

Oral History Interview with

S. Joy Mountford

On March 25, 2021

Via Zoom

Conducted by Jeffrey R. Yost

Charles Babbage Institute

Abstract: This interview is part of a series on Human-Computer Interaction (HCI) conducted by the Charles Babbage Institute for ACM SIGCHI (Association for Computing Machinery Special Interest Group on Computer-Human Interaction). In this interview Joy Mountford briefly discusses her educational background, while the bulk of the interview focuses on her pioneering work in design and human-computer interaction at Honeywell, MCC, Apple Computer, Yahoo!, Ford Motor Corporation (in Autonomous Vehicle design), and consulting work for a wide range of corporations and nonprofits. At Apple, Mountford brought experience from Honeywell and MCC to found and manage a large team (that grew to over 60), the Human Interface Group, that took the Macintosh beyond its original formulation to add size, color, and design elements to ease use and functionality. She and her team developed QuickTime VR and many path-breaking systems. At Yahoo! Mountford redesigned its front page, at the time the most visited page on the Web. In the consulting to nonprofit area (done both at companies and independently), she designed a digital display for the Internet Archives' very large digitized book repository. She launched the International Design Expo, which has been tremendously important in advancing HCI for decades and secured funding from various corporations to foster the annual event. Throughout, she reflects on these efforts and others as well as more broadly on design theory, principals, practices, and technology development within the context of organizations.

KWs: SIGCHI, HCI, Apple Computer, University of Illinois, Honeywell, Microelectronics Computer Consortium (MCC), QuickTime VR, International Design Expo, Yahoo!, Ford Motor, Autonomous Vehicles, Artificial Intelligence (AI).

Mountford: Good morning, or good afternoon, actually.

Yost: Good morning, Joy.

Mountford: Sorry, I have to give you upfront warning that I have had a cold, and so I am sniffing and coughing periodically, ok?

Yost: Ok.

Mountford: I was worried I was going to have to cancel at the beginning of the week, but I have managed to get my act together.

Yost: Well, thank you. Great. So, my name is Jeffrey Yost and I'm the director of the Charles Babbage Institute. This is an oral history being conducted for SICGHI, ACM-SIGCHI and for the Charles Babbage institute. I am here today on March 25, 2021, and it is early afternoon in Minneapolis, mid-morning where you are in California. Joy, I'd like to begin with just some basic biographical questions. Can you tell me when and where you were born?

Mountford: I was born in Somerset, in England, but I grew up in Canterbury, England, in a county called Kent, near a village called Pett Botham (pronounced Bot-ham). It is a strange name, but it's spelt b o t h a m. It is near Canterbury, a Cathedral city, and head of the Church of England.

Yost: Can you describe your interests as a student in primary and secondary school, your aptitudes and interests?

Mountford: I was so lucky. I grew up literally a street away from my school, which enabled me to do lots and lots of extracurricular activities. Most of them being around music. I entered a single sex girls' grammar school, via passing a test. I was already playing recorder and my music teacher said, "Please let her do something beyond recorder", so I took up clarinet. When I joined grammar school, it had orchestras of various types. I played in wind band, Orchestra, Symphonic Band, and sang in madrigals and choir. Every single evening, or after school, I ended up playing in something. Kent County also had a very good orchestral set of activities, so I joined in those too. That was my whole life, and that is what I thought I was going to be a professional musician.

My parents said, "Well, unfortunately, we don't think that's a good activity for someone to make a living, unless you are phenomenally good. You need to go to university for something

scientific”, because people who are artistic would not get paid very well! I needed to do something, scientific. They looked around and discussed what I should do. They said, I could probably be a musician, but only after taking a science degree. The best degree they could come up with was psychology. I applied to university and got in to do a degree in psychology at the oldest school for psychology in the world, except for Austria maybe. I went to University College London. I went there, an hour and a half away from my hometown. However, I had never really been to London, so it felt like a totally different place. I had traveled all over Europe, but I had never actually really travelled in England! London felt like a different country. This was the 70s, London was hopping, just after the 60s crowded music scene into the 70s, acid rock, etc.

Yost: So, did you have an interest in psychology or was that a big push from your parents to that particular scientific field?

Mountford: I was very interested in how people thought. Initially I thought I might be able to be a therapist. How people were consuming information or thinking about things, was quite difficult and interesting to me to understand. I worked temporarily in and out of mental institutions during college. UCL was very scientific where I concentrated on cognitive psychology and clinical psychology. I thought I was going to be a therapist at the end of my degree. I have always been interested in people and how they think, because people are engaging and fascinating, and a bit odd, so that always intrigued me. *One Flew Over the Cuckoo's Nest* had just come out, and I went see that. That I changed my mind radically and decided I could not go into being a therapist! I realized I probably would become too involved with patients. So I did a 90 degree shift.

An important point to mention here is when I went to high school it was an all girls’ school and when I went to university it was mostly all girls too. I never thought about being anything but a leader, a girl who was going to be in charge of the universe. Thinking back, in retrospect that was a very important part of getting me to be who I am now. I do not think I would be who I am now, if I had not gone through all that female education and reflection on life. When I came to graduate school in America, I got a real shock because suddenly I was surrounded by men. Of course, I had grown up with two brothers and a father, but I had thought there were going to be more women around me. When I went to graduate school in America, it was a real shock compared with University College London.

Yost: At University College London, did you have any exposure to computing, and did you think about computing at all in those years?

Mountford: We had limited computing. My undergraduate thesis was handwritten, we did not even use typewriters. Even when I was doing statistics, we actually used hand-cranked calculators that echoed in these big old Victorian halls. It was pretty far away from daily use of computers in those days. My father gave me a Commodore 64 and I did make one from a Sinclair kit. I forgot what number it was a Sinclair computer build-your-own, but my interest was in numbers, like statistics. Not in computing, particularly, because that was very new. At UCL, we had access probably to computers somehow, but we still did not use typewriters!

Yost: You went to the University of Illinois for graduate school in Engineering Psychology. Can you tell me about your interest in that particular area of psychology, and also, what the attraction with the University of Illinois was?

Mountford: Well it is embarrassing to tell you the story, because it was not a really well motivated reason to study. I had applied to work at Camp America, which was an opportunity to go and teach horseback riding in America. I worked in Maine and when I was there, I saw an American football game, and thought, "These men are very big and strong - they don't look like men I'd seen Oxford or Cambridge." I thought I should apply to graduate school in America. I came back and filled in all my applications, and the only one that was still open [deadline] was at University of Illinois. The program there was about aviation. I thought that sounded very interesting and I could potentially learn how to fly aircraft. I put the application in. I met a professor on sabbatical in London, and he thought I had a great background in statistics. He accepted me on a scholarship to go there, teaching statistics.

Engineering psychology was really man-machine systems. In England, it was called human factors, but our Illinois specialty focused on how to make pilot performance more effective, which led to my thesis work on workload. Workload is really about how to help people do two or more tasks simultaneously, which is often referred to as multitasking, accessing multiple pools of attention. Multitasking, casually today, is like chewing gum and walking!

Yost: The University of Illinois was a special place in computing with the ILLIAC and PLATO. Can you talk about computing resources there, and how you took advantage of that?

Mountford: Well, that is an interesting question because as soon as I got there, all the students were using the educational program called PLATO. The university was tracking the students and had their homework logged etc. I had never used a computer. I took a semester off from my classes to start learning how to use the computer to figure out how the students were doing and tracking their homework on PLATO. It was all very interesting to me. When I came back to my classes, I needed to catch up with the students! We had graduate students teaching us as well, how to use card decks, etc. I can remember thinking that the most important asset we had were very strong elastic bands to keep all our data cards in order, never to drop them. We had to keep bands securely around all our cards.

Yost: And was there a timesharing system or was it working with a computer operator and just the operator handling the running or processing of the cards?

Mountford: I think we were doing time-sharing. My thesis was run on a PDP 9 or 11. I am trying to remember exactly, it was so long ago. I had an undergraduate assistant as well, who walked to get our results from a different building. I worked in the mechanical engineering building with the computer; the psychology building had different computers. I was in a specialized program within aviation, and the Aviation Department had a flight simulator. It was connected to a simulator that was running the flight displays and controls, with the computer attached to them. It is hard to remember all the details that far back.

Yost: You mentioned gender in this your first educational experience that was co-educational. Can you talk about the gender environment at University of Illinois and was it conducive for women technologists?

Mountford: The program had lots of men in it from the military. It was a training program for them to get PhDs and master's degrees through the Colorado Air Force Academy. They were older, often married with children. It was different because I had never been with people that much older. A couple of women were in my office, but a lot of the other grads were men, which was all fine. All the professors were men. Probably because it was about aviation and how pilots adapted to machinery. Obviously, you could not talk about women flying aircraft, as women were not permitted to fly for the military. I believe it was not legal for them to fly in the US Air Force back then. I think it is now, but not in the 70s.

Yost: Who was your primary advisor, and can you discuss that person as a mentor and potentially other important mentors at that time in your life?

Mountford: My advisor was Professor Christopher Wickens, who at that time was untenured. He was very eager to get lots of research done, and I had the good fortune to work on one of his grants for DARPA, or maybe the Navy, Office of Naval Research. He had an idea that resources inside your mind, or your brain, were divided into different types of resources. Attention could be assigned into different types of tasks, verbal tasks or numerical tasks, both for audition and vision, and when paired with manual or verbal responses users could potentially do more activities when combined with different modalities. For example, in a cockpit, if a pilot did housekeeping tasks, which are number based task, using switches and knobs, versus preparing for spoken tasks is 'facilitatory,' so potentially pilots could do more activities than if just using buttons and switches for both.

Chris and I came up with a new theory for multi modal task performance, which got a lot of traction. Several years since then, he has had different students continuing the work. We won Best Paper of the year for the resulting research paper at the Human Factors Society. I graduated that year, which was good to have completed well-received research. Chris was the only real advisor that I had. I worked with another person in kinesiology, Karl Newell. I did some work with him on signal detection theory. I compared different amounts of feedback from a basketball shooter, either from motor feedback versus visual feedback. We compared ratings of the shooter while throwing balls with a player watching the shooter, and during different times of the ball flight, we turned off the lights. This turned out to be quite difficult to do with basketball players, because they ended up having to shoot from midline, the centerline and in the pitch-black dark, no lights, for over half the time. I worked in the heat in an indoor stadium at Illinois in the dark, inside a basketball court, with 90% humidity and 100 degrees temperature with the Illinois basketball team. It was crazy!

Yost: Interesting. Can you say a few words about the Human Factors Society, and its culture as a professional organization and how receptive and conducive it was to graduate students at that time?

