Appendix B
Accomplishments

I retired in 1999 and again in 2001. Joyce retired in 2001 also. In the first retirement I went onto full pension and added a half time teaching appointment. So I was making more money than ever. I had good advice in this arrangement. My colleagues Dr. John Campbell and Dr. Wayne Johnson had previously retired under such circumstances, and I followed in their footsteps.

In the previous appendix I listed a number of incidents or decisions which led to disappointments. In closing I mentioned the role of luck in these events. In this appendix I want to stress the role of luck, in particular, good luck. For instance, I was born into a white, Anglo-Saxon, middle class family, my last four years of elementary school was spent under the direction of an understanding and competent teacher, my high school, college, and graduate schools were all top notch, and my professional career was spent in an environment conducive to freedom, innovation, and reward.

Perhaps the most important accomplishment of my grade school days was my love of reading. As I've previously mentioned, the Millersburg school library was a five foot tall, three foot wide bookshelf with four shelves. By about the fifth grade I had read it all. My marvelous fifth through eight grade teacher, Mrs. Tippetts, recognized my interest in reading and would bring me books from the Freeport public library. By the time I graduated from the eight grade, I had read almost all the Thorton Burgess nature series, the Mary Robert Rinehart mysteries, and the Zane Gray westerns from the public library. This reading ability was a great advantage as I entered high school, college, and graduate school. I still have the rocking chair in which I read these books on the farm in Freeport.

The transition from a one-room country school with about ten students on average to an urban high school of nearly one thousand students was fairly traumatic. But it was facilitated somewhat by Mom accompanying me to meet with counselors and some of my teachers. Because of my background, I took Agriculture early in high school but always secretly admired my fellow students enrolled in Industrial Arts who made cool things like screw drivers and electronic gadgets. By my last two years I had enrolled in Debate and was well received by both my fellow students and Ralph Engstrom, the teacher and debate coach.

In previous chapters I've described the confidence and sense of accomplishment this debate experience generated in what was once a shy country boy. In addition to serving on the first string debate team with my partner, Louis Landau, I was the extemporaneous speaker for our team.

I have already mentioned the Bausch & Lomb Honorary Science Award. This was awarded each year to the graduating senior with the best grades in science. Science students took General Science their Freshman year, Biology their Sophomore year, Physics their Junior year and Chemistry their Senior year. At the time these were the only science courses offered. Since then they offer at least two years worth in some of the sciences. However, I am still proud of this achievement. I suspect adding the award to my resume helped with admission to college and graduate school. The medal still sets on my book shelf.

Another achievement, absolutely minuscule by today's standards, was the award by Manchester College of a $100 scholarship. However, in the 1950s, a whole year of college - board, room, books, and tuition - cost only $1000. So 1/10 of that helped. Another Manchester related achievement was Dr. Morris's recognition early on that I had potential as a physicist by granting me the research assistantship in gamma ray spectroscopy and a position as lab instructor. These two awards were key to my winning the Woodrow Wilson Fellowship and admission to the University of Illinois.

The crowning achievement of my college years was the award of the Woodrow Wilson Fellowship . This award covered all expenses for the first year of graduate school for students planning teaching careers. I applied, and was accepted, to Columbia, Wisconsin, Michigan, and Illinois. I chose the University of Illinois, partly out of patriotism and partly because I was familiar with the campus through my debate activities. Throughout my six years of graduate study, we were proud of the physics department at Illinois as vying with Columbia and Berkeley for top physics program in the country.

Shortly after entering the University of Illinois I became aware of the "monster in the room", the "quals". Each year the physics department admitted over a hundred graduate students with the clear understanding that the qualifying exam would weed out over half of them. The department needs this many students to serve as lab instructors for the introductory physics classes serving the engineering, chemistry, and physics departments. The quals were theoretically taken at the end of the first year of graduate study, but were in fact usually deferred till the second or third year while we studied up on previous qualifying exams. Several of my class mates from famous schools such as Berkeley and MIT took the quals twice, failing each time and leaving the university with their Master's Degree.

Prestigious schools such as Harvard admit only the best students to graduate school, and, once admitted, graduate nearly all of them. But not the state schools. I took the qualifier (meaning you qualify for further study towards the Ph.D.) at the end of my second year and passed with an undistinguished score. Nine of the twenty seven students which took the test passed. My roommate the first year, Dick LaBarge, never took the test and left after two years with a Masters degree.

Two foreign languages were also required for the Ph.D. Since I had taken two years of German and audited French at Manchester, I managed to pass each language competency exam with an undistinguished score. The fact that much of the scientific literature is written in either German and French certainly helped.

The final achievement of our educational goals came in May of 1966. Joyce was awarded the Masters Degree in Education, and I received the Ph.D. degree in Physics, and we walked in the same procession towards graduation. Both her parents and my parents were present for graduation as was her brother, Bill. She had worked in the Biology Library, taught fifth grade at Mansfield, IL, and substituted in the Urbana School system as she worked on her degree. I had worked on my thesis and taught in the General Physics labs the last several years at Illinois. We were very proud of these degrees and thrilled that we graduated the same day.

