

The Advent of Digital Typography

Interview With Liz Bond Crews

Paul McJones

■ **LIZ BOND CREWS** began her career as a systems analyst in Los Angeles, CA, USA, for RCA. She soon joined the Xerox Electro-Optical Division in Pasadena, CA, where she led a group building special systems for *National Geographic* magazine, Ginn & Company, and University Microfilm. In her final position at Xerox, she licensed high-quality typeface designs from Merghenthaler Linotype, among others, for use on Xerox's high-performance 9700 laser printer.

In the early 1980s, the Adobe cofounder John Warnock recruited Crews to Adobe Systems, where her first task was to license high-quality typeface designs to be rendered as Adobe Type 1 fonts for PostScript printers. While at Adobe, she was responsible for bringing high-quality typography to the Adobe PostScript page-description language, running corporate marketing, hiring graphics designers, and putting Adobe on a firm footing with professional designers and printers, greatly enhancing the value of their product. After Adobe, she helped found Electronics for Imaging and, after some consulting, retired in 1993.

This interview, conducted by Paul McJones, is based on an oral history transcript produced by the Computer History Museum.¹ The original transcript was recorded on May 24, 2017 in Mountain View, California.

EARLY EDUCATION AND EXPOSURE TO COMPUTING

Liz Crews: I grew up in South Texas, on the border of Reynosa, Mexico. It was a bicultural experience. It was a very loving environment, and I was encouraged by my family to excel in whatever I did. I enjoyed school immensely, and I ended up doing a lot of activities in school. For example, I ran for president of the senior class in the student body government. In those activities, I think I really excelled in doing creative things. I'll never forget the campaign I used to run for student body president; I came up with slogans like "Liz knows her biz! Vote for Liz!" Sadly, I lost the election by six votes to the captain of the basketball team. It was an encouraging environment, but it was also a sheltered environment. I was fortunate to have a family who loved me, cared for me, and absolutely insisted that I excel.

Paul McJones: So they encouraged you to go to college. Had they gone to college?

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Crews: Daddy had, yes. He was an orthodontist. After World War II was over, we moved to Altus, Oklahoma, where my father practiced dentistry. I was born in Oklahoma. But then the Korean War broke out, and they recalled all doctors. He was sent to Korea for two years. When he returned, we moved to Memphis, Tennessee, and he worked on his advanced degree in orthodontics and maxillofacial surgery. After that, because they enjoyed Corpus Christi, we moved to McAllen, Texas.

When I graduated from high school, I wanted to do something different. I wanted to get out of that environment, so I went to Bradford College, a junior college north of Boston, Massachusetts. It was a small school, and in fact, there were only two girls from Texas in the entire school. It was an interesting cultural switch for me from growing up in a small town in Texas to going all the way back east to Boston. I enjoyed that environment very much. I loved the art history, the cultural aspects, and the opportunities I had back there. But the classes I enjoyed the most actually were of math. At Bradford College, I was an editor of the annual and quite involved in activities. After I graduated, I was told I couldn't stay back east and had to come home to Texas.

From there, I went to the University of Texas and finished my degree in math and computer science. In those days, undergraduates were not allowed to enter in the computer room. We did everything by punch cards and submitted our programs to the computer center. If you dropped your box of cards, you were really in trouble.

McJones: There weren't too many women, I suspect, in that program with you.

Crews: No, there were not many women in the university's math program. Ironically, I really wanted a computer science degree. In order to get that, I had to have a double major. Math was obviously the right double major. I wasn't that interested in the theory side of math, but I liked the application side. It was like problem solving to me and the programming was fun.

FIRST POSITION AT RCA

McJones: You graduated in 1968, correct?

Crews: Yes, 1968. The question was, what would I do with the degree? In those days, interviewers came to your campus and you interviewed with everybody. I had an opportunity to go to several different organizations—Cape Ca-

naveral and NCR had a program. I interviewed at quite a few places around the country. I had about decided that I wasn't really that interested in the programming aspects entirely, so I sort of leaned toward organizations that were offering me the opportunity to be more like an analyst because I enjoyed solving problems and debugging. I felt I would rather do that than just be on a programming team. That's why I ended up with RCA.

