearted introduction, I went on to talk a little bit about Grace Hopper, who I'd met; and I wanted to give the impression of all the marvelous things she'd done. I think at that stage, I said, "I may be giving you the impression that programming is really," now I can't remember how I phrased it, but along the lines, that "I may be giving you the impression that programming is a comparatively simple task done by individuals, producing their own personal programs," and so on. I said, "No, the other end of the world that I'm interested in is

represented by very different sort of programs." And I went on, and the rest of my lecture was essentially more geared to things like software engineering because this was two years after the NATO software engineering conference, whose Report, as an editor, most of which I knew by heart. In doing my initial reading about what to say about Ada Lovelace, I didn't want to trot out what anybody could easily find, so I went looking to see what else was around. I found a reference to a paper on analytical engines by somebody whose name was not familiar to me called Ludgate. I'm not quite sure where that was. That was probably in Baxandall, the Science Museum book on calculating machines from the 1920s. There was a little reference there about—I was looking for more about Babbage, you see, and I went and found the Ludgate paper about Babbage. There, I found he talked about having himself invented a computer, and I thought, "Gee! I've never heard of that! I don't know anybody who's ever heard of that." And I started digging. And that was it. I was hooked.

Aspray: I see. And you're still digging on Ludgate, right?

Randell: Yeah. Again, this is reactive rather than proactive. A guy at Trinity College, Dublin, Brian Coghlan, I have been working intensively for several years with him now, but it's all been done by email, and I'm not really sure how to pronounce his name. It's C-O-G-H-L-A-N. I'm guessing Coghlan, ok?

Aspray: Right.

Randell: I really must find out how Brian pronounces his name. He is an active retiree from computing at Trinity College, Dublin. In recent years, he has taken over custodianship of their very large collection of documents and also machines and so on to do with the history of computing. This collection was created by the originator of that department and head for many years, probably one of the most senior professors of computing in Ireland, who died a few years ago and his mantle has been passed onto Brian. Brian was starting to look into Ludgate, and he contacted me. He and I, in particular, but with a group of others, [have] been very busy indeed these last few years on that.

Aspray: Ok. So, when you were first preparing your inaugural lecture and you ran across Ludgate, tell me about what one might call today the information ecology. Where did you find material? How did you go about looking for things? What was the nature of information that was available at the time?

Randell: Well, this was pre-internet, very much pre-internet. But at IBM Yorktown Heights, I was just 100 yards or so away from a wonderful research library. And so, I had spent quite a lot of time there ransacking that library, and I'd collected a lot of material there. I photocopied all sorts of things there. Things like the original report on EDVAC and so on. So, I guess I'd become a computer history collector in my time at IBM, if not slightly before; but not with any plan to do anything other than to collect things, right? So, I produced a pretty fairly big card index of all [the] things I'd found. Then at Newcastle, the department had its own library, and a very good one, with lots of stuff from—well, the department originated in 1957.

Aspray: Oh, that's pretty early.

Randell: Very early indeed. And the head of the department, Ewan Page, he had been a statistician at Cambridge, but he'd worked on EDSAC, so he was very much in tune with that. We not only had a very good library, we had a very good librarian. A fantastic librarian. She was great. I also found that being a professor was really quite something there. I wasn't at all in tune with the university world. I had never thought of ever going back into it. I found myself appointed to a chair never having given a lecture. I'd given seminars, right? I'd never lectured in my life. I'd not gotten a PhD, but I'd known that both Tony Hoare and John Buxton had been offered chairs, and I thought, "If they can get a chair, I can get a chair." So, I blended in naively, into this—to a position where—though there wasn't the money that IBM had got – I had good library support and secretarial support. The secretarial support was even better than I'd had at IBM. So, a lot of it was done by libraries and inter-library loans and so on and by correspondence,

typed correspondence, typed by a full-time secretary who also did some transcription of things for me. So, that's how I did it.

Aspray: Into the late sixties and into the 1970s, did you have other people who shared your interests, who you talked with about these kinds of issues?

Randell: I would talk with colleagues but there were—I don't recall any other colleagues being anything other than interested if you show them. But I was contacted by what was then Sunderland Polytechnic, it became Sunderland University, asking whether I was prepared to be a PhD supervisor for a member of staff who was being encouraged to do his PhD. And at that time, their regulations were such that I think though I'm not sure that I couldn't formally supervise his PhD, so they did this themselves. You realize I'm talking about Martin Campbell-Kelly.

