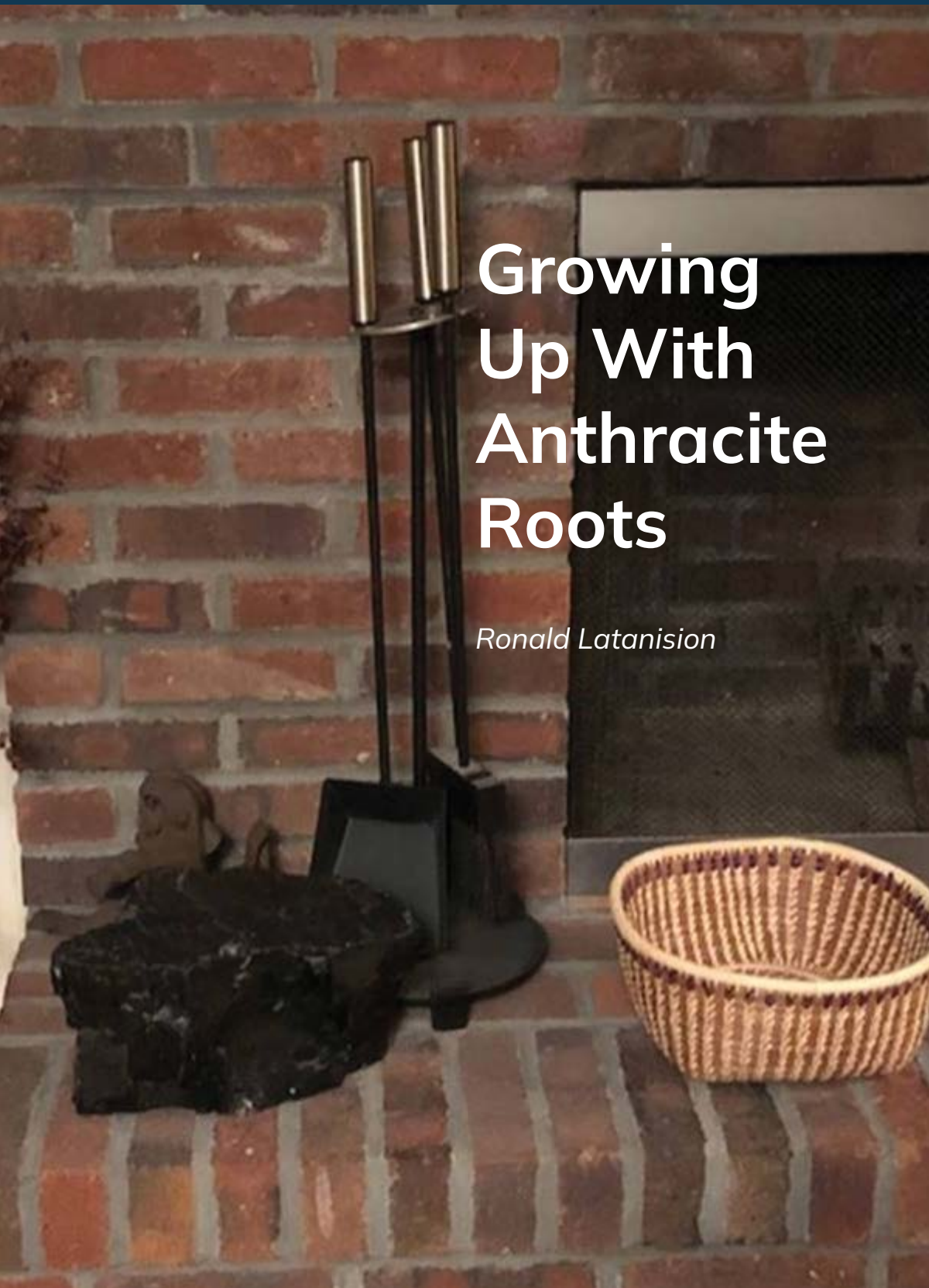

# Growing Up With Anthracite Roots

*Ronald Latanision*

Front Cover Photo: Anthracite
Back Cover Photo: Grandchildren

# Contents

# Preface

*I have always wished that I knew more about my grandparents. I never met my maternal grandparents who were from Poland, near Krakow. My paternal grandparents were from Ukraine, near Kiev, I believe. They did not speak English. My grandparents taught some of my older siblings to speak and to write in their language, but as I was the youngest and my grandparents had grown older, I think they gave up trying to instruct us, and yours truly in particular, to speak the language. I have been close to my five grandchildren and have enjoyed the whole experience of being a grandfather. But it seems to me that a record of some kind that addresses my history might be useful to shore up their memories as they, too, age. So Parts 1 and 2 track my personal evolution, while Parts 3 and 4 describe my professional experiences.*

## Part 1:

# Personal Story — The Early Years

## Childhood in Richmondale

I was born on July 2, 1942, the fifth child of Mary Kopach Latanision and Stephen Latanision. I believe, based on Ancestry searches, that Latanision is an anglicized version of what we believe to be the original spelling, Latanishyn. They are phonetic equivalents. We were all born at home at 527 Main Street in Richmondale, Pennsylvania. I had two older brothers, Steve and Tom, and sisters, Katherine and Marguerite. Richmondale was a town of about 100 people located about 20 miles northeast of Scranton, five miles from Carbondale, four miles from Simpson, and about one mile from Forest City. (These smaller towns will become part of this story.) Neither my mother nor my father finished school, both leaving after Grade 5, as I recall. Mom raised five kids and kept my dad in line, for the most part. My dad had a temper, and my mom absorbed much of his discomfort. He was a coal miner, as were just about all the other males in town. Northeast Pennsylvania was anthracite coal country. Hard coal, as it is known, was also described as the blue diamond. While bituminous (soft) coal is burned in power plants to generate electricity, anthracite coal has the highest energy density of all types of coal and was used in the steel-making industry and other metallurgical applications. Anthracite burns with a blue flame! In fact, when I was a kid, veins of anthracite coal were burning underground, and where the veins reached the surface blue flames licked from the ground. The scene was surreal–the mind's image of *hell* if there is such a place! These underground coal fires had begun years before, creating sinkholes when the ash that was produced was unable to support the ground above and collapsed. I did not think much of all of this at that time–it was just the way we lived in the Lackawanna Valley. I suppose I expected everyone lived that way.

There was an 18-year separation between my oldest sister, Katherine, and myself. Tom is four years older than I am. Steve, second oldest, was a real cut-up. Always full of life and energy. He teased me mercilessly. He used to also pick me up by my ankles and lower me head-first (almost) into the new toilet we had in our house when I was a little kid.

Our little village had a bar and one eclectic little store. Our home was small; there were two bedrooms. Tom and I slept in the same bed for a long time. It was a challenge, but better than no bed at all! I remember my dad coming home at the end of his shift in the mine–and after the obligatory stop at the bar–with a bunch of his friends, all of them black from head to foot with coal dust, white just showing through around their eyes. They wore goggles for eye protection but inhaled

*Mom and Dad (Mary Kopach Latanision and Stephen Latanision).*

*Me, six years old, with siblings Marguerite and Tom (clockwise from left).*

coal dust each and every day. He died at age 45 of black lung disease. I was seven years old. For a while, doctors thought he might have had tuberculosis (this was before coal worker's pneumoconiosis was known), and so everyone in our home at the time had to be tested for TB. We were all negative, of course.

The mines were so much a part of the life of Richmondale that my dad thought his sons should also become coal miners and the girls–housewives. When my oldest brother, Steve, who had been in the Coast Guard, decided he wanted to go to college, my dad just about disowned him. But my mom prevailed! Although my dad did not know it, my mom had squirreled away some of my dad's pay, and when Steve was ready to go to Keystone Junior College, she gave him some money and told him to go! He went to Keystone for two years and then transferred to Lehigh University for the final two years of his B.S. in mining engineering. Shortly thereafter, he took a job in West Virginia–and died in a mine collapse at the age of 27–leaving behind his wife and two kids. I was 13 years old at that point, and I was really affected by Steve's death.