I enjoy talking to people and discovering the real issue. Still, this is obviously the very beginning stages. When I was a system's analyst at RCA, I was assigned full time to a corporate account. Software developers would come in and say, "I'm having problems. I can't solve this." I'd go through their core dumps with them. We'd find the error and figure out what to do about it.

McJones: Tell us about some of your customers at that point.

Crews: Signal Oil and Gas was an interesting one that I enjoyed working with. They had a large department and I went through a lot of dumps with them. Another client was Glendale Hospital in the Los Angeles area. That was my first time to get involved with Cobol. The developers were using the RCA Spectra 70 computers and had written an accounting system in Cobol. They were having difficulty in expanding it. I went in to help them document the system, figure out how we could expand it, and then wrote code for that. That was an interesting project because I discovered very quickly how important it was to succinctly document your code and leave the right opportunities for future modifications. It was an enlightening experience because what I inherited to fix was really not very good.

McJones: You began with Fortran in college, but at this point, you were programming in assembly language and Cobol, so you had a broad range of technologies.

Crews: Yes, when I joined RCA, one of the things that appealed to me is they sent everybody back to Cherry Hill, New Jersey, for a three-month program. I was surprised at the number of people in that systems analyst program who didn't have any math or computer background. It was easy for me because I had that background, but it was a really good training program.

McJones: RCA was in the LA area?

Crews: Yes. I'd wanted to go to San Francisco, which to me seemed like the ideal place for my

first opportunity. In those days though, there was nothing going on in San Francisco in the computer industry, so Los Angeles was it!

MOVE TO XEROX ELECTRO-OPTICAL SYSTEMS

McJones: How long were you in that job?

Crews: Unfortunately, in the early 1970s, RCA disbanded its computer business, selling it off to Sperry Rand. At that point, I thought, “Now what am I going to do?” I went about interviewing with different organizations, and I even contemplated becoming a stockbroker. I interviewed with Xerox Electro-Optical Systems in Pasadena. I was fascinated with that organization because it was a group of scientists and they were looking for a systems person. I thought, “My gosh, this is where I should be,” so I joined EOS.

There I encountered a new set of problems. In the beginning, EOS did a lot of government contract work. One of the tasks I did came as a result of one of the salespeople in the Washington DC area who had been exploring the opportunity to join up some of Xerox’s technology in *National Geographic* magazine. They asked me to look at the magazine and see what we could possibly offer in automation to help them produce the magazine. I spent probably six months at the *National Geographic* Society interviewing and talking to people, figuring out their workflow.

We discovered that the main issue there was the proofing. How do you proof the pages and the mock-ups? At that time, Dale Green was doing some wonderfully interesting work with a color printer, and it was being electronically driven. So, we proposed a page markup system, and its proof device would be the Xerox color printer. We priced that out as a one supply solution, but the actual price tag was ridiculous because Dale Green only had one machine and he really wouldn’t want to put it in a user environment.

University Microfilms had another interesting issue. They were recording all dissertations on film. The corporation said, “Wait a minute, maybe we should be thinking about digitally capturing this information.” Rather than doing what we would do automatically today—scan it and store it in a digital file—we chose to actually rekey the dissertations. In other words, the abstracts would come in, and then somebody would rekey them

into a digital format. Then we would just create a page layout. Of course, dissertations abstracts have a consistent layout form, so it was easy to design a descriptive page format that you could print. We used Xerox Alto computers.

My group developed the software to do this page layout system for University Microfilms. The biggest problem we had was how to connect different dissertations together so that you could actually print them in a format. We used Ed Taft’s FTP work that was done at PARC. At that time, Ralph Kimball also had done some interesting typesetting of formulas, so we could actually typeset mathematical formulas. Using Ralph’s work, we developed a page layout system with the hope that we would be able to actually digitize all the abstracts came in-house so they wouldn’t have to go to cut and paste. That system ran for about a year, but there were anomalies. At some point, we said, “This is not going to work because it’s not a production hardware, and we cannot solve all the issues.” But the client agreed that it had been a good test.

McJones: How big of a team did you have working on something like this?

Crews: I had three software engineers and myself.