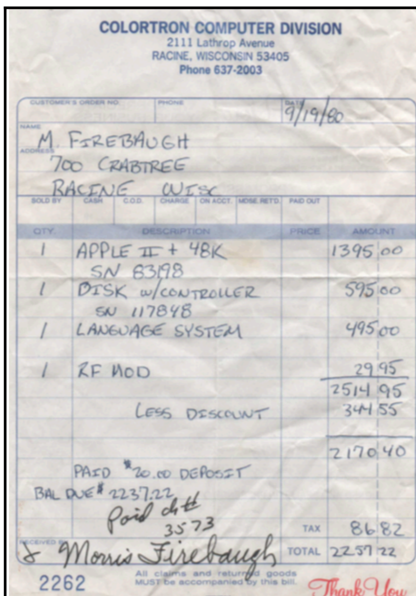
Major non-academic accomplishments took place during the later days of grad school and the first days of my post-doctoral work. These were the birth of our son, Steven, in 1965 and daughter, Susan, in 1967. Their growth and academic achievements have provided their mother and me with some of the proudest moments of our lives. We have also watched with a deep sense of satisfaction as they married, raised their own families, and achieved success in their own professions.

As I look back over my professional career I am struck by parallel development of my career with the emergence of the "information age". My computing career began in the early 1960s by learning FORTRAN on the ILLIAC I. This was one of the first main frame computers, measuring 10' x 2' x 8' and weighing 5 tons. It had more computing power than all of Bell Labs. All input and output was with teletype tape.

My academic computing career ended in the Mac Lab of UW-Parkside in 2001 with thirty "personnel computers", each with vastly more computing power than the ILLIAC I. The Oak Ridge sabbatical was a rather sharp line separating my main frame research from my microcomputer research. Although my Adage project at UW-Madison in 1970 and my teletype/ORNL main frame on geothermal energy in 1980 were both graphics oriented, the teletype and Adage terminal were both simply terminals to mainframe computers.

I was, of course, proud of the sabbatical year I spent working under the direction of Dr. Alvin Weinberg, the leading expert on nuclear power. This work led to a publication of an article in the leading journal on nuclear power, several in-house publications by the Institute of Energy Analysis, and the book I coedited with Dr. Ohanian and in which I wrote a chapter.

Upon returning from Oak Ridge I began a

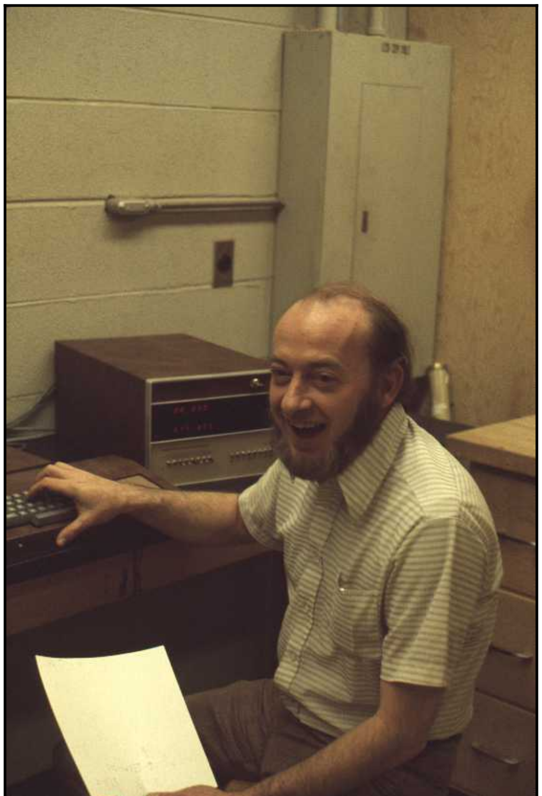

COLORTRON COMPUTER DIVISION
2111 Lathrop Avenue
RACINE, WISCONSIN 53405
Phone 637-2003

Date: 9/19/80
Name: M. FIREBAUGH
Address: 700 CRABTREE, RACINE WISC

QTY.	DESCRIPTION	PRICE	AMOUNT
1	APPLE II + 48K SN 83198		1395 00
1	DISK w/CONTROLLER SN 117848		595 00
1	LANGUAGE SYSTEM		495 00
1	RF MOD		29 95
			2514 95
	LESS DISCOUNT		344 55
			2170 40
	PAID $20.00 DEPOSIT		
	BAL DUE $2237.22 Paid ck# 3573		
		TAX	86 82
		TOTAL	2257 22

Received by: Morris Firebaugh
2262
All claims and returned goods MUST be accompanied by this bill.
Thank You