Even at age 13, I knew he was too young to die. I convinced myself, using a mathematical progression which I constructed, that based on this history, I would not live beyond 17 if I went to work in the mines! It was at that moment I determined I was not going to become a coal miner. Although the mines were very hard on families (I do not recall many living fathers in my high school graduating class of 39 people), my affection for the Lackawanna and Susquehanna Valleys remains today, despite such history. In fact, the roughly ten-inch cube of anthracite in our living room in Winchester, Massachusetts, today has been with me–forever. I tell people it is a reminder of my youth and my roots, which it is, but it is also a reminder of life as a coal miner's son and of life in our Northeast Pennsylvania village. The people were essentially all Eastern European, and they were civil and respectful toward one another for the most part. The ideals of being civil and respectful have shaped my life.

My interest in coal as an energy source, along with nuclear electric generation and renewables, persists, though not in the current mode. Miners are safer today, but coal and fossil fuels have limits the world must become willing to accept. It can no longer be acceptable to pump $CO_2$ relentlessly into the atmosphere if we want to mitigate climate changes that have now become conspicuous. I will have more to say about this in Part 3, my professional story.

*The famous chunk of anthracite coal.*

One of my other favorite pastimes as a kid was–rolling outhouses. We did not have an indoor toilet when I was very young, but our family became one of the earliest in town to adopt that "convenience"! At any rate, along with some friends, I would wait until an older guy in town got in his outhouse and then roll it over, door facing down, so the unlucky person would have to crawl out the bottom. We never got caught, though I think we were highly suspect! I also remember walking to movies on Saturdays in Forest City with my friends–it cost 12 cents to get in!–to watch cowboys like Roy Rogers, Gene Autry, and many others on the screen. Then we would come home and ride our (imaginary) horses in the woods surrounding our houses! My dad would occasionally take me by car to see a movie in Carbondale in an air-conditioned theater! As I mentioned, he had a temper! I remember one occasion when he became annoyed with someone driving in a car behind ours. He got out at a stop light and punched the guy squarely in the face! I don't

know if there was more to the story, but it was stunning to me. My dad also brewed moonshine. We had a chicken coop in the back of our house that was used to produce chickens for Sunday dinner and eggs. Well, half of it was used to produce chickens and eggs; the other half was a gleaming assembly of copper tubes! I did not realize what function it served at that stage of my life, but I knew something drinkable came out of this grand structure. So one day, some of my friends joined me in indulging in some of the product. We all became really sick! Dad and Mom were not amused. I believe he brewed for himself and his pals until, one day, some guys stopped a car outside of our house, got out with axes, and chopped up his still! That was the end of the brewery! He never rebuilt it!

I also have very vivid memories of a field/pasture that included a small pond. The pond was not really useful for swimming, but it was a great ice rink during the winter, when the cold north winds froze it over. We skated there, played hockey–so to speak. And in the summer, the pasture served as a baseball field on occasion. There was, however, the one reality that this field also served as a pasture for cows! I am not sure who they belonged to, but I suspect they were the property of the lady and her husband who supplied our unpasteurized milk! The reality of all of this sunk in–literally–when playing baseball. Not only did we have to keep an eye on the ball but also on the ground, as the cows did leave their digestive and other metabolic products on our diamond. But the grass and hay provided such a sweet smell to the air that we could–with due process–find comfortable places to lie down after the baseball game had ended! That was life in Richmondale!

After my dad died, I began to realize my mother was a very shrewd investor. We had very little income after he died, and his life insurance of $5,000 did not provide support for very long. But she became interested in the stock market and invested what she could. The mortgage on our home (which then housed Tom, myself, and Mom) had been paid off long before my dad died, but she began to work as a seamstress in a parachute factory in Simpson. With that minimal income and the interest earned on her investments, we managed. When I was in high school and Tom was in college at Lehigh, she worked as a chamber maid in resort hotels in Monticello, New York. I learned to cook–more or less!–while she was away. My mother's personal strength and wisdom were so clear to me. She was able to make ends meet and ensure her kids had an opportunity to go to college or nursing school in order to move forward. I remember with affection that she very much liked to dance. My dad did not. But after he died and while I was growing up at home, she and

*At home after church in 1955.*

I would dance around the kitchen–even though I had no idea how to dance! Carolyn, my wife, and the grandmother of our crew, would affirm I still don't!

### Early Education

I went to a one-room school in Richmondale for my first four years. The school had two floors. The elementary school (Grades 1-6) was on the first floor and the high school on the second floor. There were typically three or four kids in each class and one teacher per room. This experience shaped my entire educational experience. I began to realize one dedicated teacher could make all the difference in a young person's life. Mr. Nazak not only taught us to read and write, but he taught us to sing, and he pulled loose teeth! After Grade 4, we were bused to the William Penn School in Simpson, Pennsylvania, and then to high school in that town. Many of the small schools in the region formed consolidated schools by that time, and I graduated in a class of 39 kids–an order of magnitude more kids than in my grade school classes!–from Fell Township High School in 1960. I played high school basketball in the Scranton/Wilkes-Barre area. We had a baseball team as well, but there were not enough big kids to field a football team! We were pretty good and periodically played in the Pennsylvania state finals in our division. We once played against a team from western Pennsylvania that included a kid, Don Hennon, who became an All-American player at the University of Pittsburgh! He was unstoppable! We did not win.

Educational opportunities were limited for kids in Richmondale. The nearest library was five miles away in Carbondale. Fell High had a dedicated group of teachers, but there were not many of them, and they did not have enough breadth to offer a comprehensive pre-college program. But after Steve died, I decided college was in my future. I also discovered Penn State offered admission to all the kids who were academically first in their high school class. I was not sure how I would pay for it, but I was sure I could be first in my graduating class. I also had a superb chemistry teacher in high school, Mr. Tarris. With his teaching and guidance, I managed to get a 750 on the chemistry achievement SAT exam. I was first in my graduating class, and though I scored 400s on the Math and English SATs, was still admitted by Penn State. Every year I was in State College, the University found scholarships for me. I majored in metallurgy and so I had, in sequence, a Minerals Industries Scholarship, an American Society for Metals Foundation Scholarship, an Alcoa Foundation Scholarship, and the Bayard D. Kunkle Scholarship. I never met Mr. Kunkle, but I believe he must have been someone who

decided to give back to Penn State for similar early generosity on his behalf. That impressed me, and later on I endowed an undergraduate scholarship at the University. Without Penn State, I might not have gone to college. Only a few people in my high school graduating class went to college. Many became public school teachers, and I became a teacher at a university. Something in our experience at Fell High led all of us to lives in education. It was the dedication and commitment of our teachers!

## Part 2:

# Personal Story — On to College and Married Life

### An Undergraduate at Penn State

Access to dedicated teachers followed me to the Nittany Valley. Robert Lindsay and Harold Read were metallurgy professors who always demanded the best from students. They were excellent lecturers and made our understanding of content a high priority. But an equally high priority was their insistence that we all be able to communicate our understanding–in writing and speaking. So we wrote a lot, and each document came back with even more red ink. But we all learned to write clearly and with meaning.

Speaking was more of a challenge for me! Not because of a speech impediment, but instead because of the local dialect. In Richmondale, the "h" in words was treated as silent. As an early teenager, I used to meet my friends at a cluster of three trees to smoke cigarettes and drink beer. Yes, as an early teenager! The cluster was known as the "Three Trees," but it was pronounced, "Tree Trees"! When I arrived at Penn State as a freshman, I met with a faculty member to plan my first-year schedule. (My first year seemed like ten years; I was lucky to have algebra in high school. Most of my freshman classmates had college-level courses in calculus, biology, and physics while they were in high school!) After we had organized a class schedule, she looked at me and said, "You should see a speech pathologist!" I was crushed, but she thought it would be useful, and she was right. I met for a half-hour each week during my first semester on campus with a speech therapist from the linguistics department. She would record as we talked for the first 15 minutes and then play it back. I had never heard my voice or my language in that way, and I was astonished. This was probably among the most important investments of time in my life. I don't remember her name, but I am grateful to her for taking this time with me. When I returned to Richmondale for Christmas at the end of that first semester, my friends listened to me as if I had come from another planet. But as I wound my way through the public speaking that was part of the Lindsay-Read approach to education, I was grateful. And I am even more grateful today!

### Summers as a Collegian

I worked at Inland Steel in Gary, Indiana after my freshman year at Penn State. My brother Tom worked there, and he found me a job working with engineers in the steel mill. I drove out to Gary in the 1954 Ford I bought for $100. I stayed with Tom and Joan and their then little kids. They are a bit older now and have their own kids! The steel mill was a really exciting place to work, and I learned a lot about steelmaking

that summer. On one excursion through the mill, a door fell off an open-hearth furnace and molten metal bubbled out onto the floor. We all made a very quick exit for high ground! I think the older guys that were my supervisors liked having a kid in the mill. On one occasion, they sent me to pick up something (I can't remember what it was!) for them in Gary. Innocent that I was, I did not recognize that the address was in the red-light district. When I went to the door, an unusual lady opened it. I am sure that I blushed and turned a very deep red! And when I returned to the mill, the guys were all waiting for me! They enjoyed my story. It took me a while to get over it!!