ADVANCES IN DIGITAL FONTS AND TYPEFACES

McJones: You mentioned Ed Taft. Are there other people that you were interacting with a lot from PARC?

Crews: Yes. I followed both Alan Kay’s and Adele Goldberg’s works. Of course, I knew John Warnock and Chuck Geschke, Bob Taylor, and Butler Lampson. I didn’t work directly with Butler Lampson, but I interacted a lot with Larry Tesler and Tim Mott. That was what was thrilling about working at Xerox at that time, particularly at EOS. It gave me the flexibility to really go around the corporation and work with different people.

After exploring these different opportunities with the Xerox Education Group, I was given the opportunity to take over managing the Xerox Corporate Font Center for the Printing Systems Division in El Segundo, California. By this time, I thought that was a good idea. I’d been doing other separate projects. The development team was a small group, but this sounded like a really interesting problem to address.

When I got down to Xerox, I discovered some interesting things that were going on through the

Corporate Font Center. The majority of the electronic printers were Model 9700 high-speed printers. The first industry to adopt the high-speed technology was the insurance companies. That was a perfect application for those high-speed printers because the majority of it is boilerplate—all you have to do is insert the name of the insured person, the policy number, the dates, and things like that. There is a lot of static information, and then digital information is inserted.

For this system, the customer base would design a new form, a new thing they were producing, such as a policy. They would come back to Xerox and say, “I want my fonts delivered to me in 10.2 characters per inch.” Remember those were the days of the fixed-pitch typewriter. Next, they’d want a font done in 10.4 characters per inch. We were making bitmaps, literally a bitmap of every character. We primarily made Universe, or a bastardized version of Universe, that was similar to the Helvetica sans serif font. I was flabbergasted by the number of versions we had made. We were just inundated with this burden of creating all these fixed-pitch fonts!

The company wanted desperately to use Roman PS (proportionally spaced) and Courier. These were particularly desired in England at Rank Xerox. We didn’t have access to those, so I went to negotiate the contracts for licensing Roman PS and Courier from Eric Bauer in Neuchâtel, Switzerland. He was not at all happy with the contract because he developed type wheels, and he was Swiss, so he wanted to make it! He didn’t object to it, but he thought the idea of me paying him a royalty just so I could use the design was not really what he wanted to do. He wanted to sell print wheels. That was an interesting negotiation.

McJones: Describe briefly the font development process and the tools that were used to go from artwork to the apps.

Crews: The tools were written on Alto. I didn’t develop those tools. They were literally a raster generator. The user would bring up each character on the screen and modify it until the shape was created. That meant literally designing it so that they would match the character’s requirements of fixed-pitch type faces.

McJones: Did you use the spline-based Fred editor²?

Crews: Yes, we used that. That was the first step. Then I realized that the corporation was going

to reach a point of not being able to deliver these printers because we didn’t have enough typefaces and our internal department could not generate them. We were killing ourselves just generating the other fonts for the existing customer base.

So, I went off to meet some type designers and type developers and was introduced to Mike Parker at Mergenthaler Linotype. Rick Freeman and Xerox negotiated a contract for Mergenthaler Linotype to produce typeface families for us. They would do the bitmap development and deliver the bitmaps to us.

Of course, then the question is, “How many sizes do we make?” because we were now talking about proportionally spaced typefaces. How small of a typeface size could we actually legibly produce on a 300 dpi printer? We defined ten typeface sizes. We knew we were primarily going to be printing on 8.5×11-in paper, and they were going to be text-oriented faces, not display faces, not faces that would be used for advertising work and such. After we got the contract signed, they set off to develop some typefaces for us. I can tell you it was a challenge to get that contract though.

McJones: Was it a question of them being uncomfortable translating their designs into your format?

Crews: Yes, there was a question about which typefaces would lend themselves best to 300 dpi printing. I also worked with International Typeface Corporation (ITC) at that time. Everybody I approached in the type industry was interested in digital electronic printing. In fact, they were fascinated about it. It gave them an opportunity to say, “Can we do this? Can we make 300 dpi fonts?”