Mountford: Yes, they were very good to us. They had special student awards, and student papers and sessions. It was my first conference ever, so I learned a lot. They were very

experimentally based presenters, who had collected data from people, recorded it, and presented it in a very structured data-driven way. They used a specific methodology, approach, results, conclusions format, as well as building on various other people's work. It was often historic in nature, not a lot of visual work, mostly data-driven. This was part of the reason that I got more interested in what became, SIGCHI. Special Interest Group on Computer Human Interaction seemed more interested in displays, as well as controls. My work started to move faster into the area of designing, not just controlling. Human factors often had been about knobs, controls, and the end interactions, they are a critical part of the equation, but the equation must involve the design of the displays too.

Yost: Right. Is there anything else you would like to say or discuss about your time at the University of Illinois before we move onto Honeywell?

Mountford: I did know that Illinois had a fantastic library because I spent lots of time there, and a fantastic music hall. I remember going to some of the greatest orchestral performances there. I was very grateful for that. They used to say, "There's not a lot to do in Illinois, it is cold and isolated". Students had to enjoy the library and performance arts, the Krannert Center of Performing Arts.

Yost: What led to the opportunity at Honeywell? Can you discuss the decision process to leave Illinois and take a position in Aviation at the Systems Research Center at Honeywell?

Mountford: Well I did not know very many people in America, because at that point I had not been traveling too much for anything, I had no money. I did know of a man whose work I had read, called Robert A. North. Bob North had gone from the University of Illinois to Honeywell. I wrote to him painstakingly at night on a typewriter. My first experience with a typewriter, which of course was amazing mainly because there was erasable type writing paper! I used it thankfully to keep rewriting a letter, letter by letter. Every individual letter of a word, erasing them letter by letter, erasing it and erasing it, until I wrote to him saying, "I would like to apply for a job at Honeywell please?". Somehow, he 'wrote' back, because we did not have cell phones, or email etc.

It happened and he suggested that I come for an interview at Honeywell. I also wrote to Bell Labs, and they suggested my going there for an interview, but they wrote to me after Honeywell. I interviewed at Honeywell first, duty bound, since they were the first I wrote to. I

went to Honeywell and did my first presentation ever, where I was told I was the worst presenter in the world! That led me to nearly cry, I decided I needed to leave! Bob North said, "No, no, you need to stay, and we'll find ways of training you." I went home and then a couple of weeks later they gave me the job. In fact, they actually said I was 'eminently trainable'.

Yost: Was that in Minneapolis?

Mountford: Yes, it was in Minneapolis.

Yost: And you would go on, as I understand, to work on speech recognition, stereographical helmet displays on various bombers and fighter jets. Can you discuss that work?

Mountford: I was very lucky at some level, because I did not have a security clearance; I had to work on research things more unusual projects. This meant things like stereographic helmet displays, because those were in a research domain. We had a simulator and Honeywell was making heads-up, worn displays using oculomotors on the side of helmets, projecting onto a visor. These systems would now be called Virtual Reality or artificial reality, whichever preferred, showing painted-on information on top of wherever the pilot looked. We performed a lot of research on those information displays. Honeywell was interested in how the projections of ballistic guided ordnance could be improved using helmet displays. It was a little graphic envelope floating in space, so a pilot could see where a bomb would land in a few seconds, as a projected display. Then we would evaluate if their performance accuracy were enhanced.

In addition, we used voice recognition to turn displays on or off, and to change settings. Remember, these were not Alexa-like devices. Instead, they were devices trained individually to each pilot for a set of fixed words, usually for about six to eight words, speaker dependent and not continuous speech. They used one or two words spaced out for each particular individual pilot. It was very effective and worked very well, along with the helmets too. However, the Display Refresh rate was a bit too slow to be accurate all the time. If you moved your head too fast it would lag a little bit, but the concept was very effective. In the future, they became useful products but took another three or four years to be considered practical. I know they ended up being used in the F-18 plane. I also did some of the early tests for helmet displays used on the ground for medical purposes. The army was trying to get in and out of places where people were wounded, and to get guidance on a particular medical issue. Medics could ask their worn voice activated systems for medical assistance. Soldiers could get information from manuals, by

voice, and then projected on a calumniated lens display on their helmet visor. This could be shown pretty easily compared with in a high-speed tactical aircraft.

Yost: In the early 1980s, in 1982 specifically, there's the first meeting Human Factors in Computing Systems in Gaithersburg, Maryland, the first CHI, or what officially became CHI the next year—

Mountford: Yes

Yost: Did you attend the Gaithersburg meeting and what was your first experience at SIGCHI?

Mountford: I have been trying to remember. I was at Honeywell, and then I got offered a special assignment at MCC in Austin, with Bill Curtis. At MCC, I was the leader of a group called Visual Metaphors, and I started working in artificial intelligence for the first time. My team looked at 3-D semantic nets, so I was back to using my background in aircraft. I immediately started using very big displays with three-dimensional networks to display data interconnections in distance. We showed information connected semantically, via their relationship distance. For example, as a visual encyclopedia e.g., in CYC, an apple would be closer to a pear than a cherry. You could place them in 3-D space visually showing an apple and a pear are closer, more similar, and physically closer than a cherry. We made semantic relationships between objects in distance, all done in 3-D. I was working in that space with Bill Curtis as my manager, and he took me with him on the road, I think, to Gaithersburg. Do you know if it was Bill who brought us together, it was, right?

Yost: Yes. Well, he co-organized the first meeting with Ben Shneiderman.

Mountford: Okay, I was there with him, and we had a great meeting. I had a Human Factors background and with that Human Factors Society background, I had missed out on the display, creative visual end of interactions. However, I had been working in 3-D with big visual displays with flying as the focus. I was frustrated with human factors being so narrow or 'small' in focus. I wanted CHI to be something bigger and more encompassing. I know that is very vague, but those were my emotions at the time.

Yost: And do you recall, did you attend CHI before you attended your first SIGGRAPH meeting, can you talk about SIGGRAPH too—I read that your first SIGGRAPH meeting was very influential to you.

Mountford: Yes. I was living in Minneapolis when I was at Honeywell. I did not actually know what I was doing but I accidentally ended up getting into the SIGGRAPH film theater. I saw the first synthetically created fire and reflections of balls bouncing on glass. I remember standing mesmerized, just saying, "Wow!" I had never seen graphics like that. I had been struggling with graphics as just lines, sticks and rectangles. Suddenly I saw these 3-D balls bouncing with reflections I realized, "They're doing something amazing, and why is it that I'm stuck with sticks and flat rectangles," you know. I just stood and watched.

It was amazing stuff. I remember one of them was from Jet Propulsion Lab on 'Mathemagic Land,' a series of lessons teaching children physics using interrelationships of equations, in a graphical animation form. I immediately wanted to change and do that kind of work. I got excited by SIGGRAPH and made an emotional connection with that theater full of people, jumping up and down, being excited. Next to me was the guard telling people not to jump too high or do anything wrong and he turned to me and said, "I don't know why everyone's excited, all it is, is a ball bouncing." I realized he did not understand it was synthetic, being created by a computer. He just thought it was a ball bouncing and someone had filmed it. I remember thinking, "Oh, we have to explain to him that it's all to do with a computer," by this bunch of people geeks, jumping up and down in geekdom, and he just did not get it. I tried but it did not work. He just said, "Right," Looking at me like, I was crazy! That was before I went to my first SIGCHI.

Then we went to SIGCHI. We proceeded to try to grow it to be what it has now become, a big entity.

Yost: You, of course, regularly went to CHI, did you also continue to go to SIGGRAPH on a regular basis?

Mountford: Well, interesting enough, I got a paper into SIGGRAPH. I will tell you an interesting and equally bizarre story. I was at Apple. I had jumped from MCC to Apple. There are obviously, a set of stories there. When I got to Apple, I hired an intern, called Michael Chen, a student of Bill Buxton's in Toronto, who had written code for a virtual sphere: a one-button mouse controller of a 3-dimensional object. I took him under my wing and said, "This is very good, and we should write a paper for SIGGRAPH". He authored it with me, and we got the paper into SIGGRAPH. However, before we got it accepted one of the people who was a reviewer of that

paper was a man called Ivan Sutherland. Ivan happened to be working at Apple at the time. What a coincidence!

Out of the blue I got one of those odd phone calls, which you're really not sure is a good thing. It began with "Is this Joy?" I said "Yes". Ivan said, "Come to my office immediately". I thought I probably was going to lose my job, or I'd done something very horribly wrong. I walked across the street, traffic lights etc. to this man's office, and he was sitting in a corner. He had my paper, threw it down on the table, and said, "What are you doing, writing this paper?" I did not know who he was!

I had not realized, unlike Honeywell, Apple, did not publish at that time! I thought I was going to be told off. The paper had not been accepted at this point, I didn't know that I was supposed to get all these approvals, before submitting it. Steve Jobs was not there then. I had written it without thinking it through, and Ivan was one of the SIGGRAPH reviewers. He happened to be working at Apple for a year, just as that happened. I explained why we should write research papers and he said, "It's amazing". I said "Oh, fantastic". We then became friends and he became one of the most influential people in my career, by the way. Even after Apple, he spent many years around me, even while he was at Sun. He was a great influence on my life. That paper became the only publication I had at SIGGRAPH, but I used to go to SIGGRAPH because I like to learn new technology or techniques or tricks, we could use at SIGCHI to move HIG forward. I continued to go to SIGCHI until relatively recently, but not SIGGRAPH. It became very, very, very big, and you got lost at it.

Yost: In mentioning the publication restrictions at Apple, that was different from MCC, I assume, which was a consortium and more open. Can you talk a little bit about the culture at MCC, it was an organization that, as I understand it, grew in part out of fears that the Fifth Generation and AI research in Japan would threaten U.S. leadership in computing. Bobby Ray Inman, who I've studied from his work in the history of computer security at NSA, he was the director at NSA and was the deputy director of the CIA. He was the founding the leader of that organization, of MCC. Can you talk a bit about MCC, its culture?

Mountford: Yes, MCC was terrific. I enjoyed and learned so much there. They were ahead of their time. I got to enjoy doing things I never thought we could imagine doing. We all had very top-notch computers, very large screens. It was almost like working in dreamland. It seemed like

we had excessive amounts of money to do what we wanted to do, and also partners across Europe. The program in England was called Alvey and there was another in Europe, too. I worked with Ted Ralston, who unfortunately we've lost now. He was the front person for Europe, so we traveled together, and I got to visit colleagues who are doing similar things to us, and influential. MCC was a little bit like EuroPARC, and we were trying to be, a version of Xerox PARC, but sponsored by a set of companies. I think MCC's organizational system was very difficult. We had very different subdivisions that were funded by different companies. The problem was that we could not all talk to each other in any one meeting, because we didn't know who the sponsors were for all of our different subdivisions, which was a little bit awkward. Some people were full time; some people were liaisons to different companies, but to different sub parts. This was a weird component to support collaborative research.