I returned to Penn State at the end of the summer. One of my classmates at Penn State was Pete Lake. Pete grew up in Bethlehem, Pennsylvania. His dad was an executive at the Bethlehem Steel Company. During the summers of 1962 and 1963, Pete and I worked at the Homer Research Labs of Bethlehem Steel. I enjoyed that enormously, both technically and socially, and these years changed my life forever. At the lab, I worked on a variety of problems under the direction of people like Hilton Rahn and Dick Willison. One project I really enjoyed involved an assessment of the use of steel cans for beverages. My job was to measure the cooling rate of beer in steel cans and to compare that with aluminum cans. Given that steel beer cans did not make a splash in the marketplace, but aluminum cans did, it is not difficult to see that my research did not lead to happy news for The Steel. But I did get to drink the *unused* beer that was left over from these experiments!

I also met the love of my life! Pete and his high school girlfriend, Linda Faust, arranged a blind date for me with one of Linda's friends, Carolyn Domenig. We all went out together one summer evening, and it was love at first sight for me!

**Carolyn**

Carolyn grew up in a home with a mother who was an art teacher at Liberty High School in Bethlehem and a dad who worked for Bethlehem Steel. He was a skilled marksman, a golden glove boxer, an autobody mechanic, and an artist. Carolyn's love of the arts and her innate talent and skill as a painter are abundantly clear. She is not a hobby artist but a true professional. She is an award-winning painter with national and international clients and operates a fiscally viable personal studio, gallery, and classroom. Her workshops are in demand, and she enjoys the interaction. The students in her classes learn from an acknowledged national artistic leader and become award winners themselves. She was

*Carolyn demonstrating at The Guild of Boston Artists in 2020.*

elected to the Liberty High School Hall of Fame in 2021: a wonderful recognition by her classmates.* At any rate, we dated for about two years while I was in State College, and she was in Kutztown. At one point, I remember asking her if she had ever thought about being married to a university professor–not very subtle, I suppose, but this was at a time when no such prospects were in view, but it was on my mind. When she answered she could imagine that and, moreover, that she liked baseball, basketball, ice hockey, and football–I knew this little blond was the girl of my dreams. In reality, she does like basketball and hockey but football and baseball–not so much. At any rate, we were married on June 27, 1964, a few months before I began graduate school at Ohio State.

Carolyn and her family lived on the southside of Bethlehem on Montclair Avenue, within walking distance of blast furnaces at The Steel. Although she remembered Bethlehem Steel as noisy, smelly, and dirty, she became

* *Carolyn's Website: carolynlatanision.com*

*Our wedding day with Pete Lake looking on.*

very nostalgic when they announced the company was going out of business in the mid-1990s. Just about everyone in her family–her dad, aunts, cousins, grandparents–worked somewhere at The Steel. Her dad painted smokestacks in a bosun's chair high above the ground. As such, she managed to arrange three weeks of escorted tours through the mill before demolition began. She collected many photographs and used them to help her in memorializing The Steel in her paintings. They appear on her website. What really impressed me is how she quickly began to learn about steelmaking and the hardware she photographed. She held an early exhibition of some of her paintings and photos in a gallery in Lexington, Massachusetts. One of my favorites is a large, 5'x5' oil painting of a blast furnace–still, no smoke; if the painting had sound, there would have been no sound. This, after 120 years that were quite the opposite. Many people from Bethlehem traveled to see this exhibit. I was stunned and impressed to see that many of these people had tears in their eyes as they examined the paintings. Art should move people–clearly these paintings did just that!

*A Century of Steel — Oil on Canvas by Carolyn Latanision.*

We have found a PBS show, *Miss Scarlett and the Duke*, that we both like very much. I kept looking at Miss Scarlett and thinking she reminded me of someone. Finally, I make the connection: she reminds me of Carolyn! Miss Scarlett frowns, she protests, she grumbles–just like my wife! And they make the same facial expressions when grumbling. Grumbling frustrates me at times, but I love it! When Carolyn turned 70, I arranged a surprise birthday party. I invited 70 friends to join us at MIT's Endicott House for a dinner. This was all done very secretively and scheduled about one month before her birthday, so she would not be suspicious. I told Carolyn that we had to go to a faculty dinner at Endicott House which was not an unusual occurrence. No one gave it away! I had arranged with the Endicott House staff that when we were about five minutes from the building, I would call to inquire about parking. This served as a signal for everyone to disappear from the entrance and to congregate in the trophy room which is just off the second-floor staircase. When we opened the doors to enter that room, there was a loud and cheerful, "Happy Birthday!" It was one of my best moments ever. And I could see in her facial expression that Carolyn was clearly and thoroughly surprised. We had a great evening: a couple

of celebratory speeches–one by yours truly, a rolling electronic photo display, and lots of good cheer with friends from nearby and afar who had traveled to share in the fun.

### Graduate School

Returning to our lives as collegians, we moved to Columbus from Bethlehem in the fall of 1964 with a total of $250 in cash. Pete Lake and his wife had found an apartment not far from Ohio State University, and they secured an apartment for us as well. I had a NASA Traineeship that included a stipend. This was a Sputnik Era means of encouraging young people into science and engineering careers. But we had to get an advance from the Department Head, Mars Fontana, in order to pay our first month's rent. Carolyn taught at a youth recreation center in Columbus during our first year in the area. She had a degree from Kutztown University in art education but had to get properly documented in Ohio before she could teach second grade in the Columbus Public Schools during the remainder of our time in Columbus. She took courses at Ohio State in order to meet that requirement. Carolyn continues to hear from some of her students from the recreation center, as well as in second grade, to this day. Her commitment to art reminds me of an interesting experience. One day while we were in Columbus, Carolyn said I should try painting, so she set up a still-life of a bottle and some other stuff, found a 18x24 canvas for me and gave me some paint and brushes. And I painted it. This painting knocked around our apartment for a couple of months, and then I realized I could not find it. When I asked if she knew what had become of it, Carolyn said she "used it as texture"! That is another way to say she painted over it! I suppose this might have been an evaluation of my effort as a painter, but I have the deep hope that someday someone will uncover this masterpiece of mine.

We left Columbus in January 1968 to move to the Washington, D.C. area and lived in a rented house in Silver Spring, Maryland. I became an NRC Postdoctoral Fellow at the then National Bureau of Standards, now the National Institute of Standards and Technology (NIST).

### Our Family Begins to Take Form in Winchester

Ivan was born on November 3, 1968, while we were in Silver Spring. In September 1969, I joined the staff of Martin Marietta Laboratories in Catonsville, Maryland, and we moved to Columbia, Maryland, where we lived for the next few years. Sara was born on June 24, 1971. In 1974, I joined the faculty of the Department of Materials Science and

*The two of us during out time in Columbus – we looked very young!*

Engineering at MIT. The Institute allowed me to take an immediate leave of absence to join the staff of the Max-Planck-Institute in Dusseldorf, Germany, for a 12-month appointment as a Senior Scientist administered by the Humboldt Foundation on behalf of the government of the Federal Republic of Germany. We lived in Dusseldorf in a rented apartment during that year and traveled in Europe as time permitted. We all enjoyed this experience. Sara, then age 3, went to a German kindergarten and Ivan, two years older, to an American international school. Both kids learned to speak German, and Sara, especially, became very proficient. She spoke with a perfect Westphalian dialect and became my interpreter when we were walking in the streets. With curly blond hair and blue eyes, she looked every bit a native!