Aspray: I do. Yes.

Randell: Right. He came to see me. Newcastle and Sunderland are, what, twenty miles apart, I suppose, 30 perhaps at most. We talked about his interest, and I encouraged him to dig into the very early history of software. He produced emulators for the Pilot Ace, the Manchester Machine, and the EDSAC. He found examples of their programs and got them all working. He would come and see me; it was probably every few months rather than every few weeks. We'd have a lovely debriefing and chat and so on. I would suggest other things he might do. Next time, he'd come back having done all of that and more each time. He was the easiest PhD student to supervise I've ever had. And that's Martin Campbell-Kelly. So, that was the main person, I think, that I can recall now having face-to-face conversations with on computer history.

Aspray: How did either Martin or Sunderland identify you as the person to contact?

Randell: By that time, I'd published a book, *The Origins of Digital Computers*.

Aspray: Ok.

Randell: When I had dug into Ludgate, which I started doing in ’70, ’71, I guess, I felt it obviously necessary to find out what else was known about computing at the time Ludgate was around. So, I dug into calculating machines as well. I ended up having a paper published on Ludgate in the *British Computer Journal* and had a lot of material left over because I’d found out all sorts of things, essentially [about the period] between Babbage and World War Two. I found about Torres-Quevedo and so on, Vannevar Bush and others. So, I started planning what to do with all of this, and I had the idea of essentially gathering all these papers together into a book and writing a series of introductions. Going off slightly on a tangent, one of the people who I knew and who I’d met in the past was Don Knuth. I’m pretty sure that he was one of the people that I contacted as I decided what to cover and what not to cover, and the like. Don got interested in my plan and tried to persuade me to change from that plan to one in which he and I would jointly write a book on the history of computing, which would be – in his terminology --would be a “source book” which would use lots of comparatively small snippets from original documents but would embed those in a lot more of our own analysis. I wanted the originators to speak for themselves. So, in general, I wanted to publish complete papers with introductions. I also knew that Don was incredibly busy and that I could either be castigated by everybody for diverting him yet again from his encyclopedia or alternatively find him having difficulty in working with me because of his other things. So, I politely refused. We’re still on very good terms, and indeed when my book came out, he wrote an absolutely wonderful review of it, which you find on the back cover of the later editions. So, that book had come out, my Ludgate paper had come out. I was probably the only person in Britain who’d had written anything very specifically on the history of computing other than probably Bowden’s stuff on Babbage. And then Newcastle and Sunderland are not far apart in many ways, so I’m sure that finding me was easy.

Aspray: Ok. Can you talk about the decisions you made with respect to what you included and didn't include in the book, as well as thoughts in later years about the decisions you had made?

Randell: Ok. Let me preface answering that by going back for the moment to Dijkstra, re the book on compilers. When we asked his advice and permission, effectively to write a book describing our compiler, but something that had a lot of his footprints in it, he wrote back a letter that I treasured and have referred back [to] many times since, because he said, "Writing a detailed account of your compiler will be of interest, considerable interest, to a small number of people. If you write a book in which you describe all your design decisions, and for each of the decisions, you try and explain all the alternatives that you considered, and why you made the choice you did, and then, in retrospect, what you now think of that choice, that will be a much more useful book." That was the book that we wrote, and that is the advice that I've given to many, many PhD students ever since. So, that's the memory. Your question evoked that memory.

Aspray: Right.

Randell: So, how did I decide? It seemed rather obvious to me, having to start with Babbage. Having said that, I felt that [while] I didn't want to include any pre-Babbage papers, I did want to say something about what happened before Babbage. I did quite a bit a digging into two things: the history of calculators and the history of sequence control mechanisms. I wrote a chunk of that for the introduction. That struck me as a rather obvious, [a] well situated starting point. In *The Origins* it seemed to be that a good stopping point was when the first modern – conceptually modern – computers came into existence. As far as I was concerned, that was the Manchester and the Cambridge machines. Certainly that would involve all the important machines I could find between Babbage and EDSAC. I was just talking about computers; I was not trying to cover anything other than computers. For all that, I was basically a software guy and had worked on operating systems and languages and