The work done was pretty seminal, but it didn't get out very easily. Technology transfer was difficult back to the companies, because there became an increasingly big gap between what we were playing with every day and what they had back at home inside their companies. For example, Honeywell had level 6 computers and people were still using COBOL, the business programming language. Meanwhile MCC was using LISP, an interpretive language, which does not really translate to other languages like COBOL. This was very difficult. We wondered about how the software architecture was going to move forwards to supporting artificial intelligence.

MCC was probably the biggest artificial intelligence movement at that point in history. Today people say, they are now doing AI. They ask, "Do you know anything about AI Joy?" Well we were doing expert systems then, using semantic processing. They reply, "Are you sure?", as if I was crazy. We did a lot of AI, as well as natural language. Obviously, the computers were not as fast. It was hard to build large enough associative memories to do much in predictive technology. Much of that work is being repeated now, using the same core technology that we began. Doug Lenat was doing his CYC project and continued it for at least 20 years. He was building all of the knowledge of an encyclopedia into a set of computers, including all of its associative memory. It was a great effort, and I learned a lot from it and enjoyed it. CYC had many sponsors after MCC, but ultimately did not get traction. In fact, almost all the great research groups that I have been attached to, seem not to get enough or the best business traction. I am not sure because of the way they are funded, or the way they set up tech transfer.

Yost: Was there an interaction between MCC and some of the major academic AI labs at MIT and Carnegie Mellon?

Mountford: Yes, we had cooperation. However, there was always a little bit of jealousy I think, because people are a bit competitive. Knowing how to do the very first instantiation of ideas was important. You know, it was good jealousy and hopefully it was intended to motivate. People visited all the time, Minsky visited, whoever was the greatest AI person of that era. They would come and give us tips and suggestions. Then we would take that seriously and build it out with the best programming. Various test solutions were built and shared. Professors' students would do similar work and we would share our results. I think people tried to shut the competitive parts off, but maybe not all of it!

We started working in LogLISP, which was a weird language. A combination of LISP and Prolog. Prolog was being used in the Alvey project in England. The best parts of both languages were put together into LogLISP. Now I do not know how you feel about this, but anytime you end up inventing a new language, it limits the number of people that are really good at it, because those people are the inventors. Therefore, they are the experts, but there are too many people that do not know how to use it. Therefore, its use becomes a little bit self-limited. I think some of the work became that way too. I mean Lisp is in a world of itself, most LISP programmers do not program in object C, or anything else, they tend to stay within their own channel. It is an interpretive language, different from other languages. People had their own style, and that style suited them and stayed with them.

Every single person that I could think of wanted to spend time with us at MCC, the think tank. It was not just their students; I think people learned from hanging out with the people who got their hands on the work. By the way, I met all the people I know now, like Andy van Dam through MCC. I invited and ran a 3-D graphics symposium for MCC for a multi-company big event. I found them all and brought them to us. I still know Andy; he is another one of my great mentors. Jim Foley, I got to meet and Myron Krueger, inventor of artificial reality and others.

Yost: I understand MCC had to get special approval or a waiver from the US Congress as a consortium of this type as anti-trust law as it was written was at odds with a consortium, to preempt collusion, and you mentioned that it was sometimes complicated how you could interact with others within the organization. However, could you expand upon that and I'm

curious with the major case against IBM being dismissed in 1982. Was IBM kept out of this organization because of its past anti-competitive history with anti-trust cases against it, DOJ and others?

Mountford: So, I don't know very much about this, IBM wasn't a part of MCC, right?

Yost: Not that I could find or discern.

Mountford: No, I do not think so. That is my understanding. MCC had five buckets, and the companies could buy into up to five buckets, or not. They could buy into one, five, or any combination. However, you could only talk to people in the buckets you paid for. You could talk to any and all of them, but only the ones you bought into. This meant that employees from sponsor companies had to know somehow, which buckets your company 'belonged' to. How would you know in the corridor during conversations whether someone was in your company membership(s) or not? We needed a visual DNA stripe on everyone. I would not know if you were allowed to know all of what I knew, or if you are only supposed to [know] half of it. This went for the employees you worked with every day, and visitors. The whole thing became extremely difficult to keep your head around. Constantly wondering what you could talk about with whom! Honeywell for example was not part of all the buckets, which meant I did not know about things that some other team members knew about. However, when we went to lunch, some things people talked about around their work should not be told to others, because their sponsor was not entitled to knowledge from that program. It became too difficult to manage. People were different, some too cautious, or some too verbal and some made verbal mistakes.

Yost: When you were at Apple, you founded a major international student exposition in interaction, the Interaction Expo, one that I'll ask you about in a few moments in discussing Apple. However, I understand from communication with Microsoft Research Senior Scientists Jonathan Grudin, that while you were at MCC, you had an expo and you brought in some talented UT Austin students. Thus, I am wondering if that was that kind of a precursor? Can you discuss your work with students at that time before the larger international expo that you launched at Apple, so early to mid-1980s in Austin?

Mountford: Well, I think I have always believed you should hire people who know more than you do. Because you're not going to improve unless you actually reach out. Elaine Rich was a professor at UT Austin. I used to go to her house because she was a great cook, and her husband

was a professor there, and she used to host wonderful dinners. I realized through talking to them that the students were on a different space. They knew different things and consequently we used to have, salon-like meetings. I met some students and I realized that what I was missing was talking to people who were unlike me. We talked often to them and found out they could actually build on ideas together with me.

These CS students seemed like they needed practical experience and would appreciate some 'real work' as opposed to just working for their professor on his/her work. I proposed that, and we bought a few of them in for a couple of days a week, a couple of afternoons a week. They were relatively affordable, so no one noticed the financial debt. They provided us with inspiration, actually, and what I would call good labor to get things done. These 'interns' were faster than most of us at getting those things done, because they knew how to get things done better than we did. That move began a sort of surge of people saying, "Wow, this is a good idea. Let's try and get more of those people", because we can get them to help us get our jobs done faster and get good work done.

Yost: One other question, it comes from a prompt from Jonathan, is a television series I was not aware of called *Halt and Catch Fire* [Since have watched in full] that is on Texas Info Technology industry in early PC era. I do not know if you saw that series, but he wanted me to ask about that, but since you are nodding that you have not. Can you discuss Austin as technology region in the 1980s, of course, there was Electronic Data Systems, or EDS [H. Ross Perot's firm], Texas Instruments, and Dell and some other large tech companies but did that influence how things were done at MCC much, add a regional advantage?

Mountford: That is a great question. One problem was that we were not in downtown. We were in the Research Center, which was north a bit further out. I continued playing music, as you probably know Austin is well known for six street music venues. I played in a polka band near the state capitol, which was bizarre because I do not know polka music. We played for money for beer, and you can imagine, as the night went on the music got worse! I think Austin was in one of its tech surges, it's now going through another surge. The tech awareness made it very interesting with an emerging Film and Music interests. I was told they have even more musicians per capital than any other town. It is also a college town.

Yost: I know that to be a fact because Minneapolis actually comes in second, but I believe that is for the related statistic of live music capital where Minneapolis is second, number of performances per year per capita so tied to number of musicians per capita of course but also travelling acts.

Mountford: Okay, great. And by the way in Minneapolis, I played in a great band, which still exists. The man who got me back into my clarinet playing was my boss at Honeywell, Bob, and he is still a best friend. When I got to Texas, I played in two bands. Music is very important to people to help realize we are not just passive visual and audio receivers but active and creative participants, too. I think Austin was a good place for that, it was vibrant and intellectually focused, except a bit hot. But I lived also in Minneapolis, where it is cold.

Yost: You got both extremes between that and Minneapolis.

Mountford: Well I lived also in Illinois, which is a little bit chilly, right?

Yost: Right, not quite as bad as Minneapolis in temperatures in winter but close. So, you briefly mentioned how you got started at Apple and that was in 1986. Can you talk about starting in that position and launching and leading this major both creative and managerial enterprise with the Human Interface Group in HCI?

Mountford: Well, it has obviously become a great legacy. I did not know that would happen when I began it. There was already a person, Eric Hulteen, at Apple who even continued with me at Interval and still has stayed a friend. They thought they were going to have an interface group at Apple, but I don't think they knew what that actually meant. When I interviewed at Apple the Mac was a cube, about 12X10X6 inches. It had a floppy disk in the front. I interviewed at Apple because my boyfriend back then told me Apple was going to be big. I always did what people told me, right! I interviewed and when I came back, I cried when I got off the plane, and said, "They're not going to do anything, it's doomed to fail". I felt sorry for them. How wrong I was!

That was the beginning of my relationship with Apple. It was black and white. It only did text and numbers. It had no graphics. I had only used large SGI machines with 3 button mice, so very different! With the Mac all you could do was point and click, with a one button mouse, with no color. I had always used large screens plus always color and graphics. I was thrown for a loop. I

thought what are they doing? What do they think they are going to be? Then my friend pointed to me, “That’s why you should be there. You should go and change it.” So, I did.

It was at the beginning of HyperCard, then WildCard. Bill Atkinson was in the middle of creating it, and I could not understand what he was doing! It was awfully difficult to balance what HyperCard was trying to be, versus the Mac’s desktop world. There were two different directions of where the computer was going. My boss did not like HyperCard. I was set up to test HyperCard and show that the metaphor it was using was failing. I kept thinking, but it is comparing an apple and orange, they are totally different. What are you trying to do? “Why are you saying the apple needs to be an orange?” It does not make any sense, they were totally different metaphors. I was ‘set up’ a little bit to annoy Bill Atkinson.

Bill would come over for about 10 minutes at about 10pm and start a non-stop stream of words at me about why I was doing this and that. Ultimately, we became friends, but that is how we started working. He never even introduced himself to me. I gradually figured out who he was. He started working at midnight, worked all night, and then went to sleep. I started work while he slept; we worked off schedules, except between 10 and midnight. The Mac then was just about to introduce, what I was told, was a ‘competitive’ advantage – color. I said, “How can that be competitive, when the rest of the world has color?”

I had many interesting challenges at Apple. Larry Tesler, thought he was my boss at Apple, but he wasn’t, since he was in Research. The first thing he asked me was, “What would you do to improve the Mac?” I said, “It needs to have more buttons on the mouse, because I have only ever used a three-button mouse.” He absolutely blew up. He then spent an hour or two arguing with me about how that was wrong. I was off to a really good start!

I kept at it though, very methodically hiring great people, who were, and still are, the greatest people I know in the business. They have now become leaders, vice presidents and fellows in all the industries that we know and love today. At that date in history, there was nowhere to go to study interactive design. It was basically the first time such a group existed, focused on interaction, hard for people to believe. None of the original people were trained in interaction because there was no-where to train. Apple had to train people when they came. For example. that’s what I slowly began chipping away at. I began the Design Expo to fund universities to do graduate classes that were interdisciplinary, at the most supportive of international institutions.