One of the most memorable moments during our stay in Dusseldorf was the Christmas visit of Norman Macmillan. He was born and educated in the U.K. I met Norm when we were both members of the technical staff at Martin Marietta Laboratories. We became very good friends. In fact, he was my best friend. We shared technical and scientific interests in the fracture of materials. At the time I was transitioning to academia

*Ivan and Sara at home in Winchester.*

via MPI, he had moved on to the University of Aberdeen in Scotland. So he traveled to Dusseldorf to visit us for Christmas in 1974. Ivan had just turned six years old, and he and Norman decided Ivan should write a letter to Santa in advance of Christmas Day–with Norm's help. They sat together one evening and composed a letter–a modest wish list. After some pleasantries directed toward Santa, the letter ended with a closing salutation I had never seen before but which seemed entirely reasonable: *Your nimble and obsequious servant, Ivan!* Norman had a typically dry English wit, and he was a master with words! He was also a marathon runner. One afternoon following his return to the US a few years later to teach at Alfred University, he went out for his usual training run. He returned to the gym to stretch after the run and died on an exercise mat of an apparent heart arrhythmia. He was just about to turn age 50. I remain devastated to this day.

I began full time service at MIT in the summer of 1975, when we returned to the US and settled in Winchester, Massachusetts, where we live today. Winchester has been a wonderful place to live: good people, good schools, and an all-around nice town! One of the realities of faculty life at MIT was I had little time for much but determining how to navigate the academic world at a very high level. I enjoyed it enormously, but there was a cost. I must admit I have had more time for my grandchildren than I did for my kids while they were growing up. But I did coach their soccer teams while they were pre-teens. I had no soccer coaching or playing experience, but on the first day of the Boston Area Youth Soccer (BAYS) season, when Ivan was about eight- or nine-years-old, he and I went to the first meeting at a soccer field in town. There were more teams than coaches, so someone handed me a rule book and said, "Congratulations, Coach!" The truth is I enjoyed coaching. Ivan and Sara played in a town league in the fall and in BAYS, which included traveling teams, during the spring. I alternated coaching their teams. After each game with a team from another town, I would write a column for the Winchester Star newspaper. Amazingly, they published these letters. The kids liked seeing their names in print, and I loved writing about their exploits, especially when they won! The boys Winchester Rangers were BAYS Division Champions in 1979, and the girls Winchester West were Division Champs in 1984. These kids are all grown up now, but it is fun to see some of them in town from time to time. They are like an extended family for me.

SOCCER BANDITS STEAL ONE IN NEEDHAM

The Winchester Bandits traveled to Needham on Saturday to meet the Atoms on a hot DeFazio Field and came away with a chilling 1-0 victory on striker Jim Campo's second penaltykick. Goal tender Greg Veitch flawlessly handled about a dozen Atom's shots in recording his second shutout of the season. Both teams had several opportunities to score but played to a 0-0 halftime tie. In fact, the defense on both sides of the field played well, but sweeper Kyle Bairnsfather, stopper Hank Lynch and fullbacks Scott Hughes, Jamie Mongiello and Craig Bonnell were usually able to contain the hard-charging Atoms. Midfielders Dennis Clarke and Chris Haddad continued to play strong games on offense and defense. The Winchester goal was set up by winger Emile Wolsky who took control of the ball on the Winchester side of the field and raced upfield alon the right sideline. Wolsky passed to David Reno who was credited with the assist on Campo's shot to the left of Needham's goalie. The forward line of Reno, Wolsky, Campo and Ivan LaCandision--who moved the ball really well--played its best soccer of the season in this game.

The win brings the Bandits' season record to 2 wins-1tie-1 loss in a tough Premier Division race. The Division appears to be especially evenly balanced and competetive this year.

The Bandits play nest to the Brookline United Club next Saturday at Leonards Field.

*Letters to the editor about the Winchester Bandits Soccer Team.*

**RONALD M. LATANISION**

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M.I.T., Room 8-202
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3 May 1961

The Editor
The Winchester Star
3 Church Street
Winchester, Massachusetts 01890

Dear Sir,

The Bandits Soccer Club seems to have gotten its game in gear! We have now won two games in a row, and I am happy to send you an account of our visit to Needham.

Thank you very much indeed for continuing to publish the accounts of our games.

Sincerely,

R.M. Latanision

*Ivan and Sara with our first Cairn Terrier, Tippy.*

*The kids in New Seabury in 2009.*

Sara and Brett Kopala and their kids–Carly, Scarlett, and Juliette–live in Winchester, a few minutes from our home on Nassau Drive. Ivan and Stacey live in Middlesex, New Jersey, with two kids–Zoe and Ian. All the kids were born within a four year period, so they are wonderful to see together.

### The Stage Crew

A source of great fun and pleasure for me has been the annual Winton Club Cabaret. The Winton Club is a more than 100-year-old organization that focuses its work for the benefit of the Winchester Hospital. One of its most special events is the annual week-long cabaret that occurs during the dead of winter in late January/early February. Carolyn is a member of the club, and the husbands of members become fodder for the Cabaret Stage Crew–unless they protest! I have been a member of said crew since the time of the 75th show. The 100th show was performed in January 2020. COVID suspended activity in 2021 for the most part. The Stage Crew did meet by Zoom in January 2021 to catch up. As of 2023, the Cabaret has not yet resumed–a victim of COVID.

The Crew is like a band of brothers, and I very much enjoy the comradery. The producer of the show in 2001, Gayle O'Grady, had the vision or, perhaps, courage, to allow the Stage Crew to perform in the show. We sang and danced "Macho Man" to thunderous applause. Seriously, we were choreographed like the Village People. And the folks in the audience paid to see us perform, along with many other performers, of course! And in 2011, we gave a "Macho Man" redux! It is our signature piece! Carolyn produced the 2007 show, *Dial "M" for Music*, and we performed "Build Me Up Buttercup." In fact, the Stage Crew has performed in every cabaret since Gayle provided us with that first opportunity to demonstrate our skill–or some would say–lack of skill! Carolyn's favorite comment in reference to my performance is, "He can't sing or dance! I don't know why he does it!" The truth is I have a blast, as do the other guys. Imagine a group of doctors, lawyers, electricians, plumbers, retread MIT professors, and others on stage in front of a hometown audience. It does not get better than that! At one point, and in my capacity as self-appointed Secretary of State of the Stage Crew, I began writing an annual State of the Stage Crew Address that is delivered at the Breakdown Party immediately following the end of the show. This party has been a part of the cabaret season for over thirty years at the home of Jeff and Gayle O'Grady. I have archived my speeches on a thumb drive. The speeches are presented before an audience that includes the Stage Crew, Winton Club members, and a host of guests. My address is more of a roast, and I enjoy myself enormously. I think the audience enjoys being roasted! This began as a lark in 1999 when I wrote a speech for then Stage Crew Boss, Richard Walsh. After a hiatus, the speeches picked up again in 2004 and have been given each year since then. I love it!

*The Beer Barrel Polka—Cabaret 2019.*

## Strike Party 2007
## First Annual Richard Walsh Commemorative Speech

*4 February 2007*

As the unofficial script and speech writer for the Producer of *Dial M for Music*, I have a short statement to read.

First, I should say by way of perspective that, as those of you who have had Stage Crew experience over the past several years will know, I have served as principal (well, make that only!) speechwriter for that prince among Stage Crew members, Richard Walsh. My inaugural speechwriting experience in this regard began when Richard and Carl Boerner led the Stage Crew. So, it is with this new responsibility in clear view, that I had thought that this year I would have to have said to Richard, in the best tradition of Donald Trump, that "Richard, you're toast!" But, I must tell you ladies and gentlemen that my loyalty to this wonderful brotherhood that is know as the Stage Crew is such that I was completely comfortable with the thought of serving two masters…er…well one master and one guy who just happened to need a speechwriter. Yes, ladies and gentlemen, the Stage Crew message from Richard Walsh remains on my agenda… but this year, given the circumstances, it should be renamed as the *First Annual Richard Walsh Commemorative Address*.

Now, let's turn to a message from your *Dial M for Music* Producer: Carolyn would like you to know, and I quote, that "It has been a thrilling experience to produce the show. Moreover, I can tell you that my sweet husband and partner, Ron, has very helpful in cooking dinner, washing dishes, shopping for groceries, doing the laundry, walking the dog, and all of the things that I never do anyway…er…that I did not have time to do during this very busy year." (Carolyn: you will likely want to correct this quote, but that is what I heard!)

