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# ACORN: Entrepreneurial Narrative and History

William B. Gartner

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# **ACORN: Entrepreneurial Narrative and History**



# **ACORN: Entrepreneurial Narrative and History**

**Editor**

William B. Gartner

The Spiro Institute for Entrepreneurial Leadership  
Clemson University

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# William B. Gartner

## ACORN

*In the weeks before the initial publication of ACORN, we met with William B. Gartner, the Spiro Professor of Entrepreneurial Leadership at Clemson University and the founder of ACORN to talk about the creation of this publication.*

*– Ali Ferguson*





**William Gartner**

## **Interviewer**

Tell me a story about the startup of ACORN.

## **William Gartner**

Well, first of all, ACORN is an ongoing effort of the Spiro Institute for Entrepreneurial Leadership to publish interviews of entrepreneurs telling their stories about the creation of their businesses. I think there are many important insights into the process of entrepreneurship that can be gained by studying what entrepreneurs say about their entrepreneurial efforts. Not only do these interviews offer insights into the specific activities of how ventures are created, they also demonstrate some of the thought processes involved in venture creation in addition to providing important lessons for others who want to develop their own businesses.

ACORN is one of a number of projects supported by the Spiro Institute for Entrepreneurial Leadership focusing on “entrepreneurial narrative.” From an academic perspective, the stories that entrepreneurs tell about their business creation efforts (which is one aspect of entrepreneurial narrative) can be analyzed in a variety of ways to understand how individuals take ideas and transform them into businesses. An academic label for what entrepreneurs talk about is a “rhetoric of the future.” By “rhetoric of the future,” I refer to how entrepreneurs talk about how things will come into existence even when, for example in the interviews that follow, they are asked about the past. Entrepreneurship is forward thinking, so entrepreneurs’ talk is forward oriented as well. What I have proposed that academic scholars do as a way to study these stories is to develop a “science of the imagination.” Entrepreneurs create the future by “seeing the future in their heads” and then working to take what they

see (however clear or fuzzy these images are) and turn them into real things. So, we need to systematically study how the entrepreneurial imagination works, and one of the best ways to do this is to study what they say about how they started their businesses.

This first issue is a collection of interviews of entrepreneurs who have started businesses based around new technologies at Clemson University. We have sought out a variety of entrepreneurs who started businesses many years ago (e.g., Dee Cross: Equitox and Jack Peck: Fox Fire, both entrepreneurs were faculty members at Clemson), entrepreneurs with very recent startup efforts (e.g., Matt Geavart: Kiyatec and Elizabeth Cates: Inveca), ventures started by an entrepreneur using Clemson technologies (Michael Bollick: Selah Technologies) and blends of Clemson faculty and entrepreneurs involved in venture startups (Earl Wagener, John Ballato, and Steven Foulger: Tetramer and Chuck Pringle, Andrew Clark, and Brent Buckner: SensorTech). These interviews are by no means a comprehensive list of all of the startups that have been generated because of new technologies and entrepreneurial efforts at Clemson University. What the interviews in this issue reflect is a change in the overall mindset of the University to a more entrepreneurial view of how Clemson University can foster significant economic and technological changes that have large impacts on South Carolina, the United States, and the world. There is a lot of entrepreneurial activity at Clemson University, and these interviews reflect a part of that.

Now, as to how ACORN came into being: I actually had the idea for something similar to ACORN when I began my academic career at the University of Virginia in 1981. My

initial research involved detailed interviews of entrepreneurs, and I was struck with how much information these interviews contained about the process of entrepreneurship. While I was an assistant professor at the University of Virginia, I took a number of courses in magazine and book publishing, and I even wrote a business plan on the idea of a business publishing entrepreneurial interviews; however, for me, the time was not ripe for actually pursuing the idea. An academic career involves a significant amount of scholarly research that results in academic journal articles, so while the idea seemed intriguing, I needed to focus on my scholarly work in order to continue as an academic and climb the ladder from assistant to associate to full professor. Maybe if I had been able to “multi-task,” I could have accomplished my scholarly activities and pursue this interview idea, but I guess for me my scholarly efforts required my full-time attention for a lot of years.

It was not until I came to Clemson University in 2004 that the idea of publishing interviews of entrepreneurs became feasible. And, the feasibility of the idea came about for a number of reasons. First, I had launched a major international academic effort to explore entrepreneurial narratives as a legitimate scholarly activity. So, I could see that any efforts I put into this area could also be seen as having some scholarly legitimacy as I moved forward. This aspect should not be under-estimated. In a scholarly institution like Clemson, you have to do scholarly things. It is how the game is played. Second, I had a lot of support from the then Dean of the College of Business and Behavior Science at Clemson University, Bruce Yandel, who encouraged me to dream about what I wanted to see happen in entrepreneurial leadership at Clemson. He then helped raise money and open doors for me in the community to

make it so. Caron St. John, Director of the Spiro Institute, also played a major role in supporting me by give me a lot of freedom in my role as the Spiro Professor of Entrepreneurial Leadership to try out new things.

By January 2007, the resources necessary to start ACORN began to fall into place. Bruce and Caron had contacted the Hollingsworth Foundation on my behalf, and after writing a proposal to the Foundation, we were awarded a grant to pay for the costs of interviewing entrepreneurs and publishing edited transcriptions of these interviews. Around the same time, Provost Dori Helms had initiated a university-wide program, “Creative Inquiry,” that provided opportunities for students to work with professors on research projects. For me, this meant I could sponsor a small class of students who could earn academic credit to interview entrepreneurs and engage in analyses of these entrepreneurs’ stories. I was very lucky that two of my best students from a Sociology class that I taught on entrepreneurship were willing to work with me for two semesters to interview entrepreneurs in South Carolina. As one will see in reading these interviews, these two students (who have now graduated from Clemson University) are Elana Shorb and Judith Campbell. Their names are listed as the editors of the interviews for which they were responsible.

Our initial interview efforts focused more broadly on technology-oriented startups in South Carolina. It was after we had conducted a dozen or so interviews that we realized that the initial issue of ACORN should focus on entrepreneurs with a Clemson University technology connection. There is strong interest nationally among scholars and policy makers regarding the role of universities in technology commercialization. I think these interviews

add to this discussion by portraying the critical role of entrepreneurship in commercializing technologies. So, over the past two years I have worked with a number of students in my Creative Inquiry course (entitled: Entrepreneurial Narrative) to interview entrepreneurs about their business startups.

Now, while one part of the equation was solved by interviewing entrepreneurs, another critical aspect of developing ACORN needed to be solved: actually publishing the interviews. A lot of work has been undertaken in order for ACORN to be published in the form you see here. For example, transcriptions of the interviews needed to be fine tuned (which meant working with the entrepreneurs on their transcription revisions until they were satisfied with their stories), a layout design for ACORN needed to be created, interviews had to be put into this layout format (as you see here), photographs of the entrepreneurs needed to be taken, a printer needed to be found, the work to print ACORN needed to be coordinated, and ACORN had to be put on the Spiro Institute website, as well. A thousand different details that, frankly, I am not talented or skilled enough to carry out. All of these critical tasks were undertaken by Ali Ferguson, who became involved with this project in July, 2009. Ali graduated from the Master's of Arts in Professional Communication program at Clemson University in August and has been willing to work full time for me now on the publication of ACORN. Without her efforts at managing all of the details of the publishing process over the past three months, there would not be an ACORN. One of the academic words for how the process of starting an entrepreneurial company actually comes together is "bricolage." Entrepreneurs invariably need to "take what they can find at hand" (which is bricolage's definition) and

use these resources to create the business. Ali has proven to be an innovative “bricolager” at finding and using our limited budget to bring ACORN into being.

The story of ACORN really involves a lot of other people, besides me, who enabled this publication to exist. I suppose, that would make for an interesting issue of ACORN: What if all of the people involved in the startup of a particular business were to tell their stories: the entrepreneurs, investors, employees, suppliers, buyers, and “significant others”? Wouldn’t that be interesting to study?

### **Interviewer**

One question: Why title the publication ACORN? There seems to be a lot of controversy about the name “acorn” since, for some people, the word is associated with the organization ACORN (Association of Community Organizations for Reform Now).

### **William Gartner**

Well, for me, entrepreneurship has always been about this saying: “from little acorns great oak trees grow.” I think the oak tree analogy is very germane to creating and building businesses and for economic development. When we see a large business, we need to realize that it originally started small, just like an acorn. There are only a few exceptions to this. And, for every oak tree that grows large, there are thousands of acorns that tried to become oak trees and failed. For me, that is the critical insight for business and economic development: we all want oak trees, but, oak trees begin as acorns, so, you start there, with the acorn.

# Jack Peck

## Foxtire Technologies Corporation & FastFetch Corporation

*Jack Peck has founded a number of different companies during his career. This interview focuses on two of these companies: Foxtire Technologies Corporation and FastFetch Corporation. Foxtire creates and sells software and hardware that collects data in real time on the manufacturing shop floor for sewing activities as well as software for managing the productivity of warehouses. Jack sold this company in 2006. He then started a new company, FastFetch. FastFetch is a patented order fulfillment system built around a Personal Digital Assistant (PDA) that uses a combination of light directed picking, voice picking, and wireless scan picking technologies. This interview was conducted in October 2007 during a class on entrepreneurship at Clemson University. Since this interview, FastFetch has merged with a much larger, more established company, Wesley International, to form a new company called Wesley/FastFetch LLC, doing business as "Alexa." Alexa had a major roll-out of products at the Promat Show in Chicago and the National Retail Federation Show in New York City in January 2009.*

– Elena Shorb





**Jack Peck**

## **Jack Peck**

I was asked to come and tell you a little bit about some of the experiences that I have had with my company, Foxfire, which I started 20 years ago, but before I do that, I want to go over some of the other companies that I helped start. I have been involved in some companies that have had successes and some companies that have had failures. It is a lot easier to have failures, by the way, in case you are out to do one or the other. But oftentimes there are good lessons to be learned through the failures. I guess I always had an entrepreneurial spirit. It is easier to look back and figure these things out now than it was at the time.

My first entrepreneurial venture happened while I was attending graduate school in Louisiana. I was approached by two people that were about 10 or 15 years older than me, who had decided to start a company, and they asked me if I would join them. We started a company for which I was the technical resource and they were the experts in running the business. The others were both CPAs.

We were putting together computer systems in a company called TECH Data Systems: Technical Engineering Commercial and Hospital Data Systems. I was developing software in all of those areas. The company only survived for a little over a year before it was shut down because of illegal activities. The two CPAs were running payrolls for hospitals and other groups. They would print out a stack of checks for a hospital's payroll system and would hand the checks to the hospital saying, "Okay, give us the amount of money equal to all of these checks," and the checks would then be drawn against a common account for all customers.

Well that sounded like a reasonable way to do things. The problem was that the CPAs were spending some of the money out of that account before the checks cleared. Banks do that all the time, even today, but the problem was that they did not put the money back. So they would have to run another payroll before the last checks cleared, which made them bounce for insufficient funds. They would have to run another payroll to cover deficits from the previous payroll, and the problem would keep being pushed into the future. They would do this using more than one bank account. Today, we call that “check kiting,” which is illegal.

I did not know this was going on. I was too busy writing the programs and making sure they all ran smoothly. I learned an important lesson: if you do not understand what is going on and you ask people to explain it to you but they cannot explain it to where you can understand it, maybe they are not telling you all the facts. You need to understand everything going on in your business. I learned that lesson pretty quickly.

After that venture ended, I finished graduate school and came to Clemson University. I am on the faculty in the Computer Science Department as an emeritus professor. I started a group at the university that is still ongoing called The Division of Information Systems Development. This group does a lot of contract work for the state. I ran that group for about four or five years, and it still exists today.

We were doing work for about 25 different state agencies from the governor’s office down to Lander College. At about this time was when I started my next company called Series One Incorporated, which ended in failure. IBM, at the time, had a machine called a System 32, which became a System

36, which became a System 38, and then went on to bigger and better things. The System 32 was their commercial data processing machine, which many smaller businesses were using. They also had another machine called the Series One, which was a process control computer. Its main functions were scientific and engineering applications. We discovered that the Series One had a lot of power, but it did not have the same software as the System 32. Nevertheless, the Series One was a lot cheaper and a lot more powerful.

So several of my friends and I got together and wrote an entire operating system, the System 32 Operating System and made it run on the Series One. We also wrote an RPG compiler and all of the rest of the software that had to go on it so the Series One looked like a System 32. It really ran quite well. We had investors in our company, Venture capitalists if you will. We did not get a lot of money, but it was enough to keep us going. We got a Small Business Administration (SBA) loan through a bank in Greenville.

Then I found out that there was some behind-the-scenes dealing again. I had no idea it was going on until it was too late. As it worked out, the bank had made an investment in another company (with partial ownership by a relative of a bank executive) that was about to go belly up. The bank then sold all of the assets of that company to Series One (as authorized by the Series One president who we discovered had interests in the failing company). This in turn drained all of the SBA resources away from us. We had no money to operate and had a bunch of obsolete assets that we could not use. So, again I learned that even if the technical side is going well, the business side of it can kill you if it is not done with proper controls. So, I got out of that one. That business only cost me about four months of salary.

I next started another business here in Clemson called Info-Data Business Systems. That one did not have any crooks in it, fortunately, but it was ahead of its time. The business was doing things that became popular about 10 years later. The idea was to take small computers and move them into standard business applications. Most businesses really were not ready for small computers just yet.

Small computers, like the Radio Shack TRS 80, were more of a hobbyist thing rather than tools for running businesses. It was back in the old CPM days for those of you who may have studied a little history. In any event, that company was a little ahead of its time, so the lesson we learned was that timing is pretty important. You can have good ideas and bad ideas, but timing, getting these ideas into the market at the right time, is something that I learned from that experience.

I started another company after that called Apparel Soft. That failed, but I will not spend any time telling you about that. Finally, I started a company for which I took all of my previous experiences into consideration and said, "I am going to start a company in which I know what is going on, and if it fails it will be because of my failures, not someone else's." I was a major player rather than a minor player. I started it with another gentleman who now lives in Marietta, Georgia, and our company was named Foxfire Technologies Corporation, which started in 1987.

We had an idea for a product, mostly software and some hardware we purchased from another company. Foxfire started with two of us (actually three of us, but we bought out the other person) pretty much in my garage. Some people say, "Well why did you call it Foxfire?" Does anyone know what Foxfire is? It is a fungus that grows on dead

trees. Some people would say we named the company after a fungus, but that is not quite the way we did it. If you go back to the roots of the term Foxfire, you will learn that it exists in the woods in the southeastern part of the United States. The best place to find foxfire is in the mountains. If you find an old stump or an old pine tree and you kick it over, when the inside of the stump is exposed, there is a mold that grows inside. At night, the mold glows. Foxfire is the local term for the glowing fungus.

There was a fellow named Eliot Wigginton that taught English in a high school in northern Georgia. He had his students interview people up in the mountains—the old timers—about how they did things. There is a series of books now, about 12 or 13 books, called the Foxfire books. They are a collection of chapters with directions on how to make dulcimers and soap and a lot of other things.

We did not name our company after these books either. In reality, we were sitting around one day trying to figure out what to call the company, and we happened to be meeting in an apartment complex in Seneca, SC. The complex was named The Foxfire Apartments. We argued and nobody could agree on a name. So we just threw our arms up and said, “We should just name it Foxfire after the apartments where we are meeting.” So, we were named after an apartment building complex. It is a catchy name, and people have generally heard the word Foxfire in this part of the country. But, Foxfire often gets confused with Firefox, the Internet browser.

When we started Foxfire we got our first contract with a company called Tultex, a large apparel manufacturing company in Martinsville, Virginia. Our software product

collects data on the manufacturing shop floor, in real time, for sewing activities. At one point, Tultex had around 10,000 employees. In some of the plants they had about 2,000 people sewing in one great big building. I do not mean to tell you too much about apparel manufacturing but a little might be helpful in terms of understanding the complexity of an apparel operation and the problem we were solving.

To make a shirt, there are approximately 40 operations to be carried out. Some of them include sewing the hem, sewing the buttonholes, sewing on the buttons, setting the sleeves, etc. First the shirt fabric is cut; then multiple plies of material are laid out, typically about 40 plies high. A reciprocating knife cuts out each piece (the sleeves, the fronts, and the backs), and the pieces are all placed into stacks. There are stacks of 40 collars, 40 sleeves, 40 fronts, etc. The stacks move through the sewing floor in parallel. One collection of people work on the sleeves, another collection of people work on the fronts, and so on.

Typically there are about 10 to 15 garment subassemblies traveling independently through the sewing floor, and they have to come together for final assembly to become a finished product at some point. The aim of the Foxfire software is to make sure that the sleeves are moving at the same rate as the collars and the fronts. This way they will all come together at the same time for final assembly.

This is a non-trivial task, particularly when you have 2,000 people sewing on different stacks of subassemblies all over the factory. Typically, we have about 200,000 to 300,000 work-in-progress units going at the same time, and keeping track of all of this is very important. Also, keeping track of the efficiencies of the employees is necessary because

these people are paid by piece work. The Foxfire software increased the productivity of employees between 15% and 25%, representing a lot of savings. We installed the Foxfire software system in many other companies including Brooks Brothers, Wrangler, and Levis Straus.

**Interviewer**

Why did you choose the apparel industry?

**Jack Peck**

I started the company back in 1987 while working as a faculty member at Clemson. As a professor you experience forced unemployment during the summers. Well what kind of industry did we have in the SC Upstate back in 1987? Textiles and apparel companies were predominant. Textile people make the cloth, while apparel people sew the cloth together into garments, seat covers, clothing etc.

The original Foxfire software was a fairly complex system, and it is still being run offshore in places like El Salvador and Mexico. Most of the textile and apparel industries have moved offshore in recent years. I have spent a lot of time in El Salvador installing and training people on the software. So the system is multilingual, and right now, we are looking to move it into the Far East (China) because that is where the apparel industry has gone.

**Interviewer**

How did you come up with the idea for this real-time system?

**Jack Peck**

I had done consulting during the summers with some industrial engineers who were in apparel manufacturing. I went into plants with them and just watched what they were



doing and thought, “Man, there has got to be a better way.” When I saw how they were collecting the data, it seemed very inefficient to me.

For instance, if I am the person sewing the collar, attached to the collar is what they call a “gum sheet.” A gum sheet is a collection of coupons. Each coupon represents an operation that has to be carried out on each bundle of parts. The employee takes the coupon and sticks it onto a sheet of paper, which marks the task as completed. Every time you complete a task you have to make a record of what you have done so you can be paid accordingly. The clerical work involved with the coupons took up about 20 seconds for every single bundle, and workers might complete around 100 bundles per day. The coupon system is inefficient because you are paying employees for clerical work rather than sewing. So I said to the engineers, “If we can cut down on that clerical work and reduce it from 20 seconds to two seconds, it will result in a huge savings in terms of labor increased productivity.”

Our system became very popular. It was a little more difficult to market a system like this offshore simply because the labor rates are lower. They’ll just say, “Okay, so what if it takes 20 seconds more? I am only paying \$0.50 an hour.” There is a lot less incentive for them to become more efficient.

We eventually started to look at logistics to see if there were any opportunities in that area. This was when we started creating a warehouse management system. The way warehouses operate seems rather mundane. You take something off of a shelf, you put it in a package, and you mail it. However, there is a lot more to it than that.

One of Foxfire's biggest customers is Alltel Communications. Alltel has approximately 3,000 stores across the country all of which are shipping orders late in the day while expecting them to be delivered next day via UPS. In order to fill all of the orders quickly and accurately in a short timeframe is very difficult. When we originally went into Alltel, the warehouse was a complete mess.

We implemented our system into their warehouse and smoothed out their operation considerably. With their old system, Alltel was running three shifts seven days a week and still were not getting their work out. They were working people overtime and incurring a lot of extra costs. Today, they are shipping twice the volume and are only running one shift five days a week. You can see the kind of savings that they are looking at on labor, customer satisfaction, as well as many other aspects that are byproducts of doing a better job.

### **Interviewer**

How did you integrate your software with what they already had in place?

### **Jack Peck**

We replaced what they had. We did have to do some integration because there are things that Foxfire's software does not do. For example we do not have an order entry system. Their ERP (enterprise resource planning system), which addressed their accounting issues, order entry, and billing, was already in place. So, we had to interface with their ERP. When an order comes in, we pick it, get it packed, and ship it. The transaction transfers back up to their corporate computer that says, "You need to bill these folks because here is what we just sent them." There is a fairly clean interface.

Orders come down, and information goes back up. Of course it is a little more complicated when an order from a supplier is received because we have to know that it is received. We have to put the inventory away, know where we put it, and be able to call for it when the time comes. There are perishable issues for some products, so you want to get rid of the oldest first. There is replenishment; there is consolidation.

The Foxfire manufacturing systems are still being sold, but, in the United States, the only customers who are buying and operating this system are a protected species called “government contractors.” There is a law called The Berry Amendment that says all sewn products for our military must be made and purchased in this country if they are at all available.

Right now, Foxfire software controls the manufacturing process for 100% of the chemical protective suits made for our military. The chemical protective suits are a little different from your standard shirt or pair of socks in that you have to have a complete pedigree for the product. If there is a problem down in the field with the garment, we have to trace it back to what sewing machine sewed it, what raw materials went into it, who was running that sewing machine precisely when it was made, and what kind of thread was used. After that we have to go forward to see what other products were made using that sewing machine, which person was sewing on that machine, etc.