compilers. I don't think I even gave a thought about covering any of that in the book I was to write. My interest was in computers and things like their architecture. Essentially, I was including everything that looked interesting. I was trying to very hard to find things that people didn't know about. I was industrious enough and well enough situated in terms of library and secretary, and though I didn't realize it, professorial clout, to be able to gather things. Of course, while doing that, I dug into Turing. I made up a list of what I was going to include. I tried it out on a number of colleagues, and somebody wrote back – I'm not sure who he was now, possibly it was Fritz Bauer, but I'm not sure about that – saying, "But you've missed out Turing." And I said, "Yeah." I said, "He did that mathematical work before the war and his ACE computer post-dated EDSAC. So, he doesn't fit." And he, whoever he was, said, "Why don't you dig more and try and find out what he did during that interval?" That led to me persuading various people, eventually led by Donald Michie, to be indiscreet over Turing's work, to write a paper, to try unsuccessfully [at first] to get the Colossus declassified. One of the things I found I could do—well, I've always joked that my most important use of my title as being for dealing with recalcitrant tradesmen. But one thing I loved about Newcastle was that everything was very informal. If I was ever addressed in the department as Professor Randell, then it was sarcastic.

Aspray: I see.

Randell: Typically, by my secretary. But for all that, I learned that the title really meant a lot back in those days when one wrote letters and so on. Having tenure, and perhaps because of my attitude to the world, the idea of writing straight to the Prime Minister and expecting successfully to get an answer was what I did. That led to even the first edition of my book in 1973 having a short article about the Colossus in it. I followed leads. I don't know I was trained to do this, but it seemed natural to me just to follow leads, to look up to see what was found in the references and so on. Though I'd had no formal training as a historian, one of the things I read and got a lot of value out of was the book by Kenneth May.

Aspray: Oh, yes.

Randell: …which was to do with history of mathematics, but it contained a lovely 50 pages essentially on how to do history. I used that, essentially, as my bible. Though I don't think that book, which had a huge bibliography, gave me anything for my book but it gave me a lot on how to do history.

Aspray: Right. What was the reception of the Origins book?

Randell: That was pretty good, certainly amongst the people that contacted me. Springer had agreed to do the book as a prestige item, not expecting to sell very many. So they suggested, at least in these circumstances, rather than have the normal royalty rate, what they offered was that in the unlikely – this is my phrasing – in the unlikely happening of there being any profit, we split the profit 50/50.

Aspray: Oh. Ok.

Randell: It did start making a profit. Not a huge one, but after—I can't remember when now, possibly after the second edition – they wrote back and claimed that they'd now gone on to a new computer system for payment of royalties and the like, and this computer system couldn't cope with the arrangement that we had and they would now like to switch me on to the ordinary arrangement. I was very suspicious of this, as you might imagine. It was only when I convinced myself that this was not a device for suddenly getting out of a contract that they no longer wished to be in [that I accepted]. Sorry, that's a bit of a side issue. I guess it was not a best seller, but, well, it got good reviews. And people who were interested in it were very kind and the like.

Aspray: When I was coming into graduate school in the mid-1970s, it was one of the first things that I read -- and read it pretty carefully cover to cover, actually. Why don't you continue your story about your various kinds of involvement with the history of computing?

Randell: Ok. I suppose, I continued building bibliography; and in a certain sense, you might say, the book is an outgrowth of the bibliography. The first edition had a pretty big bibliography. I went on building that bibliography. I actually published a version of it in the Annals. I eventually stopped with the bibliography when it got to about 700 items. I then bequeathed that bibliography, in fact, to the Computer History Museum to Gwen Bell. I found that Gwen, somewhere, had written up that incident because she said I made a little ceremony out of giving her the bibliography, with the notion that hopefully somebody might carry on with it. What I said was "I'm reminded of the old fairy tale of this besotted youth who collected falling leaves in the autumn with the notion that all the ones he caught before they reached the ground were lucky. And he gathered hundreds of these and then he gave them to the lovely princess. 'Here's my set of leaves.'" I had forgotten that, but she obviously had remembered, and she wrote it up somewhere. I then gave up on the book basically and on the idea of trying to continue on the bibliography. On the subject of the bibliography, one little anecdote: as I produced the bibliography, I used word processing where the printout was a line-printer listing. We did have a printer that had upper and lower case by then. And I wrote fairly extensive notes about each item. When it came to publishing the book, I cut each of those notes down, probably on average to about a third of its original length. When Don Knuth reviewed the book… I should explain. The book was intended to include the bibliography and to have an index. The index was meant to cover both contents in the book proper and the bibliography. In his review of my book, he commented very specifically on the index. The index had been done for me by Jane Horning, Jim Horning's wife.

