4-23-2021

Carl T. Herakovich Professor Virginia Tech 1967-87

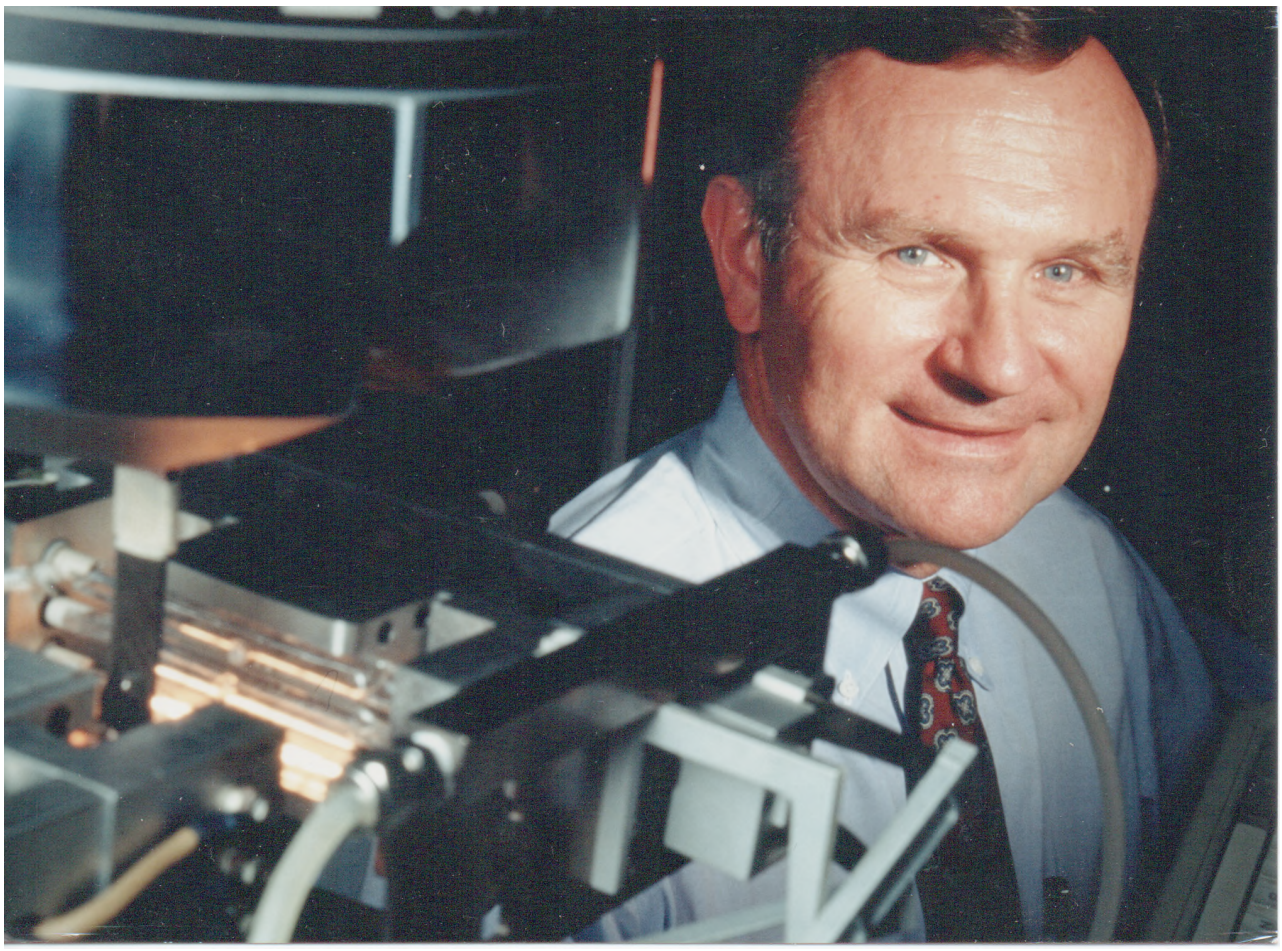
Carl Herakovich
herakct@gmail.com

Carl T. Herakovich

Professor

Virginia Tech

1967-87



CARL T. HERAKOVICH

Professor
Virginia Tech

1967-87

Mechanics, Composites, Computers

This book will be available as an eBook at a location to be determined.
A limited number of printed copies will be available at cost from the author.

Carl T. Herakovich Professor Virginia Tech 1967-87

eBook ISBN: 978-1-7345436-5-0
Print Book ISBN: 978-1-7345436-6-7

Books by the Author*:*

Mechanics of Fibrous Composites (Wiley 1998) ISBN 0-471-10636-4
Mechanics IUTAM USNC/TAM (Springer 2016) ISBN 978-3-319-32311-4
A Concise Introduction to Elastic Solids (Springer 2017) ISBN 978-3-319-45601-0
Rose Poly and Me (Apple 2020) ISBN 978-1-7345436-1-2
Rocky in Whiting (Apple 2020) ISBN 978-1-7345436-2-9
Graduate School Years (Apple 2020)

Printed by Poole Printing Company, Raleigh, NC.

Carl T. Herakovich - photo by Christian Romero (EA Photography)
November 7, 2019

Favorite Quotations:

“Nothing happens unless first a dream”.
Carl Sandburg

“Oh, but a man’s reach should exceed his grasp,
or what’s a heaven for?”
Robert Browning

“Where there is much desire to learn, there of necessity will be much arguing, much writing, many opinions: for opinion in good men is but knowledge in the making.”
John Milton

“Perhaps the most incomprehensible thing
about the world is that it is comprehensible”.
Albert Einstein

“I like the dreams of the future better than the history of the past”.
Thomas Jefferson

Preface

This book is a follow-on to three previous books that are portions of my memoir. The previous books are: *Rose Poly Me, Rocky in Whiting, and Graduate School Years*. The plan is that someday all portions of my memoir will be combined into a single book. However, until such time that all portions are complete, I will publish the individual portions as they are completed. As they say: "A bird in the hand is worth two in the bush".

I indicate that my memoir is a "Work in Progress" because not only do I remember things that I should have included, but also because relatives and friends help me by providing additional information that I want to include. While the print versions can't be modified, I will continue to update the electronic version as appropriate.

As I have said in the previous books, I often wish that I knew more about my grandparents, Peter and Hattie Herakovich, and Daniel and Catherine Buckley. I write this history of my life so that it will be available for my children, grandchildren and their descendants, and the public at-large. For this portion of my memoir, I have dropped the nickname Rocky. I did not want to be known as Professor Rocky or some offshoot of the Rocky moniker. After arriving in Virginia, I went by my first name Carl. Of course, old friends continued to call me Rocky.

As in previous books, I will continue to include many documents in the appendix so that they will be there for eternity.

Portions of my memoir that I hope to write in the future include sections on years at the University of Virginia, activities with the Applied Mechanics Division of ASME, the U. S. National Committee on Theoretical and Applied Mechanics, the International Union on Theoretical and Applied Mechanics, and retirement years.

Acknowledgements

I want to thank my editor-in-chief, my wife Marlene, for all that she has done as my companion, the mother of our four children, and my supporter for more than sixty years of marriage. Daughter Kristine and sons Russ and Doug made major contributions to editing and design.

I put a lot of effort into this memoir. Marlene pointed out what Samuel Johnson (1709-1781) said about writing:

"*What is written without effort …*
….will be read without pleasure".

I hope the reader finds pleasure when reading my books.

Table of Contents

Finding a Job

As I progressed into the third, and final, year of my PhD studies, a high priority item on my to-do list was to find a job to support my family. I wanted to find a job as a professor for two reasons. I enjoyed the work on a college campus, and I had borrowed $9,600 through the Ford Foundation forgivable loan program to support my family during the years of my PhD studies. If I taught at a university for three years, the loan would be forgiven.

I wrote a number of letters to universities that had programs in mechanics. I had two interviews, one at the University of Wisconsin in Madison and the other at Virginia Polytechnic Institute (VPI) in Blacksburg, Virginia. The interview at Wisconsin didn't go very well and I was not offered a position.

The interaction with VPI was unusual to say the least. In the fall of 1966 I wrote to Professor Dan Pletta, Chairman of the Engineering Mechanics Department. He responded that over the Christmas holiday, he and his wife would be on a train coming through Chicago and asked if it would be possible to meet at Chicago's Union Station where he would be changing trains. We did meet, sitting on one of the benches in the waiting area of the train station. The meeting went well and I was invited to Blacksburg for a formal interview.

The interview was in April of 1967. I flew into Roanoke, Virginia and was picked up by a representative from the department. It was rather cloudy and rainy while I was in Blacksburg that first time. The interview went well and I was offered a position as an Assistant Professor in the Engineering Mechanics Department at a salary of $11,000 for the academic year. I accepted the offer; It was the only job offer I had. Rose Poly did not follow through with their leave of absence commitment to me. See *Rose Poly and Me* for a discussion of that situation. Thankfully, all turned out better than could have been expected.

Pletta himself took me back to the airport, through the mountains - in the rain. He said the route was a short cut. I think he used the trip to show me the countryside and to assess my reaction to the visit.

Blacksburg, VA

In 1967, Blacksburg was a very small college town with about 8,000 residents, one stoplight, and maybe 8,500 college students. There was one (Main) street of commercial establishments near the campus and a small shopping center, on the same street, but further away from the campus. It definitely was a small college town - in the mountains of Virginia. I cannot say that my initial reaction was that it would be a great place to raise a family. I could not have been more wrong!

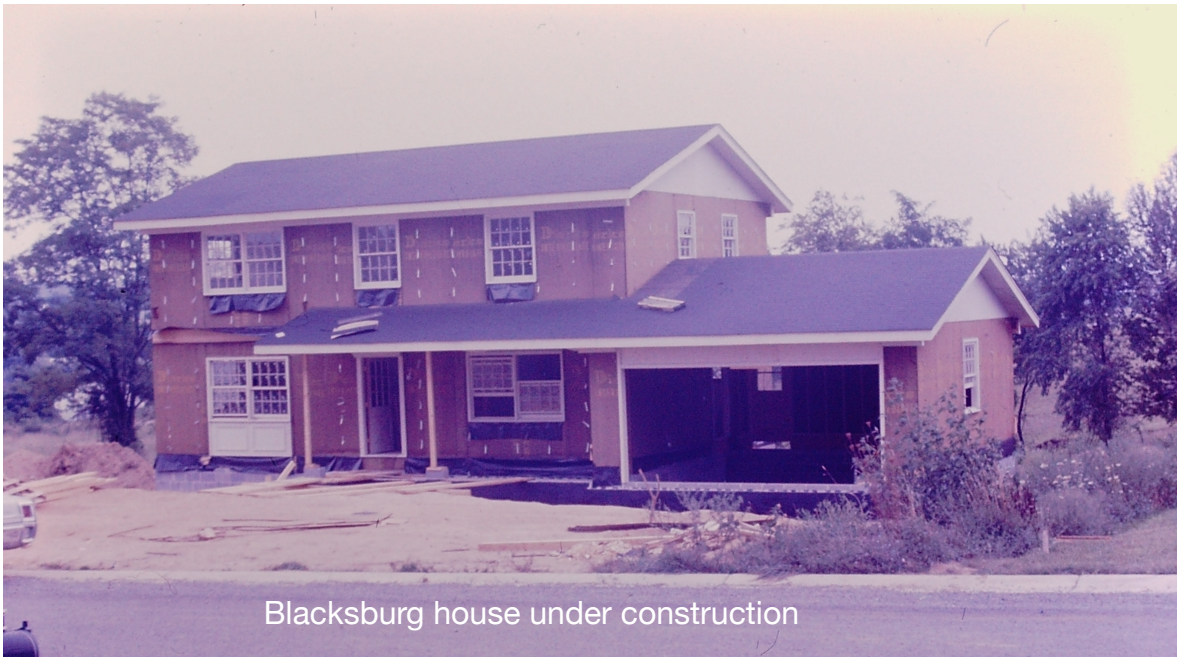
Home: 509 Stonegate Drive

In May, Marlene and I drove from Chicago to Blacksburg to find a place to live. We bought a house under construction by C. W. Poff & Son. The house was in an ideal location, in a small subdivision called Stonegate, only a few blocks from campus; it was about a twenty minute walk to my office. The house was a two story brick home

with four bedrooms, two and one-half baths, an attached garage, and a full basement, on about ⅓ acre. Our property backed up to a church and day care center. The elementary school our children would attend was across the street from the church. We paid $30,285 for the house. In 1976 we added two bedrooms over the garage at a cost of $9,668. We sold the house in July 1988 for $112,000.

Unfortunately, it was questionable as to whether or not the house would be finished before the beginning of the 1967 fall term. We arranged to arrive in Blacksburg as late as possible before classes started in order to give the builder more time to finish the house. As it turned out, the builder could not finish the construction before the term began. Another faculty member actually met my class on the first day of classes, and our family of five lived in a motel room for several nights before we could move in to the house.

When we did move in, the house was not completely finished. We had to walk across a boardwalk to get to the front door, the interior of the house had not been painted, and some of the first floor rooms, like the kitchen, needed more work - in addition to paint. The second floor bedrooms and baths were sufficiently complete that we could sleep



Blacksburg house under construction

in the house rather than spending more days and nights in a motel room.

> *<u>Aside:</u>*
> *Marlene was pregnant with our son Russell John when we moved into our home in Blacksburg. Our next door neighbor, Dean Mook (who also happened to be a faculty member in the Engineering Mechanics Department) later told us how amazed he was when he saw pregnant Marlene carrying bundles and walking across the boardwalk to get into the house. Marlene remembers that Dean came over, introduced himself and helped her carry the bundles into the house. By the way, Dean was his first name, he was not a Dean in the university administration. Dean and his wife Sally became very good friends.*

I had agreed to paint the first floor interior to allow us to get in sooner and, supposedly, to save money. The money part was a huge mistake. The paint cost much more than the reduction in price which was $90.00. Marlene's mother, Sophie, and father, Tom, arrived some time later that fall and her father helped with much of the painting.

We had only one car at the time and I usually drove it to work. Between considerations of time, carrying books, the weather and the fact that I could park right outside my office nearly eliminated my walking to work, although I did on a few occasions.

Brad was in first grade and was able to walk to Gilbert Linkous School by just cutting across the backyard of our lot, through the church lot, and across one street. Doug was going to kindergarten at the Presbyterian Church and got a ride from a neighbor. On occasion, we did arrange for Marlene to have the car to do things like shopping, doctor appointments and the like.

Russell John - Feb. 5, 1968

As I have mentioned, Marlene was pregnant when we arrived in Blacksburg. Her due date was late February, 1968.

Blacksburg did not have a hospital, so our baby would be born in the next town over which was Radford Virginia, a 20-30 minute drive from our home. I was sharing an office at the time with another young professor, Jerry Counts. One day in early January, Jerry asked me when I thought the baby would be born. Thinking about the fact that Marlene had a habit of giving birth early, I told Jerry it would be February 5. Indeed, it was late on the night of the 5th that Russell John was born, without complications.

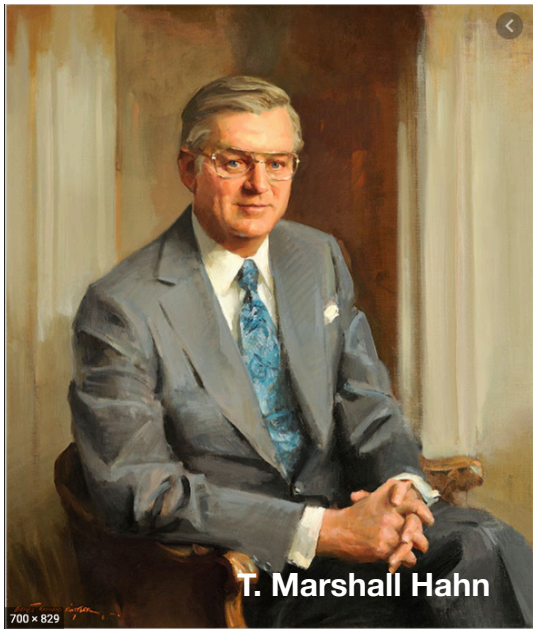
Family photo in 1981 or 82
Doug, Russ, Brad, Marlene, Carl, Kris

Virginia Tech

When we arrived in Blacksburg, the name of the school was Virginia Polytechnic Institute, known as VPI - and not VMI, (Virginia Military Institute), which may have been better known nationally at the time. In 1970, the name was changed to Virginia Polytechnic Institute and State University (VPISU). It is now most commonly referred to as Virginia Tech.

President T. Marshall Hahn

T. Marshall Hahn became president of VPI in 1962 when he was only 35 years old. At that time, there were slightly more than 6,000 students on campus, participation in the Corp of Cadets was required, and there were few women students. In 1964, Hahn had the military requirement dropped, expanded admission opportunities for women, and led a transition from a primarily agriculture and engineering college that emphasized undergraduate instruction over research and graduate programs to a major university with a strong college of arts and science, and major research and graduate programs. As a result of these changes, there was a substantial increase in the number of applications for admission. When we arrived in 1967, there were about 8,500 students. When Hahn left Tech in 1974, there were 17,400 students.

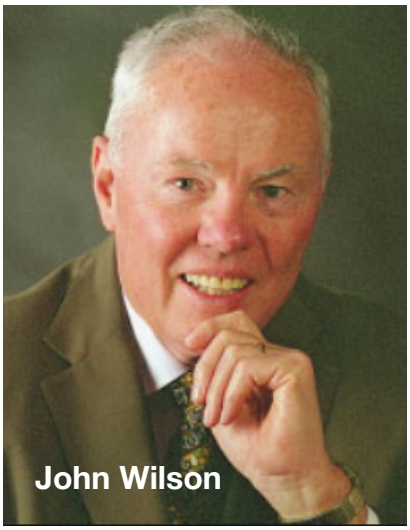


<u>Asides:</u>
After I had been at Tech for just a few years, I got a phone call from Provost Les Malpass one snowy, Sunday afternoon. He asked if I would like to play handball with he and President Marshall Hahn. As I was a handball player, I definitely said yes. There were two handball courts in what was the lower level of Cassell Coliseum, the basketball arena. This turned out to be a nice way to get to know the president of the university. The three of us played handball on several occasions - always on a Sunday afternoon.

During one of the games, I went to the back wall to return a high ball and a doorknob that protruded into the court jammed into my back. I let out a loud scream and went to the floor. I then got up, went out and laid down in the hall, then walked around a bit in the hall before going back to finish the game. That night in bed I realized that I had broken at least one rib. I couldn't move without excruciating pain. Later, I learned that Hahn had the doorknob replaced the very next day so it no longer stuck out into the court.

Another interaction with Hahn that I will always remember occurred when I was the chair of the engineering faculty dinner dance. I had invited Hahn and his wife to join us - which they did do. I was on a stage, above the dance floor, hosting the event. I had a small gift for Hahn and asked him to come up to receive it. As he came forward, he turned to go over to the steps at the side of the stage to come up and say a few words. I made the mistake of not realizing that he would make remarks and told him he didn't have to come up on stage and I just handed the gift down to him as he stood on the floor. It was a major guffaw, but he handled it was grace.

Provost John D. Wilson


John Wilson

John Wilson was provost and executive vice president for academic affairs at Virginia Tech from 1975 to 1982. He left Virginia Tech to become president of Washington and Lee University where he served from 1983 to 1995.

John graduated from Michigan State University with a BA in history; he was a star defensive back on their 1953 national championship football team. He then earned an MA in English literature from Oxford University where he was a Rhodes Scholar; his PhD in English literature from Michigan State followed. He had several university positions at Michigan State, and a seven year term as President of Wells College in Aurora, NY before becoming Provost at Virginia Tech in 1975.

I met John while serving on the Virginia Tech Commission on Undergraduate Studies, which he chaired. John and I became good friends. On occasion, we played golf together at Blacksburg Country Club, sometimes with sons. We served together on the Virginia Tech Athletic Board, and we had sons play on the same athletic team at Blacksburg High School.

John was very intellectual, very well spoken, and witty. When I hosted the IUTAM Symposium on Mechanics of Composites at Virginia Tech in 1982, with attendees from around the world, I asked John to give a talk at our luncheon. He did an outstanding job.

> *<u>Aside:</u>*
> *My favorite recollection of John was when we were sitting next to each other at a dinner of the Virginia Tech Athletic Board. Football Coach Bill Dooley was introducing his (twelve or so) assistant coaches and when he introduced the defensive end coach, John said to me "how would you like to spend your life saying, take two steps forward and turn left". That comment was a reflection of the duties of a defensive end in the 1950s when John and I played football. There is no question that a defensive end has many additional responsibilities today. I've always felt that John's comment was an expression of his belief, in which I concurred, that there was more to life than playing football.*

> *<u>Aside:</u>*
> *I interviewed for the associate provost position (under John) in 1977. The interview went so well that one of John's staff called me later to congratulate me on an excellent interview and to tell me how impressed he was with my views on higher education. However, I also received a friendly note from John telling me that John Perry worked with him at Wells College and that John had asked Perry to apply for the position. Wilson made it clear that he anticipated that Perry would be selected. I appreciated John's frank acknowledgement of the situation.*

In 1986, when John was President of Washington and Lee University, I received a delightful letter from him. Even though we had spent considerable time together on the golf course and elsewhere, I had never told John about my football records, nor did he know that I had been called Rocky in my past. He had just learned about my scoring

records in a Virginia Tech publication and wrote “you have been hiding from me your nefarious past. “Rocky” indeed.” As the letter indicates, he put things in context when he went on to say “your “fame” will be more firmly secured by your current work and by the accomplishments of you lively children”. He closed complimenting Marlene and telling us to stop by on our way to Northern Virginia. Unfortunately, we never did stop by. The letter follows.

WASHINGTON AND LEE UNIVERSITY
LEXINGTON, VIRGINIA
OFFICE OF THE PRESIDENT

January 6, 1986

Professor Carl T. Herakovich
Department of Engineering Science and Mechanics
Virginia Polytechnic Institute and State University
Blacksburg, Virginia 24061

Dear Carl:

It is Sunday evening and I've just picked up the latest Virginia Tech Magazine. There I find that you have been hiding from me your nefarious past. "Rocky" indeed. One hundred sixty eight points in a season! Did you kick field goals and extra points as well?

I really wish I could have seen you carry a ball. Congratulations, Carl, on your election to the Hall of Fame. I dare say your "fame" will be more firmly secured by your current work and by the accomplishments of your lively children, but it is certainly something to fit into a small distinguished company of Hoosier athletes. I am really delighted for you.

Give my best to your beautiful wife. And stop off to say hello one day. I know you must have to go to Northern Virginia occasionally (by car).

Sincerely,

John

John D. Wilson
President

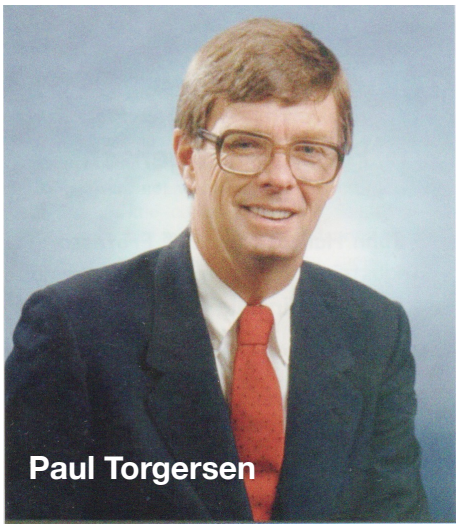
JDW/bcb

College of Engineering

Willis G. Worcester was the Dean of Engineering when I arrived at Tech. I believe that I met him during my interview, but had very little interaction with him before his term as Dean ended in 1970.

Dean Paul E. Torgersen

Paul Torgersen was a professor in Industrial Engineering when I arrived in Blacksburg. In 1970, he was appointed Dean of the College of Engineering. I don't recall that I knew him before he became our Dean.


Paul Torgersen

That same year (1970), Dan Frederick became Head of the Engineering Mechanics Department. Dan asked me to serve as his Assistant Department Head - which I did do for two years. As a result of some of my administrative responsibilities, I naturally had interactions with the Dean's office and that is how I got to know Paul. We had similar views and activities (he was a tennis player) and we became good friends. Our sons, Brad and Jamie, also were friends in high school and continued their friendship when they both went to the University of Virginia. Paul went on to be named President of Virginia Tech in 1993, after I had left Tech.

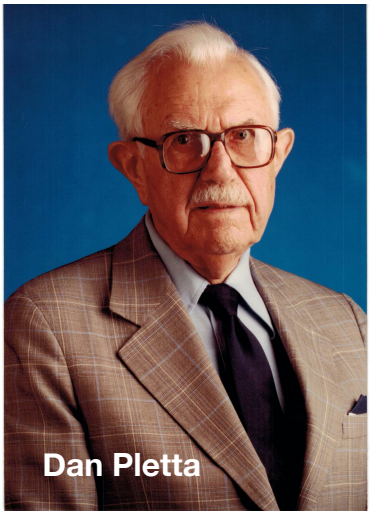
I interacted closely with Paul on two occasions. The first was on a research project he had. It involved game theory (as I understood it) applied to the leadership of a university department with emphasis on hiring and retaining faculty. He asked me and two other faculty members to play the game to determine which of us would have the best department at the end of the game. I won the game.

The second interaction involved what eventually was called the *Virginia Tech Personal Computer Initiative.* I will give a detailed discussion of the *Computer Initiative* in a separate section.

> *Aside:*
> *Years later when I was a professor at the University of Virginia and a candidate to be Dean of Engineering at Virginia, I asked Paul if he felt he could serve as a reference for me. He not only said that he would be happy to do so, but he also asked if I wouldn't like to be a candidate at Virginia Tech, as Tech was also seeking a new Dean. As I recall, he said something like, "why not have two shots at a deanship?". We had only been at UVA for about two years and I didn't think the idea of moving again was something that Marlene and I would be interested in. So I immediately said, "no thanks" I think we will just stay here for now". Later, I learned that Marlene might have liked the idea of moving back to Blacksburg.*

Professor Dan Pletta

Dan Pletta joined the VPI faculty in 1932 as an assistant professor in what was then called the Engineering Mechanics Department. He became head of the department in 1948 and continued in that position for twenty-two years, stepping down as head in 1970. He laid the groundwork for the major growth in faculty, students, graduate education and research that continued for decades after he stepped down.


Dan Pletta

Pletta and his wife Alice (who was a highly respected professor of mathematics) set a tone among the faculty and students that was exceptionally warm and friendly, as well as professional. One example was the annual party they hosted for students and faculty in their home every fall. After the students left, the faculty stayed on for more food, drinks and socializing.

Another example of their leadership was the time they dropped over at our house, unannounced, one Sunday afternoon, after we had been in town only for a week or two. They just stopped by to see how things were going for us in our new environment. One result of the visit was that Mrs. Pletta made sure that we had a cleaning lady to help Marlene who was now pregnant with our fourth child, Russell John.

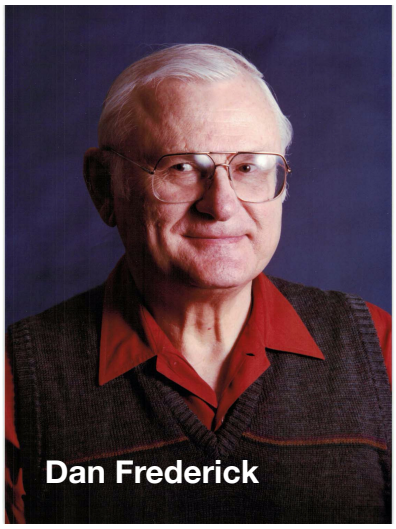
The friendliness that Dan and Alice instilled in the department carried over to the faculty. There were numerous dinners and parties in faculty homes throughout the year. When an outside speaker gave a talk, a cocktail party for graduate students and faculty to socialize with the speaker at a faculty member's home typically followed. The speaker would then be taken out to dinner with a small group. We had several of these speakers stay overnight in our home. There were picnics with families and students; faculty played on softball teams with students. It was a great environment.

Dan was what today would be called "old school". He strongly encouraged his faculty to wear a coat and tie when teaching a class. Since this was something that I always had done, I liked his approach.

The first research grant awarded to a faculty member in the department was during the 1968-69 academic year. It was for $44,284, granted to Tom Davis, a young, fluid mechanics professor. This was considered a major achievement in the department. The research activity and size of the department continued to expand at an unusually high rate for the next twenty years.

Professor Dan Frederick

Dan Frederick was a faculty member in the department from 1948 to 1992. He succeeded Pletta as department head in May 1970 and served in that position for nineteen years. Frederick continued the expansion of the research and graduate programs that Pletta had started. He asked me to serve as his first Assistant Department Head which I did do for two academic years, 1970-71 and 1971-72.


Dan Frederick

Frederick led a group of eight faculty members that, in July 1969, received the first grant in the college related to the new field of composite materials. Other young faculty members expanded the composites activity over the next two decades to the point where it was considered one of the leading university composite research groups in the world. The NASA-Virginia Tech Composite Program, which I conceived and developed, was a major component of this activity. Details of that program will be discussed later.

Assistant Department Head

My duties as assistant department head included tasks such as developing the teaching schedule for the coming term. This was a major task because the department was the service department for all undergraduate courses in mechanics and computer programming in the college of engineering. The mechanics courses included courses on statics, dynamics, solid mechanics, fluid mechanics, mechanics of materials and laboratory courses in fluids and solids. These service classes were taught to sophomores and juniors throughout the college of engineering. A separate course on static's and strength of materials was taught to architect students.

> *Aside:*
> *In the 1960's and 1970's, most engineering students were required to take several mechanics courses as they are fundamental to engineering science. However, as I write this in 2020, the expansion of engineering into new areas of activity has resulted in a substantial reduction of the number of mechanics courses taken by all engineering students. This is consistent with the evolution that naturally occurs with growth and progress. Efficiencies gained as a result of readily available computing capability also has resulted in a lowering of the number of mechanics credit hours considered necessary for many engineering disciplines.*

The fact that we were teaching a large number of students in smaller classrooms - typically, classes had fewer than 35 students - meant that, often, we were offering several sections of the same class during a given semester. In addition, some of the classes met three hours per week for three credits and others met five hours per week for five credits. The department was allocated a number of classrooms for each term and it was my job to assign the instructor and the room for each specific class.

The assignment of classes to individual professors had to be coordinated with the higher level undergraduate and graduate level courses they were teaching, the number

of graduate students they were advising, and the level of reduced teaching assignment because of “buy-out” from research grants. And all of this was to be accomplished with a goal of teaching loads being more or less equal across the department faculty.

One way to reduce the load was to assign a professor two sections of the same course. This would reduce the number of class preparations and possibly the number of tests that had to be created. Essentially all classes were taught by faculty at the rank of assistant professor or above. Graduate students did not teach classes; they did grade homework and, at times, assisted in grading test and exams.

Other duties of the assistant department head included recommending office space for faculty and graduate students, tracking the progress of faculty who might be considered for tenure or promotion, tracking the progress of graduate students, assigning undergraduate student majors to faculty for advising, assigning secretaries to faculty, hiring new secretaries, assisting in identifying new faculty that might be hired, coordinating with the Dean’s office, and overseeing the laboratory technicians. My teaching load was reduced by 50% to provide time for these duties. One major benefit of the position was that I was assigned a large office and had immediate access to a secretary in the adjacent office.

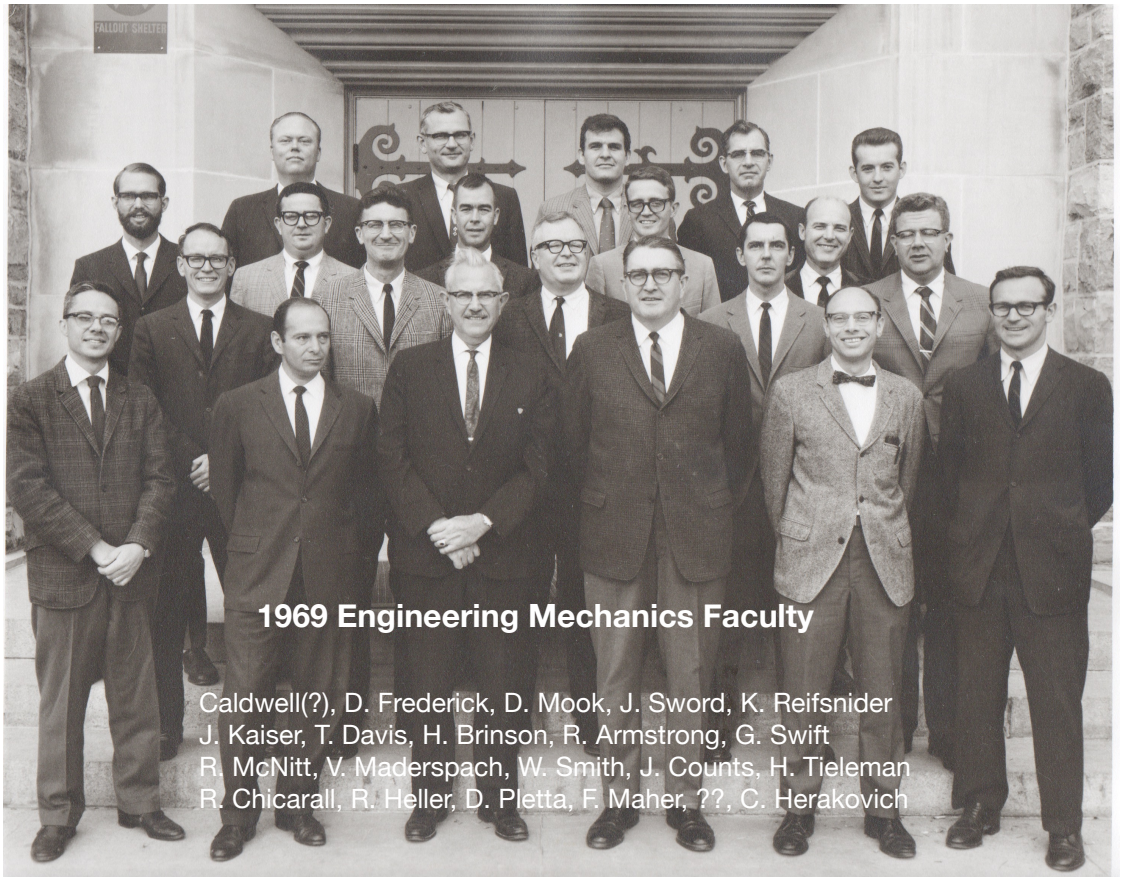
Department Faculty

When I interviewed in the department in 1967, I believe that there were fourteen, male faculty members. When I left Tech twenty years later (1987), there were more than forty faculty members. The 1967 faculty included several faculty members who did not have a PhD. All faculty hired after 1967 held the PhD degree; many were young and hired as assistant professors. It was a friendly, proud, dynamic group with a lot of ambition. During the twenty years I was at Virginia Tech, we hired several female faculty members selected from the relatively few women PhDs that were available. A significant number of the faculty rose to prominence in the field of mechanics.

Records indicate that there were twenty-three faculty members in 1971, twenty-seven in 1977, and in 1983 there were forty. The 1969 picture of the departmental faculty shows twenty-one faculty members.

Departmental Name Change

In 1972, the name of our department was changed from Engineering Mechanics to Engineering Science and Mechanics. This was largely a result of my instigation. I was bothered that my campus mail often went to the Mechanical Engineering Department, and that the general public had no idea of what it meant to study *mechanics*. People often thought that we studied how to fix a car. After I suggested that we change the name of the department, I was appointed chair of an ad hoc committee to consider changing it. After considerable discussion, the faculty voted to change the name of the department to Engineering Science and Mechanics - the first such departmental name in the country. It was referred to as the ESM department. Several other universities in the country followed using the ESM name. As I recall, it was professor Frank Maher who actually suggested the name Engineering Science and Mechanics.



1969 Engineering Mechanics Faculty

Caldwell(?), D. Frederick, D. Mook, J. Sword, K. Reifsnider
J. Kaiser, T. Davis, H. Brinson, R. Armstrong, G. Swift
R. McNitt, V. Maderspach, W. Smith, J. Counts, H. Tieleman
R. Chicarall, R. Heller, D. Pletta, F. Maher, ??, C. Herakovich

Frank Maher

Bill Smith

Two senior faculty members who stood out for me were Frank Maher and Bill Smith. They were the people I would talk to when I had questions about the department, the college, the university or the challenges of being a faculty member.

Tenure and Promotions

Being awarded tenure is a very important recognition for college and university faculty members because it ensures that the person has a lifetime academic appointment that can be terminated only for cause or under extraordinary circumstances, such as financial exigency or program discontinuation. Faculty members must be informed before the end of the sixth year of teaching that they will not be granted tenure, if that is the decision of the administration. If they are not so informed, they automatically become tenured.

I was granted tenure at the beginning of the fall term in September, 1971. I learned that I had tenure in a rather unusual manner. I was in my office of the assistant department head one day during the 1970-71 academic year when Jack Osborne appeared at my open door. Jack served Dean Torgersen as his assistant for administrative and financial matters for the college of engineering. Jack and I had become good friends through our interactions on administrative matters. I was now in my fourth year as a Virginia Tech faculty member. Jack asked me a couple of questions about my previous years of teaching at The University of Kansas, Rose-Polytechnic Institute and Illinois Institute of Technology. He then informed me that I had tenure because my six year probationary period had been exceeded and, not having been informed that I would not be granted tenure, therefore, I was tenured. Jack and I laughed about it all. I had not been worried about tenure because things had been going very well. Nevertheless, it was good to know that I could be confident of having a job to support my family for the future.

I was promoted to associate professor effective September, 1971 and full professor effective September, 1976.

Teaching

As the following table indicates, I taught twenty-six different courses at Virginia Tech. Twenty-two of these were formal courses with lectures and exams; the others were working with students who were doing independent studies or research on undergraduate theses, master's theses or doctoral dissertations.

Early in my career, when I didn't have graduate students or research grants, I had a heavy classroom teaching load. As the number of graduate students and research funding increased, the emphasis became more focused on graduate level courses and advising graduate students.

> *<u>Aside:</u>*
> *My office was in Norris Hall on the Tech campus. On April 16, 2007, the hallway where I taught most of my classes was the site of the deadliest school shooting in the United States. Thirty-two people were killed and seventeen were wounded. (Two of those killed were in a dormitory, Ambler Johnston Hall.) My colleague and friend, Professor Liviu Lebrescu, was killed and colleague Wally Grant was wounded.*
>
> *Marlene and I learned about the tragic shootings while having lunch at an outdoor, dock cafe on St. Croix. We couldn't believe that the shooting occurred in Blacksburg because we always thought it was the friendliest place. We watched a lot of TV in St. Croix over the next few days.*

Courses Taught by Carl Herakovich	
Introduction to Engineering Methods	Mechanics of Composite Materials
Statics	Mechanics of Materials
Dynamics	Computational Methods
Mechanics of Particles	Theory of Limit Analysis
Dynamics of Rigid Bodies	Applied Plasticity
Mechanics of Deformable Bodies	Mathematical Theory of Plasticity
Statics and Strength of Materials	Introduction to Finite Element Theory
Basic Engineering Concepts	Approximate Analysis of Continua
Fluid Mechanics	Mathematical Theory of Elasticity
Fluid Mechanics Laboratory	Stress Analysis of Composite Materials
Materials Engineering	Materials Testing Laboratory
Independent Study	Undergraduate Research
Masters Thesis Advising	PhD Dissertation Advising

Undergraduate Advisees

It was standard practice in the Mechanics Department to assign a faculty advisor to students who chose mechanics as their major. This faculty member would continue to be their advisor for the final three years of their undergraduate studies. I believe that the number of new advisees each time was 8 - 10. I got to know these students very well; at a minimum, they would see me prior to registering for their classes for the following term. Of course, I would also see them if there were any other issues they (or I) wanted to discuss.


