

# Cynthia Schira & Garth Fletcher talk about **JacqCAD**

**I**n a career spanning four decades, the artist and educator Cynthia Schira has devoted herself to the expressive potential of woven textiles. Schira taught for 23 years at the University of Kansas, Lawrence, retiring as professor emerita in 1999. She now lives in Westport, New York. Among her honors are two National Endowment for the Arts fellowships (1974, '83); an Honorary Doctorate of Fine Arts, Rhode Island School of Design (1989); and an American Craft Council Gold Medal (2000). Over the last decade, Schira has consistently explored the application of computer technology to Jacquard weaving, an interest that led her to Garth Fletcher, a designer of software for the textile industry. AMERICAN CRAFT invited the two to discuss the connections between the computer, designing and handweaving. Their conversation, with an introduction by Schira, follows.

Although I have been weaving for many years, it wasn't until 1990 that I was introduced to a CAD (computer aided design) program. I participated in a project at the Müller-Zell mill in Germany, where for three weeks I and four other artists experimented with the Grosse textile CAD system to create work on a computerized Jacquard loom. The Jacquard is known for the elaborate fabrics that can be made on it—damask tablecloths, brocades, men's woven ties, etc. The design potential of this technology fascinated me. I wanted to find a way of using it and making it available to my students. In 1994, at a textile computer conference in North Carolina, I saw a demonstration of JacqCAD—a textile design and technical structure program run on a Macintosh computer in a way similar to graphics programs like Photoshop or Illustrator. The CAD programs I had worked with in Germany and at the Philadelphia School of Textiles and Science (now Philadelphia College) were very expensive and required dedicated computers. The JacqCAD, in contrast, seemed to offer a new possibility.

JacqCAD was created and developed by Garth Fletcher, who is president of JacqCAD International, the distributor of this software. While JacqCAD is much less costly than CAD programs used previously by industrial mills, its price tag is still much above what school administrations would be willing to allocate. Fletcher, however, chose to offer generous discounts to educational institutions such as the University of Kansas that sought to introduce it to their curriculum. In the course of his teaching me about the JacqCAD program and helping to answer student questions, we had many conversations. I found him to be an interesting man with interesting ideas. I learned a great deal from him.

**CYNTHIA SCHIRA:** Let's talk about how you got into computers.

**GARTH FLETCHER:** On the job training, really. I went to college but dropped out after a year. It was the 1960s and we all

had other things on our minds. I ended up working as a technician in a research lab in Boston. Computers were around, but few labs could afford them, so researchers wired up electronic circuits to run their experiments—special purpose computers, you might say. I started with the wiring and later got deeply involved in the electronic design.

The lab wanted to use the university's computer to help with data analysis, so I was assigned to check that out. To get the computer to do what I needed, I had to learn how to program it in assembly language, which is telling the machine, step-by-step, what you want it to do—similar to what I had been doing with the circuitry. That was the start of my programming—about 1967. In the 70s we finally got our own computers to run our experiments, but we still had to build a lot of circuitry to connect them to the experiment.

**You were taking what you had done with the hardware—the logic of it—into programming?**

The two were intimately related. Today, one does programming in high-level languages that are farther away from what the machine itself is doing. A great blessing, as you can be much more abstract, but you can lose the feel of directly controlling the machinery.

**You came to understand both the hardware and software.**

Yes. Nowadays that's a bit unusual. One tends to specialize in either software or hardware because one has to. In '67 you could know a fair amount about almost every field in computing. Now people spend careers in a niche, like database software or networking. We've witnessed an explosive expansion of knowledge.

**That's what makes everyone uneasy?**

Well, you can't be just a doctor anymore—you have to be, say, a cardiologist, and even then you'd probably specialize in a subarea. My uncle became a doctor around the Second World War. He told me there were 60 drugs he had to know cold—facts, dosages, side effects, all that. Thirty years later, as a research anesthesiologist, he said there were 600 drugs he had to know just within his specialty.

**How long were you at the Boston lab?**

Until 1981, when my researcher retired. I then went freelance, teaching and consulting.