As you know this event is a fund raiser to the Hospital and I should tell you about Carolyn's up-close and personal experience at Winchester Hospital. On December 22nd at about 3pm she called me and said, "You have to come home and take me to a doctor!" She had been having violent intestinal cramps and other symptoms that we don't need to talk about. In 42 years of marriage, she had never done that before, so I did just what she asked. We went to see her doctor and he said that we should go directly to an emergency room. In effect, without tests

he could not be sure what was happening but some possibilities were kind of serious. Given my own diagnostic skills, I knew that she was not in labor, but this sounded about as urgent so off we went to none other than Winchester Hospital. At 3 am the following morning she was admitted and she stayed there until Christmas Eve, with what we now know is colitis. The doctors and staff were extraordinary. They treated her like ...well...like you might expect the Producer of the Winton Club cabaret to be treated...after I pointed out that she was the Producer!! Seriously, they were super! I can tell you that if you need to be convinced of the merit of this event, spend a few days at the Hospital. Women of Winton you are doing a good thing and we applaud you for that!

Let me now reflect on the Stage Crew in 2007. First, I have to say that this wonderful band of characters gave me a lot of material to work with in terms of assembling this message.

1. Early in January, Prep Keyes became the first nominee and today will become the first recipient of the *Friendly Fire Award for Valor* for his demonstration of skill in stapling his finger to the frame that he and Buck were working on. Fortunately, Dr, Hal Chasse was nearby and he very efficiently extracted the staple from Prep's finger...with sterile pliers as I understand. (Footnote: I learned after writing the above that Hal is not an MD. Nevertheless, his heroic act should be recorded in the annals of the Stage Crew. Hope you had a tetanus shot recently, Prep.) I should also note that Prep bled all over one of the flats that were being assembled, so beneath one of the wonderful paintings that the Pearl Girls have done, one flat includes a substantial quantity of Prep's blood and, as I understand, even Kill would not cover it. (Present Award)

2. As a demonstration of ultimate consistency and comradery, Carl Boerner followed Prep's example and did the very same thing the following week. Carl, macho man that he is, however, removed the staple himself...with his teeth. Of course, he bled profusely, but it was a heroic demonstration of grit on his part that he single-handedly solved his own medical problem. He, of course, becomes the second recipient of the Friendly Fire Award. (Present Award)

3. On the basis of the above acts of valor, I can with confidence and with a genuine sense of honor tell you that this year the **sweat and blood** of the Stage Crew have gone into this show. We have also coined a new word that shall henceforth become a part of the Stage Crew lexicon...the *Prep* shall forever be included in our dictionary as

a puncture wound inflicted by friendly fire such as described above. Other permutations count and given the Crew's creativity, I have no doubt that there will be other recipients. In fact, it has only recently come to my attention that Frank Massiglia is in line for not a full *Prep*, but a *half Prep*. He followed Carl's act of valor by driving a dry wall screw into a finger or was it hand, Frank? However, that act involves half the degree of difficulty of a staple gun or nail gun and so…the *half Prep*. Congratulations, Frank, you klutz! (Present Award)

4. I am also reminded of The Great Thermodynamics Debate, which occurred during the first Saturday evening party at Janet and Jim Jones' home. The issue of contention was whether hot water freezes before cold water, and, the corollary, does hot water cool faster than cold water. The protagonists were Dean and Hal on the one side of the issue and Ed, principally, and well nearly everyone else on the other side. Well…this is all about the thermal mass of the subject water and the rate of heat extraction in an adiabatic system such as a bucket: in more familiar terms, J. Willard Gibbs, that thermodynamicist of standing comparable to Norman Einstein, might say that "… you've got to get those BTUs out of the water. And the more BTUs you've got the harder it is." However, the boys went on the web, found some trashy, non-peer reviewed manuscript and attempted to argue that J. Willard Gibbs might be wrong. But, my friends, only Gibbs and God are never wrong…er…well, only Gibbs, God and the Winton Club wives are never wrong! At any rate, I believe that this debate rages still. (Dean: any rage???!)

I may (the operative word is "may") have overstated the issue of Winton Club members never being wrong… it is true, for example, that a significant spelling error was detected in the initial version of the club marquis which is hung over the entryway into the Town Hall. February was initially spelled with a missing "r". I am told, however, that artistic license may have been the source of this apparent lapse. January and Febuary were kind of symmetric and, so, it is tempting to accept that story. In any case, we have a small momento for our Scenery Chair, Sandy Richardson, that we hope will forever remind you of this small lapse…excuse me, moment of artistic license.

I do have one issue of some consequence to report…unlike the inconsequential blather I have just presented…and that is a flagrant violation of the rules of engagement that allow work in close quarters by the Stage Crew and the Pearl Girls, a.k.a. Winton Club membership. At the end of the afternoon on 14 January, at a time when many of the

members of the Stage Crew had left to watch football, two members of the Pearl Girls were observed to be using power tools left unattended by the Stage Crew. Yes, my friends, these women were using our power tools. This is a clear violation and a serious affront, but the manner in which this act was committed was so bold as to be…well…words escape me. This egregious act was committed with total disregard by two unnamed Pearl Girls in plain view of several members of the Stage Crew, who just happened to be lounging on the stage while the miscreants were hard at work on the floor of Town Hall. Now, you may think that the Stage Crew could have been more accommodating and taken the initiative to offer help to these wayward Pearl Girls rather than just sitting there and watching…like lumps…but that is another issue. In any case, I have proof of this, which I shall show you all momentarily, as Exhibit 1. It just so happened that I had access to a camera at the time that this egregious act was committed. Now, ladies and gentlemen, we are fortunate to have lawyers among our crew…did I say fortunate???… Jeff O'Grady, Esq., Jim Jones, Esq., Rich Canzano, Esq., and Ray Boulanger, Esq. Please come forward gentlemen…I need you to serve as a panel of jurists/mediators. Now, I wish to present Exhibit 1 and I ask you to review this evidence and to give us your considered opinion as servants of justice and the law: is this photo compelling evidence or not? I rest my case!

Gentlemen (I am addressing the Stage Crew), given this turn of events, we must take action or sure as I am standing here today, we will next see members of the Stage Crew, coerced by the Pearl Girls, with paint brushes in their hands. (What's that…oh…you did see a Stage Crew member with a paint brush…oh…) Moreover, I note with some concern that on opening night, just before the show began, our Choreographer Theresa was allowed into the loft for the purpose of giving the Stage Crew a bit of a pep talk…she said she wanted to kick butt as I recall. At the end of her appeal, and in a moment of overwhelming emotion Charlie Price, one of our illustrious chiefs, was heard by everyone present to say, "Thanks, Theresa…now everyone…a group hug!" Can you believe it? I noticed that even Buddy was staggered by this turn of events. Buddy, what are we coming to? I am beginning to understand why you have been eager to have your term as Stage Crew Boss come to an end.

I cannot end without a few words about the Stage Crew singers and dancers, who this year performed to thunderous applause that old favorite, *Build Me Up Buttercup*. In short, it seems to me that we have reached the stage, ladies and gentlemen, where all we have to do is to show up and it brings down the house. I don't think it matters what

we sing or how we dance. I think the boys did a good job this year, by any measure a true demonstration of entropy at work, but I will also say that we were not quite up to the level of our signature piece, which is *Macho Men*. We do owe a debt of gratutide to two Pearl Girls in particular…Janet Jones, who measured us all up for the stingers (that was fun, Janet!) and Kris Atkinson for the rrrrrrs. I must give my loudest applause this year to our own dancing phone book, Val Livada, and for the stunning rendition of that well known number, *Man in an Outhouse*, by our own Hal Chasse.

Finally, on behalf of the Stage Crew, I just want to extend our full support to the new Producer, whoever she may be. I will gladly pass on my kitchen apron to her husband. I also want to pass along our compliments and, dare I say, the heartfelt thanks of all the members of the Stage Crew to the Wonderful Women of Winton for making our lives…um… um…so…um…um…well interesting and exciting. God Bless the Winton Club and God Bless the United States of America.

### The Wilson Science and Technology Forum

I host a Science and Technology Forum that meets every two weeks in town. We had been meeting at a senior center (The Jenks Center) until COVID but are meeting virtually using Zoom on a regular basis for the moment. The Forum bears the name of David Wilson, a retired mechanical engineering professor and friend of mine from MIT. David founded the Forum in 2015, although it was not known as the Wilson Forum at the outset. I gave the inaugural talk on "Unintended Consequences of Science and Technology" at his invitation. It was videotaped and played on the town TV station. When he passed away a couple of years ago, we assigned his name to the Forum. Our activities are archived on our website.* This is a completely volunteer effort.