There was discussion at that time about whether we needed to incorporate a copier and a printer, if the next version should be a copier as well as a printer. Most of the salespeople were used to selling copiers and discussing the pages per minute and cost per page, rather than appreciating what document production could do. For example, in the color copier area, I remember a lot of people were not convinced that it was going to go anywhere. What would you copy? What really needs to be copied in color? It was a slow progression to where we are today.

McJones: Tell us about your staff while you were doing this font development work. What sort of team did you have? What skills and what people?

Crews: The actual people doing the typeface production, working on the Alto computers, were probably not very skilled. They were just people we trained to use the tool, not programmers.

I don't think they had a strong appreciation of type, and I am not too sure they saw value in what they were doing. It was like a manufacturing area.

McJones: You mentioned you also had some technical people.

Crews: When I got there, all the software had been developed and they were using it. I left the software and the actual production going as it was. But I realized that just adding more terminals wasn't going to solve our problem. We had to figure out a way to do it differently, to also get the typefaces available for the corporation where we had no expertise. It seemed appropriate for me to look outside to bring that expertise in, and I think if I'd stayed at Xerox Corporate Font Center after Mergenthaler would have delivered, we would probably have moved on to a new technology of developing fonts. But at 300 dpi, where you have to make a bitmap for every size you are producing, that's a lot of bitmaps.

By going to Mergenthaler, I outsourced the production. It seemed the only thing appropriate to do at that time, because we had to get some typefaces available for the electronic printing market, and we didn't own the rights to them. By licensing them and having Mergenthaler produce them, we also got the rights to the typeface. We weren't copying anybody else's. We were using the original designs. That was important to me.

McJones: You had credibility because you were part of Xerox.

Crews: As I approached all the type designers in the industry, I would say, "We're Xerox Corporation." Because of that name, I was able to open doors that probably no one else could at that time. They were interested and saw all the opportunity of what was going to happen. They wanted their typefaces licensed by Xerox.

McJones: Were you really moving into the world of typography personally in terms of joining organizations and so on?

Crews: Yes, when I began working with these people, I said, "We have to set the standards of what excellence in typography looks like, because the publishing industry sees Xerox as

this organization bringing typography to the world. Therefore, we have to set a level of excellence in what we're doing."

By going to different trade industry meetings and shows, I met an awful lot of people and was asked to join the National Composition Association Board of Directors, which was a group of typesetters. At that time, I was curious why they wanted me. Later, I realized that they were interested in having an insiders' input: "What's Xerox doing? What's the next thing coming?" They wanted to have a dialogue with somebody. Ultimately, I think they realized that they were going to have to expand their business. At the meetings, I suggested we all share what we were doing, how things were moving. Quite a few of them thought, "I need a new business strategy, or I am going to go out of business." I enjoyed that interrelationship, working with these different people.

McJones: Were you meeting the designers as well as the management?

Crews: Yes. In particular, I think one of the vehicles I was enabled to do that was through International Typeface Corporation. They took me under their wing and recommended to join ATyPI (Association Typographique Internationale or International Typographic Association). I went to their international conferences, where I met all the type designers and showed them what we were doing. I brought specimens, which we talked about, among other things. I think that what prompted them to think was, "What designs might work in this new xerography?"

McJones: You just mentioned specimen sheets. Would you print various kinds of things using the Xerox hardware, but with their type?

Crews: Yes, I would print things. At that time, Altos were everywhere. At Xerox Printing Systems Division, we were using Altos and Bravo, which was Charles Simonyi's development for word processing. We had one or two typefaces, so I produced examples of specimen type things that I could produce at that time. Of course, I couldn't do much. I could only print a single point size. But I showed them exactly what was happening. I showed them what happened when xerography puts down the toner; it smushes it and certain strokes get heavier. I showed them how we were doing things to make up for that. For example, if a stroke was too heavy, we took out every other bit so that, in essence, when the impression was made on the sheet you had the appropriate stroke. That

fascinated the type designers. They hadn't even thought about something like that.

JOINING ADOBE

Crews: Something happened then that was probably the most exciting thing in my whole career: John Warnock came to visit me. Chuck Geschke and he had left PARC by this time, and they came to visit me in late 1982 or early 1983. John showed me exactly what PostScript could do in type, and I was blown away. It would've solved everything. In other words, he proposed that we use PostScript software as font development software. At that point, I went up to the organization saying, "This is it. We need to move to this technology. We'll be able to make the typefaces we need, and we will be able to move forward and supply the corporation with the type." But I couldn't sell it internally.

