Interview with Josef Kates [K:]- June 9, 1992,
in his home in Toronto
Interviewer was Michael R. Williams [M:]

(after some chitchat about the publishing record of the interviewer, the interview begins)

M: Just for the record it is the evening of June 9 and I am talking to Josef Kates. What I would like you to do is just talk in anyway you feel comfortable and I will ask questions. First of all, Josef is spelt JOSEF correct?
K: That is right.
M: Do you have a middle initial?
K: No.
M: Could you tell me a little bit about your life, your young life, where you were educated, and things like that.
K: Well, I was born in Austria. I went to high school in Austria until 1938, by which time I was 16, closing up onto 17. I am Jewish, so in 1938 when the Nazis came into Austria, I went to a Technical High School - actually one of the foremost Technical High Schools in Vienna. After the Nazis walked in, and I tried to go back to school, it was impossible. I was put together with other Jewish boys in the back of the class. I was treated like a 6th class citizen and so I left Austria a few weeks later. I travelled through Italy and Switzerland, and finally ended up in England. In England I worked as an optical apprentice in a factory making glasses. The War started. I actually volunteered during the War but I was a funny kind of an alien - they were not sure if we were refugees or enemy aliens. In 1940, when the lowlands were invaded, there were lots of 5th columns and the British got frightened. So all of a sudden they interned a lot of refugees like myself. They made an agreement with Canada and Australia at that time to take prisoners of war off their hands. They were overloaded with all these refugees at that time and it was hard for them to ship food to England. I don't think they had as many prisoners of war as Canada and Australia were willing to take, so they said lets get rid of these refugees and shipped us over.

In Canada I was in an interment camp for two years. It was a very slow process and it took the Canadian authorities about two years to discover that we weren't very dangerous and that we were more antinazi than anybody else. I came out in 1942, in fact I was being sponsored to go to University but since I had some optical background there were some positions open at Imperial Optical here for some optical technicians. Thus I started as an optical technician working on war optics from 1942 to 1944.

In 1944 I managed to go back to University. I took maths and physics at the University of Toronto for four years (to 1948). All that time I also had a full time job at Rogers Majestic (now Phillips) working on war electronics peace came in 1945. I then worked on radio tube manufacture. In those days they still had tubes. In 1948, when I graduated, the University had just initiated setting up the first university computing centre. There were two professors there (Griffiths in Statistics and V.G. Smith in Electrical Engineering) who had gotten together and wanted to start a computing centre. Kelly Gotlieb was already there and was working with card processing machines and they also put together a Meccano contraption. I don't know how it came about, but somehow they got in touch with me -- probably while I was still going to classes because Griffiths was one of my professors. I had, of course, the ideal qualifications - I was both

an electrical engineer and a math and physics graduate. This whole computing thing was quite exciting, so I got a job at the University. It didn't pay me much, but together with one other gentleman - I don't know if you will be seeing him or not..
M: Is this Alf Ratz?
K: Will you be seeing him?
M: Well I hope so, but I can't find him.
K: Well you should call Bill Ratz - There is a whole Ratz family from Hamilton - you might check the University of Waterloo, I think they know about him-that's the computing people there. Bill is his cousin or something. The last thing I heard of him was that he was down in the States but that was many many years ago.

Essentially Alf Ratz and I, particularly under V.G. Smith, set about to - we were sort of the technical side of the computing centre and Kelly Gotlieb, Harvy Gellman, Tommy Hull (perhaps a mistake for Pat Hume??) and so on were the software computing side - the first thing we did was to set about to build - in those days the only organizations that built computers were universities, nobody thought that industry would ever build a computer - we set out to build what we called a pilot model it was called the UTEC for University of Toronto Electronic Computer. It was, by today's standard, a ridiculously small machine. It was a parallel machine having a 12 bit word, 512 words of CRT storage, arithmetic unit made up of tubes, it had only 8 instructions because 3 of the bits were instructions (add, subtract, branch and things like that).
M: You are answering all of my questions beautifully.
K: Maybe you want to ask questions?
M: No, you just keep going and I am ticking off my questions as you answer them.
K: That started about 1948. During that time also, because there were very few computing people around, more and more I was asked to do consulting work for this and that outfit. Ferranti were starting to build computers in Canada (this was an offspring of Ferranti in England).
M: What date was this?
K: I was in the University in the Computing Centre, officially I was there from 1948 to 1955, in fact by 54 I really left. I started more and more consulting by 1950-51 onwards. I did a bit of consulting for Princeton, Institute for Advanced Studies, who were also developing a computer by this famous Hungarian...
M: von Neumann!
K: Yes, he wrote some of the first book on computing. One of the people who worked with us, Richardson, who went to Los Alamos, he asked me to come down as a consultant several times - in fact he tried to get me to go and get a job there with their computing people.
M: What was his name again?
K: Ah, Richardson...what was his first name? You will have to ask Kelly. I don't think he was a graduate even, he was more of a technician, but he was really bright and could make it work.
M: He was at U of T and left to go to Los Alamos?
K: No he was with us in the Computing Centre, he was not really with U of T. You see we had several engineers and technicians. He got a job there helping them build the computer. Von Neumann was there. I met him down there again because he was one of the prominent people - in Los Alamos any scientist with any name was a consultant to them.

From 1948 to essentially 51 or 52, I can't be quite precise, we were building that UTEC computer. It worked. The mean free path between errors, I would say we were lucky if that was

15 minutes. The only thing we programmed it for was games - with a 512 word memory that was all we could do. We did develop a few routines: a multiply and divide routine (the arithmetic unit could only add and subtract).
M: With a 12 bit word length you really couldn't do much.
K: You couldn't really do very much. I remember I programmed it to play NIM and things like this.
M: That was quite early then.
K: Oh yea. In fact it was interesting during that time. While we were working it was still vacuum tube technology. The reason the computer was so unreliable (and similar computers that used similar technology like the IBM 701) was that the CRTs were high impedance devices. In our lab we had a shielded cage in which we did a lot of the work - especially when were developed the storage unit - because they were so sensitive that when you came in and switched the light on and off you destroyed the storage. So these high impedance devises were not very suitable. We were starting to play around with magnetic drums. We were looking into, but we didn't do any work on, mercury tubes. There were various other devices, for example we had a guy with us, Bob Johnson, who though he could develop another kind of printer - very ingenious - I think he had two rolls...I forget quite how it worked. We were sort of an idea group. We were quite small. The two top people were Alf Ratz and myself. Essentially I and Len Casciato worked mainly on the cathode ray tube part of the system, which was really the very sensitive part of the system. Alf Ratz, together with Herald ... something... was working on the arithmetic and logical part of the system. The system was sitting essentially on 12 racks, one for each bit. Below the CRT you had the control unit and below that you had the arithmetic unit.
M: I have seen a picture of the system, and it is nice to know what I was looking at.
K: I still have it on a video - someone dug it out and put it on a video tape to show the history of our company a little bit.
M: Just before we go on, I remember coming across something in the University of Toronto Archives. Very early on, back about 1948, V.G. Smith had proposed the use of some gas discharge tubes - it must have been a neon tube of some kind.
K: Yes, I recall that.
M: Did you ever work on that?
K: Yea, I think we took some gas discharge diodes and I think V.G. had some graduate students apart from us - I seem to remember seeing them in our lab. We had a big lab, right in the corner of the Mining building on the corner of the first floor. I think the reason for that was there happened to be some big space there. I don't think I personally worked with those gas discharge tubes. Essentially those diodes had a binary - you know two states, and off state and an on state. The on state had a strong light and the off state had a light luminescence which could be triggered.
M: You could trigger them with different pulses.
K: Yes, I recall that. I thought I was playing with it myself at one time. It is possible that we played with it before we went to CRTs. I don't recall it too well.
M: It wasn't a major project?
K: NO. When we first started in 48, when I was hired, at first we essentially - Williams (incorrectly called Williamson) had come over from England - he had started the first CRT with Ferranti. He explained it to use and we essentially followed in his footsteps. We also had visits from Cambridge where they were working on the ACE computer.