**How did you get involved in Jacquard software?**

Around '82, through an engineering rep I'd worked with, I met and started working with some people doing textile software. They had written a program to handle aspects of Jacquard weaving—applying weaves, punching the cards, and so on. I wrote an image program to edit pictures and other programs, including one to run a digital camera to bring pictures into the computer—this was before scanners. My

programs acted as a front-end to theirs—the pictures came in and were cleaned up through my programs, then were taken over by their weaving program.

**You had to learn about the Jacquard loom?**

Not really. I was concerned with the “design-as-a-picture” stage; they already had their “picture-to-Jacquard-cards” program.

Then I moved on to other projects, the crucial one being an image-processing program for a biologist that led to my shifting all my programming work to a new computer which was then revolutionizing graphics software—the Macintosh.

In 1989 I became re-involved in textile software, this time with a Jacquard mill in Pennsylvania. The mill owner was aware of the incredible graphic arts potential of the Macintosh systems and provided one for each of his textile designers. Now he needed an image-editing program for the Mac which would better handle textile-specific complexities. After I had developed an editor program to meet his needs, the increased production that resulted created a bottleneck farther along. It made sense to add features to do more of the Jacquard-specific processing. By late 1990, all the pieces were in place, and what became JacqCAD was born.

Jacquard software sounds complicated, but really isn't. In Jacquard weaving you independently control every warp thread. When Joseph-Marie Jacquard developed his first practical loom controller, around 1804, he used thin wood boards in which holes were drilled for each end to be lifted; the boards were strung together like rungs on a ladder to form a continuous tape—a thousand boards for a thousand pick/weft design. Later this evolved into cardboard cards and then into continuous paper (and in a parallel development into the “Hollerith punched card” and the founding of IBM, but that is a different story). Anyway, until the 1970s, the punching was still being done essentially by hand—imagine the work of punching a million holes in cards for a single 2,304-by-1,000 design!

But when you get down to the details, it's pretty simple—each hole is either punched or not; each hook is either up or down. The real complexity of the Jacquard is in the fabric's design. What's difficult is deciding which hooks ought to be up and which down. That's mostly the job of the textile designer. A lot of people can figure out the CAD aspects. But designers who can turn out fabric designs that really work are a rarer lot—at least that's the way it seems to me. It's hard even to define what an acceptable design is.

**Especially now, when you don't have a generally agreed upon set of guideposts for good design.**

For those who have visual aesthetic skill, defined or not, I guess designing may seem easy, but for the majority it is not. And that's why excessive worship of the computer as a design tool is bad, because the crucial decisions that go into making a good design should be made only by the designer. There is a worship of the tool. “If I could only afford the right brushes,

I could be a great painter. If I could only buy those \$50 tubes of pigments, my paintings would come out as I wish.”

**If I had a better computer . . .**

Exactly. Photographers do this all the time. They go from a \$1,000 camera to a \$5,000 model with a \$3,000 lens.

**But if the person is an artist, the right equipment can allow access to new areas.**

No, I don't even believe that. Take Paul Strand's stunning photography. I visited his darkroom once. He had a set of large trays, an enlarger that was nothing to brag about and maybe three different kinds of paper. He used an 8-by-10 box camera that did not have a terribly expensive lens. At the time of my visit he was recovering from pneumonia. His wife explained, “Oh, that fool! He was out there working on this photograph of a pumpkin from six in the morning to six at night and he didn't take a jacket.” He was composing this one photograph and caught pneumonia. All the creativity went to forming the composition. Typically, once he had the photograph, he'd go into his darkroom and print it without any darkroom magic because it had been so carefully composed.

**But, there are many things that the computer does . . .**

I think if Paul Strand had had a \$10,000 camera with all the gadgets, he might have made a few interesting pictures that he otherwise would not have done, but not many. And I don't think it would have changed his vision in any significant way. With computers, a better computer makes it a bit easier to do the work. But remember, in the 1800s people were doing complex Jacquard designs. One fancy brocade from the late 1800s boasted 75,000 picks or punch cards that required three man-years to execute.

**That wouldn't be possible today.**

Maybe not, but even as recently as 20 years ago, people would put a man-month into a design.