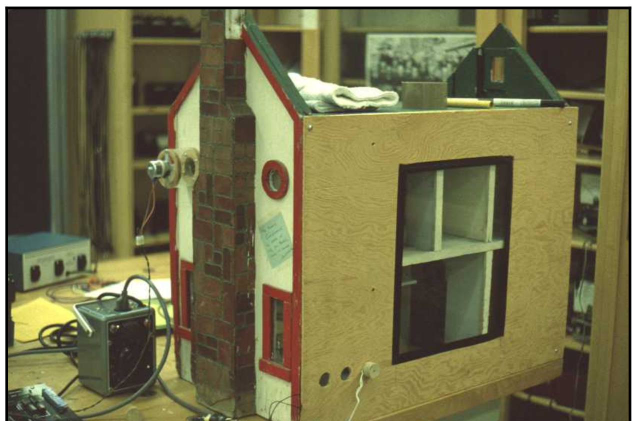
Receipt for First Computer



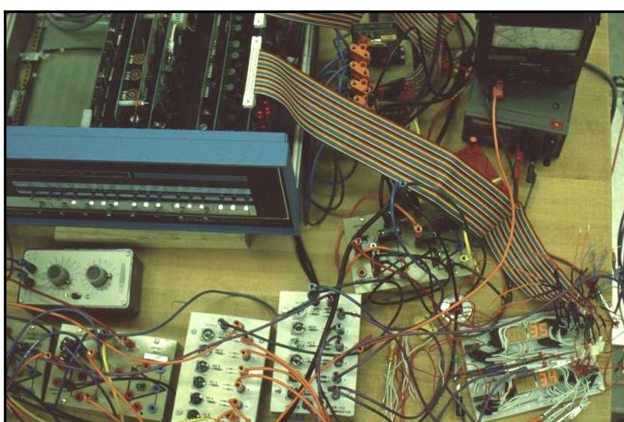
Bill Stone and the 8008 Microcomputer

life-long relationship with Apple personal computers. Show here the sales receipt of my first computer, an Apple II of 48K memory and an additional 16K "Language System" which brought the memory up to 64K and allowed programming in Pascal, a computer language which was becoming the standard for teaching computer science. At the time I was consulting for Unico, and we were researching on the feasibility of linear induction motors. One of the tools for studying the magnetic fields within the motors was finite element analysis, and I was able to run a simple FEA program on my Apple II.

The world's first personal computer became available (in kit form) in 1975. It used the relatively powerful Intel 8080 processor chip and was the basis for Bill Gates and Paul Allen's Altair BASIC and the founding of MicroSoft. Prior to the release of the Altair computer, our excellent electronics technician, Bill Stone, built our first microcomputer based on a magazine article on the relatively weak 8008 processor chip. We ordered and built an Altair 8800 computer as soon as it was available. I used it to design and build a computer controlled heating system for Susie's doll house. We used this experiment for several of my Electronics 423 classes, and I demonstrated it at the 1980 American Association of Physics Teachers convention in Chicago. So we were involved from the very first of the "microcomputer revolution".

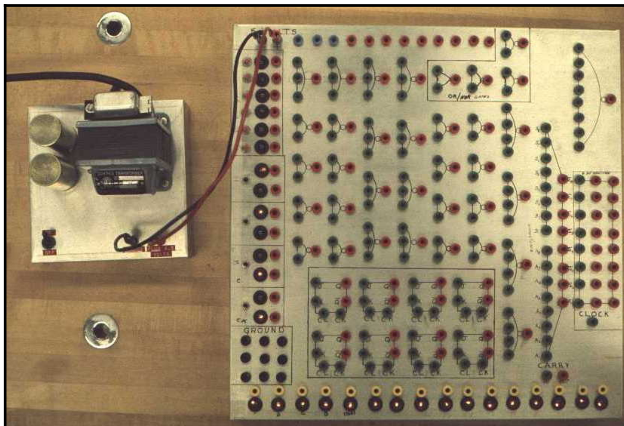


Susie's Computer Controlled Heated House

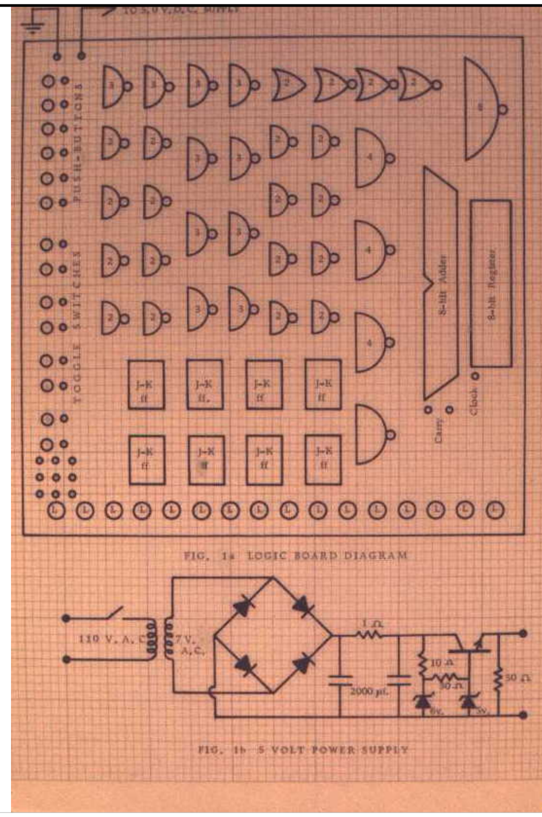


Altair and electronics Controlling House

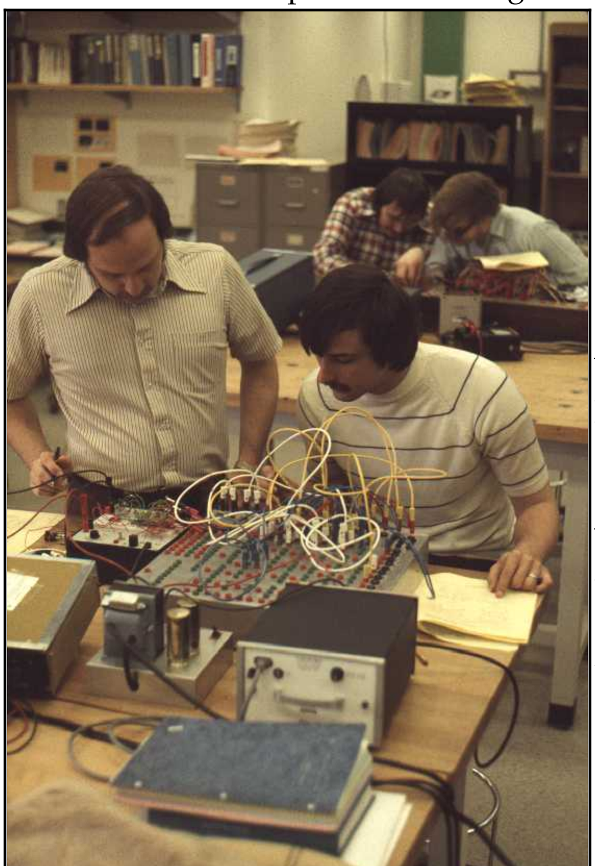
Proud as I was of the computer controlled heating system, the most signifi-



