Oral History of John Warnock part 2 of 2

Interviewed by:
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Warnock: So, when I was at Xerox PARC Doug Wyatt and myself worked on a paper for SIGGRAPH. Okay, and it described a printing imaging model, okay? So, it had clipping boundaries. It had masks, it had images. It had overlays in the way that that all worked. And, so, we tried to describe a generalized imaging model that would incorporate both geometry curves and images and color and even half tone. So, we did that paper and I think, boy, that would be in 1982 I believe or '81-- '81 or '82.[1] And that was essentially the PostScript imaging model. That was a way you described sort of everything on Earth you could think of from an imaging point of view. And, in particular, we had thought about that from the point of view of how you might implement that, where you-- even when you don't have a frame buffer, where you have too much data for any memory. So, for typesetters you had to have a way to implement that imaging model where you couldn't hold the whole result in memory.

So, the attraction for Steve [Steve Jobs] and for us was that it would be wonderful if you could write applications on a computer that use those same basic geometric constructs and imaging constructs and same imaging model, because then it would translate to anything you could possibly print. Okay? So, there was a huge advantage-- going to be a huge advantage of giving that way of expressing graphics on your personal computer. And over the years that actually developed into Canvas. Okay? So, there was SML and SVG-- the vector graphics. That was an implementation of the imaging model sort of for the Web.

Brock: Okay.

Warnock: So, whenever I do anything on the Web, I use that.

<laughter>

Warnock: Okay? Because mark-up languages, I just have never liked mark-up languages. So, this sort of procedurally allows you to describe any type, anything.

Brock: Did that model that you-- this generalized model of the image, let's say--

Warnock: Yes.

Brock: --wherever it's realized on paper through a printer or through display on whatever sort of screen, did it also-- had you at that point in time thought about the dimension of time, which I guess would be for moving images, for video or animation or things like that?

Warnock: We always felt that that was clearly an obvious extension. In other words, going into the time domain, I used to write little PostScript programs that would actually build frames and we put them together into little movies.

[1] John Warnock and Douglas Wyatt, "A device independent graphics imaging model for use with raster devices," SIGGRAPH '82 Proceedings, pp. 313-9. Added by David C. Brock.

But, yeah, it was a clear extension. Also, when we started thinking about Acrobat we always thought, you know, obviously you can incorporate video into this and you can incorporate all kinds of moving stuff.

Brock: And by rendering it in the kind of PostScript language itself for a movie-- as you say, with Acrobat, I'm not sure that I follow you exactly.

Warnock: Well, you could do it as either a sequence of images--

Brock: Right.

Warnock: --the way that most television is done or most video or you could do it as a sequence of geometric change. In other words, change-- growing a rectangle or growing a thing and just have commands that will repaint the picture but changing the geometry rather than changing the dots.

Brock: I see.

Warnock: And if you do it with sort of the geometry, you can have device independence. So, it can have any amount of resolution that you want it, because it's getting rendered to appropriate resolution.

Brock: Does any of that fast forward into the whole world of Flash?

Warnock: Not too much.

Brock: Okay.

Warnock: Flash was Macromedia's attempt to describe how animation is done.

Brock: Right, but a different model. Totally different model.

Warnock: Yes.

Brock: Okay. So, at NeXT, my understanding is that they did kind of use Display--

Warnock: Yes.

Brock: --PostScript for this very--

Warnock: Yeah, their operating system.

Brock: And was that a very collaborative project to your mind or was it--?

Warnock: Yes.

Brock: Okay. Could you maybe say a few words about how--

Warnock: Well, Bud Tribble was their head of engineering and we'd worked with Bud for years and, so-- and he had good programmers and we had good programmers and we just worked together.

Brock: And was that-- the success of that, the success of realizing on that NeXT platform-- what did that mean for you about your thinking about the future of Display PostScript and--

Warnock: Well, I always felt that the imaging model was just-- I mean, what the Mac had was Quick Draw, which was essentially a way to draw bits and it mirrored pretty much most of the approaches that were taken at Xerox PARC with the Alto.

Brock: Right.

Warnock: Okay. And, so, they did QuickDraw. And, so, when they got to the printer they had bit-mapped images that didn't look like anything that you would really like to use.

Brock: Right.

Warnock: So, what happened was when we first implemented PostScript there was an interface built that took the QuickDraw commands and sort of translated them into PostScript so that they would become device-independent. So, they could sort of liberate themselves from this bit-map architecture.

Brock: And, well, maybe we could just run that line of Display PostScript and, I guess, Display PDF--

Warnock: Yeah.

Brock: --you know, run that line into the future. How did that--

Warnock: Well, we implemented on the Macs-- they were starting to become color Macs at that time. Also, so, we built a set of routines that would display to the Macintosh, to the new color Macintoshes. So, we could start to render PostScript files directly onto the Mac screen and see the results. And the machines at that time were just making the transition from being too slow to be practical to fast enough to be usable. Okay? So, there was sort of a barrier around 1990 where the Macs started to be fast enough where you could display stuff on that screen and have it be useful.

Brock: And did that Display PostScript, Display PDF on the Mac, did that grow in terms of-- meaning that beyond the use of that for Adobe software products--

Warnock: Yes.

Brock: --did it become more generally used on that platform?

Warnock: Well, the way that it-- and let me try to get back. I don't know whether we've talked about the very early origins of PDF, but what happened is when we announced the LaserWriter-- and I think I told you this story -- I had hand coded in PostScript this very elaborate tax form.

Brock: Right.

Warnock: Yes.

Brock: You did mention that.

Warnock: Yes. And it was subroutines and calls and all kinds of things to do dotted lines and all kinds of stuff. And it used to take on the LaserWriter-- you would send the file to the LaserWriter and the LaserWriter would write for around two minutes. And then the page would come out. And Steve [Steve Jobs] really wanted to demo this at the announcement of the LaserWriter. And, so, he said, "I cannot talk over two minutes."

<laughter>

Warnock: "I can't make people interested while waiting two minutes," and he said, "But I would really like to do that." And, so, an idea occurred to me. And the idea was rather than-- what you should do is write a PostScript program so that when you came to a draw command like "Move To" or "Draw To" you had two paramet-- you had the X and Y on the stack and you say, "Move To," okay? Now, what you can do in PostScript is re-define what "Move To" means. So, you can usurp its semantics. And, so, rather than having it actually do a "Move To" what you do is you write out to a file X, Y and "Move To" to a text file.

Brock: Okay.

Warnock: Okay? Now if you do this with all the graphics commands, "Move To," "Line To," "Fill," everything else, you can turn this program that's full of loops and procedure calls into a linear stream of very straightforward graphics commands-- *only* graphics commands. So, you're taking out all of the loops. You're taking out all of the procedure calls. You're taking all of the calculations out. And all you're ending up with are the bare bones graphics of the image.

Brock: I get it.

Warnock: So, the tax form went from two minutes to twenty seconds, because the PostScript file you sent to the LaserWriter had no loops, no conditionals, nothing other than graphics commands, which made it really fast.

Okay, so, what we-- so, the idea occurred to me when we started thinking about using Display PostScript on the display and thinking about what documents could do-- the other argument that was going on at the same time is why not use PostScript as a document interchange program? In other words, if I want to send a document from Point A to Point B, why wouldn't I just use PostScript? Couple of problems with

that. The problem is that you don't send computer programs over networks. This is a no-no. There are too many vulnerabilities that you can open yourself up for.

Brock: Right.

Warnock: So, I said, "Well, why don't we use this trick and turn the PostScript program into this linear bunch of graphics?" There are a couple of advantages of that. If it's a multiple-page document, the pages are separated, because there's-- you aren't in a loop that's generating pages. I mean, one of the problems with a PostScript program you never can tell from analysis whether it produces one page or ten million. You just can't figure that out.

Brock: Because it could contain a loop--

Warnock: Yes. That generates pages. And if you do this linearization, you have page boundaries. You don't have any conditionals. You can tell by examination exactly how it's going to behave. And, so, we started experimenting with that idea. And it not only solves the problem of moving the document from place-to-place and binding up all of the fonts, everything, knowing exactly how many letters out of a font you use, it does all of those things *and* the result was unbelievably fast on a display at that time, even at that time. So, you started to get the performance.

