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To Whom it may concern:

Scott Lafferty is one of the most unique and talented individuals I have met. He has probably done more to influence the direction and advancement of the side-scan-sonar imaging industry than any other person. His accomplishments are especially amazing because he had no formal training. He learned everything he knows about sonar, mathematics, computer programming, and hardware from books and real-life experience.

I was introduced to Scott Lafferty in 1985 by a mutual acquaintance who knew we shared an interest in computers and electronic mapping. I had just finished writing *The New Papyrus*, which was the first book about CD-ROM technology, and helping organize the first Microsoft CD-ROM conference. I had also recently written a book about programming, which included a section about using a computer to manage the data produced by high-speed analog-to-digital conversion.

Scott was running a successful charter fishing operation out of Westport, on the west coast of Washington State. He had no formal training in computer technology, but when faced with a need to catalog and display information about his fishing trips he bought an early Radio Shack portable computer, a book about programming in BASIC, and wrote a program to store information about each excursion: weather, tide, locations at which fish were caught, types of fish caught, and so on. He then wrote another program to display this information on a simple map, and help predict where the best fishing would be for the current conditions. People who went out with Scott consistently caught more fish than people who went out with other charter companies.

When we met he was trying to learn about technology available for storing even larger amounts of data in such a way that it could be rapidly and accurately retrieved. He was interested in this because he had run into some people from Williamson and Associates, one of the top survey companies in the world, who were testing and calibrating a SeaMARK side-scan sonar tow fish in the Westport area. He was unfamiliar with side-scan technology, but was curious about it and talked the guys doing the work into explaining the process to him.

The SeaMARK was probably the most advanced and accurate tow fish available at that time. But the standard method of displaying the data it gathered was the same as for all other side scan...black marks on paper. Each pass over an area generated one long strip of paper. If they wanted to get an idea of how the entire survey area looked, they could try to align the strips from the different passes to create a mosaic of the ocean floor. The problem with this approach was that the spacing between the marks was dependent on the speed of the boat and the current, so a north to south pass might end up generating a longer or shorter strip of paper than a south to north pass. At best it was a poor image.

Mike Williamson told Scott that the data from a survey could also be recorded on 9-track high-density tape, which could be sent to a government satellite laboratory on the east coast, and a month or two later they would get back color images of the area surveyed. Scott had just become enamored with computers and he

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immediately asked why they didn't just feed the data into a computer and display it in real time. The old survey hands told the kid that it was because it just couldn't be done. Scott insisted that it could be done, and it became a bit of an issue between them. Scott went away determined to learn more about this.

By the time we met, a few weeks later, he had read everything he could find on the subject. He knew the ping rate for different sonar systems, the amount of data recorded for each ping, and what information was represented by that data. He was trying to visualize the kind of computer setup that would be required to process and display this, the language that would handle the data rate, and the storage medium. And, of course, how he could afford to acquire all this stuff.

I had been writing computer books for Microsoft Press for several years and had developed good relationships with many hardware and software companies. The first time we met we talked for hours, and I was caught up in his enthusiasm. He gave me a list of everything he needed and I started calling friends in the computer industry. Within a week we had computer, a 32" high-resolution display, a WORM (Write Once, Read Many) optical media drive, and all the necessary software. Nowadays this equipment wouldn't be difficult to acquire, but at that time it was state-of-the-art and not readily available to the average person.

Scott's previous programming had been in BASIC, but he decided that he would have to write this program in C. This was my first exposure to Scott's ability to teach himself something. He bought half a dozen books on the C programming language and went into seclusion for two weeks. He is not a particularly fast reader, but he has a near-photographic memory for anything he reads. He absorbed those books, installed C, and wrote a program that would process side-scan data. To him this wasn't all that impressive. But having watched other programmers spend years studying a language and still not be able to write a program this sophisticated, I was impressed.

In order to test the program, Scott talked Mike Williamson into copying a few minutes of data to floppy disks...I think we got three minutes worth and it filled about fifty 5.25 inch floppies. Since reading it from the floppies wouldn't simulate reality, he wrote a program to feed the data from the floppies onto a WORM cartridge, and then another program to read it from the WORM cartridge at exactly the speed it would have come in from the tow fish.

With very minor adjustments to his code, he had the data flowing down the screen in a waterfall display, precisely the way it would have looked as the tow fish passed over the bottom. He added more code to map different levels of return to different colors, so the operator could highlight specific types of bottom material or other objects.

A few days later we arranged to demonstrate the program to Mike and a few other people at Williamson and Associates. Mike was so excited by the demonstration that he called several sonar experts from NOAA and the University of Washington and had us show it to them. His reaction convinced Scott and me that we had a viable product. We formed a small company and named it Info Express. We would use this to pursue the side scan sonar business, as well as my less esoteric writing and publishing interests.

With input from Mike as to what would be useful during a survey Scott continued to refine his program. We borrowed a small EG&G tow fish and took the patch-board prototype system out on my sailboat to test it. The first trip out we "discovered" a WWII airplane that had crashed while trying to land at the local Naval Air Station. I am enclosing an image of that airplane and a description of the RTDDA image system. The significant thing about this event is that it was probably the first time a side-scan sonar signal was displayed in real time on a high resolution color monitor, as the boat was pulling the tow fish through the water. And it was also recorded to optical media so it could easily be replayed and the data manipulated mathematically to enhance the image.

I had been writing books about computer applications and programming for about four years. I was an adequate programmer, and enjoyed writing programs. But I associated with the programmers at Microsoft who wrote the programs that I wrote books about...and I was realistic enough to know that I wasn't in their class and never would be. They were a special breed. As Scott added more complex algorithms to the program I began to understand how he differed from most of these programmers. They thought about how people did things...what made sense to a person...and then wrote programs that essentially did the same thing, only faster.