Digital Logic Designer and Power Supply



Logic Gates on Digital Designer

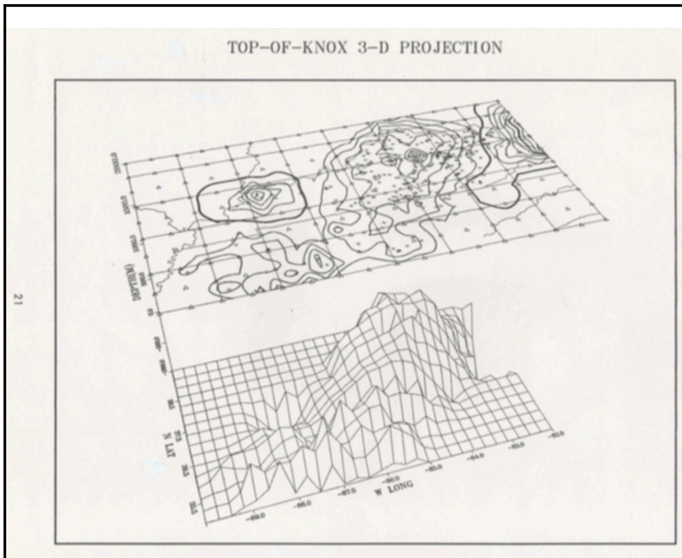


Students with Digital Designer

cant accomplishment for the electronics 223, 423, and 623 laboratories was the manufacture and experimental designs using them of at least six digital logic trainers. The original design of the logic trainers was by Professor Murray Thompson of the UW-Madison Physics Department. Murray allowed our lab at UW-Parkside to copy the design, and I wrote several laboratory exercises based on the designers. They became the primary tools for teaching digital electronics.

Here we show the logic designer and its power supply. The next photo shows the logic functions implemented. Here are some of my students hard at work on the digital logic trainer.

My interest in computer graphics, which began with the Adage experiment in Madison in 1970, continued during my sabbatical in Oak Ridge. The Institute for Energy Analysis was assigned as the lead institution for investigating the feasibility of geothermal energy in the Eastern United States. In addition to temperature and temperature gradient, the depth of the underlying rock formation (top-of-the-Knox) is of interest in calculating the geothermal energy potential. I used a teletype terminal to the Oak Ridge National Lab mainframe to enter the data, compute, and plot it out on their graphics plotter. One of the nine graphics I included in my progress report is shown below.



Depth of the Knox Bedrock Formation

I used the teletype to request a particular graph, and a day or two later the graph would be delivered by US mail. This research which took months could be completed in hours by modern personal computers. But the teletype/mainframe computing facility was one of only a few available at the Institute.

As I have already indicated, the single theme that guided my whole career was the importance of computer graphics in understanding the physical world. Before personal computers became widely available, I requested and obtained a Princeton Electronics Products 801 graphics terminal connected to the Univac 1110 computer in Madison.


PEP 801 Graphics Terminal and Projector

The PEP had a joystick input for steering the cursor around the screen, a projector for showing images in a classroom setting, and ability to generate high resolution copy of the images.

Naturally, my students and I were thrilled with the possibilities opened up by this new graphics tool.

It was not long until we were solving Schrödinger's equation for various potential wells, demonstrating Fourier analysis of waves, simulating charged particles motion in electric and magnetic fields, relativistic transformations, game of life, and applications of conformal mapping.