The Forum is open to anyone who is interested. Typically 25-30 people, many retired, show up for our sessions. They are doctors, lawyers, Westinghouse and GE technologists, Apollo engineers, nuclear fusion experts, this retread MIT professor, and occasionally a Nobel Laureate (Dick Schrock), as well as some generalists who keep us honest! Zoom offers us the unusual opportunity to invite authors from beyond Winchester to speak with us. It is ironic that a silver lining to the pandemic is we have all had to learn to adjust to life with constraints, some of which may prove to be useful. Operating in a hybrid mode to allow in-person participation as well as a remote link will likely become our standard. The participants are collegial and civil, and the spirit of our meetings satisfies part of my personal need to remain active as a technologist. Science, engineering, and the resultant technology are now a part of my DNA, and so I enjoy all of this very much. I will describe the Forum and its association with the National Academy of Engineering Quarterly, *The Bridge*, more fully in Part 3.

### Cape Cod, New York City, and Travel with Grandchildren and Granddogs

We also have a home in New Seabury on Cape Cod that we built and began using in 2000. It is a wonderful home, five minutes by walking trails to the beach which looks out at Martha's Vineyard. Some of my happiest occasions there were with our grandchildren. Altogether we have five grandchildren and six granddogs, plus one dog of our own, Rufus, a Cairn Terrier. Carly was born in 2004 (her birth date is 04/04/04), Zoe in 2005, Scarlett in 2006, and Ian and Juliette in 2008. Carolyn takes Juliette to her karate classes, to Juliette's annoyance, but

* *https://jenksst.blogspot.com*

*The kids in New Jersey in 2016.*

she has her brown belt and has made her grandmother promise she can quit after her black belt. She loves animals and has her own bunny at home. Scarlett, an avid artist, is now part of the evening watercolor class Carolyn teaches. Carly is our math and science wiz. She is now a freshman at Penn State! When she reached age 16 and got her driver's permit, I offered to help teach her to drive. I did teach her grandmother, mother, and uncle to drive, so this seemed natural! This was a wonderful experience for me. We drove together, often with Scarlett along, and talked about all kinds of things. Ian is a great soccer player, loves his electronic games, and is a freshman at Princeton Day School in New Jersey. Zoe, our singer, is now a senior at the same school and is still performing when any opportunity arises. Watching and hearing Zoe sing on stage is really an experience for me. Among others, she has sung in off-Broadway shows, with the Manhattan Girls' Choir at Carnegie Hall, and at many other places. I look at her on stage and think, "Wow, that's my granddaughter. And listen to her sing!" This often occurs with a tear or two in my eyes. I don't think anyone can see the latter, but I suspect Carolyn does! Zoe will become a freshman at the University of Miami's School of Music in the fall of 2023.

When Scarlett was about two years old and just learning to talk, she was with us for a visit in New Seabury. I remember giving her a bath one evening, and she wanted to take a toy mermaid into the tub. The mermaid had hair, and although otherwise plastic, I was concerned it might not be a good idea if the hair became wet. Scarlett insisted it would be okay, and I insisted it would not, so we had a stand-off. After her bath and while she was getting warm by snuggling with Carolyn, her grandmother volunteered it would have been okay if the mermaid's hair got wet. "In fact, it was designed to get wet," she said. I apologized to Scarlett for getting annoyed with her about this while she was in the tub, at which point she looked at me and very firmly said, "Don't do it again, Papa!" Two years old! Carolyn and I cracked up.


*Grandma with Zoe at Carnegie Hall after her performance in 2019.*

*Saks at Christmas.*

In the late 1990s, we purchased three weeks of time share at the Manhattan Club in New York City. The Manhattan Club is at 56th Street and 7th Avenue, just across the street from Carnegie Hall and a short walk to Broadway theaters which we very much like. I think I have always had a wish to have been able to perform on stage. The kids are often with us in Manhattan, and we have come to love Broadway, Rockefeller Center, Central Park, Saks at Christmas, and, of course, the restaurants.

As part of travelling abroad, we frequently take a grandchild with us. Carly has been to Italy, Japan, and Iceland; Scarlett to Italy, Ireland, and Austria; and Juliette to Italy, to this point. COVID put a hold on foreign travel (or, for that matter, any travel beyond Massachusetts). But these have been great experiences for us and, I think, for the kids.

*Juliette in Naples travelling with us.*

## The Pandemic

During the pandemic in 2020 and into 2021, our travel was limited between Winchester and New Seabury. Given travel and other restrictions associated with COVID, we did not see many people beyond Sara and Brett and their kids in Winchester. If there is anything even remotely constructive about COVID, it is that we were able to have more time with the kids on Cape Cod. Carly ruled at breakfast and has become the best waffle and pancake maker we know. Scarlett had a special chicken recipe she and Gramcracker (aka Carolyn) made for dinner. I am not sure who is responsible for the Gramcracker label for Carolyn, but it fits! We have had lots of nice weekends with these guys on the Cape. Carly learned to drive, Juliette and Scarlett painted with Carolyn, and Juliette loved Rufus–and he loved her! Rufus was our third generation Carin terrier. Sometimes I refer to him as our Cairn terror! He loved to lie angelically in front of our Christmas tree during the holidays, but he responded when we left the house without him by unrolling and chomping toilet paper–unless we closed all the bathroom doors! In Winchester, if I was in my second-floor study, he would often stand at the bottom of the stairs and talk–sort of! That's how I knew he wanted to come upstairs. He didn't like or trust stairs and needed to be coaxed or carried! Nevertheless, he was a sweet little guy.

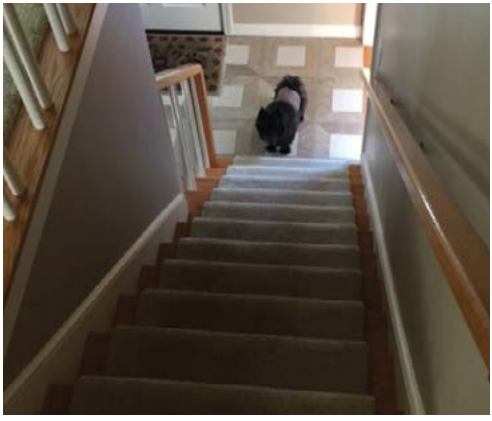
*Scarlett and Gramcracker cooking in New Seabury.*

*Sweet sixteen…a new driver in my Boxster!*

*Rufus always loved our Christmas trees...*

*...but he did not like when we left him at home alone!*

Rufus became very ill in the fall of 2022 and after a battle joined his female predecessors, Tippy and Pansy. Carolyn and I could not see ourselves without a Cairn, so we have a new puppy, Finn. He is cute and a little devil! And in keeping with Rufus' legacy, if we leave a bathroom door open, Finn finds it and unrolls the paper! He doesn't even wait for us to go out! I know Rufus is beaming–he would be proud!! All these pets were/are really loved. I wish they could all have spoken to us.



*Waiting for a lift upstairs.*

*A current photo from the Finn era. Rufus would be proud of Finn!*


*Finn as a puppy at about 8 weeks old!*

The most inspiring story of the COVID era for us is that Carolyn has become very techie! She could not teach her art classes in person but figured out how to do it all on Zoom. She taped demonstrations, showed them live with rolling commentary, and then reviewed student work, all online. She has three classes a week, each for two and a half hours, and has had no snow days during the COVID experience! She really did show me how much it means to her to be a complete professional painter and teacher!

Early in 2022, the Museum of Fine Arts in Boston opened a Turner exhibit that ran for three months. As part of their rollout, they wanted to have a watercolor painter duplicate one of Turner's paintings while being video recorded and talking with a producer as the painting was

underway. The paper and watercolor media were different for Turner in the late 1800s than they are today. So the MFA interviewed a bunch of watercolorists and chose Carolyn for this challenge. This took about two hours, but the video was edited down to about six minutes and was continuously shown in the Turner gallery during the exhibition.* She dislikes speaking in front of crowds but was superb in this instance. With a paint brush in her hand, she is incredibly comfortable–I am proud of her!