Nancy & Pat Artis

The student I remember most was Pat Artis. He developed an expertise in computers, worked in industry for a time, went to graduate school, and then formed his own very successful computer software firm. After selling his firm, he returned to Virginia Tech as a professor in the Aerospace and Ocean Engineering Department. As I write this nearly fifty years after he graduated, Marlene and I maintain a close relationship with Pat and his wife Nancy.

Graduate Students

During my years at Virginia Tech, I was the advisor to a total of thirty-eight graduate students, twenty-seven MS degree candidates and eleven PhD candidates. The year prior to leaving Virginia Tech, I was the advisor, or co-advisor, to fifteen or sixteen graduate students. A complete list of the students who completed graduate degrees with me as their advisor is given in the Appendix. I became friends with many of these students and have been delighted to follow their careers. They have gone into successful positions in industry, universities, government laboratories and as owners of private businesses.

Scholarly Pursuits

There is no question that I always had a desire to be at the top of whatever it was that I was focused on. Early on, my focus was athletics. My success was most evident as an elementary school basketball player winning local city championships, a high school football player winning a state championship, and then as a college football player setting school, state and national scoring records.

At Virginia Tech, it was now time to carry over the athletic drive and success to the academic world. There can be no question that my success in athletics gave me confidence to be successful in the academic world.

As a young engineering professor with a wife and four children, it was vitally important that I develop a quality program of research activity that would result in scholarly publications, funded research, and a team of graduate students. Success in these areas would result in a progression through the professorial ranks, increases in salary, and recognition by the mechanics (and engineering) community. Being recognized as a good teacher at both the undergraduate and graduate levels is certainly important, but it does not carry the weight that scholarly accomplishments do.

There are several truisms regarding the life of engineering professors at major universities:

"Dollars or Death"

"Publish or Perish"

Aside:
There is also the story (some would say it is sacrilegious) concerning the two engineering professors who stood at the foot of the cross looking up at Christ. One said to the other: "he had a good message, he just never published it".

Research funding is necessary to provide many of the resources required for scholarly pursuits. It can provide financial support for graduate students and post-docs, faculty salary during both the academic year and the summer, equipment, travel funds, and secretarial support.

During my first three summers in Blacksburg, I had only one small research grant; it was a $1,400 VPI Research Initiation Grant on Numerical Plasticity. As a result, I taught undergraduate classes in the summer to earn additional money, and wrote proposals and a few papers that were extensions of my PhD dissertation.

Scholarly Contributions

I would list the following as my most significant contributions – many of which were completed working with a graduate student and some that were completed at the University of Virginia. My list is influenced by how well the item has been referenced.

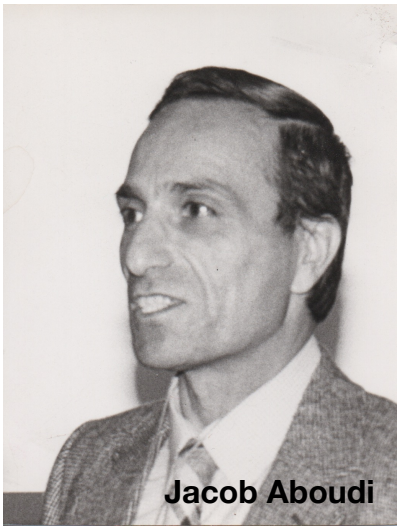
- *Conceived and developed the NASA-Virginia Tech Composites Program*
- *Proposed the College of Engineering Personal Computer Initiative*

- Demonstrated computer acquisition of experimental data using the Intel 4004 chip (with Chip Wilson)
- Formulated the free edge problem of laminated composites as a two-dimensional finite element problem (with Gary Renieri)
- Demonstrated the use of the Iosipescu specimen for shear characterization of composites (with Henry Bergner)
- Demonstrated negative Poisson's ratios for laminated composites (with Matt Buczek)
- Instigated the department name change to *Engineering Science and Mechanics* at Virginia Tech
- Demonstrated the efficacy of the off-axis tension test for shear characterization of unidirectional composites (completed at UVA with Marek Pindera)
- Published book: *Mechanics of Fibrous Composites (completed at UVA)*
- Published Review Paper: *Mechanics of Composites: A historical review (completed at UVA)*

Complete listings of the graduate students that I advised, their thesis and dissertation titles, and the one hundred thirty-four papers on which I was author or co-author are presented in the appendix. These lists show that I was involved in a broad range of theoretical and experimental research topics in mechanics of fibrous composite materials.

Jacob Aboudi

Jacob, a Professor at Tel Aviv University in Tel Aviv, Israel, was well known for his contributions to solid mechanics and mechanics of composite materials. I met Jacob during the 1982 IUTAM Composites Symposium that I co-chaired at Virginia Tech. Later, in July, 1985, at an IUTAM meeting in Haifa, Israel, Jacob asked me if it would be possible for him to spend a sabbatical year with me at Virginia Tech. Of course I said yes and I was able to arrange it on my end.


Jacob Aboudi

Jacob came to Virginia Tech for the 1986-87 academic year and we became very good friends. I found him to be very intelligent, warm, and friendly to everyone; he also was an excellent teacher. He was a great resource for the graduate students; always willing to help them.

Upon his return to Tel Aviv, Aboudi was elected Dean of the Faculty of Engineering and served in that role from 1988-93. Following his Deanship, Jacob visited with me at the University of Virginia where I was now a professor. He was at UVA for two academic years, 1993/94 and 1994/95, where we solidified our friendship more completely. Again, he made outstanding contributions to the mechanics and composites work.

Aside:
Jacob's arrival in Blacksburg turned out to be a big surprise for me. I had asked our department chair Dan Frederick if it would be possible to have Jacob spend a year with us and to provide some financial support for him. The best I recall, Dan said yes and he would contact Jacob. Well, I didn't hear anymore about it. I was extremely busy with the NASA Virginia Tech Composites Program and the many graduate students I was advising at the time. In late August, 1986, prior to the beginning of fall semester, I was walking across the parking lot at a small Blacksburg shopping area and was very surprised to meet Jacob Aboudi. He and Dan had communicated and agreed that Jacob would come, but no one told me about the arrangement. I was happy to see Jacob and learned that he had his wife and daughter with him in Blacksburg.

NASA Langley Research

Quite a few NASA Langley engineers earned graduate degrees at Virginia Tech and I had several of them in class. From them, I learned about a summer faculty fellowship program at NASA and other government laboratories. The program was administered through the American Society for Engineering Education (ASEE). It provided financial support and gave the faculty fellow the opportunity to work alongside engineers at a government laboratory. I applied for a fellowship for the summer of 1970, but was not accepted. I then learned that the faculty member should contact personnel at the laboratory of interest, in advance, to let them know he was applying and requesting their support.

For the summer of 1971, I followed the recommended procedure and was awarded a fellowship at NASA Langley Research Center in Hampton, Virginia. This was followed by a second fellowship at Langley in 1972. These two fellowships were career changing events for me. Most importantly, I was introduced to research in the burgeoning field of fibrous composite materials.

Before arriving at Langley in the summer of 1971, I did not know what a composite material was. However, my extensive background in mechanics gave me the tools necessary to conduct research in this new field that was receiving tremendous interest from the aerospace industry. This interest was spurred by the many desirable properties of these advanced materials, in particular their light weight combined with their high stiffness, high strength, dimensional stability, and excellent fatigue life.

At the end of summer of 1971, I wrote a proposal for a research grant to continue, back on campus, the work I had been doing at Langley. I was awarded a research grant for $14,546. It was my first externally funded research grant.

The ASEE program required the faculty fellow to spend ten weeks in residence at the government laboratory. As a family, we were faced with the question, do I go to Hampton, Virginia alone, and commute home on weekends, or does the family spend the summer with me at NASA. The decision was made for the family to be together in the Tidewater area of Virginia. We would be adjacent to the Chesapeake Bay and a short drive from the Outer Banks of North Carolina. We also would be only a short drive from Williamsburg, Jamestown and Yorktown, with historic Colonial Williamsburg as the main attraction.

Spending the summer at Langley did mean living in a small apartment (the four kids slept on bunk beds, all in one room), being away from friends, and the children not being able to participate in the organized summer programs back in Blacksburg, like Little League baseball. In addition, we had only one car that I took to work each day.

We always rented an apartment in a complex where there was a swimming pool and took advantage of the nearby attractions as much as we could. It was not uncommon to drive over to Colonial Williamsburg in the evening for an outing. It was only a twenty minute drive from our apartment. There were many attractions and admission to most events was free. In addition, parking and the shuttle bus that wound throughout the

historic area were free. We had meals in restaurants more often than when in Blacksburg. We purchased a large tent and made several weekend camping trips to the Outer Banks.

The summers at Langley certainly were not ideal for the family, but there can be no question that my time at NASA paid huge dividends for the development of my professional career and the related, future quality of life for our family. I was now fully committed to doing research in mechanics of composite materials.

During 1972 and 1973, I received two more grants from NASA Langley for research on composite materials. The experiences I gained working at NASA for two summers led me to conceive what turned out to be a major contribution to the growing field of composite materials. It was the *NASA-Virginia Tech Composites Program*.

The NASA-Virginia Tech Composites Program

It is my belief that the most significant contribution I made to research and graduate education in the United States is having conceived, developed, and then directed the NASA-Virginia Tech Composites Program through its formative years. The program lasted for twenty-two years; I was the university Director for the first fourteen years while I was a Virginia Tech faculty member.

My vision for this program was that it would be a cooperative effort in research and graduate education between Virginia Tech and NASA Langley Research Center. As I proposed it, graduate students would take classes on campus, and, in coordination with their faculty advisor and a NASA engineer, decide on a topic for their thesis or dissertation. This research topic would be developed substantially on campus. When the student's classes were completed, he or she would begin a residency at NASA Langley working with the NASA engineer.

While in residence at Langley, the students received all the necessary NASA support to continue their research. This might be time on the NASA computers or test specimens and facilities for experimental work. When experimental work was involved, the specimens were selected early in the process to insure that they would be available when the student arrived at Langley. Students would normally return to campus to complete the writing of the thesis or dissertation under the watchful eye of their faculty advisor.

Master's candidates were expected to complete at least six months in residence at Langley and PhD candidates were expected to complete twelve months in residence. The proposal called for the faculty advisor to make trips to Langley for consultation and coordination with the students and NASA engineers during the time the students were in residence at Langley.

> *Aside:*
> *Several years into the program, visits to Langley were made by flying on a small, Virginia Tech plane directly from the Blacksburg airport to Langley Air Force Base. This provided significantly more contact time on a one day visit. Flying from Blacksburg at 7:00 am, we could be on the ground at Langley before 9:00 am. Leaving Langley after 4:00 pm, we could be back in Blacksburg for a late dinner.*

The initial proposal for the composite program called for NASA funding to begin on January 1, 1974. I served as the on-campus Director and NASA Engineer, Dr. John Davis, served as the NASA co-Director. The program started small with support for one graduate student in 1974, but grew rapidly as its success was recognized. Four students entered the program in 1975 and five entered in 1976.

During the first two years of the program, I was a one man operation on campus. I managed the program, recruited graduate students, advised five program graduate students (as well as several other graduate students), and worked with three NASA engineers as co-advisors. I was the advisor for the first seven, ten of the first fifteen, and a total of twenty graduates of the program. I served as the faculty advisor for nearly fifty percent of the students who were in the program during my time at Virginia

Tech. Six of my graduate students were hired by NASA Langley; one of them, David Bowles, eventually became Director of NASA Langley Research Center.

As director of the program for the fourteen years, January 1, 1974, to August 31, 1987, I was the principal investigator on NASA grants that provided $2,198,227 in funding. The funds expended directly at Langley to support the students had to be at least equal to this amount. Thus, I estimate that the total value of the program during my time as director was over $4 million.

After I left Tech in 1987, the program continued for nine more years. I recommended that Professor Mike Hyer take over my responsibilities as Director; he was so named. A grand total of 91 MS and PhD students participated in the program. Fifteen different Virginia Tech faculty members advised the students on campus and twenty-five NASA engineers worked with the students when they were in residence at Langley. The total NASA grant funding to Virginia Tech for the years 1974 to 1996 was $4.2 million.

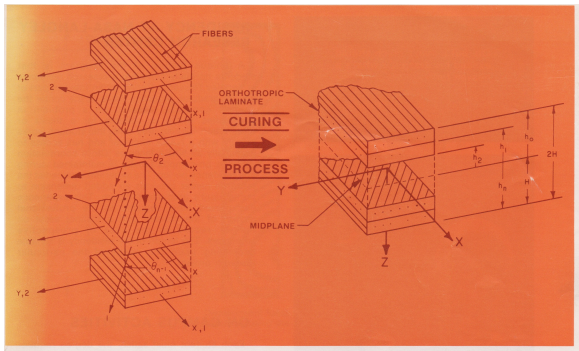
The benefits of the program extended well beyond the education and research in composite materials that were received by all involved. In addition to NASA hiring a number of the program graduates, other graduates took positions in industries, universities and other government laboratories to spread the advancement of composite materials, for both applications and education. This was a time when composites were in their infancy, and the country was in need of engineers with knowledge of the many advantages of composite materials for structural applications, in a wide variety of fields, not just aerospace. For the organizations that hired graduates of the NASA-Virginia Tech Composites Program, it was an added benefit that these people personally knew engineers at NASA. They could pick up the phone and talk to them about an issue without hesitation.

Student Recruitment

A major requirement for the program to be successful was a steady supply of highly qualified graduate students. I developed a system to promote the program and make it easy for prospective students to indicate their interest. A poster announcing the program, with detachable postcards for requesting information, was distributed each year to all mechanics and materials related engineering departments in the United States. This included departments of mechanics, mechanical, aerospace, civil, and materials engineering. The response was outstanding. I recall that one year we received as many as 700 postcards. This was due in large part to the fact that composites were experiencing tremendous interest in the aerospace field and the good reputations of Virginia Tech and NASA. The students who requested information were sent an application form and a brochure describing the program. Copies of a program poster and a program brochure are provided in the following.

A detailed listing of the eighty-seven graduate students who earned degrees through the program is provided in the Appendix.

Composites Program Brochure



THE NASA-VIRGINIA TECH COMPOSITES PROGRAM

Do not give them any more straw to make bricks with, as your custom has been; let them go and find straw for themselves.

Exodus 5

National Aeronautics and Space Administration
Langley Research Center
Hampton, Virginia 23665

Virginia Polytechnic Institute and State University
Blacksburg, Virginia 24061

NASA VIRGINIA TECH

Oh, but a man's reach should exceed his grasp, Or what's a heaven for?

Robert Browning

THE COMPOSITES PROGRAM

Virginia Tech and the National Aeronautics and Space Administration's Langley Research Center jointly instituted a cooperative effort in graduate education and research in the relatively new field of composite materials in January, 1974. The purpose of the program is twofold: to prepare qualified students for careers in research, development, design, and teaching; to conduct research on current problems. The program combines the teaching and research expertise of the university community with that of the research community to provide the student with a graduate program which encompasses the practical aspects of engineering research as well as the academic pursuits. Research activities have been concerned with both the fundamental behavior and the structural application of advanced composite materials.

RESIDENCY AT NASA-LANGLEY RESEARCH CENTER

A unique feature of the program is that students normally complete a research residency at Langley Research Center as an integral part of his/her graduate program. While at the center the student conducts research on a problem in composites which is suitable for a thesis or dissertation. During this time the student works closely with a NASA engineer and has access to essentially all NASA facilities. Close coordination with the on-campus faculty is maintained during this residency period. The experience gained at the research center provides an added dimension to the student's graduate program. This experience has proved most valuable to the professional growth of the student and a distinct asset on his/her record in the eyes of prospective employers. The length of the residency is variable depending upon the needs of the particular research project.

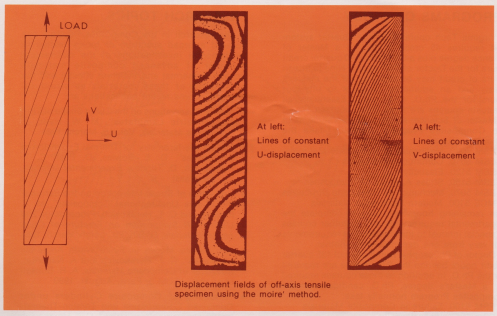
ON CAMPUS ACTIVITIES

Each student must satisfy the degree requirements of his/her major department. Master's degree candidates typically spend a minimum of twelve months on the campus and Ph.D. candidates typically spend a minimum of eighteen months on the campus. While on campus the student fulfills all course requirements and initiates research on the project which will serve as the thesis topic.

NASA-LANGLEY RESEARCH CENTER

The National Aeronautics and Space Administration's Langley Research Center is located on the Chesapeake Bay in Hampton, Virginia. It is approximately 30 minutes by car from Colonial Williamsburg, Yorktown, and Jamestown. The basic mission of Langley Research Center is to engage in objective research that will provide the technical background necessary for the design of aircraft and space vehicles which can accomplish NASA objectives.

The Composites Program is currently supported by the Materials Division and the Structures and Dynamics Division at Langley. The research in composite materials within these divisions is primarily concerned with material behavior, test methods, and application of composite materials to aircraft and space vehicles. Langley research facilities include the most modern equipment for experimental studies as well as a modern computing center



Displacement fields of off-axis tensile specimen using the moire' method.

VIRGINIA TECH

Virginia Tech is a land-grant, coeducational university with a total enrollment of over 20,000 students. The campus is located in the Town of Blacksburg on a plateau between the Blue Ridge and Allegheny Mountains and is about 40 miles west of Roanoke, Virginia.

The Composites Program is administered through the Department of Engineering Science and Mechanics and participants include both students and faculty from that department and the Aerospace and Ocean Engineering Department. The Department of Engineering Science and Mechanics offers a broad selection of courses in solid mechanics, fluid mechanics, dynamics, materials, and applied mathematics. It has excellent facilities for experimental research and the faculty is noted for its outstanding teaching and research. Research related to composite materials has been a particularly strong point since the early 1970's.

The Aerospace and Ocean Engineering Department at Virginia Tech offers a unique innovative, program centering on studies of vehicles and structures to operate in the atmosphere, space, and the water bodies of the world. Excellent wind tunnels and a towing tank are available for experimental work. The department conducts a wide-ranging research program and has a long-term commitment to work with composites because of the clear and exciting applications of these materials in the fields of interest to the department.

FINANCIAL ASSISTANCE

A limited number of graduate research assistantships are available to highly qualified students who desire to pursue Master of Science or Doctor of Philosophy degrees with their thesis or dissertation topics in the field of composite materials. Current stipends for on-campus students range from $620-$1,000 per month, dependent on academic record and performance. During the period of Langley residency the student receives a stipend which ranges from $1,300-$1,400 per month. Financial support is available throughout the calendar year. Virginia Tech is an equal opportunity employer and will consider applicants without regard to race, color, religion, sex or national origin.

Where there is much desire to learn, there of necessity will be much arguing, much writing, many opinions; for opinion in good men is but knowledge in the making.

John Milton (1644)

PROGRAMS OF STUDY

Virginia Tech operates on the Quarter system and requires 45 credit hours for a Master of Science degree plus an additional 90 quarter credit hours for the Doctor of Philosophy. Nine to fifteen hours of credit may be obtained for the master's thesis and an additional thirty-six to fifty-four hours for the Ph.D. dissertation. Essentially all graduate courses are three-credit courses.

Master of Science: Master's degree students in the Composites Program, normally, take the following courses:

ESM 4040, Mechanics of Composite Materials
ESM 5010, Continuum Mechanics
ESM 5120, Elasticity
ESM 5150, Stress Analysis of Composites
ESM 5070, Mechanics of Composite Structures
MCE 5100, Modern Composite Materials

The remaining hours are used to complete the departmental requirements and for other courses of special interest to the student. The requirements will vary from one department to another.

Doctor of Philosophy: A minimum of 135 quarter credit hours beyond the B.S. degree are required for the Ph.D. In addition to those courses required for a Master's degree, Ph.D. candidates in the Composites Program normally take:

ESM 6100, Failure in Composite Materials
ESm 6060, Viscoelasticity
ESM 6050, Fracture Mechanics

Elective Courses: Many courses in the College of Engineering which provide additional breadth and depth in solid mechanics and materials are available for the students to elect depending upon their particular interests. Some of these are:

Finite Elements & Methods
Thermoelasticity
Plasticity
Micromechanics
Mechanics of Fatigue
Plates & Shells
Experimental Solid Mechanics
Nondestructive Testing & Research
Structural Vibrations
Numerical Methods
Structural Mechanics
Stability (Elastic & Dynamic)
Variational & Energy Method
Wave Propagation in Solids
Scanning Electron Microscopy
Structural Optimization
Applied Mathematics
Aeroelasticity

NASA VIRGINIA TECH

RESEARCH TOPICS

The research in the Composites Program has covered a broad spectrum of topics related to fundamental investigations of the mechanical behavior of advanced composite materials (including thermal and moisture effects) and the application of these materials as structural elements. Some recent publications are:

- "Some Observations on the Cured Shape of Thin Unsymmetric Laminates", M. W. Hyer, *J. Composite Materials*, Vol. 15, March, 1981
- "Moiré Interferometry for Thermal Expansion of Composites", D. E. Bowles, D. Post, C. T. Herakovich, D. Tenney, *Experimental Mechanics*, (in press)
- "Influence of Stress Interaction on the Behavior of Off-axis Unidirectional Composites", M. J. Pindera and C. T. Herakovich, *Proceedings 2nd USA-USSR Symposium on Fracture of Composite Materials*, G. Sih, Ed., Leigh, March, 1981
- "On Failure Modes in Finite Width Angle-ply Laminates", C. T. Herakovich and A. Nagarkar, *Advances in Composite Materials*, A. R. Bunsell et al., ed., ICCM 3, Paris, August, 1980
- "Buckling of Composite Cylinders under Combined Compression and Torsion-Theoretical/Experimental Correlation", C. T. Herakovich and E. R. Johnson, *Test Methods and Design Allowables for Fibrous Composites, ASTM STP 734*, C. C. Chamis, Ed., Am. Soc. Testing & Materials, 1981
- "An Experimental and Analytical Investigation of the Rail Shear Test Method as Applied to Composite Materials", R. Garcia, T. A. Weisshaar and R. R. McWhithey, *Experimental Mechanics*, Vol. 20, No. 8, August, 1980.
- "The Compressive Failure of Graphite/Epoxy Plates with Circular Holes", J. F. Knauss, & E. G. Henneke II, *Composites Technology Review*, Vol. 3, No. 2, Summer, 1981

ADMINISTRATION

Program Co-Directors:

Dr. John G. Davis, Jr.
National Aeronautics and Space Administration
Mail Stop 188A
Langley Research Center
Hampton, VA. 23665

Prof. Carl T. Herakovich
Department of Engineering Science and Mechanics
Virginia Tech
Blacksburg, VA 24061

For further information, please write:

The-NASA Virginia Tech Composites Program
Professor Carl T. Herakovich, Co-Director
Department of Engineering Science and Mechanics
Virginia Tech
Blacksburg, Va. 24061
(Phone: 703-961-5372)

Composites Program Poster

_____
(date)

I am interested in the NASA-VPI&SU Program in Composite Materials Research and Education.

I (will) hold a _____ degree.
(B.S., M.S., etc.)

in _____
(mechanical engineering, etc.)

from _____
(institution)

as of _____
(date of degree)

Home phone _____

Office phone _____

_____
(name) (Please Print)

_____
(address)

_____
(city)

_____
(state) (zip)

Composites Program

Virginia Polytechnic Institute and State University and the National Aeronautics and Space Administration-Langley Research Center have instituted a Cooperative Program for Research and Education in Composite Materials. The purpose of the program is to prepare qualified students for careers in research, design, development, and teaching in order to meet the challenging problems in the relatively new field of composite materials. This program combines the academic and research resources of VPI&SU with the professional research and applications resources of NASA-Langley to provide the student with a graduate program which encompasses both academic and practical training.

Students divide their time between the campus and the research center. Candidates for master's degrees typically spend 15 months on the campus taking courses and becoming familiar with research problems in composite materials and 6 months at the research center conducting research. Ph.D. candidates typically spent 18 months on the campus and 15 months at the research center. While at Langley the students work closely with NASA engineers and have access to NASA facilities. Close coordination with on-campus faculty is maintained during this time. The experience gained at the Research Center gives the students an added dimension to their education and significantly enhances their professional capability.

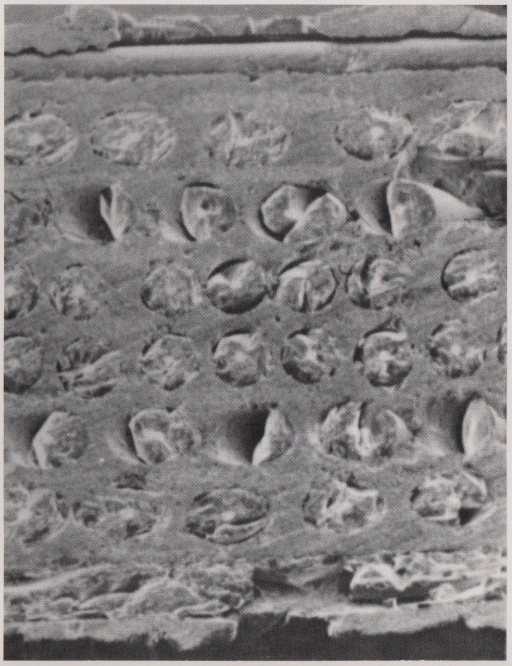
Assistantships

A limited number of assistantships are available to qualified students who desire to pursue a Master of Science or Doctor of Philosophy degree specializing in the field of composite materials. Current stipends for on-campus students range from $445-$490 per month depending upon the academic level of the applicant. During the period that the student is at NASA-Langley, the stipend is double the current on-campus stipend ($890-$980 per month). Support is available throughout the entire calendar year. VPI&SU is an equal opportunity employer and will consider applicants without regard to race, color, religion, sex or national origin.

NASA Virginia Tech
Composites Program

COMPOSITE MATERIALS

Research and Education
Graduate Research Assistantships: M.S. and Ph.D.



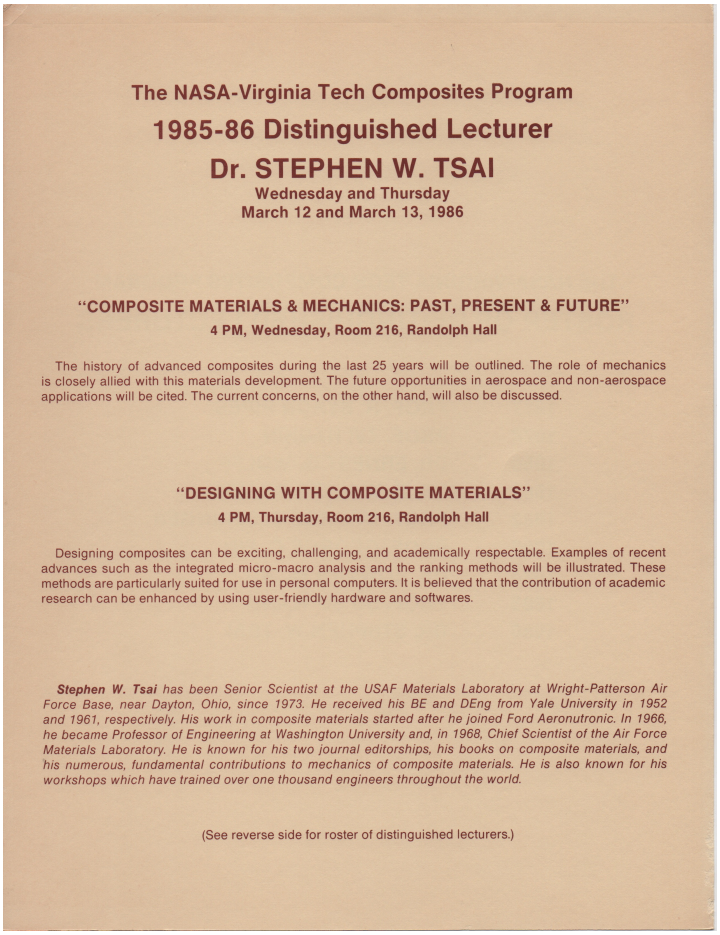
Section of [90/± 45/0] boron-aluminum laminate.

Distinguished Lecture Series

During my time as Director of the program (1974-87), we had ten truly outstanding distinguished lecturers visit the campus; these were people who had made groundbreaking contributions to the development of the field. As the roster of lecturers shows, the list includes a Who's Who of the pioneers in mechanics of composites.

Each speaker spent two days on campus, giving one lecture each day, and having additional meetings throughout the two days with faculty and students. Faculty and students had an opportunity to have lunch with the lecturers, and Marlene and I hosted a reception in our home, with faculty and graduate students joining in the celebration. These receptions were a great opportunity for the graduate students to meet the speakers in a relaxed setting. Many of the speakers stayed overnight in our home so our children had the opportunity to meet them as well.

The announcement of Steve Tsai's lectures and the full list of lecturers during my time leading the program are presented below.



The NASA-Virginia Tech Composites Program

1985-86 Distinguished Lecturer

Dr. STEPHEN W. TSAI

Wednesday and Thursday
March 12 and March 13, 1986

"COMPOSITE MATERIALS & MECHANICS: PAST, PRESENT & FUTURE"

4 PM, Wednesday, Room 216, Randolph Hall

The history of advanced composites during the last 25 years will be outlined. The role of mechanics is closely allied with this materials development. The future opportunities in aerospace and non-aerospace applications will be cited. The current concerns, on the other hand, will also be discussed.

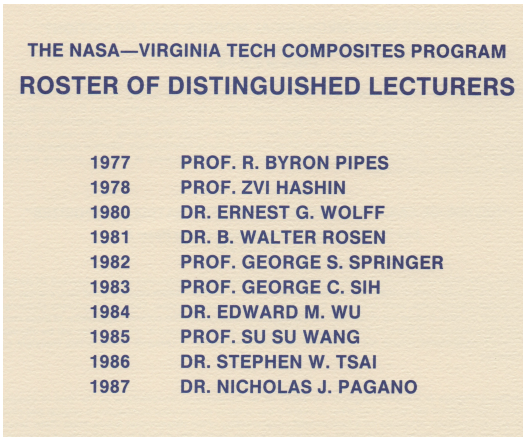
"DESIGNING WITH COMPOSITE MATERIALS"

4 PM, Thursday, Room 216, Randolph Hall

Designing composites can be exciting, challenging, and academically respectable. Examples of recent advances such as the integrated micro-macro analysis and the ranking methods will be illustrated. These methods are particularly suited for use in personal computers. It is believed that the contribution of academic research can be enhanced by using user-friendly hardware and softwares.

Stephen W. Tsai *has been Senior Scientist at the USAF Materials Laboratory at Wright-Patterson Air Force Base, near Dayton, Ohio, since 1973. He received his BE and DEng from Yale University in 1952 and 1961, respectively. His work in composite materials started after he joined Ford Aeronutronic. In 1966, he became Professor of Engineering at Washington University and, in 1968, Chief Scientist of the Air Force Materials Laboratory. He is known for his two journal editorships, his books on composite materials, and his numerous, fundamental contributions to mechanics of composite materials. He is also known for his workshops which have trained over one thousand engineers throughout the world.*

(See reverse side for roster of distinguished lecturers.)

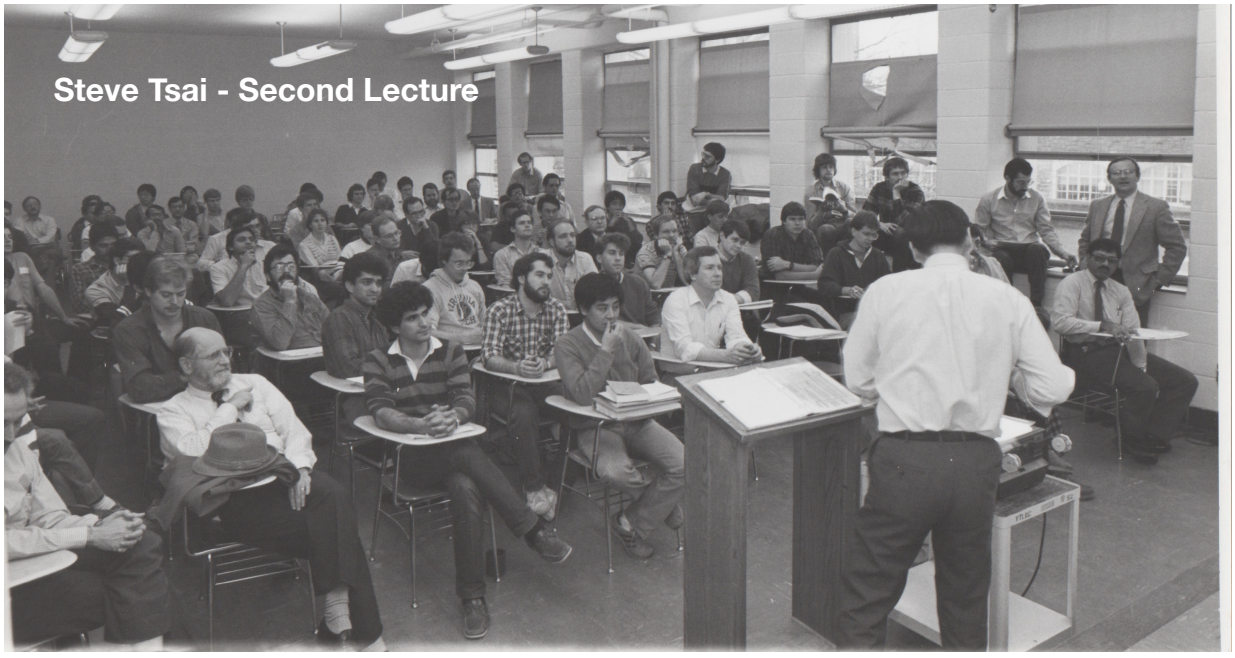


THE NASA—VIRGINIA TECH COMPOSITES PROGRAM

ROSTER OF DISTINGUISHED LECTURERS

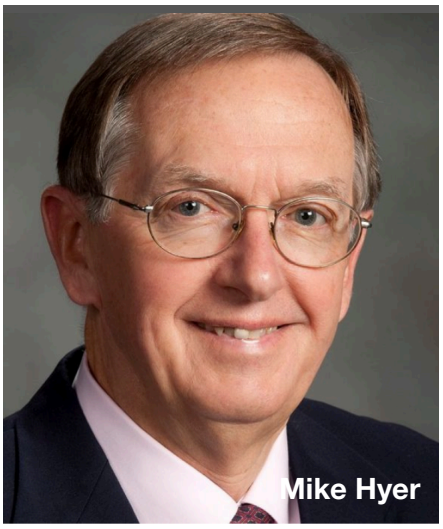
1977	PROF. R. BYRON PIPES
1978	PROF. ZVI HASHIN
1980	DR. ERNEST G. WOLFF
1981	DR. B. WALTER ROSEN
1982	PROF. GEORGE S. SPRINGER
1983	PROF. GEORGE C. SIH
1984	DR. EDWARD M. WU
1985	PROF. SU SU WANG
1986	DR. STEPHEN W. TSAI
1987	DR. NICHOLAS J. PAGANO

As the following photos show, the room for both of Steve Tsai's lectures was jam packed with students and faculty. Attendees were sitting on the window sills along the side of the room and standing in the back.



As many as sixty people attended each lecture.

Mike Hyer


Mike Hyer

Mike Hyer joined the ESM faculty in 1978. I met Mike when both of us were at NASA Langley for the summer of 1975. I quickly realized what a quality individual he was; both as a person and educator in mechanics and composites. When a faculty position became available in ESM, I recommended Mike for the position and he was selected from a number of candidates.

He and I worked together, very closely, for the remaining nine years that I was at Tech, with the exception of the year I was on sabbatical (1980-81) and the year Mike was at Maryland (1986-87). Mike did an outstanding job assisting me with administration of the program and advising graduate students. When I left Tech in 1987, I recommended Mike to be my successor as Director of the composites program; he was selected. Mike and I continued to be very good friends and collaborators, while working at different universities.

Virginia Tech Faculty in Program

During the life of the program, fifteen Virginia Tech faculty members participated in the Program, eleven from the Engineering Science and Mechanics Department[1] and four from the Aerospace and Ocean Engineering Department[2].

Virginia Tech Faculty in NASA-Virginia Tech Composites Program				
O. H. Griffin[1]	C. T. Herakovich[1]	E. R. Johnson[2]	D. H. Morris[1]	D. Post[1]
Z. Gurdal[2]	E. G. Henneke[1]	M. P. Kamat[1]	J. Morton[1]	W. W. Stinchcomb[1]
R. T. Haftka[2]	M. W. Hyer[1]	A. Loos[1]	M. J. Pindera[1]	T. A. Weisshaar[2]

NASA Engineers in Program

Twenty-four NASA engineers and scientists advised graduate students in the composites program.

NASA Engineers in NASA-Virginia Tech Composites Program					
D. J. Baker	P. A. Cooper	M. B. Dow	C. E. Harris	W. S. Slemp	G. F. Sykes
D. E. Bowles	J. G. Davis	W. T. Freeman, Jr.	M. P. Nemeth	J. H. Starnes	D. R. Tenney
R. L. Boitnott	J. W. Deaton	E. R. Long	C. C. Poe, Jr.	M. Stein	S. S. Tompkins
H. D. Carden	H. B. Dexter	H. G. Maahs	J. W. Sawyer	T. L. St. Clair	J. G. Williams

Program Scholarly Publications

The composites program resulted in more than 200 publications in technical journals and conference proceedings, and numerous oral presentations at technical meetings. These works are in addition to the theses and dissertations of the graduate students. As indicated in the various listings in the Appendix, the research covered an extremely broad range of topics.

NASA's Assessment

NASA's 2019 report *NASA's Role in Development of Advanced Composite Materials for Aircraft and Space Structures*, Final Report (Darrel R. Tenney, et al., 2019) highlighted the NASA-Virginia Tech Composites Program as follows:

> *"...because of the tremendous importance of this program to the success of Langley's composite research. Because of the recruitment activities and the strong communication with Langley personnel, the program was an undisputed success. Several other graduate student research programs on campus have been modeled after the NASA-Virginia Tech Composites Program."*

The report went on further to say:

> *The combination of a top-notch national lab and a solid college of engineering resulted in the ability to advance the state-of-the-art in understanding composite materials. The topics investigated had applications to aeronautics and space, and all topics were the subject of either an M. S. thesis or a PhD. dissertation. A sampling of the type of research being conducted under this program is illustrated by the abstract of the final report for year 1980: Composite Materials Research and Education Program: the NASA-Virginia Tech Composites Program. Final Report Herakovich, C. T.: N80-16101; NASA-CR-162719, 18 pp, Feb. 1980. Abstract: "Major areas of study include: edge effects in finite width laminated composites subjected to mechanical, thermal and hygroscopic loading with temperature dependent material properties and the influence of edge effects on the initiation of failure; shear and compression testing of composite materials at room and elevated temperatures; optical techniques for precise measurement of coefficients of thermal expansion of composites; models for the nonlinear behavior of composites including material nonlinearity and damage accumulation and verification of the models under biaxial loading; compressive failure of graphite/epoxy plates with circular holes and the buckling of composite cylinders under combined compression and torsion; nonlinear mechanical properties of borsic/Al, graphite/polyimide and boron/Al; the strength characteristics of spliced sandwich panels; curved graphite/epoxy panels subjected to internal pressure."*

In the report, NASA's Charles Blankenship, Head of the Structures Directorate at Langley, was quoted as saying:

> *"one of the most significant contributions to the country coming out of Langley's composites research was the training of an expert workforce that enabled industry to capitalize on performance benefits of composites"*

I have to admit to being extremely proud to know that something that I conceived, developed, and led through its formative years is viewed as having made a significant

contribution to the country. The fact that my model was copied for graduate student research programs on other campuses is icing on the cake.