One of the most important things that I learned from Foxfire was that when we started to get key employees, we needed to give them some interest in the company. We felt it was important that they be invested in and dedicated to

the company. The second thing was that the two of us who started the company had an agreement that we would receive the same compensation out of the company independent of who did what. That way we would not look at each other and say, “Well I did a little more than you last month, so I ought to get a little more than you do.” We just said, “Okay, we are all going to do what is required, and whatever compensation one gets, the other gets.”

My partner was full time and I was part time. At the time, I was teaching at Clemson and continued there until 2000 when I retired. One of the reasons that I formed the company was to be able to put my kids through college. At one time, I had my wife and three kids going to college at the same time. The sum of the tuitions exceeded my take-home pay from the university, so I had to have some outside income.

In any event, my partner was working full time at Foxfire, and I was working at Clemson. So, we took my Clemson compensation and my compensation with Foxfire and made it collectively equal to his compensation with Foxfire. This worked out really well for us since no one complained that one person was doing more work than the other. My partner’s specialty was not technology related; rather, his specialty was in the business aspect of things. He has a Master’s of Business Administration, so his background was more in the financial side and mine was in the technical side. We always kept an eye on each other, too.

**Interviewer**

How big did the company get, and how big is it now?

## **Jack Peck**

The largest we got was about 40 employees in the United States, but, overall, we had 50 employees because we opened an office in India. I failed to mention that. Back in the dot-com era, when the dot-com growth was really heading sky high, it was tough to get good technical people. We could not hire them because they were all moving to California to become wealthy, my son included. So it was difficult to get good people.

One of the people we hired was actually a former student of mine, an Indian student who had good connections in India. We opened an office in India to start development. That office is still doing development for us today. We have a decent number of people in the states as well.

U.S. employees design the software, ship it off to India to get the initial implementation done, get it back from India, make sure that it is done the way that it was supposed to be, kick the tires, fix any problems, and finally install it at customer sites. We felt like it was important to have maintenance and support going on in the United States versus in India. If someone says, "My warehouse is down. I cannot ship my product," we put somebody on an airplane, and within four or five hours, he/she is there on-site trying to fix the problem. We do not do this very much, but it makes our customers feel that, if necessary, we can do that. It is a little tough to do that from other countries.

Foxfire is now a growing company with new owners. The new owners of Foxfire had been chasing us for a while. They are former Datastreamers. Datastream was a company in Greenville that was bought out by a company called Infor about two years ago. One of the Datastream owners, a man

named John Sterling, had a non-compete for a year. So, after a year he jumped in and bought Foxfire and is going to do with Foxfire what he did with Datastream. He took Datastream from \$600,000 a year gross sales to over \$100 million a year. He sold Datastream for \$224 million. His idea is to again take a small company and build it up.

**Interviewer**

Did your partner stay with you the entire time?

**Jack Peck**

Yes. We are still partners in our new venture. We stayed together for 20 years while Foxfire grew. We sold in 2007.

**Interviewer**

What kept you together for 20 years?

**Jack Peck**

Well, we kept making money. We kind of liked that. We never operated in the red from the day we opened the door. We treated our employees' right as far as benefits were concerned. We had hospitalization and dental. We paid 100% of the premiums on all of those benefits, and we had really good policies. We had what is called an SEP: Simplified Employee Pension plan, which is like a 401K. We fully funded every year since we started it, which was the whole history of the company. The employees made no contribution. We gave bonuses at the end of each year depending on how well the company did. In some cases the bonuses were greater than their annual salaries. We treated our employees right, and we had very, very little turnover as you might imagine.

**Interviewer**

Did you and your partner get into any conflicts, and if so, how did you resolve those issues?

**Jack Peck**

We took a vote, and I always won. No, we did have some differences of opinion. You are always going to have differences. I gave in sometimes, and he gave in sometimes depending on the nature of what we were talking about. We rarely compromised in the sense that we took the middle ground between two positions. Sometimes that does not work very well.

If it was something that was more business related. I just let him have his way. If it was related to how we were going to spend money, if we were going to hire another technical person, who we should hire, etc., he pretty much relied on me and my technical expertise in that area.

**Interviewer**

I am very interested in the sequence of actions during the initial stage of creating Foxfire. Did you form the company before you had your first sale? How did that work? When did you have your “first sale,” and when did you start development?

**Jack Peck**

We had a contract in hand, and then we formed our company. Our customer, Tultex, was contracting with me, as an individual, for this product. They said, “Go ahead and do it.” So we said, “Let’s draw up the document, the contract, precisely describing what we are going to deliver, how much it is going to cost, how long it is going to take, etc.” We drew it up, and then we formed the company. Then, that contract

was assigned to the company because we felt it was important to have some sort of protection.

**Interviewer**

What do you feel brought them to the table as you were negotiating the contract?

**Jack Peck**

What convinced them to do business with us? The idea. This was an idea they had been asking themselves about: “How can we cut costs and increase production; how can we do it?” We told them how we could do it, which they had never considered. They said, “Well these guys are pretty creative and pretty bright, so let’s take a chance on them,” and it worked out fine for everybody.

**Interviewer**

What kind of capital did you use to start the company?

**Jack Peck**

Nights, weekends, and sweat equity. We had no capital. We drove our own cars, we paid for our own gas, and we took no money in terms of salary. I had a PC, a little bit of time, some development software, and that was all.

After we delivered our first product and we had a showplace we could take people to, we started getting a lot more business. Then we asked ourselves how we were going to market because the first time we had sold before we developed. At the time, we had an offer from a venture capitalist to put some money in. He wanted a big hunk of the action, and we decided that we would not go that direction. We decided to grow more slowly with less money rather than faster with more money.



So that may have been a bad decision. I am not claiming that it was the right decision. That was just the decision we made. In fact I suspect that, particularly when it came to the warehouse management side of the business, we actually had products before any of our competition. They beat our pants off, though, because their companies grew faster with more capital.

They grew a lot faster and a lot bigger. The guy that I knew who started Manhattan Associates sold his interest for \$400 million when he cashed out. He did pretty well. He took the venture money and grew faster, and that was a better decision. I will have to give him that.

In any event, those are choices you need to make, go slowly and maintain more of the company or grow faster and give away part of it. There is no right answer. There is just a thoughtful answer. We are growing slowly right now with my new company, but that could change.

### **Interviewer**

When you made your first contract, it appears that you arranged, as part of the deal, that you would develop the product for Tultex, but you still had the rights to it, and you could sell the product to other companies.

### **Jack Peck**

Yes, that was known right up front. We were not just consultants for hire. We were developing products that we would own, and they would buy licenses to. We gave them a really good price, as you might imagine, because of that. We did not sell products; we sold licenses to products. Obviously, if you sell a product to someone, they own it and can do what they want with it. So we sold the license to the product

and the support services. We also ended up selling a lot of media, i.e., paper.

When the company ships products from their warehouses, they have to put little labels on them that says where they will go, the shipping labels. You would be surprised how much money there is in shipping labels. If you can make a nickel on each one it really adds up. So we would go into a company and say, "Our normal license fee is \$96,000.00 for this software. We will give you a 50% discount if you will agree to buy the media from us." They have to buy it from somebody, so why not us, right?

They would jump on that, and it ends up being an annuity for us that they pay year after year. It does not take long before it exceeds the \$48,000.00 discount that was given to them. This was not my idea; this was my partner's idea. A lot of companies like to do things this way because shipping costs are coming out of a different budget.

**Interviewer**

Why did you sell Foxfire?

**Jack Peck**

I mentioned one of the reasons, money. The other reason was FastFetch, my current company. I had an idea walking through a bunch of warehouses and seeing how people were doing things.

**Interviewer**

How did you come up with the name FastFetch?

## **Jack Peck**

We tried to have catchy words, and with Foxfire, I had an idea when I was Chairman of the Board. Let me tell you a little about the idea behind FastFetch before I answer your question about the origin of the name.

My idea was to figure out how to fix things in warehouses as far as picking, shipping, and other operations. An order comes in, and you have to get all of the inventory items together, put them in a box, and ship it. That picking process is where more labor is spent in a warehouse than any other place. A lot of the big retailers like Walmart and Target will charge you a lot of money if you do not ship them precisely what they ordered. These penalties are known as “charge backs.” They will charge you back a lot of money for doing it wrong.

Sometimes the charge back exceeds the cost of the merchandise that you sent them. In this case, they will deduct the charge back from your bill before paying it. There are many companies that are very sensitive to charge backs, as it costs them millions of dollars a year. So, when you say, “I can show you how to pick your product three times faster with 100% accuracy,” you get their attention. I figured out how we could develop technology that will allow you to do just that: pick about three times faster with 100% accuracy. So, I applied for a patent on it, and as soon as the patent was granted, we began development.

We did not want to start development until we knew we had patent protection. When we started development on the product, the entire project was funded by Foxfire because development was happening inside of Foxfire. One of the people who I called in to help on the project was Ed Page.

He used to have an office right above this classroom (in Brackett Hall). He was previously the Director of Technology Transfer, and he was the head of the Clemson University Research Foundation. About a year ago, he retired from Clemson and joined me at FastFetch. Ed and I were also colleagues in the Computer Science Department.

Ed came in and we worked on the development of software as well as hardware. We developed and designed a lot of hardware and prototyped it. Ed was not an owner of Foxfire, but he was a strong participant in FastFetch, the new company. At that time, it was not called FastFetch: our product was called FoxFetch. FoxFetch is “fetching” stuff, meaning picking. We showed the technology at a trade show and got a good reception.

We thought our product had the potential to take off. FoxFetch, as a product, had no history of sales. We had been developing, getting patents and intellectual property, doing designs and prototypes, and arranging for manufacturing in China. FoxFetch had been nothing but a drain of resources.

We worried that when someone eventually came in to buy Foxfire, whether they were going to value the FoxFetch product at zero or even a negative value since there was no history of sales. We decided to move the FoxFetch product into another company. We ended up naming the company FastFetch. We did not want to call it FoxFetch because this product not only runs with Foxfire software, but it also runs with all of Foxfire’s competitors’ software. It is an adjunct to a warehouse management system. So, we did not think our competitors in the warehouse management system arena would be too happy about sending their customers to deal with one of their competitors. We wanted to completely

separate this product from Foxfire to avoid conflicts, and it has worked out really well for us.

We formed the new company, and gave Ed 25% of it. The other Foxfire shareholders got the other 75% collectively, in proportion to their ownership in Foxfire. This included some of the employees who had a stake in Foxfire at the time. It was a good way to do it, and everyone was pleased. FastFetch was then formed in August 2006 and is a little over a year old now. We have had some very good press and were picked as one of the eight most innovative products of the year in warehouse management systems.

We have had some reviews by some of the major companies. You have probably heard of Gartner and Forester Research. There is another company called Aberdeen Research with the Aberdeen Group. They did a review and had a very nice report of our product. We did a head-to-head test against Levi Straus' best system for picking in a warehouse and beat them three to one in picking efficiency with 100% accuracy.

We have been very pleased with our progress to date. We have two customers now, one of them is a company called A Beka Book. I do not know if any of you have heard of A Beka Book, but they are the largest publisher of Christian-based, home school, and educational materials in the world. They are located in Pensacola, Florida. A Beka Book is part of the Pensacola Christian College. They are actually the major source of money for Pensacola Christian College. All the profits from A Beka Book help fund the school. Instead of state appropriations, they have their own publishing company.

**Interviewer**

Is your software web based or is it non-web based?

**Jack Peck**

In terms of Foxfire, we have some Web- and some non-Web-based software. It is not an issue of what works best and makes sense. The problem with the Web is that you cannot process 100 transactions a second, but you can with a local area network. We are very sensitive to the real-time aspects of operations. Typically, the software is not Web based.

**Interviewer**

What business problems does FastFetch solve?

**Jack Peck**

Imagine a warehouse. A warehouse has racks and bays with products that are on shelves. Pickers walk through with an order and pick out the products they need to fill the order. They walk through the warehouse, generally with a cart or a tote, and put the products into an order box. It takes a long time to be able to pick more than one order at a time. We call that batch picking: multiple-order picking.

So, with FastFetch we put order boxes on the cart, we get a download of orders consistent with the capacity of the cart, for example 10 orders, into a PDA. The entire system runs on a Personal Digital Assistant (PDA). We developed some hardware that allows us to link the PDAs to lighted numeric displays (lights). One lighted display sits under each order on the cart.

The PDA verbally tells the picker where to go, what to pick, and how many of each item to pick. If you have a cart with 10 order boxes, there will be 10 lights. If you have a cart

with 200 orders, you have 200 lights, one sitting underneath each order box on the cart. Similarly, at each bay location we have a lighted numeric display. When you push your cart down the aisle, it tells your PDA where to go first. There is an infrared signal sent from each PDA that “polls” for the bay to pick from.

When the picker reaches the right the bay, the PDA says, “Stop,” using a combination of voice and visual prompts. The PDA sends the signal out to the bay and lights up the numeric displays (with a “5,” for example) where you need to pick. It will say, “Take five of that item.” When you look over at the cart, there may be lights under two boxes: one with a two and one with a three both of which are lit up. So, the first order needs two of those five products, and the second order needs three of them. This is called cluster picking. The system allows workers to pick very quickly with no paper. It tells you verbally where to go and when to stop. If you go to [www.FastFetch.biz](http://www.FastFetch.biz) there is a video you can look at of the system in operation. It is about 14 minutes long, and it tells you a lot about the system in greater detail.

### **Interviewer**

Does the system require a lighted numeric display under each product in the warehouse?

### **Jack Peck**

Well that is a good question. First of all, there is one other feature of FastFetch that helps lower cost. If you pick a certain product once a year you probably cannot afford to put a light on that location. That is pretty clear. So, what we have done is to integrate a Bluetooth scanner and a barcode scanner. If it directs you to a location where it knows there is no light, it will tell you verbally to go over and scan the

barcode on the product. At that point, you have confirmed that you are at the right spot. It then tells you verbally to pick a certain amount, for example “three.” You grab three, turn around to the cart, and the lights on the cart tell you which cart location (order) to put them in. Abeka Book, in their first phase of installation, had no lights on their bays. The only lights were the ones on the carts. They were using Bluetooth scanning to confirm that their workers were at the right bays. The Bluetooth signal is not as fast as the light calling your attention to the bay. Most people use what is often called the 80/20 rule: you put lights in 20% of the products that generally represents about 80% of your picking. So, about one-fifth of the cost buys you 80% of the benefits.

### **Interviewer**

Are you competing against companies that are developing their own systems, like Amazon?

### **Jack Peck**

Amazon and some of the others are using several different methods. Let me talk about the competing technology, which companies like Amazon use. Competing technologies are, of course, mostly paper, which is not a terribly competitive technology. Another technology is carousels. Carousels have locations that rotate. When you say, “I need something,” it rotates until the item you need is presented. However, it can take up to a minute for the carousel to present the product to you, which can be a very inefficient and time consuming.

### **Interviewer**

What do companies like Walgreens use?



## **Jack Peck**

Walgreens uses some carousels as well as other things too, but the advantage of carousels is that they do not take up a lot of floor space. You do not need the extra space to be able to walk between aisles.

Another technology is radio frequency (RF) picking. With RF picking, there is typically a portable handheld barcode scanner that receives a radio signal and tells you where to go on a little screen. It reads something like “Go to location R-15-023-014.” When you get there, you have to scan either the product or the location barcode, which is very similar to what we were talking about earlier. Typically you are doing a single order at a time. You scan the product, put it into a box, scan another one, put it into the box, and so on. Most companies that use RF picking do not do multiple-order picking. It is very slow to make a trip through the warehouse for every order; it can take you up at an hour to fill an order, particularly if you have a large warehouse.

We have developed special optimization techniques using what we call genetic algorithms. I do not know if you have heard of that term, but they borrow from the principles of biology. Say you have 200 orders. If your cart has the capacity for six orders, then you ask: “I wonder which six orders (out of perhaps several hundred possible orders) I ought to put on this cart. I would like to fill similar orders at the same time, so I will not have to walk too far in the warehouse.” So how do you determine which six orders are the best in terms of minimizing the travel time through the warehouse? It is a tough problem. It is what we call an NP-complete problem in computer science terms, meaning that the time to solve it is not proportional to any polynomial function. We have developed some very clever algorithms to

do that. It is fun taking some of the concepts pertaining to computer science and actually putting them into action by building products.

Other types of technology you see in picking are pick-to-light systems. They are similar to what I was talking about with FastFetch. The biggest difference is that the lights are only on the bays, not on the carts. So you are typically doing one order at a time and have an automated conveyor delivering the boxes from one place to another. The problem with this is that you can only pick one order at a time. Also there is a central computer in the back room that controls all of the lights in the entire warehouse. Your first light with that system typically costs you about \$150,000; whereas, our first light costs \$50.00. So you can see that we are into an area of the marketplace where we are very competitively priced. We do not have the big infrastructure that you have with pick-to-light systems.

There are a few other types of picking technologies. There are products called A-frames that are really high speed, but we are not competing with those. They are primarily used for drug wholesalers or cosmetic supply companies like Avon. It is called an A-frame because the picking device looks like an A-frame house. A conveyor runs down the center of this big A-frame; there is a box on the conveyor, and as it moves through the A-frame, it shoots out all of the ordered products into the box. It is highly automated.

I mentioned earlier that we currently have two customers. The second customer is a company called GENCO, which is in Pittsburgh. GENCO is the third largest third-party logistics company in the United States. A third-party logistics company is a company that runs warehouses for

other people. The products in their warehouses do not belong to them; they just run the warehouse for a different company. They put the stuff in the warehouse, take it out, pick it, pack it, ship it, and provide the labor. Sometimes, they own the physical building, and sometimes they do not. GENCO is very large and is right behind UPS and FedEx in terms of size. They did a test of our system and had a third-party industrial engineering company come in to monitor the test. They used their own system that they produced internally, and we beat them three to one. They are going to be putting our system into many of the warehouses that they run around the country. We are looking forward to that.

In terms of the development of the business, right now we are part the SC Launch! program, a program which is administered by the South Carolina Research Authority. What they are trying to do is help entrepreneurs who have good ideas start companies in South Carolina. In order to become part of that program, there is a fairly involved questionnaire. There is also a multi-page document that you have to fill out explaining your business plan.

That gets you into the program, and with that, you get a network of people who can help you. The second part, if you are interested in continuing, is to get some initial capital. You can get up to \$200,000 from SC Launch! in the form of a loan. Like all loans, you are expected to pay it back; however, the difference between this loan and a loan from a bank is collateral. You do not put your personal assets on line with SC Launch!, as you would with a bank.

Now if you cannot pay the loan back, SC Launch! takes part of your company. They will take interest in your company, a percentage, which is determined by different factors

depending on how well you are doing at the end of the period. At this point, we have filled out all the applications and are in the process of going through what they call “due diligence” with the SC Launch! program. We are hoping to become part of that program and get additional funding.

We were recently nominated by a group called Innovision in the Upstate to receive an award. Innovision is a group that fosters and promotes the development of technology. There are big companies like Michelin, BMW, and Fuji as well as few small companies like FastFetch. We were selected by the Innovision group as one of the three finalists to receive an award. In November, we will find out the results, but it is an honor to be one of the final three.

I might say that the FastFetch product is also good for companies similar to BMW suppliers. Within a 20-mile radius of their plant in Spartanburg, BMW has about 85 different suppliers. BMW gives them an electronic order, and within two hours, they are expected to have materials at the BMW headquarters ready for the production line.

For instance, say that BMW plans to assemble 300 cars. If I am the wiring harness supplier, they will send me an electronic order for 300 wiring harnesses all of which could be different. The pickers must very quickly and accurately pick the correct wiring harnesses. The added complexity of the BMW picking problem is sequencing the picked items onto the cart. The first position on the cart must have the wiring harness for the first car; the second position must have the wiring harness for the second car and so on. Not only do the workers have to pick quickly and accurately, but they have to sequence them onto the cart in the same order as the production line.

That is a tough problem for people to do in two hours. Our technology will do that very quickly too because it lights the light on the cart, which tells precisely which location to put the picked item for each particular car. We are targeting that marketplace as well as anybody who does replenishment: convenience stores, pharmaceuticals, auto parts suppliers, or anyone who takes point of sale data or customer orders that come in very quickly. That is the target market that we are looking to be involved with, and there seems to be a lot of companies in it. We are very excited about the future. My plan, if everything works out, is to build the company for about three to five years and then sell it to a larger company.

At Clemson there is PTR: Post Tenure Review, a process I went through when I was a Department Chair. PTR forces the University to examine the tenured faculty periodically to make sure they are all productive. We were joking the other day and saying if they start a PRR, Post Retirement Review, process, I am in trouble. I have not been doing it properly, but it has been a lot of fun.

# **Dee L. Cross**

## **Equi-Tox Pharmaceutical Research and Development**

*Dee Cross is the founder of Equi-tox Pharmaceutical Research & Development, a company that discovers and develops innovative products to improve animal and human health, directly and through partnerships. He is a Professor Emeritus of Animal and Veterinary Sciences at Clemson University. Equi-tox was founded in 1995 to search for ways to alleviate the pain and suffering of fescue toxicosis in horses, cattle and other animals grazing on endophyte-infected fescue. This interview was conducted in October 2007 at Clemson University. Since this interview, the company has continued with drug development to include over 150 specialty products and has expanded its customer list to over 5000 veterinary clinics.*

*– Judith Campbell*



**Dee Cross**

## **Dee Cross**

I am originally from Kentucky and have a Master's and a PhD from the University of Kentucky. I became a professor at Clemson University on January 12, 1973 and taught in the animal and veterinary sciences department, even though I am not a veterinarian myself. I retired in 2004, as Clemson no longer needed my services.