M: EDSAC in Cambridge, ACE in the National Physical Laboratory!
K: What storage was EDSAC using?
M: Mercury delay lines.
K: They come over and we reviewed the various storage technologies. I suspect that VG started playing with the little neon things a bit before then. We went through a sort of formal evaluation phase of the various technologies some where around the summer of 48. Somewhere around 48 or 49 we decided that we were going to go for CRTs. In fact it took a little while to form a unit. I think we got some support from NRC and Atomic Energy of Canada before we could formally start on this pilot project.
M: So that (the neon) was probably abandoned when you found out about the Williams tube.
K: I suspect so, but frankly maybe some of the other people... I do recall it, but I believe it predated the Williams tube.
M: You yourself worked on the CRT memory, in fact you did your own PhD on it.
K: That's right.
M: I actually got a copy of it. I didn't read it from cover to cover, but I did have a look. In that you keep calling it a 'space charge' memory system. Just for my own interest, where did the name 'space charge' come from?
K: Well, what happens is, the way the Williams tube works is, if you put the CRT beam on a little spot you actually discharge the spot. If you then move it sideways you can essentially form an extended charge or a spot charge. That's when you are writing. When you are writing you put on a fairly heavy beam. When you are reading you run a light beam on it and if you have a screen on the font of the tube you get either a short pulse or a lengthy pulse, depending on reading a 1 or a 0. A one would be a long charge and a 0 would be a short charge. There was a lot of heated arguments as to what was exactly the electrostatic process that was going on in the tube. My feeling is that I don't know if that was ever resolved. There was a meeting about 1951, I think it was the first meeting of the American computing society in Atlantic city. At that meeting I think there was just about everybody that was in computing in North America. There were 100-159 people there. At that meeting different people presented their theory. I presented my thesis. Up to this day I am not quite sure if I am right or wrong. By the late fifties it didn't matter. I think the IBM machine was the last to use that storage. Much more reliable media took over.
M: It is funny because when I was talking to Kelly he said "You know to this day I don't know whether Kates was right or not about this theory.
K: I don't think anybody ever went to the trouble of finding out. The problem is that our research was really applied research - trying to build a machine that worked. Trying to theorize about the phenomena we didn't have the time for. If you tried to set it up as a proper physical experiment you would probably build a tube with probes to measure the electrostatic charge in various places, but there was no scope in our project for that. Essentially one of my fringe benefits was to be able to get a PhD while I had a job in the Computing Centre.
M: Your job was essentially to build the thing.
K: To build the thing and really emulate it, we can't claim to have really originated anything. What we did was to make improvements - Williams worked with very large tubes which were very sensitive. In fact the FERUT used 5 or 6 inch tubes, we used much smaller 2-3 inch tubes.
M: I didn't realize they were that small.
K: Oh yes. I think they were 3 inch tubes. They were much easier to manage. I shouldn't use the word reliable, because nothing in those days was reliable compared to today. It made the whole

thing much more compact.
M: What were the major problems in getting an electrostatic memory like that to work?
K: The biggest problem was that the system had to be extremely heavily shielded. Each tube was encased in a shielded box. You had to be sure you had all your grounds. The whole thing was extremely sensitive to any kind of interference despite all of that. I literally would sometimes work three days and two nights in a row, without any sleep, to get things to work long enough that you could demonstrate anything reasonable with it. It was inherently a very unreliable technology.
M: As it progressed, over the couple of years that you worked on it, did it get more reliable--you said the mean time between failure was something like 15 minutes?
K: Probably, but when you say more reliable, it was just that the mean free time between errors progressed from maybe a few minutes to 2-3 hours. I can remember that if the machine was going for a morning without crashing, then that was pretty good.
M: The main problem was the memory sensitivity, the rest of the circuits were pretty good?
K: The arithmetic unit essentially used ordinary vacuum tubes in flip flop circuits and those were quite reliable.

There were a few parallel things I did at that time. As I say, Alf Ratz was working on the arithmetic unit and the control unit -- we all collaborated on certain assignments - compared to today the design was extremely primitive, a very simple control unit and a very simple arithmetic unit. What struck me was the huge size - each rack (we had twelve standard racks) contained essentially everything for one bit - twelve racks because it was a parallel machine. The adding circuit he developed, I forget, I think it used 12 vacuum tubes, just to add 1 and 1 and carry 1. I thought there must be a better way and during that time I invented what was called an Additron. The reason for that was, as you recall, I was working as a radio engineer in a radio plant, so I decided on this Additron. I went back to my former boss at Phillips and said would you build that for me. The Additron really sort of simulated the addition and that one tube would really do what those twelve tubes did all together.
M: It was essentially a half adder of some kind was it?
K: Yes, it would add two bits and produce a carry. It had two outputs, one for the sum and one for the carry. It had three inputs, two the two bits and one for the carry coming in.
M: Looking through the archives, I saw some letters from you to various people in which you said that you also hoped to devise other specialized tubes like this for subtraction and such. In fact there was one in which you could have an input which would indicate whether it was add or subtract etc. Did these ever get developed at all?
K: No you see what happened is that in the dying stages of UTEC, the semiconductor technology started to emerge. In the last year, or maybe two, we started playing with germanium diodes. It became evident to me (no body had though of large scale integrated circuits yet) but it was evident to me when I saw these little circuits that even if we use 8 diodes to make up an adder they could still go inside one vacuum tube.
M: So that is why they never go used for UTEC?
K: I was hoping to use them for UTEC but we never got them that far. We did use them in one machine, I don't know if you have ever heard about Bertie the Brain?
M: Yes, I was going to ask you about that too.
K: What happened is that I was typical young and enthusiastic man and I was thinking this world could go computers and I had big dreams. My biggest dreams are now dwarfed by reality

by hundreds of magnitudes. I remember once giving a lecture around 1951 to a fairly large group - I wasn't on the academic staff so I only gave the occasional lecture, and I think I ventured to say that within the next decade every large university would likely have a computer. You have no idea the stares I got. The thinking was that there may be one or two in Canada that would have computers.
M: In that decade they all had one or more machine.
K: So anyway I approached Ten Van Dyke (he is long since gone from cancer) he was a really European work-master. He was really interested and he used to come down to the University and kept in touch. So he built me a few of those tubes. I think that was around late 1950. He had a marketing nose too, he says "Joe, how are we going to publicize that." Well the Canadian National Exhibition was going to come up in 1951 and I said "Lets build a game playing machine for the Exhibition". So we built one, and used the Additron, to publicize the Additron. So we worked furiously, during the summer because we had only a few months, we built Bertie the Brain to play Tic-Tac-Toe. It was a reasonably smart machine because it had quite a number of intelligence levels. At the highest level of intelligence you could not beat the machine and if you made a mistake the machine was sure to beat you. At lower levels of intelligence it might not be able to beat you and you might be able to beat it. That machine attracted huge crowds around it all the time. I was quite surprised. Nobody cared about the Additron they all cared about the electronic brain. It had a big Tic-Tac-Toe board on top for everybody to see and a small board on which you played. I think it had red crosses and white noughts.
M: This was done by lights behind it or something?
K: Yes. So that people could see what was going on. That machine was quite reliable. It was working at the CNE for about 12 hours per day.
M: Was it entirely electronic or was there a lot of relays and things?
K: Well the only things that the relays did was for the lights, otherwise it was completely electronic. The logic for tic-tac-toe is a fairly simple logic. We knew enough about logic that we could design the machine - I have a feeling that I designed the machine in half an hour.
M: You designed it?
K: Yea.
M: And Rogers built it?
K: Well, we built it at Rogers, and Rogers gave us some help. Herald Stein is the guy- I believe he helped me with it. I believe most of the work was done by Harry Stein and myself. We were working up at Rogers in Leeside, well it was Phillips actually by that time.