**I feel that the computer allows design flexibility and increases risk taking.**

Absolutely. The computer has done two things. First, it has opened up the possibility of designing to more people. Previously you needed incredibly massive cast-iron equipment to perforate the cards or paper to run the looms. Now the process can be done on a desktop computer outside of a mill. The second thing is that you can make dozens of designs instead of one.

**And, hopefully, you can edit and not go for the first.**

But there is a risk, because it can become too easy to bat off a design. Rather like a digital camera, where you don't have the delay of developing film or the darkroom work. So people can go “click, click, click,” taking hundreds of shots and

**Part of a Jacquard loom showing the chain of punched cards containing the weaver's pattern. With Jacquard weaving software such as Jacq-Cad, such cards are not used and the pattern information is on a disk inserted into a computer attached to the loom.**



selecting the few that happen to work rather than having an idea that they compose and develop. You lose a lot by being a random collector and chooser instead of being a composer.

So the computer in a sense is without vision.

With the computer you can lose an appreciation of the complexity of designing. Things become too facile, and you avoid the agony of composing ahead of time—of working toward an idea. This is a loss.

There is software, like *Surface Magic* or *Weavemaker One*, in which the program will randomly generate a range of structures or designs. We did not want the students [University of Kansas] to use that aspect of a program because they will not learn about designing just by clicking the mouse.

Students who have paid their dues, who have invested time to develop knowledge and skills, may find such programs useful as an adjunct tool.

Yes, if the program is being used in composing an idea or carrying out a vision. But if you give this kind of software to beginning students who already think that the computer can do it all, they question why they should spend time learning the basics of design.

A disturbing worship of the computer has spread throughout our culture. Think of the number of times you call customer service and are told that the computer has caused the problem—the god machine they can't struggle against. It's seen as the ruling authority.

A person called us once who wanted to buy our program because he'd seen an article in *Textile World* showing some beautiful tapestries made by Riddle and Cockrell, and it mentioned that our program had been used. He thought that he too could make that kind of fabric. He believed that one simply chose a picture and then the computer would do the rest. And actually it could, right?

Not in Jacquard weaving. What the caller didn't understand was the extraordinary skill, aesthetic and technical, provided by Riddle's designers. It is a bit like calling up Van Gogh's paint and brush supplier in hopes of turning out Van Gogh paintings. A computer program could actually do a pretty good job for printed textiles, but Jacquard weaving is much more complicated. It has fundamental constraints, and that's part of what makes the Jacquard CAD area so interesting.

In printed designs, whether on fabric or paper, you are laying down dots of colored inks or dyes. The dots are so close together that your eye blends them—the crudest printers now begin at 300 dots per inch, which produces 90,000 dots per square inch! At this resolution, colors blend easily and curves appear smooth.

In Jacquard weaving you create the design by changing the physical structure of the fabric. From the start you are constrained by the size of the threads. True, you can weave silk at 300 warp ends (vertical threads) per inch, but this is the upper limit and an exception. You don't have the liberating assump-

tion that you do with a printer, where if you create a nice smooth curve the machine will print it so that it looks smooth to the eye. In Jacquard it never will.

Well, it can, though it's more difficult.

Only if the viewer stands back quite far. And it depends critically on the skilled "tricks" the designer has used to make the curve look smooth even though it isn't at all.

But if you think of the looms that have 280 ends per inch . . .