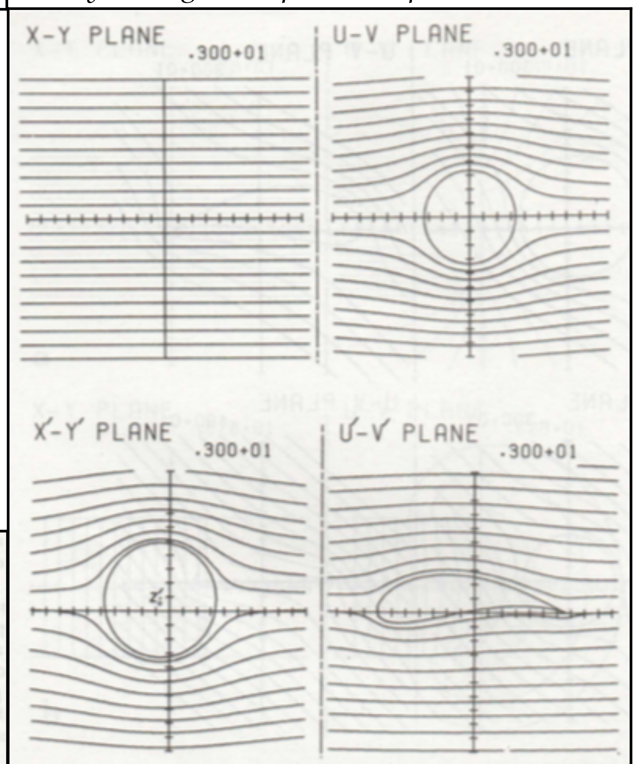

Me with Projected Functions

With the emergence of the personal

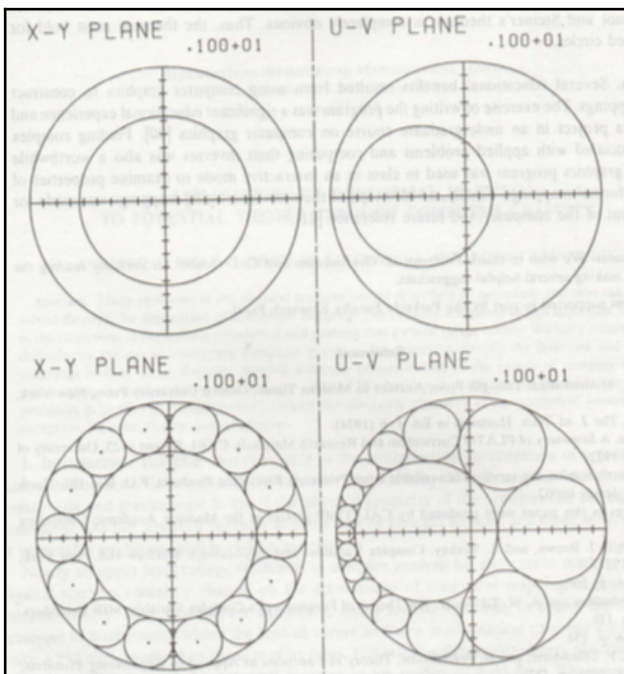
Dr. Don Piele and student Luther Johnson

computer, UW-Parkside presented a series of Computer Fairs each year for many years. Also, the American Association of Physics Teachers had sessions on computer applications. I presented papers at many of these conferences on the research we were doing.

The most significant result of our graphics work was the publication of *Applications of Conformal Mapping to Potential Theory through Computer Graphics* in the November, 1977 issue of the American Mathematical Monthly. This was the collaboration of Professor Don Piele, Robert Manulik, one of our best students, and me. Don understood the theory of conformal mapping on the complex plane. Robert wrote the FORTRAN program for performing 19 conformal mapping functions. I assisted both in the operation of the PEP 801 and the connection to the Madison Univac 1110 mainframe. Here I show two of the most powerful applications discussed in the paper.



Two Transformations to Calculate Airfoil Flow



Proof of Steiner's Theorem

The first figure shows an application from fluid dynamics in which the laminar flow from left to right in the upper lefthand figure maps to the flow around a cylinder using the first conformal map. Then this solution is used as the origin of another conformal transformation to map the solution around the cylinder into the solution of the air flow around an airplane wing airfoil. This example illustrates the power of conformal mapping combined with computer graphics to solve complex problems.

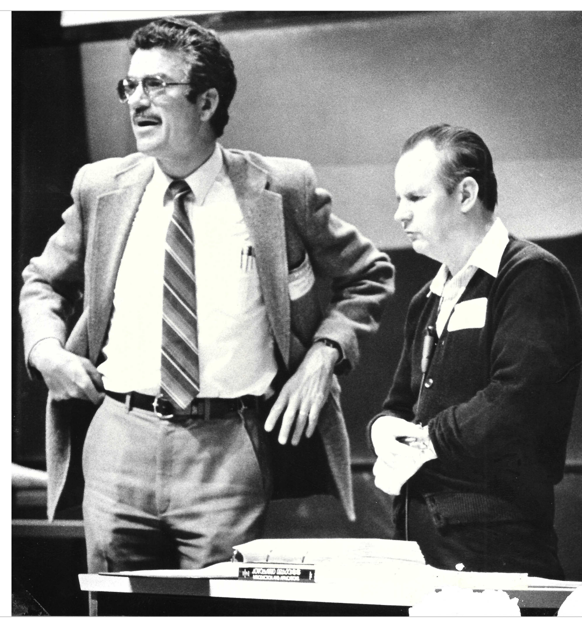
Robert's program mapped not only horizontal and vertical lines, but also circles. This makes the proof of Steiner's Theorem almost intuitively obvious. Consider the annulus between the two non-concentric circles in the upper right figure. The question is, to fit a number of varying diameter circles snuggly into this annulus, does it depend on the starting point of drawing the embedded circles? The answer is NO. This can be seen easily by the conformal map between the right hand side and the left hand side. It is obvious from the left hand side that, if the number of circles that snuggly fit is rotated somewhat, they still fit. So, transforming back to the right hand side, any place one starts drawing the circles, they will always fit. QED


Donald and me at Oxford University


Prof. Ryszard Michalski, U. of Ill.

Another accomplishment was the artificial intelligence (AI) speakers series which I organized about the time when my AI book came out in 1988. The first speaker in this series was Professor Donald Michie whose role in my AI book project I have already discussed.

Another "hero" from my AI book who spoke in this series was Prof. Roger Schank of Northwestern University who spoke on natural language processing. He was one of the leaders in the field.


Me and Dr. Larry Wos, Argonne Nat. Lab.