On the last day that year, Danny Kay attended the CNE and I think to publicize it Phillips arranged to drag him over after his last show. HE came over with a huge crowd behind him. I explained it to him and, of course, he was kibitzing around. I explained to him it was also an intelligence test. At its fullest intelligence you can't beat it but we can reduce the intelligence. So he took an interest but he got kind of mad at the machine. I said "OK I have taken it down to level 6 now, you should be able to beat it now". But he wasn't able to beat it, so I took it down some more. I wish I had some pictures of that episode. My wife was there and everybody around Danny Kay, he was quite famous already by that time around 1951. That was sort of a side excursion - after other machines could paly tic-tac-toe and when the bigger machines came out they started playing checkers and chess.
(interruption by the door bell)
K: Where were we, Bertie the Brain still?

M: That must have been one of the very first electronic game playing machines.
K: I believe it was. I some at some exhibition a year later or so, I think somewhere in the States, I am not sure if that was a relay machine or an electronic machine - there were relay machines around already, but the difference was that they were usually hardwired and had not flexibility whereas this machine, even in the short time, we thought lets demonstrate that you can have various intelligence levels. Actually now I am amazed that we managed to put it together so quickly. The machine was quite reliable, it ran the whole CNE, it was a big attraction at the CNE, and from what I remember we didn't have to fix it very much. It kept going and it used the Additrons quite effectively. Actually that was the only application of the Additrons, because we never used it in UTEC.
M: Exactly how did the Additron work, what was the internal construction of the tube?
K: I will have to remember, but essentially we had three plates on which we have the three inputs of the incoming digits and, depending on which of the three were actuated, an electron beam would be directed to and output plate. From what I remember, and I would have to reconstruct it in my memory, the idea was that we had three equally spaced plates, we had a cathode and if you had 1's on all three of them we would get the beam to excite the receiver that would give us the 1 state [he really means the 0 state] and well as the one that would give us the 1 carry. The if only two of the three plates were excited by ones then we would want to have a 0 and a carry, if only one was excited we would want to have a 1 but no carry. It was deflecting an electron bean onto two outputs with three inputs. I still have the brochure in a scrap book - it advertised it but I don't think it showed the design.
M: Did you ever take a patent on it?
K: Yes, I believe I got a patent on it. It will be described in the patent.
M: Do you recall what gave you the idea for it?
K: Well I think I was stimulated when I saw this -- in fact I gave a talk in New York at one of the computing meetings and I was quite amazed when I came back a fellow from the Globe and Mail phoned me and the next day Alf Ratz and I was on the front page of the Globe and Mail.
M: It must be one of the only times in history when a technological thing like that appeared on the front page of the Globe and Mail.
K: Afl Ratz is shown with a big bread board showing his adding thing and I am holding a little Additron in my tow fingers.
M: What date was this when you first developed this?
K: It must have been around 1950-51 because we showed Bertie the Brain at the CNE, and I am pretty sure that that was 51. Probably in the fall of 50 I approached Van Dyke to build it - he build around a dozen of those tubes. Actually it is really hard when you only build such a small number because you have to do everything by hand, all the components and so on, but it worked.
M: Speaking of just a few of them: again by looking in the Archives I found some letters--there was a couple of letters between you and Forrester at MIT because he was interested in Additrons.
K: You are ahead of me!
M: And there was a thing from Tom Kilburn at Manchester. He wrote to you asking about them. Forrester...you wanted to get a hold of one of Forrester's electrostatic storage tubes that he use don Whirlwind. He actually proposed that he would trade you the storage tube for 20 Additrons.
K: Is that right?
M: I wondered, when I read that letter, if he ever got them.

K: No we never built that many. I don't know how many we used in Bertie the Brain, but I doubt that we build more than a dozen.
M: A few months later there was another letter from Forrester asking "Where are my tubes?" That made me think that maybe he never got them.
Did you ever get the memory tube from MIT?
K: I don't recall. I kind of doubt it. I was down at Whirlwind and was amazed, it was a monster, a huge machine.
M: And those CRT's they had were very expensive!
K: There was a lot of speculating going on in those days.
M: Let us get back to my first page of questions. Going way back to your University education, when I was talking to Kelly (Gotlieb), he seemed to think "I think there was some problem with you getting into University and Dean Beatty gave you private lessons for a while".
K: No, there was not problem. Someone introduced me to Beatty when I came out of camp, even before I went to University. In fact, when we came out of camp we were under the jurisdiction of the RCMP for a couple of years and we were not allowed to move from job to job. I worked for Imperial Optical (in Toronto). That was my first job in 1942 - I was working in precision optics - we were doing the optics for Naval instruments. At that time I though I was interested in developing an electronic vertometer(sp?) -a device used to measure a lens, how many dioptres it has etc., whether it has a spherical or cylindrical component and so on. It is kind of an awkward instrument, and I felt we could do it electronically by some light beams and photoelectric cells etc. I felt I needed to find some electronic outfit to build it for me, so I approached what was then Rogers - the chief engineer was a German man - Dr. Kole (sp?) was his name and I think he worked with the University of Toronto on electron microscopes. He said that we can't really build what you want, but how would you like a job?
M: What date was this?
K: That was in 1944. I didn't like it at Imperial Optical because I felt it was almost like slave labor. I said "I can't move" and he said "you can, we have much higher grade". In those days you were allowed to move if you went from a job to a more important job. They were working on RADAR, in fact I solved some big problems for them that they couldn't solve quickly just by using some elementary mathematics. (I) was using a theoretical approach while everybody else was working empirically. So I had some very quick successes there.
M: That must have stood you very with them!
K: Oh Yea. I was lucky, we didn't have CO-OP courses in those days. I had a full time job at Rogers (I started with them in Spring 1944) and in Fall 1944 I was anxious to go back to University. At that time Tam van Dyke - Phillips was takeing over Rogers - I said to him that I really wanted to go back to University because I had been out of school for so many years. He said "No Joe, you stay on." So I had a full time job even while I went to University, but it meant that I slept two or three hours a night. (I think what Kelly may be referring to that I wrote the Sr. Matric. while I was still in the Camp, but not all of it. So I wrote grade 13 exams here again. I had applied for a scholarship to help me go through University - I had top grades but there was a bit of a racist professor or registrar or something, so I was diddled out of that scholarship. That would have helped me greatly because as long as I kept up good grades I would have retained it.
M: About those same dates, Kelly has told me that he was discriminated against greatly.
K: Well, Toronto and the whole of Ontario is very racist - there was a lot of places that said "restricted clientele" which was essentially "no Jews allowed". I remember there were lots of

places you couldn't go into. I think what he refers to is that I did get the class of 30 scholarship the first year I was there, that was $100 - big money for me because I was earning $40 per week.

All the four years I had a full time job at Rogers. What I would do is in Summer I would work regular hours and in the Winter I would start at 5:00pm and go on to 3:00am. I nearly killed myself working alone at night with the high voltage equipment. I remember once seeing my hand between tow 20,000 volt power tubes and suddenly realized that the neon light was on - and there was nobody else around. It was my own fault, I had bypassed the safety switch so I wouldn't have to keep running back and forth. I was doing a lot of work all by myself.

M: What sort of things were you doing there?

K: When I started at Rogers we were working on power tubes for RADAR. After the war they moved me into the tube factory up in Leeside (SP?). They didn't have very many engineers, so I was everything, but mostly trouble shooting. For instance, they would have big microwave machines to heat the elements of the tubes and drive out the gasses - you had to adjust these to avoid bad tubes. After the war we had a chemical engineer there who was well connected to one of the liquor families, so as soon as the war was over he went to work for them. So one day van Dyke came to me and says "Joe you are now chief chemical engineer". " I said: "I know nothing about chemistry", and he said "Well, here is the lab, put on a white coat". Besides me, there was really only one other engineer in the tube factory - his name was something like George Eatons. He was from the Old School and the two of us had to solve the problems.

I can't say we solved all the problems, but I was sort of regarded as the bright boy and if there was a problem "go fit it", and there was always more problems - I could have worked 24 hours a day.