I grew up on a farm in Western Kentucky. My dad was primarily a root-crop farmer and, as a result, did not take very good care of our livestock because they did not generate as much income as his crops. So after a while, taking care of the animals became my job. As a result, I became interested in livestock and continued in school studying biological sciences. I majored in animal science as an undergraduate and minored in chemistry and biology. Then, I went to the University of Kentucky and earned my PhD in nutrition and a minor in biochemistry. After graduating, I decided to come to Clemson and began teaching PhD students in the animal physiology program.

However, after a number of years, I started a new focus in nutritional toxicology. I began this new focus by teaching pharmacology to PhD students. Many of these students went into medical fields or became physiologists. I combined my background in pharmaceuticals and animal science, and the result was nutritional toxicology.

In 1987, I began to research a problem concerning a toxin in grass-grazing animals. The most predominant grass in the United States is a grass called fescue. When you look around campus, the green grass that you normally see is fescue, which was released a number of years ago by the University of Kentucky after originally being imported from



Europe. I am going to tell you a little story about how we started with fescue grass and how our work evolved into the startup company, Equi-Tox, at Clemson University.

For years, we noticed that cattle feeding on fescue were not performing as they should. In fact, they seemed to be showing signs of toxicity. A plant pathologist working for the USDA finally figured out that fescue had an endophytic fungus. This fungus is quite unique because it grows inside the grass; while most fungi are external. You usually see fungi blowing in the air or growing on various things, but this one was quite deceitful in that it was hiding in plants. So we combined “endo,” meaning inside, and “phytic,” meaning plant, and called it an endophytic fungus.

It turned out that this fungus was producing certain toxins, which were really natural pesticides. Many plants have protective mechanisms, which is exactly what this fungus is for the fescue grass. The plant’s development of this fungus was a protective genetic phenomenon: the endophytic fungus releases toxins that make the fescue a very hardy type of grass that is thus able to grow throughout the United States. The fungus’ toxins are essentially natural pesticides that keep insects from eating the plants and also make the grass more drought-resistant. There is a kind of a symbiotic relationship between the plant (the host) and its endophytic fungus. However, it was causing problems for livestock.

We began to notice that when the cattle grazed on fescue grass, their respiration rates were very high, they were not lactating or milking as well, they had lower weight gain, they were panting abnormally (especially in the hot summertime), their body temperatures were higher, and they had problems with their hooves.

In very toxic cases, the worst-case scenario would be that the toxin was so bad that it caused vasoconstriction in the limbs and crippled the cows. There were even some cases in which the cows' feet would come off at the ankles due to vasoconstriction, and in the winter, poor blood circulation also caused the tips of some of their ears to fall off. So, this toxicity was an obvious problem for cattle.

Approximately 100 researchers in the United States (at least) were working on this problem because it was a significant, multi-million-dollar issue in terms of livestock production. Initially, I chose to concentrate on equine toxicosis primarily. Others observed that horses grazing on fescue showed more severe toxicity symptoms as compared to other animals. However, prior to our work, no one had ever run a control study to document these findings. So, I set up what is called a two factorial controlled study in which I had horses graze on the infected fescue—we called it fungus infected—and on fungus-free fescue.

At that time, plant breeders had bred a type of fescue that was fungus-free. We thought, "Well, that's the solution," but this grass did not solve the problem because without the fungus, the plant was not hardy. The grass did not have that symbiotic relationship or those natural pesticides, so it did not produce as well. As a result, if we had a hot, dry summer, we would lose the plant, and if we fertilized it, the production was low. So, we ultimately had to quit using that particular type of grass on a large scale.

However, we did use it in our controls and were able to document the exact effects the toxins had on horses. For example, the average gestation length before a mare has foal is about 338 days, or approximately 11 months. However, we

found that the mares that grazed on the endophyte-infected fescue had gestation periods of about one year, almost a whole month longer than normal. You can imagine the effects of going a month longer in gestation before foaling! No wonder these horses were having such bad problems.

Also, we found that about half of the mares had stillborns at foaling because the foals were encased in the placenta. Some of them suffocated because the placental membrane, what we call the chorioallantois, was thickened, making it too difficult for the foals to break through. When a foal is born, he wants to break his nose through the placental membrane, take a big breath, and come alive. However, when he takes that big breath without breaking through the placenta, he just pulls the chorioallantois up against his nose and eventually suffocates. You can cut the foals out and save them if you get there in time, but normally they suffocate because the mare gives birth when no one is around.

Also, almost all of the mares feeding on the infected fescue (except for one) were what we call agalactic: they did not have any milk. On the other hand, all of the mares on the good fescue (again, except for one) were milking fine. So, we found that the infested fescue caused a huge problem in the mares' lactation. There were also higher rates of what we call placental retention afterbirth in addition to rebreeding problems; the mares on the infected fescue could not breed as well after their initial foaling. Some of the foals whose mothers were on the infested grass did live, but they were not as hardy as the other foals, at least not for about three weeks after birth. Once the mares were off the toxic fescue, they recovered and did pretty well, though.

But there was an even bigger problem: the mares feeding on the toxic fescue had dystocia, or foaling difficulty, and were not prepared for foaling. Their gluteal muscles did not relax; their vulvas did not swell; their udders did not develop; and their cervixes did not relax enough for the foals to pass through. A good corollary to this situation is trying to pull a tennis ball through a shotgun; you just cannot do it, and you are not going to be able to save the foal in such cases. Almost 100% of the foals who birthed in these conditions died. What we were trying to do at that point was save the mares, and they were so unprepared for parturition that we lost a high percentage of them during the birth process as well. So, as you can tell, the result of the toxic grass had horrible effects on horses.

I had a graduate student, Jim Strickland, who worked on this. He was a great student and got his PhD here at Clemson. Now, he directs a whole team of USDA scientists at the University of Kentucky doing research with forages and livestock. When he was working on this study, we developed a bioassay for these toxins, which we discovered were ergotalkaloids. This bioassay was very important because it enabled us to study the toxin's mechanism of action. However, developing the bioassay was difficult because assay techniques at the time were very complicated.

So we developed this bioassay system that enabled us to pull tissue slices out of the pituitary glands of rat brains and still keep them alive. After we removed these slices, we perfused them with toxic alkaloids. The pituitary is located at the back of the head, close to the brain; part of it consists of neural tissue with neurotransmitters from the brain controlling its function. So, developing this bioassay was a very delicate and complex process.

Basically, our theory centered on dopamine production, which affects the anterior pituitary by reducing the release of a hormone called prolactin. I began studying dopamine in order to create a theory as to why the infected fescue grass caused so many problems. On a biochemical level, dopamine affects the pituitary by inhibiting adenylate cyclase, which converts ATP to cyclic AMP and is necessary for prolactin inhibition. Interestingly, what we saw in all of these horses that were grazing on the infected fescue was prolactin inhibition, which led to lactation problems.

We started testing that theory, and I thought, “If I can block that receptor up there where the dopamine activates those cells, maybe I can reduce the inhibition to allow prolactin to be produced normally.” I started studying D2 dopamine receptor blockers for those particular pituitary cells in order to find a method to block the alkaloids, and we developed the bioassay system to see if those alkaloids were actually being blocked. This took us about three years.

I then began screening drugs to reduce the affects of the alkaloids and the dopamine, and we found a drug called domperidone did just this. With this drug, we successfully blocked the dopamine and alkaloids in vitro. We tried other drugs, of course, but decided to stay with this one because it did not cross the blood-brain barrier. Drugs that do cross this barrier, which are often used as psychotropic drugs, had too many negative side effects and safety issues. Liability-wise, we could not put a drug like that on the market because horse owners would have eaten us to the bone by lawsuits. So, we stuck with domperidone.

We moved to the field very quickly with this drug. Normally, when you develop something in the lab it kind of blows

up when you take it out into the field to test on actual animals, but that was not the case with domperidone. In 1991, we took it into field testing, and I began feeding the mares originally on the control pasture the toxic fescue in combination with oral doses of this new drug. I started them on this regimen 30 days prior to their expected foaling and continued until they foaled.

At the level we initially administered the drug, the mares started looking like they were getting toxic again, so we doubled the dose we initially gave them. Eventually, when we adjusted the dosage to 1.1 mg per kg of body weight, the mares started responding. We were lucky, too, because the drug worked during the first study it was used, which is rare. The mares that were not receiving the drug were still having problems, but we started seeing that the mares on the drug foaled on time, had healthy foals, and were lactating, and they did not have those thickened placentas. The drug eliminated every one of the symptoms related to the toxic grass because it blocked those receptors.

For about eight years, I did not release the fact that the drug also had another effect, which we call the alpha-1 receptor antagonist effect. We kept it quiet because if we released this information, we knew that the big drug companies might copy it. So as far as I let on, the drug was just a D2 dopamine receptor antagonist, which was how we initially classified it. However, the fact that it was also an alpha-1 receptor antagonist became very important in solving this problem. Actually, it was kind of a miracle—a lot of it was just very fortunate.

After our success with the horses (about 24 in all), we started working with beef cattle. To make a long research story

short, the drug worked great on beef cattle as well. We did studies on cows, calves, and steers and found that the drug eliminated the toxic effects of the infected fescue grass in all of them.

The next problem we faced was with the Food and Drug Administration. It cost us about \$6,000,000 to clear the drug for horses; however, for cattle, it would have been about \$40,000,000 to develop all of the data the FDA wanted for cattle, and that was if we did not run into any problems. Only a big company could have afforded that. The reason for this large expense is that the FDA has to be sure that none of the drug residue will harm humans if they consume meat from cows on the drug. This was not an issue for the horses, though, because they are non-food animals in the United States.

In 1991, we felt like we had a strong enough solution to the fescue toxicosis problem, so we disclosed our findings to the patent committee at Clemson University. The patent process takes some time, so the patent for domperidone was not issued until 1994. The patent covered domperidone use for all mammals, not just for horses, and even included humans. Some parts of the patent also included the use of ergoalkaloids as well.

In 1994 and 1995, I tried to sell the patent to a few big companies that had the wherewithal, knowledge, and money to clear the drug. Even though a few companies showed some initial interest in the drug, no one ever really bit into it, so I was really discouraged. I felt like I had something, so I came back to the university after all that and said that I wanted to buy my patent back. In other words, I wanted a contract that said that I had the right to market my

technology. The university did not make it easy, but they eventually granted me the right to have my patent and told me that I could spend that \$6,000,000 to develop the drug. As I tell people, I knew then that I was like a termite eating a cross tie, but I did not realize that the cross tie was filled with creosote.

I signed an agreement with the university to develop the technology and established a startup company, Equi-Tox. We also hired a consulting firm in Dallas, Texas that had people who knew how to clear drugs. The whole process is extremely complex; a person can spend a lot of time and money and still have his study rejected—I am personal proof of that. Two of my studies were rejected, but we eventually went to the Center for Applied Technology at Clemson University (they call it the CAT Center) and started developing the drug.

The process to get a drug accepted by the FDA is multifaceted. We had to prove the safety and efficacy of the drug and go through what they call “good manufacturing practices,” or GMP, for short. By far our biggest challenge was finding the funds to keep the process rolling. Even though it was kind of tough, the research was great: we worked hard; it was fun; and we were doing something no one had ever done before, but clearing it through Food and Drug was a challenge! That was when we only slept two or three hours a night trying to figure out how we were going to generate all of the funds to keep the process moving along.

As we were in the clinical efficacy stage of this process and were trying to get approval for the drug under clinical testing out in the field, we got a call from a large horse farm close to Washington D.C. Apparently, they learned about our



research because I had given some presentations about our work. They said that they had exactly the problem that I described and that they were losing mares and foals after having paid hundreds of thousands of dollars for breeding fees. It was a financial disaster for them as a thoroughbred farm.

I told them that we could not ship the drug because we were restricted, and they responded by saying “Well, let us see if we can do something about that.” I guess they knew the right people, being located near Washington, D.C. because not long after that, I received a call from the FDA saying that I could go ahead and ship the drug to some of those horse farms because there was no alternative therapy. So, through this unique process, we were able to start shipping our drug and generating a little income to keep the research going, which was all under FDA regulations.

In 1999, we completed a new facility for Equi-Tox because the CAT Center was not up to GMP standards; it did not meet all of the requirements that the FDA wanted for a drug manufacturer, so we had to build our own facility. It is an office complex with a manufacturing facility in the rear, and we built it like a horse barn to reflect our products.

I now have nine patents. We developed various aspects of the drug in the States and in other countries. In December 1998, the initial patent for the drug was approved. Then we started noticing that most mares, whether they were on the infected fescue or not, began rebreeding better after being on the drug. We did some control work and eventually patented a method for promoting ovulation, parturition, and lactation in mammals.

We also got patents that approved the drug for laminitis, which improves blood flow to the foot (which is important for horses) and for ease of parturition in pregnant mammals. We hope that someday women will also be able to take this drug to ease the labor process because it seems to make laboring and breastfeeding much easier. Anyway, I hope to develop this drug further in areas related to easing parturition.

We also received international patent protection and cleared the drug in Australia for follicular growth, which is related to ovulation and reproduction. We are currently in the process of clearing it in New Zealand, Canada, and then several places in Europe as well.

So in summary, we had to form a lot of partnerships and a lot of contracts with different companies. In 2000, we signed a marketing agreement with the Bayer Corporation, a German-owned company who was very interested the drug. However, things did not work out with them, and we eventually dropped the contract. Currently, we have a contract with a company in India called Reddy-Cheminor to synthesize our drugs. Of course, the work they do has to be done under GMP synthesis, so they filed the GMP under what we call the drug master file, which was approved.

We also hired a lab in Indiana, a human pharmaceutical company, to complete all of the GMP requirements in the United States, and we now have a new contract with a company out of the United Kingdom called Dechra. They are the largest veterinary pharmaceutical company in the United Kingdom, and they wanted to develop new drugs in the United States. So, they bought our technology, nine patents, and all of the FDA material that I developed over

the years. Essentially, I sold this drug to another company; I received some upfront payments, and I will get royalties. It should be marketed under their brand name next fall.

**Interviewer**

Has Equi-Tox been completely self-funded?

**Dee Cross**

Now which comes first, the egg or the chicken? If I knew what I know now, I would have taken investor capital and cleared the drug quickly because we had a lot of people who wanted to buy stock in the company, but at that time, we elected not to. So, Equi-Tox is wholly owned by me and my wife; we financed it and have never sold any stock.

Luckily, I have rental property and own a little bit of land, so I was able to borrow money against my equity to start the company. Then we got a break with the FDA because of the demands from the horse farms and their desire to use the drug. This demand enabled us to develop the drug under an investigational number and ship it out to these horse farms, which gave us the funds to keep the research running on track. Now, we are a debt-free company that nobody owns, even though Dechra now owns our technology on this one drug.

However, we have developed 150 other programs for specialty products, and we have accounts with 5,000 equine clinics in the United States. I had to be able to create a profit in order to keep the company going, so I had to become profit-minded, but the best part of this whole process was that we solved a major problem in the animal industry.

We also had the opportunity to educate many students who were then able to get good jobs because they were associated with this research. Another really great benefit to this work is that every large animal veterinary clinic in the United States now knows where Clemson is. Even though we do not have a vet school here, every veterinary pharmacology book published recently has our research about fescue toxicosis in horses, domperidone, the dosage, the effects, and so on. So, our work was about solving problems and about creating a good reputation for the university.

In order to create this company, I really had to learn how to build in the business world. Believe me, when you walk into a large company and say that you are a professor, those entrepreneurs will pick your bones. Luckily, we did not sign any contracts early on. Generally, the big companies will start out a deal with a sucker contract just to see how vulnerable a person is. I hate dealing with contracts, but it is a necessity; you just have to learn how to play the game.

### **Interviewer**

You mentioned that when you had the technology you first went to a larger company, and they turned you down. What is your speculation as to why they did not go with this drug?

### **Dee Cross**

I pushed it a little bit for cattle initially with Elanco, but they were not interested in horses. The reason for this had to do with a lawsuit against them relating to a drug they developed for cattle; some horses ingested it unintentionally and died, so they just did not want to deal with horses.

As for the other large companies, I think they screwed up. I just do not think they knew what I knew. It was hard for

me to convince them to pursue this technology because, to them, I was just a professor from Clemson University, which is not even a veterinary school, and I wanted them to invest in this drug for a problem that they knew little about, and they were not well versed in the technology at that point, so I could not convince them.

**Interviewer**

What does lack of support mean? You don't have to name names, but just say what does the lack of support mean? How would that come about?

**Dee Cross**

Probably one of the most motivational forces in society is jealousy. You get somebody jealous of you, and you have a problem. Now that I am retired, I can talk about this. When you are outdoing some of your peers who think of themselves as super-scientists, sometimes you create some friction, and then you start seeing little roadblocks being thrown out there. I had to learn how to deal with that; I had to be tough and smart.

**Interviewer**

What about your role as an academic? It might appear that you were focusing on commercializing a technology rather than on publishing in academic journals. Was this a problem for other faculty in your department?

**Dee Cross**

Yes, that is the big argument. Fortunately, I was able to publish as we went along and still protect the patents because I did a lot of the patent work later, away from the university, even though we ran it through the university patenting office. That is a potential problem, though.

First of all, look at the students who came through this program; they are very successful; they got good jobs; they learned a lot; and their data was published. So it is a pretty hard argument, but in some cases it is valid I guess. There is a proper balance; you cannot go in just one direction. The university is a complete system with all facets, and the higher-ups want faculty to develop technology. If the university had not offered me the opportunity to develop the technology, I probably would have just piddled along and never done this. That being said, I figured that if I patented, I would get some kind of reward out of it. Then later, when no one would buy the drug, I figured I would try to gain these rewards by negotiating a contract with the university because I knew I had something. Now, the atmosphere is better because we have a research foundation and ways to protect those people who have technology that needs to be developed.

So had that other argument won, you know what would be the result? There would still be a huge problem in the horse industry; we would still have mares and foals in pain and suffering. It was an economic solution as well. One farm told me that on one foal, we saved them about \$1,500,000 by treating one mare, and it cost them just \$75.00 for the drug.

There are a lot of people I need to thank for helping me through all of these little roadblocks. The Clemson University administration who supported me; the Director of the South Carolina Experiment Station; the then-Director of Technology Transfer, Bob Gillan; Ed Page, who is now retired; Steve Chapman, the University Attorney with Patents and Technology; and Vincie Albritton, who is now in charge of Technology Transfer.

If it had not been for these people, I would have quit, but they kept saying “Keep going. Keep going. We are supporting you.” Because I had some support up at the higher levels, I felt like I was okay.

Now, we are treating all kinds of animals. As one veterinarian said, “This drug will put an udder on an anvil,” so we can help a lot of animals with it. We are treating dolphins, camels, alpaca, elephants, rhinos, apes, sheep, goats, and a number of other species. Now, we are even developing several products for dogs. Even though we are going to give up our main drug, we plan to develop other things at Equi-Tox, and dogs are one of our biggest targets.

### **Interviewer**

Are there any adverse side effects of the drug that you know of?

### **Dee Cross**

Not that we know of. We are actually repeating the safety study right now. It is the hardest study I have ever done in my life. I had to repeat it because the first study did not meet all of the GLP, or the “good laboratory practice,” requirements. So, we are repeating it with some veterinarians in Tennessee. The first study was good; I just did not have all of the knowledge that I do now, so I did not get all of the checkboxes right at first.

However, on our label it will say that the drug can cause premature lactation. If a mare is not ingesting much infected fescue and she overloads with the drug, she may start leaking milk. However, that actually turned out to be an advantage for us. Currently, about 25-30% of our business is from non-fescue mares that are not lactating well. If an owner knows

that his mare is not going to lactate, he can start her on the drug before parturition, and she will be flowing milk by the time she foals (if she is capable of lactating in the first place). Some farms start mares on the drug right after foaling if they see that the horses are not lactating well.

The label will also say “Do not administer to a horse that has an intestinal blockage due to colic” because the drug stimulates the gut. If there is a certain kind of blockage in a horse’s gut, the drug can increase the pain level. So those are the two safety issues.

I should mention that for safety’s sake, every drug we make is administered as a prescription through veterinarians. We do not ship to veterinarians’ clients unless they ask us to.

### **Interviewer**

How do you administer the drug to horses?

### **Dee Cross**

We started out with a molasses carrier for the drug; it worked great, and the horses loved it, but the FDA said it looked like we may be getting a little settling of the drug. We did not think this mattered because we gave the horses an entire oral dose, so they were getting the proper amount of the drug regardless of any settling. But, the FDA argued that the molasses may not be the same volume if it is 100 degrees versus 20 below or something like that, so we had to repeat the GMP process.

I ended up putting the drug in a carbopol parabens polymer and made a gel to suspend it. Now we have a five-dose syringe with a dial-a-dose mechanism: just turn the dial, the the drug comes out, and there are four doses left. Then



we had to prove through GMP that there were no safety or accuracy issues with the syringe.

We also had to do stability studies on the drug, which took two years. We had to assay all of the other components in the syringe as well, like the parabens, the methylparabens, the apple flavor, and everything else we put in the mixture. Then we had to do batching. We started with 10% batches and proved that everything was okay with them. Then, we had to scale up the batches to manufacturing levels.

Then, the facility had to meet all kinds of cleanliness requirements: the floors, drains, air, water, etc. We had to test our water and run bacterial analysis on it, and then we had to do the same thing for our syringes, and on and on. Inspectors can always find something to shut a plant down.