Scott cut right through that paradigm. He seemed to be able to put his mind inside the computer and understand how it could best deal with a problem. Later, when he was developing a program to create mosaic images of the data from an entire survey, I commented that his maps seemed to display in about one tenth the time that other mapping applications could manage. He explained that most programmers worked in conventional coordinate systems based on latitude and longitude, meters or yards. Calculations in this system took a lot of CPU cycles. To speed this up he simply invented a new coordinate system that was based on what a computer did best, so it used far fewer cycles and was therefore far faster. He thought in a bit-wise manner at the computer register level.

Scott always looked for bottlenecks...things that limited the speed of the overall project. And then he opened them up. When it became apparent that the process of converting the analog signal from the tow fish into a digital signal that the computer could understand, and performing a lot of CPU-intensive math to apply slant-range-correction to the data, was bogging down the application, Scott decided to move all this to a separate printed circuit board in the computer.

Rather than take the conventional approach of hiring an engineering firm to design this board, Scott paid a visit to the local electronics distributors and came back with stacks of books describing every integrated circuit offered by Texas Instruments and Motorola. He spent the next couple of weeks totally immersed in these books, then started designing circuits. Some tasks could be handled with discrete components. Other tasks required programming instructions; these he wrote in Assembly language and burned into EPROMs, so they could easily be updated.

When he was working on the code to do the slant-range-correction and geo-locating, which involved some very heavy math, his father, who was an engineer at Boeing Airplane Company, talked a couple of their top Master Dimension programmers into dropping by one evening to coach Scott in calculus. These engineers took a look at what we wanted to do and dropped into lecture mode, explaining the conventional ways to do it. Scott had already tried that method and found it too slow. So after they finished their presentation and sat back to see if he understood anything they had said, he explained his approach. They listened for a few minutes, and then told him that that just wasn't the way it was done. So he turned on the computer and demonstrated both methods. They had the good grace to look closely at what he was doing and admit that not only did it work, it was several times faster than their method. They later said that if they had taken his bit-wise approach in designing the Master Dimension system, it would have been able to operate six to ten times faster.

A critical point to be aware of in this...the reason it was so hard to do...is the amount of data generated by the sonar system and the speed at which it is received. Every ping generates about a three kilobytes of image data. This has to be processed and then combined with position data from the GPS or other navigation systems, and other outside information. There are multiple pings every second, and if the program doesn't grab the data from each ping, process it and record it before the data from the next ping arrives, that data is lost forever. Additionally, the operator needs to be able to annotate the display with markers and information that may be critical later.

In order to make this work, it was important that higher-priority activities could interrupt lower priority ones without losing anything. The MS-DOS system used to run computers at that time supported a limited number of interrupts...not enough to keep up with the information. To get around this, Scott wrote his own operating system that was fully interruptible. His version of DOS could run all the programs that the Microsoft version could, but was totally interrupt-driven. This allowed the system to do an amazing amount of processing in the background without ever losing the data that streamed in from the sonar.

Once he was sure his design would work we contracted with a fellow who did PC board layout. He created a six-layer board that packed all Scott's circuitry onto one board that could plug into a slot in a standard IBM clone computer. Another bottleneck was broken.

About this time Mike Williamson came up with our first major client, a treasure hunter named Tommy Thompson, of the Columbus-America Discovery Group, who had been researching the sinking of the paddlewheel steam ship Central America in 1857. He was convinced that he knew approximately where it went down, and that it contained a lot of gold. Tommy had raised enough money to lease a ship and mount an expedition. Mike was providing the sonar gear and convinced Tommy that our system would make it much easier to find the boat in very deep water off the east coast of the United States.

We packaged up the system, which we then called RTDDA (Real Time Data Display and Acquisition), and in May of 1987 sent it and Scott to sea for a few months. Scott went along to train the operators and to maintain the system and write new code as he found ways to customize the program for this particular search. One of the images of the Central America the system produced appeared in the January 1990 issue of Popular Mechanics. I will attach a copy of a picture from that article.

The short version of the story is that the expedition was successful, and it is unlikely that it would have been without Scott and the RTDDA system. The Central

America turned out to be one of the richest treasure ships ever recovered. There have been several books and television documentaries about it.

This was the turning point for the system...it had come of age and was capable of supporting itself. Shortly after this Scott and I decided that our interests were just too far apart to be managed in one company, so we split it up with Scott taking the sonar side and me the publishing side. We remain friends and continue to work together from time to time.

Scott went on to customize the RTDDA system for various clients. He worked with several major oil companies to map existing pipelines and chart routes for new ones. He worked with NOAA to map undersea volcanoes in the Pacific Ocean. He did extensive harbor mapping around Australia. Each project required customization to maximize the effectiveness of the system.

Scott then designed and built the Sonar Imaging and Data Acquisition System (SIDA). This version of the system developed for the Royal Australian Navy could almost instantly create geo-corrected mosaics of an entire survey, so the operators could confirm that they hadn't missed any areas. They could map a harbor and later make another pass through it at any angle to the first pass and identify any objects on the bottom that were not there the first time. This system was so superior to what the RAN actually required in the Request For Proposal that it allowed them to jump ahead several years in mapping plans. It was without a doubt the most advanced sonar imaging system available at that time.

Scott and I live in different parts of the world now, and our paths cross only every year or so, but I still think of him often. I respect him and admire what he has accomplished. I understand that his interest has now been attracted to other areas that could benefit from methods of high-speed data acquisition and analysis, and I look forward to hearing about new triumphs.

Sincerely,

Steve Lambert

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