So essentially having that tube background, and seeing- you know I realized that computer had to get smaller but I didn't realize how small they would get.

M: Now getting back to developments on UTEC, do you remember where the name UTEC came from?

K: It was a fairly obvious acronym. University of Toronto Electronic Computer - I am not sure who dreamed it up. I assume it was either Alf Ratz or myself, we were basically co-equals.

M: The reason you were there is because you were interested in electronic design, you were not one of these people who were driven to computer, and thus wanted a computer, you were more interested in the design I take it?

K: Hard to say. I recall - I think I know how I got the job - I think I saw and ad. and I went to see either Griffiths or V.G. Smith, and I think I was ideal for them as a graduate of mathematics, and while I was still at Rogers I wrote the examinations of the Association of professional Engineers and in second year University I became a professional Engineer. In those days I didn't get much sleep.

M: How old were you then?

K: I was born in 21 so in 44 I was 23 when I went back to University. I graduated in 48, so I was 27. I got my PhD in 51, so I was 30.

M: The University of Toronto Archives show that you visited Princeton just after you were taken on.

K: Actually they asked us to come down. I believe they actually paid us to do consulting, but it was sort of an exchange "what are you ding what are we doing". What they were doing and what we were doing was very similar.

M: Was this very early on in the UTEC project?

K: It would have been 1949 or 50. The UTEC project was probably over by 52, I think.
M: I think the Princeton machine was being built and I think Illinois had started up too. Los Alamos was starting about that time. There were all full scale machines, I think about 40 bits. They were all parallel machines, 36 or 40 bits, not 12 bit machines. We also visited Harvard, and saw Aiken. The computing community was very small. I visited the Moore School. I visited Eckert and Mauchly, Everybody knew everybody.
M: Do you recall who went with you on these Princeton Trips? Did Alf Ratz go with you?
K: Yes, as a matter of fact I think - no, no I think I went by myself - when I was there they had a birthday party for Einstein. I remember it was kind of lonely there - I went by myself. Alf went with me to a big computing meeting in Boston when we visited both the Whirlwind and Aiken. On that trip I think Alf Ratz and I drove first to Philadelphia and saw Eckert-Mauchly's company - In fact we were thinking we could make some commercial deals with them. I don't think they had been taken over by Remington Rand yet. From there we went up to Boston, our wives were with us. We attended a big computing meeting in Boston. I remember that trip very well. The Princeton trip was earlier and I think I did it on my own.
M: I can imagine that if someone like Kelly Gotlieb was on a trip like that, one of the last things that would go through his mind would be to think about commercial deals, whereas you were obviously more of an entrepreneur even at that early stage - is that fair?
K: Yes, but it had a reason. I may get my dates mixed up, but I think it may have been around 1952 or thereabouts. The UTEC was supported by Atomic Energy and NRC and we were starting to prepare plans, especially Alf Ratz and myself and a chap who worked with me whose name was Len Casciato. The team had two top people, Alf Ratz and myself. Below that on Alf's side was Hertz Diamond(?) and myself was Len Casciato, we had Bob Johnson (I don't remember quite how he fitted in), Richardson (I can't remember his first name) and other technicians - there were 5 or 6 people. We were very concerned about our future. Because we made plans continue with computers. compared to the effort that went into computer building at other places, ours was a very small effort - we are lucky we got a far as we did. So during those days I started consulting for Air Canada. At that time I thought my career would be with the University, but we were also anxious - the entrepreneur thing came partly from the entrepreneur and partly from security. The Computing Centre was in two sides - the hardware side which was sitting over in the Mining building (later moved to the Physics building for the last year or so) and the computing side which was Kelly ran and they were much more secure.
M:You could see the writing on the wall could you?
K: Yes. I think a lot of the decisions at that time were made by the Vice President of Atomic Energy, Lewis,
(end of tape, a few words lost - check Video if it is important)
K: I was presenting my theory and he was contradicting me - I was a post graduate student.
M: Well was Lewis on your PhD committee?
K: No. But he was the most influential man in deciding where we were going. He had been over to England and I think he was being sold on the Ferranti machine. To be far to him, from his point of view, he was really not interested in research on computers he was interested in a facility that would compute for Atomic Energy Ltd. He supported the U of T because he thought he could get some use out of it.
M: Why didn't he buy it himself, because essentially the money was government money was it not?

K: I think the money for UTEC (Kelly would know more about it) I think came from Atomic Energy and NRC. I understood in equal amounts.
M: Any idea why Lewis would not have just bought the machine himself, why did he involve the U of T?
K: Well, maybe they realized it would require a fair amount of development, software development. Remember that machine came without any software. Most of the software was developed at U of T - Transcode.

I was lucky, when it was clear that we wouldn't get any money for further development of hardware, my end of the computing centre dissolved and everybody left. The only one that stayed behind was myself. It was a good thing for the University because about half my time was spent developing subroutines. I found it very interesting, but FERUT was an extremely unreliable machine and I knew more about it than the technicians they had sent along.
M: You did programming for FERUT?
K: Oh a lot. For 2 years I spent about half my time programming FERUT and about half my time helping the technicians making it run. When it conked out I would switch over - I understood the machine far better than anyone else did, so I was able to trouble shoot and get it going again. I will give you an idea of how unreliable FERUT was - when I started in business, in 1954, we used FERUT as our computer for the first year or so. One of the first jobs I landed was the design of indeterminate bridge structures. I recall there was a Greek Civil Engineer in Toronto (I can't recall how we got together) and he felt he could design a bridge structure much better using advanced mathematical methods. So I wrote the program for him (essentially a solution of simultaneous equations - so it is a matrix inversion problem) and programmed FERUT for it. The program would run something like 6 - 8 hours for one solution.
M: How big were these Matrices, do you remember?
K: They were quite large, but nothing like you would get now.
M: So 40 by 40?
K: Yes something like this. I remember once sitting at FERUT for two days and a night, full time, in order to run out three solutions to make sure I would get two the same.
M: Was it basically memory problems again?
K: Yes most were memory problems. The input was punched tape and the back up was drums - they were pretty reliable. If you ran a very long case, like the University ran it for cancer research - X-ray stuff, and a lot of the calculations would take quite long. The thing you really had to do was to run each computation several times to make sure. The error checking and correction was very week on it and the only safe way to do anything was to repeat it.
M: I have heard a couple of people intimate to me that FERUT had very nice cabinets but that the stuff inside was simply junk - poorly engineered.
K: I would say it was state of the art for those days. This was just extremely unreliable technology in those days. I bet you Whirlwind didn't work any better. That technology was simply totally unsuitable for what you wanted to do.
M: Let us back up to the UTEC again. Was it you that finally made the decision to build a parallel machine? I doubt very much if people like Griffiths of V.G. Smith, who were technically the bosses of the place, would have - they would have relied on someone like yourself.
K: Griff didn't concern himself with us - there were really two separate groups there.
M: Griff was over with Kelly and the boys.
K: Kelly, Gellman, Hume, Worsley, all those guys, were one team; the other team was - actually