So, I said, "All right, we need to prototype this." And, so, we had two really good high-speed programmers build a prototype of this and the prototype was pretty amazing. I mean, it seemed to work, but then when we said, "Look, if we're going to solve the document interchange problem, we cannot have junk code do this. I mean, we cannot have-- the code has to be architected so that the format is totally extensible." In other words, it *can* embed video in it, it *can* be extended to do all kinds of carrying, all kinds of ancillary information like tags of colors so that-- whatever you want to do. You have to have this static thing.

And, so, we got Peter Hibbard and Richard Cohen to do the architecture. So, they did the architecture and then we did a ground zero implementation of what PDF was going to be. And we documented it along the way. So, here is the portable document format. And it-- you know, it turned out that any application that produced PostScript could be turned into a PDF file that was in some sense bullet-proof. Had no loops, no control stuff in it. You could analyze it for its structure, what kinds of fonts, what letters were there, subset the fonts, package them up and send this document across the network. So, it had all the properties that were really, really important for interchanging documents.

Brock: Right. And is it-- in your description of doing that first transformation of the IRS form, the idea of kind of altering the semantics of PostScript for making "Move To" mean something different--

Warnock: Yes.

Brock: --and putting everything into a big, long text file. I hear when you say that an echo of what we talked about back with the Design System of Evans and Sutherland, in a way. I wonder if I'm really

hearing an echo-- you know, that technique of "Let's just put everything in a big, long text document and then we're going to--"

Warnock: Work with that.

Brock: "--work with that," and--

Warnock: But there probably is some relationship, because that trick sort of had worked before. The-- so, in 1991, I wrote this little paper and I-- the Camelot paper.

Brock: Right.

Warnock: And the Camelot paper described the trick of unwinding the PostScript file and that sort of became the impetus for Acrobat, for PDF. It was so funny, because when we started demoing it, nobody got it. I don't know whether I talked about that.

Brock: No, I don't think we-- I think we were about to get to the market reaction when we had to break last time.

Warnock: Yes. The market reaction. So, we announced-- I think we announced Acrobat in 1993 or '92 and we had started to talk to people about it and even our own sales team they said-- well, we would show them demos. And we'd say, "Here it is." And it was the most puzzling thing, because most people sort of didn't get it.[2]

Brock: Hm.

Warnock: They said, "Well, that's really nice. But why would people use this? What would be the thing?" And I remember-- oh, God, I wish I could remember her name. She was with one of the huge consulting firms at that time. What-- I've got to go back and figure out who it was, but there was a Yankee group-- and I mean, there were all these consulting firms and I remembering giving a demo to one of the senior consultants in this consulting firm and they said, "Well, why wouldn't you just use 1-2-3? Lotus 1-2-3 and send around Lotus 1-2-3 files or Microsoft Word files?" And I said, "The problem is Microsoft Word on a Mac can't reliably read Microsoft Word on a PC and Lotus, as they change versions, there's nothing stable--"

Brock: Right.

Warnock: "--about this. The intermediate file formats are not stable. They do build in some backward compatibility, but they don't have things. And there are all kinds of programs that will produce PDF files

[2] The public announcement of PDF was at COMDEX in November 1992. See, for example, *InfoWorld* for November 23, 1992. Added by David C. Brock.

but aren't related to those programs. I mean, there's an infinite number of application programs that know how to print--

<laughter>

Warnock: --but they don't know how to send their files to anybody else's files." And they said, "Well, they're not editable." And I said, "Yes, right. But there is this gigantic need to sort of remove paper from the equation and be able to send, electronically, files." And, so-- God, I remember my introduction to document interchange I think was in 1965 on an IBM 7040/44. In talking with IBM about document interchange, they were talking about GML and then they started talking about SGML and SGML had its own lifetime of mark-up languages for document interchange. And these things got horrendously complicated and horrendously hard to implement. I mean, they still are!

<laughter>

Warnock: And, so, I remember when we introduced Acrobat going to IBM and talking to a vice president of IBM and he just didn't get it. I mean, he really just didn't get it. "What would you use this for?"

Brock: Now, do you think you had an advantage because you had, from being in Utah as part of the APRA community and then at PARC-- you know, you had been living in a networked world for a lot longer than--

Warnock: Most people.

Brock: --the people you were talking to. Do you think that is part of it?

Warnock: Yes, I do.

Brock: Okay.

Warnock: Yeah, I do. Well, but there are also people who had approached the problem and it was really interesting. DEC was one of our big customers, early customers, and we started talking about document interchange and I remember they said, "We have been working *years* on document interchange and we have a thing called the compound document reference." And it was a set of documents about this thick that tried to-- and this was a typical approach at that time-- they would try to take every feature from every word processor and smush them all together into one format design. Well, word processors and document processors can be really complicated and, so, doing this-- what you do is you get a specification that no one can implement. Both because of memory limitations on the program and just trying to keep track of the detail.

Brock: And are all these approaches of the form where you almost have something that you might call the plain text, just the text of your document, and then everything else are these mark-ups and modifications of how it is shown.

Warnock: Yes. How it is shown. Paragraphs and indentations and leading between lines and superscripts and subscripts and, I mean, the most complex documents can be really complicated.

Brock: Sure.

Warnock: And, semantically, very difficult. And how you treat them and edit them gets sort of exponentially complicated. So, the compound document structure for DEC never went anywhere. And I think all the other attempts that we tried or that other people have tried get really complicated. I mean, if you look inside of QuarkXPress and you look inside of InDesign, these are complex programs that took years and years with hundreds of engineers figuring out how to get this all to work together.

Brock: And would-- if I were trying to explain it to my younger daughter, who's in high school, you know, if I were trying to explain-- well, I'll see if this passes-- cuts the mustard: I would tell her that the primary difference between PostScript and this kind of generalized imaging model that you and your colleagues worked on was that it abstracted out of all of that mark-up stuff, because it was this geometrical-- it was geometry.

Warnock: It is geometry. It's graphics.

Brock: It's just "Describe everything in terms of its geometry."

Warnock: That's right.

Brock: And if you can have a sophisticated enough software to describe that and to realize that geometry, it is much-- it is a great simplification.

Warnock: Yes.

Brock: Does that get to the heart of it?

Warnock: It's a great simplification that is device-independent.

Brock: Right.

Warnock: So, it doesn't depend on the resolution of the device that you're going to. And that's-- and all of the current day computing-- I mean, when you work with Photoshop or Illustrator you can make things bigger and smaller and rotate them and transform them and all of that capacity was never achieved in-- I mean-- even the most complicated word processors. I mean, they just never-- they-- the style structure-- so, here: My thinking at that time was, "If we do this, we can sort of completely reduce the paper log jam in the world." You can send newspapers around, you can send magazines around, you can send anything you can describe or that can get to PostScript around the world without any degradation, without compromising sort of the stuff there. And then I said, I thought to myself-- this is totally not in the first implementation-- I said, "You know, there may become a time in life when you can look at the page like a

human being looks at the page and deduce the structure." You can deduce where the paragraphs are, you can deduce where the line breaks are, you can deduce superscripts and subscripts by looking at a page. Humans do it all the time.

Brock: Right.

Warnock: They can infer the structure. So, what's going on right now is we're starting to use machine learning to look at trillions of documents and deduce structure. And then the computer can go back and say, "This is the way this document is put together." So, if you can do that, you can go back to the editing phase and take a PDF file and say, "This is what this PDF file is trying to do," even though there may be zillions of exceptions in there. It's like driving cars.

Brock: Yeah!

<laughter>

Brock: I think I get it. I mean that is almost re-introducing-- that's answering that initial objection when you first were showing PDF and people were saying, "You can't edit it."

Warnock: That's right. But the current versions of PDF, you can go select text and you can go in and type and what we have to do is solve sort of the next step of that-- is to sort of say, "Gee, if I insert a bunch of type here I may want the line break to wrap."

Brock: Mm-hm.

Warnock: You know, and doing that intelligently is really hard and you need lots and lots of information to do that. But I'm totally amazed every day with what Alexa does and you're asking them human questions and they're figuring it out.

Brock: Right.

Warnock: So, I think in the future all of this is going to start to get easier and easier. And much more user-friendly, where we didn't have the power in the past.

Brock: It's almost-- now you're talking about the ability to sort of extract--

Warnock: The structure.

Brock: --the human meaning from the geometry.

Warnock: That's right.

Brock: Going back again.

Warnock: That's right.

Brock: You kind of freeze it in the geometry and then you open it back up.

Warnock: Because a human can take a file and say, "Gee, these are the paragraphs. This is the quotation style," and sort of re-architect it and morph it into another style.