Yost: And this was leading a team of about 60 people, full and part time staff.

Mountford: It started smaller and I built it out.

Yost: Of course. Can you please speak about your managerial philosophy and style in hiring and managing creative people?

Mountford: I do not think I had a particular design philosophy. It evolved as HIG inched forward. I started with three of the original Apple interface people, before I started. The group was mostly responsible for icons and control panels, but that was not my idea of a HIG group. I began by asking HIG, Human Interface Group, to make a form for engineers to fill in, asking them to describe the desired product for an icon, name, and project goal. The request form reduced icon requests by about 70%. Much of the work the designers were being asked for was not 'really' for products, but just to visit us, to see friends! To justify their visit, they would then ask for an icon! Once I realized that, I decided we had to do some quality meaningful work.

I remember once we got a bigger monitor, about 16 inches by 12 inches, I suggested doing Fitts's Law evaluation work. I had a Fitts's Law award from my graduate schoolwork, but no one in the group knew about Fitts's Law. I asked people to start doing studies on the speed of icon acquisition or target acquisition, to show them that the speed and accuracy of moving a cursor to a target depended on the size of the icon/object being hit/acquired. What HIG needed to do, was to be seen as a quality group to be taken seriously, not just doing pictures. I was determined not to just do 'decoration', but rather have a quality group running documented user-based studies. I started hiring people who had some training of the right type. What type was that? It started with user studies. I hired people who had educational psychology backgrounds, who had done user testing and studies. Then in addition, people who had learned graphic design, beyond just illustration. Next those who could also use computers to do graphics, as well as people who had a background from like the Media Lab, MIT. MIT had just changed their name, from Architectural Machine Group to the Media Lab

We looked for interdisciplinary-trained people, including those who had musical training, as well as computer literate minded. They were not rigidly trained but were more creative. I guess partly they had a good feeling for others, were creative and insightful. Now I don't know how you ensure that, but I'd been around long enough, to think I knew what made quality contributors. HIG developed gradually obviously, it happened one or two people at a time, and

their successes became apparent. Then I was allowed to hire another two or three, and then another two or three and it grew significantly over time. We grew particularly in the summers, because I was allowed to hire interns, I started with four interns, and then sometimes six. Summers were a very important period for us.

Yost: You mentioned Fitts's Law and I interviewed Stu Card last year, he worked on Fitts's Law which brings to mind – wondering if you can talk a bit about the region and PARC and SRI and just the kind of Silicon Valley region as a creative area and space where people moved between different companies and organizations.

Mountford: When I was at Honeywell, in order to attend a conference, you had to have a research paper accepted. Otherwise, there were no funds to support you attending. I learned very quickly to justify going somewhere; I had to have a paper to present. To attend CHI, I realized that the Human Interface Group needed to start writing papers about their work. These were the early days, so everyone was excited to start writing papers to go to CHI. We knew who our competitors were, mainly Xerox PARC. When I joined Apple, I had to help prepare to defend Apple in a lawsuit against Xerox. I did not actually have to do that defense, but I was prepared by Apple to do it, so I was familiar with the PARC names.

It was clear that Xerox hired people who were doing 'real' research. We were not doing research; we were doing products. Xerox PARC was a research center. We were a product group that longed to be like PARC, to have time to think and create with big computers. We had little computers, in awe of Stu Card and his team. We were publishing to try and compete with his research papers. I think we had more papers at one conference than Stu and his guys. They were all guys and we were mostly women. I thought, "We're off to the races now". I was rather scared of Stu, because I thought he has a PhD and he is at Xerox PARC.

I remember once actually bumping into him in the corridor. I do not think we had ever even met. I did ask him something. The lawsuit meant that we had all been very careful not to speak, in person. He said that he thought I had a team of 50 people working on things. I think I had about five or six in the group at that time. Apparently, he was in awe of me, because he thought I had all these design creative people. He had had his wife doing visual design work with him because she had a background design, but he also had his implementers at PARC. I had virtually

none. I was jealous of him! It was very silly times, but they were the people that we looked up to the most. Anyway, what was the question? Oh, Silicon Valley...

Yost: The region as a creative environment, the relationship and interaction between people at places like at PARC, SRI, and Apple.

Mountford: We used to go to the CHI meetings, the monthly SIGCHI meetings to get updates to see what other people were doing. It was a good place just to hang out. We didn't have the internet to find things out, so CHI was a source for inspiration and social communication. It was a very important place to meet and greet people, and occasionally go to an event. Stanford would do a few lectures and things in the evenings. I used to travel a lot to places like CMU, MIT, NYU to keep tabs on things. Also, I called Ben Shneiderman too, because I was worried about his breakthroughs. He was a PC user and we were on Macs. He and I were good friends, but I was always worried that the PC and their users would take over. Apple and IBM were always arguing with each other about who was going to get into schools, the rest of the competition wasn't very serious. Remember Apple wasn't a household name then. For example, when I met Bill Gates, for the first time, I didn't know who he was. Microsoft was not a household name either then. At an in-person meeting, I had to ask my boss who he was, and he said "Bill Gates", and I said, "Who's Bill Gates?" He replied, "Head of Microsoft". Things were very different then!

Yost: Right. I asked you about the student Design Expo, interaction design expo in earlier contexts. In the later 1980s, you launched the International Design Expo, while at Apple, and it had more than a two-decade history. One thing I was super impressed with is how many students you reached globally, over 3,000, and also that you secured so many different corporate sponsors as you moved to different places, Apple, Interval, Yahoo!, Microsoft, Mattel, Ebay and Intel. Can you talk a bit about getting corporate buy-in for this? How you accomplished it?

Mountford: The Design Expo began at Apple 1986 because I could not find enough people to hire who were trained well. I suggested doing an Expo, where we can watch interns first and then hire them. It was a relatively self-serving exercise in the beginning. I also wanted to find out what was going on overseas, because I felt we needed more international input a new perspective, a non-American influence. The idea was that it was not a competition, it was more of an invited class. I began to fund the universities so they could put engineers and designers

together, also potentially with a businessperson. This class became the basis of many similar classes today, for example the D-School. The first class that Apple sponsored at Stanford was taught by Terry Winograd and David Kelly, through the Design Expo. This is known now as the D-School. This is a great success and they have another school now at Potsdam, funded by SAP. Apple also supported starting funding for the Royal College of Art, starting Computer Related Design, program in London. We also funded various programs: CMU, Utrecht, ITP NYU, IIT (Bombay) etc. I can go on, obviously, it was the right thing to do.

I did the Expo for many years at Apple. And it continued when I moved to Yahoo. I told my boss, who was Larry Tesler that I wanted to bring it with me. He said, I could only come if I brought the Expo with me. He said, "Absolutely. I love it." That is how we moved it to Yahoo. At the other different companies, they sponsored me to run the Expo, as an independent contractor. At Microsoft it was the same, Lili Cheng sponsored me because she had been a participant when she was a student. Many of these students became successful through this endeavor and they are now professors at the universities as well. At Stanford, CMU, NYU and others shared sponsorship was difficult, because companies always want to own the intellectual property. Class running is one thing, but schools do not want ideas and prototypes to be public. As you probably know, now universities allow the students to keep their intellectual property, but schools do want to own some piece of the work. They want to share the student's IP. That has been the most tricky thing. However, it turns out that if you look at the work/ideas, they are not really product ready.

I have had actually 4,000 students participate for over 23+ years now. The work was not aimed to be ready to go to product, to be directly 'productizable.' A lot more time needed to be spent to develop the work further, as well as time on the IP. Everything a company can do well, but not really students as they hand it off. There are many good class ideas that have become products in a modified form. Many companies have funded projects, similar to the way we started the Expo, over 20 years ago, it was quite a new approach. The Expo format needs to be refreshed now. I have been trying to start another one on digital diplomacy, with the United Nations. Other nations are struggling with interdisciplinary design challenges right now. Countries in Africa work very different from Western countries, the digital divide is massive. We are facing a lot of design crises. I think America is losing design talent and competency. I fear we will soon be outsourcing design to other countries, as we do now with software. 90 percent of

the graduate students I interview today at schools like CCA, NYU, IIT, and CMU are not from America. If we do not pay attention to that fact, we're going to lose American design expertise, we are going to lose any edge that we have in design.

(Break)

Yost: Ok. We were discussing Apple, your years at Apple and earlier discussing Apple and PARC and Stu Card's group being primarily men and your early hires in your Human Interface Group at Apple being predominantly women. As this team grew to 60 plus programmers, visual designers, usability experts, did it stay a gender mix towards women, and can you discuss gender in Apple's culture in the years you were there?

Mountford: I can't remember exactly how it mutated. The simple answer is when the team started to be deeper technically, especially in coding, most coders were male. My bias was to show our work best, to actually implement it further, and hire the best, which meant more men. Implementation was a question of degree because people can say, "Did that work actually ship?" It was less of an implementation more of a proof of concept. Our original gender mix was 50:50, but at the end, HIG ended up being slightly more males. It stayed clearly female led, since it always had me as a female leader, biased I suppose! The rest of Apple was not like that. We had a 25th HIG anniversary last summer, 2020, through Zoom. We could not invite the whole group, because we could not effectively host the whole ex-group. The entire list was over 100 people who had come in and out of the group. One of the comments I found interesting, was from Kristee Rosenthal who remarked, "Thank you for making sure there was always a woman at the table". It had never been top of my mind but apparently, that had been a significant thing that women in the group were aware of.

At one WWDC, Worldwide Developers Conference, I did not realize, but all the presenters were women. I think there were five women on stage. It was not intentional, but it turned out that each of the women had done a great prototype. We presented our work and strangely enough, it ended up being a rather raucous event that year. The result was that the advanced technology group agreed that they would never do an evening presentation again, certainly not with all women. The developers had been drinking too much, and they were out of control. However, it was a very big event for us, that we had had all women. We had a very strong and very talented team of women. The rest of the WWDC was male. In the audience of developers, I

would say there was only a handful of women developers. At Apple, we had a very strong woman leader in software, Sheila Brody, the rest were all men, very traditional. To this day too. In addition, I believe, there is the same percentage of women doing computer science in the 90s, as there are now, which is depressing. I think there had been a little increase, and then it went back down again. Statistically, we are not much better off now, a big question is why. I can tell you what I think, but it's sad state of affairs.

Yost: We have done events and research at the Babbage Institute in gender history in computing and computer science, and the National Science Foundation has statistics for more recent decades. Women's numbers peaked at around the late 1980s period, and then computer science majors dropped way down from being upper 30s in percent to as low as 13 percent in the late 1990s and early 2000s. Now I think it is about 20 percent, it has oscillated around 20 percent a bit above or below for a while, and the industry has been roughly the same. It's actually, percentage-wise, far fewer women today than in the mid to later 1980s.