Personal Computer Initiative

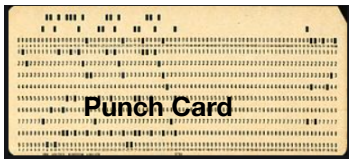
Pre Personal Computers

When I arrived at Virginia Tech in 1967, the computing facilities were, like at most universities, quite limited. It was the same system I used at the Illinois Institute of Technology (IIT) with punched computer cards that were submitted to the computing center, to be run on the mainframe computer, with the results being available hours, or maybe days, later.

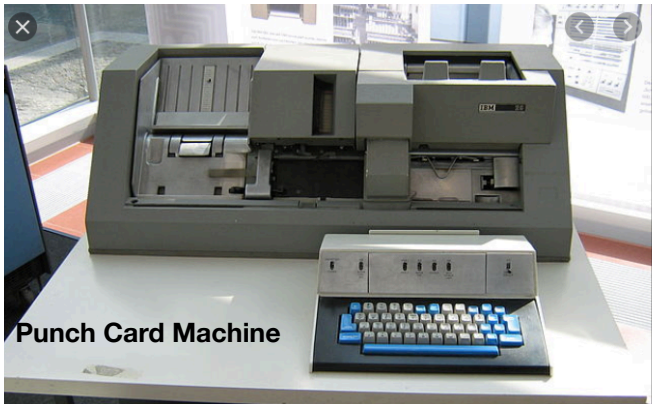
As an example, the computer program for my dissertation consisted of approximately 4,000 cards, each card containing one statement of the program. I stored the cards in two computer card boxes. It was very cumbersome to carry these two boxes to and from the computing center that was in a building some distance from my office at IIT.

I was completing the writing of my dissertation when I arrived at Virginia Tech and it was necessary to get my PhD program running on the Tech mainframe computer. Fortunately, the computing center was in Burruss Hall, adjacent to my office in Norris Hall.

During the 1970 spring term at Virginia Tech, I taught an undergraduate class EM 302, Computational Methods. There were 29 students in the class. It was essentially a class in Fortran programming. Howard Sword, a senior faculty member in the department had developed the course. Students would type their instructions at the keyboard of a punch card machine, wrap the batch of cards in paper, and place them in post office type pigeon holes that were in a hallway on the first floor. The submitted cards were picked up, maybe twice a day, and taken to the computer center where they were submitted and run on the main frame computer. The results would then be returned to the pigeon holes, usually the next day. Obviously, this was a laborious, inefficient, time-consuming process. If a mistake was made when punching a card, it had to be re-punched. If there was a mistake on any card (like a , rather than a .), the run on the computer was wasted and the process might take another day to be completed.


Punch Card


Box of Cards


Punch Card Machine

Professor Sword had set up a grading system that was a function of the number of times the student submitted the work before it was correct. This was partially due to the fact that computer time was very limited; it was allocated to the department in a block. Sword had the responsibility to distribute the time to those using it. He didn't want the students in the class using up all the department computer time. Just think about the difference today; each student has their own laptop computer (which is much more powerful than the mainframe computers we were running on in the 1970's) and can make as many runs as necessary to get the program running correctly. And, they don't have to wait hours, or days, to get the feedback; it is almost immediate.

Some of my graduate students whose work was heavily dependent on the computer ran into serious problems because of the limited computing time allocated to them and the limited memory space available on the mainframe computer. When, in 1981, I learned that students in the computer science department had unlimited computer time, I wrote to Provost John Wilson, with copy to Dean Torgersen, pointing out how unfair this was to our engineering students. This resulted in some improvement in the computer time allocated to engineering students. (A copy of my letter to the Provost is in the appendix.)

The problem of limited access to computing power was a continuing and growing problem as more and more engineering classes and research projects required more advanced computing power. Most universities were facing the same problem. Several of my students were doing research using the finite element method which required heavy use of a computer. Their work was continually curtailed by the lack of more powerful computing power and access.

In roughly the same time period, a few faculty members at Tech were provided the capability to access the computer via terminal. Once I had a terminal, I started to use email. I'm certain that I was one of the earliest users of email at Virginia Tech. I put my email address on my business card long before others did.

Ad Hoc Computing Committee

During the 1981-82 academic year, I learned from my son Brad, who was a student at the University of Virginia, that he was using terminals to access their main frame computer, without the need of punched cards. (Torgersen's son Jamie also was a UVA student using terminals.) I pointed all this out to the Dean and suggested that Tech look into getting a similar capability for our faculty and students.

Two events resulted in Dean Torgersen realizing that the school of engineering at Virginia Tech must do something to improve its computing capability. One was the realization that UVA was ahead of us by using terminals, not punched cards. The second was when a community college president complained about the fact that his school was still using punched cards; this was at a meeting Torgersen attended in Richmond. Virginia Tech was considered to be the best engineering school in the state; it shouldn't be behind schools like UVA, or community colleges, when it came to computing capability.

In the fall of 1982, Torgersen appointed a six member ad hoc committee to study the College of Engineering computing capability and he appointed me chair of the committee. The committee had representatives from the Computing Center, the Dean's Office, Mechanical and Electrical Engineering, Engineering Fundamentals, and Engineering Science and Mechanics.

One of the first things I did after being appointed chair of the committee was to talk to Rosie Higdon in the Virginia Tech Computing Center. I went to see Rosie with the idea of learning about terminals for connecting to the mainframe computer. However, when Rosie told me that personal computers were now available, my thoughts changed completely.

I was enthralled with the idea of "leap-frogging" over terminals and going directly to personal computers. The more I looked into the possibilities, I became convinced that personal computers would be the long term solution to computer access for faculty and students at Virginia Tech. Of course, I had no idea as to how common personal devices would become. It took some effort to convince the other committee members that we should adopt personal computers as our primary computing resource.

Great help in convincing the committee and the Dean that Tech should go to personal computers came from Vinod Chachra, Vice President for Computing.


Vinod Chachra

On February 8, 1983, the committee distributed a draft proposal, entitled *Goals for Engineering Computing,* to the engineering faculty, asking for reaction no later than February 15. The most far-reaching goal was that engineering students and faculty have personal computers and that the plan be implemented for the fall of 1985. A copy of the draft proposal is provided in the Appendix.

Thirty-nine responses were received (from approximately 200 faculty members), indicating strong support for the plan. Only five responses were somewhat negative. When concern was expressed, it mostly had to do with the cost to the students. There were, of course, many suggestions as to how the proposed plan could be improved. Several respondents expressed a desire that the plan be implemented for fall 1984 rather than fall 1985.

One of the more interesting comments came from a faculty member who was not in favor of the proposal. He said: *"Whatever you guys are on, you should make it available to everyone. It'll solve all the world's problems."* In one sense he was right, personal computing devices are now being used throughout the world to solve problems and to make a wide range of activities and processes more efficient.

To Lead … or To Follow

The final report of the ad hoc committee was dated May 28, 1983. I titled it "*To Lead … or To Follow*". It opened with a quote from one of my undergraduate advisees who had

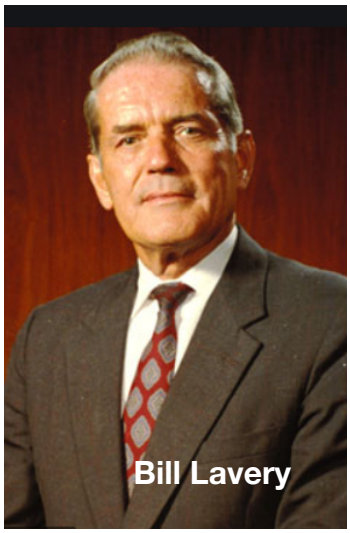
graduated in June 1982. When talking to her about using a computer, she said to me "I'm afraid of the computer". This struck me as a very surprising and disappointing comment; one that we should ensure would not be made in the future.

The committee recommended that the College of Engineering initiate a major change in the availability of computer resources for faculty and students. It recommended that we shift to personal computers as the primary resource for computing. It further recommended that each of the 1200 entering freshman engineering student be required to purchase their own personal computer. Further, the committee expressed an urgent need for action, recommending that the personal computer requirement be implemented during the 1983-84 academic year.

The proposal included specifications for the hardware and software that the desired personal computer should have as standard equipment. Specifications for machines from five companies were presented for comparison. Only one of those companies is still in the personal computer business today - IBM. By today's standards, the 1983 specifications would be considered primitive.

Dean Torgersen accepted the committee recommendations and actively worked to get the plan implemented. The next step in the process was to get the approval of the university to require that engineering freshman purchase a personal computer. We were estimating that the cost to students would be of the order of $2,000.

A meeting was held with President Bill Lavery to explain our plan and request his approval. I was in that meeting with Dean Torgersen, Vinod Chachra and Bob Heterick. Bob was a civil engineering professor who had preceded Vinod as director of the computing center. President Lavery expressed considerable concern over the cost, but eventually agreed to support the initiative. One of the points we used to convince Lavery was that Virginia Tech had a lower cost of attending (tuition plus room and board) than six other competing public universities; in particular, our costs were almost $1,400 lower than those at the University of Virginia.


Bill Lavery

Choosing the Personal Computer

With the president's approval of the proposal, Paul, Vinod and I took steps to put the initiative into effect as soon as possible. Paul and I made a visit to IBM in Boca Raton, and Vinod and I made a visit to DEC (Digital Equipment Corporation) in Boston. Texas Instruments made a visit to Blacksburg. The purpose of these visits was two-fold; we wanted to assess the capability of the company's personal computers, and we wanted to impress them with our initiative in the hope that they would offer us an attractive deal in terms of cost and support.

The College of Engineering put out a request for bids on July 29, 1983. The IBM bid is dated September 6, 1983, only a little more than three months after the committee

report was submitted to the Dean in late May. The bids that were under serious consideration were from IBM, DEC and Texas Instruments.

I have a copy of the IBM bid that was accepted. It offered several options and indicated “it is not difficult to anticipate considerable change between now and your August 1984 requirement for student personal computers”.

Freshmen entering the College of Engineering in 1984 were required to purchase a personal computer. This was only two years after the ad hoc committee was appointed and fifteen months after the committee submitted its recommendation to the Dean.

As a result, Virginia Tech became the first public university in the United States to require personal computers for some of its students.

Costs

Year	Hardware	Cost (w/ software)
Fall,1984	1 disk: 256 K Included: •Hardware cost : $1700 (list price $2900) •Software •Burn-In, software installation •Distribution •Maintenance for 4 years	$ 2153
Fall, 1985	2 disk: 256 K	$1700
Fall, 1986	2 disk: 640 K Math co-processor Enhanced software	$1950

The IBM Portable PC

The selected PC was called portable, but it weighed 40 lbs and came with a carrying case (current laptops weigh approximately 3.0 lbs). Students referred to it as "luggable". It was intended for use at their place of residence; it did eliminate the need for punched cards and the delay in response time.

Versions of this portable were used for three years with the memory and software upgraded each year. As indicated in the figure, the cost to the student, including maintenance for four years, was $2,153 in 1984, $1,700 in 1985 and $1,950 in 1986.

The version of the required PC has varied with the advancements in the technology. For the 2020-21 academic year, Virginia Tech required that all entering freshmen purchase their own personal laptop or tablet. There is a university-wide, base-line specification for all devices; individual colleges and/or departments often have additional requirements for both hardware and software.

As I write this in 2020 on my 21.5-inch Apple iMac (purchased in 2013), it has a 2.7 GHz processor, with 8 GB of 1600 MHz memory. I also have an Apple MacBook Pro (purchased in 2017) with a 2.9 GHz processor, 16 GB memory and a 512 GB hard disk. I paid $2,599 for the MacBook Pro. I also have a Dell Inspiron 17 with a 2.8 GHz processor and 8 GB memory and 1 TB Hard Drive that I purchased in 2005 for $2,163. Obviously, I have adopted Apple computers as my primary device. I keep the Dell PC for easy access to older files.

By way of comparison, the 1984 IBM PC was rated at a CPU speed of 4.75 MHz, 0.25 MB of internal memory, with a 30 MB hard drive, and monochrome monitor for $2,153.

Summary Time Line

- December 1981 - Herakovich writes to Provost John Wilson
- Spring 1982 - Herakovich notifies Dean Torgersen that UVA is using terminals
- Fall 1982 - Dean Torgersen appoints Herakovich chair of ad hoc committee
- February 1983 - Herakovich committee distributes draft recommendation
- May 1983 - Herakovich committee submits final report to Dean Torgersen
- July 29, 1983 - College of Engineering puts out request for bids
- September 6, 1983 - IBM submits bid
- September 16, 1983 - Torgersen, Herakovich and Chachra choose IBM's bid
- Winter 1984 - Engineering Fundamentals professors Rogers & Minich develop course for IBM PCs
- September 1984 - Engineering freshmen required to purchase IBM PC
- September 1984 - Professor Nunnally supervises PC distribution and support
- October 16, 2009 - Torgersen gives Vecellio Lecture on 25th Anniversary (several slides from Torgersen's lecture are presented in Appendix.)

Long Term Impact

In 1985, the Computer Science Department (in the College of Arts and Science at the time) required students to purchase personal computers. In 1986, the College of Business strongly recommended personal computers, in 1990 the Statistics Department required personal computers, and in 1997, personal computers were required of all students entering Virginia Tech.

The College of Engineering Computer Initiative is considered to be one of the major advancements in the academic history of Virginia Tech. It led the nation in the use of personal computers. Professor Win Phillips, a visiting department chairman from Purdue University, said that the Purdue faculty were very envious of what Virginia Tech was doing.

In 1993, Bell Atlantic and Virginia Tech created a partnership to connect all of the town's inhabitants to the internet and to each other, making Blacksburg a poster child for the digital age. Within six months, the Blacksburg Electronic village was featured on the Discovery Channel, in Esquire, USA Weekend, The New York Times and the Wall Street Journal.

Paul Torgersen went on to become President of Virginia Tech from 1993-2000. In October, 2009, he presented The Vecellio Distinguished Lecture that is sponsored by the Department of Civil and Environmental Engineering. At Paul's invitation, Marlene and I attended the lecture and a dinner that followed. (The lecture is available on compact disk and several of the figures presented here were taken from Paul's lecture.)

In his lecture, Paul reviewed many details of the entire computer initiative. I was very pleased that he gave me full credit for bringing the computing problem to his attention, and for proposing that Virginia Tech be a leader in the use of personal computers by "leap frogging" over the use of terminals and going directly to personal computers for all students and faculty in the college of engineering.

I take enormous pride in the fact that the Virginia Tech Computer Initiative was the result of my vision, inspiration and leadership.

Clearly, at the time, we had no idea how ubiquitous personal computers and other electronic devices would become. As I write this in the middle of the COVID-19 pandemic, thirty-six years after our 1984 initiative, education at all levels is being delivered to students who are receiving their instruction on personal computing devices. Many people are conducting business and personal interactions via the internet.

The world has come a long way since I took a computer class at The University of Kansas in 1961.

Aside:
In 1983, Apple was not under serious consideration as the supplier for the Tech personal computers. Although Apple was one of the early developers of personal computers, Big Blue (IBM) was coming on strong. Apple outsold IBM (and clones) in 1982, but in 1983, IBM (and clones) outsold Apple 3 to 1. It was still a question as to whether or not Apple would survive as a company. In addition to wanting a quality computer, we wanted to work with a strong company with the resources that could provide us with a very competitive package in terms of both price and support. Of course, as I write this in 2020 on my Apple iMac, Apple is the dominate electronics firm. It recently attained a value in excess of $2 trillion to be the world's most valuable company.

European Activities

First Trip

Southampton England

My very first trip to Europe was in September 1972. I had a paper accepted for presentation in Southampton, England at the International Conference on Variational Methods. Marlene joined me on the trip, and my parents came from Whiting to look after our four children, ages 4, 6, 10 and 11, while we were in Europe. We were away for a week or more.

Marlene and I flew into London's Heathrow airport. From London a group of Americans shared taxies to Southampton, about eighty miles southwest of London. The group took taxies because of a problem with the scheduled train. I don't remember the finer details, but I do remember that there was a small group of Americans, all heading to the meeting in Southampton. The group required at least two taxis. One of the Americans who rode in our taxi was Tinsley Oden. Tinsley was already quite famous in the field. He was very friendly, outgoing and clearly a leader. We became good friends as a result of the trip.

Upon arrival in Southampton early Sunday morning, we learned that the dormitories we would be staying in would not be open for several hours. So, a group of us walked to a local pub where we had something to eat while waiting for the room.

When we did get to our room, Marlene and I learned that we were to sleep on two small bunk-sized beds located in two different alcoves of the room. I picked up my bed and moved it into the alcove with Marlene's bed so we could sleep side by side.

It was an interesting meeting and my talk on quadratic programming and plasticity went well. Marlene had an enjoyable visit to Stonehenge on an excursion organized by the conference.

Paris France

At the end of the week, Marlene and I flew over to Paris for a weekend visit. I had always wanted to go to Paris and this was my first opportunity. My brother Jack had worked for UNESCO in Paris and was able to recommend several hotels on the Left Bank where we might stay. Jack was no longer in Paris; I think he was in New Delhi at the time.

Probably the most memorable experience of the trip to Paris was finding our hotel. After arriving at Orly Airport, we went to a travel booth where we made a reservation at one of the hotels Jack had recommended. We then took the train into Paris. We hadn't been on the train but a few minutes when we realized that we didn't have a written copy of the hotel reservation and we didn't remember the name of the hotel where we had a reservation. We knew it was a French name and that it was in the St. Germain area, but didn't have the exact name. We, unsuccessfully, tried several hotels and then

decided that we had to go back to the airport travel desk to retrieve our reservation information. Since we did not speak French, our communication skills were very limited. We left our luggage with one of the hotels we had visited and went back to the airport.

Fortunately, all turned out well. We went back to Orly, got the name of the hotel, Hotel du Pas-de-Calais, and went back to Paris. The hotel was just off Rue St. Germain and not far from two famous Paris cafes, Café de Flore and Les Deux Magots. It was an excellent location. We had an enjoyable time in Paris.

We have been back to Paris many times since that first visit. It is my favorite city in the world.

Paris Sabbatical

The only sabbatical I had during my twenty years at Virginia Tech was for the 1980-81 academic year; I was at École Polytechnique in Palaiseau, a suburb of Paris. Professor Zvi Hashin of Tel Aviv University assisted in arranging the sabbatical by contacting Professor Joseph Zarka at the university on my behalf.

Family in France

The family flew from Dulles Airport on August 17, arriving at Charles De Gaulle airport in Paris on the 18th. Marlene had just completed her master's degree at Virginia Tech, Brad had completed one year as a student at the University of Virginia, Doug had just graduated from Blacksburg High School, Kris had completed eighth grade, and Russ had completed sixth grade (they all took a gap year - as one would say today). We rented out our Blacksburg home for $525/month while we were in Paris.

> *Aside:*
> *Our first night in Paris was somewhat typical of the first time we did many things in Europe. When we arrived at Charles de Gaulle Airport we had too much luggage to fit in the station wagon we had rented. So, we put a lot of luggage in storage lockers at the airport. After settling in a motel on the South side of Paris – the airport is on the North – Brad, Doug and I drove back to the airport to get all of our luggage. It was evening and dark by the time we were doing this and on the return to the motel we got lost. We were not getting off the auto-route at the correct exit and it took forever to find the motel. Marlene became worried we were so late in getting back. In the end, everything turned out okay.*

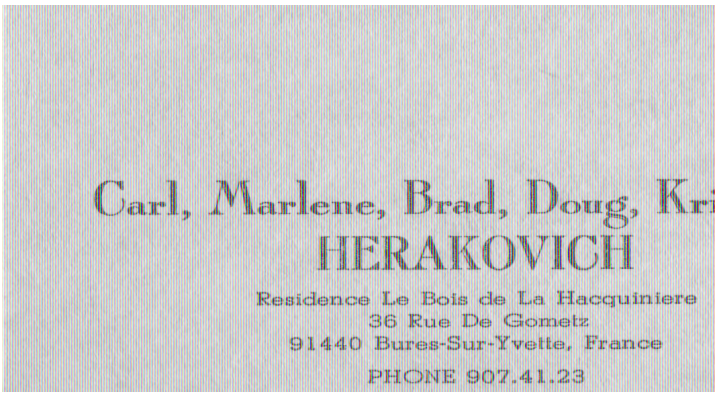
One of the first things we did after arrival in Paris was to drive to Brussels in the rented station wagon to pick up the VW Vanagon Microbus we had ordered from the States. We got the bus on August 20. I remember several things from that trip. One was the high cost of our first lunch at an autoroute rest stop. Another was how we all overslept (jet lag) and had to be awakened by the lady of the small hotel (Astor Pension) where all of us were

VW Vanagon

sleeping in one large room. It was getting past the time for breakfast which she knew we would want. I think she made us a breakfast that included juice, coffee and pastries.

We paid $10,379 for the Vanagon and drove it 16,717 miles. We had to ship it back to the states at the end of our visit because it was made to US specifications and there would have been a very high tax to sell it in France. The cost of shipping it back to the states was $1,250. I had to go to Wilmington, DE to retrieve it. We then sold it in Blacksburg. See the Appendix for details of the purchase and shipment to the US.

We laughed a lot when Doug and Marlene both had difficulty driving the station wagon on return to a rental agency. The problem was that the parking brake had not been released. People along the street were shouting instructions to them, in French, as the car jerked its way along the street. I was ahead of them driving the new Vanagon.




36 Rue de Gometz

In Paris, we lived in a three bedroom, third floor, walkup apartment at 36 Rue de Gometz in the Residence Le Bois de La Hacquiniere, in Bures Sur Yvette, a Paris suburb. The children slept in small single beds; we did have two bathrooms. It took 30-45 minutes to get into Paris, depending on the traffic and whether we drove or took a train. Our average monthly rent was $1083. We all had business cards with our names and address. At times, this made it easier to say who we were and what our address was, and it ensured that we would always know how to get home.

The other families living in our building were mostly French. Names like Laj, Mousseau, Valentin, Bruter and Kouchkovsky. There was one Japanese family, the Murata's. All the people were very friendly. Several of the French families invited us over for a Sunday lunch or dinner. These meals usually lasted several hours.

> *Aside:*
> *Mr. Murata was in France in much the same capacity that I was, working in a scientific laboratory. Mrs. Murata was pregnant with the child to be born in France. Her family back in Japan did not know she was pregnant because they would not have let her go to France if they knew. Their young son, who may not have been more than ten years old, took the train into Paris everyday to attend a Japanese school. A couple of years later, Mr. Murata visited us in Blacksburg and stayed over night.*

Kris and Russ attended the local public French school that was a short walk from the apartment. They walked to school with several other French children who lived in the same apartment complex. We had been led to believe that most teachers in France would speak some English. That turned out not to be the case. As a result, it was a difficult year of school for Kris and Russ. The school did set up a special French class for the several American and Australian students who did not speak French.

Kris took horseback riding lessons and Russ played basketball. When we returned to the United States, Kris and Russ basically skipped a grade because nothing could transfer from France.

Brad and Doug studied French at the Alliance Française in Paris for three of the months that we were there. This meant they took the train into Paris each morning, leave at 7:10, walk to train station, train to Paris, then Metro to Alliance, class from 8:30 - 12:30, returning to Bures Sur Yevette mid to late afternoon. The trains into Paris, typically, were very full and smothered in cigarette smoke. There were students from all over the world in the class and the only language spoken in the classroom was French. The days were long and difficult; they came home tired and hungry. They played basketball on a local French youth team, traveled with the team to Lyon, France for a tournament, and played some golf at a local course.

Marlene and I attended a French class one day a week for a couple of months. Marlene occasionally attended a lunch at a local CNRS (Centre National for Scientific Research) laboratory where the French researchers were getting the opportunity to practice English over lunch. The facility was a fairly long walk from our apartment for Marlene. When Brad and Doug were not taking French classes in Paris, the days could be long for them, as they were often for Marlene.

Early on, we made many day trips to Paris, visiting famous sites like the Tour Effel, Centre Pompidou, Champs-Élysés, Notre Dame, Montmartre and Sacré Coeur, the Louvre, the Flea Market, Shakespeare and Company Bookstore, Boulevard St. Germain and the Café de Flore and Les Deux Margot, and nearby Versailles. We purchased many English language books at Shakespeare's during our time in Paris. The flea market was huge and a favorite place to browse, and occasionally buy something.

Midnight Mass at Notre Dame

For Christmas Eve 1980, we decided to attend midnight mass at Notre Dame Cathedral on Île de la Cité, an island in the River Seine, in the center of Paris. We knew that Joan Baez would be giving an outdoor concert on the large square (now known as Place Jean-Paul-II in honor of Pope John Paul II) in front of the cathedral, prior to the mass, so we arrived what we thought was early.

We drove onto the island from the Right Bank and quickly realized that there was a huge crowd and no place to park. We exited the island to the Left Bank where Doug and I took the van to find a parking place, and the rest of the family got out of the van to head to the cathedral while listening to the concert. Doug and I found a parking place nearby, parked the van, and walked back searching for the rest of the family. We

quickly realized that we had no idea where they were in the large crowd. We walked along the Left Bank toward the front of Notre Dame and the Little Bridge (Petit Pont) that crosses the Seine in front of the cathedral. To our great surprise, our family was standing there waiting in a crowd to cross the Seine.

When we got to the front of the cathedral, we found that the entrance was fenced off – no-one was being allowed in yet. When the gate was opened, it was like a crowd rushing into a rock concert. People were running down the center aisle to find the pew they wanted. We managed to get a pew about halfway down the center aisle.

When it was time for communion, Russ realized that a cardinal was distributing communion to one of the lines so he got us all to get in that line. So, we had communion, from a cardinal, in Notre Dame Cathedral at Midnight Mass on Christmas Eve, 1980.

École Polytechnique

École Polytechnique, established in 1794, is one of Frances most selective and respected, elite universities which are known as grande écoles. It is excellent in science and engineering. In 1804, Napoleon Bonaparte gave the school military status and its motto: “Pour la Patrie, les Sciences et la Gloire” (“For the Fatherland, the Sciences and the Glory”). It is no longer a military academy, but is still supervised by the French Ministry of Defense. Many of its graduates have risen to high level positions within the French government.

I interacted with mechanics faculty, graduate students and staff at the university. I found them to be very warm, friendly and helpful, even though I did not speak French. I was given a very nice, large office and access to all the testing facilities and computers that I might need for my work. Several graduate students were particularly helpful. I didn’t have a lot of interaction with my host Professor Zarka as he was there only a couple of days of the week, and his work was not in composite materials. While there, I did get my free edge computer program working on their computer system and conducted tests on specimens provided by the French aerospace industry.

Lunch at École Polytechnique was a very social activity that increased my appreciation for and understanding of the French culture. We would walk across the campus to another building that housed a very nice cafeteria with excellent food. We generally sat together at a large table - and then walked back to our building for a coffee. The discussions were most interesting - to the extent that I could follow them.

From the professional point of view, the most significant benefit of being in Paris those months was experiencing, first hand, how education and research were conducted at a highly respected university, and the freedom to travel throughout Europe - gaining more experiences as to how things were done in different European countries.

In many ways, the sabbatical experience had a major influence on my approach to research and my interactions with graduate students. It seems to me that graduate students in Europe take fewer classes, do more independent learning by reading the

literature, and generally require less supervision. There is no question that the graduate students at École Polytechnique were some of the very best students.

Travels 1980-81

Day Trips

The entire family traveled throughout Europe in the Volkswagen Vanagon that we had ordered from the United States. The Vanagon proved to be more than adequate for the six of us and our luggage. On weekends, we made many trips into Paris and nearby places of interest.

We made three trips to Chartres southwest of Paris. It has an outstanding cathedral and village center. We visited it once in daylight to see the cathedral and went back again one evening to see the town lit up for Christmas; it was beautiful. The precious stained glass windows of the cathedral were removed in 1939 just before the German army invaded France; they were hidden in caves and reinstalled after the war.

Other day trips were to the Palace of Versailles and Château de Fontainebleau.

Compiègne - February 17
Marlene and I drove to Compiègne where I gave a talk at the University de Technology de Compiègne. Our host was Francois de Charentenay. He and his wife took us to lunch and then Francois' wife showed Marlene around while I was giving my talk.

Compiègne is where the armistice of 22 June 1940 was signed in the same train carriage that the armistice of 1918 was signed to end the First World War. The 1940 armistice entailed France's surrender in the Second World War. Hitler was present at the 1940 signing.

Overnight Trips

We were on overnight trips for a total of forty-seven days during the nine months in Europe. I traveled an additional eight days on my own, two to Grenoble and six to Riga, Latvia. Often, I had arranged to give a talk at a university, government research laboratory or industry; the family came along to see Europe. Usually, I was given a small honorarium for my talk.

I had a library of Fodor and Michelin (red and green) travel books with highlighted details of all of our travel through Europe. Unfortunately, I gave the books to Goodwill before we moved from Charlottesville to Raleigh. The books would have been very helpful when writing about our trips. I have a map of Europe with most of our routes highlighted. It shows that we visited many major cities, regions and countries. I also have a large cache of meal and hotel receipts from our travels, a record of when and where we bought gas for the VW, notes in a 1981 date book about lectures, and credit card reports for all but the first two months of our visit. Marlene wrote diary notes about our trips; they were invaluable for everything including details of the places that

she and the children visited while I was away given a lecture. All of the travel was accomplished without the benefit cellphones and GPS.

Highlights of trips are outlined in the following.

Normandy - Sept. 21-22

Our first weekend trip was to the American Cemetery and beaches at Normandy. The American Cemetery is something that an American doesn't forget. We went to Caen, St. Lo, Pointe du Hoc, Omaha Beach and Utah Beach. Our hotel, the Mulberry, was in Arromanches-les-Bains. We had to walk through the kitchen of a restaurant to get to the rooms which were very close to the church, Stella Maria, that rang bells all night long. We stopped at a German Cemetery on the way back to Paris.

Brussels & Luxembourg - Oct. 29 - Nov. 1

I gave three lectures at Vrije (Free) University in Brussels at the invitation of Professor Albert Cardon. While there I met Clement Hiel, a graduate student who later spent a year at Virginia Tech. Both Albert and Clement became good friends who we saw on a number of occasions in the following years. We were in Brussels for three days including All Saints Day, Nov. 1, which is a holiday in Belgium. We visited Ghent and Antwerp during the day (the lectures were in the evening) and Clement took us out to dinner one night. We stayed at Astor Pension for the second time.

From Brussels we drove southeast to the Ardennes where the Battle of the Bulge was fought. In Bastogne we visited the museum, got gas and bought a picnic lunch of bread, ham, cheese and drinks. In Luxembourg we visited General Patton's grave at Hamm, then drove up to Echternach on the German border where we stayed overnight at the Hotel du Commerce. On the final day of the trip we drove through the Moselle Valley, stopping for gas in Remich on the bank of the Moselle River, on our way back to Paris.

Coast Brava & Barcelona - Dec. 26 to Jan. 2

A trip that was not associated with a talk was over the 1980 Christmas break. We went south through France and along the Costa Brava to Barcelona. We left Bures Sur Yvette the day after Christmas and were away for eight days. Many highlights of this trip are described in the following.

Montélimar, France

On December 26, in Montélimar, we stayed at the hotel Relais de L'Emperevr and had dinner in the hotel. At dinner, we learned that our waiter had served with American troops during the 2nd World War and spoke good English. He seemed happy to be able to speak English to Americans. What we all remember is how quickly and efficiently he cleaned the fish of bones. We really did enjoy him. Marlene and I stayed down in the lobby after dinner and had a cognac when the kids went up to bed. It was a relaxing enjoyable evening.

From Montélimar we went through Lyon and Marseille to Toulon where we stayed at the Hotel De L'Amiraute. From Toulon we went to Arles (where there was a little snow), then to Avignon and Le Palais des Papes, and ended the day in Perpignan at the Hotel Athena.

Costa Brava
From Perpignan we continued south to the Costa Brava and Hotel Cluamarsol at Lloret De Mar. We really liked this hotel and the small town on the shore of the Mediterranean. The drive along the rocky coastline of the Costa Brave was beautiful and somewhat tedious because of its spectacular cliffs with many twists and turns.

Barcelona
In Barcelona, there were two experiences that were memorable. We were going out for dinner on New Year's Eve (1980) to the Restaurant Los Caracoles. It was some distance from our hotel so a taxi was required. However, in Barcelona, we had to take two taxis so the family was split between two cars. I was in one car with two kids and Marlene was in the other with two kids. I knew the name of the restaurant and told the driver. Unfortunately, no one in the other car remembered the name of the restaurant. They did remember that it was famous for roasted chicken. Their driver only spoke Spanish so Doug using what French he knew managed to covey to the driver what type of restaurant we were going to. Fortunately, both cars ended up at the same restaurant and we had a great meal.

It turned out that several American sailors were sitting near us at the restaurant and we started to talk to them – it was a treat to speak in English to Americans after many months of trying to speak French. The sailors were from the American naval ship Saipan that was at dock in the harbor. As the following day was New Year's Day, American football bowl games would be on TV so they invited us to visit them aboard ship to see some of the games. We did join the crew and had a nice visit that included a tour of the ship.

We walked the Ramblas and stayed at two different hotels in Barcelona, Hotel Gala Placid and Hotel Residencia Wilson.

Montserrat
One day we visited the Montserrat Monastery, a beautiful Benedictine monk retreat high in the mountains outside Barcelona.

Carcassone
Leaving Barcelona on New Year's Day, we drove to Carcassonne in France, staying at Hotel Terminus. The city is famous for its medieval, walled citadel, La Cité.

On the 2nd of January, we drove back to Bures-Sur-Yvette arriving about 1:30 am on Jan. 3rd.

Brugge, Delft, Amsterdam, Heidelberg, Baden-Baden - Feb. 7 to 13

We drove to Brugge, Belgium on Saturday the 7th visiting the city and staying at the Hotel Cosmopolitan. The next two nights we stayed at the Hotel Central in Delft, The Netherlands. On Monday I gave a talk at Delft University while the family when to the Delft pottery factory. Delft was very nice with small rivers running through the town and many people riding bicycles.

It was then on to Amsterdam where we stayed at the AMS Hotel. On Monday, I gave a talk at Fokker Aircraft while the family visited the house that Anne Frank hid in during the second world war. They found it very impressive.

From Amsterdam we drove through Arnhem to Heidelberg, stopping at Koln (Cologne) on the Rhine River to see the cathedral and have lunch at McDonalds. We stayed at the Diana Hotel in Heidelberg. We liked the city very much; there was a strong American influence evident from the presence of the military and SHAPE Headquarters. From Heidelberg we drove to Baden-Baden.

Baden Baden Germany

Our family had a most interesting experience during our visit to Baden-Baden Germany. We stayed at the Hotel Etol. We were out looking for a place to have dinner and stopped to read a restaurant menu. As we stood there trying to read the menu that was in German, a very distinguished, tall, German looking man started to talk to us in American English, but with a German accent. He recommended the restaurant highly, pointed to a particular dish that he said was very good, and concluded by saying that he would like to join us in the restaurant, but he had an appointment down the street.

We went into the restaurant, sat at a long table and probably ordered what he recommended. I seem to remember that it was a pork dish. We hadn't been there long at all when he showed up and sat down with us. It became clear that the staff knew him very well. He didn't order anything to eat, but did drink a lot of red wine. The staff kept filling up his glass whenever it got low.

We must have talked to him for a couple of hours. He obviously came from a well-to-do family, had gone to college in the United States - he said it was Harvard, but I haven't been able to confirm that. He said that he went to school with a now famous American who he met when they were adjacent to one another in line when registering. I knew the American when he mentioned the name, it may have been Sarnoff, but again I can't confirm that. John remembered the names of our children and often referred to them by name throughout the evening. He claimed to have been friendly with the Russian aristocracy including being at gala functions in Russia. When I asked him what he did during the second world war, he replied "Oh, that's another story" and would not say more. He talked about his Mercedes car. He pronounced Mercedes as a German would and I didn't recognize the name at first. He also said he didn't drive but he had a driver. I wrote his address on the back of a card that I still have. We drove past that address on the way out of town; there was a large gate at the entrance.

Years later Marlene and I were back in Baden-Baden on a day trip from Stuttgart having an ice cream at a large outdoor cafe/tea garden. The place was very crowded and the two of us were sitting at a large table that was otherwise empty. A lady came up to our table and, in German, asked if she could sit with us. When she realized that we didn't speak German, she switched to English. It turned out that she was American and her husband was an executive with the Bayer Aspirin Company. She sat with us and we had a nice conversation. When we told her about meeting Uihlein she walked us (quite some distance) over to a fountain he had donated to the city.

The latter visit to Baden Baden ended after listening to a wonderful, outdoor concert in a park.

Grenoble - March 1 & 2

I went alone by high speed train (TGV), Paris to Grenoble, to give a lecture at the University of Grenoble, Institute of Technology. It was a strictly business trip. I stayed just long enough, overnight at Hotel Alpazur, to give the lecture and then returned to Paris.

Spring Trip - March 29 to April 15

The major stops on this eighteen day trip were Cannes, Milan, Florence, Roma, Napoli, Pisa, Munich, Friedrichshafen, and Zurich. I attended a conference on Fracture Mechanics in Cannes, and gave lectures in Milan, Roma, Napoli, Pisa, and Friedrichshafen. Some details follow.

Cannes

We drove south from Paris over the mountains down to Cannes. It was a very difficult drive in the Alps at night. It was very foggy on a steep twisting road down the mountain into Cannes on the seashore. We arrived late at night and had difficulty finding our hotel, Des Roses, where we stayed for four nights. Professor Bill Smith from Virginia Tech was at the meeting and it was good to see someone from Blacksburg. We also visited nearby Nice and Monaco. We learned from the hotel concierge that President Reagan had been shot. She showed us a TV in a reception area outside our room where we could follow events.

Milan

We stayed at Villa Carlotta on Lago Maggiore, outside Milan, for one night. The family stayed at the hotel in the morning while I met in Milan with engineers from the aircraft company Giovanni Agusta. The family did not come into Milan.

Florence

We stayed at the Hotel President in Prato, just north of Florence. On Saturday we toured Florence visiting the Duomo cathedral, Michelangelo's "David", and Pointe Vecchio, the medieval bridge, over the Arno River, with its numerous small shops.

A memorable event in Florence was the bat that was in the room that the children were sleeping in. Marlene and I were in a separate room a couple of floors below the children's room. At some point during the night one of the children came down to tell us that a bat was flying around in their room and they couldn't get it out. (Typically

there are no screens in Europe and windows are left open when there is no air conditioning.) We tried to tell the young night clerk about the problem, but he didn't speak any English and, of course, we didn't speak Italian. Somehow we managed to convey the problem to him and he brought a broom up to the room and the bat was chased out. We had a lot of laughs over that incident.

Roma

We stayed at the Rex Hotel in Roma for two nights. I gave a talk at the Sapienza University of Rome. The talk was scheduled for late morning on the 9th or 10th floor of a high-rise building. About the time the talk was set to begin, my host said to a group of us. It time to go for an espresso. So we went down the elevator, got in cars, and drove to a nearby coffee bar, had a quick espresso, got back in the cars to the university, up the elevator, and I gave my talk. My host commented on "Italian time" for the talk. The family did see many of the Rome highlights, Vatican, Coliseum, Forum, Spanish Steps, and shopping areas.

We had cappuccino for the first time. We were having dinner in a nice restaurant just off the Spanish Steps. Marlene ordered cappuccino because she had read about it in a book. Many of us liked the look and taste of the cappuccino and we order several more. In the end, I became a fan of cappuccino.

Doug had an interesting exchange with an artist on the Spanish Steps. The artist pressured him to sit for a sketch saying there would be no charge. Initially Doug said no, but finally relented. When the sketch was completed and Doug would not give him any money, he got very mad.