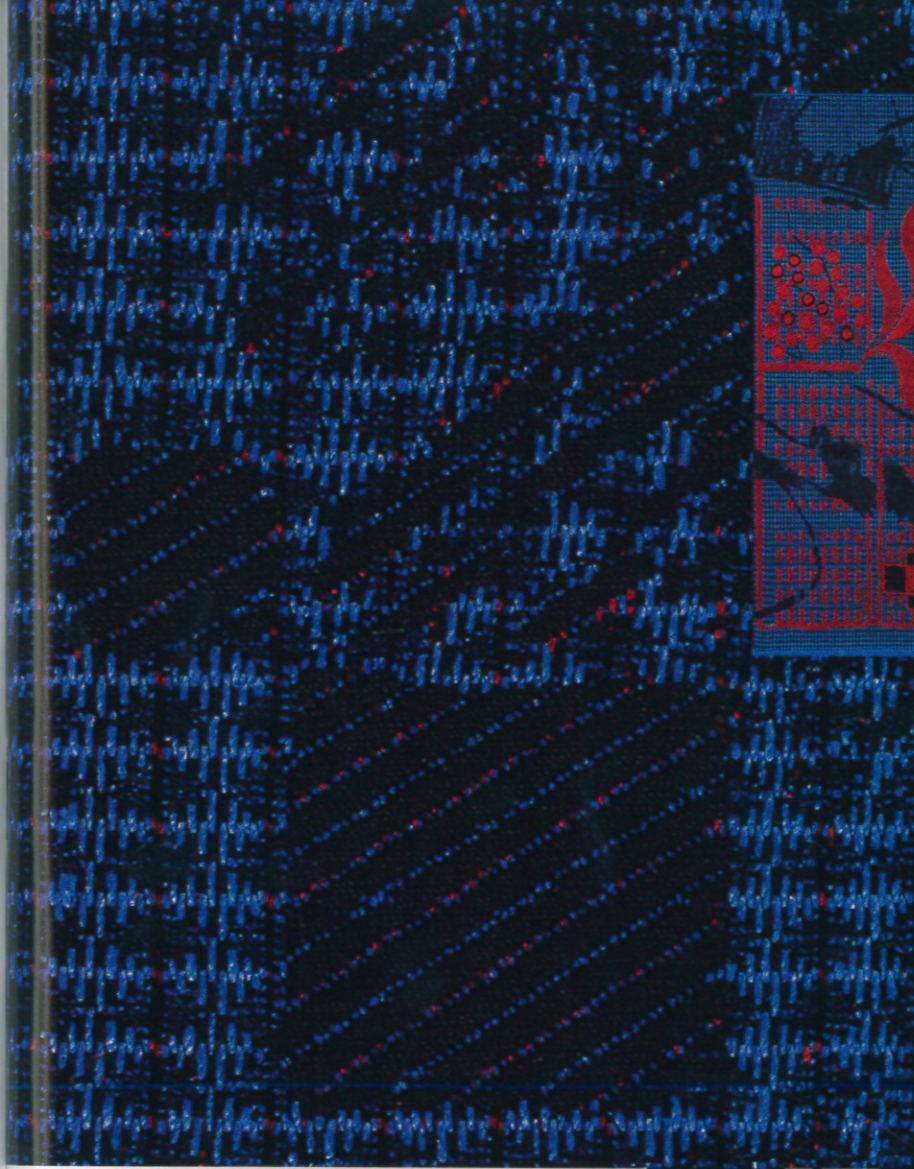
It depends on the structures you use. Say you are weaving a tapestry using a six-color warp at 240 ends per inch. In order to create a yellow spot, you need to move the yellow warp to the surface and simultaneously move the other five colors to the back. You really have to handle the six warps as a single unit—which means that you really have only 40 "dots" per inch for design, even though you are controlling 240 warps per inch. The three wefts (light, dark and binder) also have to be controlled as a single unit, so though you might be weaving at 120 wefts per inch you only get 40 "dots" per inch in terms of the design. In other words, even though you are weaving 240 by 120 threads to the inch, you only achieve a rather coarse 40 by 40 to the inch resolution for your design! Think of the difference: the simple printer is placing 90,000 dots of color in a square inch while the Jacquard loom is placing only 1,600 "dots" (40 by 40) in the same area—50-fold fewer.

Jacquard designers learn to work within these constraints. The amazing beauty of some of the designs is evidence of their extraordinary skills. They also have an entire palette of their own and three-dimensional texture, which the printing folks don't have. A lot of this was discussed in *Textile Graphics/Computer Aided*, a 1973 book by Janice R. Lourie. A handweaver by avocation and a computer analyst at IBM by profession, Lourie put together the first Jacquard CAD system back in the 1960s. It was shown at an exposition in 1968—visitors could design at the computer and then immediately see their design woven on the loom. Computers have gotten much better since then and so have looms, but Lourie's basic analysis is still valid. She concluded that given Jacquard weaving's limited resolution, there is no recipe for how you are going to place a curve on that grid that will look good to the human eye, because that is fundamentally an aesthetic judgment. You have to include a human being with human aesthetic judgment in the process.