Mountford: Tonight I'm doing a Clubhouse event, and it's going to be my first event during Women's History Month, and I'm going to talk about women in tech, talking about some of these issues. I have been doing a little bit of research on it, and the facts are quite extraordinary to me. There was a great big pay gap in the order of about 30 percent, when I began. The career boost for women occurred because we were working in a visual medium. Traditionally graphic design is more female, so that helped interaction design and HIG developed women more.

I also wanted to mention, because we were talking about mentors, Don Norman has been around my life for a lot of time. The work I did with Chris Wickens on multiple pools of attention was also something Don Norman had also worked on in the 60s. I was not working in the 60s, but Don had done previous relevant work. I invited him to evaluate early versions of HyperCard, which was an early multi-media programming tool. I interviewed him and have this wonderful quote from Don. He said, "Why does a fish have a telephone number?" There was a card with a fish drawn on it, a graphic, and a telephone number. Don Norman could not understand why cards would have things like graphics and numbers and text attached to them. Although he's a great mentor, it was interesting how jarring the idea of multi or hyper media index cards having collections of different media information on them was. It was still quite new and bizarre.

Yost: Interesting. Yes, I really enjoyed interviewing Don. Had read his work. It was a great experience. Shortly after coming to Apple, and perhaps immediately after coming to Apple, you remained involved in MCC in the Natural Language Group, is that correct? And I understand that the CEO John Scully had a great interest in this area and thought that that, language processing was perhaps more important than keyboards, natural language understanding and voice recognition? Am I getting that correct or not?

Mountford: At Apple we were also doing voice recognition work. I notice we often do things that go in out of fashion. When they come back again you often have to do similar work again. Back in the eighties, I did voice recognition in the cockpit, then it dropped in popularity. Then it revived itself at Apple, except we had different applications for speech. We thought the best thing to do was not just talking to a computer, as we do with today with Alexa. We rather thought of using it to set up housekeeping tasks, calendars that kind of thing, and reminders. Don Norman thought you should just talk in free form, but we were trying to get him to realize that you probably would have to train it, using task-oriented grammar.

I remember standing on stage with him as he gave a great voice demo with Casper. Later they demoed it on Good Morning America. This was not my work, but after the demo they forgot to turn it off. What happened was the host kept talking to the audience and the speech system kept asking, "Say again. Say again, say again". It was an awful demo, which showed exactly why speech recognition was not a good idea yet. It was pretty much the end of that phase of speech recognition at Apple, until Siri! That version demoed poorly, since the user had to keep turning it on and off, and it had no name.

Yost: At the Babbage Institute, we did an early experiment to see if we could use it, in the early 2000s, so we would not have to get oral histories transcribed. It could work if you trained to someone's voice, but we could not ask people to read in for 90 minutes for their voice training. It did not work for us at that point and in fact, we still use human transcriptionists for oral histories.

Mountford: So, what system do you use to transcribe?

Yost: We in fact still use human transcription. If there's enough errors in the cleanup ends up taking as much time as the transcription, it does not make sense to automate. And it's a cleanup that, you know another benefit is our administrator over time develops knowledge of

terminology in computing even though she's not a historian, and so, things that voice recognition would miss, basically.

Mountford: Right.

Yost: And many names are mentioned too.

Mountford: Yes.

Yost: So, Mike Mills came for a sabbatical to Apple and stayed for a half dozen years and you collaborated very extensively with him and did some amazing work with QuickTime. Can you talk about that collaboration and that project?

Mountford: It is an interesting story. Mike Mills came from NYU, from the Interactive Telecommunications Program at the Tisch School of Arts at NYU. He was on sabbatical from Red Burns program. By the way, I thank her for being my best female mentor. She was unbelievable. Great friend, great supporter, she allowed me, as she said, to 'spend time' with Mike. Then, I quote 'stole him', as she said with a smile. He came for a year and he did not leave. He is still in California, floating around on a boat somewhere now. I started funding ITP, because they were doing very interesting work with televisions, using their own cable network show. They were using tools like HyperCard and video discs, to control strange, cable television shows too.

In fact, something was set up to go on David Letterman. I loved Letterman and thought, how interesting. A television program that's interactive? What does that mean? Live in the television, didn't seem to make sense to me! Immediately I wanted to get involved because it didn't make sense. I went out to ITP, spent time there, sponsored them, found Mike Mills, brought him to Apple, and then brought other people who interned with him. One of them was Dan O' Sullivan, who is now the head of the program, after Red Burns passed away. He joined HIG with other graduate students, then Danny Rozin, who is another an amazing person, a Chrysler design award fellow. When the NYU people came, we got influx of people thinking about computers as 'objects'.

HIG members started thinking of creating new interactive spaces, not just a space, but one projected at you. They tied Macs, literally, physically to cameras, using cameras as the lens to see the world. Dan and Mike's team helped create what we called QuickTime VR, which was a camera attached to a rotating security cam. The camera head could move around like a security

camera in all directions and collected pictures over 360 degrees, 1000s of images. The original 1 button mouse used to control 3-D movement of the QuickTime movie, came from the SIGGRAPH work of Michael Chen. The other interesting idea was an object maker, for which we built a steel frame within which a camera could hang, and then move around an object, in 360 degrees, like a CAT scanner. That was the inverse of VR, creating a virtual 3-D object to look around the entire 3-D object. VR projects with you, inside, an object maker allowed you to look around it.

These ideas initially were 'navigable movies' kits released on CDs. Mike Mills managed the ideas initially, helping make QuickTime a significant effort. A confounding matter is that no one person builds a product and no one team does it. It requires a hardware team, a software team and a design team. There was also work going on at MIT that we were fully aware of, and we were competitive trying to get a real product out. MIT called them Micons, moving icons, we called them, Dycons, dynamic icons. It was all very exciting, beginning to put movies onto computers. The interface had to be designed because no one thought that images were going to move. First of all, they just got images, now moving images?

The processing capabilities of computers were so slow that no one could imagine an image could become a moving image, certainly not a movie. Remember they were postage-sized images, so tiny that no one could really 'see' anything that small. I actually remember showing the first one to Jean-Louis Gasse, Apple VP, who could see that it would be useful. He said, "My grandmother now will want a computer." People in HIG, would make illustrative examples and then management would suddenly see, "Oh, the reason the graphics groups is important or the reason the hardware has to be changed is to let these kind of things happen." The application end had to be 'imagined' also, before the hardware and software could also be built. They would go on in parallel but having the application was very important. I actually did a session at CHI called "When computers are TVs are computers," which I proposed was going to be the future. Again, people said, "That was ridiculous, Joy," As so often has happened!

Yost: You had a good relationship with NYU, ITP.

Mountford: I continue to have close relationships with them to this day, now through Dan O' Sullivan. We did some amazing things like shooting a movie off the top of the Golden Gate Bridge, which was pretty dangerous but very impressive. Ian Small and Michael Chen with Dan

had to get the Mac, to the top of the Golden Gate Bridge to shoot a QuickTime VR movie. The Macintosh then was bigger than the elevator. That elevator took staff from the ground to the top of the bridge. The elevator held two humans, but it was too small for one Macintosh with its stabilizing platform, and a security rotating head with a camera on top! The team had to hand crank or yank the cable with the Mac-camera attached to the top of the Golden Gate Bridge into the middle of the bridge to record the movie. That was complicated and difficult, but it's all fun when you're doing things with press and drama.

The QuickTime VR rig also went with an HIG/ITP crew to Pavlovsk Palace in Russia, in St. Petersburg to film the interior of Maria Feodorovna's bedroom. A viewer could then see the intricate floor and ceiling, which are ornate and beautiful. We tried to work with the National Gallery on filming a Fabergé egg from inside the china cabinet. I suddenly realized the insurance costs for mistakenly crashing into a Fabergé egg with the camera, was not going to be worth the expense. We didn't do that, but we bought a cheap teacup from Costco and filmed that to show people the concept of a VR object. The concept was pitched to the National Gallery, DC, who was excited to work out an arrangement for a Palaces of Russia show.

Yost: By the way, we did not talk about the CHI kiosk, which I think Jonathan Grudin wanted you to do as well.

Mountford: Right. In 1989 in Austin. Yes, right.

Yost: Tell us about the badge system and conference kiosk. I read a bit about it in your article on HIG at Apple!

Mountford: Another challenge to me was that the community of SIGCHI was not using computers at conferences. When we went to conferences, we sat in a room and the speakers basically read papers, which made me frustrated. You can read papers at home on your lap. Why were we going to conferences? HIG had this idea that we might want to use conferences to find out about attendees. At that time, HyperCard was really big. Gitta Salomon thought we could use it to show attendees who was presenting, all the events that were going on at the conference, as well as about downtown Austin. All this inside, a CHI kiosk, an information kiosk, placed all around the hotel/building a Tech information kiosk. Attendees could just go up to the kiosk in the middle of the hotel and check on what was going on and by whom, instead of

looking at a brochure, fumbling through it. It was clearly a much more interactive experience using this kiosk.

That year the conference was in Austin and everyone was at the same hotel, which was super convenient. Gitta Salomon led the project team to create all these information HyperCards. Cards on the best restaurants in Austin, where you could walk to close by, all the individual speakers and attendees at the conference. We recorded presenters telling us about their papers in media and put them into this big database. HIG made phone recordings onto cards as well. It was an up to-date modern, multimedia presentation tool or kiosk. Data was on hyper-cards, individually, that could be indexed, sorted and search through by attendees by keyword topics, etc. We uploaded relevant data, every evening, at the actual conference in the center of the lobby. It all worked well, even loading the data at night. The team scrambled around like nut cases in the hotel to put new daily information into the Macs. The Mac did not hold much information in those days, so we had to move data in and out by hand, uploading every day. The goal was to show people that computers could be used live, in an effective manner. This was better than walking around with paper fliers. Fliers are out of date, and do not show the most relevant information

Yost: Very Impressive. You also designed and delivered Apple human interface guidelines in your group and high-tech notes which helped thousands of Mac developers create applications on the Apple platform. Can you talk about this work?

Mountford: Yes, that was something that made a big difference to the Apple developers that we had—

Yost: Also, what was the timing of this? Do you recall?

Mountford: Yes. The first year I got to Apple, which was 1986—is that correct?

Yost: Yes.