Brock: Well, it's interesting-- the idea that-- well, this, of course, deep relationship between PostScript and PDF. By the time that you are-- well, I guess that by the time that PDF really starts to gather momentum, PostScript is both-- has become a de facto standard and it is becoming more and more of a kind of formalized published standard.

Warnock: Yes. No, we did get it through all the standards.

Brock: So, it's there.

Warnock: Yeah.

Brock: Was that-- so, with the motivation for PDF in terms of solving this problem of exchanging information, really--

Warnock: But now the world's morphed. Okay, what the world has done is said, "Okay, PDF is standard. All my applications have to just generate PDF directly." They don't go through necessarily the printing thing. So, Microsoft applications just generate PDF, because they know how to generate PostScript, so all they have to do is modify themselves a little, go through the PDF manual, and say, "I'll just generate it directly." So, the world has-- every time I get on the Web it says, "Gee, do you want a PDF converter?"

<laughter>

Warnock: You know, so that I can take the Web stuff and convert it to PDF. So, that's becoming a direct path now.

Brock: Right, without the transit through PostScript. What I was-- and I see that all the time and just also in the browser--

Warnock: Yeah.

Brock: It just renders--

Warnock: "Do you want to download a PDF?" I mean, every single user manual in the world is downloaded as a PDF. I mean, that's just what they use.

Brock: Well, what I was curious about was-- and we see that, too, with places like the National Archives of the United States of America; PDF-A is the archival format for documents. And many other institutions, of course, are following that lead. And it has become this kind of universal format. And I just wondered if-- is it inherent-- because PostScript was at the very beginning an attempt to make a standard of this kind for imaging--

Warnock: Yes.

Brock: --you know, was it kind of inherent in your efforts at PDF that this was-- if successful, it would be a standard? It would not be proprietary. It was in its nature trying to become a standard.

Warnock: Yes, absolutely. The whole idea was the Internet in 1994 after PDF was introduced and grew incredibly slowly--

<laughter>

Warnock: In 1994, the Web came alive and people started figuring out, “Gee, this is a way to send information all around the place.” Our early adopters in PDF were the most grateful customers I’ve ever-- the Center for Disease Control, the IRS. I mean, these people were buried in paper. And they wanted to be not buried in paper. I mean, the IRS put up all the forms and said, “Gee, now I’m saving the printing cost and saving zillions of trees by being able to electronically send this stuff around.”

Brock: How has it been for you, because you had to-- I would imagine you had to really, you know, face these headwinds from people not getting it and continue the investment in your company, in the effort and all of this to see it--

Warnock: Well, the board of directors at that time when it got off to a very slow start-- I mean, a question we would get at every board meeting is “Why are we continuing to invest in Acrobat? I mean, Acrobat isn’t taking off like Illustrator did or Photoshop and it’s got a big development team who’s working on it.” And Chuck and I said, “We don’t care what you think. I mean, we really don’t care what you think. We are going to-- if you want to take us off our jobs, fine. But we’re going to invest in this, because this is going to change the way people communicate.”

Brock: Now, do you think you had a special position there in terms of being the founders, being active, being-- having the established business record by then and also the technical record to be able to make those arguments in the face of that sort of resistance?

Warnock: Absolutely.

Brock: I mean, a lot of places-- you know, we hear about quarter-to-quarter and the short-termism-- the pressures that people face in corporate environments and it seems like--

Warnock: Well, we were a-- yeah, and the thing is they saw Google doing what Google did and they saw Netscape doing what Netscape was doing. And they saw all this growth and everybody was jumping on the Web and starting to build Web pages. And, "Gee, don't you want to put a huge amount of effort into HTML?" Okay. And my constant answer is "Never." Because in some sense HTML is sort of a hack. I'm sorry, it really is. It's not an architected thing that has lots of foundation.

Brock: Well, it's a mark-up language--

Warnock: Yes, and I'm not a mark-up person--

<overlapping conversation>

Brock: --which is in contrast to geometry.

Warnock: Right. Right. And, so, that was my personal opinion. We had-- we were growing and the application business was starting to grow, but growing slowly at that time. And they were-- I mean, the board was looking at what everybody else was doing and saying, "Well, why aren't you doing that?" And I guess our opinion was "This solves a fundamental problem and that fundamental problem is an important problem to solve."

Brock: And I suppose because the company was so-- had experienced this period of hyper-growth and had been-- it was so very successful that even with that questioning it wasn't-- wouldn't be too hard to say, "Well, okay." Because in the context of it, everything is going gangbusters.

Warnock: Well, it wasn't going as fast as we would have liked it to go, but the Internet-- I mean, it was so obvious the Internet was going to change everybody's lives. I mean, and over the years you say, "Okay, retail businesses are in trouble. They are going to be in serious trouble." And they'd say, "Oh, no, you always need the corner store," and you walk into Macy's and you see, oh, God, they're discounting things seventy-five percent. And you see the writing on the wall. And in the case of-- sometimes do the following experience: Put ".pdf" and then do a Google search and see how many hits you get.

<laughter>

Brock: I won't even guess.

Warnock: I mean, it's probably-- I mean, it's hundreds and hundreds-- I mean, it's billions.

Brock: Right. Yeah.

Warnock: I don't know whether it's trillions yet, but it's hundreds of billions.

Brock: Yeah, I'm sure.

Warnock: And you look at the way more and more people are doing business. You download user manuals-- everybody does their user manuals. They hate printing them.

Brock: Well, it's also really re-shaped an important -- I'm sure an area that's personally important to you given your background -- the whole world of scholarly, academic publication.

Warnock: Yes.

Brock: You know, the world of science and the humanities. You know, it's a la carte download PDFs--

Warnock: Yes.

Brock: --you know, pre-prints as PDFs. It's re-shaped that whole landscape.

Warnock: And if it's hard math we can do hard math. We can do anything.

Brock: Yeah. Well, at the-- I wanted to ask you about something that-- just to finish off this line kind of about Display PostScript and Display PDF. Someone told me recently and I don't know if they were correct, but that for Apple devices, you know, anything that one sees on a screen -- your phone presumably, the watch, your laptop, whatever it is -- that all those images on every screen are Display PDF.

Warnock: They're a variant of it. Yeah.

Brock: Could you unpack that a little bit, how that exists?

Warnock: Well, I think that everyone said, "Well, gee, because we have different devices at different resolutions--" I think the systems programmers started to upgrade the graphics commands. They're not bit maps anymore. And they have started to implement their version of the graphics model.

Brock: So, is that in modern operating systems--

Warnock: I think so.

Brock: --in general have adopted this-- your imaging model.

Warnock: I think so.

Brock: This geometrical turn.

Warnock: I haven't delved into their operating systems, so I don't know.

<laughter>

Warnock: But I would guess so, because they can't do it otherwise.

Brock: And someone was telling me a feature that I use often, the reason why you can sort of-- there's a feature in the-- as of this filming, the contemporary Apple operating system, that-- where you can select any item and preview it. It will pop up a preview of a PowerPoint, a Word, or what have you--

Warnock: Yes.

Brock: --a PDF, but that-- and the reason that it can-- I was told the reason it can do such a thing is because essentially everything is rendered as Display PDF. Which is interesting because it's a representation of this kind of general model of any image.

Warnock: I believe that that's correct, I haven't looked.

Brock: That's fascinating to me. Well, maybe we could go back in time then to talk a bit about the Photoshop story and how it relates to this overall kind of geometry approach.

Warnock: Well, so you have to-- so there was a lot of graphics in the world that sort of were separately-- there was sort of the stuff that happened at Xerox and there was sort of another branch of it and a lot of those guys went to Industrial Light and Magic. The Knoll Brothers went there and they were using very, very high end hardware to make movies. And that sort of advanced independently of the rest of the world. I mean there were the programmers who worked at Industrial Light and Magic and then there's the rest of the world. And the stuff that they used wasn't available to the rest of the world because it was both expensive, very high-powered computing, and was specialized to deal with the problems in making movies.

The Knoll Brothers both worked there and they said, "Well, gee, this Mac is really a cute little device," and so they said, "Wouldn't it be fun if we could take sort of this high end imaging stuff and smash it down into a 512K Mac." And that was their first implementation. So the problem with that and the reason that wasn't at all interesting to Industrial Light and Magic was that the 512K Mac was a black and white machine with a bitmap display, just on or off, had 512K memory but they said-- and here is the other problem, there were no scanners, there were no cameras and there was no, other than PostScript, there was no way to actually print out images.