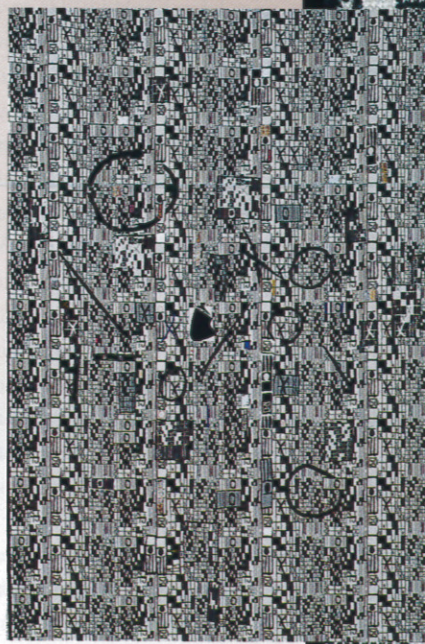
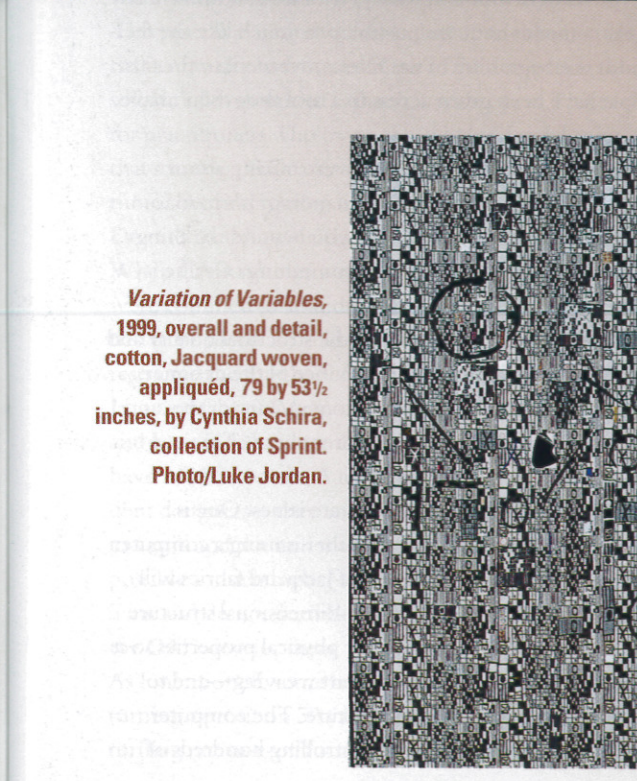
What you are saying is that the computer is a tool. It does not negate your craft, your physicality and your world unless you let it. You as an artist have control over it.

Absolutely. Of course, there are areas in industrial textile design where the primary need is to get the job done quickly, and quality is secondary. Some computer textile programs are designed to automate an acceptable "canned" solution. The problem here is that you can lose the control you need to get the design right. I'm not attracted to this approach.