Aspray: Oh. Wow.

Randell: She was—she wasn't a professional indexer, but she was professional in that field. She published a book on the history of the detective story or something like that, which is a quite scholarly book. So, she did the index, and the copy of the bibliography she worked from involved the full annotations rather than the short ones. Don Knuth, in commenting about the index said, "this book had

got a marvelous index, I found, for example to my surprise, it listed such and such an item as including information about, I think von Neumann". And, he said, "That surprised me. I didn't think there was anything about von Neumann in that. There is nothing in the bibliography to explain why that bibliographic item should be indexed for von Neumann. So, I went and looked at the original, and yes, it's got some interesting stuff about von Neumann in it". That had been cut out of the notes, right? So, the index was on something that was more informative than even the bibliography. By pure accident, I had wowed Don Knuth with somebody else's index. Sorry, what was that an answer to? What question was that an answer to?

Aspray: I forgot.

Randell: Oh, yeah, other things that I've done.

Aspray: Exactly.

Randell: Right. As I was doing the book, I came across various things which led me to write up the articles. I was invited at some stage to give a lecture on history of computing at MIT. That led me to putting together a paper, on Torres-Quevedo and Vannevar Bush and Ludgate. That's right. I found a way of tying them together. I think for that paper I did more digging into Vannevar Bush. When I discovered Torres-Quevedo I wrote up about his work. There were other odd things. I found a really weird advertisement about difference engines in a Victorian newspaper. That lead to a paper in the Annal called *The Mysterious Advertisement*, which, to my great sadness, has not evoked [responses], I've not had responses to the challenge of understanding the advert. I think I should write to the Annals again. No, I should write to some [history of science professors] or somebody, say, "Why don't you get your students to look up this advert?" You can now get so much information from the internet, so this might be solvable. On that subject, it's a little, again, going sideways a moment, I think Sydney Padua's book on Lovelace and Babbage is wonderful, in various directions – in particular, the amount of new

research that is there because she made so much use of the internet and the ability to access Victorian newspapers. There's a huge amount of new information in that book. It's time for other people to do a Sydney and re-look at things that may have been investigated and documented but now could be reinvestigated with all these new tools.

Aspray: Did you continue to have interactions with Martin Campbell-Kelly after he completed his dissertation?

Randell: I'm sure I did. I can't remember what they were now, though. But certainly, after the things I've now talked, my work on history went rather onto a backburner or at least became [less] proactive. if I did something, it was because somebody managed to persuade me to do it. I wasn't taking the lead any more on things. This latest work on Ludgate: I'm a follower and helper. With Martin Campbell-Kelly, I'm just trying to remember now what sort of interactions we had afterwards. He and I would both be involved in all sorts of things, like reviewing something or meetings or whatever. But we didn't together work on anything [together].

Aspray: Did you get to know some of his doctoral students, for example, Mary Croarken or Ross—I've forgotten his last name?

Randell: Not really. I would know of their work and I would see the result, but no.

Aspray: Were there other people who came into the British academic community interested in the history of computing, say in the 1980s, who you might have had some interactions with?

Randell: I'm sure there were. The reason I'm sure is I found that my correspondence archive contains far more information than I can remember. It has been humiliating to find out what really happened, to find out how I found some of the things that are in the book. For example. I'm amazed at the number of

people I've corresponded with. I therefore am sure that I had more correspondence with more people working on historical things that I can now remember, I'm afraid.

Aspray: Right.