### Personal Reflections

I have had a few experiences in my life I had not expected. One stands out! While I was traveling back to Boston from Washington on Friday, May 5, 2017, rushing through Reagan Airport to catch a flight, I began to feel some chest discomfort. I continued to walk to my gate, and when I stopped walking, it eased up. I got on-board, had a beer, and traveled back to Boston. I then had a relatively typical weekend for me. I would probably have ignored this except when I walked Rufus on the following Monday morning, I began to feel a more muted level of discomfort. So I called my doctor at MIT, had an EKG (which was normal), later in the week a stress test, and then a cardiac catheterization. Amazing to me, my coronary arteries were significantly blocked. All of this for a former runner and a person in seemingly pretty good health. In short, I had no advance notice of what was at work inside. The immediate intervention was bypass surgery at MGH on June 2. I returned home on Friday, June 9. I am not sure what it feels like to have hit by a truck, but I think this experience must have some common features! After a few days at home, Carolyn, aka Sergeant Carolyn, gave me back my mobile phone and allowed me to use it and my laptop within limits she had imposed. She is tough–thankfully!

One of the moments that most moved me during this entire experience was a message in the form of a card I got from then 9-year-old Juliette the day before my surgery. She is a bit moody: when she puts her head down and storms off, she reminds me a bit of Gramcracker, and even more of myself! But her card was priceless. She has loved bunnies forever. This card was from Dr. Bunny, and it has as its core message, “Be Tough.” I needed that!

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* *https://www.mfa.org/video/painting-a-turner-watercolor*


*Dr, Bunny card given to me by Juliette on the eve of my bypass surgery. This meant more to me than I can express.*

My PCP at MIT, Dr. Bill Ruth, commented to me when I first saw him after the Reagan Airport event, "The bad news is that you had chest discomfort, and the good news is that you had chest discomfort." All things considered, I feel incredibly lucky to have gotten this advance notice of the need for intervention. I suppose after all the years of ice cream (my favorite food), this is not too big a surprise!

In my contemplative moments, I remind myself this medical emergency focused on internal plumbing–it was just plumbing. Well, not just plumbing: I am sure my life style, which included lots of stress, and my diet, which included lots of ice cream, contributed. But all of this convinced me I need to be mindful of both physical and intellectual exercise as I grow older. So I do work out for 50 minutes most days, and I continue working, though not the traditional 60-hour weeks. These mental and physical gymnastics have become an important and welcome part of my life.

I have had to temper my enthusiasm for physical exercise on occasion because of a back problem. When I was in my early 60's, I awoke one morning and could barely stand up. I had an MRI that indicated I had spinal stenosis, a narrowing of the spinal canal which can add pressure to the spinal cord and nerves, and is not uncommon as we age. So I had physical therapy for about a month and was back to running. This all recurred a second time about eight to nine years later and once again at age 79. In the latter instance, I had physical therapy, but this time administered by the Winchester Hospital. These folks not only manipulated my limbs but showed me how to do the same, so even though I am not free of stenosis, I can manage it by doing prescribed exercises. My favorite is the "pelvic tilt" which may sound slightly indecent but is a totally proper exercise I can do while walking, standing at a lectern, or exercising to relieve the pressure on my spine.

**At any rate, this is a very long way of saying: do not ignore messages your body is sending to you. I contacted my doctor with chest tightness on that first Monday morning because I was really thinking of heading out of town on a three-day National Research Council site visit beginning on Tuesday. I was prepared to ignore the signals I was receiving. In retrospect, that would likely not have been a good idea.**

I have had a very interesting experience at MGH. I have struck up both a clinical and a research relation with my cardiologist, Dr. IK Jang. IK is a

world class cardiologist and researcher and, on a personal level, a terrific person. He uses optical coherence tomography methods for identifying problems and their treatment in coronary arteries. He can distinguish the character of plaque erosion from that of plaque rupture which informs the decision regarding whether the best patient treatment is to use drugs, to introduce stents, or to perform surgery.

What has stimulated our interaction is that I, too, have interest in tomographic study and treatment of deposits, though in metallic pipes and tubes in power plants, and using X-ray computed tomography. I see the same kind of phenomenology in the work I do. In such metallurgical systems, the key is to find the areas where blockage occurs and to then either remove that section, introduce a sleeve, or chemically treat the water. Basically, I look for deposits and blockage in the internals of pipes. The parallel with coronary artery intervention is intriguing. We have had some interesting discussions in his lab at MGH, and he invited me to meet with his research group which I enjoyed enormously. I am impressed by what IK and his research team are doing. This seems to me to be very consequential research that may be of immense value to coronary patients in the future.

The last several paragraphs regarding my research represent something of a transition from my personal evolution as a grandfather to my professional career as an academic and technologist, more details of which follow in my Professional Story.

## Part 3:
# Professional Story

## Introduction

After graduate school at Ohio State, I had a succession of interesting experiences at the National Bureau of Standards in Gaithersburg, Maryland; Martin Marietta Corporation (now Lockheed Martin Corporation) Labs in Catonsville, Maryland; the Max-Planck-Institute in Dusseldorf, Germany; MIT in Cambridge, during which time I was also a founder of Altran Materials Engineering Corporation; and ultimately Exponent, Inc., which has its headquarters in Menlo Park, California, and a major East Coast Office in Natick, Massachusetts. The early experiences at Ohio State and Martin Marietta Labs were especially important in shaping my career. Roger Staehle and Bert Westwood were particularly important as teachers, mentors, and life-long friends, and I feel enormous gratitude for their support and counsel.

I learned a lot from Roger, my graduate school thesis advisor at Ohio State. Much of this has to do with corrosion, of course. But I consider most important his sense of humanity. Roger was the exemplar for the view that reasonable people can disagree without becoming personally disagreeable. I recognized this in him early on, but that sense was reinforced when we were on opposite sides of a legal argument in court: the Westinghouse steam generator litigation in the 1990s. In the litigation in which Duquesne Light and Power alleged that Westinghouse had sold them defective steam generators for their

*Roger Staehle: a Fontana gradstudent and my thesis advisor.*

pressurized water reactors, Roger and I were in court in Pittsburgh waiting for opening arguments. He represented the utility, and I was there on behalf of Westinghouse. He approached me and said, “Ron, we have been friends for a long time; we will be friends after this ends, right?” I could not have been happier than to hear this. My response was emphatically, “Yes!” I was really concerned he would think I was somehow disrespectful. We had both examined the same information but came to different opinions. It is true we disagreed, but we were not personally disagreeable. Never! I have exercised and extended this vision through all my life interactions. It is a philosophy I think would be useful to everyone, including our elected officials in Washington who are supposed to lead this country: they, too, may disagree without being personally disagreeable.

Bert Westood was my first non-academic boss when I joined Martin Marietta Laboratories. He was incredibly bright, well-spoken, and a gifted writer. And I always wondered after my interview why he hired me! I spoke about my thesis research during a presentation that accompanied that interview. He and the other folks in the audience peppered me with so many questions, for many of which I had no answers, that I felt like my head was spinning. At the end of the day and to my amazement, he offered me a job. I asked him, “Why!?” He told me: (1) he only hires people who are smarter than he is, and

*Bert Westwood, Martin Marietta Labs.*

*Mars Fontana.*

(2) he liked the way I handled myself and the unanswerable questions following my presentation. It was kind of a set-up! But at Martin Marietta Laboratories, I learned how to interact with the consumers of my research and to say I did not know the answer when necessary but also how to get to a practically useful answer.

### I Am a Corrosion Engineer

Studying as a graduate student at Ohio State and working with Roger Staehle were two very important personal decisions. Mars Fontana was a legendary corrosion engineering educator and Roger was one of his students. He became a faculty member when I began graduate school. Corrosion–the environmental degradation of materials–affects virtually every aspect life on planet Earth. I have had the good fortune during my career to have had association with people who are the legends of corrosion science and engineering: Mars Fontana at Ohio State, Marcel Pouraix of CEBELCOR in Brussels, and Herb Uhlig at MIT. I will forever treasure the guidance and encouragement of these wonderful people. All engineering systems perform in some service environment, sometimes very aggressive service environments, whether these

*The MIT Corrosion Team: Herb Uhlig, Greg Yurek, and yours truly...*


*Marcelle and Marcel Pourbaix with Herb Uhlig celebrating Marcel's 80th birthday.*