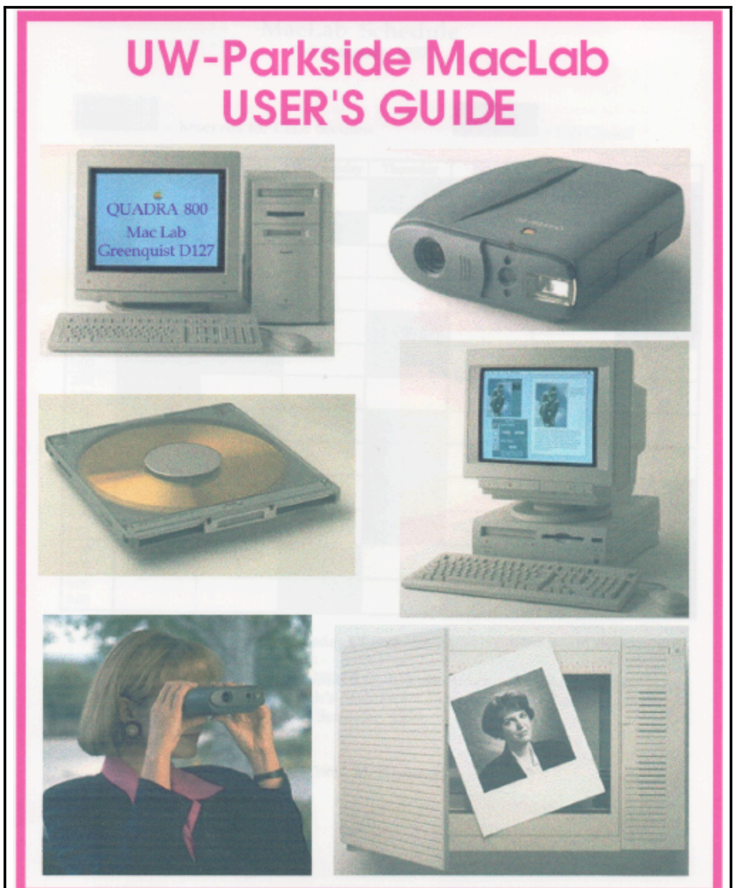
Prof. Ryszard Michalski of the University of Illinois spoke on machine learning, his field of expertise. And my colleague from Argonne and one of my AI "heroes", Dr. Larry Wos, spoke on automated reasoning, an area in which he had written a book.

This series of AI lectures from the leaders in the field presented our students and colleagues with a comprehensive introduction to the field of AI which is currently revolutionizing computer science and its applications. We are already seeing the applications of AI in visual perception, speech recognition, language translation, neural networks, and the deep learning required for self driving vehicles and medical diagnoses.

Two other activities at UW-Parkside which I arranged should be mentioned. First was Prof. Douglas Hofstadter's visit to the campus and social event at our home. He was the author of the Pulitzer Prize winning *Gödel, Escher, Bach* which Steve was using as a text in one of his International Baccalaureat courses in high school at the time. I introduced him at a student/faculty seminar on campus, and we had him to our home for a visit.

The second event of 1983 was the Wisconsin Association of Physics Teachers convention which I organized and ran at UW-Parkside. I solicited and received financial resources to cover the travel expenses, motel costs and three meals for 45 Wisconsin physics teachers at the conference. I invited Dr. Ned Goldwasser, who was then Vice Chancellor for Academic Affairs at the University of Illinois, as the principal speaker at the conference.We also had him in our home for a social hour. It was one of the biggest WAPT events ever, and I got many thank you letters from physics teachers able to attend only through our grant. It was the last time Ned and I got to visit in person.

The most significant accomplishment of my academic career was the establishment of the MacLab. In 1995 I published the UW-Parkside MacLab USER'S GUIDE, a copy writed, 22 page manual for the information and regulations of students using the MacLab and their professors. It was used by the



1995 MacLab USER'S GUIDE

MacLab USER'S GUIDE

Inventory of MacLab Hardware and Software

Hardware

# Items	Description
1	Quadra 800 w/1 GB Hard Drive
6	Centris 650
18	Centris 660AV
1	HP 4M Plus Laser Printer
1	HP InkJet 550C Color InkJet Printer
1	Microtek 600 dpi Color Scanner
1	Apple QuickTake 100 Digital Camera
1	Magnavox CamCorder
1	Zenith VCR
1	Tripod for CamCorder or Digital Camera
4	HeadPhones

Software

# Copies	Title
24	Microsoft WORD
24	Microsoft EXCEL
15	Microsoft PowerPoint
20	Claris Works
5	PageMaker Desktop Publishing Program
2	Adobe Illustrator
1	Adobe PhotoShop LE
15	Fractal Design Painter
15	Think C++ Programming Language
25	Think Pascal Programming Language
1	FORTRAN System
20	HyperStudio
25	Deneba ArtWORKS 2D
12	Swivel 3D Pro
7	RayDream Designer Ray Tracing Program
3	Adobe Premiere Vs 4.0
2	Adobe Premiere Vs 3.0
3	Virtus WalkThrough Pro Virtual Reality Designer
3	Morph 2.0 Morphing and Warping Program
24	Mathematica
24	MatLab + Simulink
24	Image Processing ToolBox
24	Control System ToolBox
24	Neural Network ToolBox
24	Signal Processing ToolBox
5	Autocad Vs. 12 (Student)

4

MacLab Hardware and Software

Physics, Chemistry, Computer Science, Education, and Drama departments

The first three pages of the GUIDE show the Schedule, Policy, and Rules for the lab. Pages four and five list the hardware and software available in the MacLab. Even now I am overwhelmed by the effort involved in cajoling the administration into the purchase of 25 state-of-the-art computers, the laser and inkjet printers, scanner, the first widely available digital camera, and several other audio/visual devices listed below.

In addition to this impressive array of hardware, the MacLab featured 26 software programs, ranging from the Microsoft standards of Word, Excel, and PowerPoint to sophisticated analysis and design programs such as Mathematica, MatLab and Simulink, and Autocad. In addition to these standard, widely used programs, the MacLab provided an enormous wealth of specialized graphics and 3-D design programs. It provided 3 computer languages in widespread use at the time: Pascal, C++, and FORTRAN.