Randell: But also, a big chunk of my life also from the mid to late 80s onwards has been an interest in genealogy, and that sort of overlaps as well with my historical interest. My wife and I had inherited a whole set of boxes of family history documents from her father in about 1970, just before he died, which we had promised to look after, which I had no interest in. The idea of genealogy did not appeal to me. I thought that sounded like a very self-centered and very lonely hobby, I'm not interested in that. But then in the late '80s, a distant cousin contacted me. He found out a lot about the Randells, which turned out to be a very interesting family, at least one chunk of them, of mariners and so on. One day he said, "My son tells me I should buy a computer and put the Randells on it." And I thought, "Hell's teeth. If the Randell's go on a computer, I'm going to be the one who does it; and I'm going to be the one who finds out how best to do that." I rapidly realized genealogy was a very interesting application of computers, exemplified by the fact that one of the internet colleagues that I had in genealogy early on had said he'd done a Masters in computing at Cambridge some years earlier. He was very interested in genealogy software now and would I supervise his PhD on genealogical software and the merging of genealogical. I wrote straight back and said "No. I would, however, supervise you on a PhD on the merging of incomplete, inaccurate overlapping databases, and you would need an example, wouldn't you?" Because I realized that in all of my life on computing, I had been working with exact data. And the notions, the problems, that concerned inexact data were great. I not only got involved in genealogy, but I got involved in a whole series of really interesting student projects that were motivated by genealogy but were definitely computing science projects. For example, say you've got a huge family tree. I had a couple of students, I think, who automated the task of analyzing that family tree, identifying

inconsistencies in the dates, and providing estimates for all of the missing dates. A lovely example of mathematical relaxation. Ok?

Aspray: Yes.

Randell: I also got interested in name matching, which I found was a really important arena being ignored in computing science but really important in certain areas of business. Lots of business had huge databases with people's names but they had to match people together very often. And there was a lot of work in genealogy on trying to do that. I found that there was an interesting group down at Cambridge, one of the people came to give a lecture at Newcastle on the work that they had done there. This was a group on the history of population, I guess. The sort of thing that they had been doing had been using an IBM 360/65 to try and pull together all the records of a particular parish from before the censuses in order to calculate the, I forget the term now, wait, population statistics for a century earlier than had ever been done. They did some very interesting work, and they tried to tie together all the families, all the families in this village from about six or eight different data sets. One of the things they did was prove what some of these data sets actually were. They managed to establish by linking the data sets together that this unknown dataset had to be just of males who were between 18 and death who were born in the village, or something like that. I found this fascinating. But I was fascinated by their attempts to link people together, and I chased down some of their papers and got a bit suspicious. I went to my colleague who is one of the world experts in computing and statistics. He read the paper and said, "Their technique there involved choosing these parameters, and they have no scientific basis for their choice." Alright? This was when I was starting to get interested in genealogy, I was trying to find out what the rules were. I then went and looked at a number of the most impressive-looking textbooks on genealogy, and I was horrified by what I read. They were all extremely wooly on how you made your decisions as to whether A and B were the same person. Or whether A was the son of B, and so on. At the time, there was only one newsgroup or mailing list on genealogy in existence, I

think called soc.roots. So, I wrote a little two or three-page memo, I think it was entitled "On genealogical proof," essentially complaining about the subject and saying, "How should we do this?" I found myself with a set of instant friends, eager to talk about this. And a larger number of enemies who wanted us off this mailing list. We went off, we took ourselves off and formed another mailing list to discuss just that. All of this I found intriguing and really interesting from the point of view of computing. There was a real growth of applications area, so I had a whole sequence of students who did various projects like this. That also got me interested in history and how to do history properly because genealogy, as far as I'm concerned, is a branch of history. There's a lovely set of books from the Open University. There's a set of four books, they must've been published about the year 2000. One on community history, one on family history, one on social history, and I forget the fourth one is. They're really good textbooks. Well, this is later than my book, but certainly gave me very strong views about history and doing history properly. I'm sorry, another analogy. I'd done my book. I was visiting on a sabbatical at Toronto, I have put this in a paper somewhere. And at Toronto, Kenneth May, I had used his book, he was Director of their Institute for the History and Philosophy of Science, I think.

Aspray: Yes.

Randell: He invited me to go along there and give a talk. With some misgivings, I agreed to go along there. In talking beforehand, he picked up the fact I was nervous and why I was nervous, and he made this comment that I have treasured ever since when he said, "Brian, there is as much bad history of science written by historians who don't understand science as by scientists who don't understand history."