Napoli

We stayed two nights in Napoli at the Parker's Hotel. I gave a talk at the University of Naples. One night my host took us out for dinner at a Pizza restaurant. The menu was very different from what we would see in the States. I got sick before the food arrived and had to go out and lay down in the Vanagon. The host was left to eat with the family.

The Irpinia earthquake had occurred in the region during the previous November. As a result, there was considerable devastation, low employment and crime in Naples. When we were leaving our hotel to walk into the center of town, Marlene was told to leave her purse at the hotel even though she had a strap that went over her head and shoulders. Thieves were known to ride by on a moped, cut the strap, and take the bag. For safety, we were told to park our vehicle in the hotel's underground lot that was under the hotel. We did have the opportunity to visit the ruins at the ancient city of Pompii.

Pisa

We stayed one night in Pisa at the Hotel Mediterraneo. While I gave a talk at the University of Pisa, the family toured the city and climbed the stairs of the Leaning Tower of Pisa.

Trento

Trento is in Italy's mountainous northern region. It was a beautiful stop on the way to Munich. We stayed at Albergo Villa Madruzzo just outside of town. The villa was built around a historic, 16th century residence of a noble family. A number of older folks (mostly women) had permanent residence at the Villa. When we came down for breakfast in the morning, we saw that pills were already set out on the tables for the residents who always sat in the same seat. There was also a very small chapel on the grounds; it could not have held more than ten or fifteen people. Indeed, the Villa was a very interesting place, one that I remember fondly.

Munich

Having arrived on Saturday, we had two days to be tourists. We visited the shopping square, had lunch at a beer hall, and made a day trip to the concentration camp at Dachau. There are no words that can adequately describe the evidence we saw as to what happened there.

On Monday, I gave a talk at MBB Munich (Messerschmitt-Bolkow-Blohm). We stayed two nights at Hotel garni adria.

Friedrichshafen

This was a short drive from Munich. The city is on the shore of Lake Constance (Bodensee in German) and is famous in aviation history because Zeppelin airships were built here. I gave a talk at what was then Dornier Systems, an aircraft manufacturer. We stayed at Hotel Fohr which was very nice.

Zurich

We had a nice ferry ride across Lake Constance from Friedrichshafen to Zurich. We saw a little of Zurich, staying at the Waldorf Hotel. This was a stopover on our way home. On the way back to Paris we stopped in Basel Switzerland for lunch.

We arrived back in Paris on Wednesday, April 15.

England - May 10 - 17

London

On Sunday we drove to Calais and then took the Hovercraft, with the van on board, over the English Channel to Ramsgate, England. From there we drove to London and stayed three nights at the Park House in the Knightsbridge/Kensington area of London, not far from Hyde Park. It was a very nice hotel in a great location. We didn't leave on Saturday because Doug was playing in a basketball tournament which his team won.

I was away from the family a good portion of Monday and Tuesday, the 11th and 12th. I gave a talk at the University of Surrey on Monday and at Harwell Science on Tuesday, My host at Surrey, Mike Bader, and his wife kindly took me out to dinner on Monday and invited me to stay at their home that night to minimize my driving time back and forth between London, Surrey and Didcot where Harwell is located. On Wednesday the 13th, I visited the US AFOSR (Air Force Office of Scientific Research) office in London.

The family saw a lot of interesting places in London while I was away: Harrods, changing of the guard at the Palace, Parliament, Big Ben, Westminster Abbey, Tower of London, London Bridge, Carnaby Street and Wimbledon. They also enjoyed hearing English spoken, eating American type foods, McDonalds, KFC and Pizza. They also went to the theater twice, Annie and My Fair Lady.

Cambridge

We stayed at Arundel House Hotel in Cambridge. I gave a talk at the University of Cambridge on Thursday. On the way to lunch with my host, we crossed over a bridge on campus only to see that my family was below us “punting” on the creek. Lunch was in a large, stately hall with everyone sitting together at long tables, all eating a family style meal. The lunch was a very British event. One that I never encountered elsewhere.

London

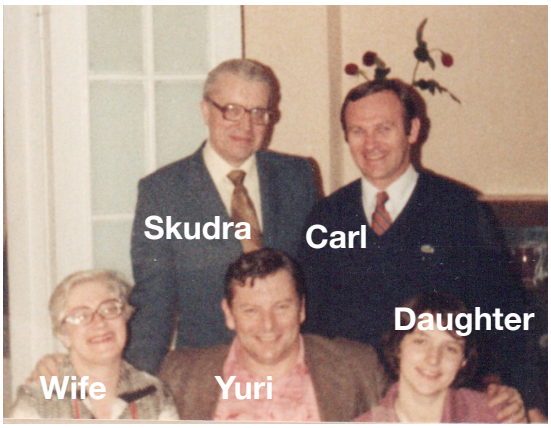
We returned to London for three more days during which time I actually got to see some of the city. On Sunday, we returned to Paris retracing the route we used coming.

Also on Sunday, Brad & Doug left London going to St. Andrews to play golf. They took a train to Edinburg and then rented a car to St. Andrews. They stayed at a Golf Hotel in Elie, just a few miles from St. Andrews. They played the Old Course at St. Andrews and the Ladybank Golf Club, an excellent course in Fife, often used for qualifying to play in the Open.

Riga Latvia - April 27 - May 2

I was invited to Riga by Yuri Tarnopol'skii. This was in spring 1981 and I had to go to the Russian embassy in Paris to obtain the necessary visa papers for the visit. I went alone and was there for five nights. It was a very interesting experience.

I flew from Paris to Moscow and then Moscow to Riga. Upon arrival in Moscow there was a thorough search of my luggage. I was then led to a separate waiting area where there was only one other person. It was dark and somewhat eerie. We saw busloads of people being taken out to the planes while we waited. Finally, we were escorted to a bus; we were the only two travelers on the bus. When I got to my plane, it was jam packed, but a seat was reserved for me. When I arrived in Riga - very late at night - I was met at the airport by Yuri and A. M. Skudra. They drove me to the tourist hotel in the center of Riga. Before we had gotten out of the car, a women came up and said something that I later determined to be an invitation to party. She was ushered away.



I gave lectures at Riga Polytechnic Institute and the Institute of Polymer Mechanics. My English was translated as I spoke. Yuri had a lunch at his home; I believe that he and his wife were celebrating their anniversary. There was a lot of vodka to be had at the table. I was careful not to have too much. I was also taken to a resort on the Black Sea where we had lunch in a nice, big dinning room. This was late April and too cold for people on the beach. I was shown the small dachas that many people had as weekend and summer get-away places. This included some of the faculty.

While in Riga there was a lady who often went with us serving as a translator and guide. I was asked if there was anything I wanted to do or see. When I said that I hoped to get a souvenir from the recent Olympics in Russian (I think it was a bear) for my daughter, I was taken to the local commercial area to look in the shops. We didn't find anything that I wanted to buy. Indeed, all the shops seemed to be almost empty of items for sale. During that local excursion, the guide referred to Riga as little Paris - Riga did have some cobblestone streets. When we went to lunch that day, we walked down a very quiet street to a nondescript door. A knock on the door resulted in a small window opening and our guide conveyed something about an American. We were let in and up a narrow flight of stairs and led to a corner booth. It became clear that the

restaurant was primarily for international visitors. I could tell that the (young) people in the booth next to us included some Japanese who spoke some English.

> *Aside:*
> *A partial listing of places the family visited would include:*
> *London, Cambridge, (St. Andrews), Amsterdam, Rotterdam, Antwerp, Delft, Brugge, Ghent, Brussels, Koln, Arnhem, Heidelberg, Baden-Baden, Rouen, Normandy (Deauville, Caen, Arromanches, St. Mère Église, American Cemetery), Strasbourg, Luxembourg (Trier), Versailles, Tours, Dijon, Basel, Freiburg, Zurich, München, Innsbruck, Verona, Venezia, Bologna, Firenze, Roma, Pisa, Napoli, Milano, Torino, Grenoble, Nice, Cannes, Toulon, Marseille, Avignon, Arles, Nimes, Montpellier, Carcassonne, Albi, Toulouse, Perpignan, Barcelona, Aix-en-Provence, Limoges, Loire Valley, Fountainebleau, Monaco and Bastogne.*

International Travels

1983 - Europe

In June 1983, Marlene, Kris, Russ and I flew to Paris and then drove to Villard-de-Lans in the Alps, outside Grenoble where I presented a paper in a conference on “Failure Criteria of Structured Media”.

After the conference, we drove to Salsomaggiore, Italy to visit with Angela and Paolo Herakovich. From there to Rome where I gave a lecture at the University Degli Studi di Roma. Doug flew into Rome to meet up with us. From Rome we drove to Venice and Vienna where I met with a professor at the Technical University Vienna. From Rome to Stuttgart where I delivered a lecture at the University of Stuttgart.

Next we drove to Paris from where Marlene, Doug, Kris and Russ flew back to America and I flew to London. In London, I met Brad who was at the London School of Economics as part of a UVA international program. I then went on to Surrey where I gave a lecture in a short course on composite materials. The short course was sponsored by the University of Surrey and UCLA. Returning to London I flew back to the States.

1984 Brussels

I gave a talk in Brussels at the European Mechanics Colloquium 182, on Fibre Composite Laminates.

1985 Israel

Marlene and I flew to Israel where I gave a talk in the IUTAM Symposium on Mechanics of Damage and Fatigue in Haifa. Marlene and I then went on to visit Jerusalem.

1986 Japan

Marlene and I flew to Tokyo where I presented a talk at the 3rd Japan-US Conference on Composite Materials. After the conference we visited Osaka and Kyoto.

1987 London, Rome and Glasgow

Marlene and I flew to London where I gave a talk at the International Conference on Composite Materials. From there we flew to Rome and met Riccardo Raciti of BAT International. From Rome we flew to Glasgow, Scotland where I gave a talk at a conference on Composite Structures at Paisley College.

1987 Villard-de-Lans

In August, I returned to Villard-de-Lans, France to present a talk at a conference similar to the one I attended in 1983. I flew in and out of Geneva Switzerland and traveled to the conference by train. It was a quick trip as we were in the process of moving to Charlottesville.

Odds and Ends

Frank Maher Award

In the spring of 1986, the Engineering Science and Mechanics Department honored me with the Frank J. Maher Outstanding Educator Award. I was very pleased to receive such an honor from my colleagues. Frank was a highly respected professor who I often sought out for advice.

Midwest Mechanics Lecture Tour

In 1982 I was invited to be an Invited Lecturer for the Midwest Mechanics Seminar Series. I did not know until reviewing for this memoir that the series was started in 1957 by my major professor, Phil Hodge. He started the series after he joined the faculty at the Illinois Institute of Technology in Chicago. Originally, there were six universities on the tour; it grew to ten universities in 2002. Hodge wrote a history of the tour (available on the web) that was updated by Hassan Aref. The schools in 2002 were: Northwestern, Notre Dame, IIT, Illinois, Purdue, Michigan, Michigan State, Iowa State, Wisconsin and Minnesota. I am please to note that, later in life, both Phil and Hassan were my good friends.

There were two events from my tour that stand out in my mind. Phil Hodge was now a professor at Minnesota and during my visit there he and I ran laps around the track in the field house; there was a lot of snow outside. Phil was a marathon runner and I was staying in shape for football officiating so we had a good run.

During my visit to Illinois, I stayed at the home of Dan and Ann Drucker. Dan was Dean of Engineering and highly regarded throughout the world for his contribution to mechanics. I felt honored to be invited to stay in their home. Later, in 1998, I was Chair of the ASME Applied Mechanics Division when we established the Drucker Medal and I had the distinct pleasure of informing Dan that he would be honored with the first Drucker Medal.

I was very honored to be invited to speak in this seminar series because as the list of speakers (available on the web) shows, it is a Who's Who listing of prominent people in the field of mechanics.

1982 IUTAM Symposium: Mechanics of Composite Materials

Zvi Hashin from Israel's Tel-Avis University was a well-known contributor to the field of composite mechanics. I got to know him because we attended many of the same meetings. In 1978, I invited Zvi to be the second distinguished lecturer for the NASA-Virginia Tech Composites Program. Zvi suggested that we propose an IUTAM (International Union of Theoretical and Applied Mechanics) symposium on composites at Virginia Tech. Together, we made the proposal to IUTAM and it was approved. This was my initiation to IUTAM; years later, I became very involved with IUTAM.

The symposium was held at Virginia Tech, August 16-19, 1982. It was attended by 124 researchers from sixteen countries around the world. Thirty-six of the researchers were from foreign countries. Many spouses attended as guests. The countries represented were:

Countries Represented at 1982 IUTAM Symposium on Mechanics of Composite Materials			
Belgium	Canada	Denmark	France
Germany	India	Israel	Italy
Japan	Korea	The Netherlands	China
Republic of China	Sweden	United Kingdom	USA

The lists of presenters and attendees included many of the pioneers of the field, as well as Virginia Tech faculty and graduate students.

The proceedings of the symposium were published in the book:

> *Mechanics of Composite Materials: Recent Advances,* Edited by Zvi Hashin & Carl T. Herakovich, Pergamon Press,1983.

The symposium was the first international meeting organized by an ESM faculty member. Hashin was in Tel-Aviv so responsibility for the arrangements fell primarily to me. The symposium was held in the Virginia Tech Center for Continuing Education on the campus. The Center was ideal for the symposium; attendees rooms, meals, and technical sessions were all in the Center. After the evening meal, a room with refreshments was available for socializing. Daughter Kristine and son Brad assisted in that room. Marlene and Pat Hyer organized a spouses program that included trips to Abingdon, for an afternoon play, and a tour along the Blue Ridge Parkway. One evening, Marlene and I hosted a social at our home that was attended by nearly 100 people. For many years after that, Marlene noted how often wives she met at international meetings commented on the party they attended at our home. All indications are that the symposium was an outstanding success.

> *<u>Aside:</u>*
> *Our son Brad took several interested attendees for a swim at our neighborhood Shawnee Pool. Two of the swimmers were Nick Hoff and Sia Nemat-Nasser.*

Virginia Center for Innovative Technology

In the fall of 1983, Dean Torgersen appointed me to a Virginia state–wide committee to develop a plan for a new activity in the Commonwealth, the Virginia Center for Innovative Technology (CIT). The committee had representatives from several Virginia universities. The plan that evolved recommended that Institutes be formed in key technology disciplines where the Commonwealth had significant expertise. The plan was accepted and a headquarters building was erected in Northern Virginia near Dulles International Airport.

Torgersen appointed me Director of the Institute for Materials Science and Engineering. There were five major research thrusts in the Material Institute: Adhesion, Advanced Composites, Electronic Materials, Metals and Ceramics, and Polymers. My responsibilities were to provide leadership for the development of an organizational structure, research plan, and budget for the Institute. More than ninety faculty members throughout the Commonwealth were involved with the Institute. As Director, I administered a budget of $3.0 million.

The Director position was distinct from my academic responsibilities and paid a small consulting fee. I served in that capacity from February 1984 to January 1986 when I decided that it was too much of a distraction to my academic activities.

The focus of the Center for Innovative Technology has changed considerably since I was involved. Rather than centered on academic research, it is now more directly involved with innovation in the private sector.

Virginia Tech Athletic Board

I was appointed a member of the Virginia Tech Athletic Board from June 1974 to August 1980. During my time on the Board we hired Bill Dooley as our athletic director and head football coach. That was a very interesting activity as I knew Dooley from officiating his games at the University of North Carolina. Previously, I wrote about the comment John Wilson made to me at a dinner of the Board - a comment that I enjoyed so much. It was the comment about the duties of an assistant coach who had responsibility for defensive ends. I went off the Board when I went on sabbatical to Paris, France in August 1980.

Teaching at Dahlgren

One term, I taught a course at the Naval Surface Warfare Center in Dahlgren, VA. I was one of several Tech professors who would fly on a small plane from the Blacksburg airport and land at the Warfare Center in time for a 9:00 am class. Each professor would teach a class in the morning or afternoon and then have the remaining time for preparation and/or research. We flew back to Blacksburg in time for dinner.

These were rather interesting flights. The plane to take us would fly up to Blacksburg from Roanoke, pick us up and then fly up to Dahlgren, not far from Washington, DC. The small Blacksburg airport did not have a flight tower so landings had to be visual. With Blacksburg in the mountains at an elevation of about 2000 feet, there could be low clouds early in the morning. On more than one occasion, when Marlene and I were

still in bed, the phone would ring and it was the pilot asking about the cloud cover in Blacksburg. We would look out the window and report the cloud status to the pilot. That's how the decision was made as to whether or not he could land in Blacksburg.

The flights also were interesting because I flew with good friends Rich McNitt and Jack Lytton. We had a good time in the cramped quarters of the small plane. The ride up to Dahlgren often was very bumpy. On one morning flight, with only me and McNitt on the plane, the plane dropped so much and so quickly that we both bounced our heads off the cockpit roof, even though we had seat belts on. The flight home was always enjoyable because it had been a long, trying day and there was a cooler in the plane with a variety of liquid refreshments.

Teaching on TV

I taught one class on TV. It was a class on mechanics of composites and offered to non-resident students. There were only a few TV students and most were from the Naval Surface Warfare Center. I was teaching the same class on campus with about forty students in the class. The difference between the two classes was like night and day. I really enjoyed the on campus class because there was a lot of interaction with the students. In contrast, there was essentially no interaction from the TV students. I'm sure that this was as much my fault as theirs, but I didn't enjoy going to the small TV classroom to teach to a TV camera.

Football Ticket Sales

For a number of years, our sons bought and sold tickets for Virginia Tech football games. In the early years it was just Brad and Doug; Russ joined them when he got a little older. Kris would join in at times as a "runner". It was an excellent learning experience of the financial world for them. It probably started when I had tickets that I was not using because I was away officiating. The boys would be outside the gate, along the path fans followed from the parking lot to the gate, with tickets in their hands, offering them for sale. They soon realized that they could buy tickets for a very low price and then sell them at a higher price.

When Russ joined them he was still quite young. He would post himself further from the gate asking fans if they had tickets to sell. He was so young that he often got tickets at a very low price; in fact, on occasion, tickets were given to him. He would then run his tickets up the line to his brothers who would sell them. Once the game started and most of the fans were in the stadium, they went in to watch the game. When I returned home from officiating, I was often very surprised at how much money they had made.

Russ recently told me that selling tickets at the Virginia Tech football games "..taught me a ton about sales, markets, and asking for business. I view this as the most important job that I had growing up".

Pool Tables

Shortly after Christmas one year, I'd guess it was 1969 or 1970, we learned that Brunswick Corporation in Marion, VA had so many unsold pool tables that were to have been sold through Sears, that they were storing them in barns around the Marion

countryside. The tables were now available at a significant reduction in price. This was between Christmas and the start of classes in January; so, several of the young faculty members in ESM rented a truck and drove down to Marion (about 60 miles south) and bought six or seven pool tables. We brought them back to Blacksburg and distributed them to the buyers. The tables came in boxes and had to be assembled. I recall hauling one up a narrow staircase to the second floor of an apartment that one of the buyers was renting. I still have my table here in Raleigh, some fifty plus years later. No doubt that the desire to keep the table goes back to my high school days in Whiting when I played a lot of pool and snooker.

Colonel Acuff's Karmann Ghia

In 1970, in order for our family to have two cars, I bought an old, white Karmann Ghia from Colonel Earl Acuff for $75.00. The colonel was a faculty member in the Corp of Cadets. Earl was 18 years older than me and an outstanding handball player who literally wiped me off the court. Even though I was a decent player, I was happy when I scored a few points off of him. He had won the Army Championship for handball. In 1974, he rose to Commandant of Cadets at Tech and was promoted to General. I really did like Earl. He was a unique individual who had an outstanding military career, most of which I didn't know until I read his obituary years later.


Earl Acuff

The car was not worth more than $75.00. It was a stick shift which Marlene didn't normally drive. The driver side door was difficult to open, Marlene scooted over to the other door to get out the few times she drove the car, but it did get me back and forth to school, and it gave Marlene the opportunity to have a car on a regular basis to shop and get the children where they needed to be. As the family grew, we bought a station wagon. Marlene often took many neighborhood kids to school and other places in the station wagon, including the cub scout pack that she led.

After several years, I sold the Karmann Ghia and bought a used Volkswagen Scirocco. This was a much better car that I cold use when traveling to officiate football games on weekends. We still had the Scirocco when we moved to Charlottesville.

2010 External Review of ESM Graduate Program

In 2010, I was chair of a committee along with Nadine Aubry, Wilfred D. (Bill) Iwan and John L Junkins to assess the status, needs, and aspirations of the Graduate Program in the Engineering Science and Mechanics Department.

We made several recommendations including an emphasis on non-traditional mechanics areas and cross-cutting thrusts such as biomechanics, nanomechanics, multiscale modeling and simulations-based engineering science.

In 2014, ESM merged with the department of Biomedical Engineering to form the Department of Biomedical Engineering and Mechanics (BEAM).

Leaving Virginia Tech

The decision to leave Virginia Tech in 1987 was not an easy one. The twenty years we lived in Blacksburg were a very happy time for our family and I felt that my career there had been very successful. We had basically raised our children in Blacksburg, and they were now college age or older.

Marlene had had an interesting time, in addition to raising our children, she taught in two pre-schools, was a counselor at New River Community College, earned her masters degree at Virginia Tech, and made a lot of good friends and neighbors.

During my years at Tech, the NASA-Virginia Tech Composites Program was a resounding success that brought much recognition to me, the department and the university. I had advised a large number of graduate students, had a very good teaching record, published many papers, and attracted national and international visitors including professors and post-docs.

I had been a candidate for positions as professor, department chair and Dean of Engineering at other universities; some positions were offered to me, some were not, and others I chose not to pursue. Obviously, I did not accept those that were offered, and I can say that I wasn't overly disappointed when I wasn't offered a position. I was happy at Virginia Tech; if I was going to make a move, I had to feel that the position was significantly better than what I had at Virginia Tech.

Nevertheless, I'm sure that I believed that the future could hold something better for me. As good as Virginia Tech was, it did not have as high a standing as other nearby universities like Virginia and Duke. In addition, other faculty in my department had been rewarded with chaired professorships; I had not. There is no doubt that the fact that I had not received such recognition weighed on me. Another factor that influenced me was that I was, simultaneously, the major advisor, or co-advisor, for as many as fifteen graduate students; I was spread too thin.

As Director of the CIT Materials Institute, I made visits to the University of Virginia for meetings with the other center directors. This provided me the opportunity to see the UVA facilities and to meet Ed Starke, the UVA Dean of Engineering. I was impressed with Starke - his BS was from Virginia Tech - and UVA clearly had more space for engineering than did Virginia Tech.

At some point, I decided to look into the possibility of a position at the University of Virginia or Duke University. Since I knew Starke personally, I called him and asked about the possibilities. I also sent a letter to Duke asking about the possibility of a position. I was invited for an interview at both schools during which I gave a technical presentation and met faculty.

I was offered a position at UVA and decided to accept it, in part because I would stay in the Virginia Retirement System. I withdrew from consideration at Duke before they made a decision on me.

Since I was friendly with Dean Torgersen, I told him that I was considering an offer from UVA, before I told my department chair Dan Frederick. I later learned that Starke had called Torgersen to tell him that I had expressed an interest in UVA before I talked to Torgersen. Starke did this because they were institutions in the same state and often worked together on state-wide issues. Starke later told me that he didn't want Torgersen to think that he was raiding the Virginia Tech faculty.

In no way did I indicate to Torgersen that I was negotiating for a better offer from Virginia Tech. I told him because we were friends; we worked together on the computer initiative, and he had appointed me to the director position in the Virginia Center for Innovative Technology.

Torgersen encouraged me to stay at Tech and offered me a chaired professorship and a $16,000 yearly supplement from the chair, with half going to my salary and half being available for research activities. I was somewhat surprised by the offer and there is no question that I thought it was a little late in coming. Having basically decided to seek a position at what I believed was a better university, I found it difficult to pass up an opportunity that I had sought. This was true even though Starke could only say that he hoped to offer me a chaired professorship, but it would have to wait until more funds were received. He did offer me a two year appointment to the UVA Center for Advanced Studies. I wasn't required to teach during the appointment, but I did teach a composites course each year. I used most of my time building a composites activity at UVA.

It was not easy for Marlene to leave the home where we had raised our children and she had many friends and associates. She enjoyed her work at New River Community College, working primarily with students with disabilities, our neighbors and friends from the university, and St. Mary's Catholic Church. She told me that in view of the previous offers that I had turned down, she didn't expect me to want to make a move. When I told her that I did want to accept UVA's offer, it put her in a difficult position. She had already taken a couple of courses toward a doctoral degree at Tech. I thought it would be easy to complete her studies long distance or transfer to the University of Virginia. That turned out not to be the case. Nevertheless, she did agree to the move.

> *<u>Aside:</u>*
> *Paul Torgersen and I remained good friends. When I was a candidate for Dean of Engineering at UVA, I called Paul and asked him to be one of my references. He agreed and then asked if I wouldn't also like to be a candidate for the Dean position at Virginia Tech; he said it might be good to have two shots at being a Dean. We had only been in Charlottesville for a couple of years and without giving his suggestion much thought, I said thanks but I don't think we would want to move again. Hindsight says that quick decision may have been a mistake.*

Going Away Party

Before Marlene and I left for Charlottesville, more than fifty of our friends, neighbors, and colleagues gave us a very nice going away party at the home of Sally and Dean Mook, our next door neighbors for twenty years.There were gifts including a cake from Sally. The pictures from this event bring back many fond memories; they can even make me wonder why I decided to leave Blacksburg and Virginia Tech. There can be no question that Blacksburg and the ESM department was a very friendly place.

Kris, Marlene and Carl
Going Away Party

More of the party

Football Officiating

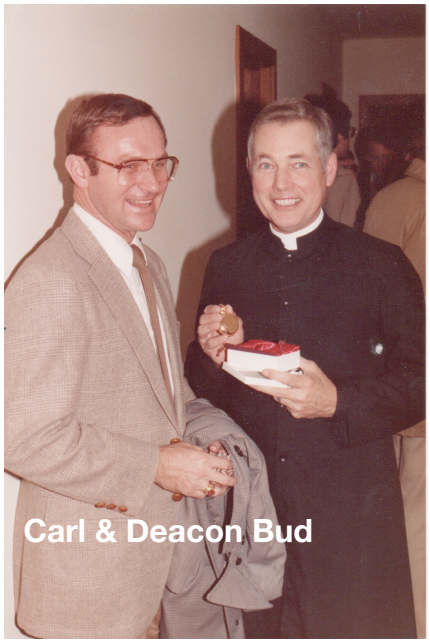
High School

Even though I had officiated high school football in Terre Haute and Northern Indiana, when we arrived in Blacksburg I had no plan to officiate football in Virginia. That all changed when I met Bud Robertson at a neighborhood party. (I think it was a party at our house, but I can't be positive of that.) The Stonegate neighborhood where we lived was one street of very friendly people, most of whom were new to Blacksburg, and worked at the university. All of us were happy to meet our new neighbors. Bud and his wife Libba (and children) lived on Stonegate Drive, just a short walk down the street from our house. Bud was a history professor who had just come from the University of Montana. More on Bud will follow later.

Talking to Bud at the party, I learned that he was a high school football official. When I told Bud that I had been a football official, the conversation quickly turned to the question of why I shouldn't officiate in Virginia. It wasn't long before I decided I should give it a try. I took the exam to be a Virginia high school football official and started officiating games in the fall, 1968.

The local football officials association worked out of Salem Virginia, near Roanoke. Meetings were on Tuesday evenings and that is when we found out our assignments for the following Thursday and Friday. JV games were played on Thursday afternoons and varsity games on Friday nights. Officials from the Blacksburg area worked games in what was the New River District with teams from Southwest Virginia. There were several officials from Blacksburg and we would car pool to the Tuesday night meetings. It was about a 40 minute drive. The games were played in places like Blacksburg, Radford, Christiansburg, Narrows, Dublin, Pulaski, Hillsville, and Galax. Galax was more than an hour south of Blacksburg.

Bud & Carl
Off to a 1985 Game



Carl & Deacon Bud

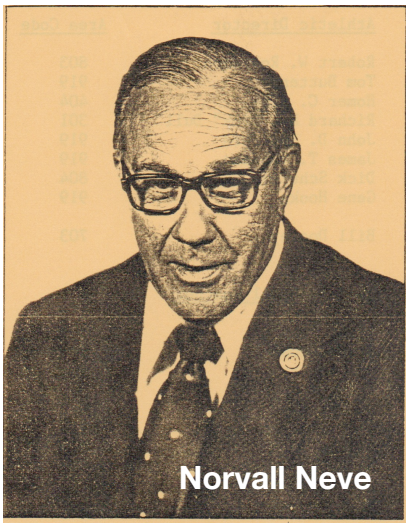
Bud Robertson

Bud was a referee and, most often, I was the umpire on Bud's crew. As a result, we spent a fair amount of time together in the fall, riding to and from meetings and games. Bud was an excellent football official. He knew the rules, gave very precise signals, kept his uniform impeccable, and hustled on the field. We had much to talk about during those trips, between football rules and university life; we became good friends.

I learned that Bud, formally Dr. James I. Robertson, Jr., was a distinguished Civil War Historian who gave outstanding lectures in the classroom and at speaking engagements; eventually, he was the author of more than a dozen books. He had been appointed Executive Director of the Civil War Centennial Commission by President John F. Kennedy and, as discussed in Manchester's book, *The Death of a President*, played an important role in planing Kennedy's funeral. Mrs. Kennedy had instructed the chief usher to follow the protocol and details of Lincoln's 1865 state funeral. Bud was in Washington at the time and considered a scholar of Lincoln's funeral. Late at night, he and two others searched through the lower levels of the Library of Congress with flashlights (the lights were off and could not be turned on until morning) looking for writings that gave details of Lincoln's funeral. Bud also became a Deacon in his church during his time in Blacksburg.

ACC

Norvall Neve - Supervisor of Officials


Norvall Neve

For several years, I officiated high school and small college football games, and Virginia Tech fall and spring scrimmages. On December 15, 1970, I wrote to Norvall Neve, Supervisor of Football Officials in the ACC (Atlantic Coast Conference) making application to be an ACC official (copy of the letter is in the appendix). Neve was the ACC supervisor until 1983.

In late April 1971, I received a memo (dated April 23) from Neve asking me to work a scrimmage at Wake Forest on May 1. This was the first time that I had any response to my letter of December 15, 1970. As I had already agreed to work a scrimmage at Virginia Tech on May 1, I told Neve that I was sorry that due to a previous engagement I would not be able to work the scrimmage at Wake Forest. I did not tell him what the previous engagement was; that turned out to be a mistake.

The next communication I received from Neve was dated May 28, 1971. The memo asked me to confirm availability to work as clock operator at two 1971 Virginia Tech games, September 24 against Maryland and October 1 against West Virginia. I wrote back confirming and noted that I was looking forward to a field assignment. Neve wrote back, on a copy of my note to him: "You turned one down, N. Neve". That explains why I should have told him the reason I couldn't work the scrimmage at Wake Forest. I immediately wrote and told him what my previous engagement was and he

agreed that an official should honor all commitments and said, “had you explained at the time, I would have understood”.

This incident demonstrates the difficulty, at times, in dealing with the supervisor of officials. Over time, it became apparent to me that being a football official in a major conference, such as the ACC, is considered a very cherished position, in the eyes of both the officials (it was for me) and the conference. As a result, the relationship can be one in which the official is in a precarious position and often willing to do most anything to keep the office happy.

> *Aside:*
> *Wives and secretaries of officials were well aware of the importance of a phone call from the supervisor of officials. Many told stories of the instructions that were given to secretaries; if family members or Norvall Neve call, put them right through.*

ACC Game Assignments

The first time that Neve saw me officiate on the field was at a Virginia Tech scrimmage. It would have been in the spring or fall of 1971, I’m not sure which. What I do remember is that he came in the dressing room after the scrimmage and, while I was in the shower, told me that based upon what he observed “you can make a very positive contribution to the ACC”. I was delighted with his comment and expected an on-field assignment to an ACC game in the near future. It didn’t happen that way. I didn’t get an on-field assignment to a varsity game until 1974.

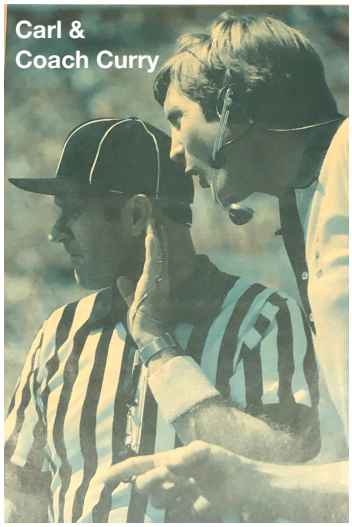
> *Aside:*
> *Dan Henning, at the time, an assistant Tech football coach, made a very nice comment to me after seeing me officiate Tech scrimmages. He said that while watching film of the scrimmages, referring to me, he told the other coaches “that’s the guy we should be recruiting”. Obviously, I was very pleased with the comment. Henning went on to have a twenty-five year career as an NFL coach including head coaching stints with the Atlanta Falcons and the San Diego Chargers.*

The early 1970s was a time when college freshmen were not allowed to play on varsity teams. Hence, there were freshmen teams and freshmen games. For the three years 1971 to 1973, I worked ACC freshmen and other small college games assigned by the ACC office. I was assigned as the clock operator for several Virginia Tech varsity games during these years.

I am in doubt as to which games I actually was assigned to as clock operator in 1971. I have a Virginia Tech Program for the game on October 23, 1971, on which I wrote “first ACC assignment”. However, I believe I wrote that years later and it may be a mistake. I wrote to the ACC to get clarification on my assignments in 1971, ’72 and ’73, but never received an answer. I was moved up to varsity games in 1974 and have complete records for 1974 to 1991.

> *Aside: A*
> *fter being on the ACC freshman roster for a year, I wrote to Neve recommending Bud Robertson as an official. Bud was accepted. A copy of my letter is in the Appendix.*

In the early years that I worked in the ACC, the officials had to be at the game site three hours before kickoff. We would have a pregame conference going over rules and unusual incidents from previous games. When it was a split crew of officials from two conferences, we reviewed officiating mechanics, the responsibilities of individual officials and the required coordination between officials on plays such as touchdowns when several factors were involved, i.e., was it a catch, was the receiver inbounds, was it a touchdown.


Carl &
Coach Curry

For me, living in Blacksburg, VA, this meant that I could often leave early in the morning of a game and be at the game site by 10:00 am for a 1:00 pm game. The ACC had only eight teams in 1974, Clemson, Duke, Georgia Tech, Maryland, North Carolina State, University of North Carolina, Virginia and Wake Forest. Clemson and Georgia Tech were the only ACC schools that required an overnight trip for me. Games at non-ACC schools always required an overnight trip.

My family went with me to many of my games during the first few years of varsity games. They would tour the campus and have lunch before the game. At places like Clemson and Virginia they could also visit the adjacent city. The family stopped coming with me as the kids got older, had visited most of the campuses, had activities in Blacksburg, and the ACC reporting policy changed requiring officials to be in town at 6:00 pm the night before an afternoon game the following day. This change in policy was due in large part to the availability of film or tape of a previous game that the officials reviewed on Friday night. The new policy also resulted in the crew getting to know each other much better over Friday night dinner.

My first on-field assignment for an ACC varsity game was September 21, 1974, Clemson at North Carolina State, in Raleigh. I remember it well as the officials dressed in a motel room some distance from the stadium; the university did supply rides to and from the stadium. We six officials returned to the motel room after the game and took turns using the one shower before dressing for the trip home. We had to pay for the use of the motel room; that really did surprise me. Fortunately the policy of requiring officials to pay for the room, even when they didn't stay over night, changed soon thereafter (I think it was by the following year). Most schools provided a dressing room for the officials at the game sight, even during the early years. As my memory is not the best, I will not mention schools other than NC State (my first game) where we dressed in a motel room.

Officials received a travel allowance in addition to our game fee; typically, it was sufficient to cover the cost of an overnight room when the room was necessary. We always received a room allowance once the 6 pm Friday reporting time was introduced several years later. The game fee was $200 in my first year; it was $450 during my last year, eighteen years later.

Complete listings of my ACC varsity football game assignments, the officiating crew for each game, and the coaches and schools that I worked for are provided in the Appendix. These lists show that I officiated 153 games, with 57 different schools, and 93 different coaches. I haven't counted the number of officials that I worked with but the number must be in the hundreds. I officiated in eleven post season (division playoff, championship and bowl) games.

The Crew

From 1982 to 1984, I worked most of my games on the same crew. The officials were: Robin Wood - referee, Scott Dawson - umpire, Bill Jamerson - head linesman, Carl Herakovich - line judge, Bud Robertson - field judge, and Bill Lovett - back judge. This was a great crew of football officials. All were very good officials (Dawson and Lovett went on to work in the NFL) and we had a tremendous amount of fun from the Friday evening dinner get-together to the Saturday departure after the game. The crew worked four post season games during the three years we were together. Bud and I traveled together for most of these games. There is no doubt that these three years were the most enjoyable and rewarding of my time as an ACC football official.

The Crew 1982
Lovett, Herakovich, Jamerson, Robertson, Wood, Dawson

In 1985, the ACC went to seven man officiating crews. This changed the dynamic of the crew in the following years. Five of the six officials were together for seven of our eleven games in 1985, but the dynamic was not the same as the other two officials were seldom the same.

Memorable Games

Astro-Bluebonnet Bowl - Dec. 23, 1974; N C State vs Houston

This game was memorable for several reasons. It was my first year as an ACC official and I did not expect to get a bowl game. However, on reflection, it should not have been out of the question. This was the first year of six man crews with all new field judges. Thus, it was reasonable that some of the new field judges would be selected for a bowl game.

I learned that I was selected for the Astro-Bluebonnet Bowl when Marlene and our son Doug showed up at my Virginia Tech office one day. Marlene had taken a phone call at home and learned that it was Norvall Neve calling to tell me that I had been selected for the bowl game. Doug was ill and home from school. Wanting to tell me in person, Marlene and Doug got in the car and came over to the university to tell me. When they didn't find me in my office, they went through the halls looking for me. When next door neighbor Dean Mook saw them he asked if he could help as this was very unusual, Marlene essentially never came over to my office unless there was a problem. Marlene didn't want to tell Dean what was up before she told me, so she just said that she needed to see me. They did find me and that was when I learned that I would officiate in the Astro-Bluebonnet Bowl.