The FDA is not rational. For example, our drug was used on non-food animals, and it showed no safety problems. Before it was cleared, we treated 100,000 mares with no negative results. The FDA told me once, “We know the drug is safe. You would have been sued and put out of business if it was not safe,” but they still put us through the same requirements as those for a human drug except for tissue analysis. That is why the whole drug-making process costs so much and takes so long.

**Interviewer**

I was just wondering if there a chance that this drug will be marketed to women?

**Dee Cross**

Yes, actually there is. Our daughter-in-law had her baby at the hospital in Charleston. While we were visiting, I asked

them if they had ever heard of domperidone, and they told me that they were actually using it now.

But here is the bottom line: big pharmaceutical companies and the FDA work together. They do not like it when little companies come along because we are not familiar with the drug-manufacturing process, which costs them a lot of time. Big pharmaceutical companies make the process go much faster, which justifies their positions.

**Interviewer**

How were the doctors getting the drug?

**Dee Cross**

They were not getting it from us. We stayed away from humans for liability reasons, but they read our research and began getting the drug through formularies. A formulary is a very important part of the pharmaceutical industry. The FDA hates them, and big pharmaceutical companies hate them, but when you have a unique problem, you need a special formulation to solve that problem. A doctor can prescribe a pharmacist to make him that formulation for his patients, and that was how domperidone was being used.

**Interviewer**

Did companies look at the patent to see what the formulation was?

**Dee Cross**

We have had so many violations of our patents, and I have hired patent attorneys and sent letters. We would send the formulary makers threatening letters saying that we were going to sue them, but then I began to look at it from a different standpoint: we would have needed about \$100,000

to file a patent lawsuit, and if the company we were suing was bigger than us, they could have outlasted us and busted our patents. We have wholesale black marketing of the drug going on, but I have turned that over to Dechra now. But they say that it is a sign that you have a good drug when all the thieves come out and start selling it.

**Interviewer**

What kind of patent do you have?

**Dee Cross**

We have a use patent, not a formula patent, so we could not protect against the formulary development. However, I patented the drug in terms of all of the methods for administering it, and I have nine patents covering everything I could think of in terms of the drug's use. It is a matter of getting in the court with lawyers and everything, and at my age, I have decided that I am going to take a buyout and let the big pharmaceutical company deal with this problem. So that is what Dechra is doing now; we transferred all of our files on patent litigation to them. That is what happens with patents; unfortunately, you have to be big enough to defend them.

# Michael Bolick

## Selah Technologies

*Michael Bolick is the founder and CEO of Selah Technologies, which is based in Pendleton, SC. Selah Technologies is an advanced materials company focused on the development of nanotechnology-enabled products for the biomedical and consumer electronics industries. Michael founded Selah Technologies in May 2006. He has more than 17 years of experience in designing, starting, building, managing, and growing advanced materials manufacturing companies. Before starting Selah Technologies, Michael spent ten years in the pharmaceutical industry as an executive with a Greenville-based contract research and manufacturing company. This interview was conducted in July 2007 at the Clemson University Renaissance Center. Since this interview occurred, the company has hired eight full-time employees and has raised over \$1.5 million through a private equity placement.*

– Elena Shorb



**Michael Bolick**

## **Interviewer**

So the question I would like to begin with is how did you develop Selah Technologies? How did it happen? You can start anywhere you want.

## **Michael Bolick**

In my youth I was awarded a scholarship to attend a Hugh O'Brien youth leadership conference. The conference celebrated our nation's free enterprise system. My interest in running my own business took root in this setting. After earning a degree in Chemical Engineering from North Carolina State University, I accepted a job offer to work on a startup team for a Japanese-owned specialty chemical manufacturing plant in Chattanooga, Tennessee. I really enjoyed the experience of helping to design the facility, specifying and purchasing equipment, tracking construction and equipment installation, writing operating procedures, hiring and training people, etc.

In 1997, I was blessed with an opportunity to move to Greenville to help start up a Swiss-owned active pharmaceutical ingredient (API) manufacturing plant. At that job, I held more responsibility, but the process was basically the same: a grassroots startup of an advanced materials manufacturing plant. Once again, I thrived in the startup setting.

Over those past 15 years, I enjoyed a successful and satisfying career. But about two years ago, I realized that I could no longer accept the thought of continuing in the same direction. I considered looking for another startup opportunity, but this would most likely require relocation, which was not an attractive option. I have three children, Perry (14), Connor (12), and Madison (9), who have grown

up in the home we built here in Greenville. The last thing I wanted to do was move again for a new opportunity.

Coupled with this was the realization that I really wanted to finally reach for my dream of building my own company. My wife Sheelah was very supportive during this process. We talked and prayed together and decided to start a new business.

Once we had a plan in place, I reached out to a group of more experienced business people in the area. I was very fortunate to have a group of people who were willing to block out some time and listen to me. When we sat down, I laid out the situation and asked for input. My side of the conversation usually went something like this: “I am planning to make a transition to start my own business. I need to make a break. I need to make a change, but I do not want to do it in a rush. I want to do it in an organized manner. Do you have any suggestions of how best to proceed?” I got a lot of really good advice and thought starters from this set of meetings.

I looked at a number of options. I looked at buying franchises or existing businesses. I have friends who made the transition from corporate life to entrepreneurial ventures. One started a bread-baking business. Another started an attractive high-end butcher shop. I seriously considered that route, but I kept coming back to my desire to start something that would allow me to leverage my advanced materials manufacturing background.

At about this time, I heard about the InnoVenture conference here in the Upstate. The idea behind the conference, as I understood it, was to mix inventors,

entrepreneurs, and investors together for collaboration and idea sharing. I took two days of vacation and attended InnoVenture 2006, consciously looking for an opportunity with my mind wide open. Several people were praying for me to find what I was looking for, as my search had not yet borne fruit. I joined them in asking for guidance and wisdom. Most of my prayers were along the lines of “If there is something here, please help me to hear it; help me to recognize it.” And I will tell you there was a really exciting vibrancy to the community that was there. There were a lot of opportunities to consider. Unfortunately, to my chagrin, still nothing clicked for me.

That is, until I saw the presentation by CURF (Clemson University Research Foundation) representative Matt Gevaert. Matt presented on a technology that had been invented in Clemson’s advanced materials laboratories. The technology was called “carbon dots,” short for carbon-based quantum dots. Quantum dots are light emitting nanoparticles that are very promising for a broad array of applications, including cancer detection and other life science applications. The main point I remember hearing was that this new technology was based on carbon rather than on cadmium or other heavy metals. A carbon-based quantum dot was expected to be less toxic than heavy metals and would, therefore, have a compelling advantage in the marketplace. The market was growing rapidly even without a heavy metal quantum dot alternative. This really caught my attention.

I remember it was not a very long presentation. Afterwards, I went out to the CURF booth and spoke with Matt Gevaert and Vincie Albritton. I handed Matt my transition card with my personal contact information and said, “I want to start



my own business, and this technology looks very attractive to me.” About three weeks later, I signed a NDA—Non-Disclosure Agreement—and got a chance to really dig into the technology.

As I said earlier, for the last ten years I have worked as an executive for a contract research and manufacturing firm servicing the pharmaceutical industry. Sometimes we would make APIs for a drug that was already on the market. More frequently we produced materials that supported clinical trials. This means that we made small amounts initially and then scaled up production volumes as a given API was taken to larger and larger clinical trials. Our home run was to make an API for a company from the clinical trials through launch and into the market. This experience provided me with the ability to look at this new technology and see that it could be very scalable.

Near the middle of May 2006, I formed a company called Selah Technologies, LLC ([www.SelahTechnologies.com](http://www.SelahTechnologies.com)). The name “Selah” means “to pause and reflect on what has been said.” Selah Technologies obtained an exclusive option to negotiate for the technology. Now, this option is not the actual license; instead, it is a period of exclusivity to conduct due diligence to determine the value for the base technology and to develop a commercialization plan. This period is effectively the start of the business planning process.

Around this time, there was a paper that was published in the *Journal of the American Chemical Society (JACS)*. The paper described the implications of a carbon-based quantum dot and referred inquiries back to Clemson. Quite a few people read this paper and contacted Clemson and the inventor. Many of these contacts were referred on to

me. Some of the inquirers came through, and I took the opportunity to sit down with them and try to evaluate how we could collaborate to commercialize this technology.

So, as the summer progressed, I realized that we had an outstanding opportunity on our hands. I entered into negotiations with Clemson to obtain the license not only for the carbon-based quantum dots but also for another technology that allows enrichment of carbon single-walled nanotubes. Both of these advanced materials technologies are referred to as “platform technologies.”

A platform technology has great potential in a number of vertical markets. To be able to license two platform technologies is a blessing. It means that we have more than one arrow in our quiver. On the other hand, an abundance of market opportunities can be a siren song that keeps the entrepreneur from focusing on a particular “go-to-market” strategy. This lack of focus is sometimes referred to as trying to “boil the ocean.”

In September, we concluded negotiations, and Selah obtained a worldwide exclusive license to develop and commercialize both carbon-based nanotechnologies.

I have to tell you that Clemson was very supportive, and they were great partners in the negotiation. CURF was a good steward of the technologies invented at Clemson. The CURF representatives really pushed me to demonstrate that I had the ability and a sound plan to move into the market. I also think Clemson and CURF were interested in engaging with the entrepreneurs in South Carolina to help transition our state to a “knowledge-based” economy.

Once Selah had the exclusive license on both technologies, I was able to kick into full gear. I took advantage of the preliminary contacts that we put in place to start what we considered to be our strategic intent. This intent was to build relationships with major multinationals that already had ongoing nanotechnology research programs.

We are bootstrapping the business right now: building value in the business before we seek outside investment. This is a challenge to balance properly. I see myself as a steward of this opportunity set.

So, in a nutshell, that is the story behind how Selah was developed. We were blessed to have a number of potential industrial partners, and customers responded very early and very positively to Selah's technologies. I cannot get into the specifics just yet, but these interactions have been very encouraging.

I will conclude by mentioning that in January, our Chief Technology Officer, Dr. Andrew Metters, joined us from Clemson University. Before joining our team he was an assistant professor at Clemson. It was decided that before he joined the project full time, he would finish out a previous commitment to his students. He had two students who had not yet defended, so he worked on a part-time basis for Selah until just recently.

And then, in March of this year, Ken Morgan, our Chief Operating Officer, joined us as well. So we have the technology in place; we have potential partners and customers encouraging our growth; and now we have a core team of motivated folks that are all pulling together. Selah is blessed with a lot of momentum.

**Interviewer**

So, let's start at the beginning in terms of your background knowledge. It sounds like the expertise that you brought to the project was primarily about understanding how to upscale manufacturing.

**Michael Bolick**

That is correct.

**Interviewer**

What about your background in marketing?

**Michael Bolick**

Marketing and finance are two areas that are the least familiar to me. In my career, I learned that everyone involved in a startup has to wear a lot of hats. I also learned the lesson of trying to take on too much by myself. Finally, I learned to delegate responsibilities, to empower others, and to share the load.

I spent my entire career serving customers in the advanced materials manufacturing business. I know what it means to work with customers: day in and day out for both long-term and short-term projects. Making sure that you communicate effectively is the key to doing business.

You learn how to discover and be sensitive to what your customer's real needs are, and you communicate with them to ensure they are always fully informed. It is important to establish a relationship based on trust and ethical dealings.

So in summary, I have a solid set of skills that will be directly translatable. There are also some areas where for which I do

not have experience, but I am gathering an extended team of associates and advisors that will fill in the blanks.

I believe that without counsel, plans fail, but with many advisers, they succeed. That is not my concept; it is from the Bible (Proverbs 15:22). As you broaden the group of people who give you advice and counsel within a certain context, you will make your decision making more effective.

### **Interviewer**

Could you elaborate on some of the kinds of advice you have been given to help make the business become a reality?

### **Michael Bolick**

Well, I have to admit that a few of my friends thought I was going down the wrong road. They would say “You are making great money. You have an excellent job. How can you walk away from such a successful career? What are you thinking?”—that type of thing.

I listened to the whole range of perspectives, but I knew it was time to make a change. I believe that if you are not careful, it is very easy to float along in the security of a larger company. Do not get me wrong, corporate politics and layoffs are not much fun, but there is a set of rules by which most corporations and people play. Lifetime employment does not really exist anymore from my perspective. Typically, you are going to have to keep going and build a career with a series of companies.

In this setting, however, you do not have the opportunity to influence the direction of the company as readily as you do if you start something with a team of people and you are right there at the center of it.

In any event, there were a few people that really made a difference in my decision. One really good friend, who has his own business here in town, encouraged me to seize the opportunity to realize my dreams. He said, “Look. I know you. If there is anyone I know who should run his own business, it is you.”

I said, “Well, you know...”

He said, “No, you are not hearing me. You need to start your own business.”

Once I psychologically made the leap and said “Okay, I can accept the fact that I am taking a huge risk and that it may not work out,” I realized that I was in it for the long haul. I have great faith in God’s providence, and this gave me courage. At the end of the day, I knew that I had no idea whether or not Selah Technologies would turn out to be a success, but I was convinced that I needed to make a go of it.

At this point, I realized that I needed to broaden my advisor base. I started looking for serial entrepreneurs in the local community who would be willing to guide me. I was blessed to find several people, who were willing to stop, listen, and give me counsel. Most of these individuals did not have advanced materials manufacturing experience, but each had entrepreneurial start-up experience, including successful exits.

I said, “Okay, what do you think of this idea?” I laid out the basic technology information and the market analysis that I had compiled. I picked their brains. I asked “How would you approach this? What do you think I should do?” I spent a couple of months bouncing ideas off people.

And the responses I got were along the lines of “You need to read this book; you need to look at this opportunity; etc.” I was introduced to the concept of how a lifestyle business compares to a growth-mode business. Other issues were pushed to the front burner: “What kind of financing do I need to have? Where am I now in the process? What do I want the company to be when it grows up?”

I had several mentors reinforce the idea that with a technology-based business, you have to push to get your product to market in a focused manner with an eye on the next big thing coming along behind you.

I was fortunate to have many introductions from InnoVenture 2006. I also reached out to the Greenville Chamber of Commerce. I was introduced to and joined a group called NEXT at the Chamber of Commerce, which focuses on creating new entrepreneurial infrastructure in the Greenville area. I engaged with a number of entrepreneurial support organizations available in the area.

### **Interviewer**

At what point had you written a business plan?

### **Michael Bolick**

I had an early draft, but it needed improvement. I was fortunate to learn this before I needed to raise money. You do not want to go to Angel or institutional investors unless you are well prepared. You only have one chance to make a first impression. People will establish perceptions about your competence based on your initial pitch.

On the other hand, I was also aware of the danger of getting so preoccupied with establishing an infinitely detailed plan

that you forget the reality that things will vary from your plan. You have to be able to adapt. Practically speaking, making projections longer than three years is extremely difficult. Then there is the balance between projecting the exciting future you see and establishing realistic expectations for a number of stakeholders.

I finally settled on a business plan that is tied to critical goal categories that then flow out to action items for our team. We plan to keep an eye on the plan and to adapt and update it as needed to take advantage of changing market conditions and opportunities.

### **Interviewer**

So at this point, are you self funded?

### **Michael Bolick**

Yes. My wife is my partner. When we started the business, we reviewed the opportunity and our financial situation. Then we decided on an amount of money we thought we could afford to invest. At that time, we set out milestones to gauge our progress.

Looking back, we are pretty close to that original set of expectations, but I have to admit that in the planning, I did not include all of the other expenses that I had historically paid for with my prior paycheck. I knew these expenses were still going to be there, but I think I just blinded myself to the problem.

Every successful business person I know tells me that “cash is king.” I am reminded that if you are not extremely careful and you do not plan in a safety factor beyond what you think is likely to happen, you will end up running out of runway



before you can take off. Fortunately, because my wife is an excellent partner and my best friend, we have been able to get through these types of things and not “sell out early” to the detriment of our family or the company.

Our goal is to build an advanced materials manufacturing business selling to the global marketplace from the Upstate of South Carolina. I see this as an opportunity to step in and engage as part of our state’s transition to a knowledge-based economy. We are fortunate to be in the right place at the right time to do good, solid, ethical work during a rising tide of opportunity. We are so blessed to be here. This is a wonderful community. The people here are very friendly. There are a lot of people moving in from other parts of the country because they want to be part of this great thing we have going on and where our state and our region is going.

Some people have said that the transition to a knowledge-based economy is the end of manufacturing in South Carolina. I respectfully disagree. Our community knows how to do manufacturing. On the contrary, the transition to a knowledge-based economy is a means provided to enable us to save and grow manufacturing in South Carolina.

**Interviewer**

How did you do your due diligence when you had the option to explore the nanocarbon technology?

**Michael Bolick**

That is probably the most challenging part of this whole process because of the concept of technology transfer. I have lead teams doing technology transfer from a number of customers to our laboratories for more than a decade in the pharmaceutical industry. Every time you transfer something,

there are going to be problems. Every time you scale up, there are problems.

The question is how many problems will there be? Hopefully, if you have been down a given path a few times, you have the luxury of experience. Recalling problems similar to mistakes that were already made, you try not to make the same mistakes again. Regardless of past experience, when you have chemistry involved and you try to scale up, you will likely encounter things that could not be anticipated.

So we are looking at technology that has been proven on a research scale— in a very small vial, so to speak—in a research laboratory. We now need to extrapolate the process to a manufacturing plant. I would have been fooling myself to think that I could look at that and see every challenge that we might encounter. But what I was able to see, what I saw right off, was that there was not some multi-million dollar piece of capital equipment that would be necessary to begin production.

I looked at the complicated, expensive, and inconsistent way that the current market leaders are making heavy-metal-based quantum dots and compared this to what had been invented in the Clemson research laboratory. Our process is robust and highly scalable. It is a very elegant answer to a not so elegant problem.

At the core of our product, no pun intended, we have carbon instead of cadmium. I mean we are made from carbon. Organic life forms are made from carbon. I drink water every day from a carbon-based water filter.

I want to point out that we will not just assume that there are no negative health effects from a carbon nanoparticle, but I am confident from looking at it initially that the potential problem is greater with cadmium than with carbon.

So, I am trying to follow up on all of these things. My initial thought was that this looked like a no-brainer for a base technology, possibly not for every application, but there are going to be places where the carbon dot will be a very well-received alternative to the heavy-metal-based quantum dot.

I interacted with the researcher at Clemson University, a brilliant man. I received assurances from him that he would be a partner with us to transfer the technology out of his laboratory into our laboratory. Those assurances were fundamental to my decision-making process. I was brought up to believe your word is your bond. To have this fellow indicate a willingness to step up and help was very, very important in my decision-making process.

Now, at some point you have to stand on your own two feet, which is why I looked for someone who had Dr. Metters' qualifications—not only the qualifications from an academic perspective and a technical perspective but from a personality standpoint. I needed to grow the manufacturing capacity and scale up the process. We do not need to come up with a different type of dot; I just need to make this dot be as good as it can be.

Although that happened after we had the license, it is still part of the due diligence process because I am still funneling money into the business. I learn more on a weekly basis about the technologies' potentials, and fortunately, I continue to become more confident and thankful rather

than more concerned. I feel more and more excited rather than more scared.

### **Interviewer**

Please talk about the specific potential applications of this technology.

### **Michael Bolick**

Well, I have to be careful with this. The nanotechnology field is experiencing an intellectual property (IP) blizzard right now, so I have to be wise about what I publically disclose. Several years ago, there was a bit of a nanotechnology patent gold rush. Patent applications were filed claiming very fundamental things. In some cases, patents were issued that had overlapping claims, and some patents had been issued that confused the playing field.

Some of that is getting shaken out now, but when we talk about taking carbon dots into a particular application, you have to know that each one of those ideas represents a potentially different intellectual property position. Each case might need to be protected by a patent application before being publicly disclosed.

What we are trying to do now is share ideas about the potential of our technology without giving away the farm. My younger son, Connor, gave me an idea for one of the ideas that we are sharing openly: carbon-dot-enhanced paints. The idea is to make a paint that glows when you turn on a black light in a dark room. Imagine painting the walls of a play room or media room and turning on a black light. The walls will glow with a fantastic electric blue.

There is no paint on the planet right now that will do that! This has never been considered by any kind of quantum-dot manufacturer because no one would want to pay for cadmium-based quantum-dot paint, not to mention the environmental issues with the disposal of a cadmium-based product.

Well, one readily available excitation source for carbon dots is the black light. The excitation source provides the electric blue wall color. We could also change the wavelength of the excitation source to, in turn, change the color of the wall. What color do you feel like today?

This phenomenon is called photoluminescence. Carbon dot electro-luminescence is another exciting option we want to investigate. Scientists have already proven that heavy-metal-based quantum dots will emit light when exposed to an electrical field. With this technology, you would no longer need the black light; your whole wall would become the light source.

One of the most exciting areas to employ carbon dots is in the life sciences. The ultimate goal is to use carbon dots as a biological imaging agent. In other words, we want to develop a way to use the dots to find biological targets like cancer cells as part of a diagnostic toolset.

The first application we are targeting in this area is called *in vitro* diagnostics. *In vitro* means the test is being performed outside the living organism. A physician takes a sample of interest (such as a biopsied tissue) and places it in a Petri-dish-type container. The physician then applies the carbon dots as part of a testing process to determine if the sample has cancer cells or some other target of interest.

Organic dyes are being used in this market, but these have a number of limitations, including a tendency to photobleach. Photobleaching occurs when the dye stops emitting light after only a very short testing period. Carbon dots are much more resistant to photobleaching compared to organic dyes.