Mountford: There was a draft of the Human Interface guidelines then, from Technical Publishing, and the following year it came out, I think. I did not write the original version I helped in editing a version. When I received it, it was a slim document, probably half an inch thick. I had no idea that it was going to be so important. Partly it was important because nobody had actually codified the rules that Apple implicitly used when designing applications. At that

point, the rules were embodied in products such as, MacWrite, MacDraw and MacPaint. They were the applications we used as models for other applications to follow. If we hadn't designed those initial applications, then the Mac would not have been the seminal tool that it became. We wanted it to be easier for people to follow the guidelines than not to follow them. They were written very clearly. We wrote exactly what developers should do with applications, how something should highlight, how a menu should show up, what features should be in every menu etc.

Expectations with every application should be the same, consistent, not jarring or confusing. They should be identical. A user should be able to move from one application to the next, with the same expectations, being comfortable using the application immediately. That was the big idea. It sounds easier to do than it is; it is incredibly difficult to do. By writing those 'rules' simply in such a small volume took very eloquent writers. That was not my skill. Many people wrote very well, rewrote, and rewrote them until the guidelines were simple and strong. I think it got republished several times, with a few technical updates, while keeping it small and concise, so that developers could easily 'follow those rules'.

In fact, most developers would follow the guidelines. Developers used to say, we were the Macintosh police! When I went and gave talks in the evenings to User Groups, they would say, "Do you have the police out?" I was confused. Developers thought I had a 'police' force that would go around and enforce the guidelines, if developers didn't write applications the right way! I realized that the 'police' were the guidelines. It didn't actually matter since developers could do whatever they liked. I used to say, if you want to violate the guidelines, go ahead. What people knew was that if you did violate the guidelines the application would be less popular. Consumers would get frustrated with the application, so it was easier and better if you did the right thing. There were no police!

Yost: And I would guess that this was something that Apple did that Microsoft did not do or did not do as early. Is that correct?

Mountford: My understanding is yes.

Yost: One thing that Jonathan mentioned to me was how you brought new people into the fold, into CHI and how important that was and one of these groups was animators at Disney. Can you

discuss how you formed connections with new groups of designers and people and kind of brought them in to the SIGCHI fold?

Mountford: Well yes, I've always found it hard but fun to understand things. I think understanding life is difficult. At Apple, I realized that people were starting to animate things around the screen, especially in applications. How can we start to understand how to do that better? I thought "Why don't we find out how the 'old' world worked?" See how to emulate or learn from animators? Coincidentally, Apple had been working with two of the 'nine old men of Disney', Frank Thomas and Ollie Johnston. I phoned Frank one day. We didn't have the internet, so people actually used the telephone for making connections! I said, "I'd like to come and visit you". I did. He was a super charming man, in his late 80s. I sat with him and tried to understand how this great man had created such memorable scenes, like the loving spaghetti scene in "Lady and the Tramp". How do you draw spectacles coming on and off a snake, without hands or ears? I asked him about things I couldn't understand. How did he even imagine them?

I spent a lot of time talking to Frank and realizing that his wisdom and point of view was very valuable for others to understand. He was a great, great teacher and had written a valuable book called, "*The Illusion of Life*", which I immediately got. It is a very thick book, 500 more pages. I immediately took a section of the book, on the principles of animation, and shared it with everyone in HIG group to read. I asked him to spend time with the interaction community, because he had many words of wisdom to share across our discipline. In the same way, I reached out to choreographers, another creative language, like animation. How is movement translated to a physical body? How do dancer and choreographer communicate? Does the creator walk around and move the body, or how do they do that? It seems difficult to do. How do they communicate?

How do you use a pencil to create an emotional film like Bambi? Many difficult and interesting questions. I love talking to animators. I also worked with architects. How do architects make giant buildings? They don't physically make the building. How do all these complex new ideas get translated into a computer? I spent a lot of my time asking people who did not use computers how they did creative activities. Another was gardening, how do landscape architects plan a garden, plants grow at different speeds, and have different sized foliage? These all could be great things for a computer to do. I was curious about how to use computers in new ways. That's why I reached out to other professions and asked for help, because I feared computers

would continuing doing the same old things. I felt computers needed to do new things for new people to do creative tasks, not just functional tasks. I also learned the power of observation from Frank Thomas.

Yost: I understand that you reported jointly to the Apple Computer VP of Advanced Technology group, so R&D and then also the VP for Software Engineering. Was that difficult reporting in two different directions and can you discuss that tension, if that existed?

Mountford: Well, yes.

Yost: Or balancing act, perhaps?

Mountford: I remember at one point I had two offices in two different buildings, so I had to walk between the two and I had three assistants. I don't know why three, but anyway. I was confused all the time. I didn't go home often. I pretty much worked all the time because I loved my job, and you could not carry computers home in those days. When you were tired, it meant you had to go to sleep. You drove home and slept. Then you woke up and went back to the office. I was very happy, but I did not have much life balance. It was difficult, and the jobs did reach a crisis point. No one could do both of those two jobs. The goal of research group was to do the next thing. The goal of the product group is to do today's thing. In essence I was putting on two different hats. I think people who are good at either one of those things are not necessarily good at the other and vice versa. I am not sure I did either very well, but I did try.

I was always biased towards the research team, because I like doing new things. I tried to do the things that were necessary for everyday products too. For example, the guidelines are not that glamorous, but they are necessary and super important. However, they are not as interesting as doing a quick photoshoot, off the top of the Golden Gate Bridge. Obviously, you can't do Golden Gate Bridge shoots every month, but trying to balance those positions was difficult. I was ultimately told to make a choice. Don Norman told me, you have to make a 'choice' which is you have to go and do system software. No choice! I said, I don't want to do that! I left. Shortly after Steve Jobs came back and took over with his Next staff, which was the job I was going to do, or should have done, according to Apple.

Yost: Speaking of Don, one area he contributed immensely to that I that you did as well is the complementary area of science and design, or science of design. Can you discuss those two areas?

Mountford: Don talks very well about almost anything right. He's the Neil deGrasse Tyson of science and design.

Yost: Yes.

Mountford: Very few people can speak clearly and simply about the world, period. I think Don is one of those rare, eloquent people, and he has made so much of a difference to design. He changed our life. Let's pretend interaction even had a life before Don. My interaction life has always been around Don, so it's hard to believe there was interaction design before Don. We used to spend time fretting about, "Will anyone pay attention to us please?" He made the landscape fairer, suddenly people stopped saying, "Oh, you're *just* a designer." I always say to younger people, please don't use the word 'just', because it is belittling. Initially when I worked in man-machine systems we fought for every little change which was tough. At Honeywell, it was somewhat easier because we had an ultimate success criteria. If you didn't design things well, the man, the pilot, might die. That's a great motivator to design things well!

In the world of computing, poor design does not cause the user to die! You have to justify decisions by other non-critical metrics, and sometimes that is very hard. I have had to justify, explain why something is right, and defend it 10 ways. People ask, "Well, how do you know?" They don't seem to care about my use of science or experience. Don has made that much easier by being a very clear communicator with some gravitas and documenting supporting metrics. The only thing I wonder is what he has actually designed. Even with that gravitas and metrics, design is still challenging and difficult. Remember, nothing is ever finished being 'designed'. It's shipped as is, now. It is now, what it is at this point in time, for this amount money and level of patience.

It's feels like a very heartless task. Is a painting ever really done? You finish it based upon your own personal criterion, as best as I can, with the given money, and given time and amount of effort. I have designed something but two days later thought, "This is awful!" and suddenly realize it's gone to be 'shipped'. "Can I take it back?" You can't. I think interaction design is harder than any other design profession.

For example, if you are an industrial designer making a pair of glasses. The glasses do not change every time I put them on, they don't change at all after they've been shipped, except they may break. As an interaction designer, I have to consider every single combination of anything that might happen with that interface, and for any single type of person that may ever interact with those glasses. Those computational combinations are quite large. That's a very big design space to solve for, so you have to shrink the design space to succeed. Interaction designers have to decide on an approximate user, approximate task, approximate error states. An interaction designer has to address all the fluid states of the potential product changes. Industrial design does not have to do this. Industrial designers have traditionally used 3-D tools that are not used by lay people at home, which adds mystique. They often have more credibility and get paid more, and you can hold it - here it is. You can't hold an interaction design, by the time you've clicked/pressed on it, it's gone away. Then you have to do another instantiation, another one, another one and so on, because the design moves all the time. There is less mystique with interaction design because the tools are accessible to every computer user. I think it is the hardest and most frustrating and requires a range of skills. Often the underlying software or hardware messes you up too. It may not respond the way it was designed to, now the designer has to design a solution to a new problem, not the original problem you initially were trying to solve.

[Short break]

Yost: We were talking about science and design, or design and science.

Mountford: That's a difficult new path. I think what is beginning to start nowadays is generative design. Generative design is quite interesting offering two schools of thought from designers. One is that designers don't like algorithms doing their work, but they could embrace the potential. I think designers should allow themselves to do the difficult and fun parts of design, which are the most creative parts. However, if generative design iterates too long creating too many solutions, the designs can become too similar, and less interesting. The choices should be constantly allowing variations to introduce more breadth. The solutions must ensure not iterating too many generations resulting in too much sameness.

What do we do as designers, and why do we do it? Designers should reject the boring parts of their job, it is not a repetitive task like, Color by Number. However, why do we do enjoy coloring

by numbers, Mandelbras, or all do that kind of art? One reason is because it allows you to do something mindless, filling in numbers, or a spreadsheet. The question for generative algorithms is what is the best balance of mindless repetition with bursts of amazing creative design? It is too draining to burst with creativity every nanosecond. How do generative algorithms become part of crafting an experience for the designer so the designer can engage in design actively? I don't know that balance yet.

Another thing I have heard discussed is how you slow computers down. Answers come up too quickly for users to actually understand. Think for a moment how people in the olden days used to write narrative stories about experiences at fairgrounds to understand optical illusions. They were interesting tales. I used to understand things better, because it took time to read and there was a story. Nowadays a search gives a result. There's no story, I don't have time to absorb anything about it, it is just a factoid/result. I believe that you have to live with something long enough to understand it. I don't know how quickly you can keep just getting stuff and understanding it.

Yost: Did the continual adaptation and creativity of the Human Interface Group programmers influence software engineering more broadly at Apple, including in terms of systems, and perhaps in terms of movement from waterfall to agile to development techniques?

Mountford: When I was at Apple, we didn't have words like waterfall or agile. I hear people now claim that Agile is not particularly conducive to creativity and designers push back on using agile a lot. I think there's good in both good. I think the world of no constraints, time, even money, do not help people to design well. You need constraints. Actually, if you say you've got infinite time and infinite resources, nothing much will happen fast. Look back at MCC, or other places like that, where there was little push back, folks got lost. It's better to have some limits.