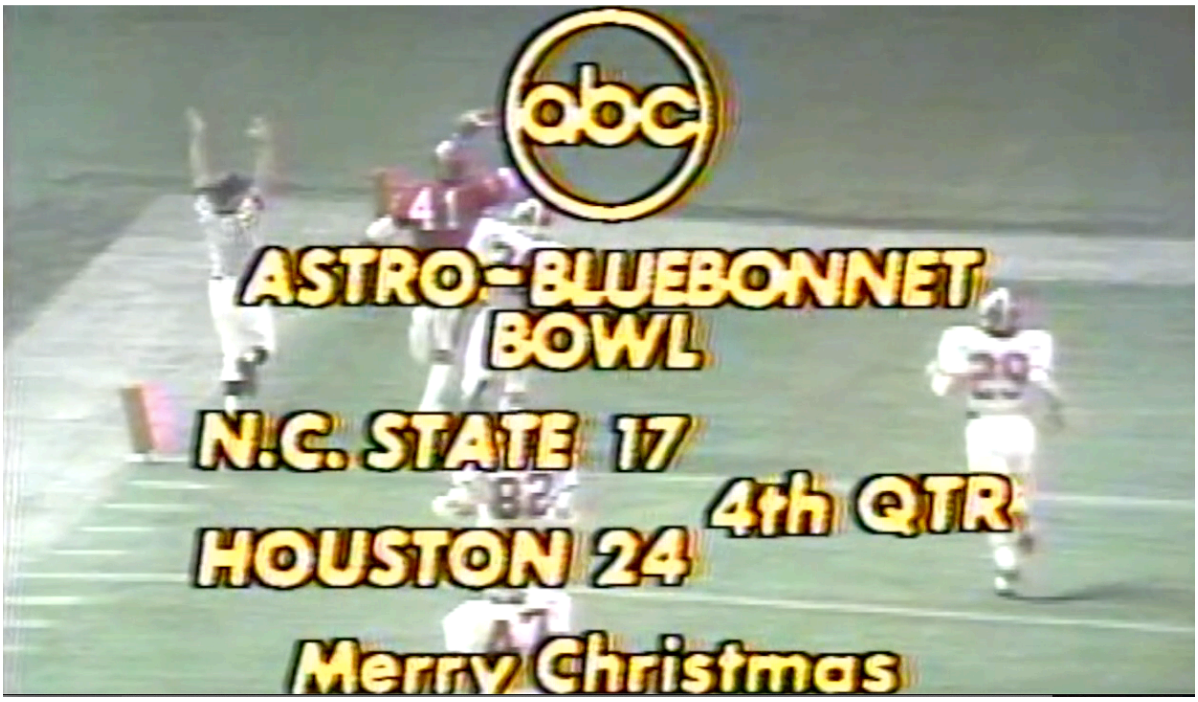
Our family of six all flew down to Houston, Texas for the game. It was my first bowl game and was played in the Astrodome. The only thing I remember from the game is how surprised I was when I walked out of the locker room on to the field. The "rug" was quite rough with seams that were very evident. I thought about the possibility of tripping on a seam.

When we returned to Blacksburg, I was under the impression that the game had been played, and officiated, without incident. However, Bud Robertson told me how the TV commentator Darrell Royal, the very successful former Texas coach (who had just retired), made me somewhat of a star. Bud had taped the game using an eight track taping system I had borrowed from the university. It required the use of a large, heavy supporting unit and two large tapes for the entire game. I still have these large tapes. By todays standards, the taping system was archaic.

The key play was a 74 yard touchdown pass play where I ran along side of the receiver to the end zone. The touchdown was replayed several times on TV and Royal commented "hey look at the official, he's the only one who can keep up with him. I wonder if he is from the Southwest or over at the Atlantic Coast. That guy in the stripes, he can run". Chris Schenkel, the play by play announcer, added "he sure can".

This play has to go down as my personal officiating highlight. Later I learned that Mike Lavery, son of the Virginia Tech President Bill Lavery was watching the game on TV,

knew that I was the official, and tried (unsuccessfully) to contact ABC to tell them who I was.



The play certainly didn't hurt my reputation among the ACC officials. I only learned much later how much the play impressed Norvall Neve, ACC supervisor of officials. When he retired in 1983, I wrote to him congratulating him and thanking him for what he had done for ACC officials. A copy of his hand written reply to me is in the Appendix.

The first paragraph reads:

> *"I was especially pleased to get such a nice letter from you. You were and always will be a special guy to me as well as a special official. I guess there never was a prouder moment in my professional life than when I watched you cover that long run in the Bluebonnet Bowl game. That was beautiful."*

Neve's comment made all the time and effort I put into officiating worth it.

> *A TV replay of the touchdown run and comments can be seen on YouTube at: 1974 Astro-Bluebonnet Bowl.*

Maryland at North Carolina - Sept. 20, 1975

This game is memorable for the most significant injury that I ever received on a football field. I was the field judge and back deep on punt plays. Early in the game, when the receiver gave a fair catch signal for a punt, I (too quickly) moved in front of him signaling time out in an effort to ensure that the kicking team players did not hit the receiver. One of the kicking team players didn't hit the receiver, he hit me! I went down momentarily, the Maryland doctor (who was also the doctor for the Washington Redskins) came out to attend to me. I was led off the field and taken, in an ambulance, to a hospital where a plastic surgeon repaired the cut above my eye with seventeen

stitches. I was driven back to the stadium, went to the locker room and changed into my civilian clothes. I believe I said goodby to the other officials when the game ended and then I drove back to Blacksburg.

It was an afternoon game and I was back in Blacksburg before 10 pm. When I walked into the kitchen from the garage, Marlene couldn't believe what she saw. My head was wrapped in white bandages. There is no question that I must have had a concussion and probably shouldn't have driven home. However, I wanted to be home. I had a huge black eye as a result of the hit. Fortunately, I didn't have a game the following Saturday and I was able to officiate two weeks later.

The best I recall, I asked another professor to take my class on the Monday following the hit. That experience taught me a lot about moving into a play too quickly. I now know why NFL officials are told to stay off the field as much as possible.

UVA at Texas - September 17, 1977

This was a split crew of officials with three from the ACC and three from the Southwest Conference. The officials had a breakfast meeting on the day of the game. We went over the usual items to make sure we were all thinking the same way. I don't recall why, but I brought up the fact that the ball was dead on the spot if there was a quick whistle. Well, on the ensuing kickoff after Texas scored one more time to make the score 61 - 0, the UVA returner caught the ball in the end zone and started to run up field. He was at about the one and a half yard line when the referee (from the Southwest) inadvertently blew his whistle. Rather than simply indicate that he blew it while the receiver was in the end zone (to put the ball on the twenty yard line), he put the ball down at the one and a half. UVA fumbled on their first play, Texas recovered and scored again on their first play. The final score was 68-0. Earl Campbell was the star of the Texas team. I don't recall how much he played, but he did score four touchdowns.

Bowie State at Liberty Baptist - September 22, 1979

This was the only game that I was the referee on the crew. I enjoyed it and thought I did a good job. Another thing that made the game unforgettable was that I met Jerry Falwell, Sr. The referee always goes into both locker rooms prior to a game to introduce himself to the head coach and go over any particulars for the game. When I went into the Liberty Baptist locker room, the Reverend Jerry Falwell was there and I was introduced to him.

Another thing that made this game memorable is the picture that I received from the Liberty Athletic Department. The attached note said that Coach Tom Dowling wanted to know "how I stayed so clean" on such a muddy field.

Georgia at Georgia Tech - November 28, 1982

(YouTube: 1982 Georgia Tech @ Georgia)

The thing that made this game memorable was that Herschel Walker was the tailback for Georgia. He was in his prime and would win the Heisman Trophy the following year. I was the back judge and at the snap, positioned in the defensive backfield. What sticks out in my mind is a play with Georgia having the ball near the goal line. My

Carl as Referee at Liberty Baptist

position put me deep in the end zone. However, there were so many photographers wanting to get the picture of Walker scoring that I had to (try) to back them out of the end zone. There was no other game that I officiated that had so much interest from the press.

NC State at Wake Forest - September 12, 1981

This turned out to be one of the more disappointing experiences I had as an ACC football official. It was the first game I worked after laying off for a year while we were in Paris, France where I was on sabbatical. It was a night game so the officials had to be in town by noon on game day. That afternoon most of us official laid around in our hotel rooms, often together in a room watching the U. S. Open tennis tournament. Both John McEnroe and Jimmy Connors were playing. I wasn't feeling well and went back to my room and tried to sleep for a bit. The referee on the crew was Rod Dailey. We never saw him until we appeared at the locker room. Rod spent the afternoon with his girlfriend.

In the locker room, we suited up as usual and then Rod conducted the pregame conference. During the conference, I continued to feel poorly and actually nodded off. Rod noticed this and brought me out of my "nap". Rod did not know that I hadn't been feeling well during the afternoon. Norvall Neve entered the locker room before the pregame conference was over. After the pregame conference was over, with Neve still

there, I quietly got two aspirin, went in to the adjacent bathroom and took them. Since Neve was there, Rod and I never spoke about the incident before going out on the field. He didn't know that I took the aspirin. We officiated the game without any difficulties. I felt fine while officiating and never thought to say anything to Rod after the game. I forgot all about it.

The following Saturday, I worked a game at Florida. When I got home, there was a letter from Neve informing me that I was "suspended from the Varsity Officials Roster until further notice". Without talking to me, Rod had told Neve that I had fallen asleep during the pregame. And, of course, Neve suspended me without ever talking to me about what happened. I never had a chance to tell him that I wasn't feeling well.

I called Neve and explained to him that I wasn't feeling well most of that day and told him how I, quietly, took two aspirin while he was in the locker room. I pointed out that it was my first games after being away for a year and there was no way that I was lacking preparation for the game. I was excited to be officiating a football game again. I pointed out that Rod had not been around all afternoon and had no knowledge of the fact that I hadn't been feeling well.

When the conversation ended, I was still suspended. This left me very disappointed with the entire situation. I felt that I had been giving more than 100% to officiating and now was being treated very unfairly. I was ready to end my career as an ACC football official.

I was scheduled to work a Virginia Tech freshman game at Tech on the following Thursday. However, I took the attitude that since I was suspended I should put my time into my academic work and not officiate the freshman game. I simply didn't show up for the game. A few days later I got a call from Neve. He seemed surprised that I didn't work the freshman game. I told him, "if I'm suspended, I'm suspended". I made it clear that I was being treated unfairly and if this was the end of my career as an official, so be it.

After a brief discussion, he told me to go ahead and officiate the next varsity game that I was scheduled for. I was no longer suspended. We had a good relationship after that.

Later I learned that when Rod and Bo Hackney, the field judge on the crew at Wake Forest, were walking around the field before the game, Rod asked Bo what he should do about Carl. Bo told him "nothing" forget about it, there's no problem. Bo was a more senior, highly regarded official who had been around for some time. He usually worked as a referee, so it isn't surprising that Rod would ask for his advice. It's too bad he didn't take it. Obviously, Rod Dailey was never my favorite referee after this incident.

Tangerine Bowl - December 18, 1982; Auburn vs Boston College

(YouTube Boston College vs Auburn 1982 Tangerine Bowl)

The crew for this game was the set crew of six that had been working together for several years: Wood, Dawson, Jamerson, Herakovich, Robertson, and Lovett. Doug Flutie was the BC quarterback, but it was not the game in which he threw the "Hail Mary pass". Late in the game Auburn was ahead by a couple of touchdowns when BC

got the ball and marched down the field to score as the clock ran out. Many fans poured out onto the field and Robin, Scott, Lovett and I all left the field thinking that there would not be an extra point. Well, the field was cleared, Bud took over as referee, Jamerson as headlines man, and the extra point was run. The four of us who had left the field were sitting in a police car under the stands waiting for the other two to show up. As we waited, the policeman driving the car had the game on the radio and so we listened to the extra point. Of course we were laughing at what had happened. We were concerned after the game that Mr. Neve, supervisor of officials, would be very upset with us. Later we learned that he had watched the game on TV and the announcers never picked up on the fact that four of the officials were not on the field for the extra point. Only recently, I verified the TV presentation when I saw the game on YouTube.

Later, we told Neve what had happened and he accepted it without concern. In fact, our next assignment from him was the Inaugural Kickoff Classic in the Meadowlands the following August.

Inaugural Kickoff Classic - August 29, 1983; Penn State vs Nebraska

(YouTube: 1983 Kickoff Classic #1 Nebraska vs #4 Penn State)

The highlight for this crew was when we were chosen to officiate the inaugural Hall of Fame Kickoff Classic between Nebraska and Penn State on August 29, 1983. The game was played in the Giants Stadium (the Meadowlands) in East Rutherford, New Jersey, outside New York City. Penn State was the defending National Champion and Nebraska was rated number one for the coming year. The coaches were Joe Paterno for Penn State and Tom Osborne for Nebraska. I was the Line Judge working on Joe Paterno's sideline. Nebraska won by a score of 44-6. There were no issues regarding the officiating. This was the only game I officiated between teams rated as number one and number two. There was a very nice reception the night before the game and my entire family made the trip with me.

Amos Alonzo Stagg Bowl - December 3, 1983; Augustana vs Union College

This game was the 1983 National Collegiate Division III Football Championship. For the first time in history, it was played on Galbreath Field, adjacent to the National Football Foundation College Football Hall of Fame in Kings Island, OH, outside Cincinnati. The crew of officials was the same crew that had worked the inaugural Kickoff Classic the previous year. We had gone out to dinner to a German restaurant on Friday night and Bud had a dinner that included sauerkraut. Well, midway through the game, Scott came over to me and told me that we were going to a five man crew, Bud had to go to the bathroom. There was a chainlink fence around the field and I saw Bud, on the far side, running along the fence, it was about four feet high, and he just jumped over it. When he got back, we returned to a six man crew. For years, we couldn't stop laughing about the incident.

The official observer for that game complimented the crew on an excellent game and noted two calls that he thought were particularly good; I had made both of them. One was an offensive pass interference call. I forget what the second one was.

Maryland at Clemson - Nov. 16, 1985

(YouTube: Maryland at Clemson 1985)

This game had the most unusual ending of all the games that I officiated. The crew included Robin Wood, Scott Dawson, Bill Jamerson, Bud Robertson, Jimmy Knight, Dan Post and me. Danny Ford was now the head coach at Clemson. Wood, Dawson, Jamerson, Robertson and I all knew Ford quite well because we worked Virginia Tech scrimmages when he was an assistant at Tech.

It was a hotly contested, Saturday night game on CBS national television. Maryland kicked a field goal to go ahead with only a few seconds left on the clock. Ford was convinced that the 25 second clock had expired before the snap and raised quite a ruckus. When the game clock ran out during the ensuing kickoff, the Clemson bench and the hometown fans poured out on the field. We officials hurried off the field to our dressing room that was under the stands at one end of the field.

1987 Gator Bowl Officiating Crew
Gil Rushton, Doug Foley, Bill Luper, Robin Wood, Carl Herakovich,
Bill Wampler, Dick Tyndall, Ted Jackson

My wife Marlene and son Russ had come to the game with me because our daughter Kris was a student at Clemson. Marlene later told me how she had gone over to the area near our dressing room to ask a police officer if all of the officials had made it into the locker room. She was told yes, we all made it in.

We officials showered and changed into our regular clothes and then were told to wait there for a while as the fans out in the hall were still quite agitated. After twenty minutes or more, it was decided to move us officials over to the police station that was adjacent to the stadium. We gathered our gear and, with a cordon of police around us, we walked the short distance to the police station. We stayed in a second floor room there for as much as another thirty minutes while the crowd dissipated.

The police then told us that they would escort each of us to our car. My car was at the Clemson House on the other side of the campus. I was able to contact Marlene who was in Kris's dorm room to let her know to meet me at the Clemson House. I was led to a police car right outside the police office and driven over to the Clemson House where Marlene, Russ and Kris met me. We said goodbye to Kris, got in our car and a police car led us through town to make sure that we were able to leave Clemson without incident.

During the drive home, Marlene told me how the mother of Kris's roommate told her that the 25 second clock had run out before the snap "because the radio announcer said so". We made it home without further incident.

Maryland at Carolina - November 2, 1991

Rickey Patterson, the field judge for this game, was in his second year as an ACC official. When we came down the field after the opening kickoff, the ball was downed between Rickey and me, but closer to Rickey. As I blew my whistle, I heard Rickey yelling, "I don't have a whistle". As I always carried a spare, I gave him a whistle.

Prior to including this story in my memoir, I checked with Rickey who has now been an NFL official (he is number 15) for twenty-five years. He told me that that was the only time that ever happened to him and, as a result, he developed a checklist that he reviews before going on the field for every game he has officiated since that Carolina game, including all his NFL games which includes two super bowls.

I told Rickey that I had a checklist that I reviewed every time I left home to officiate a football game. The last thing an official wants is to be without a required piece of equipment at the game site. They are not everyday items that can be picked up on a moment's notice. My family was aware of my list so much so that my daughter Kristine made a needle point of the list and it still hangs on my wall today.

Tokyo Bowl - December 1, 1991

This was the annual game between two football teams from one American conference, with the conference rotating from year to year. Clemson played Duke in 1991 and I was the head linesman in the game. The game was played in the Tokyo Dome which is surrounded by an amusement park. We were provided rooms in a hotel some distance from the Dome. Prior to the game we were given a ride in a van to the game site.

The game went off without a hitch. However, after the game, there was no one there to give us a ride back to the hotel. So, we seven officials, in uniform, walked through the amusement park and found a major boulevard where we basically stood out in the

traffic to hail down two taxis. Now we didn't speak Japanese, we did not have any money, and we weren't too sure where our hotel was. Somehow we convinced the taxi drivers that we would pay them at the hotel if they would give us rides. It worked out in the end.

That was my last game as an ACC football official.

Tokyo Bowl - 1991
Tommy Hunt, Bud Elliot, Carl Herakovich, Ernie Cage

<u>Asides:</u>
A suggestion that I made to Norvall Neve resulted in a national change in the manner that chain crews functioned along the sideline of a game. It had always been the practice that the chain crew stood right on the sideline, with the result that players often ran into members of the crew, the chain or the poles at the chain ends. The location of the chain was maintained by clipping a marker to one of the five yard lines between the poles each time the chain was moved. This allowed the chain to be returned to the correct location if the chain was moved out of the way of the players. I pointed out to Neve that once the marker was attached to the chain, there was no need to keep the chain and chain crew at the sideline, they could be moved back off the sideline reducing the possibility of an injury to a player or the chain crew. This became the national policy for chain crews the year after I suggested it to Neve.

On a different note, a call I made in a game had the effect of changing the football rules thereafter. For many years it was illegal for a runner to hurdle over a player trying to tackle him. When I threw my flag for hurdling in a game, it was the only time it was called that year, throughout the country, and the best I was able to determine, it was the first time that it had ever been called. The following year, it was no longer illegal to hurdle over a tackler. It is now very common to see runners try to hurdle over the tackler; they are seldom successful.

ACC Retirement

As I look back on my time as an ACC football official, it is apparent that I reached a point where the demands of officiating were competing with my family and academic responsibilities. I got to the point where I was up for a football game when it was a highly contested game between teams of near-equal quality. However, when that was not the case, I often wondered why I was spending so much time officiating. After we moved to Charlottesville in1987, Marlene was in a new city and alone (our last child Russ was now in college in Blacksburg) when I was away officiating on Friday and Saturday, and, on occasion, part of Sunday. On the academic side, I was trying to establish a new group in mechanics of composites at UVA, while improving my standing in the larger, national and international mechanics community. It didn't help my academic work that I had to leave on Friday in order to be at a game site before 6 pm that evening.

The incident that stands out in my mind was working a 1989 game with Duke at Tennessee. There were more than one hundred thousand people in the stands; as I walked around the field prior to the game, I actually thought to myself, why am I doing this with Marlene at home alone? I retired after the 1991 season.

In April, 1989, I wrote to Bradley Faircloth, the ACC supervisor of officials, and told him that I was anticipating working no more than three more years as an official. Copies of my letter and his response are in the Appendix.

I thoroughly enjoyed my time as an ACC football official and I have chosen to write about all those good times and great friends that I had the good fortune to meet and work with. Football officials are proud, dedicated men trying to do the best job that they possibly can and I have tremendous respect for them.

I want to add a personal comment about announcers making reference to a "make-up call". In all my experience, there isn't such a thing. I can't tell you how often an official I was working with made the statement that he hated that his call might look like a "make-up" call, but it was there and he just had to make it.

Real Estate Investments

Oxford House

Rich McNitt (another young ESM faculty member) and I ventured into rental properties in 1969 when we purchased an older, frame house and adjacent, vacant lot on Progress Street in Blacksburg. The house was a short walking distance from campus. We learned that it was for sale from a graduate student who was renting one of the apartments.


Rich McNitt

We both put up $2,500 as our initial investment and secured a $12,000 loan. The home had two apartments in it when we bought it; we converted it to three apartments. We named our business, *Oxford House,* in recognition of the fact that the building was painted an Oxford gray color.

Over the next several years, we added a modular duplex on the vacant lot, purchased another duplex on Pepper Street (across the street from the campus), purchased 2.379 acres and an old farm house on Giles Road when the Virginia Highway Department took our duplex on Pepper Street, bought the duplex back from the state and moved it, setting it on top of two newly built apartments to form a fourplex on the property we had purchased on Giles Road. We sold all the properties in 1985.

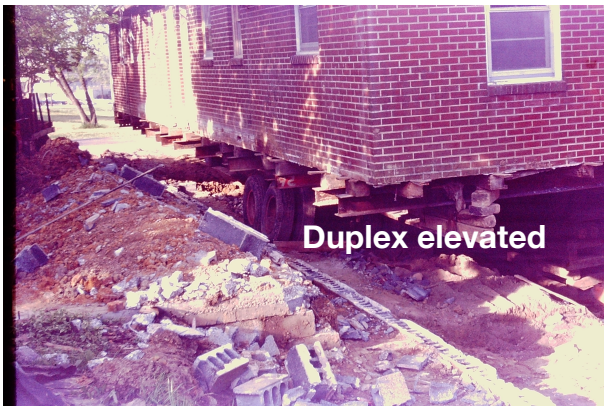
We had a friendly banker in Blacksburg which allowed us to make these purchases without putting in additional capital. Each time a new purchase was made, we rolled over existing loans into new, larger loans. A table in the Appendix details all of these transactions.

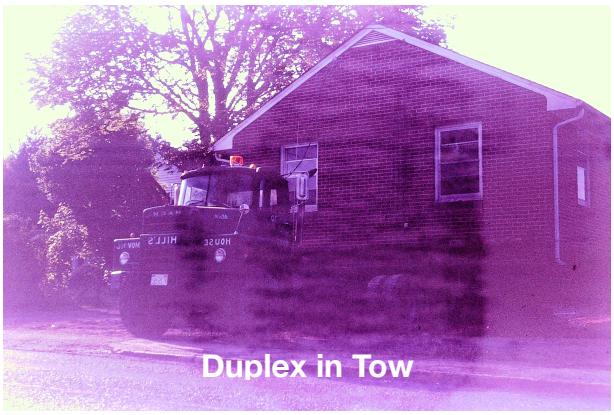
> *<u>Aside:</u>*
> *During the process of converting the original Oxford House on Progress Street to three apartments, we discovered (behind a wall) newspapers from 1904, possibly the year of construction. I retrieved two items from the house for my home, a chandelier and a rocker. Both are now in my home in Raleigh. It is apparent that they are both very old, and probably have been around for more than 100 years.The rocker has been refinished and the*

chandelier has been rewired. McNitt took a collection of old bricks that were loose on the property; he installed them as a walkway to his front door in Blacksburg.


Oxford House Rocker

The final accounting indicated that our initial investments of $2,500 resulted in a net profit of $100,000 for each of us. In addition to the cash received, we were able to provide one of Rich's brothers a summer job as he did much of the construction work, along with Rich, me and some of our children, in building the two apartment foundation of the fourplex on Giles Road. Rich and I both did many repairs at all of our apartments through the years (without payment). Children were paid when they did things like cut





the grass. And, my son Doug lived in one side of the modular duplex on Progress Street, as caretaker, for the last three of his years as a Virginia Tech student. It definitely was a worthwhile financial venture.

Sunset Beach

In 1986, Marlene and I purchased a home at Sunset Beach, NC. I had learned about Sunset Beach from Don Safrit, a fellow ACC official. Don was a builder who lived on Sunset. Sunset Beach is a small community, 35 miles north of Myrtle Beach, SC. Most


One Lane Bridge


Open Bridge

of the town lies on an island across the intercostal waterway. The years that we owned property there, access to the island was via a single, one lane bridge that swung open on the hour to let boats on the intercostal pass through. The island was essentially a community of rental, vacation homes. There was one general store (owned by Don) and one or two other shops and several rental agencies. The beach was a long, beautiful, sandy beach. Today, the one lane bridge has been replaced with a permanent, elevated, two lane structure.

SUR MER

Don Safrit built the first home we purchased; it was on the 3rd row (away from the beach). It was a two story, wooden structure with four bedrooms and 1,746 sq. ft. of heated living space. The house was elevated to allow for the possibility of flood waters. There were decks on two levels. We bought the home in April, 1986 for $152,900,- using the proceeds from the sale of the Blacksburg rental properties. The house was located on Lot 7, Block 7, Sunset Beach. The postal mailing address was 604 Canal Street, Sunset Beach.

We rented the home to vacationeers throughout the summer. Our family spent time there mostly on holidays before and after the summer rental season. We named the house SUR MER, which I translated from French to English as “At the Sea”. We sold SUR MER eight years later in November, 1994 for $212,500.

A LA PLAGE

We purchased an ocean front lot (Lot 23, Block 15-R) Sunset Beach in September, 1994 for $375,000; then built a duplex with a total of eight bedrooms on the lot. The postal mail addresses of the two sides of the duplex were: 1704A and 1704B, East

Main Street, Sunset Beach. We named the two sides of the duplex A La Plage (Est) and A La Plage (Ouest), translated as At the Beach East and At the Beach West.

The duplex with a total of eight bedrooms was built by Fred Yarbrough of Yarbrough-Farr Construction Company. The cost of construction was $246,083.35; a total cost of $621,083.35 for the land and the building. We sold A La Plage in 2002 (eight years later) for $1,194,000.00 with two different buyers each purchasing one side of the duplex.

I provided the names and overall design for the signs for both of our houses on Sunset Beach. A local sign company provided the actual signs.


1704
E
W
A La Plage Street View


A La Plage - Ocean View


A LA PLAGE
1704

Epilogue

There can be no doubt that the twenty years our family spent in Blacksburg, Virginia was a very happy, exciting and enriching time. The four children received their elementary (Gilbert Linkous), middle and high school (Blacksburg) educations in the local public schools. When the children were young, Marlene taught part time at Methodist pre-school and the Carousel Day-Care Center, she earned her master's degree at Virginia Tech (1980) and was a counselor at New River Community College in Dublin, working with Head Start teachers and students with special needs, after we returned from France.

Brad, Doug and Russ had paper routes and all three boys had stints working summers at the Virginia Tech golf course. Kris worked at a local bank two summers and one at a Pizza Hut. Doug and Kris worked in the dining room at the Center for Continuing Education. One summer Brad worked on construction building a new building on the Virginia Tech campus. Doug worked in the Virginia Tech Sports Information office all four years that he was a Tech student. Russ worked in the business office at the University of Virginia Hospital two summers after we moved to Charlottesville. And, as discussed previously, Brad, Doug, Russ and Kris all made a small business of buying and selling Virginia Tech football tickets.

All four children graduated from college in four years and did not have any debt upon graduation. Brad graduated from the University of Virginia (1984), Doug (1985) and Russ (1990) graduated from Virginia Tech, and Kris graduated from Clemson University (1988). Later, Kris earned two master's degrees, one at Virginia Commonwealth University and an MBA at William and Mary. Russ earned an MBA at Virginia's Darden School of Business.

We spent three summers in the Newport News, Hampton, Tidewater area of Virginia while I worked at NASA Langley Research Center. This gave us the opportunity to explore Williamsburg, Cape Hatteras, and the North Carolina Outer Banks. I coached little league basketball for a couple of years and at least one year of summer baseball. I was an officer with the Gilbert Linkous PTA for a year.

After one (sorta failed) summer vacation where I tried to find a cottage on a lake similar to the ones I had vacationed at when a child, we learned to go to the ocean in the Myrtle Beach area for summer vacations. We drove back to the Chicago area about once a year to visit family. It was about a twelve hour trip in our station wagon. On the first trip to Whiting and East Chicago, all six of us stayed in one hotel room for one night. After that we decided it made more sense to drive straight through. We always stopped at Beckley, West Virginia for mid-morning tea and toast, often packed a picnic lunch, and, on occasion, stopped briefly in Columbus, Indiana to visit with friends Ron and Sherri Rosin and there two sons Todd and Matt.

I worked through the ranks from Assistant to Associate to Full Professor, conceived and developed the NASA Virginia Tech Composites Program, and provided the initial idea for the Virginia Tech Personal Computer Initiative.

We purchased a four bedroom home and then added two additional bedrooms over the garage. The family traveled throughout Europe while I was on sabbatical at École Polytechnique in Paris. I officiated ACC football and the family traveled with me to many of the campuses during the early years of officiating. We purchased rental real estate properties in Blacksburg and then two rental homes at Sunset Beach, NC.

We attended St. Mary's Catholic Church, and made many life-long friends. Living in a small college town in the mountains of Virginia was a very satisfying and enjoyable time.

The following family photo was taken prior to Doug's 1993 wedding to Gerri Robuck:

Herakovich 1993
Russ, Brad, Carl, Marlene, Kris, Doug

Appendices

Herakovich Graduate Students

Virginia Tech and the University of Virginia graduate students (total 54) that I advised are listed below.

Virginia Tech (38 total)

(* Denotes participation in NASA-Virginia Tech Composites Program, 16)

PhD (11)

Name	Year	Name	Year	Name	Year
Rafik Y. Itani	1975	O. Hayden Griffin, Jr.	1980	Gaurang N. Choksi	1988
Peter W. Hsu	1975	Marek-Jerzy Pindera*	1981	Deidre A. Hirschfield	1990
Gary D. Renieri	1976	Scott M. Milkovich*	1984	D. Scott Norwood*	1990
Michael P. Renieri	1976	William B. Avery*	1987		

Master's (27)

Daniel M. F. Wong	1974	Anya Nagarkar	1979	Susan M. Reed	1986
C.N. Viswanathan*	1975	J. Steven Mills	1979	Takahiro Fujita	1987
George H. Wilson, III	1975	David E. Bowles*	1980	Jack L. Beuth, Jr.	1987
Larry R. Markham*	1976	Ernest W. Brooks, Jr.*	1982	Elizabeth A. Strauss	1987
John M. Kennedy*	1977	Mathew B. Buczek*	1982	Derek J. Fox*	1987
Edward A. Humphreys	1977	Daniel S. Adams*	1983	Steve Mathison	1987
Henry W. Bergner*	1977	Michael A. Gregory	1984	Wolfgang Becker	1987
David A. O'Brien*	1977	Andre Barbe	1985	S. Prasad Kadiyala	1987
Mark J. Shuart*	1978	Stephen W. Burns*	1985	Tamara Wright Knott	1987

University of Virginia (16 total)

PhD (3)

Name	Year	Name	Year	Name	Year
Jeffrrey S. Hidde	1989	Cheryl A. Rose.	1992	Clifford J. Lissenden	1993

Master's (13)

Joseph J. Carey	1989	David L. Larom	1990	Eric J. Lang	1991
Jeffrey D. McGee	1992	M. Wren Sigrest	1992	David C. Fenton	1992
Cheryl L Hersh	1994	C. Scott Sealing	1996	Robert D. Schroedter, III	1996
Christopher G. Seitz	1996	Alysha Roerden	1998	Erik A. Phillips	2000
Nathan D. Flesher	2001				

Graduate Student Research Topics

(* Denotes participation in NASA-Virginia Tech Composites Program.)

Ph.D. Dissertations - Virginia Tech

Name	Title	Date
Rafik Y. Itani	Elastic/Plastic Torsion of Non-Uniform and Nonhomogeneous Bars	Jun 1975
Peter W. Hsu	Interlaminar Stresses in Composite Laminates - A Perturbation Solution	Jun 1975
Gary D. Renieri	Nonlinear Analysis of Laminated Fibrous Composites	Jun 1976
Michael P. Renieri	Rate and Time Dependent Behavior of a Structural Adhesive	Jun 1976
O. Hayden Griffin, Jr.	Three-Dimensional Inelastic Finite Element Analysis of Laminates	Jun 1980
Marek-Jerzy Pindera*	An Endochronic Theory for Transversely Isotropic Composites	Sept 1981
Scott M. Milkovich*	Space Radiation Effects of Graphite-Epoxy Composite Materials	Jun 1984
William B. Avery*	A Study of the Mechanical Behavior of a 2-D Carbon-Carbon Composite	Jun 1987
Gaurang N. Choksi	Crack Growth in Unidirectional Composites Using Singular Finite Elements and Interactive Computer Graphics	Jun 1988
Deidre A. Hirschfield	Failure Analysis of Notched Graphite-Epoxy Tubes	Feb 1990
D. Scott Norwood*	An Analysis of Interlaminar Stresses in Unsymmetrically Laminated Plates	Sept 1990

Master's Thesis - Virginia Tech

Daniel M. F. Wong	Tensile Behavior of Aluminum Reinforced with Angle-Ply Boron/Epoxy Laminates	Jun 1974
C.N. Viswanathan*	Tensile and Compressive Behavior of Boric/Aluminum Composite Laminates	Jun 1975
George H. Wilson, III	A Microprocessor-based System for Laboratory Data Acquisition	Jun 1975
Larry R. Markham*	Optimum Design of Composite Laminates with Thermal Effects	Jun 1976
John M. Kennedy*	Influence of Temper Condition on the Nonlinear Stress-Strain Behavior of Boron-Aluminum	Jun 1977
Edward A. Humphreys	Nonlinear Analysis of Bonded Joints with Thermal Effects	Jun 1977
Henry W. Bergner*	Analysis of Shear Test Methods for Composite Materials	Jun 1977
David A. O'Brien*	Finite Element Stress Analysis of Ideal Composite Damage Zones	Dec 1977
Mark J. Shuart*	An Evaluation of the Sandwich Beam as a Compressive Test Method for Composites	Aug 1978

Anya Nagarkar	Nonlinear Temperature- Dependent Failure Analysis of Finite Width Composite Laminates	Sept 1979
J. Steven Mills	Transverse Microcracking in Celion 6000/PMR-15 Graphite Polyimide	Dec 1979
David E. Bowles*	Thermal Expansion of Composites using Moire Interferometry	Jul 1980
Ernest W. Brooks, Jr.*	Advances in Moire Interferometry for Thermal Response of Composites	Mar 1982
Matthew B. Buczek*	Finite Element Models for Predicting Crack Growth Characteristics in Composite Materials	Oct 1982
Daniel S. Adams*	Characteristics of Thermally Induced Transverse Cracks in Graphite-Epoxy Composite Laminates	Jun 1983
Michael A. Gregory	Prediction of Crack Extension Direction in Unidirectional Composites	Aug 1984
Andre Barbe	A Critical Assessment of Crack Growth Criteria in Unidirectional Composites	Aug 1985
Stephen W. Burns*	Compressive Failure of Notched Angle-Ply Composite Laminates: Three Dimensional Finite Element Analysis and Experiment	Aug 1985
Susan M. Reed	The Effects of Space Radiation on a Chemically Modified Graphite-Epoxy Composite Material	Jul 1986
Takahiro Fujita	Temperature-Dependent Tensile and Shear Response of Graphite/ Aluminum	May 1987
Jack L. Beuth, Jr.	An Analytical & Experimental Study of Crack Extension in Center-Notched Composites	Jun 1987
Elizabeth A. Strauss	Finite Element Analysis of Damaged Cross-Ply Composite Laminates	Jun 1987
Derek J. Fox*	Space Environmental Effects on Graphite-Epoxy Compressive Properties and Epoxy Tensile Properties	Jun 1987
Steve Mathison	Nonlinear Analysis for the Response and Failure of Compressive-Loaded Angle-Ply Laminates with a Hole	Jun 1987
Wolfgang Becker	Mechanical Response of Unidirectional Boron/Aluminum under Combined Loading	Jun 1987
Tamara Wright Knott	Effect of Fiber Morphology on Composite Properties	Jun 1987
S. Prasad Kadiyala	An Experimental and Numerical Study of Notch Sensitivity of ARALL® Laminates	Sep 1987

PhD Dissertations - University of Virginia

Name	Title	Date
Jeffrey S. Hidde	Notch Sensitivity of ARALL® Laminates	Dec., 1989
Cheryl A. Rose	An Approximate Solution for Interlaminar Stresses in Laminated Composites	May, 1992
Clifford J. Lissenden	Inelastic Deformation of Metal Matrix Composites	May, 1993

Master's Thesis - University of Virginia

Joseph J. Carey	Notch Sensitivity of ARALL® Laminates and Aluminum Alloys	Nov 1989
David L. Larom	Elastic Wave Propagation in Radially Impacted Composite Cylinders	June 1990
Eric J. Lang	Failure Initiation in Notched Composite Laminae	May 1991
Jeffrey D. McGee	Micromechanics of Fiber/Matrix Debonding	May 1992
M. Wren Sigrest	Micromechanical Analysis on the Strength of Notched Composites	Dec. 1992
David C. Fenton	Interlaminar Stresses in Stiffened Composite Panels	Dec. 1992
Cheryl L Hersh	A Two-dimensional Cylindrical Finite Element for Three-Dimensional Analysis of Stiffened Composites	May 1994
C. Scott Sealing	Probabilistic Damage Modeling for Bi-Axial Stress States	Jan. 1996
Robert D. Schroedter, III	Mesoscale Damage Modelling of the Laminated Carbon Fiber-Polyimide matrix Composite IM7/K3B	Jan. 1996
Christopher G. Seitz	Thickness Effects in Notched Graphite-Epoxy Lamina	Jan. 1996
Alysha Roerden	Inelastic Thermo-mechanical Response of Hybrid Fiber Composites	May, 1998
Erik A. Phillips	Finite Element Modelling of Damage at the Meso-Scale in Fibrous Composites	Aug. 2000
Nathan D. Flesher	Damage Evolution in Stiffened Composite Structures Subjected to Variable Loadings	Aug. 2001

NASA-Virginia Tech Composites Program

Complete List of Students

All Graduates of the NASA-Virginia Tech Composites Program				
C.N. Viswanathan	David A. Erb	Susan M. Reed	Derek J. Fox	Hannes P. Fuchs
John M. Kennedy	Ernest Brooks	Carl T. Rousseau	Jeremy C. Howes	Eduardo Moas, Jr.
Larry R. Markham	Eric Klang	Scott A. Ragon	Mark D. Sensmeier	Andrea L. Ogden
Henry W. Bergner	Judy D. Wood	Scott T. Burr	Scott S. Norwood	Carol A. Meyers
Gary L. Farley	Daniel S. Adams	Edward H. Glaessgen	Richard D. Young	Karen Levander
Mark J. Shuart	Matthew Buczek	Marshall B. Woodson	Gary D. Swanson	Nancy Vandermey
David A. O'Brien	Douglas M. Carper	John D. MacRae	Peter N. Harrison	Nicole L. Breivik
James F. Knauss	Scott M. Milkovich	Timothy L. Brown	Robert N. Yancey	Larry D. Peel
Ramon Garcia	David Cohen	Scott E. Steinbrink	Mark S. Derstine	Ellisa Carapella
Ronald D. Kriz	John Short	Clayon R. Carter	Steven J. Claus	Christine Perry
Mark A. Palie	Mike Rooney	John C. Fingerson	J. Scott Collins	Vincent Hammond
J. Steven Mills	Douglas Loup	Jaret C. Riddick	Robert P. Ley	Hal Radloff
Richard L. Boitnott	S. Tim Tyahla	Jose G. Perez-Batista	Frederick Stoll	Carol A. Meyers
Marek-Jerzy Pindera	David E. Cooper	Aaron Caba	J. Michael Starbuck	Keith Furrow
David E. Bowles	Edward J. Derian	Jonathan Rich	Forrest E. Yocum	D. Muheim Thompson
Thomas A. Zeller	William B. Avery	David Cohen	Mark Weideman	
Kimberly N. Yates	Philip H. Dara	Steven R. Mathison	Lynda S. Olesuk	
Michael P. Nemeth	Stephen W. Burns	David L. Bonanni	Todd M. Wieland	

College of Engineering Computer Initiative

Letter: Herakovich to Provost John Wilson

COLLEGE OF ENGINEERING

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Blacksburg, Virginia 24061

THE NASA-VIRGINIA TECH COMPOSITES PROGRAM PHONE: (703) 961-5372; TELEX: 710.87.53699

December 17, 1981

Provost John D. Wilson
Provost's Office
201 Burruss Hall
Campus

Dear John:

There is something fundamentally wrong in this University with the allocation of computer funds for academic work. This Fall quarter I have been teaching ESM 4040, Mechanics of Composite Materials. Thirty-two students are enrolled in the course, approximately half graduate and half undergraduate students. The only practical way to work with the equations which describe the behavior of composite materials is on the computer. Computer funds in our department are very limited and I have had to beg, borrow and almost steal to secure a grand total of $3865 dollars in computer funds for these 32 students, an average of $121 dollars per student. Because of the limited funds in our department it has been necessary for me (working with computer center staff) to set up individual student accounts to monitor and limit the use of funds by each student. During the past two weeks I have been distributing funds to the students in $10-15 increments. Students often cannot do their work because they are out of funds, they can't find me, I am out of funds to give them or it is night or weekend and the office in the computer center is closed. This has all been very frustrating to me and the students. The time and interruptions have played havoc with my scholarly pursuits.