Aspray: So, I should let you know that I spent a year studying with Ken May at Toronto.

Randell: Yeah. Right. He was a great guy. It was a wonderful book.

Aspray: Right.

Randell: That was quite some institute, as some are. I hope it is still flourishing after his death.

Aspray: It is. It's one of the leading centers in Canada for the study of the History of Science. Couple of other questions for you. You had done your undergraduate degrees in maths…

Randell: Yup!

Aspray: Did you get to know some of the British historians of mathematics, it was a pretty active group: Ivor Grattan-Guinness, little bit later Jeremy Gray, some other people as well.

Randell: I think I corresponded in Ivor Grattan-Guinness, that was the only name of those that I remember. But no, I didn't. I didn't find much in the way of help from academic historians or historians of science. I didn't find them. I went looking. At Newcastle, I found that there had been somebody in mechanical engineering who'd done quite a bit of work on the history, some history of mechanical engineering. But he'd retired and departed I guess just before I started looking for him. There really wasn't anybody in our department of history, for example. I'm sure now that there were people that I corresponded with, but I certainly didn't find myself collaborating that I could remember at all with any historians of mathematics.

Aspray: There were longstanding programs both at Oxford and Cambridge in the history of science, and Manchester also had a fairly strong program. Another question—

Randell: I went looking into the history of science, and in general, when I was looking at it, right, just about all the historians of science were looking at much earlier science then, for example, than anything post-war.

Aspray: Yes. It wasn't until the '80s and 90s that you saw a lot of work on the post-war era. Did you ever write about the history of software or software engineering independent of all these things that we've been talking about?

Randell: Yes, but reactively, I guess. There was a Dagstuhl conference organized by several people, including Jim Horning, on the history of software engineering, and I was invited along to that and I produced something for that. I joked there and since that I thought I'd been invited as a historian, but I felt I was being treated like a historical artifact.

Aspray: So, I was one of the coordinators for that workshop.

Randell: Ok, right. Ok. Sorry. I forgot that.

Aspray: That's fine. Reihhard Keil-Slawik was the principal person.

Randell: I am right that Jim Horning was one of organizers?

Aspray: Jim was there. He wasn't an organizer, but he was there.

Randell: Ok, because Jim was somebody who I'd worked with while I was at IBM. I got him as a summer student. He was still doing his PhD at Stanford and we've stayed close ever since. Well, stayed. Wrong – past tense, unfortunately.

Aspray: Right. What topics haven't we talked about that we should?

Randell: There was something I thought about a moment or so ago and now for the moment it's escaped my mind. I've very much enjoyed my time and occasional, typically annual, visits to the Boston area concerning the Computer History Museum. So, I guess that fits into my history of computing. I found that I was being described as the Chairman of their Collections Committee or whatever, but I never actually met a Committee. I think I was their only Trustee who wasn't a millionaire or billionaire. So, I had some interesting times there.

Aspray: Do you want to say anything—

Randell: This is hard—yes these are just lovely incidents. One of the incidents harks back to - telling the story in the wrong order, I ended up donating a Curta calculator to them, essentially to Gordon [Bell], [and] being very surprised when a couple months later he donated back to me an arithmometer from a very posh London antique dealer, a 1909 Layton Arithmometer. As far as I was concerned, I had given him a gift. The notion I would get anything back was but on one or two of my trips there, I would come away with something really quite interesting. On one of them, they gave me a Comptometer, which was a real challenge to my luggage allowance. The interesting thing, how did I have a Curta. Newcastle, for many years, over thirty years, ran an international seminar which lasted most of a week, notionally on the teaching of computing science. That seminar got together a worldwide set of speakers [of our] choice, half a dozen speakers, and had an audience which was European faculty, a lot of them quite senior. At one of those seminars, the opening evening was again at our house, and so there were 20, 30, 40 people there. One of them was Bill van der Poel, and he wandered off into our sitting room library and came back saying, "You've got a Curta!" There was a Curta on the bookshelf there. I said yes. I had explained that [it] had been my late father-in law's Curta, he'd been a research scientist when he'd had that. So that was a family memento. And Bill said, "I've been searching for a Curta for years." He went on about that and he said, "I'd even swap my Enigma for that Curta." This was back probably in about '72. Enigmas were starting to get a bit known. They certainly weren't famous. And so, I said, "Your what?!" He said, "My Enigma." We shook hands on a deal that I had three months to find him a Curta because I wasn't willing to let father-in-law's go. We'd swap his Enigma for a Curta. So, I started searching; and I'm sure I went through all of his routes and further, getting nowhere until I happened to mention it at a meeting at the university to the guy who ran the little computer installation in the Department of Psychology. And he said, "Ah! We got a drawer full of about a dozen. How many would you like?" I ended up swapping one copy of my book for three Curtas.