The other example I have described in a public setting involves skin cancer. I recently had a small growth cut from the back of my leg. The doctor told me she wanted to cut away only the suspect cells, but it was a bit of a guessing game. She said, “There is a balance between cutting too much healthy tissue away versus leaving bad cells behind. I am going to send this part off to have it tested.” I had to wait a few weeks before I found out that the test was inconclusive and that I had to have more tissue biopsied to repeat the test. Just imagine how many times per day this happens. Fortunately I was only dealing with what turned out to be a benign growth on the surface of my skin.

We are planning to create “point-of-care carbon-dot-based test kits” that will allow a doctor to spray a carbon dot solution across questionable tissue. The doctor would then turn on a special light in the office to light up all of the bad cells. If there were cancerous cells present, the doctor would be able to see them with the naked eye. So, when the doctor comes in to cut out the bad tissue, the margin will be well defined. If a doctor does not have to guess at the location of the margin, treatment will become significantly safer and more effective.

Now, whether the cancer is in a Petri dish or on the surface of the skin, medical decisions are being made. This means that any product involved in making a medical decision will undergo scrutiny by the FDA. The FDA helps to ensure

that such a tool is safe, effective, and consistent. This is why we are focused on generating data for in vitro diagnostics to support an eventual move to in vivo diagnostics: in vivo means “in the body.”

Looking out to the most exciting in vivo applications, we wanted to enable doctors to use carbon-based quantum dots as the imaging agent in full body scans, such as the MRI or CT scans of today.

We have been blessed with a great deal of potential and momentum. I see my primary role as that of a steward of this set of opportunities. We have to watch the cash burn rate. We have to hire the right team. We must work to get the business on its feet and then identify and work with the right partners and collaborators.

### **Interviewer**

Were there problems that you thought would occur that did not occur?

### **Michael Bolick**

Well, let me think a bit about that one. I envisioned a whole range of problems potentially occurring. We could have gone out of business. We could have run out of money already. Thankfully, none of those things happened.

We could have found it difficult to find outstanding people to grow our team. Instead, we have been blessed to have outstanding people interested in joining our team. People are now coming to us saying “we heard about this great opportunity. We want to be part of it.” It is interesting to see that dynamic change.

I try not to worry. I try to plan for risks and then put things in place to mitigate those risks. I work very hard, and then I pray for wisdom and positive results.

**Interviewer**

Were there problems that you did not think would be problems but turned out to be?

**Michael Bolick**

Yes. The actual technology transfer into our laboratory did not go as smoothly as I had hoped. We have thankfully moved past this problem, but this delay was more than I had hoped for. You know, the plain truth is that God does not promise us a guarantee of an easy road to success on this Earth. We are sometimes given adversity to strengthen us. During these trials, we have to have faith and keep working. That worked for Selah in this case because we were blessed to have a group of people that stepped up—both inside and outside Selah—to help address the base-technology transfer issues. So, there have been unexpected problems, but again, we have been provided with the means to address those problems. For this I am very grateful.

**Interviewer**

The last question is what advice would you give other entrepreneurs considering a technology business?

**Michael Bolick**

Well, the first thing, the most important thing is to never forget that your word is your bond.

Next is if you do not try, you will never know. I struggled for some time before I could finally turn in my resignation and walk away from lucrative employment with great job security



and a great career path. I guess you could call that decision a leap of faith. I do not know if we will make this all work, but I know with absolute certainty that if I had not given this a shot, I would have always regretted it and looked back wondering what might have been.

Unless you can get to strong cash flow early, you are likely to need to go out and ask other people for money. This is not my favorite part of the job, but it is a necessary part of the job. Make sure your documents are well thought out and clean.

We are seeing a rising tide of entrepreneurial opportunity in South Carolina right now. If you have the burning desire to do this, listen to your instincts. Do everything you can to build the right plan and team, but do not lean only on your own understanding; be willing to listen. If you do, there are a lot of people here that will help you.

Proverbs tells us that a wise man “sees danger and hides himself, but the simple go on and suffer for it.” This reminds me that not every idea is a winner. Some ideas are just plain wrong. A really good mentor will tell you when your idea stinks.

I have had quite a few of those conversations in the last year and a half. Truthfully, I will not say that in every case I completely agreed, but I listened, and hopefully I listened well enough to make wise decisions as we go forward.

Finally, remember the difference between a lifestyle business and a growth-mode business. Unless you can figure out a way for your technology to be “it” for an extended period of time, it is difficult to build a lifestyle business around

technology. You have to be of a mindset that you have to grow or die, but remember that you cannot grow so fast that you outrun your cash supply. Focus on these conflicting priorities, and you will have a great shop and will grow a real business.

I say this last part with a silent prayer in my heart. We have not gotten there yet. God willing, our team will look back and see that we made a real business of Selah.



# Elizabeth Cates

## Invenca

*Elizabeth Cates is co-founder of Invenca, an advanced materials company in the chemical and biochemical separations field. Founded in 2007, Invenca emerged from work done at Clemson University and is now located in Greenville, South Carolina. In this interview, which was done in July 2009, Elizabeth discusses Invenca's founding, current work, and future goals. Currently, the company's work centers on developing new materials for liquid chromatography and creating cost-effective separation products for proteins and other large molecules.*

– Ali Ferguson



**Elizabeth Cates**

**Interviewer**

So, how did your company start? Where did you begin?

**Elizabeth Cates**

Invenca got its roots in 2006 when Dr. Brian Morin, my cofounder and business partner, went to Clemson to talk with Phil Brown at the Palmer Science and Engineering Department about some of the work that he was doing. Phil introduced Brian to this technology at Clemson that used fibers as the basis for chemical separations.

Brian examined the technology and immediately saw the utility in it. Then, with a little more research, he realized that he could build a pretty successful business around this technology and decided to license it from Clemson.

For this type of work, you really need to have someone who understands the chemistry behind the technology. I have known Brian for 20 years; we went to high school together and have kept in touch ever since, so when he needed a chemist for this company, he called me up and asked me to get involved. I came on board in late 2007 and launched the company.

Clemson University has filed several patent applications in this area, to which we have an exclusive license. The technology invention is not commercially viable, so we need to find the innovations that will make it a commercially viable product. We are trying to find ways to take this technology and really make it something that we can manufacture commercially to meet commercial demands.

**Interviewer**

Okay, so what exactly is your technology?

## **Elizabeth Cates**

The technology that we are producing is a basis for chemical separation. Chemical separation is done in the liquid state. So, if you have a mixture of chemicals in a liquid, then you can use our technology to separate them.

The technology itself is called High Performance Liquid Chromatography, or HPLC for short. HPLC is one of the most frequently used analytical techniques in the world, second only to weight measurement and pH measurement. It is used every day by thousands of chemists and technologists worldwide to measure things like the purity of the product that a company is producing, whether that is in a pharmaceutical plant or a personal-care product like hair spray. It is used in clinical testing to look for disease markers and in drug concentrations in patient samples (urine or blood samples typically). It is also used in environmental testing, as a way of determining the presence of environmental contaminants and quantifying their concentration. As you can tell, HPLC is used very regularly for analyzing the purity or composition of materials.

On a larger scale, the same principles can also be used for purification. If we can isolate a compound and identify how much is present in a given solution, then we can also isolate that compound and collect it in order to have a pure sample of the compound.

Chromatography is also one of the primary methods for purification of biopharmaceuticals. Most of the vaccines and over half of the drugs in the pharmaceutical pipeline right now are based on protein structures, so the technology that we have developed is suited very well for the analysis and purification of proteins.

**Interviewer**

Are there other companies that do this kind of thing?

**Elizabeth Cates**

There are a surprising number of companies that make products like ours. The industry itself is about 50 years old, so it is a well established industry. For an industry that is fairly mature, there are a surprisingly large number of companies. In a mature industry, you would expect to find only a handful of companies present; however, the number of companies that are making products in this area is well over 200.

It is a vibrant industry that really loves new products and new technologies. The small companies out there really focus on creating niche and custom applications and developing new applications; that is where Invenca fits in—developing new applications.

**Interviewer**

So, is your product unique as compared to the others, or is it just better?

**Elizabeth Cates**

It is a unique product. If we look at the HPLC industry as a whole, it has historically focused on small molecules, pharmaceuticals primarily: things like aspirin or acetaminophen. The technology has evolved around these small molecules because they comprise the bulk of the current HPLC market.

However, as I mentioned before, the market for biotechnical materials is growing very rapidly. Even in this economy, it is still seeing double-digit growth, and like I said, more than



half of the products in the FDA's pipeline right now are biologically-derived materials.

As it turns out, the characteristics required for the separation and analysis of small molecules are different than those for proteins because proteins are much bigger. It is like comparing a marble and a beach ball. The aspirin is the marble, and a protein, like some of the therapeutics used in chemotherapy, for instance, is about the size of a beach ball. Because of their different sizes and characteristics, proteins behave differently in separations, so we are really focusing on protein separations currently.

### **Interviewer**

So you essentially make instruments to separate proteins?

### **Elizabeth Cates**

Yes. What we make is called a column. They are about the size of a pencil or a chopstick. The column is a consumable piece that fits into an instrument. The instrument itself has pumps to pump solvents through the system, and then it has an injection needle to allow you to introduce a sample.

The column is where all the magic happens; it separates the components in the liquid into different compartments, if you will. Imagine that you have a tube lined with Velcro and that you are going to throw tennis balls and golf balls through it. The golf balls will not stick to the Velcro; they will just fly through and will all come out in one clump. The tennis balls, however, will stick to the Velcro a little; they will lag behind and come out in another clump.

This is same principle behind chromatography. You get a time-based separation of materials with the column doing

the separation. The columns are consumables, but they can be used multiple times. Most columns have a lifetime of anywhere from three months to a year depending on how much they are used and what is being put through them.

### **Interviewer**

As a company, what challenges do you face or have you faced in the past?

### **Elizabeth Cates**

As an entrepreneur in a startup company, I have had a very different experience than working in a large company. Prior to this, I had worked in a medium- to large-sized company, so if I had a question about legal issues, like patents or business contracts, I would go to the legal department for help. If I needed to buy something I would just fill out a purchase order and hand it over to someone else who would actually place the order. If I needed a website, I would just talk to the IT department, and they would make the website.

However, as an entrepreneur, you do it all yourself, so you have to be crafty about finding the right people with the right expertise when you need them. Everything is, by necessity, outsourced, so you do as much as you can inside, but you have to understand the limits of your abilities and know where to go for help in the outside world. Fortunately, we have a lot of good resources available to us.

The Clemson University Research Foundation, CURF, has been supportive in terms of helping us find connections within the university and the entrepreneurial groups there. In Greenville, there is the NEXT organization, which is run through the Greenville Chamber of Commerce, and Brenda Laakso does a great job of organizing meetings for the

member companies. That group meets on a monthly basis for a round-table discussion of pertinent issues, such as how to find venture capital funding, how to do viral marketing for your product successfully, or what pitfalls companies frequently deal with. They are a great resource.

The South Carolina Launch! organization has been a phenomenal resource for us as well, especially in terms of making connections and helping us find the resources that we need. So there is a great deal of assistance for entrepreneurs to get things started, which helps make it easier. I think for a lot of us, it is a rush trying to do it all; we just have to get our fingers in everything.

### **Interviewer**

Do you have other people working with you?

### **Elizabeth Cates**

I do. Right now, Invenca has three employees. I am the chief technical officer and director of operations. Mark Housley is our CEO. He came from the same, medium- to large-size company that I had worked for previously, and his background is in new business development. He did a lot of intrapreneurial work at this company, bringing in technologies and building businesses around them. He has seen and done it a lot and has built multimillion-dollar businesses around new technologies like ours.

He also has the finance, marketing, and sales background, while I have the technical and production background. Between the two of us, we cover all of the bases. Then I have a young lady working in the lab as a technologist who actually handles most of the testing that we do.

**Interviewer**

In terms of finances, how did you first get money to start Invenca?

**Elizabeth Cates**

Well, the first way everybody gets money is through friends, family, and fools, as they say. Our initial fundraising was done through friends and family, and then it was extended to the existing investors in Innegrity, which is our parent corporation.

Innegrity is the majority shareholder in Invenca. They contributed mostly non-monetary goods, and after that, we received some funding from SC Launch. I have been applying for state and federal grants and different research grants to help with some of the technical development work, and we are also currently raising funds right now for the next year to help get us through the product launch and to scale up.

We are also looking to private investing groups like the Angel networks and some of the larger organized investment groups. The American Chemical Society has expressed interest in investing in our technology, and we are talking to SC Launch! and other related groups about round-two funding.

**Interviewer**

Is it difficult to get that money?

**Elizabeth Cates**

It is. It is a scramble, but it really forces you to be creative. Two years or three years ago, it was so much easier to raise money; everyone had plenty of cash, and it was almost like

going to Vegas. Everybody was willing to gamble a little bit on the slots, but that is not the case as much anymore.

Now, you really have to have a good story to tell people. I think we are in a really good position, though because we have a really great story to tell, and we have patent protected technology that is new and different. It brings a lot of benefits to the market in this particular growth niche.

### **Interviewer**

That is great. Now, where do you see yourself and the company in the future; what do you hope to do, or what are your grand ideas?

### **Elizabeth Cates**

Grand ideas. Every now and then, we come back from something, whether it is lunch or a meeting, and we go on about all of the things we would do if we had enough money.

Overall, though, my grand ambition is to make an impact. Part of it is very personal because I am a cancer survivor. Advancing this technology will allow researchers to develop cancer therapeutics faster and get them to the market more quickly, which ultimately helps society as a whole and is a cause that is near and dear to me.

We want to be a good corporate steward, so we also approach our work from environmental and community standpoints as well. Community outreach is really important to us; we work with local schools and the community to help raise awareness about science and technology in our area and how it could really be a big boom for Upstate South Carolina. We really want to build a knowledge-based community, so that is another one of our goals right now.

Our ambition is to grow as a company. What you see in our industry is that the major players in the market address pretty much every market segment there is, but when it comes to developing new technologies, they keep their eyes out for what the small companies are doing. When something starts to gain traction in the market, they start looking for mergers or acquisitions.

**Interviewer**

Do you hope to do that or do you want to remain a separate company?

**Elizabeth Cates**

I think for me, the thrill is in the building of a business. Once the business is established and is in more of a maintenance and organic growth mode, I do not think it will be as exciting for me, and frankly, I do not think I am as good at running a business in that stage. There are people with different skill sets that are better at that sort of thing. As such, I think I would be willing to hand it off one day, so I can go off and do it again.



# Matt Gevaert

## KIYATEC

*Matt Gevaert is the co-founder and CEO of KIYATEC, LLC., which is based in Pendleton, SC. KIYATEC develops and commercializes enabling technologies for the pharmaceutical, biomedical, and life science industries. The company focuses on advanced in vitro diagnostic capabilities for analyzing cell-material interactions and drug discovery. KIYATEC lab-based technology provides more accurate simulation of phenomenon inherent within the living systems of the body. Accurate modeling of these dynamic conditions provides opportunities for advanced medical treatments and enhanced diagnostics. This interview was conducted in August 2007 at the Clemson University Renaissance Center. Since this interview occurred, the company has secured \$175,000 in seed funding and has established operations in a wet laboratory and office space in the Center for Applied Technology (CAT) Incubator. KIYATEC's focus is currently on product development and advancing applications for its 3-D cell culture technology platform. KIYATEC hired its first full time employee, a Cell Culture Scientist, in June of 2009 and was using its product internally in laboratory experiments in August of that year. After securing additional seed funding in September and closing the seed round entirely, founders Gevaert and David Orr joined the company full time shortly thereafter. The team will utilize the seed funding to pursue product development and its demonstration in large market applications in preparation for a Series round in 2010.*

*– Judith Campbell*





**Matt Gevaert**

## **Interviewer**

Tell me the story of how you started KIYATEC.

## **Matt Gevaert**

I came to the United States from Canada to do my graduate work at the Clemson University Department of Bioengineering because of its reputation in bioengineering. I had an undergraduate degree in chemistry, and I wanted to get Master's and Ph.D. degrees with a biomedical focus. There were only a few such places to go with a chemistry background in 1996 because most bioengineering programs focused on the engineering side of things, but not so much on the material side. However, Clemson has this 40 plus-year-old program in biomaterials and professors who wrote most of the textbooks in the bioengineering field in the 1970s. So to Clemson I came.

While I was a graduate student, I went through the invention-disclosure process several times. If all of these patents are eventually issued, I will be an inventor on four patents as a graduate student on three different topics, which is a little unusual.

Some of the technology transfer staff have kindly called me prolific. I think I was just annoying. I was that guy who, when they said as part of the patent process, "We will do such and such within two months," I would wait two months and a week and then go back and say "Okay, what is going on?" So, I got to know everyone in the Clemson patent office (Clemson University Research Foundation).

I had invented some things that I thought were interesting and would have commercial value. The first invention was a co-polymer. If you have ever had stitches that go away, they

are made of the molecule lactic acid. Lactic acid is produced when you exercise; you get sore because of lactic-acid buildup. It is a natural product, and your body knows what to do with it. When lots of these little lactic acid molecules are knit together, long chains form. These long chains make up the plastic used to produce those stitches that “go away.” This co-polymer could also have usefulness for incorporating drugs into absorbable materials. A patent on this co-polymer has already been issued.

The second invention, which was actually a catalyst of this company, is a tool used in labs to grow cells in a certain way. A patent on this technology has also been issued.

The third and fourth inventions relate to a very tough kind of plastic that might be used in an artificial hip, knee, or spine. It was the focus of my Ph.D. work, which was done in collaboration with a company in Canada. The quick story there is that with the blessing and support of my advisor (who also had some money, which is important) I looked up an old connection of hers, and said, “Hey, let’s do a project together. I do not want money. I want you to teach me how you make these really tough plastics, so that we can deconstruct it and then put it back together in a way that is biocompatible for use in medical devices.” So, that made up inventions three and four. After graduation, I held a one-year post-doctoral position at Clemson, working primarily with the Canadian company on the plastic compound. After that position, I worked at CURF (Clemson University Research Foundation) on technology transfer projects.

But let’s bring our focus back to the inventions. Again, invention two is a tool for laboratory use. I have a friend, David Orr, who was also a colleague in the Ph.D.

bioengineering program at Clemson and also had a laboratory tool.

Around the summer of 2005, David and I had both invented small plastic pieces that could be used in a lab to grow cells. At the time, he had his MBA and was getting his PhD, while I already had my PhD and was beginning to gain interest in the commercial side of things. We were also good friends, so we decided to go into business together.

We founded our company: KIYATEC. You might wonder about the name. It is based on a Hebrew word, but we mutilated it a little bit to make it an English word. The Hebrew root word is “chayah,” with a C H. If you have seen the famous movie “Fiddler on the Roof,” you might remember them saying “La Chiam,” which means “to life.” So, KIYATEC, after Anglicization, roughly means life technology, or technology centered around life.

### **Interviewer**

Tell me about how those ideas came about in the lab.

### **Matt Gevaert**

I can answer this question for my invention better than I can for David's. My Master's project was creating an absorbable polymer, and then my Ph.D. project was creating a non absorbable polymer. Both times, my committee said (and reasonably so) “Talk about how toxic the material is. You have to prove that you can put it inside someone's body and it will not poison them.”

The first time around with the absorbable polymer, I stumbled into this problem: I wanted to be able to look at how cells grow on this material. What I wanted to do was

put the cells right on top of the material and see if they would stick. If they did, I wanted to know how they grew and how fast they multiplied. These types of answers are important indicators of how toxic the material is going to be. However, the existing ways to address this problem were, in my mind, not robust enough to give me the answers that I wanted.

For example, a conventional method to test a material like mine is to grind it up, soak it in a medium, and then take that liquid and test your cells against it. That will tell you whether it is going to leach out anything or not and whether the leachables are toxic. This test is important, but not what I wanted. There are some other ways people try to do this, but few of them were suitable for my material. So, when I did my Master's thesis, I did not include any tests in my results that were done exactly the way I wanted because I did not have the method to do so. That was the catalyst of my idea. One of my committee members was Dr. Karen Burg, and after switching projects from my Master's to Ph.D., I said to her "I would like to revisit that problem. I have some ideas on how we might go about solving that testing need in a better way." She said yes, and gave some other suggestions as well. Between the two of us, we came up with a design.

The device that we developed is essentially based on the design of a cell-culture "Petri dish." If you have watched the television show "CSI," you will often see them looking at cultures in a six-well Petri dish-type configuration (or twelve-well or twenty-four etc.). Dr. Burg's and my invention is an insert that fits on top of the Petri dish shape and holds the plastic (or other material) to be tested down, so you can grow cells on it. There were a number of variations that we could have generated based on this design, but ultimately, we did

not go with it but instead went with this (a 3-D cell culture chamber).

The device has ports on either side going in and out, so fluid can flow in two parallel paths. There is a little chamber about the size of a pencil eraser. There is one on the top and one on the bottom, and in between, there is a membrane. You can grow cells in three dimensions in that chamber. Instead of growing them in the Petri dish configuration, which is two-dimensional, you grow them stacked on top of each other in a 3-D configuration.

Cells grown in three dimensions behave much more like those in your body since the cells in your body also grow in three dimensions. When growing cells, you want to get relevant and useful information, and when the environment for growing these cells is more like it is in your body, then the results of those tests are more valuable.

The 3-D cell culture device is based on David's Ph.D. work. His invention was also co-invented with Dr. Burg, and it also went through the patent disclosure process. We both worked with Dr. Burg as students independently of one another. Their invention involved growing cells in a way that was more physiologically relevant. In fact, his project started as a project actually working with stem cells. Just to be clear as far as that goes, there is no controversy relevant to his work; there are many different kinds of stem cells, and we have always worked with adult stem cells only.