In contrast to the ESM Department, a student I know quite well is taking CS 3301 this quarter. She claims to have spent over $5,000 herself this quarter on computer work associated with her course. There are about 50 students in the CS class and there is one account shared by all the students. Thus the faculty member is freed of administrative interruptions. Computing Center personnel have verified to me that very large sums of money are being spent by students in CS courses.

I would appreciate it if you could look into this matter and institute a more equitable policy for allocation of computer funds.

Best regards,

Carl

Carl T. Herakovich
Professor of
Engineering Science and Mechanics

clb
cc: P. Torgersen
J. Osborne
D. Frederick
J. Sword
V. Chachra

COMPOSITE MATERIALS RESEARCH & EDUCATION

National Aeronautics & Space Administration
Langley Research Center
Hampton, Virginia 23665

Reply to: The NASA-Virginia Tech Composites Program
Department of Engineering Science and Mechanics
Virginia Tech
Blacksburg, Virginia 24061

Committee Draft Proposal

TO: All Engineering Faculty 2/8/83

FROM: Ad Hoc Committee on Undergraduate Computer Capabilities
(C.T. Herakovich, Chairman)

Your reactions to this draft proposal are requested no later than February 15, 1983.

DRAFT PROPOSAL ON GOALS FOR ENGINEERING COMPUTING

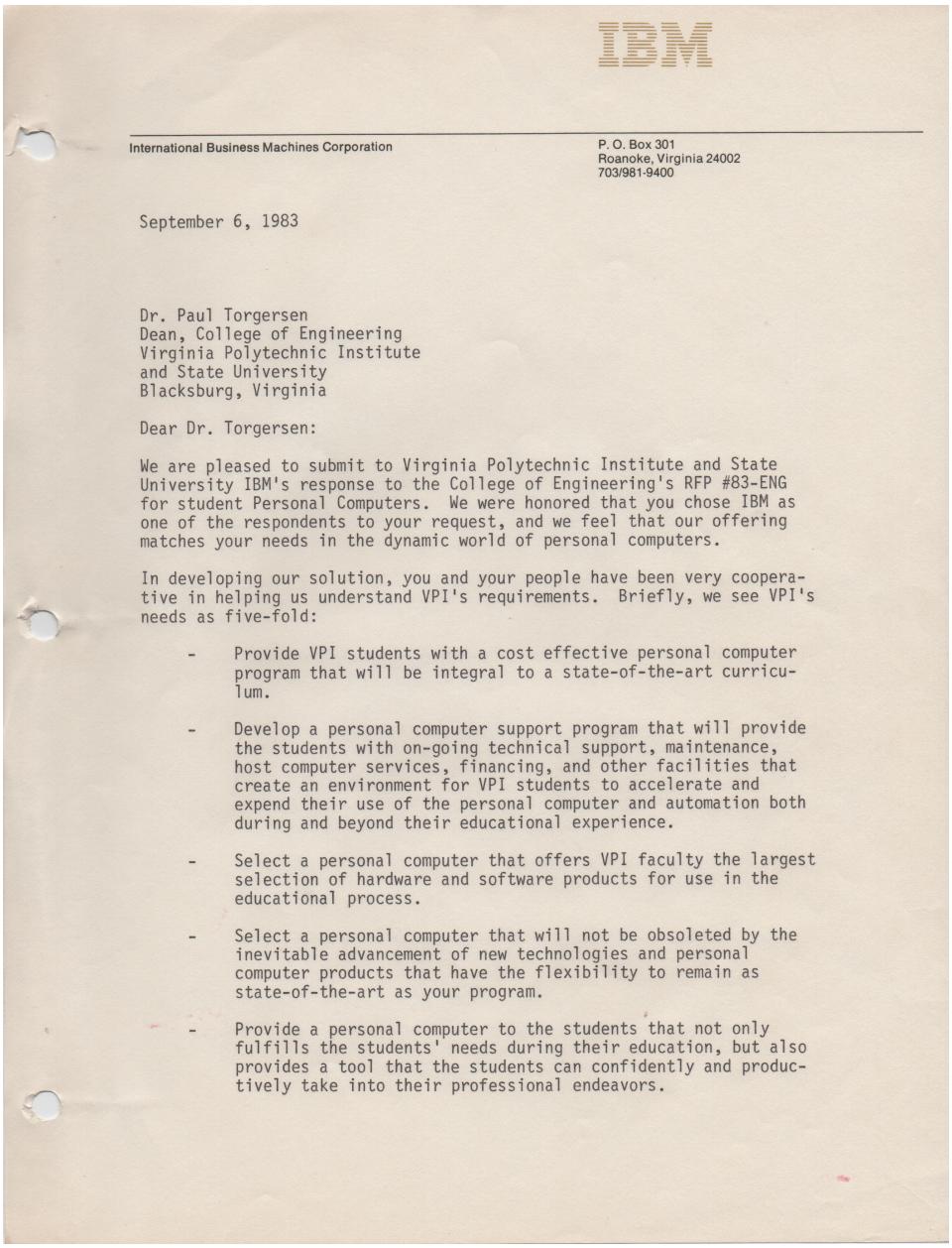
LONG RANGE GOALS (TO BE IMPLEMENTED BY FALL '85)

OVERALL OBJECTIVES:

- TO INSURE THAT ALL ENGINEERING FACULTY AND STUDENTS ARE COMPUTER LITERATE IN EVERY SENSE OF THE WORD
- TO FULLY INTEGRATE THE COMPUTER INTO ALL LEVELS OF EDUCATION IN THE COLLEGE OF ENGINEERING
- TO USE PERSONAL COMPUTERS (PCs) RATHER THAN LARGE HOST COMPUTERS AS MUCH AS IS APPROPRIATE FOR ACADEMIC AND RESEARCH COMPUTING IN THE COLLEGE OF ENGINEERING

- SPECIFIC OBJECTIVES:
  - Every faculty member, who so desires, shall have a PC in his of her home or office
  - Every entering engineering freshman shall purchase his or her own PC which meets specifications stated by the College of Engineering
  - All faculty and student PCs shall be linked to a dedicated host computer through a campus-wide network
  - A minimum of 2 credit hours of Engineering computer course work be required during each of the three quarters of the freshman year
  - The freshman year course work shall include coverage of: FORTRAN, an interactive language such as BASIC, file editing, computer graphics, interactive computing and word processing
  - Essentially unlimited computer time for Engineering faculty and students
  - Computer usage required in the sophmore, junior and senior years of each undergraduate engineering curriculum
  - Appointment of a standing College of Engineering Computer Committee charged with the responsibility of continual moderization of computing activities within the College and coordination of course work in the freshman year with that in the following years

IBM Cover Letter



IBM

International Business Machines Corporation

P. O. Box 301
Roanoke, Virginia 24002
703/981-9400

September 6, 1983

Dr. Paul Torgersen
Dean, College of Engineering
Virginia Polytechnic Institute
and State University
Blacksburg, Virginia

Dear Dr. Torgersen:

We are pleased to submit to Virginia Polytechnic Institute and State University IBM's response to the College of Engineering's RFP #83-ENG for student Personal Computers. We were honored that you chose IBM as one of the respondents to your request, and we feel that our offering matches your needs in the dynamic world of personal computers.

In developing our solution, you and your people have been very cooperative in helping us understand VPI's requirements. Briefly, we see VPI's needs as five-fold:

- Provide VPI students with a cost effective personal computer program that will be integral to a state-of-the-art curriculum.
- Develop a personal computer support program that will provide the students with on-going technical support, maintenance, host computer services, financing, and other facilities that create an environment for VPI students to accelerate and expend their use of the personal computer and automation both during and beyond their educational experience.
- Select a personal computer that offers VPI faculty the largest selection of hardware and software products for use in the educational process.
- Select a personal computer that will not be obsoleted by the inevitable advancement of new technologies and personal computer products that have the flexibility to remain as state-of-the-art as your program.
- Provide a personal computer to the students that not only fulfills the students' needs during their education, but also provides a tool that the students can confidently and productively take into their professional endeavors.

These needs represent a formidable challenge, but there are always significant challenges whenever innovative and creative programs are proposed and adopted.

This documents represents a unique offering of hardware, software, maintenance, financing, and support that, when combined, have never been offered to any other IBM customer. The primary hardware and software configurations, and their maintenance and support programs, are contained in this document. It also represents IBM's best offering as of the September 6th submission date. Given the rapid pace that the personal computer marketplace has shown over the past year, and looking specifically at IBM's personal computer announcement history, it is not difficult to anticipate considerable change between now and your August 1984 requirement for student personal computers. To best accommodate for this inevitable change, it might be best to focus on the nature and structure of this offering and the architecture, features and functions, and historical price performance of IBM's personal computer products. This will provide the best framework from which to build a complete understanding of IBM's solution to all of VPI's personal computer requirements noted above. Should the university desire more specific detail on the PC family of products, request for additional information can be channeled through this local office to the product divisions.

The IBM Personal Computer product line has distinguished itself as the premier system in this rapidly changing marketplace. Its cost-effectiveness, design, performance, reliability, and its proven ability to evolve into a compatible family of processors are all factors that should give you confidence in selecting this system for your students.

Again, thank you for the opportunity to assist you in this leading-edge program. IBM Roanoke, and in particular those 34 professionals with over 547 collective years of IBM experience who provide direct day-to-day support to Virginia Tech, are ready to assist you in making this endeavor a success.

Sincerely,

Jay S. Haladay
Branch Manager

James J. Zawaski
Marketing Manager

William C. Roberts
Senior Marketing Representative

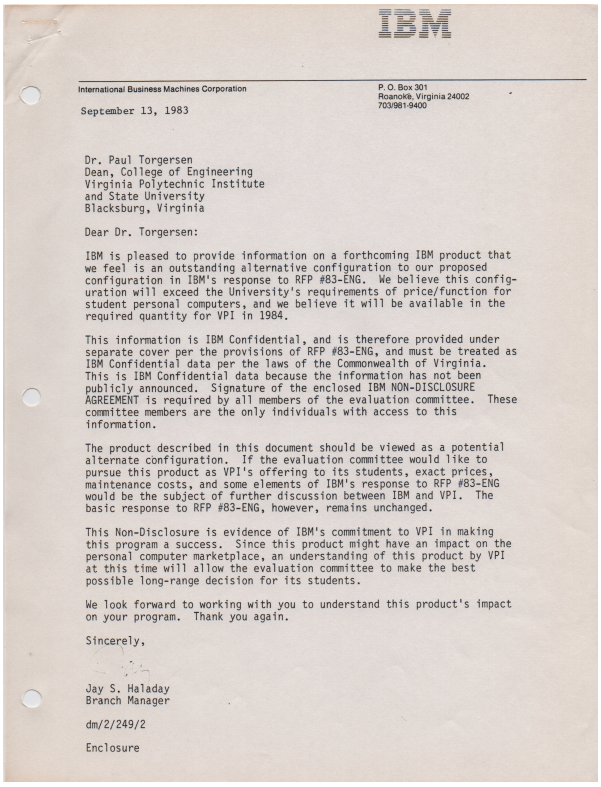
Raymond P. Roberts
Systems Engineering Manager

Steve O. Rice
Systems Engineer

John S. Malone
Systems Engineer

dm/2/249/3
Enclosure

IBM Alternate Proposal



IBM

International Business Machines Corporation
P. O. Box 301
Roanoke, Virginia 24002
703/981-9400

September 13, 1983

Dr. Paul Torgersen
Dean, College of Engineering
Virginia Polytechnic Institute
and State University
Blacksburg, Virginia

Dear Dr. Torgersen:

IBM is pleased to provide information on a forthcoming IBM product that we feel is an outstanding alternative configuration to our proposed configuration in IBM's response to RFP #83-ENG. We believe this configuration will exceed the University's requirements of price/function for student personal computers, and we believe it will be available in the required quantity for VPI in 1984.

This information is IBM Confidential, and is therefore provided under separate cover per the provisions of RFP #83-ENG, and must be treated as IBM Confidential data per the laws of the Commonwealth of Virginia. This is IBM Confidential data because the information has not been publicly announced. Signature of the enclosed IBM NON-DISCLOSURE AGREEMENT is required by all members of the evaluation committee. These committee members are the only individuals with access to this information.

The product described in this document should be viewed as a potential alternate configuration. If the evaluation committee would like to pursue this product as VPI's offering to its students, exact prices, maintenance costs, and some elements of IBM's response to RFP #83-ENG would be the subject of further discussion between IBM and VPI. The basic response to RFP #83-ENG, however, remains unchanged.

This Non-Disclosure is evidence of IBM's commitment to VPI in making this program a success. Since this product might have an impact on the personal computer marketplace, an understanding of this product by VPI at this time will allow the evaluation committee to make the best possible long-range decision for its students.

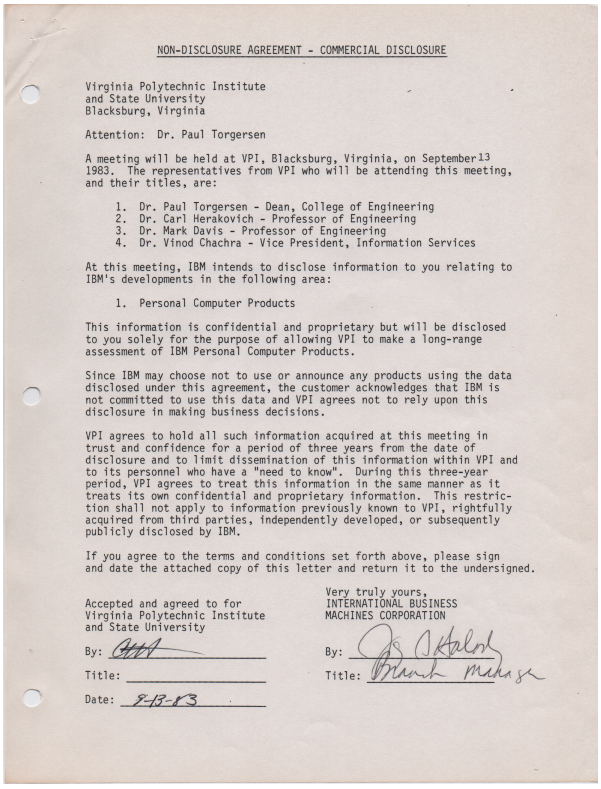
We look forward to working with you to understand this product's impact on your program. Thank you again.

Sincerely,

Jay S. Haladay
Branch Manager

dm/2/249/2

Enclosure



NON-DISCLOSURE AGREEMENT - COMMERCIAL DISCLOSURE

Virginia Polytechnic Institute
and State University
Blacksburg, Virginia

Attention: Dr. Paul Torgersen

A meeting will be held at VPI, Blacksburg, Virginia, on September 13 1983. The representatives from VPI who will be attending this meeting, and their titles, are:

1. Dr. Paul Torgersen - Dean, College of Engineering
2. Dr. Carl Herakovich - Professor of Engineering
3. Dr. Mark Davis - Professor of Engineering
4. Dr. Vinod Chachra - Vice President, Information Services

At this meeting, IBM intends to disclose information to you relating to IBM's developments in the following area:

1. Personal Computer Products

This information is confidential and proprietary but will be disclosed to you solely for the purpose of allowing VPI to make a long-range assessment of IBM Personal Computer Products.

Since IBM may choose not to use or announce any products using the data disclosed under this agreement, the customer acknowledges that IBM is not committed to use this data and VPI agrees not to rely upon this disclosure in making business decisions.

VPI agrees to hold all such information acquired at this meeting in trust and confidence for a period of three years from the date of disclosure and to limit dissemination of this information within VPI and to its personnel who have a "need to know". During this three-year period, VPI agrees to treat this information in the same manner as it treats its own confidential and proprietary information. This restriction shall not apply to information previously known to VPI, rightfully acquired from third parties, independently developed, or subsequently publicly disclosed by IBM.

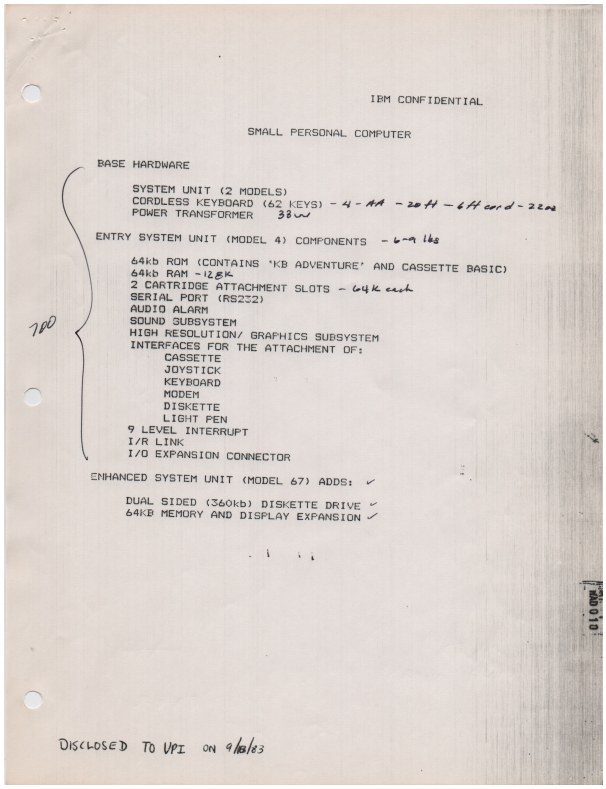
If you agree to the terms and conditions set forth above, please sign and date the attached copy of this letter and return it to the undersigned.

Very truly yours,
INTERNATIONAL BUSINESS
MACHINES CORPORATION

By: Jay S. Haladay
Title: Branch Manager

Accepted and agreed to for
Virginia Polytechnic Institute
and State University

By: _____
Title: _____
Date: 8-13-83



IBM CONFIDENTIAL

SMALL PERSONAL COMPUTER

BASE HARDWARE

SYSTEM UNIT (2 MODELS)
CORDLESS KEYBOARD (62 KEYS) - 4 - AA - 20 H - 6 ft cord - 220
POWER TRANSFORMER 38 W

ENTRY SYSTEM UNIT (MODEL 4) COMPONENTS - 6-9 lbs

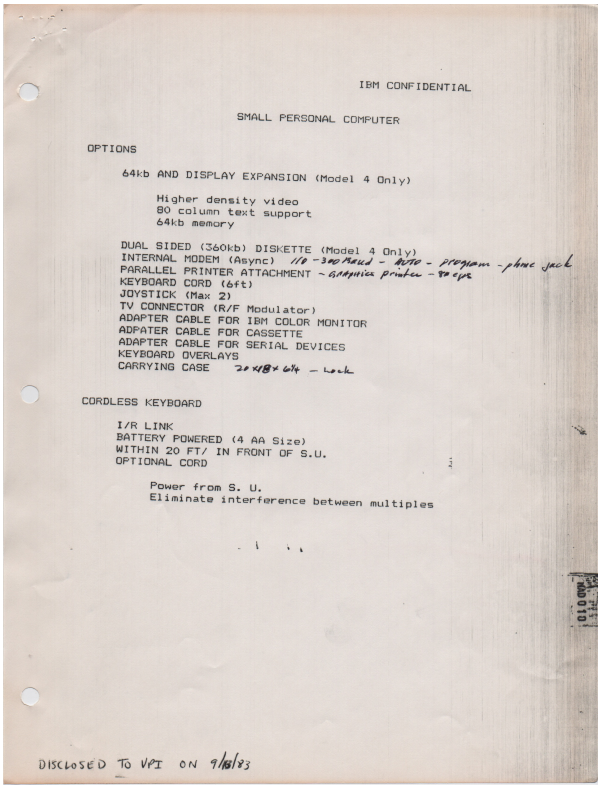
64kb ROM (CONTAINS 'KB ADVENTURE' AND CASSETTE BASIC)
64kb RAM - 128K
2 CARTRIDGE ATTACHMENT SLOTS - 64K each
SERIAL PORT (RS232)
AUDIO ALARM
SOUND SUBSYSTEM
HIGH RESOLUTION/ GRAPHICS SUBSYSTEM
INTERFACES FOR THE ATTACHMENT OF:
CASSETTE
JOYSTICK
KEYBOARD
MODEM
DISKETTE
LIGHT PEN
9 LEVEL INTERRUPT
I/R LINK
I/O EXPANSION CONNECTOR

700

ENHANCED SYSTEM UNIT (MODEL 67) ADDS: ✓

DUAL SIDED (360kb) DISKETTE DRIVE ✓
64KB MEMORY AND DISPLAY EXPANSION ✓

DISCLOSED TO VPI ON 9/13/83



IBM CONFIDENTIAL

SMALL PERSONAL COMPUTER

OPTIONS

64kb AND DISPLAY EXPANSION (Model 4 Only)

Higher density video
80 column text support
64kb memory

DUAL SIDED (360kb) DISKETTE (Model 4 Only)
INTERNAL MODEM (Async) 110 - 300 Baud - AUTO - program - phone jack
PARALLEL PRINTER ATTACHMENT - Graphics printer - 80 cps
KEYBOARD CORD (6ft)
JOYSTICK (Max 2)
TV CONNECTOR (R/F Modulator)
ADAPTER CABLE FOR IBM COLOR MONITOR
ADPATER CABLE FOR CASSETTE
ADAPTER CABLE FOR SERIAL DEVICES
KEYBOARD OVERLAYS
CARRYING CASE 20 x 18 x 6 H - Lock

CORDLESS KEYBOARD

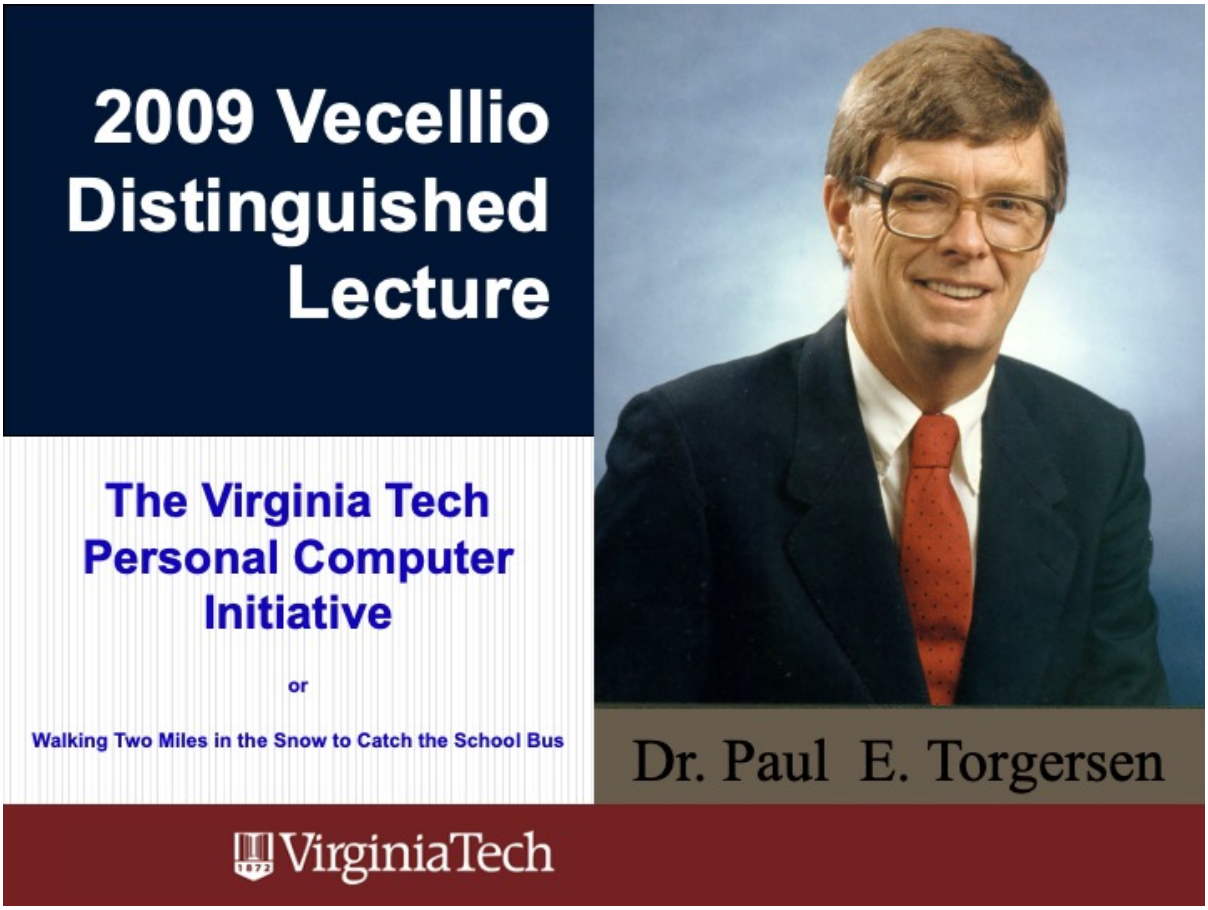
I/R LINK
BATTERY POWERED (4 AA Size)
WITHIN 20 FT/ IN FRONT OF S.U.
OPTIONAL CORD

Power from S. U.
Eliminate interference between multiples

DISCLOSED TO VPI ON 9/13/83

Torgersen - 2009 25th Anniversary Lecture

Following is a selection of slides from Dean Torgersen's talk.



Why Change

"Funny Money"

- Funds allocated to the colleges and administrative units for accessing the IBM 370
- ***Carl Herakovich's letter to the Office of the Provost and a reply***

And finally...two incidents

- Richmond Conference – Paul Torgersen
- Carl Herakovich's son at UVa

Following good advice …
"No good deed should go unpunished."
-Governor Gerry Balliles

Herakovich Committee Appointed

Ad hoc Committee on Undergraduate Computer Capabilities

- Carl Herakovich, Chairman
  - Appointed Fall of 1982
- Implied Goal: Catch up with UVa
- Options:
  - Expand mainframe and/or install minicomputers (i.e. VAX or HP)
  - Cost?

A meeting in the Computing Center

- Herakovich meets with Rosie Higdon

Herakovich Committee Report

Opportunism and Timing

- "To play leapfrog"
  -Carl Herakovich

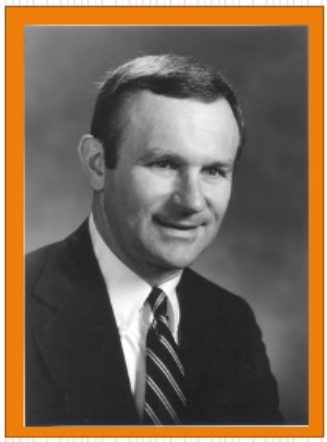
Cards / Key Punch	(Plan) Expand mainframe and terminals and/or mini-computers	Require PC's

Final Report
"To Lead...or to Follow"
May 28, 1983

- "The requirement that each entering freshman purchase a personal computer beginning with the Fall Quarter, 1984!"
- 15 months

Moving Forward

Principal Players



Carl Herakovich
Engineering Science and Mechanics

Vinod Chachra
Vice President
Computing and
Information Technology

Charles "Butch" Nunnally
Electrical Engineering

Selecting a Vendor

- Selection Committee
  - Vinod Chachra
  - Carl Herakovich
  - Paul Torgersen
- RFP issued July 29, 1983
- Selection on September 16, 1983

State Purchasing Regulations
Department of Information Technology

Reactions

Student Comments

Class of 1988

- "The class of '87 students were quite jealous of the class of '88… We actually programmed on our PCs, did drafting on our PCs and wrote papers on our PCs."
- The PC portables led to an explosion of computer gaming in Pritchard Hall…Oh yeah, we also used it for school."
- "The requirement to own a PC led to a widespread computer literacy that made the Virginia Tech engineer at ease with the computer and in the end, more marketable."

Virginia Tech PC Requirement for Entering Freshmen

- 1984: College of Engineering Freshmen
- 1985: Department of Computer Science
- 1986: College of Business (strongly recommended)
- 1990: Department of Statistics
- 1997: The University

Impact

Engineering Faculty Meeting
A year later...

- "I want you to know that the faculty at Purdue are very envious of what you are doing here at Virginia Tech."

- Win Phillips
Head of Mechanical Engineering
Purdue University

Blacksburg Electronic Village

1993

- The Appalachian town of Blacksburg, Va., created an ambitious partnership between Bell Atlantic of Virginia and Virginia Tech to connect all of the town's inhabitants to the Internet and to each other. Making Blacksburg a kind of poster child for the digital age.

Within a period of six months, the Blacksburg Electronic Village was featured on the Discovery Channel, in Esquire, USA Weekend, The New York Times and the Wall Street Journal, and it was even part *24 Hours in Cyberspace* project.

New York Times, 1997

Final Analysis

"Re-reading faculty comments now (in response to the Draft Proposal to the Faculty, February 8, 1983) twenty-five years later, all this makes me realize, just how little we understood at that time how computing would evolve, how pervasive it would become in our daily lives as well as our engineering work. In that sense we were lucky rather than enlightened."

-Carl Herakovich

Summer 2009

In Summary

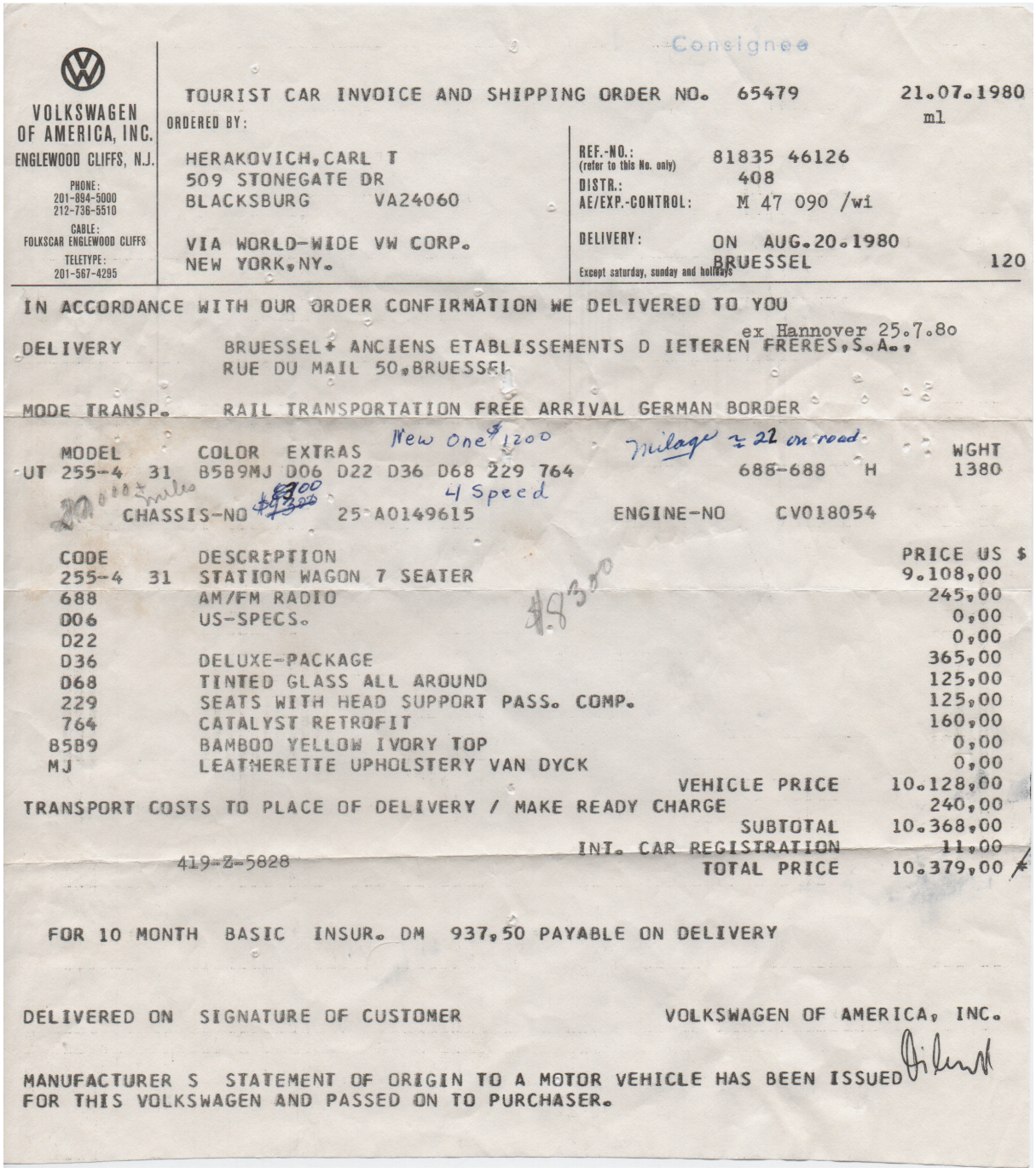
- This was a team effort
- It changed both the College of Engineering and Virginia Tech

Paul Torgersen

Summer 2009

VW Vanagon

Purchase



VOLKSWAGEN OF AMERICA, INC.
ENGLEWOOD CLIFFS, N.J.
PHONE: 201-894-5000 212-736-5510
CABLE: FOLKSCAR ENGLEWOOD CLIFFS
TELETYPE: 201-567-4295

Consignee

TOURIST CAR INVOICE AND SHIPPING ORDER NO. 65479 21.07.1980
ml

ORDERED BY:
HERAKOVICH, CARL T
509 STONEGATE DR
BLACKSBURG VA24060

VIA WORLD-WIDE VW CORP.
NEW YORK, NY.

REF.-NO.: (refer to this No. only) 81835 46126
DISTR.: 408
AE/EXP.-CONTROL: M 47 090 /wi

DELIVERY: ON AUG.20.1980
BRUESSEL 120
Except saturday, sunday and holidays

IN ACCORDANCE WITH OUR ORDER CONFIRMATION WE DELIVERED TO YOU

DELIVERY BRUESSEL ex Hannover 25.7.80
ANCIENS ETABLISSEMENTS D IETEREN FRERES, S.A.,
RUE DU MAIL 50, BRUESSEL

MODE TRANSP. RAIL TRANSPORTATION FREE ARRIVAL GERMAN BORDER

New One $1200 Milage ≈ 21 on road

MODEL		COLOR	EXTRAS						WGHT
UT 255-4	31	B589MJ	D06	D22	D36	D68	229	764	1380

688-688 H

20,000 Miles $1300 4 Speed

CHASSIS-NO 25 A0149615 ENGINE-NO CV018054

CODE		DESCRIPTION	PRICE US $
255-4	31	STATION WAGON 7 SEATER	9.108,00
688		AM/FM RADIO	245,00
D06		US-SPECS.	0,00
D22			0,00
D36		DELUXE-PACKAGE	365,00
D68		TINTED GLASS ALL AROUND	125,00
229		SEATS WITH HEAD SUPPORT PASS. COMP.	125,00
764		CATALYST RETROFIT	160,00
B589		BAMBOO YELLOW IVORY TOP	0,00
MJ		LEATHERETTE UPHOLSTERY VAN DYCK	0,00
		VEHICLE PRICE	10.128,00
TRANSPORT COSTS TO PLACE OF DELIVERY / MAKE READY CHARGE			240,00
		SUBTOTAL	10.368,00
		INT. CAR REGISTRATION	11,00
419-Z-5828		TOTAL PRICE	10.379,00

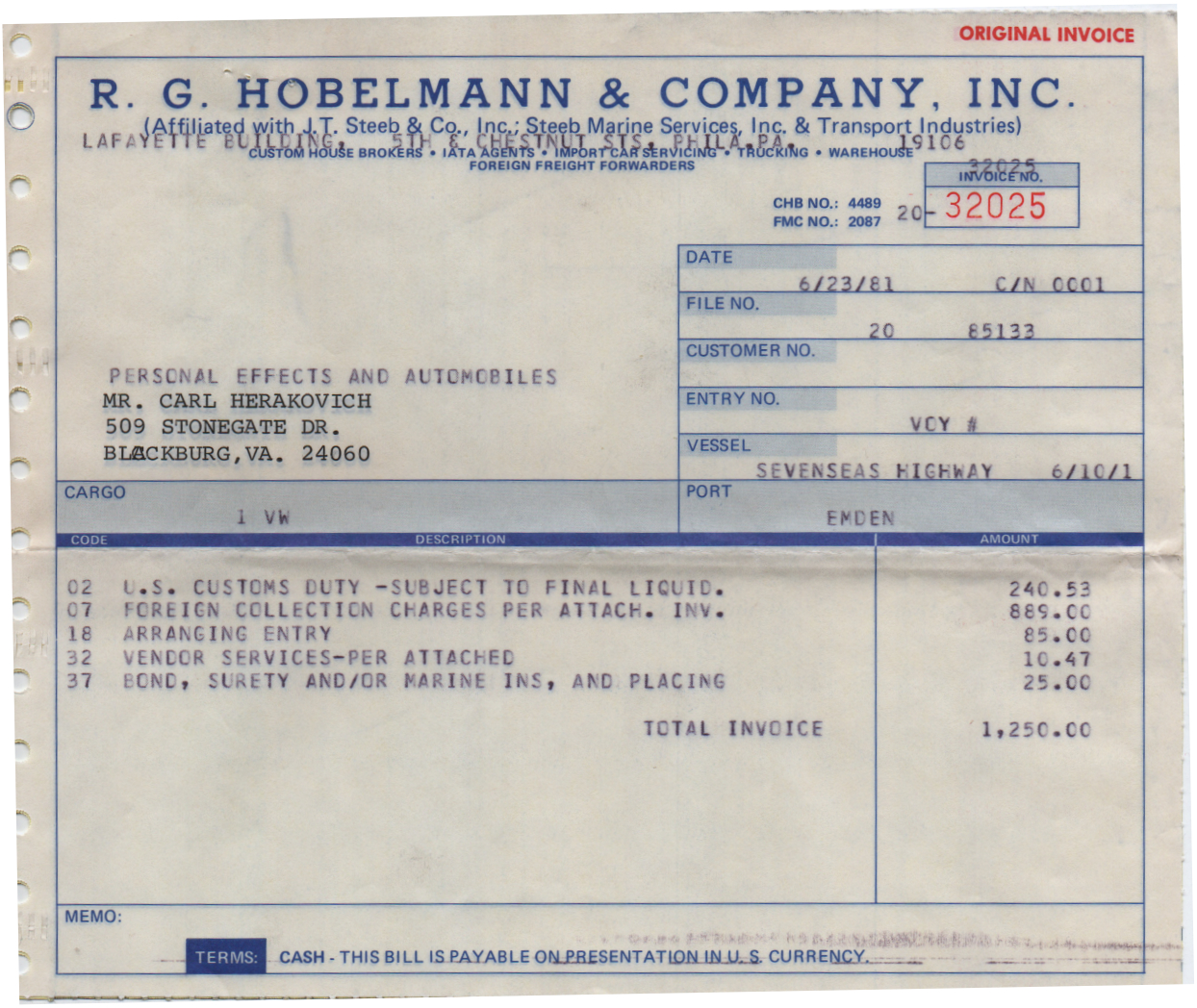
$9.380

FOR 10 MONTH BASIC INSUR. DM 937,50 PAYABLE ON DELIVERY

DELIVERED ON SIGNATURE OF CUSTOMER VOLKSWAGEN OF AMERICA, INC.

MANUFACTURER S STATEMENT OF ORIGIN TO A MOTOR VEHICLE HAS BEEN ISSUED FOR THIS VOLKSWAGEN AND PASSED ON TO PURCHASER.