On CD-ROM the MacLab offered several encyclopedias, atlases, and art galleries of high-resolution color photographs for students to use in special projects. The USER'S GUIDE itself was a student's special project. The remaining 17 Pages of the GUIDE were brief descriptions of each program and resource CD-ROM. In addition to the five departments utilizing the MacLab, I invited the RacineKenosha-Mac User's Group (RK-MUG) to hold its regular meetings in the MacLab. They were thrilled with this opportunity, since often everyone in the group could have their

MacLab USER'S GUIDE

Disk-based Educational Programs

# Copies	Title
1	Discovering America
1	Sim Life
1	Sim Earth
1	Fun Physics

CD-ROM Educational Resources

# Copies	Title
1	Grolier MM Encyclopedia
1	Encarta Encyclopedia
1	Art Gallery
1	Street Atlas USA
1	Whatever Became of Carmen Santiago?
1	The Oregon Trail
1	MYST
12	Corel CD-ROMs, each with 100 High-quality Photographs, on

- North American Wildflowers
- American National Parks
- Images of France
- Greece
- Egypt
- California Parks
- Glaciers and Mountains
- Caribbean
- Auto Racine
- Wolves
- Ski Scenes
- Skiing in Switzerland

MacLab Resource Disks

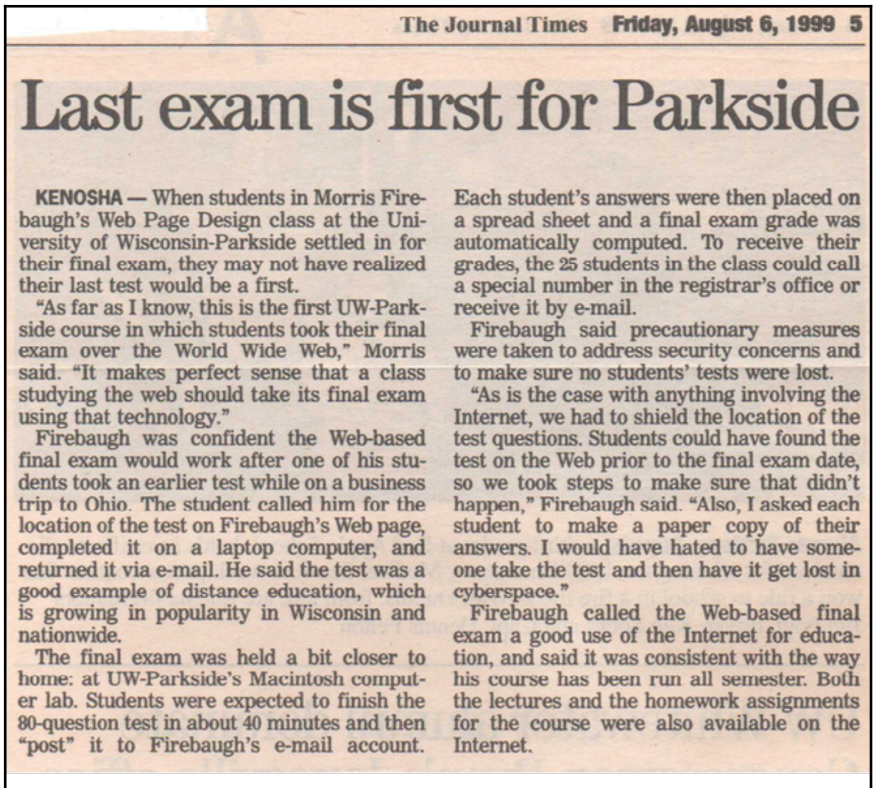
own computer to run the program(s) being presented. As President of the group for several years, I presented at least six lectures for RK-MUG, and they are available on my website under *Seminars*.

As one might expect, considerable effort was involved in obtaining permissions and licenses for 26 programs. Towards the end of the 1990s, the Computing Center of UW-Parkside developed a modern Mac Laboratory with the next generation of Macintosh computers. This made my MacLab obsolete, and I taught the last several years of my career in the Macintosh laboratory of the library.

The final accomplishment of my university career was the conversion of my MS-Word course notes to HTML format and posting them on the Internet. The first day of classes, I would announce to my students the availability and address of my lectures and indicate that, if they ran them off, they would only have to note my anecdotes and asides I added in lectures. I did this for four of my main courses and seven of the mini courses I taught late in my career.

This worked exceedingly well, and saved students having to slavishly copy my lectures. Towards the end of my career, I began to give only multiple choice questions on tests. My professor, Dr. J. D. Jackson, had shown to his class in electrodynamics at the University of Illinois that multiple choice questions are just as effective at measuring students knowledge as mathematical derivations or proofs are. So for my web page design course, I gave the final exam completely on the WWW. Each student took the exam on a computer, their answers were automatically entered onto a spread sheet, and their final score computed automatically. As the article points out, this was the first such automatic, machine graded exam given at our University. These days it is common for high school and university courses.

The final professional achievement I wish to mention is the public service I performed for the National Academy of Science. I've already mentioned my activities with the NAS in the Associate Program Review Panel for the Engineering, Comput-



The Journal Times Friday, August 6, 1999 5

Last exam is first for Parkside

KENOSHA — When students in Morris Firebaugh's Web Page Design class at the University of Wisconsin-Parkside settled in for their final exam, they may not have realized their last test would be a first.

"As far as I know, this is the first UW-Parkside course in which students took their final exam over the World Wide Web," Morris said. "It makes perfect sense that a class studying the web should take its final exam using that technology."

Firebaugh was confident the Web-based final exam would work after one of his students took an earlier test while on a business trip to Ohio. The student called him for the location of the test on Firebaugh's Web page, completed it on a laptop computer, and returned it via e-mail. He said the test was a good example of distance education, which is growing in popularity in Wisconsin and nationwide.