the person that took a lot of interest for a year was Professor Bullard who was very well known.
M: He eventually went to the National Physical Laboratory in England.
K: Yes, he is the famous guy with the magnetic anti-mine ring. He was quite a guy. He was a typical British intellectual.
M: Harvey Gellman said essentially the same thing.
K: Yes, he was a big moral booster. On the other side we had V.G. Smith, Alf, and myself and then with us we had on the next echelon Harold Stein, Len Casciato. I think the major directions were between Alf and myself with input via committee meetings, V. G. Smith etc. As I recall there wasn't any controversy about it. Really, to some extent, you could say we were copy cats. The early machines were serial, rather slow. In order to get speed we realized we had to go parallel and that meant we had to duplicate circuits a lot. If you use one circuit and run everything through it it would have been a mismatch because the CRT storage is very fast. I forget what our cycle was but I think it was something like 10 microseconds - it was quite a short cycle. We wanted to get speed, which we did get. I think the decision was made very soon after Williams visited here.
M: Do you think it was mainly you that pushed for the development of that particular kind of machine, or was V. G. Smith into it enough to decide such matters.
K: I think the group, V. G. Smith and myself, were very interested in building a machine. I assume they had hired me for the hardware side of the business. I am not sure when Alf Ratz joined us, but I think it may have been after the decision was made. He was there the whole time I was there, but I think he came in a bit later than I did. I started in the summer of 1948 and I think the decision to build a machine was made by early 1949. For 6 or 9 months we were essentially educating ourselves as to what was going on, the various technologies etc. I believe it was probably early 1949 when Williams visited and outlined his stuff, that was probably the trigger. I don't think anyone went to Manchester to see what he was doing there. To us it seemed a real quantum jump from the other technologies we had looked at. It was a pretty obvious way to go. Our innovation was to go to a smaller tube. We independently designed our circuitry. It was really a prototype development so that you could develop the skills and the know how.
M: You were the one who was mainly responsible for the parallel memory,..
K: Well we had decided on a parallel machine...
M: Right. It was essentially Ratz how did the detailed design of the adder circuits etc. and you did the detailed design of the memory?
K: Yes. The Logic we worked on together. We decided on a minimum machine and we realized that a word was either going to be an instruction or a data, and we realized that we needed three bits for the instruction in order to get any reasonable flexibility (when we worked on it we proved to ourselves that three instructions were sufficient to build any computer, so we could have used only a two bit instruction) so things fell into place. I think Williams had a thousand bits on a tube and we had 512 on our little tubes - perhaps we thought that with 1,000 we couldn't get the reliability or something, I am not sure.
M: As you say UTEC was intended as a pilot model for a much bigger machine, do you recall what word size you had in mind for the large machine?
K: I think we had in mind about 40-48.
M: It never really got designed properly did it.
K: We had plans, but what I can't recall ... we were starting to play around with diodes and we

were starting to investigate magnetic core memories., so I forget whether the plan was for using the same technology or not. In the last year both Alf and I were going on to other technologies. I realized that tubes were out. The early germanium diodes were also temperature sensitive when we were experimenting with them. Len Casciato may recall if we were simply planning to build a bigger UTEC or if we were planning to go a different way. It seems to me that I felt that we really needed two separate branches one to build a computer and one to do technological research, and that the research group should determine the technology before the others began. I think we had plans for the computer but I don't think we had nailed down what technology we wanted to use.

M: Let me ask a question that has nothing to do with UTEC. Just recently there was a letter from someone in the RCAF that indicated there were some German planes shot down during the war and the electronics people found magnetic cores that were used as part of a very high gain amplifier. Some of these were sent to the RCAF and their people tested them, and eventually sent them around to various people interested in computers after the war. Do you recall anything like that?

K: I didn't know anything about these planes being shot down, but I do remember testing cores. They were used by analog amplification before they were used as a digital switch.

M: That would have been after the war?

K: Yes, we were following that research. Being in the radio field I recall hearing that these cores (I don't think I ever saw them) could be used to replace tubes in amplifiers. It was known that this was, or could be, an alternative to vacuum tubes. I don't recall the years, but I do recall the fact.

M: When you were working on UTEC there were evidently some young students hired. I remember hearing the name Jim Mayberry.

K: Yup. There was Mayberry and another guy - I believe he became a software consultant or something.

M: It was Harvey Gellman this morning that told me about Jim Mayberry, but he couldn't remember the name of the other one and I was hoping you would remember it.

K: It was possible they were not on the hardware side.

M: I think they were on the software side because ...

K: We did have one or two very bright students on the hardware side too.

M: Do you remember who they were?

K: It is possible that it was Mayberry and then we moved him over to the software side. I think they were with us for the last summer. They were very bright. Then when our end of the business folded they went over to the software side. I believe one or two of them worked on the hardware side first and we saved their jobs by moving them over. I recall that I was very impressed with one or two of those students.

M: It sounds like you had a lot of bright people.

K: Yes it was because we were at the forefront of development - looking back now we were way under financed, compared to other labs. We didn't have the resources and shutting us down was probably a good decision because I don';t think we could ever have raised the kind of funding that Illinois or any of the other places could. What really opened up my eyes was, probably around 54-55, I went down to Endicott N.Y. to IBM who were building their first 650s. Then I started to realize that IBM had, for each component of that machine, IBM had a team several times the size of our team which had to deal with everything.

M: One more item on UTEC - in the Archives there was some information on Raytheon - ordering a very expensive magnetic tape unit, about $10,000 at the time.
K: That wasn't all that expensive in those days - they were very expensive things in those days.
M: When ever I read anything about UTEC it says that the input-output was via a flexowriter or something. Did you ever get that Raytheon magnetic tape unit to work?
K: It rings a bell. I seem to recall that we felt that this would give us more reliable and faster input-output - the machine was quite fast compared to the speed of the paper tape. I am really not certain - something tells me we did get it to work, but I am not certain. If you hadn't mentioned it, I wouldn't have remembered it. It just rings a bell. I have a feeling that Casciato would remember better than I. He is much more of a detail man than I am. I have a feeling that he keeps stacks of files in his basement.
M: When FERUT actually came, how long did UTEC development go on after that?
K: I think UTEC development stopped before FERUT arrived. It was almost the same time. I think the University acquiring FERUT was a good idea because they wanted a computing facility. I felt it was a lousy idea because I felt that computing technology had a big future and we should keep going. Ontario was quite rich in those days, Canada was quite rich, and both ranges should have been going. We have this inferiority complex that we can't do things in Canada and I was quite sensitive to that. We phased out just as FERUT came in. I remember FERUT being unpacked and I remember helping with that.
M: Feeling disgruntled or let down at the time?
K: I was not very much. Len Casciato and the others were quite upset because they lost their jobs. I was able to switch and I got very interested in software. I enjoyed the software thing and enjoyed the trouble shooting. I was never opposed to the idea of getting FERUT, what I felt was that the premier university in Canada should be into the technology of computing. It was going to grow and be very important. I felt strongly that the University research and development should continue. It perhaps should have gone more into the technology than the construction. I realized when I was down at IBM and so on that the universities were not the place to commercialize computers. I felt that universities were good places to do a lot of development work.
M: Alf Ratz left at about the same time as Len Casciato?
K: Yea, the hardware group pretty much disbanded all at the same time, I believe that was 52, but I may be off by a year. I believe I was working for about two years on the software side.
M: Let's talk about KCS a little bit. This morning Harvey Gellman said he thought you went to work for Watson-Watt in Montreal?
K: It was in Toronto, so did Harvey Gellman! I think it was in late 1953. It was a bit more Len Casciato's doing than mine. Len, after he left our Centre, worked for the meterological service but he wasn't happy there. We first formulated ideas about going into business as a result of working with another Richardson, Lyman Richardson, at Air Canada, then called TCA. Their communications department started to become interested in reservation systems. Lyman Richardson thought that the transaction system would be mark sensed cards. I don't know how we got together, whether Lyman came to Toronto to visit us at the Computing Centre...
M: He was working in Montreal was he?
K: Yes Montreal. He got himself working with Len Casciato and myself (for some reason Afl Ratz and Herald Stein weren't part of that) and I believe Air Canada paid us a bit for consulting work to help him develop a report.