Shipment to US



ORIGINAL INVOICE

R. G. HOBELMANN & COMPANY, INC.

(Affiliated with J.T. Steeb & Co., Inc.; Steeb Marine Services, Inc. & Transport Industries)

LAFAYETTE BUILDING, 5TH & CHESTNUT STS., PHILA., PA. 19106

CUSTOM HOUSE BROKERS • IATA AGENTS • IMPORT CAR SERVICING • TRUCKING • WAREHOUSE
FOREIGN FREIGHT FORWARDERS

CHB NO.: 4489
FMC NO.: 2087

INVOICE NO. 20-32025

DATE 6/23/81 C/N 0001

FILE NO. 20 85133

CUSTOMER NO.

ENTRY NO. VOY #

VESSEL SEVENSEAS HIGHWAY 6/10/1

PERSONAL EFFECTS AND AUTOMOBILES
MR. CARL HERAKOVICH
509 STONEGATE DR.
BLACKBURG,VA. 24060

CARGO 1 VW

PORT EMDEN

CODE	DESCRIPTION	AMOUNT
02	U.S. CUSTOMS DUTY -SUBJECT TO FINAL LIQUID.	240.53
07	FOREIGN COLLECTION CHARGES PER ATTACH. INV.	889.00
18	ARRANGING ENTRY	85.00
32	VENDOR SERVICES-PER ATTACHED	10.47
37	BOND, SURETY AND/OR MARINE INS, AND PLACING	25.00
	TOTAL INVOICE	1,250.00

MEMO:

TERMS: CASH - THIS BILL IS PAYABLE ON PRESENTATION IN U. S. CURRENCY.

ACC Officiating

Application Letter

VIRGINIA POLYTECHNIC INSTITUTE and STATE UNIVERSITY
BLACKSBURG, VIRGINIA 24061

COLLEGE OF ENGINEERING
DEPARTMENT OF ENGINEERING MECHANICS
PHONE: (703) 552-6651

December 15, 1970

Mr. Norvall Neve
338 N. Elm Street
Greensboro, N.C. 27401

Dear Mr. Neve:

I would like to make application to be an ACC Football Official next year. This year I worked three Mason-Dixon Conference games as well as a full slate of Virginia High School League games. I am 33 years old and have ten years of experience as a football official. I am in fine physical shape and have no difficulty keeping up with the college game.

My experience as a football player and coach includes the following:

1954 - Quarterbacked Whiting High School to the Indiana High School Football Championship

1955-58 Played halfback for Rose Polytechnic Institute, Terre Haute, Indiana.

Honors: 1955 - First team All-Opponents Defensive Team, University of Illinois at Chicago

1957 - Captain and leading scorer in the State of Indiana, 102 points. Indianapolis Star Most Valuable Player Award.

1958 - Captain and leading scorer in state and nation, 168 points. Established new record for scoring in State of Indiana. Indianapolis Star Award for Most Valuable Player. Little All-American (honorable mention)

1962-64 - Head Football Coach and Athletic Director, Rose Polytechnic Institute.

For the past three years I have also officiated at all Springg and Fall football practices at Virginia Tech. I am sure that former Coach Claiborne would write a letter if you desired one. While officiating in the Mason-Dixon, I worked with Robert Wood and Willis McCauley who, I believe, worked in the ACC this year.

At the present time I am an Assistant Professor and Assistant Department Head in the Engineering Mechanics Department at VPI. I received a Master of Science Degree at the University of Kansas and my PhD from Illinois Institute of Technology. If there is any other information which you would need in order to evaluate my qualifications, I would be most happy to assist you.

A reply at your earliest convenience would be appreciated.

Sincerely yours,

Carl T. Herakovich

Norvall Neve Letter to Carl

ATLANTIC COAST CONFERENCE
POST OFFICE BOX 29169
GREENSBORO, NORTH CAROLINA 27429-9169

Office of the Commissioner

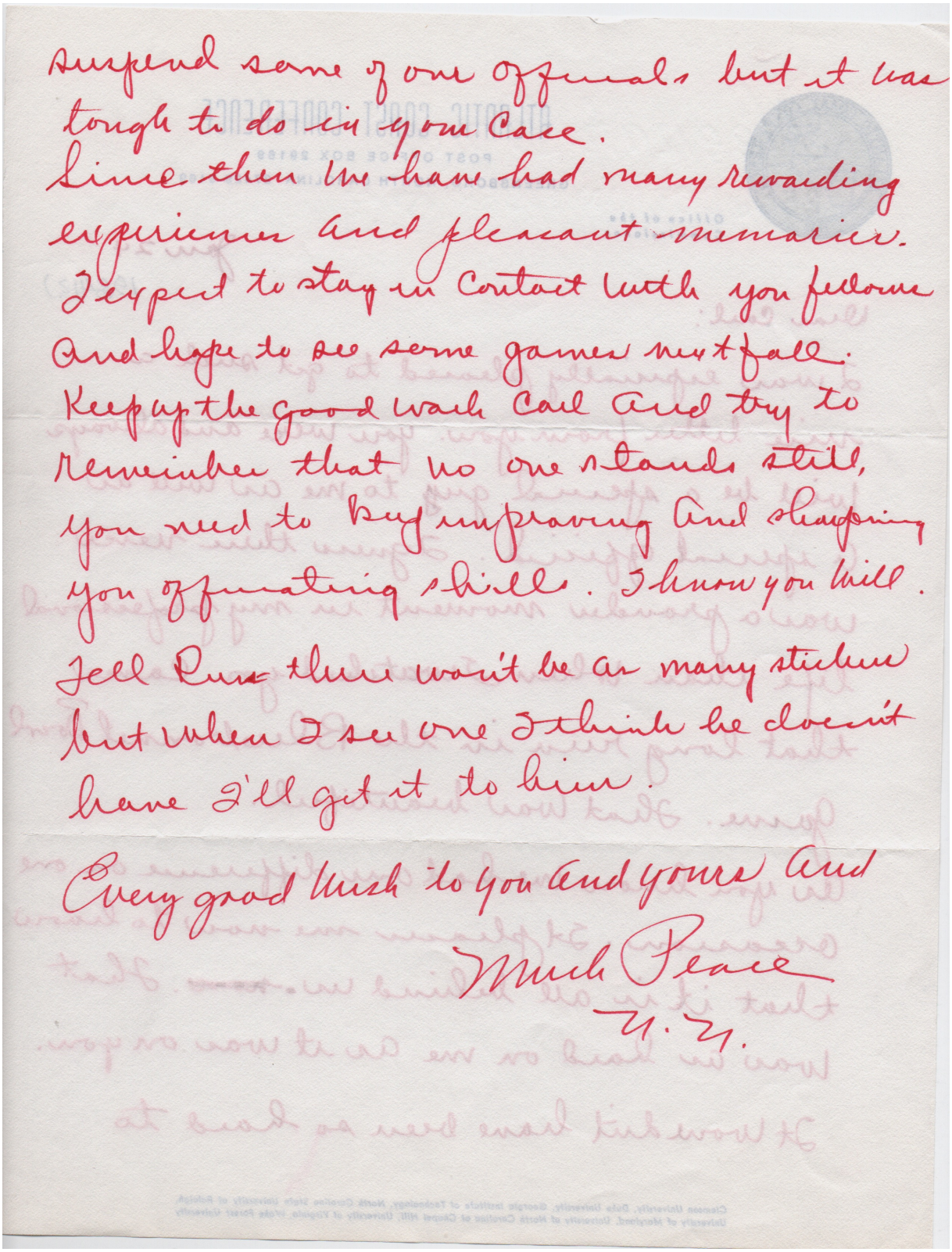
Jan 24
1984(?)

Dear Carl:

I was especially pleased to get such a nice letter from you. You were and always will be a special guy to me as well as a special official. I guess there never was a prouder moment in my professional life than when I watched you carry that long run in the Bluebonnet Bowl game. That was beautiful.

As you know we had our difference on one occasion. It pleases me now to know that it is all behind us. ~~now~~. That was as hard on me as it was on you.

It would just have been so hard to



suspend some of our officials but it was tough to do in your case.
Since then we have had many rewarding experiences and pleasant memories.
I expect to stay in contact with you fellows and hope to see some games next fall.
Keep up the good work Carl and try to remember that no one stands still, you need to keep improving and sharpening your officiating skills. I know you will.
Tell Russ there won't be as many stickers but when I see one I think he doesn't have I'll get it to him.

Every good wish to you and yours and

Much Peace

H. H.

ACC Game Assignments 1971-82

1971	1974	1975	1976	1977	1978	1979	1981	1982
9/21 (CO) MD@VT	9/21 Clm@NCS	9/13 WF@NCS	9/11 SC@GT	9/10 ECU@Duk	9/9 ECU@NCS	9/8 SC@UNC	9/12 NCS@WF	9/18 MD@WVA
10-1 (CO) WVa@VT	9/28 UNC@MD	9/20 MD@UNC	9/25 Duk@UVA	9/17 UVA@Tex	9/23 MD@UNC	9/15 MD@Clm	9/19. GT@Fla	9/25 WCU@Clm
	10/12 NCS@UVA	10/4 UNC@UVA	10/23 UVA@WF	9/24 WF@NCS	9/30 VMI@UVA	9/29 W&M@GT	10/3 GWb @Lib	10/2 Nvy@Duk
	10/19 NCS@UNC	10/11 WF@Clm	11/6 WF@Duk	10/1 ECU@SC	10/7 MiO@UNC	10/13 MD@NCS	10/24 NCS@Clem	10/9 Clm@UVA
	11-2 GT@Duk	10/18 UNC@NCS	11/13 Clm@MD	10/8 UVA@Clm	10/21 WF@MD	10/20 UNC@NCS	11/14 MD@Clem	10/16 NCS@UNC
	11/16 UVA@Clem	11/22 UVA@MD		10/15 SC@OMis	10/28 Clm@NCS	11/3 NCS@SC	11/21 Mia@NCS	10/23 SVT@Lbty
	9/23 Rch@UVA	9/27 Lby@VT		10/22 Duk@MD	11/11 WF@Duk	11/17 NCS@Duk	11/28 GA@GT	10/30 SC@NCS
				10/29 WF@Clm	11/25 SC@Cle	9/22 BS@LB		11/6 MHS@Lbty
				11/5 PSU@NCS				11/13 GT@WF
				11/12 UNC@UVA				12/4 Div 1-AA DelvsCrl
	12/23 Blue Bonnett NCSvsHtn		12/18 Tangerine OkSUvs BYU	12/31 Sun Stanvs LSU	11/18 Div II CMUvsDytn			12/18 Tangerine AubUvsBC

ACC Game Assignments 1983-1991

1983	1984	1985	1986	1987	1988	1989	1990	1991
8/29 Inaug Kickoff Classic PSUvsNeb	9/8 OHU@NCS	9/7 UNC@Nav	9/6 MTS@TS	9/2 Clg@Duke	9/3 WCU@NCS	9/2 Frm@Clm	9/1 WCU@NCS	9/7 APS@Clm
9/3 UNVC@SC	9/22 WF@NCS	9/14 WF@BU	9/13 VndMD	9/12 Rch@WF	9/10 IIS@WF	9/9 VT@SC	9/8 UNC@SC	914 Cin@UNC
9/10 Duk@IU	10/6 UNC@Clm	9/21 UVA@GT	9/20 WF@NCS	9/19 UNC@GT	9/24 NCS@MD	9/16 Duk@Ten	9/15 Clem@MD	9/21 Clg@Duke
9/17 Citl@NCS	10/13 NCS@MD	9/28 Frm@NCS	9/27 UVA@Duk	9/26 ASU@WF	10/1 Duk@Vnd	9/23 GT@SC	9/29 Duk@Clm	9/28 GT@Clm
10/1 UNC@GT	10/20 WF@UVA	10/5 MD@NCS	10/4 GT@UNC	10/3 GT@NCS	10/8 UNC@WF	9/30 KNS@NCS	10/6 UNC@WF	10/5 Vnd@Duk
10/15 Clem@Duk	11/10 WF@Duk	10/12 WF@UNC	10/11 BC@MD	10/10 WF@UNC	10/15 VT@Cin	10/7 MD@GT	10/13 Clm@GT	10/12 MD@GT
11/5 Clem@UNC	11/17 UVA@UNC	10/19 Clm@Duk	11/1 Duk@GT	10/17 ECU@VT	11/5 WF@Duk	10/21 UNC@GT	10/20 MD@Duk	10/19 Mrh@NCS
		10/26 UVA@WF	11/8 NCS@UVA	10/24 Duk@MD	11/12 GT@WF	11/18 VT@NCS	10/27 Clm@WF	11/2 MD@UNC
		11/2 GT@Duke	11/22 GT@WF	11/7 ETS@NCS			11/10 Duk@NCS	11/9 Duk@WF
		11/16 MD@Clem					11/17 GT@WF	11/23 WF@Nav
12/3 Stagg Bowl Augustana vs Union.		12/28 Citrus Bowl OSUvsBYU		12/31 Gator Bowl SCvsLSU			12/1 GT@GA	12/1 Coca Cola Bowl Tokyo DukevsClem
							12/27 Liberty Bowl OSUvsAir Force	

ACC Crews 1974-76

Year	Date	R	U	HL	LJ	BJ	FJ
1974	9-21	Deane	Chambers	Cummings	DeSousa	Sandell	Herakovich
	9-28	Deane	Moore	Jamerson	Carroll	Rushton	Herakovich
	10-12	Carpenter	Baugh	Harris	Carroll	Rushton	Herakovich
	10-19	Clary	Chambers	Elliott	Rosser	Waites	Herakovich
	11-2	Clary	Griggs	Cummings	Moseley	Bouni	Herakovich
	11-16	Clary	Rimer	Elliott	Menton	Waites	Herakovich
	12-2	Buckley	Moore	Jones	Rosser	Gorges	Herakovich
1975	9-13	Carpenter	Faircloth	Manning	Rosser	Waites	Herakovich
	9-20	Deane	Moore	Jamerson	Rosser	Waites	Herakovich
	10-4	Safrit	Gaston	Harris	Luper	Ray	Herakovich
	10-11	Price	Moore	Elliott	Davis	Ray	Herakovich
	10-18	Clary	Chambers	Cummings	Menton	Rushton	Herakovich
	11-22	Carpenter	Rimer	Menton	Rosser	Burke	Herakovich
1976	9-11	Carpenter	Griggs	Jamerson	Henderson	Herakovich	Patrick
	9-25	Cooper	Noble	Cummings	Cooper	Herakovich	Waites
	10-23	Long	Hines	Tyndall	Kane	Herakovich	Hunt
	11-6	Safrit	Baugh	Cummings	Rosser	Herakovich	Rushton
	11-13	Safrit	Baugh	Carrington	Rosser	Herakovich	Strickler
	12-18	Hackney		Jamerson			Herakovich

ACC Crews 1977-79

Year	Date	R	U	HL	LJ	BJ	FJ
1977	9-10	Hackney	Rimer	Manning	Burke	Herakovich	Lovett
	9-17	Fuller	Faircloth	Shaw	Menton	Herakovich	Hatch
	9-24	R. Cooper	Gaston	Manning	Kane	Herakovich	Strickler
	10-1	Hackney	Rimer	Currin	N. Cooper	Herakovich	Sandell
	10-8	Hackney	Chambers	Harris	Burke	Herakovich	Hunt
	10-15	Burdeson	Gaston	Stephenson	Luper	Herakovich	Horton
	10-22	Long	Gaston	Tyndall	Menton	Herakovich	Sandell
	10-29	Deane	Rimer	Cummings	Burke	Herakovich	Hunt
	11-5	Carpenter	Faircloth	Elliott	Menton	Herakovich	Waites
	11-12	Long	Baugh	Currin	Kane	Herakovich	Waites
	12-31	Safrit	Baugh	Manning	Luper	Hunt	Herakovich

1978	9-9	Carpenter	Baugh	Currin	DeSouza	Herakovich	Hunt
	9-23	Carpenter	Gaston	Elliott	DeSouza	Herakovich	Strickler
	9-30	Wood	Marrtin	Harris	Saleeby	Herakovich	Lovett
	10-7	Deane	Montgomery	Currin	Hanig	Herakovich	
	10-21	R. Cooper	Stuart	Tyndall	Davis	Herakovich	Hunt
	10-28	Hackney	Chambers	Godbold	DeSouza	Herakovich	Sandell
	11-11	Safrit	Noble	Jamerson	Burke	Herakovich	Rushton
	11-25	Hackney	Ellis	Elliott	Carroll	Herakovich	Walsh

1979	9-8	Safrit	Chambers	Manning	DeSouza	Herakovich	Jackson
	9-15	Carpenter	Rimer	Elliott	Benson	Herakovich	Sandell
	9-22	Herakovich	Chambers	Foley	Luper	Bell	
	9-29	Dailey	Ognovich	Harris	Bender	Herakovich	Strickler
	10-13	Dailey	Dawson	Manning	Menton	Herakovich	Barnett
	10-20	Carpenter	Chambers	Godbold	Benson	Herakovich	Sandell
	11-3	Knight	Chambers	Tyndall	Luper	Herakovich	Rushton
	11-17	Dailey	Noble	Jamerson	DeSouza	Herakovich	Strickler

ACC Crews 1981-83

Year	Date	R	U	HL	LJ	BJ	FJ
1981	9-12	Dailey	Faircloth	Manning	Austin	Herakovich	Hackney
	9-19	Mauzy	Pratt	Jamerson	Lambert	Herakovich	Horton
	10-3	Austin	Dawson	Jamerson	Herakovich	Barnett	
	10-17	Herakovich	Faircloth	Tyndall	Jackson	Sandell	
	10-24	Dailey	Rimer	Schroer	Davis	Herakovich	Post
	11-14	Safrit	Chambers	Manning	Rhoads	Herakovich	Hackney
	11-28	Mauzy	Pratt	Neely	Lambert	Herakovich	Pace

Year	Date	R	U	HL	LJ	BJ	FJ
1982	9-18	Bower	Dawson	Farina	Herakovich	Lattanzi	Hill
	9-25	Wood	Dawson	Jamerson	Herakovich	Robertson	Lovett
	10-9	Wood	Dawson	Jamerson	Herakovich	Robertson	Lovett
	10-16	Wood	Dawson	Jamerson	Herakovich	Robertson	Lovett
	10-23	Wood	Dawson	Jamerson	Herakovich		Robertson
	10-30	Wood	Dawson	Jamerson	Herakovich	Robertson	Lovett
	11-6	Wood	Dawson	Jamerson	Herakovich		Robertson
	11-13	Wood	Dawson	Jamerson	Herakovich	Robertson	Lovett
	12-4	Wood	Dawson	Jamerson	Herakovich	Robertson	Lovett
	12-18	Wood	Dawson	Jamerson	Herakovich	Robertson	Lovett

Year	Date	R	U	HL	LJ	BJ	FJ
1983	8-29	Wood	Dawson	Jamerson	Herakovich	Robertson	Lovett
	9-3	Wood	Dawson	Jamerson	Herakovich	Robertson	Lovett
	9-10	Nealon	Dawson	Walker	Herakovich	Neemers	Lovett
	9-17	Wood	Dawson	Jamerson	Herakovich	Robertson	Lovett
	10-1	Wood	Dawson	Jamerson	Herakovich	Robertson	Wall
	10-15	Wood	Dawson	Jamerson	Herakovich	Robertson	Lovett
	11-5	Wood	Dawson	Jamerson	Herakovich	Robertson	Lovett
	11-19	Wood	Dawson	Jamerson	Herakovich	Robertson	Lovett
	11-26	Gentry	Dawson	Ackerman	Herakovich	Oldham	Lovett
	12-3	Wood	Dawson	Jamerson	Herakovich	Robertson	Lovett

Year	Date	R	U	HL	LJ	BJ	FJ
1984	9-8	Wood	Gaston	Jamerson	Herakovich	Hogue	Lovett
	9-22	Wood	Burton	Jamerson	Herakovich	Robertson	Lovett
	10-6	Wood	Dawson	Jamerson	Herakovich	Robertson	Sandell
	10-13	Wood	Dawson	Jamerson	Herakovich	Robertson	Lovett
	10-20	Wood	Dawson	Jamerson	Herakovich	Robertson	Lovett
	11-10	Wood	Dawson	Jamerson	Herakovich	Robertson	Lovett
	11-17	Wood	Dawson	Jamerson	Herakovich	Robertson	Lovett

Year	Date	R	U	HL	LJ	SJ	FJ	BJ
1985	9-7	Wood	Dawson	Jamerson	Herakovich	Johnson	J.Robertson	Rhoads
	9-14	Kober	Dawson	Pickett	Herakovich		Compton	Huggins
	9-21	Wood	Dawson	Jamerson	Herakovich	D. Robertson	J.Robertson	Hunt
	9-28	Wood	Dawson	Jamerson	Herakovich	Carter	J.Robertson	Rhoads
	10-5	Phillips	Noble	Harris	Menton	Herakovich	Rhoads	Sandell
	10-12	Wood	Dawson	Jamerson	Herakovich	Johnson	J.Robertson	Rushton
	10-19	Phillips	Noble	Tyndall	Booker	Herakovich	Cage	Wall
	10-26	Wood	Dawson	Jamerson	Herakovich	Hogue	J.Robertson	Rushton
	11-2	Wood	Dawson	Jamerson	Herakovich	Carter	J.Robertson	Sandell
	11-16	Wood	Dawson	Jamerson	Herakovich	Knight	J.Robertson	Post
	12-28	Price	Amato	Gumann	Herakovich	McGee		Sandell

Year	Date	R	U	HL	LJ	SJ	FJ	BJ
1986	9-6	Safrit	Dawson	Jamerson	Herakovich		J.Robertson	
	9-13	Goss	Lock	Ackerman	Herakovich	Johnson	Shanks	Huggins
	9-20	Carpenter	Gaston	Godbold	Herakovich	Johnson	Long	Rushton
	9-27	Phillips	Dawson	Neely	Herakovich	Carter	Luper	Lovett
	10-4	Wood	Burton	Jamerson	Herakovich	Carter	J.Robertson	Lovett
	10-11	Wood	Wayler	Jamerson	Herakovich	Johnson	J.Robertson	Sandell
	11-1	Dailey	Burton	Jamerson	Herakovich	Smith	J.Robertson	Rhoads
	11-8	Wood	Burton	Jamerson	Herakovich	Johnson	J.Robertson	Rushton
	11-22	Carpenter	Gaston	Godbold	Herakovich	Smith	Long	Rushton

ACC Crews 1987-89

Year	Date	R	U	HL	LJ	SJ	FJ	BJ
1987	9-5	Wood	Amato	Jamerson	Herakovich	Wyant	J.Robertson	Lovett
	9-12	Chambers	Amato	Rosso	Herakovich	D.Robertson	Gibbons	Lovett
	9-19	Wood	Burton	Jamerson	Herakovich	Wyant	J.Robertson	Rushton
	9-26	Downey	Burton	Saunders	Herakovich	Wyant	Linebarger	Elgin
	10-3	Wood	Burton	Jamerson	Herakovich	D.Robertson	J.Robertson	Lovett
	10-10	Wood	Burton	Godbold	Herakovich	Wyant	Hogue	Lovett
	10-17	Monk	Lock	Mollman	Herakovich	Wyant	Waites	Elgin
	10-24	Wood	Burton	Jamerson	Herakovich	Wyant	J.Robertson	Rhoads
	11-7	Wood	Burton	Jamerson	Herakovich	Bing	J.Robertson	Lovett
	12-31	Wood	Wampler	Tyndall	Herakovich	Foley	Luper	Rushton

Year	Date	R	U	HL	LJ	SJ	FJ	BJ
1988	9-3	Wood	Burton	Jamerson	Herakovich	Wyant	J.Robertson	Lovett
	9-10	Wood	Pearce	Tyndall	Herakovich	Wyant	Williamson	Hunt
	9-24	Dailey	Cage	Samples	Herakovich	Wyant	Smith	Hunt
	10-1	Gilbert	Lambert	Ackermann	Jackson	Hogue	Stanton	Herakovich
	10-8	Mauzy	Dawson	Elliott	Herakovich	Wyant	Long	Rhoads
	10-15	Miller	Pressgrove	McGrath	Herakovich	Wyant	Lange	Lovett
	11-5	Dailey	Burton	Godbold	Herakovich	Wyant	Long	Lovett
	11-12	Dailey	Amato	Samples	Jackson	Hogue	Smith	Herakovich

Year	Date	R	U	HL	LJ	SJ	FJ	BJ
1989	9-2	Wood	Burton	Elliott	Herakovich	Wyant	Key	Lovett
	9-9	SICOA	Lock	SICOA	Herakovich	Wyant	SICOA	SICOA
	9-16	SEC	Burton	SEC	Herakovich	Wyant	SEC	SEC
	9-23	SICOA	Dawson	SICOA	Herakovich	Post	SICOA	SICOA
	9-30	Dailey	Cage	Jamerson	Herakovich	Wyant	Key	Hunt
	10-7	Wood	Lock	Jamerson	Herakovich	Wyant	Key	Denton
	10-21	Long	Dawson	Elliott	Herakovich	Wyant	Rhoads	Samples
	11-18	Wood	Lock	Tyndall	Herakovich	Wyant	D.Robertson	Lea

ACC Crews 1990-91

Year	Date	R	U	HL	LJ	SJ	FJ	BJ
1990	9-16	Armstrong	Pearce	Elliott	Carter	Hogue	Key	Herakovich
	9-8	Knight	Lock	Neely	Jackson	Hogue	Foley	Herakovich
	9-15	Knight	Lock	Samples	Jackson	Hogue	Foley	Herakovich
	9-29	Phillips	Wampler	Elliott	Booker	McGee	Key	Herakovich
	10-6	Wood	Dawson	Godbold	Jackson	Harper	D.Robertson	Herakovich
	10-13	Mauzy	Dawson	Tyndall	Benson	Post	Williamson	Herakovich
	10-20	Wood	Burton	Tyndall	Kane	Hogue	Williamson	Herakovich
	10-27	Dailey	Cage	Elliott	Booker	Allen	Key	Herakovich
	11-10	Knight	Wampler	Elliott	Booker	McGee	Key	Herakovich
	11-17	Wood	Lock	Elliott	Kane	Hogue	Key	Herakovich
	12-1	Phillips	Wampler	Tyndall	Jackson	Allen	Patterson	Herakovich
	12-27	Knight	Gaston	Godbold	Benson	Post	Smith	Herakovich
1991	9-7	Armstrong	Lock	Howey	Burton	Harper	Key	Herakovich
	9-14	Wood	Amato	Elliott	Allen	Jackson	Williamson	Herakovich
	9-21	Armstrong	Pearce	Stephenson	Jackson	Harper	Patterson	Herakovich
	9-28	Knight	Dawson	Stephenson	Jackson	Hogue	Patterson	Herakovich
	10-5	Mauzy			Jackson		Looney	Herakovich
	10-12	Mauzy	Dawson	Tyndall	Jackson	Hogue	Williamson	Herakovich
	10-19	Phillips	Wampler	Howey	Page	Cage	D.Robertson	Herakovich
	11-2	Mauzy	Dawson	Stephenson	Benson	Post	Patterson	Herakovich
	11-9	Wood	Lock	Samples	Allen	Cage	Smith	Herakovich
	11-23	Wood	Burton	Tyndall	Benson	Mack	Looney	Herakovich
	12-1	Dailey	Gaston	Elliott	Herakovich	Cage	Knight	Hunt

Letter to Faircloth on Retirement

720 Garthfield Lane
Charlottesville, VA 22901
April 16, 1989

Mr. Bradley E. Faircloth
Assistant Commissioner
Supervisor of Football Officials
Atlantic Coast Conference
P. O. Drawer ACC
Greensboro, NC 27419-6999

Dear Bradley:

Enclosed is my Registration Form for the 1989 Football season. As you review it you will see that I have marked Oct. 28 and Nov. 4 as dates that I will not be available. I expect to be in Germany at that time for an international meeting that I have been invited to speak at.

I also have another date conflict with officiating. I have been invited to speak at an international meeting in Beijing, China this summer. The dates of the meeting are August 1-4 which makes it impossible for me to attend the clinic on Aug. 4-6. I decided that I could not pass up this opportunity. In addition to the meeting being very good for me professioanlly, it will be my first trip to China. I did not make this decision lightly and realize the significance of my decision. I hope that you can understand my reasoning. I do plan to attend the Spring Clinic in Myrtle Beach. I would be happy to talk to you about this is you like. Just give me a call or we can talk at Myrtle Beach.

This also seems like a good time for me to convey to you my attitude concerning my eventual retirement from officiating. I would like to go out while I am still at the top of my game. However, I do still have a few goals that I would like to fulfill before retirement. They are: 1) work 150 varsity games .... I have about 120 now... if there is any way I can get to 150 in three more years that would be great; 2) work one of the major bowls, I never have had that opportunity; 3) work as a referee ...I'd really like to and think I would be a good job ... I really enjoyed working as a referee at the scrimmage here two weeks ago ...it would also do a lot to rekindle the fire within me ... and I think that would be good for me.

That's about it. I hope that my goals aren't too different from your plans. I look forward to hearing from you. Best regards.

Sincerely yours,

Carl T. Herakovich

Faircloth Response

ATLANTIC COAST CONFERENCE
6011 LANDMARK CENTER BOULEVARD
POST OFFICE DRAWER ACC
GREENSBORO, NORTH CAROLINA
(919) 854-8787 FAX (919) 854-8797
ZIP CODES:
MAIL 27419-6999
DELIVERY 27407

Office of the Commissioner

May 1, 1989

Mr. Carl T. Herakovich
720 Garthfield Lane
Charlottesville, Virginia 22901

Dear Carl:

This acknowledges receipt of your letter of April 16. I will close out the dates of October 28 and November 4. I will excuse you from clinic attendance as I am in agreement as to the impact your meeting could have on your professional career.

Regarding your goals as outlined in the letter, based on your performance in the past and your overall approach to officiating, I see no reason you would not be working at least 30 more varsity games to reach the desired level of 150. As for a major bowl, there are different opinions as to which bowls fall into this category. I think most football oriented people consider the Rose, Cotton, Sugar and Orange Bowls to be major with the Fiesta on the borderline. The last time the ACC furnished a crew for one of these was in 1982. I am sure you are aware as to how these are assigned. If we are fortunate enough to be assigned one of these bowls you will be extended consideration.

There will be some retirements occurring in the referee position within the next two to three years. This would afford you a short period in which to work at this position. You have not been entirely ruled out at this position, and I will discuss the pros and cons of this decision with you at Myrtle Beach.

Thank you for your continued support and dedication to the Atlantic Coast Conference Football Officials Association.

Sincerely,

Bradley

Bradley E. Faircloth
Assistant Commissioner

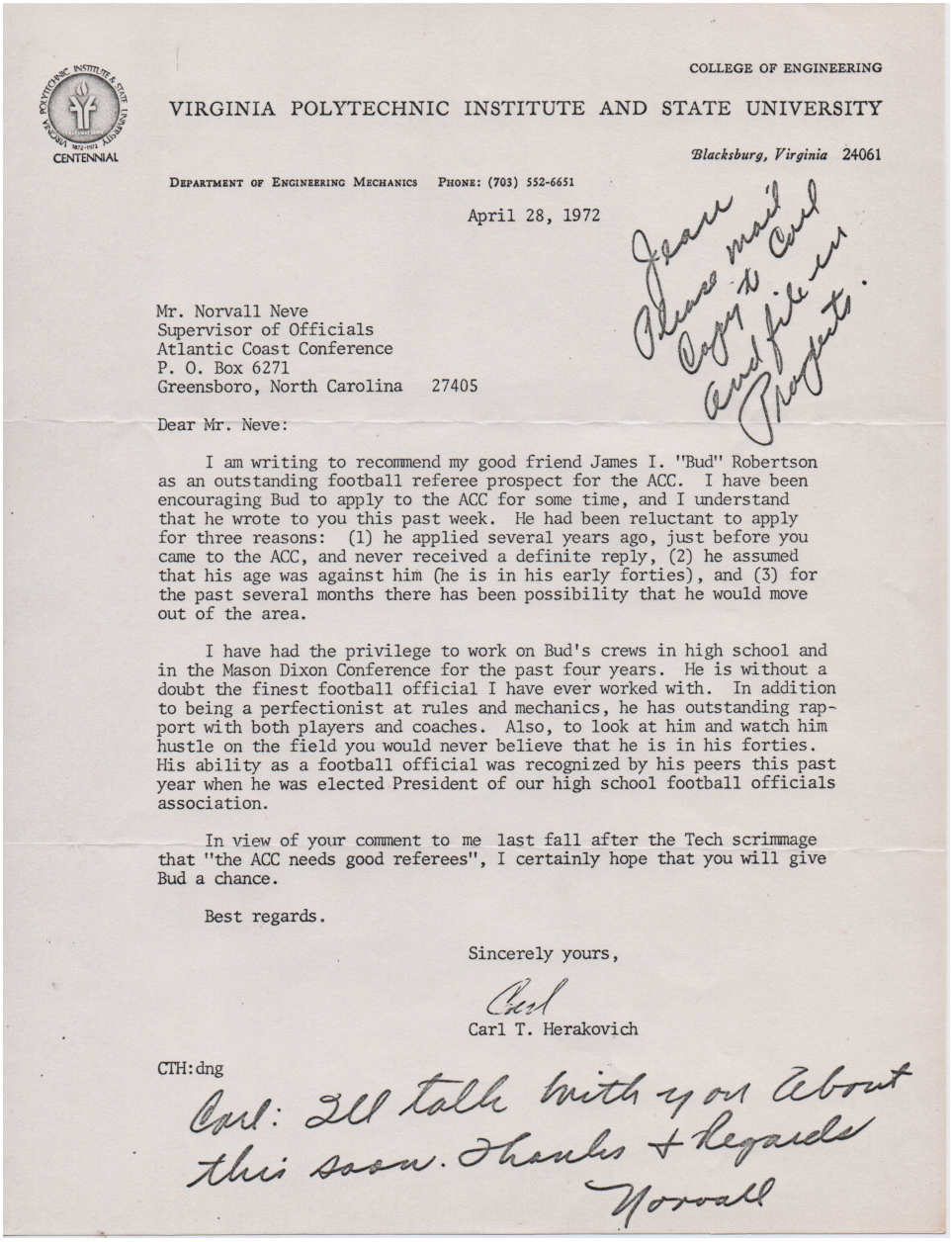
BEF:kch

Coaches Who's Games I Worked

Team	Coach	Coach	Coach	Coach	Coach
Air Force	Fisher DeBerry				
Appalachian State	Sparky Woods	Jerry Moore			
Auburn	Pay Dye				
Augustana	Bob Reade				
Boston College	Jack Bicknell				
Boston University	Steve Stetson				
BYU	LaVell Edwards				
Carnegie Mellon	Chuck Klausing				
Cincinnati	Dave Currey	Tim Murphy			
Citadel	Tom Moore				
Clemson	Red Parker	Charley Pell	Danny Ford	Ken Hatfield	
Colgate	Fred Dunlap	Mike Foley			
Dayton	Rick Carter				
Delaware	Harold R "Tubby" Raymond				
Duke	Mike McGee	Shirley "Red" Wilson	Steve Sloan	Steve Spurrier	
East Carolina	Pat Dye	Art Baker			
East Tennessee	Mike Ayers	Don Riley			
Florida	Charley Pell				
Furman	Dick Sheridan				
Furman	Jimmy Satterfield				
Georgia	Vince Dooley	Ray Goff			
Georgia Tech	Bob Bossons	Pepper Rogers	Bill Curry	Bobby Ross	
Houston	Bill Yeoman				
Illinois State	Jim Heacock				
Indiana	Sam Wyche				
Kent State	Dick Crum				
Liberty	Tom Dowling				
LSU	Mike Archer	Charlie McClendon			
Marshall	Jim Donnan				
Maryland	Jerry Claiborne	Bobby Ross	Joe Krivak		
Miami	Tom Reed	Howard Schnellenberger			
Middle Tennessee State	James (Boots) Donnelly				
Mississippi	Ken Cooper				

Team	Coach	Coach	Coach	Coach	Coach
N C State	Lou Holtz	Bo Rein	Monte Kiffin	Tom Reed	Dick Sheridan
Navy	Gary Tranquill	George Chaump			
Nebraska	Tom Osborne				
North Carolina	Bill Dooley	Dick Crum	Mack Brown		
Ohio State	John Cooper	Earl Bruce			
Ohio University	Brian Burke				
Oklahoma State	Jim Stanley				
Penn State	Joe Paterno				
Richmond	Dal Shealy				
Saginaw Valley	Jim Larkin				
South Carolina	Jim Carlen	Joe Morrison	Sparky Woods		
Stanford	Bill Walsh				
Tennessee	Johnny Majors				
Tennessee State	Bill Thomas				
Texas	Fred Akers				
Union	Al Bagnoli				
Vanderbilt	Watson Brown	Gerry DiNardo			
Virginia	Sonny Randle	Dick Bestwick	George Walsh		
Virginia Tech	Frank Beamer				
VMI	Bob Thalman				
Wake Forest	Chuck Mills	John Mackovic	Al Groh	Bill Dooley	
West Virginia	Don Nehlen				
Western Carolina	Bob Waters	Steve Hodgin			
William & Mary	Jim Root				

Recommendation for Robertson



COLLEGE OF ENGINEERING

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Blacksburg, Virginia 24061

DEPARTMENT OF ENGINEERING MECHANICS PHONE: (703) 552-6651

April 28, 1972

Joan
Please mail
Copy to Carl
and file in
Projects.

Mr. Norvall Neve
Supervisor of Officials
Atlantic Coast Conference
P. O. Box 6271
Greensboro, North Carolina 27405

Dear Mr. Neve:

I am writing to recommend my good friend James I. "Bud" Robertson as an outstanding football referee prospect for the ACC. I have been encouraging Bud to apply to the ACC for some time, and I understand that he wrote to you this past week. He had been reluctant to apply for three reasons: (1) he applied several years ago, just before you came to the ACC, and never received a definite reply, (2) he assumed that his age was against him (he is in his early forties), and (3) for the past several months there has been possibility that he would move out of the area.

I have had the privilege to work on Bud's crews in high school and in the Mason Dixon Conference for the past four years. He is without a doubt the finest football official I have ever worked with. In addition to being a perfectionist at rules and mechanics, he has outstanding rapport with both players and coaches. Also, to look at him and watch him hustle on the field you would never believe that he is in his forties. His ability as a football official was recognized by his peers this past year when he was elected President of our high school football officials association.

In view of your comment to me last fall after the Tech scrimmage that "the ACC needs good referees", I certainly hope that you will give Bud a chance.

Best regards.