McJones: Were you trying to convince Xerox to adopt Adobe technology?

Crews: I wanted Xerox to commit to buy PostScript and use it internally for our font generation, but I couldn't sell it internally. I can think of reasons why it wouldn't sell. When I told that to John, he said, "I think you ought to come talk to us."

When I went to talk to John and Chuck in Palo Alto, they showed me more of what they were thinking about—device independence. They had a strong desire and a passion for fine typography. They didn't have direct contacts with type designers or the type foundries. They knew about them, but they didn't have an "in" with these people, so they said, "Why don't you come and join us? Let's do this."

So, I decided to quit Xerox after eleven and a half years. I realized I'd reached a glass ceiling; I was not going to go anywhere, and it was time to move on. It was exciting.

I was employee number 15 when I joined Adobe. I don't remember what my title was. In those days, we were just engineers; you went out and did what needed to get done. The first thing that John and Chuck needed, that Adobe needed, was to license the typefaces so we could generate the type. Right away, I called Mike Parker at Mergenthaler. I told him and Jonathan Seybold that I was leaving Xerox before it was announced publicly—I'd told Xerox, but the industry hadn't been told.

I'll never forget Mike Parker coming over. I sat with him on my back patio in Southern California as we daydreamed together what this could mean. What would it mean if you had device independence and printers were pervasive? He said, "As you know, typefaces cost \$35 a typeface." I said, "Mike, it ain't going to go. We can't do that. Just think of the volume and numbers if a copier in your office becomes your printer. They're going to be everywhere." I think he started generating, cogitating, and realizing that the whole pricing scheme for fonts had to change, so that it was a good meeting.

McJones: That was a fascinating story. Let's jump ahead. A font price of \$35 would have been for one size?

Crews: No.

McJones: For one typeface.

Crews: It would've been for one typeface and remember that CRT typesetters could generate any size.

McJones: I see.

Crews: What I heard was encouraging, because we wanted the licensing rights to use the design. We did not want to have them produce it for us. I was suggesting that he needed to rethink his strategy. He wasn't selling fonts. He was selling designs. He was selling the Mergenthaler quality and, therefore, deserved a licensing royalty versus a sale. That was a new way of thinking for him, that he now had a royalty-based revenue stream for his designs.

McJones: Would they deliver camera-ready artwork?

Crews: They'd deliver artwork that we would then use. We had the excellence of their artwork, and then we would actually produce the typefaces ourselves.

McJones: Were you running the type production at Adobe?

Crews: No. I didn't do that, mainly because it took a lot more energy and effort to do these contracts, to get things set up. The actual production was done by a group of engineers. My expertise was the ability to get these licenses. That relationship with Mergenthaler helped to get the licensing and the typefaces, which then enabled our salesperson to negotiate the contract saying that they would use PostScript in a lot of typesetters. We wanted the high-end typesetters because we knew that we had the ability of device independence. It

had to be both at the high and low end (300 dpi). Mergenthaler Linotype was really a key in the beginning, and I enjoyed giving them the opportunity to get an inroad there.

McJones: Because you already knew these people, you were trying to help them move to a new technology.

Crews: Yes. I'd known the people for quite a while, so it was a good relationship-building opportunity there.

LINOTRONIC MACHINES AND TYPESETTING

McJones: Did you design specifically for the Linotronic machine?

Crews: Yes. The Linotronic was the machine that we drove, or "bundled," our software with, or put PostScript into.

McJones: Describe that machine briefly. Modern audiences are aware of things like laser printers and ink jet printers, but they may not be familiar with typesetters.

Crews: The Linotronic was a film recorder. A lot of typesetters are film recorders, and this was a digital machine, so we were able to put PostScript in. Then, instead of generating output at 300 dpi on a xerographic-based engine, it produced 1270 dpi on film. After it was produced, the film would then be taken to a printer, who would make plates. Then you would replicate as many copies or print as you needed.

Today we think of the machine in our office as being our printer; we don't, in essence, create a plate. We create an image in memory that is produced on the actual output. With the Linotype machine, you, in essence, were going through a production process, which involved going to a printer who makes plates.