Now PostScript was also being used by typesetters to make separations and it was also being used in high end imaging equipment, film recording equipment, so they had been shopping PostScript[3] around and I don't know how many people they interviewed before they came to us, but I think they went to Apple and Apple: "Ho hum." They came to us and they gave a demo of them taking an image and sort of zooming in on the image and correcting the image and changing it to the extent that you could do on a bitmap display. The interesting thing that they had in the implementation-- so a couple of people who looked at other companies came to me and said, "You really need to look at Photoshop." And so I got the

[3] John Warnock intended to say "Photoshop." Added by David C. Brock.

demo and the other people were enthusiastic about it but if you sort of got to the practicality of it, there were no scanners, there were no cameras, the memory was too small. The good part about their implementation was they had built a virtual memory architecture that could go out to the disks. Now remember at that time, the largest disk you could get on a Mac was 20 megabytes, that's the largest one you could buy. Okay, and here's this black and white thing. Now they will claim that they convinced me to do this…

<laughter>

Warnock: And I will claim I was very aware of the growth in the technology: That color displays were going to come, that scanners were going to come, and that the basic fundamental architecture of Photoshop was sound, okay? So we decided to license Photoshop from the Knoll Brothers and I told our board and I told the rest of the company, I said, "We're going to sell maybe 200, 250 copies of this a year until the world changes, but if we sort of put our faith in this, there will eventually be a large market for it."

Brock: And what convinced you that the kind of fundamental architecture of Photoshop was the right kind of platform for doing this?

Warnock: Two things. They came from Industrial Light and Magic and I had, in my early days at Evans and Sutherland, we had taken tours of the R.R. Donnelley plants where the Sears Roebuck catalog was produced in this massive color printing industry. And I said to myself, “Those devices that those guys use in R.R. Donnelley cost hundreds and hundreds of thousands of dollars,” and I thought to myself, “That technology is going to come down to the desktop.” I mean desktop publishing was starting to get a word and I said the next obvious thing is to bring color down and PostScript had all the definitions for color and screening and all of that stuff and if we can sort of catch that on the way down and have a product there then that is a big component of the printing and publishing industry.

Brock: And particularly for that dealing with photography.

Warnock: Yes.

Brock: And integrating that into the whole system.

Warnock: PostScript printing, yes.

Brock: So you initially licensed it and were you correct in that you were selling just a few hundred copies each year initially?

Warnock: Well I think the industry started to catch up because Apple had its first digital camera which was sort of a piece of crap but it was its first digital camera but-- and one of our big customers was Eastman Kodak and they thought film was going to last forever and we knew the CEO and actually the CEO of Eastman Kodak was on our board for a while and we said, "Look, your days are numbered. I

mean really your days are numbered. If you don't sort of do a huge digital push, your business is going to go away."

Brock: You were saying this in the…

Warnock: Late '80s.

Brock: …late '80s.

Warnock: Yes, early '90s.

Brock: And the reaction was…

Warnock: Oh, they didn't believe that.

Brock: …hard to conceive.

Warnock: Yes because these of these Mickey Mouse little digital cameras but there was a huge amount of work that was going on in research into sensors, into how you capture stuff digitally, how you build cameras and the cameras started out bad and then they got better and now they are frickin' amazing.

<laughter>

Warnock: I mean the cameras are amazing. The other thing is you had to have faith that the cost of memory was going to go down. I mean one of the big gambles that Steve Jobs made when he brought out the LaserWriter was that the cost of memory was going to go down and that Moore's law was going to kick in and he was exactly right, I mean he was right. So the machines got better, it took like what, ten years or something for things to really start to roll but at that time everybody was figuring out how to do everything they wanted to do in Photoshop and Photoshop was growing with that.

Brock: And when did you decide to-- at some point you changed from licensing Photoshop to…

Warnock: Yes.

Brock: You changed that relationship, could you talk about that?

Warnock: I think that-- we still have a relationship with the Knowles Brothers but at one point, I think it was around 2004 or something, I would guess 2004 because I had stepped down as CEO and Bruce Chizen had taken over but we were sort of presented with the fact we can continue to pay the Knoll Brothers on a base of royalty or we can buy them out. And my opinion was buy them out because the photography business and Photoshop are not at end of life. So we bought them out. And I haven't talked to them about whether they liked that idea that they sold out or not.

Brock: And were they also involved in-- obviously by that time there's, what 15 years of development of Photoshop, had they kind of been a part of the team within Adobe who was advancing the project?

Warnock: Yes, yes.

Brock: Okay. Were they employees as well as kind of licensors?

Warnock: No, I think we-- I don't know what the financial arrangement is, I know that they made huge royalties and I don't know whether they wanted to semi retire from that or not, so all those possibilities but I haven't had the conversation with them.

Brock: But from a kind of point of view of advancing the software, they were involved in this…

Warnock: Yes.

Brock: …consistent development over…

Warnock: Well there was one guy, Mark Hamburg. Mark Hamburg left Adobe and went to work at Microsoft. I can't remember how many years he was at Microsoft but then he came back and he had this idea of rewriting Photoshop in a way where you never touched the original image, so that was Lightroom. So Lightroom was sort of the next phase of editing and so there's Photoshop Lightroom and it's called Photoshop Lightroom because of the brand name Photoshop but Lightroom was a grounds up reimplementation that had a very different philosophy that people apparently love: You never destroy the original image.

Brock: I suppose you can always, there's the idea you can…

Warnock: Always revert.

Brock: …revert to original.

Warnock: You can always revert.

Brock: <laughs> I can see the appeal.

Warnock: And that's what Lightroom, and so right now, I think Photoshop is still on top but Lightroom's close.

Brock: Had you been-- I remember we were talking either while the camera was running or before, last time about your interest, your *personal* interest in photography.

Warnock: Oh yeah.

Brock: Now that had, and I can't remember if that was-- that was of long standing, so when you were…

Warnock: I started my own dark room I guess when I was 15 years old and I started mixing my own chemicals for the dark room when I was like 16 or 17 and I had my own enlarger and I had a graphics camera and I was on the yearbook photography staff, so I've had a long history with cameras and photography. And I learned to do a lot of things in the dark room and I started seeing those in Photoshop, the things you could do in a dark room and then it became totally obvious that anything you could do with an image, you could do in software.

Brock: How would you put together that long involvement with photography and your kind of-- do you see a connection between that and in your professional career, this engagement with this kind of geometrical approach to things. Do you see anything relationship between them?

Warnock: Oh yeah, I draw, I paint, I studied geometry, I'm a mathematician. I've never separated my visual world and the world of mathematics.

Brock: Because there is a lot of geometry in that kind of film photography that you're doing, lenses, all of this.

Warnock: Yes, oh yeah. And there's a lot in the fact that I watercolor, I oil paint, I draw and…

Brock: Perspective, composition.

Warnock: Composition, all of that stuff. The geometry part of my brain is not separated.

Brock: Just hearing that, it finally clicked for me. I wanted to talk a little bit about, by the time we're getting into the middle 1990s, I have some-- by the dawn of the 1990s, the revenue of the company is increasing, for example in 1991, the revenue increased by 50 percent to almost a half a billion dollars and the head count is going from 300 people to 1,300 people in two years in this time period. I wonder if you could just talk for a little bit about the life of the company and you and Chuck Geschke, how you were contending with all of this expansion and growth.

Warnock: Well there were two major components. The printing business which was, it really was becoming a standard, we had most of the Japanese manufacturers, we had most of the domestic manufacturers, we had most of the typesetter manufacturers and so the printing business was very solid. Building a software business, application software, selling boxes takes distribution channel, takes different kinds of sales force, completely different kind of sales force, takes applications development, takes all of the marketing material and that was starting to take traction in the early '90s. In other words we really started to be able to do that and we were starting to contemplate getting into competing with-- well '94 we bought Aldus, okay, so now we had the document creation market and that was a big thing. We bought, '96 was Macromedia I think or something. When was Macromedia, no it might have been later.

Brock: I'm sure I'll find it as we get down into the list. Yeah, Frame Technology, 1995.

Warnock: That was the total technical document creation business.

Brock: Right. Macromedia in, maybe it was '93, I can't seem to find out.

Warnock: No, it's later.