In the Design Expo for example students say, "Well, you told us to design a computer system that had two menus and one leg", and I say, "Yep!" They say that's too constrained. "I want to it to be able to do anything I want". However, I say, "That's actually going to be much harder, but go for it anyway". The result is students spend 90% of their time trying to figure out what problem is the best to solve. And then 10% of the time left is spent really doing something. I believe using constraints helps designers be more productive, quicker. That's why I think Agile

does help. It helps a majority of designers push themselves. I don't know what they do at Apple because I have not been there for 20 years.

Yost: I understand from Jonathan that you were very influential and a major force with Brenda Laurel, influential and important book, the *Art of Human/Computer Interface*. Can you discuss her work and your interaction with her?

Mountford: Well initially, we agreed HIG would write that book. Apple, ATG paid Brenda to edit that book, as a contractor. It ended up being a difficult relationship, because I didn't know my name was not going to be co-editor on the book. Most of the people writing the chapters we're working in my team, obviously not Timothy Leary and Nicholas Negroponte. We brought them in as in-betweens, to introduce some fun bits. The other chapters were written by people in the Human Interface Group and it turned out to be one of the longest published interface book for many years. It covered a good spectrum of work, and it's not really out of date today. I thought about re-editing it recently, with the same authors, but Apple copyright permissions would be hard to deal with etc.

The book was the right thing to do. We got the group together, and we read each other's chapters and re-read, and edited the work together to make it flow effectively. I'm glad we did the book. It took a lot of effort to put the book together, because you have to get everyone on the same page, as well as get everyone at the same time to finish their work. Larry Tesler was worried that we needed an Apple person on the book to get recognition for it. That's why I thought it was going be me with Brenda. She has gone ahead and had a great writing and editing career, contributing some very important books to our area. Her ex-husband worked for me, at Apple and Interval, and is a really great guy, Eric Hulteen.

Yost: Before I ask you a handful of questions on some of the other places you have been, is there anything else you'd like to say about Apple?

Mountford: Well, it is easy to forget that HIG did many other interesting projects. One of them was an interface to the first Apple camera that was shown at a WWDC event, QuickTake. We also had a product called Scribe, which had a touch screen you could write on, and showed the first touch screen, drag-able post-its or tags to categorize and label photos, by Laurie Vertelney. My TED3 talk showed an interactive VideoPostcard, Videologger with a History Controller. Only a couple of years ago, finally, Apple shipped the last piece of work from HIG when I was there,

called stacks. HIG called them 'piles', from Gitta Salomon's team. It was the last thing that the Human Interface Group did in 1994 and shipping it many years later in about 2008. This just shows you how long it can take to actually ship things that you create, but I'm glad they didn't just stay in the closet/boxes.

Apple was an excellent place to go and learn, and it is still one of the greatest places I've ever enjoyed being a member of. All of us are still friends too.

Yost: Can you tell me about the move to become a senior manager at Interval and working with Paul Allen?

Mountford: Yes, well it was interesting. I gave a 1994 keynote address at SIGCHI. One of the things I showed was the Apple store I thought they should build, while wearing some interactive clothes and jewelry. When I came off that presentation David Liddle was standing there, he had been at PARC and said, "I think it's time you had a break," and suggested I move to Interval. I said, "I don't want to go to Interval because you don't build anything. You just research." He said, "Come to Interval and change it." So, that was that!

He negotiated me moving there, and I negotiated moving there with a team. I wanted to build some musical products that would help people who did not read notational music to make music. I did do that in different forms. One was a bead box which Bill Moggridge wrote up as a chapter in his 2006 book, worked on with Tom Dougherty. I did others, one of which came out as a Lego product in Europe. It was a derivative work with 'blocks' that plugged into a base board to play music. That was an exciting for me, working with several well-known musicians, another great phase of my life.

Yost: I also understand you had built systems for collaborative music jamming over the internet. Can you discuss that?

Mountford: It was called early 'physical computing', which meant we embedded electronics inside physical devices. One was a set of 3-inch beads pushed into holes in a base that triggered sound samples. Where each bead was plugged initiated different sound samples. Each plug had an unique interactive resistive ID chip wrapped inside it. It 'contained' the trigger for a different sound sample when it hit a specific location, therefore building up a soundtrack system. We had different CD sound samples, so you could jam with different people with you, and over the

'internet'. The samples were designed by different musicians so that in whatever order they were triggered, they would always sound good and 'musical'.

You could switch from one set of sound sources to another set of samples. Ultimately, the goal was to do that over the internet to pull in different sounds and also push them out, to mix them. I was told the internet was a 'passing phase'. So, the product would probably not 'work', which was clearly obviously not true! Anyway, it was hard to get out as a product, partly because it used such little pieces that could easily get lost. The idea was great, and it worked well. I didn't have the financial ability to put it out as a product, even when the Internet became real. All ages young to old loved to play music, jamming with the Beadbox.

Yost: And you also did some work with systems for printable interfaces that interacted with physical books, cloth objects. Can you discuss that?

Mountford: Yes. I wanted to be able to design products using existing media to create new ideas, such as paper and books. We took a portable color sensor and attached it remotely to WebTV to sense/read colored information. This then triggered events on WebTV through the internet. We built an ordinary CYMK color reader. It was a new type of barcode, literally reading or sensing existing colors to 'trigger' an attached interactive experience on the television from the internet. In addition, users could 'read' colored inks on a T-shirt. We created smart internet enabled books or clothing. In addition, users could add colored Avery paper dots to magazines or existing fabrics. A server system set up tracked all the inter-connections to enable new paper-based experiences, enhancing books already published. Disney was very interested in this, and they tried to buy it from Paul Allen. But Paul Allen, didn't want to sell that to Disney.

Yost: Was that licensed to them?

Mountford: He wouldn't license it.

Yost: Is there anything else that you would like to say on Interval before we move on? Ok. Is it pronounced ID-bias?

Mountford: No. I.D. Bias.

Yost: Okay. Can you talk about that interaction design company?

Mountford: Yes, I decided that I would create my own interaction company. We had about six people and two offices, one in San Francisco, and one in Mountain View. I had a young child, so it was a good lifestyle change for me. We worked initially with a company called military.com, which actually got bought by Monster.com. We did various consulting gigs for them, including the 50th anniversary website for the Korean War. We also worked for a company called B3, B2B2B banking work, not very interesting, but it paid well, including the Research Library Group. The good thing was, I did not get myself stuck in a lease agreement. I had kept trying to find office space to lease but missed out. But then the dot-com crash happened. That ended up being good luck for me. We also worked for Lego, and some of the previous Interval ideas from music jamming came out as a European Music Blox product for children.

Yost: This was good news for colleagues and friends of mine at the Computer History Museum because they found out that the Silicon Graphics building was available and purchased it very cheaply, at the about the absolute trough, very cheaply compared to the bubble peak.

Mountford: Good point.

Yost: Can you tell me about design with phone based financial transactions that seems really early to me, can you talk about that?

Mountford: I think we thought about it. A lot of these ideas were illustrated, we talked about being able to speak and being understood by the computer. We did an audio note taker called WalkAbout, by Eric Hulteen. These ideas sound so obvious now, like the Apple store. I can show you example pictures of the Apple future store I made for a talk, but Apple said, "That's ridiculous!" You may remember when Apple first started, they didn't even know where to sell computers, because computers were not a product category. They had to sell them in TV shops. When we were designing new computer applications, we wanted to have computers in a place where we could see what they would look like in different situations, even worn. We had scrapbooks of ideas, showing where you might carry devices and wear interactive devices/clothes. We staged product design ideas so people could imagine what they might do in the future. Remember we were women, saying "I don't want to do this thing until I see what it looks like in a place or situation, on my body or carrying it". All these ideas were sketches or prototypes called Screenplay, from Laurie Vertelney. We tried them out, and we showed them,

mainly to our bosses. Unfortunately, my managers were all men who would say, "No, I don't think we're going to do that." They couldn't see themselves doing such ideas.

When we talked to our bosses about those ideas, it was uphill, difficult to persuade unless the managers could imagine themselves doing it. I spent a lot of my time trying to persuade them about new application areas. I once showed an Apple/Mac enabled lunchbox for children, standing in front of the Apple executive board during the presentation. The manager of ATG came over to me afterwards and said, "Pearls before swine!" Our HIG direction was so different from the direction they wanted to go. The board were planning on shipping products to schools for educational purposes. Our ideas were more consumer focused, as Apple is today. Some of our bosses seemed to have little imagination; this was around the Knowledge Navigator, video in 1987 focused on education. There was little, long-term view.

Yost: You were at Yahoo! from 2005 to 2008 and directed a major redesign of what was at the time was the most visited webpage, the front page of the site. Can you tell me about that effort?

Mountford: Yes, the home/front page had been pretty static before I got there, and the philosophy had been always, if the content is important, put it on the front page. If the user didn't see it immediately then no one will find it. No one really scrolled. There were two solutions to that problem. You make things smaller and smaller as more information came in. This did not really work, because ultimately it just looked cluttered and ugly. Or, if you take things off probably no-one will find or use it. What we came up with was an idea showing that rolling over something would expand it. Therefore, you can get more information inside a small space, you get two layers of information. Management thought this would be difficult, because people would get confused because the page would move. Remember, these were the old days where things on a page didn't move around, like they do today. We did that.

Yost: Right.

Mountford: We built a roll over personal information manager (PIM) to show personalized feeds for six items: email, messenger, local traffic, weather, events, even horoscopes. These were the top used properties. They were quick to glance/look at, and most frequently viewed. All these applications were inside one small, contained area so that users could roll over and glance at them for quick updates inside a little window. The rest of the page information were items users

could engage with for longer, more serious time. Those items were for buying something, reading a personal ad, or news. Those items would be clicked on, as opposed to rolled over. We built the PIM module, and did live A/B testing of the front page. There was no drop in views or visitations, the page stayed as the number one biggest trafficked internet page. Nobody freaked out when the PIM moved, everything was good. That was the beginning of users being willing to accept changes, pruning, as opposed to stuffing more and more material on the front-page.

Yost: And you won the company Superstar award for that, correct?

Mountford: Yes, apparently, yes. I walked around with a star on my head!

Yost: [Laughter] Another thing you did there was you commissioned a research prototype of a large format five by six-foot multi-touch screen to demonstrate innovative applications and multi-user interaction. Can you tell me about this?

Mountford: I was doing the property page redesign, relatively well then Yahoo decided to give me another job. There is a pattern here right? I became head of a research group, in addition to my day job. I created a new team for data visualization, Ben Clemens and Aaron Koblin. That team was actually in San Francisco the other group was in Sunnyvale. The data visualization group was responsible for showing the first real time traffic across the internet. The team visualized all sorts of Yahoo properties, data, local traffic, Yahoo Answers, flickR, Delicious, and Yahoo search.