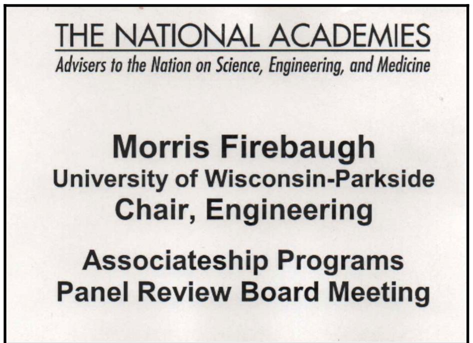
The final exam was held a bit closer to home: at UW-Parkside's Macintosh computer lab. Students were expected to finish the 80-question test in about 40 minutes and then "post" it to Firebaugh's e-mail account. Each student's answers were then placed on a spread sheet and a final exam grade was automatically computed. To receive their grades, the 25 students in the class could call a special number in the registrar's office or receive it by e-mail.

Firebaugh said precautionary measures were taken to address security concerns and to make sure no students' tests were lost.

"As is the case with anything involving the Internet, we had to shield the location of the test questions. Students could have found the test on the Web prior to the final exam date, so we took steps to make sure that didn't happen," Firebaugh said. "Also, I asked each student to make a paper copy of their answers. I would have hated to have someone take the test and then have it get lost in cyberspace."

Firebaugh called the Web-based final exam a good use of the Internet for education, and said it was consistent with the way his course has been run all semester. Both the lectures and the homework assignments for the course were also available on the Internet.

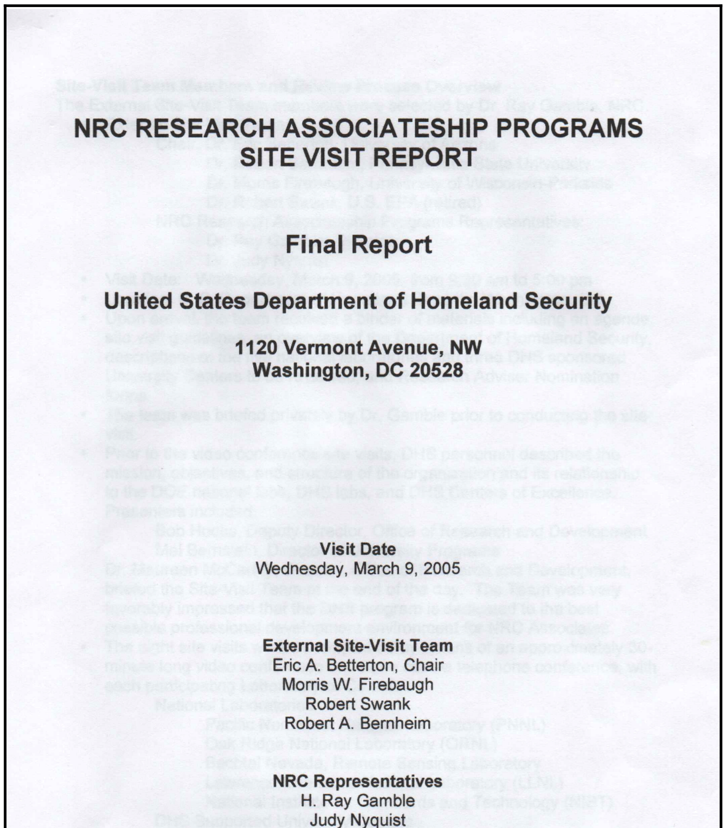
Newspaper Article on my Final on the WWW



Name Tag for my Job

er Science, and Mathematics program. I was Chairman of this panel the last several years with the NAS. This was a volunteer assignment.

However, on two occasions we were hired as paid consultants to review programs to see if they qualified for NAS review as valid hosts for post-doctoral research. The first was Wright Patterson Air Force base and associated university. The second was the Department of Homeland Security which was requesting approval for hosting sites at Pacific Northwest National Laboratory, Oak Ridge National Laboratory, and Lawrence Livermore National Laboratory among several others. Amid very tight security at the Department of Homeland Security, we reviewed the programs at five national laboratories and three university centers by a 30 minute video conference with representatives from each institution. They all had quite impressive credentials, and we approved them all in our report.


NRC RESEARCH ASSOCIATESHIP PROGRAMS
SITE VISIT REPORT

Final Report

United States Department of Homeland Security

1120 Vermont Avenue, NW
Washington, DC 20528

Visit Date
Wednesday, March 9, 2005

External Site-Visit Team
Eric A. Betterton, Chair
Morris W. Firebaugh
Robert Swank
Robert A. Bernheim

NRC Representatives
H. Ray Gamble
Judy Nyquist

Site Visit Report for Homeland Security

Again, I don't wish to bore the reader with the details, but the nine years I spent with the National Academy of Sciences/National Research Council were what I consider a significant public service contribution and an achievement.

Finally, I end this chapter and memoir with two accomplishments of a personal nature. First relates to family. Our children and grandchildren are, by far, our most important contribution to the world. As I have indicated, Steve and Susie are both making the world a better place to live. And their children are preparing to do the same. We are very proud!

The second relates to the mountains. Although I never became a famous mountaineer, our family and I spent as much time in the mountains as we could spare. This allowed me to climb all of the major Tetons, most of the high peaks in the Wind River Island Lake region, about half of Colorado's 14,000 footers, and most of the volcanic peaks in the Pacific Northwest. So when I'm gone, I hope I'll be remembered for my love of the mountains.

View in the Canadian Rockies