Aspray: Geez.

Randell: Then I gave one, essentially to the department. One, obviously to Bill van der Poel to get the Enigma, and one to Gordon Bell. That is one of the most fantastic deals I've ever done in my life. A few years ago, our youngest son, who's in the finance world, said to me, "Dad you're going to have to start thinking about putting the house on the Enigma insurance, rather than the Enigma on the house insurance, the way things are going."

Aspray: Right.

Randell: That Enigma, which is a complete and operational one, with all its wheels, in wonderful condition, recently reconditioned at the National Museum by one of the guys there, is now on indefinite loan at the Discovery Museum in Newcastle. So, they've displayed it wonderfully, and more importantly, they're paying its insurance. Even more important than that, it wasn't so much the cost of the insurance but the rules that they were going to put on our house if it was going to stay there. So, that's completely off the subject. But it's to do with that museum.

Aspray: I'll tell you a story that's also a little off-subject. When I was working as the Executive Director of the Computer Research Association, the chairman of the board was Ed Lazowska, from the University of Washington. I don't know if you know Ed or not.

Randell: I know Ed, yeah. Ed was in Toronto when I was there, if I remember rightly.

Aspray: Ah, yes.

Randell: I think, yeah.

Aspray: Ed had done wonderful things for CRA, and so when his term was up, we got him a Curta as a present. They weren't so hard to find by that time, but this was much later. Anyways…

Randell: When the internet became available—

Aspray: Yes.

Randell: —the internet had dramatic effects on findability – and cost.

Aspray: I have one other question that comes to mind. I understand that you were on the original editorial board for Annals of History of Computing.

Randell: That's right. Yeah.

Aspray: Do you have stories to tell me about its founding, or its early decisions or interactions, whatever?

Randell: Bernie Galler was editor in chief, if I remember.

Aspray: I can't remember…JAN Lee or Bernie. I can't remember which was first.

Randell: Then it was Bernie. Ok. Bernie, I knew quite well. He had a year's sabbatical in Newcastle. And Newcastle and Michigan were very closely linked together in all senses. For many years our main university computing service ran the [Michigan] Terminal System, so I knew and got on with Bernie exceedingly well. I'm trying to remember any stories …embarrassingly I don't think I can at the moment. I do think that in the early days that there wasn't the, as far as I was concerned, rather big surge towards sociological history of computing. I'm sure that didn't happen under Bernie's regimes, so to speak. I think through lack of memory, my assumption was it all ran rather smoothly, that it was an editorial process that one sought and managed to find papers, and one had a good referring process and the like. I had been a CACM editor for a number of years previously, and I guess that was my main editorial experience. Embarrassingly, [I can't recall much, but I still have my files] and I would find it interesting and embarrassing to read those up. However, I cannot get into those archives now, not during Coronavirus, except that next week, I am due to get the vaccine.

Aspray: Oh, good! I'm glad to hear that. Anything else that we should talk about today?

Randell: There's a story I've got to tell against myself. This is that in the very early days of my putting together, the book. I was talking to my wife about it, explaining something about the history of computing. I should explain that she was a French teacher. She, in fact, did a PhD in French linguistics only a few years ago, as one might say as an extremely mature student! She suddenly realized in the way I was talking that I regarded Pascal as somebody whose main claim to fame was the way he had designed a calculator. Right? And that was one of the—I think that was one of the things that warned me [about] naïve internalist history without me knowing the term. I was very aware when I was doing my book that I was not a trained historian and that I had to, essentially, remember that and be careful about what I wrote and how I wrote it. Also, be very aware that I was in danger of missing out important things which should've been said, do you see what I mean? So hopefully I did that adequately. But I do know that in the helping with the writing up of the Ludgate work now, I've been with co-authors who have been able to flesh out what we'd been writing about Ludgate with what else was happening in Ireland at the same time. He was doing his work right in the middle of the geographically and historically, in the middle of various, very dramatic events and so on.