McJones: That was on your table when you first started at Adobe, to start negotiating that deal.

Crews: Yes, that and the ITC typefaces. We were also working with Apple at that time. Steve Jobs realized the importance of having typography in the first laser printers. When the first printer came out, I believe it had only two typefaces: Helvetica and Times Roman. (Editor's note: It also had Courier and Symbol. All but Symbol included roman, italic, bold, and bold italic versions, making 13 faces total.) I helped Steve's team pick the typefaces that would be in the LaserWriter Plus. (Added to

the original 13 face were four faces each of ITC Avant Garde Gothic, ITC Bookman, Helvetica Narrow, New Century Schoolbook, and Palatino as well as Zapf Chancery Medium Italic and Zapf Dingbats.)

In doing that, I don't consider myself a type designer. I think I have some good graphic design sense, but I looked to the industry experts to help me figure out which typefaces we should recommend to Apple, so that came from a group of people. That is how we ended up with the 35 typefaces that were in the first LaserWriter Plus.

McJones: Yes, there were 13 and then 35 faces.

POSTSCRIPT EVANGELISM

Crews: Once those sorts of things had gotten going, we were working on trying to get original equipment manufacturer contracts. We had this thing called PostScript, but a lot of people had problems understanding what it was because you couldn't see it, and you didn't buy it. It was embedded in a printer. I spent some energy and time going to industry conferences and giving talks about PostScript: what it is, why it is important, and why you were going to need it. I did an awful lot of talking, which I enjoyed. I found it challenging to try to get that information out, to take materials to these conferences and trade shows, etc. I had to write PostScript programs because there were no tools. It was interesting to literally produce your own slides by writing a software program.

McJones: You were going back to your old skills from a long time before.

Crews: After doing that, I ended up being the marketing communications person for the company because we did not have anyone. Of course, I used every opportunity I could for us to speak at a conference. I asked John if he'd do it. Chuck and he were often willing to speak.

Our challenge was, how do you show off what PostScript's going to do? That's when I realized that we needed some graphic arts quality people in-house. I went to the Rhode Island School of Design (RISD) to talk to some of the people there. There were several graphic arts people who were talented and needed summer work. I said, "Why don't you come out to California and work for me? You can use some of these new tools." Hugh Dubberly came out. At the same time, I found Russell Brown and Luanne [Seymour] Cohen and

some very talented graphic artists who were willing to leap into this new technology. I hired them for a limited time, but I think John and Chuck realized quickly that they were assets for our company, so we were able to convert some of them to full-time work.

PROOFING VERSUS HIGH-RESOLUTION PRINTING

McJones: Let's back up a bit and talk about the relationship between proof printing and high-resolution printing. I'm wondering if you were introducing two different groups to each other and you had to adapt your story for each. For example, the LaserWriter could be thought of as just a printer, a simple tool for the high-end people, but for the office people it was the main thing and the high-resolution printer was this sort of remote thing. Were there these two cultures? How did they fit together?

Crews: That's interesting. There are two cultures. At that time, this was mostly about black and white printing. We had not introduced color at all into it, so to the high-end person, the one that's looking to produce editions of something, the LaserWriter looked like a simulation of what you were going to get off the printing press; to them it was a proofer, a proof printer. I think that's what the people from the typography world and the industry felt when they saw the first low-resolution printers coming into market. They sold them as proof devices.

Now, of course, the people who were interested in having that capability in their house or in their graphic design studio would say, "My gosh, I've got the final piece. I don't have to go to a printer." So, in essence they were creating in-house, camera-ready art. It's interesting to see how the two industries interrelated. Because the printers were stable, black and white, you did not have any stability issues. Unless your toner ran out, it was a nice solution.

Still, in the beginning all we had was text, so at Adobe we said, "Wait, there is power in PostScript—a device-independent page-description language—that's in these printers that's not even being touched." For example, one of the pieces we would show in the beginning was type on a spiral that went around and around and around, because that was very difficult to do. People were

flabbergasted. That's what led, I think, to John Warnock deciding that we should put some energy into making a drawing package that would take advantage of this technology and allow people to do illustrative work. We developed Adobe Illustrator for that, and the packaging was fun because we were doing everything internally. Luanne Cohen was the one who came up with a design using Botticelli's "Venus" for the outside of the packaging.