Brock: Yeah, sorry I can't find it in my notes.[4]

Warnock: It's when-- yeah, Bruce Chizen I think, so it may have been 2001 maybe, I don't know, yeah, it could have been later. But yeah, the company was starting to gain traction, Acrobat was-- well yes, Acrobat had just started to gain traction. I think Acrobat's still the biggest business.

Brock: It's really…

Warnock: Yeah. But now we've got this whole other enterprise software business that's growing the company like a weed.

Brock: Well how did you-- personally I can't imagine contending with something like that so of course, I'm curious about how…

Warnock: I was just Chairman of the Board.

Brock: Well, I mean, but even before, how did you find colleagues and make a structure to continue this work? How did your day change when the number of your colleagues is increasing so rapidly and the size of the company?

Warnock: Well they were-- you try to-- you know, I think a big part of the company, and maybe Chuck talked about this, is the culture of the company. And one of the things Chuck's always said is always hire people who are smarter than you are. And we've also tried to be very egalitarian. There's never been an Oracle-like structure in the company. I mean it's always been cooperation, it's always been teams, it's always been giving people opportunity, it's always taking care of people, being fair, never having-- I think one of the things we worked at more than anything else is not allowing political infrastructures to grow. Kill off politics, don't have power centers.

Brock: How do you do that?

Warnock: You try to develop a level of transparency where people can't hide things. I mean I think this is really important. And when you see people who are trying to do that and use politics to get their way or build their products or take their resources, you have to really sort of stamp it out.

[4] Adobe purchased Macromedia in 2005. Added by David C. Brock.

Brock: And you do that individually by telling people that's not the culture or you…

Warnock: Well there was a point we got to where it was a huge crisis in the company and I'm trying to remember the date but it was I think 1999 or 2000. Chuck and I had started talking about succession planning and we said, "What we have to do is we have to hire people who could potentially take our place." So hired a head of products that came out of Silicon Graphics, we hired a head of marketing that had a very strong resume, we hired a chief financial officer who came out of a place, we hired a head of sales. And all of these people were very ambitious and they felt highly of their abilities.

The problem is, Adobe had been very successful with this sort of non political environment where everybody, this division helped this division, everybody helped each other and there were no real boundaries in the company, everybody had their job, they knew what their job, if they needed a resource, they went to the people who had the resources and everybody worked and it was really very, very transparent, we didn't keep secrets from anybody.

But what we noticed over a year is the growth of the company had started to slow dramatically and we started not hitting our numbers and the stock was having troubles. And Chuck and I would have these executive staff meetings and we were frustrated just beyond words because there wasn't transparency, there wasn't growth, there wasn't-- people started building these invisible walls and having their politics and fighting between the executive staff about who had the power to do what, fights between creative and marketing.

And I remember Chuck and I were just terminally frustrated. We just felt that first of all there wasn't a prayer in hell that we would give anybody else the job, any of these guys our job. The growth of the company had slowed down. So Chuck and I had meetings in summer, the summer that this happened, and the stock market was not being good to us because the CFO was trying to not give projections to Wall Street and then they would see the results and the stock was bad. So Chuck and I had a meeting, I remember this meeting, just he and I…

Brock: Where was it?

Warnock: I think it was in Chuck's office actually, and we said, "How are we going to fix this?" And so we went down through the various members of the executive staff and we said, "All right, who can we keep and who do we let go because we have to do something?" So we came to the conclusion that we had to fire all of them, we said, "Here's what we're going to do, we're going to-- " Bruce Chizen was sort of a shining star down below, a couple, a level down below, he ran one part of the business and we knew him pretty well. We were pretty happy with the layer underneath these guys because they were sort of old school Adobe. So we called a company meeting and I think it took us a day and a half, we let five senior executives go. We fired head of products, we fired head of marketing, we held on to head of sales for a couple of months, we fired the CFO and let's see, there was one other, marketing, I think, let's see, there was Jack-- anyway…

Brock: Had you ever had to do anything close to that in the history of the firm?

Warnock: No.

Brock: Yeah.

Warnock: No.

Brock: Had you ever had to do anything like that in your life before this?

Warnock: No.

Brock: Okay.

Warnock: So I said, "Here's what we're going to do," so we said to these guys, "You're fired." The CFO said, "This is the worst mistake you're ever going to make in your entire life." Nobody took it well, okay, we said, "That's all right, you're gone." So I called Bruce Chizen and said, "Bruce, here's what we've done. We would like you to come back," and we elevated some people to take over as head of products that were old time Adobe. We hired within, we didn't go out at all. All of these guys had come from outside.

We then called a meeting with the financial advisors and we said, "Here's what we're going to do, we are going to grow the business from this month over the next year and we are going to hit these numbers," and we put it out there, we just said, "We are going to hit these numbers." And I mean it sort of shocked the market and I can't remember what the market activity was at that time. We had a meeting with company and we said, "Here's what we're going to do, and we're going to grow the company this much over the next year and Bruce is going to be the interim Executive CEO and we're going to hit these numbers."

Brock: A couple of questions about that. How did you come up with those numbers, that goal, was it really just…

Warnock: Chuck and Bruce and I talked about it and said, "Here's what we can do."

Brock: And you felt it was a realistic stretch if everybody pulled together and really went for it.

Warnock: Yeah, and we hit all the numbers, we hit all the numbers.

Brock: I mean what was your-- if we were talking to your colleagues from Adobe and you weren't around and we talked about hitting those numbers, what do you think they would have said, I mean was it a real strain or did it turn out to be…

Warnock: No because I think everybody was relieved enough that they felt empowered.

Brock: Right. Unlocked.

Warnock: Unlocked.

Brock: Yeah. And do you think that in bringing these accomplished people from other organizations, it sounds to me like maybe you hadn't realized just how specific of a corporate culture you had created, like there was such a mismatch?

Warnock: I think that's a, yes, there was a huge mismatch. I think that the person who was in charge of HR was relieved. I think our board really was relieved. I think they had faith in Chuck and I, that we could do this and that we wanted to sort of bring back the old Adobe and it turned out good.

<laughter>

Brock: And it's interesting to think though that if the pair of you had created a company that maybe was, well had a different culture, a strategy like that could have worked well, of bringing highly accomplished people from the outside.

Warnock: Yes, no, all recruiters thought that this was the right way to go and the board did too.

Brock: Right.

Warnock: So as an example, the guy who came in from marketing, to head up marketing, had a deep sort of Microsoft-like experience, I don't think he worked for Microsoft but he sort of had a deep sort of business environment experience. And all of our packaging, all of our stuff had this enormous creative component to it. All the way we did ads, everything had this creative component and he wanted to make it gray. I mean he wanted to say, "You need to appeal to the Microsoft Word user," I mean really literally he said, "You have to change all of your packaging to conform." No, I'm serious. And we got revolts all from in-- everything about Illustrator was creative, everything about Photoshop was creative, everything about all of our products and he wanted to dumb them down from a marketing, message point of view.

Brock: To make it more friendly to sort of a corporate IT purchaser person or something.

Warnock: I guess, I guess, I guess.

<laughter>

Warnock: And that just didn't work.

Brock: Right.

Warnock: Oh, and the finance guy said, "Oh, Chuck and John, you don't have to bother talking to the financial analysts, I'll take care of that," okay? And so he tried to wall us off from the investment bankers and we'd been delivering the Adobe message all our lives. And so he was in some sense trying to isolate

us and shield us from all that boring financial stuff. But it was very clear he was making a power play to elevate what he knew over what we knew.

Brock: Right. Well also taking on the role-- I mean it's a powerful social move to take over the role that you and Chuck had been doing with that community because I know that that was-- a case I know pretty well was the Intel case and Gordon Moore used to-- Gordon would always give the presentations to the analysts and when he was shifting away from that and Andy Grove was taking over that responsibility, there was a big shift that analysts in particular were-- it didn't go unnoticed. That was more of a very seamless friendly kind of thing, but that was a significant social change.

Warnock: Yes.

Brock: Yeah, so I can see, yeah, they probably…

Warnock: And the guy who was in head of products was technically very competent but he sort of didn't understand that all of those products really had to have the user interfaces to creative people, I mean he-- I don't know whether he ever became a user of Photoshop or a user of Illustrator, but he was managing all of these engineers. And from day one, I've used Illustrator every day of my life. And I've used Photoshop every day of my life and I've used Acrobat every day of my life and I've used InDesign, not that much, but I was deeply immersed in the products and he wasn't.