Aspray: Right. You know one person comes to mind; did you get to know I. Bernard Cohen?

Randell: Oh, that's another anecdote I can tell you. Oh, I have to tell you that anecdote! Sorry, I have to watch the time too. I can't remember how I initially got to know him, but at some stage he wrote to me and said that they had just found the photographic plates of the book *A Computer Perspective*. They had been lost. They had been found when the second of Charles and Ray Eames died. So, they were both gone. I hadn't realized that they were man and wife, Charles and Ray. The plates had been found—was the whole reason why the book had never been reprinted. It would've been far too expensive without having those plates. He said, "So, now we can reprint it—but we do need to bring it up to date, because this was about 20 years on. We have to keep to the same number of pages, same pagination, but I am going to redo the three pages of introduction." The final few pages, they weren't done by the Eames,

they were done by the IBM sales department. They just did a sort of telegraphic-type history of computing beyond the era covered by the main book, concentrating entirely on IBM's work. And he said, "I've always been embarrassed by that. Would you be prepared to rewrite the history of computing" from I guess, probably it was 1960 or 1970 to 1990? So, we're talking about the exponential growth of happenings, and I was being asked to cover twice the length in years that had been covered, ok? And I had to do it in the same number of pages. He said, "I've read a number of things that you've written, and you'd be great to do that." I wrote back and said, "I don't know what you're referring to, but I have not written anything about the post-1950s history." And things went quiet for a bit, and a few weeks later he wrote back and said, "It must have been a lecture I heard you give." I wrote back and said, "I have never given a lecture on the history of post-1950s computing." But by this time, I was getting intrigued by the challenge, and I think I talked to Jim Horning and others about it, and I decided to take it on. I wrote to fit into four pages. Essentially four sections, I think were the 1950s, the 1960s, 1970s, no. Perhaps it's the 60s, 70s, 80s and 90s and the future. Something like that. And incredibly tightly written. I had sent it off and Bernie was happy with what I'd written. A few months later, I was in the States and he had invited me to dinner in Boston at Legal Seafood. Halfway through the meal he said, "Oh, I found out about the business of the paper I'd said you'd written. It wasn't you; it was Maurice Wilkes." A few months or perhaps a year or so later, I met Maurice Wilkes and I started to tell him the story. I got to the point of Bernard speaking of a paper I'd written, and Maurice interrupted, and said in what I would say was his typical rather waspish style, "Oh, yes, Brian, you wrote quite a few papers like that didn't you?" And I said, "Maurice, I think you better let me finish the story!" We were with some other people, and his face, when I got to the point of telling him of my learning that the paper Bernard had been thinking of and had found had been by him was quite something. Sorry. I didn't tell that one very well, but it is one of my favorite memories of the world of history.

Aspray: Is there anything else we should talk about in the last minute or two or should we just call it a day?

Randell: The one thing I'd like to add is that though I've never given much in the way of lectures on the history of computing, there was a time when I was giving an annual lecture to undergraduates, a single lecture on the history of computing. And I felt then a need to justify it. So, I would have a starting slide that said why am I doing this, so to speak, and I said, One, it's interesting. Two, for a subject that is as important as this, it really is worth knowing where it came from and to be able, in some sense, to give praise to the people to whom we owe this subject. Three, it's good in pub quizzes. But more importantly, this subject is moving so fast that the only way you've got any chance of understanding what might happen and what could happen in the future, is understanding that what you're learning about in the present needs to be against a perspective of how the present got to be the present. As far as I'm concerned, that's more than enough reason for computer history to be regarded as an important subject as well as an interesting one.

Aspray: Absolutely. Ok. That's a fitting way to conclude, I think. It's been a delight to spend this time with you and we'll be back in touch with a transcript of this interview

Randell: Right. Lovely seeing you, Bill. The greeting I'm afraid I still have to use these days is "stay safe".

Aspray: Yes, you too!