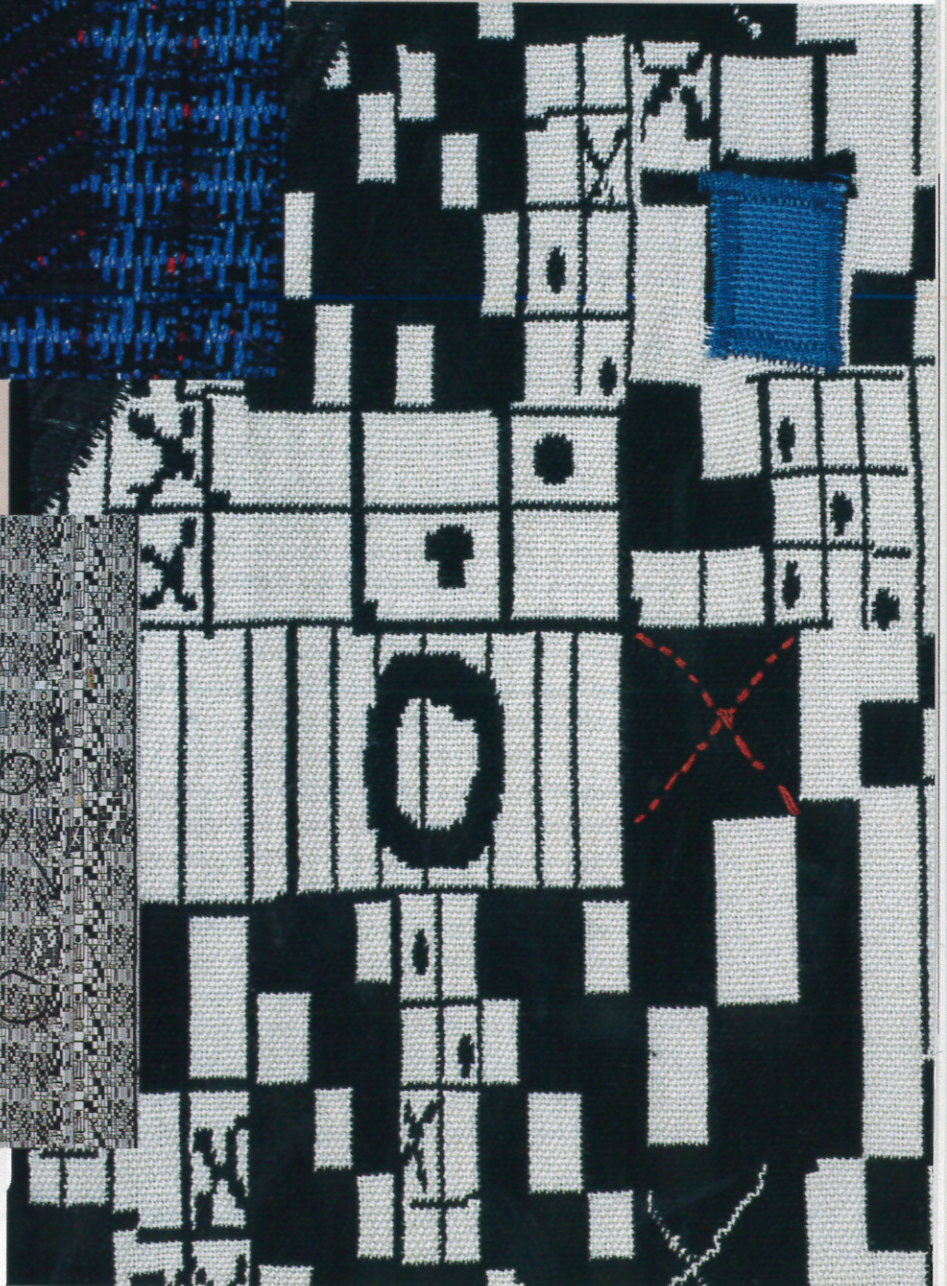
But that's what is interesting about your JacqCAD program—



*Tablecloth*, 1998, overall and detail, cotton and linen, 48 by 42 inches, handwoven by Cynthia Schira on a Jacquard loom using JacqCad software, collection of Renwick Gallery of the Smithsonian American Art Museum. Photo/Luke Jordan.



*Variation of Variables*, 1999, overall and detail, cotton, Jacquard woven, appliquéd, 79 by 53½ inches, by Cynthia Schira, collection of Sprint. Photo/Luke Jordan.



it isn't as automated as others. One must make many decisions, which is also why some people don't like the program.

That is what I wanted. There is always pressure for the one-button solution, but in the long term I find it unworkable. I believe that if there is a particular thread crossing that you want to change, you have to be able to change it. No programmer, nor any weaver, however expert, knows enough to dictate what the optimal, forever solution is.

*I don't think there is a best way. There are many ways.*

Yes, and they change constantly. The ways that might come to your mind today would be very different two or three years from now. You might be working with different materials or learning something new, and so forth.