McJones: You also created a newsletter.

Crews: When you're a startup company, how do you get your message out? You can go to conferences, you can talk to people, you can talk to industry leaders, you can talk to your potential customers, but how do you get your message out to a broad group of people? It occurred to me that maybe we should do a newsletter. This was before newsletters were really ever done. In the newsletter, which we called *Colophon*, we talked about what PostScript could do. A colophon is the thing that you find at the back of a book that lists how you put the book together (the typefaces, the typography, etc.) so that seemed like an appropriate name.

We produced *Colophon* all in PostScript because there were no other tools. We did a large form size and had it printed, and we sent it out to every possible person that would have any possible interest. It was for people we had made contact with. Of course, it was not cheap to produce this because we had to print it and send it. We probably did it over two years. It was a way for us to communicate, between meetings and conferences, with the potential users of this technology, saying, "This is an example of what you will be getting and doing."

ADOBE'S TYPE CATALOG

McJones: Adobe also had to start producing catalogs of typefaces.

Crews: Yes. We were producing type, so we had to produce catalogs for the typefaces. That was a challenge. We did that and packaged typefaces, so it was an interesting time.

By this time, we had developed a type group. I had known Sumner Stone from previous work (ATypI and all) and introduced Sumner to Chuck. Chuck and Sumner hit it off beautifully. Sumner came in to run our type development group, and he brought in some very talented young people.

They actually produced some of our own designs. They're Warnock designs, and we used Chuck Bigelow's Lucida typeface. It was a wonderful group of talented people.

McJones: I remember the names Robert Slimbach and Carol Twombly.

Crews: Yes. Carol was a wonderful type designer. Charles Bigelow was an asset because Sumner was very connected with him. I believe his students came out of RISD (Rhode Island School of Design) and other places where Charles Bigelow had worked. He had also been at Stanford, so we had some people from Stanford. Cleo Huggins came in, and I think she was through our Stanford connection. It was a talented group of people, and Sumner did a wonderful job of positioning the company as not only the first to produce and have typefaces, but as also having a type program. Of course, there were other people at this time who were also starting their own type foundries that wanted to develop PostScript fonts. Adobe Type 1 format was absolutely critical, and then it became available.

McJones: Would other developers develop in your format?

Crews: Yes, we decided to open that up, so other typeface developers could develop in our format and we would have more on the market—more faces, more reasons to print, more reasons to develop good typography, and more reasons to use our printing engines. The type and the applications were just another reason for PostScript to become pervasive and provide an amazing solution for the industry.

In the beginning stages, it was common to have a document that you wanted to print on somebody's else printer, but it wouldn't print. You couldn't even send it. That was the building block for desktop publishing. If we hadn't had PostScript, the page-description language that allowed us to have a route for fine printing as well as proof printing and production printing, we wouldn't be where we are today. But to do all that, we needed the applications and the typefaces to actually do publishing.

McJones: So, type was a catalyst. It wasn't necessarily a huge profit center, but it established that everybody should have PostScript in their printer.

Crews: Yes, it did. I call type the glue that made it all happen, because if we hadn't had that, we just wouldn't be where we are today.

Type caused the whole revolution, and I can't stress the importance of the fact that we brought quality to the market. It was absolutely imperative. When I joined Adobe, I agreed 100% with John and Chuck that if we didn't do it right, if we didn't do it with the quality it deserved, we weren't going to change the world at all. That was one of the reasons I joined Adobe, because they believed in fine typography and the point that's intellectual property. Those typeface designs are intellectually beautiful pieces of art. They should be respected and honored. They shouldn't be just ripped off like other organizations were doing.

GRAPHICS AND COLOR

McJones: Say a little bit more about the onset of graphics and color.

Crews: During my time at Adobe, it was all black and white. Color brings in another set of technological problems, so the question becomes, how do you manipulate more memory? How do you handle halftones? How do you produce color separations? If you're going to print on a press, you're going to have to produce four-color separations. When will we have a color printer?