M: That's paid you personally, not the University?
K: Yes, us personally. At first it started as simply a brain storming exercise, later they paid us something. Lyman Richardson was a bright guy but not with a formal education - some type of technician that was working in the Communications Department at Air Canada. By coincidence, during the same time, I remember going to a luncheon which was being addressed by Watson-Watt, the developer of RADAR (but it was later controversial, there are a number of claimants to that). He had come to Canada. He had quite a fight with the British Government for rewards and I think the British Government paid him and a number of other people sizable rewards (for those days). He had come to Canada to set up a small office in Montreal called Adalia. (spelt A-D-A-L-I-A). To me he looked like a big wise man, so I wrote to him in Montreal. I thought he might sponsor us. He said come and see me, so I went to Montreal. I met him. The whole office was himself and he had a "slippery-type" manager with him. I mentioned to him that Air Canada seemed to be interested in a project and he picked up his ears and said "I can help you get the project". I think we got from Air Canada a $30,000 contract, which seemed to me to be an enormous amount of money in those days. So I left the University on a leave of absence - I wasn't that sure about it - set up a small office at 2 Carlton St. Len Casciato came with me. I don't know if Bob Johnson came with us - there was a whole group - the only job we had was to do a planning report for Air Canada. We worked on that for 6 months.
M: This wasn't KCS yet.
K: No, this was Adalia - a branch office. The job didn't go very well, mainly because I wasn't an experienced consultant. I didn't realize in those days that we were far too technical for Air Canada. We would write reams of highly technical reports where what we really needed to do was to explain it in general terms. I remember the president of Air Canada coming to Toronto and we had a presentation to him. I remember riding in the car with him. Looking back now I realize how inexperienced I was - I knew a lot about technology but was totally inexperienced as a high level consultant. What annoyed me is that I got no help at all. I sold the job to Air Canada, I did all the work, I had all the struggles and I got no help at all from Watson-Watt and his guy there. I though they would participate with us. I think this started in the spring of 1954 and by the fall I though we were getting close to finishing and I would go back to the University. I gather Watson-Watt got very angry about that. He went to the head of the Physics department, my boss Dr. Watson, and painted me in the worst possible colours. Watson was ready to fire me. I went to him and gave him my side of the story, and Watson turned right around and told me to forget it all. Watson was worried that they would make a scandal about me.
M: If it is any interest to you, Kelly Gotlieb didn't like Watson-Watt a lot either.
K: Yes, he was a very sneaky type - the sort that would take all the attribute to himself, all the good development work which I am pretty sure was done by other people. He was just taking a ride - I get to know that character pretty well in those days.

So we left and went back to the University but Len Casciato kept egging me on to go into business. Also at the University was a third guy called Joe Shapiro. A very bright guy. Somehow the three of us got together and decided we would go into business and we called it KCS (Kates, Casciato, Shapiro).
M: What did Shapiro do before?
K; He must have been in the software side of the computation centre. Len really only had a hardware background. We were still at the University because we didn't really have any work. So what we did was set up Len in a small office which was sublet from a Tailor who was on 740

Bay Street. A little two room office which housed an accountant - we rented the back office from him - it could hardly hold the three of us. Len was our full time employee, we paid him $300.00 per month, and we paid Joe Shapiro and myself $100.00 per month. We started beating the bushes for work while we were still at the University. I think that was in the fall of 1954 when we actually incorporated - I remember because we had to deal with banks and so on.

The first job we got was for $50.00 (which seemed like an enormous sum) it was designing radio antennas for General Electric - I knew the guy there. We had started the program at the University and he wanted a more sophisticated design, so I got a $50.00 job from him improving that program. The second job I got was from Lazarises(sp?) for the bridge thing where I worked like blazes. I am not sure what Len did all the time, he was not a software man, so he essentially worked as our secretary. He was really a business administrator, but there was nothing much to administrate. Then we started, and we worked like nuts - we must have been effectively paid something like $5.00 per hour if you counted the hours. The bad thing was that we demonstrated to the Ontario Highway Department, who were building a lot of roads and bridges in those days, that you could reduce the cost of a bridge - that only meant that Lazarises(sp?) got less because it was all done on a percentage basis, and our research cost him more. I think that job, if I remember it right, was a $20-$30,000 job - it was huge money for us. We wondered if we could ever make $50,000 in a year, we thought if we could make $50,000 in a year we are really doing well.

Then in short succession we got jobs - a very big thing from British American Oil. Originally they were doing all their statistical calculations with calculating machines - I think they were electrical, but still basic machines. So the first job was to assist them with quality control - that was when I got Joe Shapiro active, because he was a good mathematician - everything was programmed on FERUT for the first year or so. Then we got into much bigger things - linear programming for refinery planning, large scale planning, etc. We had a contract with British American Oil for 10 years - I remember they paid us $30,000 a month - that kind of contract today would pay $300,000 per month. We had a whole group working for them. I also got contract from Metropolitan Toronto, their planning Department to develop methods for transportation planning - also we started on the traffic control area which was very good because we could use Len's skills (communications- hardware man). So gradually we got more a more jobs and we grew very quickly. We stayed down at this little office no more than 6 months. So we moved up to a basement office at 880 Bay Street , just south of Queen's Park. Then we became aware of the 650. I went to Endicott and the guys there didn't know how to program it, I said "give me a manual", and I started programming it while it was still there. So we ordered a 650 and we went into an office behind a big window upstairs - the 650 went into the window. We grew fairly rapidly and had to rent an office across the road. When I look back, now I work hard as hell to sell a job and I realize that then the chickens were flying into our mouth. We were the only computer consulting company around - Gellman started about 6 months later.

M: So you were the first in Canada?

K: Oh yes. I think there was also a difference, we were always much more technically whereas Gellman went much more in the business direction.

M: So you weren't really competing with one another?

K: I don't recall competing with Gellman. He was more like a management consultant dealing with administrative systems. He was quite small at first, and kept it small, where as we were growing. Then we made a real big step and moved to Spadina Road where we at first rented one

floor. We had a chance to become part owner - I wish we had the money because we would have done very well. Eventually we had three floors. Even though we had three floors we had to rent space on Younge Street for our traffic division. We also expanded abroad. We started up in the States. By the time we merged with Pete Marwick in the beginning of 1967 we had 4 offices in the States, our main office was in Toronto where we had two locations, we had a smaller office in Montreal and a very small office in Winnepeg. I was doing work in Brazil and Europe - all over the map. I still travel a great deal, I spend one out of ever three or four weeks in England now on business.
M: These smaller offices, like the 2 man place in Winnepeg, were set up because you had a contract there?
K: Yes, we had a number of contracts and we had a guy that acted as a salesman. It never amounted to very much, but we had a number of government, transportation, contracts. Also a very big thing we did was in Saskatchewan. When the NDP came in around 1957, when Tommy Douglas took over, they were the first to nationalize the hospital service. They ran into trouble very quickly and we became troubleshooters. They set up a system, and they thought they would have only one system, they ended up with 6-7 systems. I looked at the situation and, in order to administer the system, they would have had to hire something like one third of all the nurses because for editing the claims you had to have some medical knowledge. I told them that they only way you can do that is by computer. In those days it would usually take you years to get a computer - if you wanted one you usually had to place your order two years ahead. I had pretty good relations with IBM here - we had the second 650 in Toronto only a few weeks after Manufacturers Life got theirs. IBM also became a competitor of ours - just as soon as we got it running they would say "you don't need that consulting firm, do it yourself". So I told them if they don't computerize that service right away, you are going to be in deep deep trouble. We will make sure we get a computer in time and we will program it for you - during that time the Doctors actually went on strike in Saskatoon, the whole thing was a very heated situation for several months and I was in the middle of it. One day I went to Regina airport and they paged "Dr. Kates", and you should have seen the people were ready to lynch me - I had to say "I am not a medical doctor". Within about 6-9 months we processed the bills faster - the biggest firm in the country was Private Physicians Service Inc in Toronto and they would usually take something like 8 weeks to process their bills and we beat them by four weeks. We set up a two year history for every resident in Saskatchewan on the computer. That was because we wanted to do automatic editing - essentially the whole thing was a huge editing job. We used tape 650s in those days because that was the state of the art machine. Then we did similar things in the Maritimes, we set up hospital and health insurance services, got into education, we got into everything.
M: I recall the Saskatchewan using an FP6000, was that used in that medical project?
K: No. I think that was either SaskTel or Sask Power.