For David's Ph.D. project, by using the same stem cells on either side of this barrier, he grew cells that changed into bone on one side and cells that changed to cartilage on the other side. The result was a little plug that was half bone

and half cartilage. This would very valuable for people with cartilage defects, say as a result of a car accident or some kinds of arthritis. Cartilage is very hard to work with; it is avascular and gelatinous, and it is not easy to get things to stick things to it. This idea, then, has a lot of potential, but it was still very far away commercialization.

But, back to the formation of KIYATEC. David had this invention, and I had one similar to it, and we said: “Okay, these are both technologies that we can commercialize synergistically inside this company. In order to do this, we will need a lot of the same things: injection molding and incubators to grow the cells and to conduct a number of tests on the materials and the process. And, we will need to figure out a way to market and sell these devices.”

So, this was the formation of our company. It made a lot of sense to us, and we were both excited. We both recognized the value of doing it together instead of apart, so we formed the company around these two technologies.

**Interviewer**

On what date did you incorporate your business?

**Matt Gevaert**

I believe September 1, 2005 was the legal day of incorporation. The discussions started probably that spring and went into that summer.

**Interviewer**

Did you hire a lawyer for your incorporation? How did that process work?

**Matt Gevaert**

We did, but since we were cash strapped, there was a bit more to it than that. We did some research on possibilities for finding money to help pay for business development expenses, and we identified a program called SBIR Phase Zero (SBIR—Small Business Innovation Research.) This program provides small grants, I believe up to \$4,000, to help entrepreneurs submit for an SBIR grant to a government agency. As part of the SBIR Phase Zero grant, there is a list of reimbursable expenses that you can accrue, which includes legal fees. We applied for and received one; I think our SBIR Phase Zero grant was about \$2,000.00.

We asked many people we knew about lawyers who were willing to work with startups and who might have reasonable fees on the front end and were known to do good legal work. While it would have been possible to do the legal work of incorporating ourselves, we decided to hire a lawyer because we both recognized that legal issues were not our strength. The legal aspect of incorporating the business was something that we did not want to make an early mistake on and then dread finding later. Our initial legal costs were less than \$1,000.00, and the SBIR Phase Zero program supported those expenses.

**Interviewer**

It sounds like the first part of the process was that you had the idea to commercialize these two inventions and then you received an SBIR grant.

**Matt Gevaert**

No, unfortunately we did not receive an SBIR grant even though we applied for one. The purpose of the Phase Zero grant is to encourage people to apply for an SBIR grant.



**Interviewer**

And then what happened?

**Matt Gevaert**

While I was working a full-time job and David was completing his Ph.D., we ended up submitting three different grant applications that fall, which is pretty good productivity for the first four months of a company. These proposals were targeted to supporting either of the two inventions since we did not know which one might be of interest to possible funders. None of these proposals ended up getting funded, but we were also able to develop our business concept further.

**Interviewer**

Were your proposals submitted to major agencies, such as the NIH— National Institutes of Health?

**Matt Gevaert**

There are many departments under the NIH, and these two technologies would appeal to different sections. We had a strategy: this one fits best here; this one fits best over there. We were competing against bigger organizations and universities for these grants, and as I mentioned, we did not get funded. But, in parallel, we were exploring the commercial side of things. It was around the next spring that we started talking to people about the different devices.

**Interviewer**

Can you elaborate about what “talking to people about the different devices” means? Who did you talk to?

**Matt Gevaert**

We tried to figure out how we would go about making and selling these devices. First of all, there is always the issue

of finance. We needed capital, so we needed people who understood that we could make money on these devices. Then, we needed a way to get the products to customers, such as through big distributors of lab apparatuses. Therefore, we needed to know how these companies did business and who our major competitors in this field were.

What we realized after exploring this industry is that we are a “tools company.” We are not making a drug or an implant; we are making tools for researchers. We found out very quickly that many of those markets are pretty small.

In both my CURF position and in my entrepreneurial position, I found that many individuals have clever ways of solving problems in the lab. These lab solutions are good ideas, they work, and they are often patentable. But, when it comes down to it, there are not enough scientific labs around the country, or even around the world, to justify spending a lot of money to commercialize a product to solve these problems. On the very extreme, if you are a very specialized scientist and you work at one of only three labs in the world that can do such-and-such research, if you create a tool for that specific lab, you can see that the market size is potentially three labs total.

Now, of course, it generally does not work that way, but if you are going to raise money, you need to have a market big enough for investors to have a chance of making a substantial return back on their investment. This was the issue with the first device, the one that I had invented. While it was closer to commercialization and a simple patent on the device was closer to being issued, the market was not large enough to sustain a large outside investment.

We thought we could get this device into the marketplace and generate a revenue stream and then use these revenues to develop the other device further. However, what we found is that there was not a lot of investor support because of the small market size. If we had a lot of our own money, we might have gone ahead with that device because it could be promising right now.

I recently received something in the mail from a Finnish company who has a device that is pretty similar to mine, and they are trying to get market penetration. However, because we do not have that kind of capital, we need to talk to people who can invest.

We could obtain money through government grants, which we have pursued and are still pursuing, and then, there is private money as well. There are tradeoffs between the two. Government grants often take a long time to get, but the money you receive is non-diluting. Government funds also enhance your credibility because if you get funded, a specialist has looked at your proposal and judged it worthy of funding. But, government grants take a while to get. If you apply for the grant and get funded, you do not receive any money for another six to nine months, and in the business world, that is a long time. On the other hand, there is private money, which you can generally raise more quickly, but an equity investment dilutes the ownership stake of earlier investors. So, we were trying to strike a balance between both.

In looking at the marketplace, we found a number of possible uses of the 3-D cell culture technology. One application would be for drug discovery. There are a number of different estimates, but it appears that between \$800

million and \$900 million is spent in production for each new drug that comes out. There are a number of steps in drug discovery that occur before these drugs reach clinical trials. I am oversimplifying the process, but conceptually, companies initially test new drugs with a very simple biochemical assay. Then they might move to testing the drug on live cells, cultured in ways like the one we just discussed. From there, if it passes muster and everything else works out, they would move towards testing the drug on animals to study the drug's toxicity and effectiveness. After these studies, they would consider testing the drug on people. By the time the drug is used on people, it has gone through a long process of testing. On average, for every 10,000 new drug compound candidates, only one makes it through. It is a long and costly process.

Our invention allows us to grow a certain cell type on top and another cell type on the bottom, which creates a 3-D test system. Cells in this system behave more like cells in the human body when interacting these different drugs. Secondly the 3-D cell culture method, although it is not yet standardized, is used in some form in many labs already. Our product creates a way for multiple cell types to “talk” to each other while growing in three dimensions, which is hard to do using existing equipment.

I will give you a good example that I am preparing a grant application for: Cancer. For cancer studies, many researchers have said that previous 2-D cancer studies are not meaningful because you have to grow cancer cells in three dimensions to make them behave as they do in the body. If you test an anti-cancer drug against cancer cells grown in a 2-D environment, you might not be getting an accurate answer of whether it will actually work or not.

Another strong point of interest is liver cells. Drugs are processed in the liver, but when they are, the liver may potentially alter the drug; the liver might tweak it a little bit into another compound entirely. It is important to understand how that occurs. Does the drug become more effective? Does it become less effective? Is it toxic?

So, what I am proposing in this grant application is to be able to culture liver cells three-dimensionally on the top and cancer cells on the bottom. Then, I would test this mini-biological system using four drugs that are already known to be significantly affected by liver-cell processing.

Two of these drugs are known to become more effective when they are processed by liver cells, and you can understand why this is important to know. The other two, however, are known to become less effective when they are processed by liver cells. If I can use this invention to test these drugs and tell exactly how they affect the cancer cells growing adjacent to them, post-metabolism by the liver, I would be able to provide drug companies with very valuable information. I will demonstrate this using four drugs that we already know affect the liver in particular ways. By implication, if we can test four drugs with this invention, then we can test ten or 100 more drugs for which we currently do not have answers. With this invention, I can get answers cheaper and faster without involving people.

This is the essence of the technology. KIYATEC will eventually make instruments with a lid that can be opened in which ten to twelve of these little cubes can be plugged. These cubes have conditions in which you culture cells: at the right temperature, at the right humidity, and at the right carbon dioxide level.

We envision that drug companies will use this tool to determine how effective a drug is going to be. I just gave you one example of culturing liver cells with cancer cells. There are a lot of different possibilities: if you are trying to construct a drug for diabetes, you might want to culture pancreatic islet cells, or if you want to test a drug to see how much of it resides in fat cells, you could also do that.

### **Interviewer**

Tell me more about the commercialization process, in terms of discovering your market for this invention.

### **Matt Gevaert**

I have sought to develop relationships with people engaged in drug discovery, people who would understand the value of this invention. They understand that we need better in vitro assays to do drug testing. The drug people are saying, “Well, show us. Prove that your invention can do what you say it does.” So, this is the stage of commercialization at which we find ourselves: needing to raise money to do proof-of-concept studies for the drug application.

We have already proven the effectiveness of our other application for the research market, but for this particular market (testing drugs), we want to be able to show that it works on known drugs first. The next step would be to test it on more drugs: say, ten drugs for which drug companies already have answers, but we (KIYATEC) do not. Then, we will test the device on ten drugs for which even the drug companies do not have answers. We have to demonstrate the value for a particular application for each customer.

Risk goes down as time goes forward. Right now we are in an area where they want to see the invention mature a little

bit more. They want to see the invention's effectiveness more readily for these particular applications, and that is the challenge. I think my immediate focus is going back towards government grants because this is an interesting scientific problem, and it will be valuable if we can show that it works.

A number of people have asked about whether they can invest in the company. I want to hold off on that issue until I get some of the other questions answered. I think that you have to build value into your company to a point where you can actually accept money. It makes sense for downstream dilution issues. Many of the venture capitalists I know have explained that it makes sense to prove the technology first before taking outside investment money. So that is what I am trying to do.

### **Interviewer**

Did you do a business plan?

### **Matt Gevaert**

Yes. I will give the credit to David for this. He was the mastermind behind most of the business plan writing. He graduated with his Ph.D. in the fall of 2006. He was working full time with the company and dedicated his time to writing a business plan, among other things.

We have an award-winning business plan. We entered and won the Charlotte Five Ventures Business Plan competition this last spring. We competed against teams mostly from North Carolina. We made the top three among non-student teams, and then went to Charlotte for a day, where we met with review panels, had discussions, and engaged in mock scenarios of investors and companies asking us about the technology. Again, I will give David credit. He championed

that process, and we came out with the win. So, we have an award-winning business plan.

**Interviewer**

Did you find the business plan competition valuable?

**Matt Gevaert**

Yes. It has given us a lot of good exposure. Winning the competition adds some credibility to what we have done. I am still realizing the value of that. For example, we now know a lot of business people in Charlotte. So, yes, absolutely.

**Interviewer**

Is there anything missing from the story?

**Matt Gevaert**

What is missing from this story is that after we won the business plan competition, you should be asking yourself, why I am sitting here, and not David, who I have mentioned many times.

Picture the scenario that David, as a young entrepreneur, is also married. He finished his Ph.D. in August, so now he is with the company, but we do not have money to pay his salary. This was a challenge of whether we could raise some money, and get this money into the company in time to actually start paying him a salary. He has a Ph.D. and MBA. He has some very valuable skills, and at the end of the day, we were not able to raise the money to have him employed. So he has taken a job up in Indiana with “Cook,” a great medical-device company that has need of a similar set of skills.



As a result, we have shifted from where before I was in the passenger seat in terms of ownership and responsibility to where I am now in the driver's seat in terms of both of those things. So now, it is up to me to lead things forward as far as it can go, and this is what I am trying to do. But sadly, I have to note that this region lost a great entrepreneur to a job up in the Mid-West.

In retrospect, I think we were a ahead of the curve on a couple things. If you look at the developing infrastructure in this area for entrepreneurial activity, young companies like KIYATEC are growing. So, there are options available now that were not a year ago, which is definitely good.

I guess those things were not in place quickly enough for our company, and/or we did not click into what was in place soon enough to have made it work where David would still be here. We certainly have had our struggles and learned lessons on the way too, and I am still looking for that grant or something else to get things going. I might also talk to some investors in January. But either way, our goal is to get some money into the company by next summer and to go forward with developing the invention concept and its validation and then to go from there.

### **Interviewer**

I know some people are interested how technologies from Clemson University are licensed. Since you have been on both sides of the licensing process as both an inventor at Clemson and as a licensor of this invention, could you explain how does the process work?

**Matt Gevaert**

Basically there is usually some upfront consideration, quid pro quo from the company for the use of the asset “as is”: early and often unproven but still representing something in which the university has invested resources. Part of a standard license also involves royalties, which people tend to focus on, but royalties do not come into play until you actually start making sales, which is downstream. Typically, there is an understanding that these technologies often take several years to commercialize. For example, there are no royalty expectations on this technology any time in the next year. If I did start making this invention and selling it, then, yes, there would be some royalty expectations.

**Interviewer**

My sense is that there is a basic understanding that technology commercialization takes a long time, and the university is saying “let us put these patents out in the world and have companies commercialize them” and that there is a royalty if it works and sales are generated from the patents. But probably most of them do not work. However, some of them do, and these are the ones that provide revenue to Clemson.

**Matt Gevaert**

Yes, that is exactly right. There is an understanding that it takes time, and there is an understanding that most of the patents will not work or be valuable in the market. The university’s job, with which the technology commercialization officers are involved, is to create the possibility that patents generated at Clemson University are licensed by others and commercialized.

The goal is to create a good licensing deal that makes sense for everybody. The deal should make sense for the company who takes the technology in, and it should make sense for the university who passes it out. For example, the university is concerned that companies will license technologies and not do anything with them. So, there are typically provisions to ward against companies just licensing technologies and sitting on them. Most licensing contracts have an annual minimum companies have to pay to maintain the license, or if the company has not sold the first product by a certain date, then the license expires. Provisions like these are certainly always in place as well. In licensing a technology, we look to see whether the company is really trying, doing a good job of commercializing the technology, and moving things forward.

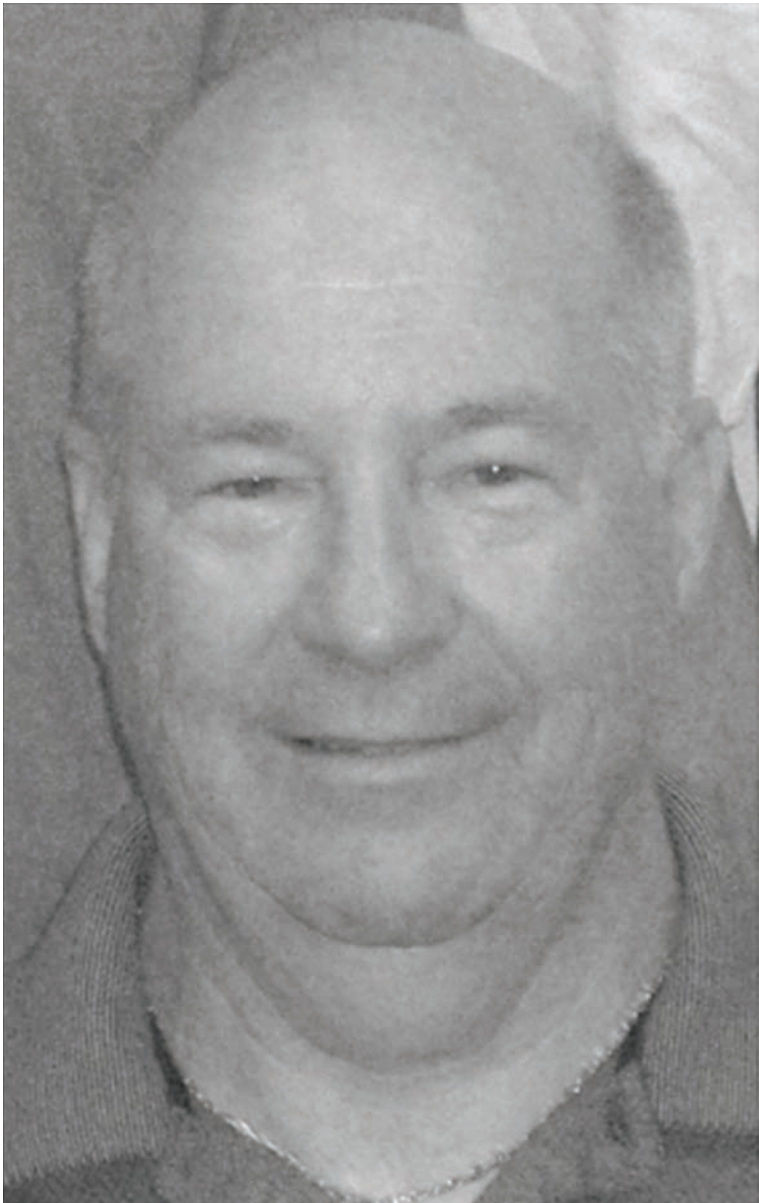
But they are also structured in a way that makes sense for a young company that is not going to have royalties any time soon. In addition, there are ways to offset the initial cost required by a company for the upfront licensing fee. The research foundation, for example, may ask the company for equity in the business in lieu of a cash fee. In this way, the university will be rewarded as part owners of the company.

# Charles Pringle Andrew Clark Brent Buckner

## SensorTech

*In the following interview, Andrew Clark, Chuck Pringle, and Brent Buckner discuss the founding of SensorTech, LLC., a startup company that emerged from research done at Clemson University. SensorTech specializes in the development of a novel contact sensing material that can be used in a wide array of industrial applications. While doing research as a doctoral student at Clemson, Andrew discovered a method for conducting electricity through a polymer to create a sensing material. This research and resulting technology became the foundation of SensorTech, which Andrew and Chuck founded in May 2007. The initial technology was used to create trial tibial inserts for knee replacements and has expanded to include load cells and stent-testing devices. SensorTech was originally based out of the Griffith Building in Pendleton as part of a Clemson incubator but has since moved to a new facility in Greenville. At the time of the interview the company was working on negotiating contracts with the Applied Research and Development Institute and the Department of Defense to establish new uses for this novel material.*

– Ali Ferguson



**Chuck Pringle**



**Andrew Clark**



**Brent Buckner**

**Interviewer**

Please introduce yourselves, and then tell me the story of how you got into this business.

**Chuck Pringle**

I am Chuck Pringle, CEO (Chief Executive Officer) of SensorTech.

**Andrew Clark**

I am Andrew Clark, CTO (Chief Technology Officer).

**Brent Buckner**

I am Brent Buckner, Director of Business Development and Administration.

**Chuck Pringle**

SensorTech was started as an outgrowth of Andrew's work in the BioEngineering Department at Clemson. Andrew went to Clemson for his entire educational career; he earned his Bachelor's, Master's, and PhD degrees here and graduated in May 2007. During the course of his graduate studies, Andrew started to work with UHMWPE, which is a high-strength polymer, and discovered a method to make it conductive so it could be used in a variety of measurement applications. Initially, he did some work centered on load cells as they are used a great deal in industry. He also began working on a "smart" trial tibial insert that is used in total knee replacement surgeries. The patent is actually based on this body of work. These inserts are becoming increasingly important because the number of such surgeries is rising steadily in our aging population.

In January, 2007, Andrew and I began discussing what he wanted to do with his PhD after graduation. During the



first half of 2007, we took advantage of an exclusive option to license technology from Clemson University through CURF (Clemson University Research Foundation). We eventually began moving in the right direction to developing our company and establishing our initial business activities. Around the first part of July 2007, we obtained some space in the Griffith Building in Pendleton, which is a CURF facility for advanced materials and an incubator for startup companies. We had to set up a lab space, which essentially took up the rest of the summer because we had to identify and procure the equipment required for our work.

The equipment started to arrive around the first of September, and soon after, we realized that we would have to leave the CURF facility due to lack of space. As of January 2008, we completed the move from the Griffith Building to our new facilities in Greenville. Actually, we are having our lab floor finished today, and we will be moving into the space tomorrow. SensorTech truly is a startup just getting into business.

Those were some of the first steps we took. We received our initial funding from a \$50,000 university startup grant from CURF and SC Launch, and we also received some money from friends and family. Our plan for the fall entailed further technical characterization of our materials. This type of characterization is a common technical task in the sale of products and goods, so we put a good bit of time into that.

However, the material characterization process was hampered a bit by our initial lack of space and by the few times we relocated within the Griffith Building. So we had a few stops and starts in the Griffith facility, which motivated us finally to relocate here. I have to say that Andrew did a very

good job during that time, especially because the work was very difficult and we did not have a fully functioning lab.

Andrew's initial work was so intriguing that we even had some interest shown by outside companies during the study period. People wanted to talk with us directly about what we had, perhaps even before we were quite ready for them. We were also encouraged by the load cell market research we had done with Spiro International.

At the same time, we had some initial conversations with ARDI, which is a technical institute joint venture of South Carolina Research Authority and Clemson University. ARDI is working on a R&D contract from the Office of Naval Research pursuing solutions for naval material issues.

Through this relationship, we also became aware of a program that they were working on in prosthetics. Long story short, we have submitted a proposal to them to develop a material for using in fitting prosthetics. It should be a significant award, especially for a startup company. ARDI's interest further solidified our initial thoughts that our material could be used in a wide array of applications and would have significant advantages over existing products in the marketplace.

Overall, there are still some medical applications that hold promise, but we believe that our near-term success will be to begin on the ARDI contract and, at the same time, add additional resources in order to begin looking at load cells in earnest. During the remainder of the year, those two things will probably be our focus areas, trial tibial inserts and stent-testing devices. We are very encouraged. That is pretty much where we are.