I was fascinated by that next step being into color. Who was going to solve that issue? I was approached by Efraim Arazi, who was at Scitex Corporation. He developed Scitex and wanted to start a company in Silicon Valley. He had hired Don McKinney as his director or vice president of sales and marketing. I had known Efi from industry conferences, and he asked me if I'd help him start EFI, Electronics for Imaging, and be his vice president of corporate communications.

By this time Adobe had grown, and we had launched into Europe and had divisionalized the marketing communications activities to help support each of the divisions. John Warnock had said, "Liz, why don't you now be the spokesperson for the company?" So rather than running the marketing communications activities, I joined EFI.

Looking back, Adobe was probably the best job I ever had, but it was time for me to move on and find another problem to solve. How do you communicate where we're going next? At EFI, we were developing mapping tables to allow people to integrate into their software the ability to say, "I must have this mapping table if I want to go to a color

printer of this type or the display has to be this type of mapping. Am I going to go RGB or CYMK?" We were dealing with those types of color mapping issues. The EFI had that technology with Scitex from Israel, so I went over to help him start that company, and we worked on getting that message out. I will never forget going to one of the conferences, Seybold or MacWorld. We wanted to show that color copiers were unstable and that you had to have mapping tables. We sent an engineer around to make color copies from different copy centers throughout the San Francisco Bay area. He came back with examples, and you could see how the colors had migrated. That was one of the ways we put together a demonstration to show people that, "This is a problem. We are going to have to work on this."

McJones: Did EFI make complete printers that included the mapping?

Crews: No. They just made the controllers. It was called an EFI controller; it went on to your color printer and gave your mapping.

McJones: Were you at EFI for a few years?

Crews: Yes, just a couple of years. At the beginning, when we started the company, the question was, how were we going to get funded? There was a general patent that Efi had from the Massachusetts Institute of Technology days. He used that as a way to acquire funding and suing people who used that patent.

McJones: Talk briefly about his background, about what Scitex did.

Crews: EFI came out of the printing and publishing industry. One of the things that they needed was a page makeup system that allowed them to place halftones, color, text, and graphics. In essence, a picture page layout system like we have today, one of the book composition programs where you place pictures and text. That was done on a high-end Scitex machine, probably in the 1980s. This would've been an example: if you had to emulate something on the desktop, you would have said, "I want that Scitex capability." That is what we now have today.

McJones: After EFI, you did a little consulting work.

Crews: Yes. Robert Norton, who was a type designer from England consulting at Microsoft, wanted me to look at their program and recommend what they could do, so I did. I

recommended a type program for them and the faces to balance what Adobe was doing. At Adobe I had taken on all the responsibility for the public relations work in the beginning, as well as the advertising. So, when Microsoft was getting ready to do something, I went back to a Seybold conference in Boston, and I wanted some of those Microsoft people to meet certain people in the industry. I had a breakfast meeting and a couple of them didn't show because they were working up in their suite. I talked to my husband that evening. He said, "Are you having fun?" and I said, "Not really." He said, "Why are you there?" I said, "That is a good question."

I decided this consulting for companies was not the path I really want to go down. That's what triggered me saying, "It's a time to go take your expertise and skills and move them to some other area, like nonprofit work." That precipitated our move to New Mexico. I continued doing some technology work for the Museum of New Mexico Foundation because they had no online presence, and I worked on some ideas for them.

FINAL WORDS

McJones: Anything else you want to add?

Crews: I think if you maintain your sense of ethics, sense of balance, and never give up a sense of the best possible quality that you can produce, you'll go a long way.

I'm also delighted to see more women in the industry now, a lot more women. That's exciting and encouraging.

ENDNOTES

1. *Computer History Museum* "Oral history of Liz Bond Crews," Interview by P. McJones, Reference no. X8213.2017, 2017.
2. P. Baudelaire, "The Xerox Alto Font Design System," *Vis. Lang.*, vol. 50, no. 2, Aug. 2016; <http://visiblelanguagejournal.com/issue/202>

Paul McJones retired in 2009 from his career alternating between software research and product development (including stints at Xerox and Adobe). He is a Computer History Museum Volunteer in the area of software preservation. Contact him at paul@mcjones.org.