Brock: Did you also-- being deeply immersed in your own products and using them to do kind of the work of the company, was that something that was widespread throughout the company, not just you but your other colleagues?

Warnock: Certainly the marketing department used all of the products every day. And the engineers were very attached to the customer set so they understood what customers wanted and what they-- and a lot of their imagination and their imagination today comes from their sort of engagement with the product.

Brock: And a certain point in the company you in a way I believe sort of formalized that process by really as I understand it, having a lot of maybe structured interactions with lead users or super users of the various programs or…

Warnock: I think there is a great deal of that going on. I mean I still use all the products every day and as a board member I get demos and track what everything does and how it does it and I meet with the chief technical officer regularly and try to figure out what's going on. It's harder now because it's a huge company.

Brock: Do you have any thoughts about how you, I mean in a practical sense, how you built and maintained that corporate culture because you'll often hear people say that culture is the most important thing in terms of an organization, but it seems like beyond that, it's much harder to articulate, "Okay well if culture is the most important thing, what do I do?" What, as you reflect on it, do you think were some of the most important tangible things that you did?

Warnock: Well, when Chuck and I first started the company, we explicitly said to each other, we want to build a company that we would like to work for. Okay, this is sort of number one. We also felt that transparency is really, really, really important. You don't have “need to know kinds of stuff.” I mean if you work with the government, I guess at certain points you have to have “need to know kinds of stuff” but it's not really ever part of the culture. We've sort of tried to bend over backwards to keep both the cultural and ethnic distribution of the company and the male-female balance there and I think we do really well at that. So we've been in the top ten companies to work for for the past forever. I mean when you get to the size where you get into that measure. We've tried to be completely fair, give people their vacations and their sabbaticals and their bonuses and tie people's rewards to the success of the company.

Brock: And have you used sort of stock options and…

Warnock: Yes.

Brock: …employee stock purchasing plans…

Warnock: Plans, yes.

Brock: …and these sorts of things?

Warnock: Yes, yes, all the time.

Brock: And that seems just like a very direct and powerful tool for aligning everybody's interest in the same direction.

Warnock: Yeah, and we try to keep the salaries balanced and fair. And I think it's-- I don't get into the details because I'm not on the comp. committee, but I think that that's still balanced.

Brock: Could we talk for a little, well I would be interested in, at a certain point you find yourself at the helm of one of the very largest software companies and I think, so naturally you're coming into competition with other large software companies.

Warnock: Companies, yes.

Brock: And one question I had was just about that competition, how you thought about competition, how you addressed competition for some very aggressive competitors and also the connection between competition and the culture. Were there any times that you felt-- yeah.

Warnock: Well, when we did this firing of all execitive staff, Quark tried to do a hostile takeover. And our reaction to that was, "A cold day in hell!" <laughs> "That is *not* going to happen!" And in particular, "We're going to take them out."

Brock: Okay.

Warnock: <laughs> We felt that we had just started sort of deep design. We had acquired Aldus, and there's-- and Aldus was run in a completely different way than Adobe. I mean, it was just really different. And when we found out about that, we tried to correct it. So the way that Paul [Paul Brainderd] used to run Aldus was if you had PageMaker for the Mac, then you had a completely separate team that was PageMaker for the PC. Okay, if you had another platform, then it was PageMaker for that platform. And so the development teams were isolated by their platform and the product. And so he had these silos of development to produce all the programs-- and when PageMaker was small, that probably made sense.

Adobe very, very early on didn't do that. At the base level, Microsoft Windows and Apple OS had sort of a fundamental set of UIs that you programmed into. And so in the early days when the PCs were sort of trailing the Mac, they didn't have enough memory. So it was very difficult to port Illustrator to a PC. But the observation that we made early on is what we should have is we should have a layer of software where we have the Adobe interfaces; and then on a Mac you build the layer of software to the Mac OS; and on the PC, you build a layer that goes to the PC OS. And in that way, the core Illustrator program is the same, but then it has this thin interface into the Mac, and a thin interface into the PC. And so the guys who did this thin interface was called Core Technology. And they--

Brock: Okay, and this is-- I'm sorry, please go ahead.

Warnock: This is Core Technology, and so the Core Technology Group has sort of been one of the foundation-- most important groups within the company because when you come to Acrobat or when you come to Photoshop, or when you come to anything else, the way you do this is through Core Technology. You build this interface to these two interfaces, to the operating system. Then if another operating system comes along, you use Core Technology to get to those.

And this worked like a charm. And what we had to have do is switch Aldus so that they interfaced into Core Tech. And that happened, and then they started-- they're very bris-- brilliant people started the architecture of InDesign. And that was like a two- or three-year development. So they weren't porting PageMaker. I mean, we left PageMaker on its own, and we started porting InDesign, but InDesign uses Core Technology. And when InDesign came, and we released it on the world, the world said, "Why would I use Quark?" <laughs> And so there was a big transfer from Quark to-- and I guess Quark is still around somewhere, but I don't know where.

Brock: And was that transition happening during that hostile takeover period or--

Warnock: Yeah!

Brock: Okay. And did you have other means--

Warnock: It was really funny, at one of the Seybold conferences, Jon-- this became an issue at the Seybold Conference. And Jonathan said, "Well, how many of you would like to see Quark take over Adobe?" and no one raised their hand. <laughs> No one raised their hand. Maybe one. I don't know. But--

Brock: Some of the people from Quark. <laughter>

Warnock: Yeah, people from Quark. But you know, they were not great at customer relations. And they--

Brock: And just in terms of your reaction to that hostile takeover attempt, and the product and technology competition, it sounds like in this area of your life you were very competitive. That's a strong reaction. Not only like, "No, we're going to fend you off, but you know, we'll go beyond fending you off."

Warnock: Well, I get-- did I tell you with the 1989 Seybold Conference, where Microsoft teamed up with Apple, and Jean-Louis Gassée was sort of on the stage for Apple, and they said, "We're going to clone PostScript and have our own font technology and bury Adobe." And Steve Jobs was on for NeXT. And he said, "Well, I don't believe that's going to happen." But Gates and Jean-Louis were saying, "Here's what we're going to do, and there's going to be a new type standard." And so at that time, we released the Type One format, and we said, you know, I went back to the office and said, "We're going to out-invent the bastards." And so we came up with ATM [Adobe Type Manager] to do the font stuff. We pre-empted them. They tried to make a PostScript clone, and I don't think they ever sold it.

Brock: Now you were on the stage with them when they were saying that.

Warnock: Yes, yes.

Brock: So that just-- in terms of--

Warnock: I said, "This is the biggest bunch of garbage mumbo-jumbo I've ever heard in my life." <laughs>

Brock: Well, it just seems like such a-- I don't know, an odd thing to happen socially on a stage-- you know what I-- just in terms of--

Warnock: Yeah. It was war. <laughs>

Brock: Yeah, that's very-- I mean, that is extremely strong.

Warnock: Yes.

Brock: So do you think that-- well, I know that technical people can be extremely competitive about ideas and products and technology and ideas about direction and that's a certain domain of maybe we could just call it like intellectual competition. And then there's this other realm of sort of market, business, capitalism competition, and I wonder if-- do you feel like that's something that that kind of maybe economic competition, is that something that you feel you were-- was that natural for you, or do you feel that that was something that just by the nature of things you had to get into.

Warnock: Well, it was really interesting. Because when Steve left Apple, Steve, in some sense, took us along with him. I mean, he wanted to have a close partnership. And he wanted to work with us. Jean-Louis Gassée wanted to be the next Steve Jobs. That was his mental attitude. He felt he was smart enough, he felt he was a good enough businessman, that he could do that. So he wanted nothing to do with anything Steve liked. He was going to reinvent Apple. So we had been talking about Display PostScript. “No, that was Steve's idea. Not gonna happen!” He also-- we, at that time, I think Apple was still selling PostScript printers—“Not going to happen.” So he shut down the printer business. So--

Brock: The whole printer business.

Warnock: Well, I don't think-- I think they were almost out of that business anyway at that point. So he was very hostile towards us. I mean, I don't know whether we want to go into public-- <laughs>

Brock: Well, it's up to you.

Warnock: Yeah, public fights. But he became very hostile. So he said, "Okay, I'm not going to have any dependency on these guys. So I'm going to do a deal with Gates." So he negotiated a deal where they were going to take the TrueType technology, which actually was invented at Apple, and sort of do a deal with Gates to do this. And they got up on the stage and they said, "We're not only going to do that, but Gates had acquired a PostScript clone. And they were called TrueVisi-- I don't know what it was called. Because it never got off the ground. So they got up and they essentially declared war.