(There is some fussing around at this point with the tape recorder and a break was taken)

(here starts the second tape)

M: The Toronto traffic control system - was that the first that had ever been done that way?
K: Yes. There were several articles written about it. My idea was that computers can do

everything. We had started to work for the Metropolitan Toronto Planning Board on developing methods for estimating traffic flows to help in planning. It was obvious that the operation of an individual traffic signal was a complicated thing and groups of traffic signals were even more complicated - an ideal computer application. Of course now everybody accepts that everything is run by computers, in those days the first thing you had to overcome was a tremendous amount of scepticism - no way computers can do that or they wouldn't be reliable etc. So I got myself introduced to two gentlemen, one is Sam Cass (sp?), who was the retired Metropolitan Traffic Commissioner, and the other was Bob Burton (sp?) who is still around but must be closing in on around 100 years by now. Metro had just started, the year before we started in business, in 1953. Sam Cass had worked for Burton at he City of Toronto and had moved over to become the Traffic Director for Metro. So I told them I though computers could run traffic signals - they looked at me bewildered but I was used to that whenever I said computers could do something. By that time we had the card 650 in our office, it would be about 1956. The only way you could communicate with that machine was to feed punched cards into it - or by hand switches. I borrowed the traffic signals the police used for training their traffic control people (in those days, at rush hour, the police controlled the lights by hand - did a far worse job than if they had just left them alone) and hooked them on to the 650 so that the 650 output would operate the traffic signal. To simulate traffic we used different coloured cards: red cards were southbound, green cards were northbound, blue cards eastbound etc. (with a code punched into each). When operating a traffic signal you are obviously trying to divide the green time according to traffic amounts, so Sam Cass and Bob Burton came into the office one afternoon and we told them to set up any kind of mix they wanted and look at your watch and time the traffic signals. Lo and behold the whole thing worked. If they put in all red cards and no blue cards, they would see a lot of green time on one phase and very little green time on the other side of the signal.

They gave us a $10,000 study to develop a plan for this. We said the next thing to do was a pilot project. We would have been very happy to get $75,000 for a few months. Fred Gardner, who really did a lot for Metro, said "if they can do it for $250,000 they can have it". That's like getting 2.5 million today. We put up a fair sized demonstration on Eglinton Ave. The subway stopped at Eglinton Ave in those days, and there was a lot of congestion at Eglinton and Younge because all the busses terminated there and radiated out. The experiment covered the area from Eglinton and Younge to Eglinton and Ceder - there is three major north-south arteries (Younge Street, Avenue Road, and Bathhurst St.) we went past Bathhurst street and we actually controlled the traffic lights north and south - we had an area-wide control. To pick up the traffic we had radar detectors - Len would know this much better because he was the manager of this project. So we developed traffic control program on our, by that time, tape 650. We were sitting at Spadina road, which is four miles away and we were connected by telephone wires to the detectors and the traffic signals. We built electronics that, if anything happened to the computer control it would revert back to local control - so there was a lot of technology to be developed. We also had to do a lot of traffic studies to prove things. In order to watch it we set up a closed circuit TV camera on the NW corner of Bathhurst and Eglinton - it was a 4 or 5 story building so we could actually see a long way, not all the way to Younge, but you could see to Avenue Road. That went very well. That was financed for about 1.5 years if I remember right - about 1959 to 1961 I believe - it was a 15 month project. At the end of it we wrote a report. I think the most important thing that happened was not that we proved something but that nothing went wrong. The system was, of course, fail safe - if anything at all went wrong the system would just drop

control right back to the local controller.

Based on our report we recommended that Metro put in a full scale system, which was actually put in in 1963. Metro is now involved in a second generation system and I am involved with it again.

M: How big a system was the 1963 one?

K: Well it was progressing. Initially it covered the downtown area but it was planned to cover all of Metro. At the moment Metro is about 1600 signal light controlled intersections and I suspect in those days it would have been about half, about 800. We started in the downtown and gradually expanded it.

M: What sort of machine did you use to control it?

K: The machine was a UNIVAC I - it was actually two machines a UNIVAC I which did the main planning and the very heavy communications (in those days 8 wires to each signal, now down to four) used another. Len will know it better than me but I think you actually sent instructions and interrogated each signal 32 times per second. You were constantly monitoring the signals to make sure that once you gave it an instruction it actually obeyed it.

M: When they went to the next biggest system what sort of controller machine did they use?

K: Actually the system has only gone through two changes. At the moment it is using a dispersed system called concurrent minicomputers. Within a month we are probably starting on a program to replace that with PCs. There is individual cells, each of which controls 32 traffic signals.

That was a very interesting project and definitely the very first one in the world. In fact there are very few area-wide systems. The British have developed one called SCOOT now which is starting to become popular. In the United States they have never really developed a centralized area-wide system. The systems just run groups of traffic signals. To some extent there is a good reason, most the U.S. cities are grid cities with a relatively small mesh compared to ours - ours is a 1.25 mile mesh for the old concession roads. Under those conditions you can produce ideal progressions in all directions with relatively simple equipment. It is only when you get the complex streets and so on - I think that is why the British went ahead with more sophisticated area control systems. The funny thing is that now we are importing these systems from England here.

M: You worked on this Air Canada reservation system. Was that before the KCS days?

K: Well we went in several stages on that. We did the sort of real studies as part of Adalia. When we left Adalia, Air Canada gave us a second stage project where we simulated the reservation system and so on the FERUT.

M: Was this before people like American Airlines were getting into their SABRE system and things?

K: The SABRE system came much later. There was the Reservisor system, but that was not a programmed machine. That machine used a drum and was fully hardwired and had no flexibility. The first reservation machine that used a programmable computer was RESERVEC I for TCA. We developed the original plans and which was implemented by Ferranti and KCS still went on as a consultant to Ferranti, but it was pretty much a Ferranti show. It was using the GEMINI computer, a twin machine, which used marked sense cards. Lyman Richardson, when it became obvious that CRTs and keyboards were going to take over, always felt that marked sense cards were it. In fact he applied to do the stock exchanges - I think he sold it to a stock exchange in Sao Palo - I think two or three stock exchanges went on it. And for a stock exchange it is quite neat - they focus on the buy-sell price. He had formed a company which was actually financed

by Consumers Gas, but the company never made any money. He left Air Canada and went through quite checkered thing - he hooked up with Len Casciato - I am not quite sure I am tracking it right - after he left Air Canada he set up a company called T-Scan I think it was called. The idea was to promote a more sophisticated version and they actually built the unit for marked sense cards. He felt there was a lot of applications for it but of course a marked sense card has no where near the flexibility of a CRT with a keyboard - just like my little additron the technology quickly became obsolete. After that he was in business together with Len Casciato and Howard White - that was years later. They had some contracts with TTC (Toronto Transit Commission) for their bus monitoring system and he had some contracts with Metro on the next generation of Traffic control systems, but they all fell apart. In fact White was very unsavory, he got into these tax credits and so on. I am not sure what Lyman Richardson is doing now, I think he lives in Richmond Hill and is retired. I talked to Len fairly recently on the phone and he seems to be fairly retired now. He told me he is flying now, partly for fun and partly for business.
M: So Lyman Richardson is still around some place?
K: Yes, Len will know. Last thing I know is that he was living in Richmond Hill.
M: You were into constructing time-tables at one stage were you not?
K: Oh yea, that is right. I think that was done by Les Green and perhaps another guy. We became quite large at one time, I think 250 staff.
M: So it is pretty hard to keep track of things. That is a big firm.
K: For Canada, yes.
M: It was eventually bought out by Pete-Marwick?
K: It was really bought in parts. The main part of the company was really consulting and we opened up a fairly large US operation and a pretty good UK operation. So Pete-Marwick came after us because the big accounting firms realized they were being left behind by the high-tech firms. So the big accounting firms used to have management consultants all to themselves. So more and more management consultants became high-tech consultants, computers and so on. They came after us, we also had what was the first computer service bureau and they did not want that, but they wanted to buy the consulting operation. They were a series of partnerships, so Pete-Marwick in Canada bought our Canadian operation and it was called Kates-Pete-Marwick for many years. Pete-Marwick in the UK bought our operation in the UK which was known as Pete-Marwick-Kates there. The US took our operation and merged it with Pete-Marwick-Livingston. I was left with the service bureau and I sold a piece of that to Consumers Gas and by 1974 I had wound it up.
M: That is when you got into your present job?
K: NO, what happened is I was with Pete-Marwick for two years, I was a Deputy Managing Partner, but the problem was I still had the computing business and in those years the computing business suddenly became the darling of the stock market, quite irrationally because everybody predicted 100% growth - they were growing but not that quickly. A friend of mine who was in real estate got interested (and I had the first service bureau) and said he would by half of it. I realized he wanted to make a stark market killing with it - but he needed my name so he wanted me to come back as President on his promotion. He was going to make a lot of money, just like what is being repeated now with the real estate bubble. This was in 1968 and the stock market bust in 1969. All of his plans to raise a lot of money went away and I bough all his shares back from him for twenty five cents on the dollar. But then I ran into trouble because we tried to get into time sharing and we got a Burroughs timesharing system which proved to be a total flop and