**Interviewer**

I have a lot of questions. First, can we start with some issues about the technology? How did you decide on what particular ideas or commercial ideas you wanted pursue?

**Andrew Clark**

Just common sense, I guess. We just saw where our technology might fit and what its potential was. As a research engineer, when you work with something for so long, you intuitively know where your technology can go.

**Brent Buckner**

Well, I think one of the challenges that we are having right now is that we need to concentrate on one major focal point that will become our revenue driver. We know we have these three focal areas (load cells, prosthetics, and smart trial tibial inserts) pretty much locked in, but we need to decide in which area we are going to create a functional product that will produce revenue over time so we can develop and market these other ideas.

We probably have 50 or so research and development ideas that seem to come up on a daily basis. So our challenge right now finding something that will generate a steady stream of revenue for us, but we have to do a little more research before we reach that point.

**Chuck Pringle**

I want to add a little something to what Brent's saying about the load cells and go back to what Andrew was saying as well. In the course of this work in the lab at Clemson, Andrew used load cells successfully in some of the testing that he was doing. So, he became aware of their functionality early in his research.

**Interviewer**

Now, can you describe what a load cell is in layman's terms?

**Andrew Clark**

Okay. A load cell is a device that measures load, like mechanical forces.

**Interviewer**

So it can sense pressure—basically, pressure from an electrical current?

**Andrew Clark**

Essentially, yes.

**Chuck Pringle**

Load cells are ubiquitous in industry. They are used in many applications from load cells in your bathroom scale at home all the way up to load cells weighing tens of thousands of pounds for industrial purposes. Inside a load cell, there is a device called a strain gauge, which creates the measurement. The load cell is a device that surrounds the strain gauge and enables it to conduct the current into an external device that gives the output. Load cell technology has not changed much in 30 years so there is incredible opportunity for us as verified by our market research!

**Interviewer**

So a load cell is essentially a polymer with properties that produce currents when pressure is applied, and then you get a sense of how much pressure applied by measuring the current. Thus, load cells can be used many applications.

## **Chuck Pringle**

One of the beauties of being in the Upstate is that there is a lot going on here technology-wise that we can get involved with, from work at the Clemson University International Center for Automobile Research (CU-ICAR) to work of the Greenville Hospital system. There are a number of companies that work specifically with vascular technology.

We are also doing some work with CU-ICAR. After Andrew finished up his initial graduate work, I would say that there was at least a modicum of interest in our work from mechanical engineering faculty. Some of those faculty members have since relocated to the CU-ICAR campus, so we plan to continue interfacing with them in the future.

Also, we have talked to Michelin and BMW about some automotive-related applications. So those are examples of things we will get to at the right point in time, but we are not quite ready for that right now.

In the short term, we will be doing more evaluations on the load cell. I should make one other point. The money that we received from SC Launch also came with some resources. Warren Weeks, who was the technical director at SC Launch when we received the money, came to us to discuss our product and its applications.

Fortunately, we will not be asking for money from external investors for a while, which will save us some time and energy. We want to make sure that we have a much more solid story before we go to a group of external investors.

**Interviewer**

Great. So, can you tell some stories about how you got involved?

**Chuck Pringle**

I have known Andrew through his parents before he was a student at Clemson, so I knew what he was up to at Clemson. As he approached graduation, I went to visit him to discuss setting up this business. We decided we would make a good team because Andrew has the technology skills, and I have a long-term set of business skills and some extra time because I retired early from Fluor. That is how we got matched up, and then Brent came on during the fall.

**Brent Buckner**

I am a former banker and finance person. Before I took this job, I was working at a bank in Chicago and just got really burned out because I was on the investment banking side. I am originally from Greenville, so I moved back here and was really just searching for something different.

I was looking at a couple of different opportunities, and then Chuck introduced me to the company and the work they were doing. I was looking for something that had a vision and ideas that I could get at the front end of and really explore with the new company, and that is what we have here. Everyone is very passionate about what we are doing here, and that was something I definitely wanted in a new job. As soon as Chuck called, I came in, and we started working on an ARDI proposal. It has just been a blast getting to do something enjoyable.

So starting up with a new company is exciting (and sometimes stressful), but in the end, the reward is going to

be great. So, that is how I got on board with everybody. I bring a different side that I think is unique for this company: we have a scientist, the guy with the idea; a veteran, Chuck who has been around business for a long time; and me, who brings the financial and sales skills. As you can see, we are pretty well-rounded right now, and we are going to continue to grow in the future.

### **Interviewer**

What do you see as your biggest potential problems, and how are you surmounting them? You might want to think about the history of the problems the firm has encountered.

### **Chuck Pringle**

Probably the biggest issue we have faced so far has been the whole space issue. We really wanted to be part of the incubator at the Griffith Building.

I would say that a lot of problems were avoided due to the initial funding from SC Launch. When we started, the whole startup company incubator picture in South Carolina was in its infancy, and everyone (including us) was going through growing pains. Since moving to our new facility, we have missed having the camaraderie of the other startups in the incubator. However, we have planned to meet with a few of them, Selah and Tetramer specifically, on a periodic basis and share stories and business opportunities. This is important because we hope to do some symbiotic types of work with both of these companies in the future, even though it will not be quite as easy as it would have been had we stayed in Griffith.

On the other hand, SC Launch has provided us with a set of resource partners to whom we gave a presentation earlier on

in our work. We will probably come back to them in the next few months to get some of their advice and guidance, but we will wait on that until we become a bit more mature and understand our own issues better.

I would say the next issue we will face is the next level of funding. We already have a fairly large contract that we are negotiating now, but we have to stop-gap finance that somehow, which is an issue that we will have to confront. SC Launch! may be a solution for that, though. In addition, in our contract, we also have people who are willing to pay money for our product, so we have to evaluate some issues related to that as well. We will eventually go forward with external advisors and get some advice on how much money we are really going to need.

I would say that if there was an error in judgment so far, it was that we discounted the startup costs. We had different kinds of startup costs than the usual company, though; the whole lab and equipment is maybe a bit unusual. We decided not to use lab equipment from Clemson. We might have been able to do that but decided that it would have been inefficient because we would have had to work around other people's schedules. So we bit the bullet and spent some money to obtain our own equipment.

Also, let it be said that we did not do everything we wanted to do. Andrew did a great job in keeping down the price of equipment. We have fairly nice equipment that we are proud to show anybody, but it is not top of the line. I would say that Andrew's got promise if he ever needs to pursue a career in procurement because he did a heck of a job with the pricing from our equipment vendors. So, hats off to Andrew for being able to get that equipment for us.



In Andrew, I think we have a technology guy who understands his product remarkably well. On top of that, he is not only a research guy but is also a very practical person in many ways. He really put all this together. As a company, we are very lucky to have him because he is very handy. As he likes to say, he likes to find technology solutions to real-world problems.

Those are some of the issues that we are dealing with and how we are dealing with them, at least from my perspective. Anything to add?

**Brent Buckner**

We have the same issues that I guess most startup companies have: deciding what equipment to buy; choosing what kinds of computers we need; finding a location for our office; finding funding; hiring new employees etc. These are the types of things that any company would probably have to deal with, and we certainly have them. These issues challenge us on a day-to-day basis, but that is what you have to do to run a company.

**Interviewer**

It is a nice story about a seed company. You are right at the beginning.

**Brent Buckner**

Yes.

**Chuck Pringle**

We are, and it is very exciting. It truly is. I mean, one of the things that turned me on to this work goes back to when I was working with the South Carolina Research Authority (SCRA) where I was a board member and chairman. As

I was exiting the chairman's role, we were beginning to plant the seeds for what is now SC Launch!, so I was always interested in the subject of what goes on with research and how a company moves on to the "real world."

Starting this company was really a blending of my business and program and project management skills and Andrew's technical skills. This blending resulted in the ARDI contract, which is a significant piece of research for Clemson University and for the upstate in general.

I was excited about the prospects for SC Launch!, and being where I was in my station in life, it was a no-brainer to work with someone who was passionate about what he had found and about bringing it to life. Also, there were some real-world applications that we had already seen relating to what he was working with, so I knew that this work was not going to be research just for research's sake; this is an application that we are continually discussing and moving forward with.

### **Andrew Clark**

I think that growing in Greenville is also very uplifting, especially after having gone to Clemson. It is great to see how much excitement and work is going into companies in the Upstate and in South Carolina in general. There are a lot of good things going on here that make what we are doing even more exciting because we know that we have people behind us that want to see industries come into this state and make a difference. I think a lot of good things are going to happen in years to come, especially in Greenville.

### **Chuck Pringle**

In a year or two, we would really like to be a poster child for startups in South Carolina. That is another of our goals.

**Interviewer**

It sounds like you are really close. One more investment here, one more project, and you have it.

**Chuck Pringle**

Yeah, well, this is a significant project for us, and we are just hoping that everything works out.

# **John Ballato Earl Wagener Steven Foulger Dennis Smith**

## **Tetramer, LLC**

*John Ballato and Steve Foulger are two of the four founding members of Tetramer, LLC., and Earl Wagener is the company's CEO. In this interview, the three men tell about the founding of this faculty-based startup company and the unique challenges they faced along the way. Tetramer was established in 2001 when four Clemson faculty members from different engineering and technical backgrounds decided to combine their knowledge and research interests to develop specialty polymeric and oligomeric materials. The company's current research and development is focused on polymer fuel cell and gas separation membranes, biorenewable resources, piezopolymers, and optical polymers. Tetramer's research endeavors and unique products have enabled them to make strategic partnerships with larger industrial companies, including General Motors (working on fuel cell technology) and Cargill (creating renewable biomaterials). Since this interview in, Tetramer has also created strategic partnerships with Membrane Technology and Research and Draka.*

– Ali Ferguson



**Earl Wagener**



**Steven Foulger**



**John Ballato**



**Dennis Smith**



## **Interviewer**

Tell me the story of how you got into business.

## **John Ballato**

I love telling this story. There are now three of us professors here at Clemson University all working in different departments: me, Steven Foulger, and Dennis Smith. I have been here ten years, and I was hired into what was then the Ceramic Engineering Department.

The next year, Dennis Smith was hired into the Chemistry Department, and the year after that, Steve Foulger was hired into what was then the Textiles Department. Through a series of interesting circumstances, we realized that we had a lot of complementary things in common in terms of our research interests.

We had a chemist, an optics person, and a physicist. Originally, we had another partner, but he is no longer here. So, initially, we were just these four junior faculty from four different departments who really did not realize that it was not a typical thing in universities for people in different departments to talk to one another. At the time, we thought that was common practice. We realized later on that it was not, but we still began to share resources, laboratory space, and equipment.

To make a long story short, these four people from essentially different walks of academic life came together because we were much more effective in doing the research we needed to do together. As we began working together, we had no upfront thoughts about creating a company; we were just junior faculty trying to get promoted and tenured and were doing what we thought we were supposed to be doing. First

we wound up founding a research center, COMSET, which has been very productive, and then we established Tetramer not long after that.

So, we did our research, published our papers, and went to conferences to present our work. As that work became better known, we were invited to speak at more and more conferences. After a few years of speaking at these conferences, people from various companies started coming up to us after our talks and asking us where they could get some of our material.

Being junior faculty, we did not know any better and ended up just giving these people samples of our material to test. We did not realize that we were essentially testing markets that really did not exist at that point. Shortly after that, Dennis suggested that we start a company because there was so much commercial interest in our materials.

I think that is how many companies like ours start. We did not go in necessarily thinking about spinning out a company; we simply knew we had something of value, and there ended up being a market pull for the materials that we were developing at Clemson.

### **Earl Wagener**

I think one of the pieces to the formation of Tetramer is that Dennis, who was at Dow Chemical for about eight years, had industrial background. So, one of his natural thoughts was, “Hey, we can make this stuff and sell it.”

### **John Ballato**

We began thinking about this idea of spinning out a company, and the first thing we did was contact Caron St.

John at the Spiro Center. She gave us marvelous advice as far as what to do, what not to do, whom else to talk to, and what steps we should take, especially as faculty members.

When we were beginning to set up the company, there had been maybe one case in which a faculty member had actually created a company, and there were some other horror stories. There are a lot more guidelines in place now to protect faculty and other people internal to the university when they want to take their ideas outside.

In many ways we were charting unknown waters, but this was something we wanted to do because there was interest in our materials and because we liked working together.

After speaking with Caron, we found a lawyer and created the LLC (Limited Liability Corporation), Tetramer. Somewhere, I have all of these bar napkins on which we diddled out different names, and then we searched them on the Internet to see if they were taken. The etymology of that word came from “tetra,” which means “four” (because there was four of us), and “mer,” which is the root of the word of “polymer” (because we work with polymers).

Anyway, Tetramer was born out of this market pull for the materials that we had developed and are still developing at Clemson. Their performance was superior to many things that were on the market at the time.

The most important thing to the success of the company to date has been Earl Wagener. In our case, we liked being faculty members; we were good at being faculty members, but we are not good at running companies because we do not know anything about it. Well, Earl does.

Steve and Dennis have industrial experience, but working in a research lab for a massive company is very different than being the CEO of a small startup company. So, the best thing we ever did was to get things started and then get out and give the reins over to somebody who actually knew how to run a business.

**Interviewer**

You said you never really got out, though, right?

**John Ballato**

Right. We are still involved; we just handed off that part of the business to people who actually know how to manage a company. That is another pitfall that a lot of faculty fall into: they see dollar signs in the possibilities of spinning off companies not realizing that very infrequently do those dollar signs ever materialize or at least not to the magnitude that they think they will.

Many faculty members and most people in general, have egos that make them think that the work they are doing is the best out there and that people are going to give millions of dollars for their products. However, they have no idea about the other dynamics involved that make a product or an idea valuable or not. So, they have these grandiose ideas of spinning out companies, making their fortune, and retiring on a lake somewhere, but it never happens. Very few people that get into academia actually make the transition to running companies. As a result, our decision early on was to find someone to run the company because we knew that we could not do it.

Low and behold, we found Earl Wagener, who is the perfect Clemson man for the job. Earl was born and raised in

Clemson, and his grandfather was in the first graduating class at Clemson and one of the founders of Clemson's Chemistry Department. Earl earned his PhD here as well and just loves South Carolina in general. He definitely bleeds orange and wears it.

### **Earl Wagener**

The situation was exactly that. I earned my degree here and really wanted to stay in the Southeast. Initially, I got a job at Milliken. I thought I had nailed it right on because I looked really hard: I looked in Atlanta; I looked in Columbia; I looked in Knoxville; I looked all around.

I got the job with Milliken in Spartanburg, but two weeks later, they fired me because they had such a massive layoff that they just said they could not use me. So, plan B was to go to Dow Chemical up in Midland, Michigan.

I viewed the Midwest as this vast, cold, white tundra, but it was my only choice, so I left the Southeast, went to Midland, and worked at Dow. As it turned out, I loved Midland. My philosophy is that you can enjoy anywhere you go if you take the attitude that it will be a great place.

I worked in Midland at Dow's central research area and learned some background about the fundamentals of polymer chemistry. Then, Dow offered me a job to set up a lab in Walnut Creek, California, which is near San Francisco and the Bay Area.

When I left Michigan, everyone kept telling me that my career would tank because I was leaving the center of Dow Chemical. I just looked at them and said that it would not be bad out there and that I could help the company grow.

The Walnut Creek lab was called Discovery Research, and we were looking at new things like artificial kidneys, membranes for gas separations, new polycarbonate-type structures, and that sort of thing. We also wanted to establish a lab in Japan, so I spent a fair amount of time in Tokyo, and we eventually set up a lab in Gotemba as well. That was a neat experience because I got to learn about a different culture and how research was done in Japan.

I was in Walnut Creek for ten years, and then I got an offer to go to Europe. My family and I lived in the middle of Europe, outside of Strasburg or Baden-Baden. The idea was for me to help Dow take the entrepreneurship side of the company into Europe and do new things. So, I was out looking at acquiring companies and different technologies. Then I was told that it was time for me to get back into the mainstream of Dow. So, I was sent to Texas and headed up the group called thermosets, which worked with polyurethanes and plastic. I had a pretty high-level job at Dow while I was in Texas, but my wife developed a mold allergy while we were there, and I told Dow that I had to leave because my family life was in trouble.

I look at my career as having three foundations: my work life, my personal life, and my spiritual life. A lot of people think that entrepreneurs have to burn both ends of the candle all the time, but if you do that, you will be a workaholic, and you will burn out. And if you burn out, then you will not have the sensitivity to motivate and enjoy people or help them get through the tough times.

So, we moved to Chicago, Illinois where there were not many mold spores in the winters, and I was back in the Midwest shoveling snow again. I worked for ten years as the Vice

President of Research and Development for a company called Stepan, which is a specialty chemical company. They wanted me to set up their European operation, so I was doing that when Dennis called me up and said “Hey, we have a company down here...”

Also, there is one thing that I forgot to mention about Dow. While I was there, I was asked to be part of what is called the Dow Capital Investment Finance Group. I was the research component of this group that went out and invested Dow’s money into other companies. The stipulation for these companies was that they had to have some way of tying that money back into Dow in order to create a synergy with Dow that would make them more money.

During this time, I got to see how a lot of small companies operated. I saw just how tough it is, but I also enjoyed seeing how much they liked what they were doing. They barely had ten cents to make it to the next day, but they had the attitude that it would work. I always wondered, “Could I ever do that?” I could not have managed it during most of my career because I had a family to raise, but then this opportunity arose, and here I am.

### **John Ballato**

It gets better. So at that point, I did not know Earl, but Dennis got his PhD in chemistry at the University of Florida, and his advisor was Earl’s brother. Well, Earl’s brother actually got Dennis a job at Dow through Earl. So when Earl decided to retire and move back to Clemson about seven years later, Dennis decided to return the favor by asking Earl to meet with us two days after he had officially retired.

The company was about a year old at that point, and we ended up getting everyone together at a coffee shop downtown where Loose Change is now. We just told him about our company and what type of work we were doing, and the rest was history really.

### **Earl Wagener**

While we were having coffee, we talked about a lot of the projects they were doing, but the thing I looked for was the dynamic between these guys. They could speak the truth as they saw it with each other. If they thought something was right or not right, they would say it, but in the end, they liked each other. That is what you need.

You cannot have a small company and have one person with the attitude that he is going to take over the company at the expense of the other partners. That was not the case with these guys. It still is not the case, even though it is becoming more difficult for them to spend time with the company with their growing careers in academia and everything else.

Anyway, we looked at the products and asked ourselves what had been done before and what we could do. My natural instinct kicked in, and I told them what the critical values of their products were had how we would evaluate the product in industry. We sorted through each product and decided which to keep and which to let go of.

We wound up with basically four platforms that were really interesting. When you are a small company (we only have eleven people now), it is tough because you get fewer at-bats. So you want to avoid going for the home runs at first and stay with the smaller stuff.



Essentially, from a career standpoint, you have to get back to zero, and it is good for you; it is renewing at many levels. Small companies usually last two-and-a-half years, but we are now on our sixth year and still going strong, and our revenues are increasing. In fact, we just received a notification today that we are receiving another half million to continue our work.

We deal with big companies like General Motors, for example. General Motors is making a fuel cell car, and we are in line to make the fuel cell membrane for that particular car.

### **John Ballato**

You also have to realize that there is going to be some risk in things that are new. In many ways, we got into things that really had nothing to do with our expertise. We have our material and know about that, but there are other aspects of the business (like using Linux, for example) that we do not know anything about. We believe that our material is going to work.

### **Earl Wagener**

In addition to working with General Motors, we still have the optical side of our work. We coat fibers for high temperatures and that sort of stuff, and we are looking into other optical materials as well. For example, Sony is interested using our polymers as part of their DVDs.

We are also looking at piezoelectricity, which involves taking a material and stressing or bending it until electricity is created by the tension. Or, you can put electricity in the material, and it will bounce up and down; that is the technology behind speakers, for example.

We have found a way to make piezoelectricity six times more effective using our polymers than anything that is out there now. The fact that we all have backgrounds in different areas helps tremendously because we can go to each other and say, “Does this really make any sense? Is this worthwhile?” And, we can tell each other exactly what is going on.

Then, there is the renewable area, which is going to be big. We are looking at taking renewable materials and putting them into industrial chemicals, like shampoos and plastics for example. We want to find a way to convert soybean oil and vegetable oil and are actually working with a company called Cargill, which is the largest private food company in the world.

Now, the neat thing about all this is that we have created twenty-five jobs. We have eight PhD-level jobs in South Carolina, and we are going to keep on creating jobs. While eleven jobs is not a lot, if we get the sales we have projected and the grants we have applied for, we are going to have five more jobs next year.

### **John Ballato**

As faculty, we initially started our work with research grants from the National Science Foundation and the Department of Defense. We only had a little “bubbler” in the lab and were just making small, amounts of our materials, just enough to take some measurements, write these papers, and go talk about our work.

Fortunately, for us at least, the devices that generally use the material only require a small amount. We had a material that was very high value but very low volume. So, we did not need tanker cars worth of material, which was part of what

helped us get started. We did not have to go into developing a commodity-scale material. We could get away with something that was just very high value

So, Dennis, being a chemist, knew a gentleman who started a company at the University of Texas at Austin that made planar waveguide devices. Planar waveguides are to light what integrated circuits are to electricity; they route the optical information around to be processed.

The plastic that we developed was superior to what was available for the types of things that they needed to do. After doing the math, we realized that we were capable of making the materials they needed because it would be done on such an elementary scale; all they needed was a thin layer of plastic that they could carve up, and we could handle that.