*If there are six ways within the CAD program to do one thing—for example, to erase something or change a color, something simple—then the sequence that you do it in, or the situation where you use four instead of two—all that is going to create differences.*

Right. Our users come up with ways of solving a problem that never would have occurred to me, or to other users. They have a particular structure that they've developed or they are aware of special needs and have found solutions. It's terribly important to have that level of control.

Some people seem to have lost confidence in themselves—in their ability to believe in their own decisions. They prefer to have someone else authenticate it. So, if you have a CAD system and it tells you to do it a certain way, you don't have to worry because the system told you how.

That's not a recent problem. There have always been those who hope for simple solutions.

But it's more obvious now because everyone wants everything—the career, the money, the house—so much more quickly, without having to spend a lot of time. It's easier to defer to somebody else.

I'm not sure I agree. There have always been folks who want to do the minimum. They are content to be reliable workmen, but don't invest in their work. This is part of the human condition. There are a smaller number who have ambition and commit more to a particular job; they do the really great work. In an unfortunate way, computers contribute to the de-skilling of the labor force. Because the machine can do a usable job, it becomes easier to let it do the work even if the result is second-rate. I would rather see people use the computer as a tool to permit them to do a first-rate job.

*Is this true in the computer field?*

I think it is happening to programmers too. My life has spanned the glory days of the computer programmer. Early on, it was a skill held by a few, and it allowed them to be independent, even eccentric. Those days are ebbing. Programming has become much more rationalized and organized; programmers can be stuck in cubicles like replaceable cogs cranking out software. Few now have the privilege I've had of being the archi-

tect and implementor of a major piece of software.

*Let's talk about making JacqCAD usable on a Mac and available to more people.*

Sure. If you go back 20 years, the price of CAD and card-punching equipment was astronomical. Using 1980 as a benchmark, any Jacquard CAD program was going to set you back over \$100,000, possibly a quarter million, in 1980 dollars—call it twice that amount in today's inflated dollars. That sort of investment could only be justified by large mills with lots of looms to run, and even they could only afford a few CAD systems. The bottom line was keeping the looms running. With many looms and few CAD systems, large quantities of each design had to be woven.

Now the situation is very different. The CAD systems are more effective, so each one can crank out more designs per week. Their cost has fallen dramatically, so a mill can afford many more CAD stations. At this point a mill can weave as little as 50 yards of a single design and still turn a profit. Ironically, however, it's not clear that the mills have really gotten ahead. Buyers now insist on smaller lots and the mills are running faster to stay in place. The real winners are the consumers, who have a much wider choice than ever before.

Using your JacqCAD program has allowed me, as a crafts-person, flexibility and freedom to use various looms that I would not have used in the past—for example, the hand Jacquard loom I've been renting regularly over the past five years at the Montréal Centre of Contemporary Textiles. That's how the international traveling exhibition "e-textile," of Jacquard works by 11 contemporary artists, which opened last fall at the Montreal Museum of Contemporary Art, came about. There was such excitement about the possibilities, much like the feeling we had at the beginning of the fiber movement in the 60s. Craftspeople have been given access to a tool they didn't have. Now they must learn how to use it.

*And they have to use it with what we were talking about before—with vision, intent and understanding. It's hard to learn, and in and of itself it doesn't get you beyond the things you had to do before, as far as making something of value is concerned.*

The machine can crank out fabric, but the structural quality and aesthetic value of that fabric are the province of the designer.

*The CAD system is incredibly logical to you, but for me, and I think for many artists, it requires a different kind of logic. I have always judged everything by eye.*

I think you may be conflating two separate issues. One is designing for Jacquard fabrics and the other is using a computer to help you with the task. The design of Jacquard fabrics will always be intricate because of the three-dimensional structure of the fabric, which you manipulate for physical properties so it holds together—perhaps less critical in art weaving—and to create the design through color and texture. The computer helps with the incredible tedium of controlling hundreds of

thousands of thread crossings, but it does it in an arbitrary way. **But, that's what is so wonderful about the computer.**

It lessens the tedium but doesn't take away from the interesting problems of designing the weaves and structure. You have to understand what you want to accomplish, then the computer can make it easier.