Brock: And I mean, clearly, that wasn't a successful fight on their part.

Warnock: No!

Brock: So but did that force you into a more competitive stance with Adobe than you had been previously?

Warnock: Well, Microsoft-- and not Bill so much as-- Ballmer was really a competitive person. And he was not the easiest guy to deal with. But it became competitive. He was going to sort of try to-- so they were going to sort of break Adobe's hold on the printer and imaging business. That was their goal. And John Sculley was going along with this, and all of that. So we had been developing technology in the backroom to be able to render the typefaces on low resolution devices, on the screen. And no one had been able to do that. You had to have your bitmaps. And all their imaging models were not device independent. So that-- this speech at Seybold happened in the fall. I went back and I said, "We're going to out-invent the bastards!" and they brought together that technology and then announced ATM. I don't know whether you remember ATM. It was the Adobe Type--

Brock: Manager?

Warnock: Manager, yes, Type Manager.

Brock: Yeah, yeah.

Warnock: And so now all the screen fonts could use our fonts and everything. And Microsoft tried to go into a catch-up mode, and never caught up. And so they weren't able to successfully sell their TrueType stuff to any vendors.

Brock: And then did they have-- and then how does-- so war is declared.

Warnock: War was declared.

Brock: So you win that war. And then how does that-- then is there kind of a détente or more of a partnership after that?

Warnock: It was-- I mean, we still produced Apple products. We didn't rely on Apple for anything. The printer manufacturers had come in and they all attached to Apple products, and they were sort of like Microsoft for that period in that it was a relationship where we were a developer and they took care of us as a developer, but for this business thing. Then I can't remember the circumstances under which John Sculley left. I don't know whether the board asked him to leave?

Brock: I believe so.

Warnock: I believe so. And then Gil Amelio. Well, I had known Gil Amelio for a long time, and he and I were on the American Film Institute Board together. So we were very friendly, and he and I sort of reestablished the relationship. But Apple was struggling. And I don't know-- Gil was a capable manager, but he came from the wrong side of the business. He came from the semiconductor side of the business. And he came and he said, "You know, gee, I've been talking with NeXT and should I buy NeXT and let Steve come back?" And I told he him should.

Brock: Hm.

Warnock: I said, "Steve is really a bright guy. He really knows the markets. He's really talented. He's got lots of vision." And so he brought Steve back, and at that time, I had always had a good relationship with Steve. Bruce Chizen, not so much. But Bruce was the CEO at that time, and he had some problems with Steve. But our relationship to Apple, I think, is normalized.

Brock: Hm. Mm hm, yeah, because he had a long-standing-- Steve Jobs had a long-standing respect for just Adobe's technology and products and probably taste, which is probably a big factor there. <laughs>

Warnock: It was a big component. And Steve and I-- just before he died, we met together and- and he's gone!

Brock: Yeah. And how has that competition-- there's an interesting tension of competition and cooperation, I would imagine, also with Microsoft in that they want all of the Adobe programs to run on Windows.

Warnock: Well, our relationship, I mean, Shantanu [Shantanu Narayen] is a phenomenal CEO! I can't say enough-- he's technically very competent. He understands the business. He manages all of the huge components extremely well. He went to school with the CEO of Microsoft. So they're old school buddies from India.

Brock: Okay.

Warnock: So our relationship with Microsoft currently is extremely good. We cooperate on almost everything.

Brock: Which seems to be maybe part more of their-- a shift in their strategy to be more of a cooperative entity.

Warnock: Cooperative, non-monopolistic kind of company. No, Microsoft, you know, they have a different culture. It's a very different kind of place than Adobe is, but we have figured out how we can work together closely, and apparently it's working.

Brock: Could you talk for a little bit about in the 1990s and, I think, then, even more particularly in-- let me just find my notes-- in the 2000s, there is just a long string of both internal developments of new applications, but also of acquisitions. And I would be interested to hear your kind of take on the relative advantages and disadvantages of those approaches to advancing technology in the company.

Brock: Well, I think with the management problems that we had in the early 2000s, I think we've-- in all of our acquisitions-- looked much more closely at the cultures of the companies. You're certainly buying their technology, but you have to say, "Gee, are these guys going to fit?" You know? Are they going to be happy that they came, or unhappy? And the majority of them are happy, but it's-- we didn't want to introduce management that wasn't going to fit. So that's one critical thing in looking at acquisitions. We've acquired all kinds of companies. And the logic that is working now is how easy-- and I must say, Adobe is really good at acquiring companies and assimilating them. I mean, they're just really good at it! We've never had a hitch! I mean, you can lose a CEO at times, and you can lose because they have different expectations, but in general, people are happy. <laughs>

Brock: Is that-- I mean, I suppose that's a combination of doing that-- I guess you would call it due diligence before you do something, so you kind of have a sense that there's a good fit. And I would imagine that there's also sort of a-- having an institution that has done it many times, there's almost like a discipline for doing these things now.

Warnock: There is a discipline, yes.

Brock: Is there anything in that discipline that you would say really stands out as particularly critical?

Warnock: We have a young lady who's head of people, places and things. So she's head of HR, she's head of all facilities. She's from Canada, and as far as I can tell, she walks on water.[5] <laughter>

Brock: So get a great person to do it for you! <laughter>

Warnock: Well, you get a person and their organization, who is very sensitive to personnel and personnel's needs, and--

Brock: How--

Warnock: And the management, in general. Our head of sales now also walks on water. I mean, he's really good![6] And Shantanu is just amazing! And the head of the various technologies are brilliant people! I mean, they're bright, they're creative, they've very inventive. They're just really good people. So that's the secret.

Brock: Good people.

Warnock: Good people, yeah.

Brock: And speaking of good people, it seems that it's fascinating to me that over the lifetime of Adobe, just the landscape of where people are developing software, and different models for developing software, including having development and research groups far-flung across the world. How have-- well, how has Adobe been engaged with that, that kind of internationalization? And what are your thoughts about that?

Warnock: Well, I think that they have been-- they have sort of been steadfastly keeping track of the technology, the hardware accelerators, all of the things. We now have a-- because-- I think we take 30 trillion transactions a month on our servers. We have 30,000 servers, something like that, that gather data off the net. This is the group in Utah, this is the Marketing Group who divert ads. Everyone else thinks it's obnoxious, but when you go to one site and then you see ads all over everywhere you go, unfortunately, that's us! <laughter> But you're building huge, *huge* databases. And we're trying to hire absolutely the best Artificial Intelligence people, A.I. people in the world to learn from that data. There's A.I. in the stock photography business, so that if you go up to Adobe Stock and type in any search term you want, you ought to see what it can do!

Brock: Hm, I'll do that.

[5] Donna Morris. Added by David C. Brock.
[6] Matt Thompson. Added by David C. Brock.

Warnock: Do! Because it's amazing! <laughter> And I think what do we have-- I think if it's not in the 50 million photographs, it's in the 100 million photographs up on the Stock? Huge! I mean, it's huge! And that's the only word that describes it. <laughs> So whenever, for instance, I want to send a birthday card, I go up to Adobe Stock. And you say, "birthday card" and you can download it and print it and you're done! No, and it's *amazing* the *wealth* of stuff! Mother's Day, Christmas, you know, any specialty you want, photographs. You know, "I want sunsets. Or I want sunsets with boats, or I want sunsets with mountains, or I want--," you know?

Brock: Well, I'm working on a presentation now, so I may just do that. So I've gotten a very good tip from you, thank you. <laughs>

Warnock: Well, and a lot of it's in Illustrator format, so if you want to change the wording and the fonts and everything else, it's done! I mean, it's really great!

Brock: And just thinking about-- well, one thing I was thinking about when you mentioned artificial intelligence and machine learning was clearly so much of that is-- as we were talking previously about with PDFs and analyzing trillions of documents and this, that-- a lot of that is directed toward the image, and images, in general. But one thing that I saw recently was a-- I can't remember the exact name of the product, but it was using Artificial Intelligence techniques for the kind of manipulation of voice. I'm sure you've seen this thing.

Warnock: Yes.

Brock: Where you can essentially, you know, get a sample of someone's spoken voice, and then essentially be able to say how--

Warnock: You can say anything you want.