I thought it would be interesting is to use a world map to show where photos were being uploaded in real time from flickR, which was very popular then. Interestingly, it turned out that we saw from this visualization there was much photo uploading activity happening in Africa. We didn't know that before, but realized the reason was people didn't have a lot of desktop machines in Africa. Instead they were using their mobile devices to upload photos, opposed to posting onto their desktops. We used a world map, rear-projected on a multi-touch surface table. It was circular, the world is spherical, and therefore they worked well together. We kept the world rotating, and where you touched the surface of the world, you saw a live feed stream below your fingertip via touch. Consumers got a direct connection between themselves, where their fingers were virtually and the actual place where the photos were being uploaded. We used the multi touch table with multiple people standing around simultaneously touching in

different locations. I think the prototype company (MOTO) we worked with was sold to Microsoft, to become part of their multi touch surface products.

Yost: Did the visualization tools also influence types of strategic development and planning at the company?

Mountford: That is a good question. They should have, because obviously watching where people are visiting, and where they are hanging out, should improve or change your business position or strategy. At that historic time, 2005, Yahoo was the biggest search engine and provider of email accounts. Hard to believe Google was second, but when I asked Y! people in the executive suite, what search engines they were using. The answer was Google. The writing was on the wall I thought. Yahoo was not a search engine, but actually a data aggregator. This meant Yahoo should focus on other data assets like Yahoo groups, and other Y! data trends.

Y! Groups was a superior product, with loyal users. We wanted to support Yahoo groups, but the executives didn't think that Yahoo groups had a 'monetizable' angle. The User Experience team showed them what users were searching for, through their critical key word searches, which was pretty prescient. Search interests, second by the second, showed an ever-changing world. It was helpful to know what these wonderful waves of movement might indicate about customer behavior across the world. (We were thinking about where and when to place ads or news.)

We also processed data AT&T out-going telephone calls, live. It was the first live feed, shown at MoMA in New York, with Aaron Koblin. The data showed area codes of phone calls, where they were going to and from. Many were to Vietnam and simultaneously to the Netherlands. We learned a lot of people from New York have relatives in Vietnam or the Netherlands. Families moved to the Netherlands and to New York. A connection you would not have known unless you were indigenous to that country. Insights and learnings can be seen from search, and other visualizations of emerging patterns of data traffic, not just from the end results. The executives did not really use that information to decide how to move the business forward. Instead, they terminated the group. That group then became the core group Google Data Arts Insights team. They all left Yahoo to go there. But not me, since I was the vice president!

Yost: Well, certainly it has had a huge impact on the world.

Mountford: Well, we had. Yes.

Yost: Is there anything else you wanted to mention about your years at Yahoo!?

Mountford: Yes. I guess I have to look at my own resume right and find out what I did. One important project was our work for the Internet Archive. We built an image browser for the out of print books that Brewster Kaehle has diligently archived, with Ben Clemens and Michael Cheng. I've worked with Brewster for years on and off. And as he has often said "Joy, I forgot again. You know, the interface!" He does all the heavy lifting, except he had forgot to put a browser on top of the book's images. Therefore, we built an image browser for the hundreds of thousands of books the archive has scanned, all to work in one 'zoomable' window. Now users could quickly see all of the pictures as thumbnails.

Librarians and museum archives, archivists, loved it, Because they could now quickly see pictures of inside the book's content. If you didn't have such a browser, the images are essentially lost, or never surface from inside the book. Users did not have enough time to look inside all the books to see all the images. You can read the title, but you do not know what pictures are in there. The pictures are so incredibly illustrative of what is inside the text, the content which is really important. You need the pictures to be quickly scanned or skim-able let's say. We did that browser for the Internet Archive.

We were looking forward to installing a demo at the Exploratorium, where I had had a fellowship, as an Osher fellow. We had built a touch enabled vertical surface to edit data, images and text into a poster that people or kids could print, to leave the museum with. However, the Exploratorium, was moving their location during that time, so it never happened.

Yost: When we had a pre-interview short meeting, you showed me that visualization for the Internet Archive and I was fascinated by it. I come from the, I'm a historian but I work with archivists and librarians and we are the leading archives for computer history in the world, CHM leads in artifacts and exhibits, so this was tremendously interesting to me—

Mountford: Wow.

Yost: Really with both books as well as manuscript collections and that kind of stuff so it was really fascinating to see. And I'm a big fan of the Internet Archive and Brewster's work.

Mountford: Yes. Have you ever been to the building?

Yost: No, I haven't. I had breakfast one day with Brewster at the Computer History Museum, but I've not been to the building.

Mountford: You know it's a church, right?

Yost: I did not know that.

Mountford: Yes, so when you see it from the front, it's has big columns, sort of fake Egyptian columns thing and then inside an altar/organ.

Yost: Fascinating, I will have to visit, at least to see the building. You became the Senior Director at Akamai Technologies. Senior Director of user experience and design from 2012 to 2015. Are there any topics you want to discuss with this today?

Mountford: Akamai is a company that was founded by a professor of Mathematics at MIT, Tom Leighton. Reason I mentioned this is, it is even more design-phobic than the average technology company. They have a quarter of a million servers around the world, carrying most of the Internet traffic for large companies. They hold up most of the CDN data going around the world, which is exciting, because it's so big. It needs to be understandable. They have what they call a big NOCC, Network Operating Control Center. It is in Cambridge and can be watched from the street windows, showing lots and lots of real time data traffic, flying around the internet world.

The rotating globe shows the quantity of data use as vertical spikes, travelling across the Internet all over the world. No one knows really the details of what is going on inside, but the NOCC looks super exciting. It's very expensive to keep track of all this data and has very technical users, who are very literate. It's very complicated system and product to get your head around. Akamai wanted my team to try and figure out where servers might potentially [be] losing data, through visualizations. Customer companies needed to know when and where there might be real net attacks to protect them from the dark net. Akamai holds up products like iTunes and the Olympics, World Cup etc. This live data is very important for people to see in real time. If the network dropped data or made any mistakes that would be very bad for their viewers.

It was a great challenge, especially very complicated. My goal was to make it easier for the companies who use it to understand. We tried to do that and succeeded to some degree. One of the great quotes from one of our users came through the customer advisory board that we set

up. When we got feedback about the Network Operating Center he said, "I want one of those big, spikey, globey thingeys". This quote motivated us to help him get his own "spikey globey thingey", to see his data, his own data, not just generic world data. His own "spikey globey data", as his interface. That's what I achieved when I was at Akamai, and it was great to build tools for individual companies to have tools to see their own data, thanks to Ben Mandenberg.

Yost: That's fascinating. And from there, in 2015 to present with Ford Motors at Greenfield Labs in Palo Alto, the Interaction Design lead, and recruiting and leading an interdisciplinary team in user experience in AV. Can you, I realize there is some limitations on what you can discuss with the present time, company, but are there things you can say about this work in general.

Mountford: Well, autonomous vehicles are a holy grail that many people are all trying to do, so we can reduce our stress levels while driving, and reduce the number of accidents caused by driving. It's obviously more complicated than it sounds. The amount and depth of technology you need to build to avoid hitting anything is huge. If we made it good enough to avoid hitting small things, like a paper bag, AVs would never get any traction in the world. I have to say AVs involve a lot of new exciting, sensing technology. The idea of helping a passenger trust a vehicle, without a person driving, has been my most recent research interest with Melissa Kim. This topic is not going to be an easy transition, because people trust people, they don't trust machines. As witnessed with airplanes, people don't like to think of an autopilot landing planes. The passengers want to know a pilot is landing them.

Going back to the beginning of my career, thinking again about how the relationship between a person and a machine develops. How can we develop trust to make valid transactions, how will people believe in machines? One of the parts of my job at Ford was to develop a digital assistant, more than sophisticated than Alexa or Google. I worked on aspects of a voice system that included voice tone, pitch, and phatic used by the assistant. When I talk to you my intonation, hopefully makes a difference to what I say. Even the nods that you make, and noises you use between words make important contributions. They make me believe you're listening, maybe you're not, but it makes me believe more of what is happening between us. Not just, okay, okay, it's far more to do with the subtle noises, surprise noises, pleasurable noises. Anything but not just silence. Not just an assistant saying, "Say again". "Say again." "Say again".

Fortunately, we have moved on a lot from the old days. My favorite funny example is from the 80s when we had voice chips in cars. If passengers left the door open, the door would speak, "The door is ajar." Well first of all, the door is not a jar! The door is a door! This was an awful, awful message. Very quickly, cars got rid of speech synthesis messages, because of that horrible error. Then we went back to "Beep", "Beep", "Beep," which is also horrible, but for different reasons! Nowadays, we're looking at a whole different way of talking with digital assistants. One idea is to have the assistant take over the role of a person driving autonomously. There will have to be a transition and over time. There could be an assistant helping in that transition, maybe even temporarily, until passengers are comfortable with the new Autonomous Vehicle. That digital assistant has to start to make other human kind of transactions to establish elements of trust, that's the area I have been interested in.

Yost: That is intriguing. Are there topics we have not discussed that you would like to before we conclude?

Mountford: I don't know. I'm doing a Clubhouse event tonight. Do you know what Clubhouse is? It is audio only, radio social network. I'm going to be running it about my life and technology. I get back on stage at six o'clock. I want to talk about how to be inspirational to women. I did not know my journey was going to be this when I began my career. I didn't know I was going to be as successful as I have. I didn't ever think I was going to be a role model for other women. I think that is important for women to know that you don't set out to be a role model. I think accidentally you do what you can do, and then you find out it may make a difference.

I was remember seeing Grace Hopper once give a talk. I was at a Honeywell dinner, and accidentally saw her at her hotel when she was talking, I was in the back of the room and I saw this tiny framed woman wearing a stark Navy admiral's outfit with her hat on, giving out her nanoseconds of wire, carrying a scotch and a cigarette. I remember thinking, well; I want to be like her when I grow up. Which was obviously a ridiculous idea that I would be a Navy admiral. I'm going to start drinking scotch and smoking, which is not what I meant! But the whole idea of her being a counterculture character and being a 'different' person. Having people's sitting listening to her too. I had some notion or an idea of what I wanted to be. I think I was probably 22 or 23. That was my idea of what my future was going to be.

Yost: Well, thank you so much. This has been really fascinating for me. It will be treasured by SIGCHI! Your work has contributed to so many different interesting areas and the impact you've had on so many aspects of HCI has been really remarkable and impressive and I thank you for your time and for powering through on a day when you have multiple presentations and with a bad cold, thank you so much.

Mountford: My voice, I am just losing my voice a bit that is all but, so we are going to get together again and try to talk about the AV version, right.

Yost: Yes.

Mountford: How many weeks gap?

Yost: Oh, it was wonderful to chat and generally, we are getting transcripts to people to do editing that they wish to do in about a month or so.

Mountford: Great. Thank you, Jeffrey. Ok.

Yost: Take care. Bye.

Mountford: Bye-Bye.