**If you don't know about the basic elements of designing . . .**

That is a big problem. It's crucial that students truly understand the 3-D structure of fabric. Too often they approach it as nothing more than placing an image on top of a fabric—at that point it makes more sense to use printing and forego the richness that Jacquard fabrics provide through texture and structure.

**You have made an enormous difference in this field through your program, making it available to students who will be the coming generation of designers.\***

It's been fun working with the professors and students, but there is also, as for any Cad vendor, enlightened self-interest—to increase demand.

**And it has increased.**

It's too early yet to see the fruits of that "investment," but I'm confident it will pay off in the long term. It takes a number of years for students to finish school, find jobs and develop influence in their workplaces.

**You have influenced other programmers and companies who are now following your lead, beginning to give educational discounts.**

We certainly helped change the industry. When we started selling our program in '92, the going rate for a CAD system was around \$150,000. We came out with a system for \$30,000. This price was entirely feasible, but up to then no one had seen that a new day had arrived. One of the fascinating things about software development is that it is wide open. This can be scary for practitioners who try to earn a living at it because it means that someone with a few thousand dollars and a lot of skill and time can come roaring in with a new product.

**Doesn't that democratize the design process?**

When CAD systems were million dollar operations, they were confined to an industrial setting, which meant designers had to be based at a mill or in large design studios. This restricted the number of people who could be engaged with Jacquard fabrics. Mom-and-pop firms with a dozen looms, and even independent designers with no looms, can now have a CAD system. A number of our customers are independent designers—they end up sending a floppy disk or e-mail to a mill and the mill weaves the fabric for them. It's made possible a much higher degree of fertilization in design.

**That and design flexibility are incredibly positive aspects of the CAD development.**

As I mentioned, some of our industrial users are weaving and turning a profit on 50 yards of upholstery. Some are even turning out one-offs at a profit—in other words a few yards.

For a customer willing to pay a small premium, they can get a woven product that is absolutely unique, produced in an industrial mill. This opens up all sorts of new possibilities. For example, an interior designer redoing an apartment or house can have cloth woven for that one customer. Centuries ago, only royalty could afford that.

**What about craftspeople. Will their products become obsolete?**

That question is very interesting and any real answer is likely to be uncertain. It would begin by asking, What does a craftsman do? Which things are craft products and which are not? We both know what an incredible can of worms that topic can be!

On industry's impact on crafts, I think the answer may be that there will be some, but not too much. Widespread and effective CAD programs allow industry to make much smaller runs, and that intrudes on territory previously reserved for craftspeople for reasons of scale. Shorter runs also mean that it is no longer necessary to design only for mass-market taste. The range of industrial designs could increase, again intruding on crafts.

However, this still leaves an enormous range accessible only to crafts. Designs that are both intricate and low volume will still require an "uneconomic" amount of design effort. No mill can afford to invest more than a few hours of design time if only a few dozen yards are to be woven. Also, any fabric that requires nonstandard manipulations will remain outside of industrial production. Industrial looms are optimized for production speed and depend on simple and predictable motions and materials. Unusual warps or wefts quickly cause problems for a production loom. Anything requiring hand intervention is, by definition, out of bounds.

For the craftsman, accessible CAD opens new avenues. Though Jacquard weaving originated among handweavers, for the last century it has been the domain of industrial mills because of cost and complexity. Craftspeople were effectively excluded from the Jacquard weaving they pioneered. The new CAD systems and electronic looms have removed "card punching" from the mills. Independent designers and/or craftsmen now can control the entire design process and contract with a mill to perform the final step of weaving. Of course, there will be heated debate about whether the weaving itself is the sine qua non of a craft product.

At the same time, the redevelopment of Jacquard heads mounted on handlooms has opened the door for truly handwoven Jacquard products. While such a loom is still too expensive for widespread individual ownership, it has certainly become possible for a school or cooperative to own one and the CAD system to go with it. ■

\*The JacqCAD program is currently available at the following schools in the United States: California College of Arts and Crafts, Cleveland Institute of Art, Eastern Michigan University, Georgia State University, Kansas City Art Institute, Montclair State University, Philadelphia University, Southern Illinois University, University of California-Davis, University of Idaho, University of Kansas, University of Nebraska.