I had to chuck it out and I got into litigation with Burroughs. That took up to 1977 to settle. I won a pretty handsome settlement, but it was one of the toughest things because I was in court for four months and I personally was in the stand for a whole month.
M: That would be tough to live through.
K: It was a very interesting episode - we made mincemeat out of Burroughs, everything they tried to bring up I could tear to pieces.
M: Was this one of the B5000 machines?
K: The B5000 yea. The system they had was quite advanced and the system was good, the problem was that Burroughs International was milking - in the States there was quite a few happy customers but here you got absolutely no support, on the hardware or the software, so the system was pretty unreliable. As long as we were in bath mode the effects of an unreliable machine didn't matter too much, once we went to timesharing and you hooked the customer right on to it and you constantly interrupted his business I was being threatened by law suits. I offered Burroughs a way out. I said just take this thing back and we will go back to batch processing because we still had a good batch business. They were pretty nasty, so we were forced into a law suit. By 1974, when I had left Pete-Marwick, I had left with a non competing agreement, so I decided to go back into consulting. I was on the Science council by then (I was on for two terms, 68-74) and the second Chairman of the Science Council came to me (he was Director of the University of Montreal) and wanted to know if I wanted to take over as Chairman. I was just starting the consulting business and I hadn't built up a staff or anything, so I agreed, and went on to the Science Council for three years. It is supposed to be a half time job, frankly you could easily make it one and a half times. While I was on the Science council I had acquired two significant projects, one was the Tel-ride system in Mississauga, as prototype system, and the other was a project for the seaway authority. We had a major project with the seaway authority in the old KCS days - we saved the Welland Canal here.
M: I don't know about that, I know the Seaway had some calculations done on FERUT.
K: No, no we totally revamped the Seaway. The lower Seaway opened in 62 or 63 - the lower seaway locks were built the same size as the Welland Canal locks. In 1963 he first big Russian wheat deals came and what they never figured out was that the Welland Canal was busy before that time with simple lake traffic - they didn't realize that once the lower seaway was open you would get ocean going ships coming up. All of a sudden the Seaway got terribly congested and it looked like the Canadian economy was going to go into the pits. Fortunately, just by coincidence I had, several months earlier, introduced myself to the Vice-Chairman of the Seaway Authority. We had done a lot of traffic work, so one day I got a call, about May 1964, saying we would like to talk to you. I met a very shaken three man Authority - a man Rankine which was really a journalist from Halifax (these were all political appointees) the second was a Geography professor from Quebec and the third was an accountant from Windsor. The Seaway was being blasted by the shipping companies, from Hydro - Pickersgill was the Minister of Transport. Pickersgill said to the Authority that they had better hire a consultant and take a look. I have a feeling that the Vice-Chairman called me because I probably looked like a pretty innocent guy and they felt that I would come up there and put in a report saying they were doing everything possible. So I said I would go down to the Welland Canal on the weekend and look around and I will come back and give you and idea if we can do something.

So Lilly and I, and my third in command Fullerton and his family, packed into two station wagons and went down to the Welland Canal on a Sunday. There were ships backed up

from the entrance of the Welland Canal all the way to Hamilton 20-30 ships. At the other end of the canal it was the same thing. I looked at the situation and I know queuing theory and traffic problems and I watched what was going on. The beauty of that is that everything goes so slow. In those days a lock cycle was of the order of 120 minutes to get one ship down and another up. I know that if you increase the productivity by a small percentage then it makes a big difference everywhere. I could see 50 things I could speed up. Hugh Fullerton is a professor at Queens now, and on the way back I ask him if he saw what I saw - and I said "Hugh, we can fix this". I went back to Ottawa on the Monday. The Seaway's chief engineer's ambition was to build more locks and parallel the Seaway. This would have taken 7 years and, in today money, billions of dollars; in the meantime things would have gotten worse. I think that was May 1964. The project, a typical operational research thing, went ahead. We measured everything and we started first on a quick and dirty set of improvements - thinks like getting the ship to go into a lock with stopping, improving the safety things on the locks and speeding up the locks etc. - anything we could do in a few months to save a minute here and a minute there. I had to draw a diagram for the Chief Engineer - on average the locks handled about 20 ships a day and if we saved a few minutes on each then, if you could handle one more ship a day, within a few days you didn't have a backlog. I don't think anybody listened. They were convinced that we were compromising their paralleling scheme. They get some of the shipping companies to send telegrams to Pickersgill saying that Kates is going to ruin the whole scheme. Pickersgill asked for a report from the Authority and fortunately by that time we had made some progress. At the end of the season, when you have the 'down bound rush', is the busiest time. The fall before some ships actually got locked in the ice, by 1964 we could demonstrate that we were handling 20% more vessels and doing it faster. I put together a 20 page report, listing the improvements we had done, those that we were suggesting for the next two years, and the statistics for this year (the list of ships etc.). Pickersgill said to the industrial people to be patient. By the end of the next year the steamship lines sent telegrams to Pickersgill as to how much things had improved. By the end of the next two years we had built up a modern traffic control facility - tellemetering, closed circuit TV etc. Nowadays nobody would talk of twinning the Seaway anymore - it is now running slack.

To me, that was my best project.

M: What led into this was that you were saying you were Chairman of the Science Council of Canada. You were also Chancellor of Waterloo were you not?

K: Yes, for two terms from 79-85.

M: Did you have previous connections with the University of Waterloo?

K: I think that came through the Science Council. We were very much interested in the relationships between the universities and industry. I took a certain fondness to Waterloo - I felt their Co-OP courses were good etc. I visited there more than others and when I left the Science Council they nominated me.

M: I have a couple more small questions. You were the first person in Canada to get a PhD by working on computers were you not?

K: Well my PhD was actually in Physics, but it was on a technical aspect of computers. It is not too likely that anyone did anything on computers before me, at least on the hardware side.

M: Who was your supervisor, Kelly?

K: Kelly was the director of the computing centre, but my supervisor was actually Griffiths and V.G. Smith. To be frank I don't suspect anyone took very much interest. When I went to take my orals I had an aura of being the aggressive sharp cookie and I was amazed that I wasn't being

asked questions. I have a feeling that nobody wanted to show that they hadn't really studied or considered the thesis. I think I got away with murder.
M: In the very early days when Trixie Worsley came, she tried building a Differential Analyzer. Do you remember any details of that machine? How any integrators etc?
K: I saw it. I knew the technology and understood it, but I was not connected with it.
M: I noted down something, which may be an error, that you did shell firing testing at Camp Borden, that was not you was it?
K: No.
M: I think it must have been Kelly and I simply got the bits of paper mixed up.
K: The big projects were the Seaway calculations and there was the cancer calculations - a big guy took a medical degree as well as a physics degree - I forget what his name was, he went to Chicago to get his medical degree, Kelly will remember him - he was simulating radiation with different apertures and how the radiation would concentrate on the tumours etc.. I was involved mostly with library subroutines.

(interview ends with Kates looking up Casciato's phone number)