This was all around 2000 or so when the telecom bubble was just getting bigger and bigger. We were very excited because this company that we were making materials for was going to talk to Intel, which was essentially ready to make an investment. That meeting was scheduled for September 12, 2001.

We all know what happened the day before, and that was the end of everything: no more investments; markets fell; telecom's bubble burst. That was the end of that, and we were just sitting there thinking "Well, good thing we have faculty positions to fall back on."

About a year later, there was another company in New Jersey called Lightspan that was doing similar work and producing planar waveguides as well. We were very excited because we thought that our material was really going to revolutionize

the field. But then, the head of that company, David Stone, died suddenly from a brain aneurism. There went the company. Again, we were thankful to have our faculty positions to fall back on. Really though, had either of those opportunities worked out, we would have been in trouble because we would have done okay for maybe a year, but we could never have scaled up beyond that. We would not have known how to do it, and we would not have had the capital to do it either.

We probably would not be around if those first couple of things had come in. We needed to start small, so we just kind of began bootstrapping these other things little by little.

**Interviewer**

Which means you were getting money?

**John Ballato**

Yes, we received money early on through small sales, testing the market, and small research grants.

**Interviewer**

Well, if people were really curious about your work, would they give you money?

**John Ballato**

Yes. Actually, the day we went down to the lawyer to set up the company and sign off on all of the paperwork, we had a \$20,000 check from a company interested in our materials.

At first, researchers just wanted to test our material to see if it would work for their specific applications. They would work for their specific applications. They would say that

they just wanted a kilogram of our material to make some prototype device to see if it was what they needed.

So, we used the \$20,000 check that one such company gave us to start up our own company and to purchase some scale-up equipment and other supplies. Then we took advantage of SBIRs, or Small Business Innovation Research grants. Now, there are a series of other grants, contracts, and monies that are coming in.

### **Earl Wagener**

In terms of research, South Carolina needs to do a lot better. These SBIRs are basically the U.S. Council of Competitiveness' way of making sure that innovation keeps going in the United States.

These awards are \$100,000, but the chance of being awarded one is only 8 percent. Almost every time there is a call out, which is twice a year, there are 3600 proposals submitted, but only about 200 are awarded. Eight percent is not too great; however, we have been awarded 13 SBIRs out of the 16 we have applied for because Clemson's technology is excellent.

We have a tremendous business engine inside this university, but it really is not being tapped. We can do a tremendous amount with it, and there is just more and more research that can be done.

We already have a fairly decent reputation inside NSF because of our track record. Researchers from all over the United States apply for these awards. We are competing against California, Michigan, Massachusetts, etc., all of the

big engines for innovation, and we hold our own with them very well.

In addition, we work with many companies and have signed joint development agreements with them in return for funding, for example, our arrangement with General Motors for fuel cells. In return, we have joint patents, which protect our ideas and allow them to have exclusive use of the patents in the automotive area.

Fuel cells will also be used outside of the automotive industry. They are used in houses, fork lift trucks, laptops, and that kind of stuff. We have the right to take the technology that has been jointly developed between our company and GM and sell it in the non-automotive area. We would then have to pay the other companies, like GM, a royalty for the joint patent, but we have the right to go explore that.

So, as a small company, you need a partner. You cannot do it all yourself. You have to go out and sign joint development agreements and that sort of stuff.

### **Interviewer**

When did the business start to push in terms of product? It seems to me that people wanted your product before you were necessarily ready to give it to them.

### **John Ballato**

Sometimes, it is just a combination of both a pull from companies and a push on our end. We got started because there was a pull from companies wanting our product. The push began, essentially, to move into things like the fuel cells and these gas separation membranes.

We had a material platform that we knew worked for this one application. That is why there was an initial attraction and people were pulling it out of us, but we knew that we could do more with the material than what we initially used it for.

So, we began working with the material that we had developed for one application and looking at it for other things, and then we began trying to push that towards GM and other companies.

### **Earl Wagener**

For example, Nafion membranes from Dupont are the standard materials used in the chloralkali and fuel cell industries, and the companies that produce these materials are huge, global manufacturers.

We sent some competing materials up to GM and told them to test them to see if they worked as well or better compared to these other materials. We did a few tests on it ourselves and gave them our data, and they said “Well, if we can reuse that data, we might be interested.”

The material actually worked quite well, but all GM could say was “How in the heck does a tiny company, in South Carolina of all places, outdo Dupont?” And I said, “Good question. Come on down and find out.”

There is research proving that companies that startup at universities last a lot longer than their counterparts who go it alone. Here is the arrangement that creates a win/win: because I am licensing technology from Clemson, I have access to their analytical resources and equipment—for a fee of course.

We brought GM down and showed them that we have the technology and capabilities through Clemson to compete with larger companies. We took them through AMRL and showed them how we were doing the polymer fundamentals and understanding the kinetics of the polymer, how we put the polymer together, what a block copolymer looks like, how we actually sulfonate it, what type of yields we were getting, and so on. They were impressed by our work and decided to bring down the next level of people, and I knew that once we got to the people in Detroit, we were in.

### **John Ballato**

So, how does a company like Tetramer compete with Dupont? Well, we showed them that the Clemson facilities and that we have equipment that is as good, if not better than, what Dupont has, especially in the areas in which we work.

### **Earl Wagener**

The resources these Clemson faculty need to do their work are expensive, but they can get this expensive equipment because they are good. They submit good proposals, so the synergy begins to work. Clemson makes Tetramer look good by providing resources, and Tetramer makes Clemson look good with its talent and success. A lot of that talent comes straight from Clemson; over the years, we have had about 19 people work for us, and about 90 percent of them came from Clemson.

### **John Ballato**

That is the loop coming full circle. When Earl graduated, he could not find a job in South Carolina. Now, a lot of our graduates can actually stay in the state through companies like ours.



**Earl Wagener**

It is by no means easy. We are always looking for more money. Right now, we have SBIR money, but about 40 percent of our other income is starting to come from other places. Some of it comes from General Motors, and Cargill is purchasing a lot of materials directly from us to help them work with some Nobel-Prize-winning technology out of Caltech.

**John Ballato**

For small companies, especially, you can never really be sure where the money will come from. I mean, you have so much money in the bank, and you have payroll. One month, you may be fine, but the next month you may have to start worrying about bringing in more revenue.

**Interviewer**

So what was the most difficult challenge you faced as a company?

**Earl Wagener**

I think one of the hardest things we had to deal with was product liability insurance. The first time I sold some of our material, the buyers asked about this insurance because all big chemical companies have it. I figured I better find out about that.

I called several different insurers that the bigger chemical companies use, and they basically said, "Let me get this straight. You are a three-person company, and you want to sell chemicals right after 9-11. These are chemicals, right?" I tried to explain that they were plastics, but chemicals are chemicals to these people. They asked us questions like "Does your stuff burn?" or "Will it explode?" Of course the

answer to these questions is yes; they will burn and, under the right conditions, they will explode.

Well, they basically said that they could not risk insuring us because we might be a little terrorist group setting up a bomb operation. It took me 18 months to find a small company out in Seattle that would actually sell us insurance, and it was from a guy that I knew from Dow who had broken off and sold insurance. We had to get two million dollars worth of insurance, and it cost us an arm and a leg. It cost us \$8,000, and we had not even sold anything yet. But, we had to get it; whether we were going to sell 10 grams or 100 grams, we had to have product liability insurance.

The second challenge we have faced was finding quality health insurance. It is ridiculously expensive. We went to the Small Business Administration and said, "Okay, SBA, you have a pool of small companies. We want to join that pool so we can get lower rates for insurance." No way. It does not work that way. Even if you are in a big pool, it cost much more for a small company to get health insurance than it does for a bigger company.

So, each one of our employees goes through Blue Cross Blue Shield, and it costs us \$800 a month, but the insurance is really not that great. We would like to be able to get into the state employment system as part of a start-up in an incubator, but that has not happened yet.

### **Interviewer**

You talked about an exit strategy in terms of exiting everyday management. Did you have an exit strategy before you started the business?

**John Ballato**

We did not have a strategy up front per se. I mean, the strategy was simply that we knew we had to find somebody who actually knew how to run a business, and it was not us.

So, the strategy was the realization that we could start up this company. We could be technical directors, but we do the best work when we are in labs at Clemson innovating and working with our students. If we did not have this company, we could help drive technology, but having an exit strategy in that sense was the realization that we are not business people. We had to find someone who was.

**Interviewer**

So, are you still the principals of the business?

**John Ballato**

Yes, that is right. So, the four of us all have equal shares in the company, 25 percent shares. So, yes, we are the principals, and we own 100 percent of the company.

**Interviewer**

That is why I was curious because the next question I want to ask is why did you even start a business? Why not just license out your materials?

**John Ballato**

License to whom? There was not anybody else. The polymer technology was essentially one that Dennis brought with him by and large from Dow Chemical.

You can actually get into the polymer itself with Dow; however, for a company the size of Dow Chemical, this size business is of no interest to them because it is too

low volume and too low revenue. For a startup company, however, it is a great opportunity.

We were innovating on an existent polymer; it just was not sufficiently big enough to attract Dow, but there was this market pull. So, we spun out the company to fill the gap that existed.

### **Earl Wagener**

Part of the issue is when you have a product that you have to develop. It has to have an application because most companies are not going to buy an idea that does not have a patent, and many times an idea takes three years to get a patent for.

So, if you license your idea, it does not have a lot of value even though people like to think it does. A technology transfer group will do what you are talking about; they will just license it, and the average licensing is low, around \$2,000 or \$4,000. There are a few homerun ideas that can succeed going this route, but they are very rare. You really have to develop mores applications before an idea has value.

If you look at product development as a five-stage process with stage five being commercializing, you do not know the value of the product until you are in stage two or three. You may have a great idea that you are able to patent, but you do not know if your product is valuable until these stages because you do not have a customer yet. Your product is not worth anything until your customer tests it and says, "I got the same answer you did."

This is what happened with us when we worked with GM. If they had gotten one bad number, we would have been out

of the loop, even if their technician hooked up the machine wrong or the test was run incorrectly. To them, we are just a tiny little company with another membrane.

**Interviewer**

Did you ever think where you wanted to go in the future? Did you ever think that if you reached a stage with a certain number of products or product sales that you might want to ramp up, build a plant, and produce your products on a larger scale and maybe license out to larger companies?

**Earl Wagener**

Yes.

**Interviewer**

So, where do you see the company: as one that is going to license to larger companies to make these kinds of polymers, or do you see yourself in that business?

**Earl Wagener**

All of the above. Okay, the materials that are PFCE oriented are high in value but small in volume, so we will definitely ramp up and make those. Basically, we can take care of making what we need with a 50-gallon reactor, and since we are selling it for \$10,000 a kilo, we are going to make a lot of money. We are in great shape in that area.

In the renewable area with Cargill, we are more on the intellectual-property side because they want about 10-20 million pounds of our material. We will make the first half million or million pounds, and at that point in time, we will ask Cargill if they want to take the product internationally and start to manufacture it because they have a lot of catalysts they can do that with.

Or, we will ask ourselves if we want to stay locally. South Carolina obviously went out of the textile business a long time ago, but the residual specialty chemical companies that made the dyes and chemicals to treat the fibers are still around. In fact, there is one such company over in Easley called Ortec that we have talked to, and they would love to scale up to the 10- to 20-million-pound range.

We could carry it up through that level because at 20 million pounds, Cargill will still think that the material is in an early stage of development, but we could make a lot of money from that. So, the differential is between being a company like Cargill, which some people have estimated is a 100-billion-dollar company, and Tetramer, which is maybe a one-million-dollar company. To them, a million dollars is lost in the rounding in terms of revenue.

So, we fill that range. So, yes, for one of the products, the specialty plastics, we will go ahead and make it. For the others that start to become high volume, we will begin to manufacture them, and then at some point in time, we will probably have someone else manufacture them and take about 3-4% of what they sell.

We have had to think about this type of strategy for each of our products, but we have to get out of stage two and three to find out what the most viable strategy is: if we want to manufacture in large quantities or if we want to stick with smaller quantities.

### **Interviewer**

How do you deal with competing technological interests? How do you choose between these different avenues and technologies?

## **Earl Wagener**

As John said, the pull from the optical area looked very interesting to begin with. So, that was initially our defining technology, which is called PFCB technology. It is very versatile stuff, and you can make a lot of different products out of it.

But, that area essentially crashed and burned, and we had those incidents that John talked about how the two companies went belly up and could not pay us. Several other companies did the same thing. So we decided that maybe we could go get a little bit more money in order to look at Steve's technology a little more closely. We got an SBIR to do that, all the while hoping that the optical industry would come back, but it really did not.

It is coming back now, but at that time we had to ask ourselves what other things our technology could do. We did not shift over into something like polyimides, or polycarbonates, or something totally different.

That is when we got into fuel cells. We sat down and talked about fuel cells, how they are structured, and what materials are used in them, which got more ideas flowing. We decided that our technology could be used in fuel cells and would maybe even be better than what is out there already.

So, we did some work on that, and wrote a proposal for it. We got an SBIR to start down that road, and that gave us the diversity and the time to say, "Okay. If we can do fuel cells, what else can we do with the material?"

Well then we tried encapsulating nanocrystals because we knew from work that Steve and Dave [Carroll, one of the

founders who subsequently left Clemson and Tetramer] had done that our material disperses nanocrystals very uniformly. That got us looking at things like quantum dots, which is basically a type of light source.

So, we are using the same technology, but we have found many different uses for it.

**Interviewer**

It seems like you have a very versatile technology, but is that unusual? I mean, was the start of your company unusual compared to others?

**Earl Wagener**

Let me put it to you this way. The fact that we had four faculty members and me with the industrial background really helped. I knew where value was, but I was not sure if the material would work or not.

The luck came when we actually ran the experiments, and the material started dispersing things extremely well. So, you make your own luck. I mean, we could not just take the same stuff and just throw it out there. We had to modify it, and the stuff we are doing now is much more modified than what we started with, but again, it is the same polymer technology.

**Interviewer**

Did you originally begin with a business plan; did you write one?

**Earl Wagener**

Yes, we did have a business plan, but ours was much simpler than the business plans Caron [St. John, Director of the



Spiro Institute for Entrepreneurial Leadership] writes and the ones you will have to write. The model I used was a four-box business plan that I took from Dow.

The first box included market attractiveness, both internal and external. If there is enough market attractiveness, you assess your competitive advantage. You have to determine if your competitive advantage is based on patents, costs, performance, etc. This makes you ask yourself “if I sell this around the world, am I going to be okay?”

If you are still going strong after those two boxes, then you come to the box for your strategy. How are you now going to take this competitive advantage and the other information you have and then make something of value for the customer? Which customers are you going to choose and why? You have to have about three or four customers to start off with; you really cannot sell to 50 customers, so you have to examine how to go about that.

Finally, there is the financial impact part of the business plan. What does your pro forma look like? If you have this hockey stick curve, how do you think that you will be selling six times what you are making today in five years? You have to re-evaluate all of these boxes while making the plan.

### **Interviewer**

Did you come from educational cultures that embraced commercialization? How is that relative to Clemson’s culture for commercialization? Does Clemson University inhibit or encourage entrepreneurship?

## **Earl Wagener**

Now, Clemson wants to be much more entrepreneurial than it has ever been in the past, and it is trying to do this by hiring knowledgeable entrepreneurs like Bill [Gartner].

However, the Clemson of five or ten years ago absolutely did not encourage entrepreneurial activity. They threw stuff out here and there and granted a few patents, but the faculty was certainly not rewarded for trying to become capitalists of any type. Doing so was viewed as negative.

I hope that what we are doing with this company, though, will give back to Clemson. My Clemson roots go very deep because when my father died, my mother had to raise three boys all by herself. So, the town of Clemson ended up raising us a bit, too, because she barely made enough money on her own.

The town and the university gave us a tremendous kick forward, and all three of us wound up with PhDs somehow. We are giving back right now through this company, and I hope that what we are doing can become an example for others. Clemson's entrepreneurial activity could be better, but it is a tough road to hoe.

I hope that there are more people who will stand up and encourage others to try this sort of thing and let them know that there is help out there to do it. People like Caron St. John, Dave Bodde, and Bill are working on the system to try and make it better.

The younger faculty, these 26- and 28-year olds, who are coming in now are asking, "What can I do? Can I do something? Can I start a business?" because that is the

paradigm in other universities, which tell their faculty to go ahead and try such ventures.

### **Steve Foulger**

Well, when we all arrived, Dennis, John, and I, we really did not come from this type of culture, per se. It was a personality trait or dysfunction that we all have that made us come together.

We have this kind of commercialist attitude, but I did not initially think it would be of any use at Clemson. I honestly thought that Clemson was a village university where research was a hobby and that there was no aspect for commercialization. When I first got here, I did not think I would stay longer than a year, but I was proven wrong.

I got caught in the telecom crash in 1999 when I came on board, and it was a rough road to do anything with the company. In fact, I pretty much stayed outside of active work with the company early on. I got smacked a number of times from the college for being too active in terms of patenting things. I had a number of patents coming in, and I was still patenting, but I really got nailed at the Dean-level for a lot of the interactions I had with the company, and I was basically told to back off, even though I was within the letter of the law.

So, I stepped back at that time, but the culture has changed quite a bit since then. However, at one point, we had a number of really interesting comments about how running a company as a university professor is sort of a grey area, even though it is perfectly legal.

For the university, it sounds great when they are having news meetings or talking to administrators about what the university is doing for startups, but behind closed doors, they are looking at you and saying, “Why are you making money?” or “Why do you have these commercial interests?” They pretty much said that because we were professors, we should not be doing that kind of work.

### **Interviewer**

When you are trying to develop new things are you motivated by your scientific curiosity or by your entrepreneurial goals?

### **Steven Foulger**

It has changed since then, but it was rough at first.

### **Earl Wagener**

A good friend of mine went to Purdue in 1994, and I like to compare them with Clemson because Purdue is 100 miles from Indianapolis and 100 miles from Chicago. They are pretty much in the middle of nowhere like us, but they have much more support for commercial interests because they were able to align the governor, the president of the university, and the tech transfer office.

They now have 105 companies in their little “village,” which are generating a huge number of jobs, and they realized that allowing such businesses is a good deal because they are the source of roughly 18 % of the grants that the faculty get.

### **Interviewer**

You talked about your competitive advantage and how you compete resource-wise with bigger companies. Do you have

a certain process that sets you apart from your competitors, or is it the material?

**Earl Wagener**

It is the material that sets us apart because its molecular architecture is better suited to do certain jobs than other materials that are currently out there. For example, it is better at generating electricity in a fuel cell than the competitors' materials.

**Steve Foulger**

Well, most of us are extremely aggressive people. Yes, we are technically trained, and all of us did extremely well in school and moved very quickly.

We are not the introvert types of people, and it was just our personality traits that really made us come together. We all had very similar personalities and thus similar goals.

**Interviewer**

In expanding the company are you trying to use the same products and use them in more ways, or are you trying to improve the product? For example, if someone else comes out with something that is better than your product, are you working on being able to make up for that or develop things that are better than your competitors' products?

**Earl Wagener**

Both. Whenever you are selling something, in most cases you will have a three bottle approach. I will use a commercial example of shampoo ingredients, which I dealt with at Stepan. Let us say that L'Oreal currently has a shampoo product (bottle #1), but Procter and Gamble also has a shampoo (bottle #2) that has better performance than

L'Oreal's, putting L'Oreal at a commercial disadvantage. L'Oreal would come to us at Stepan and say "if you will develop a superior performing shampoo (bottle #3) to Procter's (bottle #2), we will agree to buy all of our ingredients from Stepan.

Our job then was to analyze bottles #1 and #2 and come up with bottle #3, which would outperform both. In some cases if bottle #3 just equaled Procter's bottle #2 but was lower cost, we got the business.

In essence, commercializing new technology is making bottle #3 products. And then you basically put technology together and try to improve it. In these situations, communication with the customer is the most important thing because they have to tell you what their pain points are. They always want you to lower your costs, but in the game we play, we have to consider both performance and cost. Because our cost is large compared to other materials, there is no way that we can compete with polycarbonates in terms of just cost. Polycarbonates are maybe \$2.00 per kilo, and our material is \$10,000 per kilo, so we clearly have to have superior performance.

We are also inventing and innovating new materials. We keep investigating what else we can do with the same material. The way we do that is by contacting companies and telling them that we think our product can meet their needs, just like we did with GM. Right now we are going through that process in the area of coating glass fibers.

### **Interviewer**

Do you have a marketing department?

**Earl Wagener**

No, not yet, but we will need one sometime. We cannot afford marketing right now. Until we have the money to pay someone a salary, we will just have to do some of the non-technology-related stuff, like marketing ourselves. In terms of the marketing side, our faculty owners do an excellent job because this is a highly technical content product. When they go out and give fundamental academic seminars, they are essentially selling our technical competitive advantages. Since they know this technology well, they are very successful at selling it. It is really a win/win situation because they get recognition and grants for doing something really unusual, which then makes their product more sellable.

**Interviewer**

What's your miss rate, and how does that impact your future projects?

**Earl Wagener**

Well, in the optical area our miss rate was very high to begin with. We sent a lot of samples out, but people did not call us back, or we had to have people who could manipulate the material in particular ways that we could not do ourselves. So, we had to send it out to them and have them do it, but they did not always do the right thing, so there were a lot of misses there.

Early on our miss rate was probably around 80%, but now, I would say that we have a miss rate of 20-25% percent. We are hitting pretty well right now.