Sincerely yours,

Carl

Carl T. Herakovich

CTH:dng

Carl: I'll talk with you about this soon. Thanks + Regards
Norvall

Oxford House Transactions

Oxford House - Blacksburg Property Transactions						
Date	Property	Address	Action	Amount ($)	Net ($)	Comment
5/1/69			Investment	5,000	-5,000	2,500 each from Rich $ Carl
5/6/1969	House & Lot	701 & 704 Progress St.	Purchase	16,000		Is it 701 or 702?
5/6/1969	House & Lot	701 & 704 Progress St.	Bank Loan	12,000		Original FNEB Loan 12K
9/20/1971	Modular Duplex	704 Progress	Bank Loan	33,000		Buy Modular Duplex, rollover FNEB Loan
Sept. 1971	Modular Duplex	704 Progress St.	Purchase	????		Paid using bank loan funds
2/22/1973	Duplex	444 Prices Fork Rd	Purchase	30,000		
2/22/1973	Bank Loan	444 Prices Fork Rd	Bank Loan	28,000		New Bank loan $28,000,
1/10/1978	State takes duplex	Prices Fork Rd	Sell to State	40,000		Funds used for fourplex on Giles Rd.
2/28/1978	Giles Rd 4-plex	901 Giles Rd.	Bank Loan	62,000		Move Prices Fork Duplex and build 4 plex
3/15/78	2.379 Acres & Farm House	901 Giles Rd.	Purchase	33,000		Used 62K loan
3/18/1978	Duplex	905 Prices Fork Rd	Purchase	250		bought back Duplex from state
4/1/1978	Move Duplex	905 Prices Fork Rd	Move			Not sure of moving cost
9/27/85	3 Apt Bldg.	702 Progress St.	Sell	50,000	27,741	All three properties sold to Patrick Cupp et al with a loan to Cupp of 25K carrying 10% interest charges. It was repaid. Paid off two existing loans. $15,987 and $49,259.
9/27/85	Duplex	740 Progress St.	Sell	53,000	46,413	
9/27/85	Giles Rd Property	905 Giles Rd.	Sell	137,000	45,756	
10/10/1987	Cupp 25K Loan	905 Giles Rd.	Sell	25,000	25,000	
7/18/2000	5,093 Sq. Ft (0.1172 Acre)	Turner & Prices Fork Rd	Sell	60,060	60,060	Lease Purchase Option. Property paid as of May 1, 2007.
5/1/2007					199,970	99,985

Scholarly Publications

Books:

- Herakovich, C. T., Mechanics of Fibrous Composites, (John Wiley, Inc., 1998)
- Herakovich, C. T., Mechanics IUTAM USNC/TAM (Springer, 2016)
- Herakovich, C. T., A Concise Introduction to Elastic Solids (Springer, 2017)

Papers in Journals & Proceedings:

1. Hodge, Jr., P. G., Herakovich, C. T. and Stout, R. B., "On Numerical Comparisons in Elastic-Plastic Torsion, "*Journal of Applied Mechanics*, ASME, Vol. 35, 1968, pp. 454-459.
2. Herakovich, C. T. and Hodge, Jr., P. G., "Elastic-Plastic Torsion of Hollow Bars by Quadratic Programming, "*International Journal of Mechanical Sciences,* Vol. 11, 1969, pp. 53-63.
3. Hodge, Jr., P. G., Belytschko, T. and Herakovich, C. T., "Quadratic Programming and Plasticity, "*Computational Approaches in Applied Mechanics*, Proceedings, ASME Computer Conference, Chicago, June 1969, pp. 73-84.
4. Herakovich, C. T., "Strain Hardening Torsion of Solid Bars as a Minimization Problem, "*International Journal Mechanical Sciences*, Vol. 12, 1970, pp. 985-995.
5. Herakovich, C. T. and Carri, R. L., "Tensile Strength of Boron-Epoxy Reinforced Aluminum, "*Proceedings, Sixth St. Louis Symposium on Composite Materials in Engineering*, St. Louis, May 1972, pp. 311-321.
6. Herakovich, C. T., "On the Application of Minimum Rate Principles to Inelastic Materials, "*Proceedings, International Conferences of Variational Methods in Engineering*, Southampton, England, Sept. 1972, pp. 2/28-2/43.
7. Herakovich, C. T., Davis, Jr., J. G. and Dexter, H. B., "Reinforcement of Metals with Advanced Filamentary Composites, "*Composite Materials: Testing and Design,* (Third Conference), ASTM, STP 546, ASTM, 1974, pp. 523-541.
8. Henneke, III, E. G., Herakovich, C. T., Jones, G. L. and Renieri, M. P., "Acoustic Emission from Composite Reinforced Metals, "*Experimental Mechanics*, Vol. 15, No. 1, Jan 1975.
9. Herakovich, C. T., Renieri, M. P. and Davis, Jr., J. G., "Influence of Specimen Features on Strength of Boron/Epoxy Reinforced Metal, "*Journal of Materials Engineering and Technology,* ASME, Vol. 97, No. 3, Jul 1975, pp. 259-263.
10. Itani, R. Y. and Herakovich, C. T., "Elastic-Plastic Torsion of Nonuniform Bars as a Quadratic Programming Problem, "*Proceedings, 12th Annual Meeting, Society of Engineering Science*, Austin, TX, Oct 1975, pp. 1245-1254.
11. Brinson, H. F., Renieri, M. P. and Herakovich, C. T., "Rate and Time Dependent Failure of Structural Adhesives, "*Fracture Mechanics of Composites*, ASTM STP 593, Nov 1975, pp. 177-199.
12. Wilson, III, G. H. and Herakovich, C. T., "Application of a Dedicated Microprocessor for Automatic Data Acquisition of Load Strain and Acoustic Emission Data, *Experimental Mechanics*, Vol. 16, No. 3, Mar 1976, pp. 111-115.
13. Herakovich, C. T., Renieri, G. D. and Brinson, H. F., "Finite Element Analysis of Mechanical and Thermal Edge Effects in Composite Laminates, "Army Symposium on

Solid Mechanics, 1976, *Composite Materials: The Influence of Mechanics of Failure on Design,* Cape Cod, MA, Sep 1976, pp. 237-248.

14. Herakovich, C. T. and Itani, R. Y., "Elastic-Plastic Torsion of Non-Homogeneous Bars, "*ASCE Journal of the Engineering Mechanics Division,* Vol. 102, No. 5, Oct 1976, pp. 757-769.

15. Herakovich, C. T., "On Thermal Edge Effects in Composite Laminates, "*International Journal of Mechanical Sciences*, Vol. 18, No. 3, 1976, pp. 129-134.

16. Herakovich, C. T., Davis, Jr., J. G. and Viswanathan, C. N., "Tensile and Compressive Behavior of Borsic/Aluminum, "*Composite Materials: Testing and Design* (Fourth Conference) ASTM STP 617, American. Society for Testing and Materials, 1977, pp. 344-357.

17. Hsu, P. W. and Herakovich, C. T., "A Perturbation Solution for Interlaminar Stresses in Bidirectional Laminates, "*Composite Materials: Testing and Design* (Fourth Conference) ASTM STP 617, American Society for Testing and Materials, 1977, pp. 296-316.

18. Herakovich, C. T., Kennedy, J. M. and Tenney, D. R., "Effect of Cyclic Loading and Temper Condition on the Tensile Behavior of Boron-Aluminum, "*Environmental Effects in Engineering Materials*, VPI&SU, Blacksburg, VA, Oct 1977, pp. 331-344.

19. Hsu, P. W. and Herakovich, C. T., "Edge Effects in Angle-Ply Composite Laminates, "*Journal of Composite Materials*, Vol. 11, Oct 1977, pp. 422-428.

20. Herakovich, C. T. and Wong, D. M., "Influence of Residual Stresses on the Tensile Strength of Composite-Metal Sandwich Laminates, "*Experimental Mechanics*, Vol. 17, No. 11, Nov. 1977, pp. 409-414.

21. Farley, G. L. and Herakovich, C. T., "Influence of Two-Dimensional Hygrothermal Gradients on Interlaminar Stresses Near Free Edges, "*Environmental Effects on Advanced Composite Materials*, ASTM STP 658, American Society for Testing and Materials, 1978, pp. 143-159.

22. Kennedy, J. M., Tenney, D. R. and Herakovich, C. T., "The Nonlinear Stress-Strain Behavior of Boron- Aluminum Laminates during Cyclic Loading, "*Proceedings, 2nd Int. Conference on Composite Materials*, The Metallurgical Society of AIME, 1978, pp. 539-554.

23. Herakovich, C. T. and O'Brien, D. A., "Failure Analysis of an Idealized Composite Damage Zone, "*Proceedings, 29th MFPG Symposium, Advanced Composites: Design and Applications,* Gaithersburg, MD, May 1979, pp. 242-254.

24. Herakovich, C. T., Nagarkar, A. and O'Brien, D. A., "Failure Analysis of Composite Laminates with Free Edges, "*Modern Developments in Composite Materials and Structures*, (J. R. Vinson, Ed.) ASME, 1979, pp. 53-66.

25. Herakovich, C. T., Davis, Jr., J. G. and Mills, J. "Thermal Microcracking in Celion 6000/ PRM-15 Graphite/Polyimide, *Thermal Stresses in Severe Environments*, (Hasselman and Heller, Ed.) Plenum Publishing Corp., 1980, pp. 649-664.

26. Herakovich, C. T. and Nagarkar, A. P., "On Failure Modes in Finite Width Angle-Ply Laminates, "*Proceedings ICCM-III*, (Bunsell, et al., Ed.) Paris, Aug 1980, pp. 425-435.

27. Herakovich, C. T. and Bergner, Jr., H. W., "Finite Element Stress Analysis of a Notched Coupon Specimen for In-plane Shear Behavior of Composites, "*Composites*, July 1980, pp. 149-154.

28. Herakovich, C. T., Bergner, Jr., H. W. and Bowles, D. E., "A Comparative Study of Composite Shear Specimens using the Finite Element Method, "*Test Methods and Design Allowables for Fibrous Composites,* ASTM STP 734, (C. C. Chamis, Ed.) Amer. Soc. Testing & Materials, 1981, pp. 129-151.

29. Herakovich, C. T. and Johnson, E. R., "Buckling of Composite Cylinders under Combined Compression and Torsion -Theoretical/Experimental Correlation", *Test Methods & Design Allowables for Fibrous Composites, ASTM STP 734*, (C. C. Chamis, Ed.) Amer. Soc. Testing & Materials, 1981, pp. 341-360.

30. Pindera, M. J. and Herakovich, C. T., "Influence of Stress Interaction on the Behavior of Off-Axis Unidirectional Composites, "*Proceedings Second USA-USSR Symposium on Fracture of Composite Materials*, Lehigh University, Mar 9-13, 1981, pp. 185-196.

31. Herakovich, C. T., "On the Relationship between Engineering Properties and Delamination of Composite Materials, "*Journal of Composite Materials,* Vol. 15, Jul 1981, pp. 336-348.

32. Griffin, Jr., O. H., Kamat, M. P. and Herakovich, C. T., "Three Dimensional Inelastic Finite Element Analysis of Laminated Composites", *Journal of Composite Materials*, Vol. 15, Nov 1981, pp. 543-560.

33. Bowles, D. E., Post, D., Herakovich, C. T. and Tenney, D. R., "Moiré Interferometry for Thermal Expansion of Composites, "Experimental Mechanics, Vol. 21, No. 12, Dec 1981, pp. 441-447.

34. Herakovich, C. T., "Influence of Layer Thickness on the Strength of Angle-Ply Laminates, " Journal of Composite Materials, Vol. 16, May 1982, pp. 216-227.

35. Hyer, M. W., Herakovich, C. T. and Post, D., "Thermal Expansion of Graphite Epoxy, "ASME Special Publication, AD-03, Advances in Aerospace Structures & Materials, (Laurenson & Yuceoglu) 1982, pp. 107-114.

36. Czarnek, R., Post, D. and Herakovich, C. T., "Edge Effects in Composites by Moiré Interferometry", Experimental Techniques, Jan. 1983, pp. 18-21.

37. Nemeth, M. P., Herakovich, C. T. and Post, D., "On the Off-Axis Tension Test for Unidirectional Composites, "Composites Technology Review, Vol. 5, No. 2, Summer 1983, pp. 61-68.

38. Pindera, M. J. and Herakovich, C. T., "An Endochronic Model for the Response of Unidirectional Composites under Off-Axis Tensile Load, "Mechanics of Composite Materials: Recent Advances, (Hashin and Herakovich, Eds.) Pergamon Press, 1983, pp. 367-382.

39. Hyer, M. W., Herakovich, C. T., Milkovich, S. M. and Short, Jr., J. C., "Temperature Dependence of Mechanical and Thermal Expansion Properties of T300/5208 Graphite-Epoxy, "Composites, Vol. 14, No. 3, Jul 1983, pp. 276-280.

40. Stiffler, R., Henneke, II, E. G. and Herakovich, C. T., "Detection of Acoustic Emission from Composite Laminates using PVDF2, "Proceeding, First Int. Symposium on Acoustic Emission from Reinforced Composites, "San Francisco, Jul 1983, Session 5, pp. 1-11.

41. Buczek, M. B. and Herakovich, C. T., "Prediction of the Direction of Crack Growth in Fibrous Composites, "Mechanics of Composite Materials, (Dvorak, Ed.) ASME AMD 58 Amer. Soc. Mechanical Engineers, 1983, pp. 75-82.

42. Adams, D. S. and Herakovich, C. T., "Influence of Damage on the Thermal Response of Graphite- Epoxy Laminates, "*Journal of Thermal Stresses*, Vol. 7, 1984, pp. 91-103.

43. Pindera, M. J. and Herakovich, C. T., "An Elastic Potential for the Nonlinear Response of Unidirectional Graphite Composites, "Journal of Applied Mechanics, ASME, Vol. 51, Sep 1984, pp. 546-550.

44. Herakovich, C. T., "Composite Laminates with Negative Through-the-Thickness Poisson's Ratios", Journal of Composite Materials, Vol. 18, Sep 1984, pp. 447-455.

45. Herakovich, C. T., Gregory, M. A. and Beuth, Jr., J. L., "Crack Growth Direction in Unidirectional Off- Axis Graphite-Epoxy, "in Mechanical Characterization of Load Bearing Fibre Composite Laminates, (Cardon & Verchery, Eds.) Elsevier Applied Science Publishers, NY, 1985.

46. Herakovich, C. T., Post, D., Buczek, M.B. and Czarnek, R., "Free Edge Strain Concentrations in Real Composite Laminates: Experimental-Theoretical Correlation, "Journal of Applied Mechanics, Vol. 52, No. 4, Dec 1985, pp. 787-793.

47. Gregory, M. A., Choksi, G. N. and Herakovich, C. T., "Orthotropic Fracture using a Singular Isoparametric Element, " Pressure Vessels Components Design and Analysis, (R. C. Guialtney, Ed.) ASME PVP, Vol. 98-2, NY, 1985.

48. Gregory, M. A., Beuth, Jr., J. L., Barbe, A. and Herakovich, C. T., "Application of the Normal Stress Ratio Theory for Predicting the Direction of Crack Growth in Unidirectional Composites, "Fracture of Fibrous Composites, (C. T. Herakovich, Ed.) ASME, AMD Vol. G00294, NY, 1985.

49. Beuth, Jr., J. L., Gregory, M. A. and Herakovich, C. T., "Crack Growth in Unidirectional Graphite- Epoxy under Biaxial Loading, "Experimental Mechanics, Vol. 26, No. 3, Sep 1986, pp. 245-253.

50. Herakovich, C. T., and Hyer, M. W., "Damage-Induced Property Changes in Composites Subjected to Cyclic Thermal Loading, "Engineering Fracture Mechanics, Vol. 25, Nos. 5/6, 1986, pp 779-791.

51. Buczek, M. B. and Herakovich, C. T., "A Normal Stress Criterion for Crack Extension Direction in Orthotropic Composite Materials, "Journal of Composite Materials, Vol. 19, No. 6, Nov 1985, pp. 544- 553.

52. Gregory, M. A. and Herakovich, C. T., "Predicting Crack Growth Direction in Unidirectional Composites, "Journal of Composite Materials, Vol. 20, No. 1, Jan 1986, pp. 67-85.

53. Sykes, Jr., G. F., Milkovich, S. M. and Herakovich, C. T., "Simulated Space Radiation Effects on a Graphite Epoxy Composite, "Polymeric Materials Science and Engineering, Proceedings of the ACS Division of Polymeric Materials: Science and Engineering, Vol. 52, Amer. Chemical Society, 1985, pp. 598-603.

54. Herakovich, C. T., "Free Edge Effects in Laminated Composites, "Chapter 4, *Handbook of Composites*, Vol. 2, Structure and Design, (Herakovich & Tarnopol'skii Eds.), North Holland, 1989, pp. 188-230.

55. Pindera, M. J. and Herakovich, C. T., "Shear Characterization of Unidirectional Composites with the Off-Axis Tension Test, "Experimental Mechanics, Vol. 26, No. 1, 1986, pp. 103-111.

56. Avery, W. B. and Herakovich, C. T., "Effect of Fiber Anisotropy on Thermal Stresses in Fibrous Composites, "Journal of Applied Mechanics, Vol. 53, No. 4, Dec 1986, pp. 751-756.

57. Adams, D. S., Bowles, D. E. and Herakovich, C. T., "Thermally Induced Transverse Cracking in Graphite-Epoxy Cross-Ply Laminates, "Journal of Reinforced Plastics and Composites, Vol. 5, No. 3, Jul 1986, pp. 152-169

58. Milkovich, S. M., Sykes, Jr., G. F. and Herakovich, C. T., "Space Radiation Effects on the Thermo- Mechanical Behavior of Graphite-Epoxy Composites, "Journal of Composite Materials, Vol. 20, No. 6, Nov 1986, pp. 579-593.

59. Milkovich, S. M., Sykes, Jr., G. F. and Herakovich, C. T., "Fracture Surfaces of Irradiated Composites, "STP 948 - Fractography of Modern Engineering Materials: Composites and Metals (Masters/Au, ed.,) Aug 1987.

60. Beuth, Jr., J. L. and Herakovich, C. T., "On Fracture of Fibrous Composites, "Composites '86: Recent Advances in Japan and the United States, (K. Kawata, S. Umekawa & A. Kobayashi, ed.,) Proc. Japan- US CCM-III, Tokyo, 1986.

61. Burns, S. W., Herakovich, C. T. and Williams, J. G., "Efficient Three-Dimensional Finite Element Failure Analysis of Compression Loaded Angle-Ply Plates with Holes, "Proceedings, ICCM-VI, & ECCM 2, Vol. 5 (Matthews, Buskell, Hodgkinson & Morton, eds.), Elsevier Applied Science, 1987, pp. 5.231- 5.241.

62. Beuth, Jr., J. L., Gurdal, Z. and Herakovich, C. T., "Composite Fracture using the Normal Stress Ratio Theory, "Advances in Composite Materials and Structures, (S. S. Wang and Y. D. S. Rajapakse, eds.), AMD-Vol. 82, American Society of Mechanical Engineers, New York, 1989, pp. 1-8.

63. Burns, S. W., Herakovich, C. T. and Williams, J. G., "Failure Modes for Compression Loading of Angle- Ply Plates with Holes, "Composite Structures 4, Vol. 2 Damage Assessment and Material Evaluation (I. H. Marshall, ed), Elsevier Applied Science, 1987, pp. 2.175-2.191.

64. Choksi, G. N. and Herakovich, C. T., "Fracture of Composites using Singular Finite Elements, "Proceedings, 4th Int. Conference on Numerical Methods in Fracture Mechanics (Luxmoore, Owen, Rajapakse and Kanninen, Eds.), San Antonio, TX, Mar 1987.

65. Gurdal, Z. and Herakovich, C. T., "Effect of Initial Flaw Shape on Crack Extension in Orthotropic Composite Materials, "Theoretical and Applied Fracture Mechanics, Vol. 8, 1987, pp 59-75.

66. Reed, S. M., Sykes, Jr., G. F. and Herakovich, C. T., "Influence of Electron Radiation & Temperature on the Cyclic, Matrix Dominated Response of Graphite-Epoxy, "Journal of Reinforced Plastics and Composites, Vol. 6, No. 3, Jul 1987, pp. 234-252.

67. Pindera, M-J, Gurdal, Z., Herakovich, C. T., Hidde, J. S. and Starbuck, J. M., "Mechanical Response of Aramid/Epoxy Under Tensile, Compressive and Shear Loading, "Journal of Reinforced Plastics and Composites, Vol. 8, No. 4, July 1989, pp 410-420.

68. Herakovich, C. T., Fox, D. J. and Sykes, Jr., G. F., "Degradation of Graphite-Epoxy due to Electron Radiation, "ASME Journal of Engineering Materials and Technology, Vol. 110, April, 1988, pp.146- 152.

69. Pindera, M. J., Choksi, G. N., Hidde, J. S. and Herakovich, C. T., "A Methodology for Accurate Shear Characterization of Unidirectional Composites, "Journal of Composite Materials, Vol. 21, Dec 1987, pp 1165-1184.

70. Pindera, M. J., Aboudi, J. and Herakovich, C. T., "Nonlinear Response of Boron/Aluminum Under Combined Loading, "Yielding, Damage, and Failure of Anisotropic Solids, EGF5, (J. P. Boehler, ed), 1990, pp 235-249.

71. Aboudi, J., Lee, S. W. & Herakovich, C. T., "Three-Dimensional Analysis of Laminates with Cross Cracks, " Journal of Applied Mechanics, Vol. 55, No. 2, June 1988, pp. 389-397.

72. Herakovich, C. T., Aboudi, J., Lee, S. W. & Strauss, E. A., "Damage in Composite Laminates: Effects of Transverse Cracks, "Mechanics of Materials, Vol. 7, 1988, pp. 91-107.

73. Kadiyala, P., Gurdal, Z. & Herakovich, C. T., "Notch Sensitivity of ARALL® Laminates with Circular Holes, "Transactions, 4th Japan-US Conference on Composite Materials, Univ. of Delaware, 1988.

74. Herakovich, C. T., Aboudi, J., Strauss, E. A. & Lee, S. W., "2-D and 3-D Damage Effects in Cross-ply Laminates, "Mechanics of Composite Materials - 1988, AMD - Vol. 92, (Dvorak & Laws, eds.), ASME, 1988.

75. Herakovich, C. T., "Failure Modes and Damage Accumulation in Laminated Composites with Free Edges, "Composites Science & Technology, Vol. 36, 1989, pp. 105-119.

76. Beuth, J. L., Jr., & Herakovich, C. T., "Analysis of Crack Extension in Anisotropic Materials Based on Local Normal Stress, "Theoretical & Applied Fracture Mechanics, Vol. 11, 1989, pp 27-46.

77. Herakovich, C. T., "Effects of Morphology on Properties of Graphite Composites, "Journal of Carbon, Vol. 27, No. 5, Nov 1989, pp. 663-678.

78. Fujita, T., Pindera, M. J., & Herakovich, C. T., "Temperature-Dependent Tensile and Shear Response of P100/6061 Graphite-Aluminum, "Thermal and Mechanical Behavior of Metal Matrix and Ceramic Matrix Composites, ASTM-STP 1080, (J. M. Kennedy, H. H. Moeller, and W. S. Johnson, Eds.) American Society for Testing and Materials, Philadelphia, 1990, pp 165-182.

79. Hidde, J. S., & Herakovich, C. T., "Notch Sensitivity of ARALL® Laminates, "ICCM 7 - Proceedings of the Seventh International Conference on Composite Materials, (Wu Yunshu, Gu Zhenlong and Wu Renjie, Eds.) International Academic Publishers, Pergamon Press, Beijing, China, Nov 1989, Vol. 1, pp. 435-440.

80. Herakovich, C. T., "Edge Effects & Delamination Failures, "Journal of Strain Analysis, Vol. 24, No. 4, Oct 1989, pp 245-252.

81. Herakovich, C. T., "Lamination Theory, "International Encyclopedia of Composites, (Stuart M. Lee, ed.) Vol. 3, Jan 1991, pp 44-55.

82. Mathison, S. R., Pindera, M. J., and Herakovich, C. T., "Nonlinear Response of Resin Matrix Laminates using Endochronic Theory, " Visco-Plastic Behavior of New Materials, MD - Vol. 17, (Hui & Kozik, eds.), ASME 1989.

83. Herakovich, C. T., "Modeling Fracture of Resin Matrix Composites, "Mechanics of Plastics and Plastic Composites, AMD - Vol. 104, (V.K. Stokes, ed), ASME 1989. Also in Polymer Composites, (Roger S. Porter, ed.) Vol. 11, No. 6, Dec 1990, pp 322-327.

84. Knott, T. W., and Herakovich, C. T., "Effect of Fiber Orthotropy on Effective Composite Properties, "Journal of Composite Materials, Vol. 25, No.6, June 1991, pp732-759.

85. Knott, T. W., and Herakovich, C. T., "Influence of Fiber Morphology on Strength of Unidirectional Graphite Composites, "Proceedings of American Society of Composites, Blacksburg, VA, Sept 1989.

86. Pindera, M. J., Herakovich, C. T., Aboudi, J., and Becker, W., "Nonlinear Response of Unidirectional Boron/Aluminum, "Journal of Composite Materials, Vol. 24, No. 1, Jan 1990, pp 2-21.

87. Herakovich, C. T. & Mirzadeh, F., "Properties of Pultruded Graphite-Epoxy, "Journal of Reinforced Plastics and Composites, Vol. 10, No. 1, Jan 1991, pp 2-28.

88. Herakovich, C. T., Duva, J. M., Mirzadeh, F. & Lang, E. J., "A Probabilistic Perspective on the Failure of Composite Laminae, "Mechanics USA 1990, (C. F. Chen, Ed), Proceedings, Eleventh USNCTAM, ASME Press, New York, 1990.

89. Herakovich, C. T. & Mirzadeh, F., "Characteristics of Micro-Level Fracture in Notched Unidirectional Graphite-Epoxy, "Microcracking-Induced Damage in Composites, (G. J. Dvorak and D. C. Lagoudas, eds.), AMD- Vol. 111, MD- Vol. 22, ASME, 1990, pp 1-7.

90. Hidde, J. S. & Herakovich, C. T., "Assessment of Damage in Notched Composites, "Damage Mechanics in Engineering Materials, (J. W. Ju, D. Krajcinovic and H. L. Schreyer, eds.), AMD- Vol. 109, MD- Vol. 24, ASME, 1990, pp 167-177.

91. Herakovich, C. T. and Duva, J. M., "Thermal Cracking in Fibrous Composites using the Normal Stress Ratio, "Thermal Effects in Fracture of Multiphase Materials, (K. P. Herrmann and Z. S. Olesiak, eds.), Springer-Verlag, 1990, pp. 105-113.

92. Herakovich, C.T., Aboudi, J. and Beuth, J.L., "A Micromechanical Composite Yield Model Accounting for Residual Stresses, "Inelastic Deformation of Composite Materials, (G.J. Dvorak, Ed), Springer- Verlag, New York, 1991, pp 373-388.

93. Norwood, D. S., Shuart, M. J., and Herakovich, C. T., "A Geometrically Nonlinear Analysis of Interlaminar Stresses in Unsymmetrically Laminated Plates Subjected to Inplane Mechanical Loading", AIAA Paper No. 91-0955. AIAA/ASME/ASCE/AHS 32nd Structures, Structural Dynamics and Materials Conference, Baltimore, MD, April 8-10, 1991.

94. Larom, D. Herakovich, C. T., and Aboudi, J., "Dynamic Response of Pulse Loaded Laminated Composite Cylinders", Int. Journal of Impact Engineering, Vol. 11, No. 2, 1991.

95. Rose, C.A., and Herakovich, C.T., "An Approximate Analytical Solution for Interlaminar Stresses in Angle-Ply Laminates", Composites: Design, Manufacture, and Application, (S.W. Tsai and G.S. Springer, eds.) , ICCM VIII, SAMPE, 1991.

96. Norwood, D.S., Shuart, M.J. & Herakovich, C.T., "A Geometrically Nonlinear Analysis of Interlaminar Stresses in Unsymmetrically Laminated Plates Subjected to Uniform Thermal Loading, "Creep Fatigue Interaction at High Temperature, AD- Vol. 21, (G.K. Haritas & O.O. Ochoa, eds.), Am. Soc. Mechanical Engineers, New York, 1991, pp 81-90.

97. Thornton, E.A., Starke, E.A., Jr., and Herakovich, C.T., "Materials and Light Thermal Structures Research for Advanced Space Exploration, "AIAA Paper No. 91-3431, AIAA/ NASA/OAI Conference on Advanced SEI Technologies, Sept. 1991.

98. Herakovich, C. T., "Microlevel Thermal Effects in Metal Matrix Composites, "Thermal Structures and Materials for High Speed Flight (E. A. Thornton, ed), V 140 AIAA Series Progress in Astronautics & Aeronautics, (A. R. Seebass, editor-in-chief), AIAA, 1992, pp 327-338.

99. Aboudi, J. Hidde, J.S., and Herakovich, C. T., "Thermo-Mechanical Response Predictions for Metal Matrix Composite Laminates", Mechanics of Composites at Elevated and Cryogenic Temperatures, AMD- Vol. 118, (S.N. Singhal, W.F. Jones, C.T. Herakovich, eds.), ASME, 1991, pp 1-8. Also, Science & Engineering of Composite Materials, Vol. 2, No. 3, 1993, pp. 151 - 170.

100. Herakovich, C.T., and Hidde, J.S., "Response of Metal Matrix Composites with Imperfect Bonding, "Ultramicroscopy, Vol. 40, 1992, pp 215-228.

101. Hidde, J. S. and Herakovich, C. T., "Inelastic Response of Hybrid Composite Laminates, "Journal of Composite Materials, Vol. 26, No.1, Jan 1992.

102. Lissenden, C. J. and Herakovich, C.T., "Comparison of Micromechanical Models for Elastic Properties", Engineering, Construction and Operations in SPACE III, Eds., W. Z. Sadeh, S. Sture, and R. J. Miller, Space'92, Proc. 3rd Int. Conference, pp. 1309-1322, American Society of Civil Engineers, 1992., pp 1309-1322.

103. Lissenden, C. J., Pindera, M-J., & Herakovich, C. T, "Response of SiC/Ti Tubes Under Biaxial Loading in the Presence of Damage", in Damage Mechanics in Composites (D. H. Allen & D. C. Lagoudas, eds.), ASME AMD- Vol. 150, AD- Vol. 132, ASME, 1992, pp 73-90.

104. Rose, C. A. & Herakovich, C. T., "An Approximate Solution for Interlaminar Stresses in Laminated Composites Subjected to Bending and Extension", Proceedings Am. Society Composites Seventh Technical Conference, Technomic Publishing Co. Inc., 1992, pp. 1125-1135.

105. Hirschfeld, D. A. and Herakovich, C. T., "Failure Analysis of Notched Unidirectional Graphite/Epoxy Tubes under Combined Loading", in Composite Materials: Fatigue and Fracture (4th Volume) ASTM STP 1156, (W. W. Stinchcomb & N. E. Ashbaugh, eds.), Am. Soc. Testing & Materials, Philadelphia, 1993, pp. 72-85.

106. Lang, E. J., Duva, J. M, & Herakovich, C. T., "A Comparison of the Plane Stress Approximation & Full Three-Dimensional Stresses in Notched Unidirectional Fiber Reinforced Composites", Composites Engineering, Vol. 3, No. 3, 1993, pp. 261-269.

107. Rose, C. A. & Herakovich, C. T., "An Approximate Solution for Interlaminar Stresses in Composite Laminates", Composites Engineering, Vol. 3, No. 3, 1993, pp. 271-285.

108. Choksi, G. N. & Herakovich, C. T., "Formulation and Implementation of a Singular Anisotropic Finite Element", Journal of Theoretical and Applied Fracture Mechanics, Vol. 19, 1993, pp. 157-171.

109. Herakovich, C. T., Duva, J. M., Seitz, and Sigrest, M. W., "Thickness Effects in Notched Composites", Mechanics of Thick Composites, ASME-AMD- Vol. 162, (R. Rajapakse, Editor), Am. Soc. Mechanical Engineers, New York, 1993.

110. Lissenden, C. J., Pindera, M-J., & Herakovich, C. T., "Stiffness Degradation of SiC/Ti Tubes Subjected to Biaxial Loading", J. Composite Science & Technology, Vol. 50, 1994, pp. 23-36.

111. Aboudi, J., Mirzadeh, F. & Herakovich, C.T., "Response of Metal Matrix Laminates with Temperature Dependent Properties", J. Composites Technology & Research, Vol. 16, No. 1, Jan. 1994, pp. 68-76.

112. Duva, J. M., Aboudi, J. & Herakovich, C. T., "A Probabilistic Micromechanics Model for Damaged Composites", in Damage Mechanics in Composites, (D. H. Allen & J. W. Ju, eds.), ASME, AMD- Vol. 185, 1994, pp. 1-20. Also in J. Engineering Materials & Technology, ASME, Vol. 118, 1996, pp. 548- 553.

113. Lissenden, C. J., Herakovich, C. T., & Pindera, M-J., "Damage Induced Room Temperature Creep of TMC", in Durability of Composite Materials, (R. C. Wetherhold, ed), ASME, MD- Vol. 51, 1994, pp. 39-50.n

114. Lissenden, C. J., & Herakovich, C. T., "Modelling Interfacial Debonding in Titanium Matrix Composites", in Inelasticity and Micromechanics of Metal Matrix Composites, (G. Z. Voyiadjis and J. W. Ju, eds.), Elsevier, Studies in Applied Mechanics 41, Amsterdam, 1994, pp. 239-260.

115. Lissenden, C. J., Herakovich, C. T., & Pindera, M-J, "Response of SiC/Ti Under Combined Loading, Part I: Theory and Experiment for Imperfect Bonding", *J. Composite Materials, Vol. 29, No. 2, 1995. pp. 130-155.*

116. Lissenden, C. J., Herakovich, C. T., & Pindera, M-J, (1996), "Inelastic Deformation of TMC Under Multiaxial Loading", in Life Prediction Methodology for Titanium Matrix Composites, ASTM STP 1253, (W. S. Johnson, J. Larsen & B. Cox, eds.), Am. Soc. Testing & Materials, pp. 257-277.

117. Lissenden, C. J. & Herakovich, C. T., (1995), "Numerical Modelling of Damage Development and Viscoplasticity in Metal Matrix Composites", Computer Methods in Applied Mechanics and Engineering, Vol. 126, pp. 289-303.

118. Lissenden, C. J., Herakovich, C. T., & Pindera, M-J, (1995), "Response of SiC/Ti Under Combined Loading, Part II: Room Temperature Creep Effects", J. Composite Materials, Vol. 29, No. 10, pp. 1403-1417.

119. Lissenden, C. J., Lerch, B. A. and Herakovich, C. T., (1996), "Response of SiC/Ti Under Combined Loading, Part III: Microstructural Evaluation", J. Composite Materials, Vol. 30, No. 1, pp. 84-108.

120. Aboudi, J. and Herakovich, C. T., (1996), “An Interfacial Damage Model for Titanium Matrix Composites”, Damage and Interfacial Debonding in Composites, G. Z. Voyiadjis & D. H. Allen, eds., Elsevier Science B. V., New York.

121. Lissenden, C. J. & Herakovich, C. T., (1996), “Interfacial Debonding in Laminated Titanium matrix Composites”, Mechanics of Materials, Vol. 22, pp. 279-290.

122. Herakovich, C. T. & Mirzadeh, F., (1997), “Thermal-Mechanical Response of Stiffened Composite Cylinders”, Applied Mechanics in the Americas, Vol. 5: Mechanics of Fluids, Thermal Problems, Optimization and Control, Experimental and Numerical Methods, Biomechanics, Applications, (M. Rysz, L. A. Godoy, L. E. Suarez, Eds.), The University of Iowa, Iowa City, IA.

123. Herakovich, C. T. & Mirzadeh, F., (1997), “Discrete Layer Analysis of Orthotropic, Stiffened Composite Cylinders”, J. Thermal Stresses, Vol. 20, pp. 87-111.

124. Herakovich, C. T. & Aboudi, J., (1999), “Thermal Effects in Composites”, (invited review paper) in Thermal Stresses Vol. V, (R. Hetnarski, Ed.), Lastran Corp., Rochester, NY.

125. Herakovich, C. T. and Baxter, S. C. (1999), “Influence of pore geometry on the effective response of porous media”, J. Materials Science, V. 33, pp. 1-15.

126. Hersh, C. L. & Herakovich, C. T., (1999), “Local Effects in Stiffened Composite Tubes under Generalized Plane Deformation”, J. Composite Materials, Vol. 33, No. 5, pp. 420-442.

127. Roerden, A. M. and Herakovich, C. T., (1999), “Inelastic Response of Porous, Hybrid Fiber Composites”, ASME Pagano Symposium, J. Composites Science and Technology, v60, pp. 2443-2453.

128. Gan, H. Orozco, C. E. and Herakovich, C. T., (1999), “A new Method for the Micromechanical Analysis of Multi-phase Composites”, Int. J. Solids & Structures, Vol. 37, pp. 5097-5122.

129. Herakovich, C. T., Schroedter, R. D., III, Gasser, A. & Guitard, L., (2000), "Damage evolution in [+- 45]s laminates with fiber rotation", Composites Science and Technology, v60, pp. 2781-2789.

130. Baxter, S. C., Herakovich, C. T. and Roerden, A. M., (2001), "Influence of Porosity on the Response of Fibrous Composites", Theoretical and Numerical Methods in Continuum Mechanics of Porous Materials, W. Ehlers (Ed.), Kluwer Academic Publishers, pp. 131-136.

131. Phillips, E. A., Herakovich, C. T. & Graham, L. L., (2001), “Damage development in composites with large stress gradients”, *Composite Science and Technology*, v61, pp. 2169-2182.

132. Flesher, N. D. & Herakovich, C.T. (2006), “Predicting delamination in composite structures”, *Composite Science and Technology*, v66, Issue 6, pp. 745-754.

133. Hersh, C. L. & Herakovich, C. T., (2010), “Modelling Generalized Plane Problems with Cylindrical Anisotropy”, in *Advances in Mathematical Modeling and Experimental Methods for Materials and Structures: The Jacob Aboudi Volume,* R. Gilat & L. Banks, Eds., Solids Mechanics and Its Applications 168, Springer, The Netherlands, pp. 297-308.

134. Herakovich, C. T., (2012), "Mechanics of composites: A historical review", Mechanics Research Communications, v41, pp. 1-20, Elsevier.

Books Edited:

1. Herakovich, C. T., (Ed.) Inelastic Behavior of Composite Materials, ASME, AMD No. 13, 1975. (Also translated into Russian by Y. Tarnopol'skii.)
2. Hashin, Z. and Herakovich, C. T. (Eds.), *Mechanics of Composite Materials: Recent Advances*, Pergamon Press, 1983.
3. Herakovich, C. T., (Ed.) *Fracture of Fibrous Composites*, ASME, AMD Vol. G00294, NY, 1985.
4. Herakovich, C. T. and Tarnopol'skii, Y. (Eds.), *Handbook of Composites, Vol. 2, Structures & Design*, North Holland, 1989.
5. Singhal, S.N., Jones, W.F., and Herakovich, C.T. (Eds.), *Mechanics of Composites at Elevated and Cryogenic Temperatures*, AMD- Vol. 118, Am Soc Mechanical Engineers, New York, 1991.
6. Herakovich, C. T. & Duva, J. M., *MEET'N'93 ABSTRACTS*, Vols. I and II, University of Virginia, 1993.

Carl T. Herakovich

Virginia Tech Professor - 1967-87

Mechanics, Composites, Computers

This fourth book in the author's memoir series discusses the twenty years he was a professor at Virginia Tech, rising through the ranks from assistant to associate to full professor.

He reviews his role in conceiving and developing the NASA-Virginia Tech Composites Program. A program that had a major impact on graduate education and the production of engineers capable of working with fibrous composite materials. According to a NASA administrator the program was "one of the most significant contributions to the country coming out of Langley's composites research".

The author discusses his leadership role in the Virginia Tech personal computer initiative. This 1984 initiative resulted in Virginia Tech being the first public university in the country to require freshmen engineering students to purchase their own personal computer. The initiative is considered to be a major academic advancement at Virginia Tech.

During his years in Blacksburg, the author became an Atlantic Coast Conference football official. He discusses many of the highlights of games he worked including, then TV announcer, Coach Darrel Royal, commenting on national TV during the 1974 Blue Bonnet Bowl game "look at that official, he's the only one that can keep up with the runner".

The book includes details of the year that he was on sabbatical at École Polytechnique in Paris, France, including highlights of his families travels throughout Europe when he would give lectures.

The book also includes discussion of rental property ownership in Blacksburg and Sunset Beach, NC.

The Appendix has listings of graduate students, scholarly publications, officiated football games, crews and coaches, and details of the Virginia Tech personal computer initiative, the NASA-Virginia Tech Composites Program, and real estate transactions.

In 2020, the author was recognized with the Albert Nelson Marquis Lifetime Achievement Award.