Brock: Fantastic, I mean, fantastically powerful. But also for me, raised up something--

Warnock: All kinds of questions! <laughs>

Brock: But that you've been living with from Photoshop.

Warnock: Yes!

Brock: Which has become, you know, this has-- as Photoshop, too, has become just such a predominant tool, our trust in photographs, our trust in voice. You know, what are your thoughts about that whole domain?

Warnock: Well, there's a demo that they did. If you go back to the last MAX Conference, and you go to the demos, there's a demo where-- and this-- I swear to god this works. You make a sketch. You say, "Okay, here's a woman, she's in a trench coat, and here's a lamp," and you make a sketch of it. And let's

see, let's put something else in it. Oh, there's a car in the background or something. So you make a sketch. And you scan the sketch. And so what this software does is it goes into these 100 million photographs, and it recognizes lampposts, it recognizes women, it recognizes the age of the woman, it recognizes her hair length, it recognizes the trench coat. And it finds the closest thing, does color correction and puts them all together. <claps> And you can see this demo online. And you say, "Really?" <laughter> No, but it really does this! It color balances, it does the whole nine yards. It says, "This is night," so it'll look for things at night. And you can sort of make a sketch. And I've seen this demo two or three times with three or four sketches, and you say, "Really?" But it has parsed these 100 million photographs and put them into a structure, where it can find things. So--

Brock: It's quite incredible.

Warnock: Yes!

Brock: So you're sketching a photograph, if you will.

Warnock: You're sketching, yeah. You're making a rough sketch. And it's recognizing the sketch. And the facial recognition stuff is amazing. I mean, it's becoming predominant and stuff in a lot of software.

Brock: Right. Well, how does the--

Warnock: How do they do that?! <laughs>

Brock: I mean, that is obviously, you know, to me, that sounds like a wonderful capability that many people would find useful, like such a wonderful way to create illustrations, or do creative things. But I wonder what your thoughts are about these for fakery and things like that. Are we just into a new era, or are there tools that can help us with this? I'm just be interested in how you're thinking about it.

Warnock: Well, I saw it in advertisement for a piece of software that says, "This piece of software can tell if Photoshop has manipulated this image." Okay? Now, I don't know whether I buy that, but I don't-- I haven't seen it demoed. And I haven't challenged it, but I saw this in a news release. But it's get-- boy, you see this demo, and you say, "Oh, my god!"

Brock: Right, there's no-- that is really beyond a limit to what can be--

Warnock: Well, and the whole A.I. thing is becoming pretty outstanding-- pretty amazing. I mean, Amazon looking for music, or anything-- I mean, it's pretty amazing.

Brock: I wondered if-- one thing I wrote a quick note about was just about language. And I guess what I mean by that is speech and voice. You know, so much of-- and what I wanted to get at was so much-- from one degree, or one vantage point, so much of your career has been about a real-- a profound transformation in what computing is about. Really from calculation to image. You know, and now it seems

like it's almost by and large calculation in service of image. And I wonder-- and so much so that that seems almost so natural, how could anything else be? But is voice a new area?

Warnock: I find this all mind-blowing. Because I used to work on computers that could barely get anything out. I mean <laughs>, they didn't do anything! They didn't have *any* memory! But now they're talking about analyzing terabytes and terabytes and terabytes of data. And in some sense, throwing the magic of semantics on it, and being able to understand it. And that's what all this machine learning is about. But we, you know, it wasn't that long ago when we didn't even *dream* of having that kind of memory. I mean, if somebody had told me that I could buy five terabytes of stuff for a couple hundred dollars, I couldn't even *think* about five terabytes, let alone fill it up!

Brock: Right.

Warnock: Yeah. So I mean, it's to a point now where it's hard to establish what the limits are, and when the self-driving cars come out, you know, you look up and you say, "How in the hell does that work?"

Brock: <laughs> So I would just-- is it-- do you think that with this kind of great abundance of computing power, of memory, of storage, and especially in context of sort of like a hyperscale data center and things like this--

Warnock: All of those things exist. <laughs>

Brock: Which all exist. But does it become, in a way, harder to see what the direction is going to be in computing? In some ways, I would imagine having more constraint gives you more constraint. You know, you can't-- so you might be able to discern direction.

Warnock: You can't do that. Yeah, you can't do that, because I mean, I remember I used to go to these lectures in the '60s, and let's see, was it in the '60s? No, it was in the mid-'70s, and it was down at IBM Research, and they were telling us how much data you can put on a flying head disk. And they said, "Here are the constraints of physics." And really reputable physicists would come and say, "Here's the constraint of how much data you can put on a disk. How close you can get the disk to the thing because of the aerodynamic properties." And it was all bullshit! <laughter> I mean, they're talking about physics that you can't do that. And yet, they do! And they said-- and then I went to one lecture where they said, "You know, you can't make chips smaller than this, because cosmic rays come in and disrupt the bits and you can't store them." I mean, have you ever been to a lecture like that? And that's crazy! Because they do!

Brock: Yeah, right.

Warnock: I mean, so this five terabyte disk that I have is this big.

Brock: Yeah, it boggles the mind.

Warnock: It boggles the mind. I mean, I just-- I don't even know how to think about that.

Brock: So it is an interesting situation where, with the abundance, the applications and the uses become harder to see.

Warnock: Harder to imagine and harder to see.

Brock: Yeah.

Warnock: Well, I'm currently reading a book on machine learning, because I feel totally obligated to come up to speed.

Brock: Yeah. It just seems like it's-- well, it's already being deployed more and more in different-- more in different areas. It seems to me, my impression is that Adobe was concerned about a diversity in terms of gender and ethnicity and race, you know, diversity of all kinds in terms of its workforce before the more recent era where it's become more of a topic of conversation, and a more widespread concern, thankfully! But do you think it's fair to say that Adobe was concerned about and active in this question of diversity kind of ahead of your peers?

Warnock: We have always tried to be ahead of the peers. It's hard in Silicon Valley. I mean, it's hard. The educational infrastructure has to change its attitude. And the society has to change its attitude and so you're trying to help push that process.

Brock: Mm hm, by providing a pull, right? By creating a market for it, if you will.

Warnock: Sure.

Brock: Now, I was just-- could you talk about where that came from? You know, I'm interested to know where that commitment to building diversity, having diversity, you know, where'd that come from?

Warnock: Well, it clearly probably-- it probably started with Chuck and I, but Chuck and I are quite liberal. So we have always believed that there should be equality and opportunity. And always believed that diversity, hybrid vigor is great! <laughs>

Brock: <laughs> That's a nice phrase! I haven't heard that before. <laughter>

Warnock: And having people with different views is great, and having them be able to exchange those views is great. So information flow should never be dampened, and transparency is great.

Brock: Yeah, I was just going to say, kind of-- I hadn't put it together in a way how that goes with transparency. Because if you don't have transparency then you don't get the value of the hybrid vigor, or whatever you called it. <laughs>

Warnock: Yes.

Brock: Yeah.

Warnock: So, and Donna is always-- she's the head of HR -- she is always sort of standing up and trying to tilt the scale, so there's more diversity.

Brock: Well, I thought maybe I could ask you to just kind of close with-- I'd just be interested to hear your reflections on outside of Adobe, outside of your work. What have been just important parts of your life outside of work? We've talked about artistic pursuits of different kinds and I think we talked a little bit last time about some of your passion for books and book collecting. But just if-- to the extent that you're comfortable sharing, I'd love to hear about other parts of your life that--

Warnock: Well, we're doing more and more traveling, which is great. Getting exposed to the world is, I think, really important for everyone, because I mean, we've been to Miramar, and we've been to Iran, and we've been to Russia a couple of times, and Yugoslavia, and so we have-- we go to Mexico quite a bit. We haven't been to South America. Probably need to do that. My wife and I have a very extensive collection of Native American artifacts.

Brock: When did that start?

Warnock: That started around early 2000, or mid-2000s. We have about-- represented about 50 tribes.

Brock: Hm.

Warnock: All over North America. So we've-- as part of that, you learn a lot about it. Yeah, if you go to a site called SplendidHeritage.com, you can see the collection. You can actually see four collections, but the majority of it's stuff-- we're two large collectors in other things. Other art. I would say that sort of covers it. The books are good.

Brock: <laughs> I'm sure! You're preaching to the choir for that. <laughter> Well, great! Well, maybe this is a good time to pause. Thank you very much!

Warnock: Oh, you're so welcome.

Brock: Yeah.

END OF THE INTERVIEW