*Before Marcel's lecture...*

*...and after the lecture!*

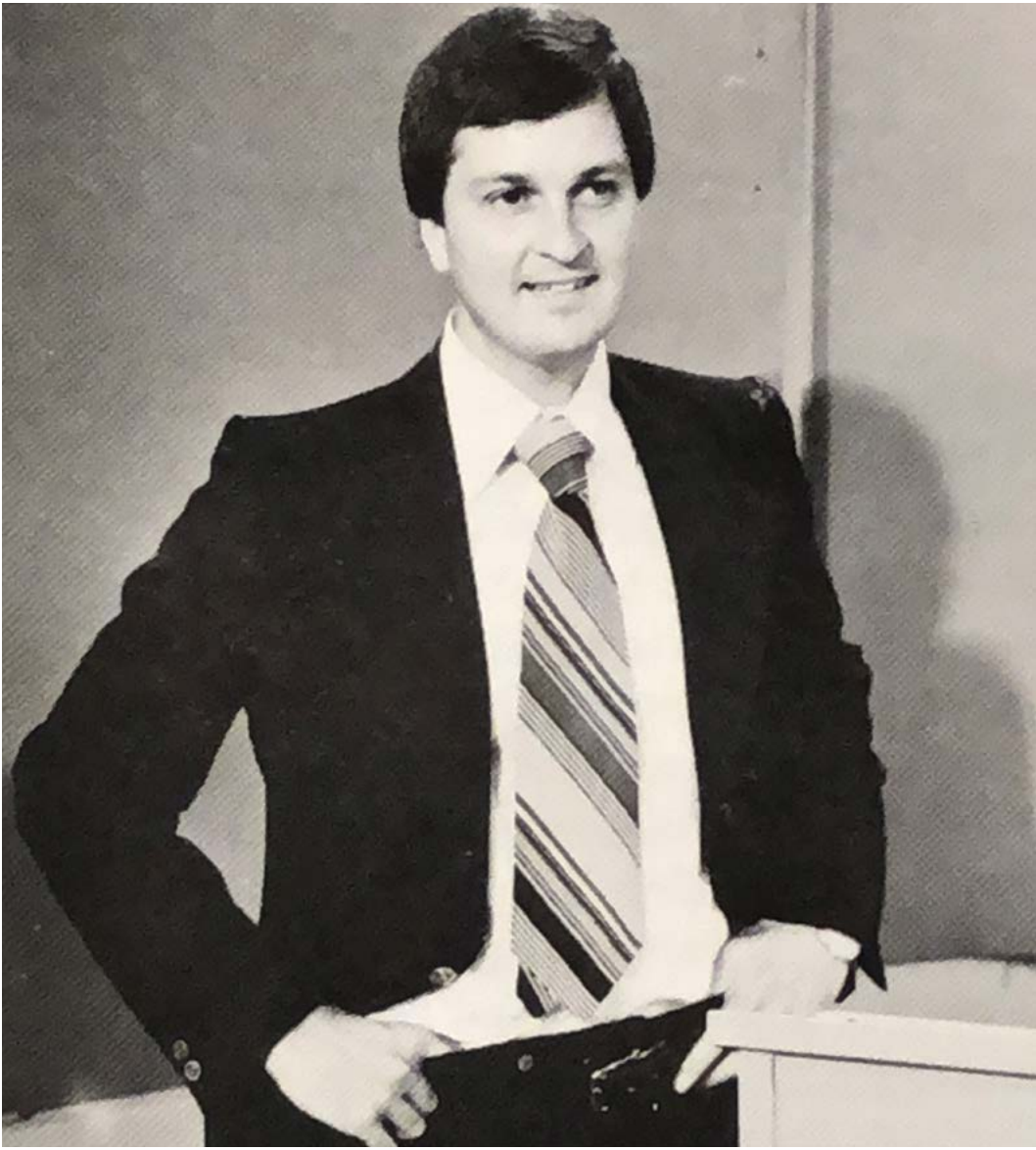
systems are used to meet the energy needs of the inhabitants of this planet or to treat and transport water, food, and other necessities of life. From heart stents and implantable drug delivery systems to airframes, nuclear electric generating stations, and electronic devices; corrosion is part of our technologically intense world. These systems and others must be protected from corrosion in order to extend their service life.

Here is what I would offer to students, policymakers, and industrial leaders: new engineering systems, which will be created in the future to make innovative use of scientific understanding, will succeed if they are of value to society and if they can be protected from corrosion in service. To the students who may read this, you represent the human technological infrastructure that is required to control corrosion in both contemporary engineering systems and emerging technologies that may find their way into the marketplace of the future. To any government officials and policymakers, you control the speed at which all of this will happen, and through meaningful regulation you hold the best interest of the people throughout the world in your–hopefully–wise hands. Finally, to the industrial organizations that will design and build these evolving systems, know the ultimate beneficiaries of your hard work are the people who use and benefit from your products. You must begin to consider the unintended consequences or your technology in society and that should involve input from social scientists, whom we have far too long ignored in our collective decision-making processes.

**The Chronology of an Academic**

As a NASA trainee at The Ohio State University, I worked at the direction of Professor Roger Staehle and was awarded a Ph.D. in 1968 for my work on the plastic deformation of electrochemically polarized nickel single crystals. Ohio State was then and remains today one of the legendary institutions that produces corrosion engineers; the other is MIT. After Sputnik, NASA made available traineeships intended to encourage young people to pursue careers in science and engineering. I was a beneficiary of that program at Ohio State.

Then I received a National Research Council-National Academy of Sciences Postdoctoral Research Associateship tenable at the National Bureau of Standards, now the National Institute of Standards and Technology (NIST), in Gaithersburg, Maryland. With guidance from Dr. A.W. Ruff, I studied the temperature dependence of the stacking fault energy in Fe-Cr-Ni alloys by means of transmission electron microscopy. I joined the scientific staff of Martin Marietta Laboratories in September



*Speaking at MIT in the late 1970s.*

1969. In January 1974, I was appointed Head (Acting) of the Materials Science Group at the Laboratories. By July 1974, I joined the faculty at MIT as an Associate Professor of Materials Science and Engineering and Director of the Corrosion Laboratory. Before I began teaching, I was allowed a leave of absence in order to take up a year-long appointment as a Humboldt Senior Scientist at the Max-Planck-Institut

fur Eisenforschung in Dusselforf, Germany. I returned to the Corrosion Laboratory at MIT for academic year 1975. In 1982, I dedicated the Laboratory, in honor of my predecessor, as The H.H. Uhlig Corrosion Laboratory. I had the great honor of being named the Shell Distinguished Professor of Materials Science in 1983, an appointment I held for the next five years. I led the School of Engineering's Materials Processing Center at MIT as its Director from 1985 to 1991. My joint appointment as a Professor of Nuclear Engineering began on July 1, 1996. I was a visiting professor at the University of Naples "Federico II" Department of Chemical, Materials, and Industrial Production Engineering for many years beginning in 1989. In April 2015, I was appointed as an Adjunct Professor in the Key Laboratory of Nuclear Materials and Safety Assessment of the Institute of Metal Research of The Chinese Academy of Sciences.

I was elected to membership of the National Academy of Engineering (NAE) in 1985 at age 43, a relatively young age for NAE membership. Additionally, I am a Fellow of the American Academy of Arts and Sciences (1997). I am the only corrosion engineer to be a concurrent member of both Academies. I am a fellow of ASM International (1988) and NACE International (1995). I am listed in *Who's Who in America*, *American Men of Science*, and the *International Scholars Directory*. I am an Honorary Alumnus of MIT (1992), Distinguished Alumnus of the Ohio State College of Engineering (1991), Centennial Fellow of the Penn State College of Earth and Mineral Sciences (1996), and Centennial Scholar of Case-Western Reserve University (1980). I am the recipient of the Campbell Young Author's Award (1972) and the Whitney Award (1994) from NACE International, the McFarland Award from Penn State (1986), the Henry B Linford Award for Distinguished Teaching from The Electrochemical Society (2004), Chemist of the Year (2007) from the New England Institute of Chemists, and The Charles L. Hosler Alumni Scholar Medal from the College of Earth and Mineral Sciences at Penn State (2014). I served as a U.S. Delegate to the International Corrosion Council and as an Overseer of the Boston Museum of Science.

All of the above recognition has meaning to an academic, and it does to me. But receiving the Campbell Young Author's Award was very special for me. Mars Fontana, one of the legends of corrosion engineering, was not only the Head of the Metallurgical Engineering Department at Ohio State, my graduate alma mater, but he was also the chairman of the NACE Awards Committee at the time of my award. So he was the one to introduce me to the audience as he presented the award. He had many nice things to say, and I was pleased with that, but when he described

me as his "gradson," he had tears in his eyes. So did I! See, my thesis advisor, Roger Staehle, was a grad student of Font's, and since I was a student of Roger, that made me Font's gradson. I treasure that moment. And I am happy to say I now have many gradsons and graddaughters of my own.

**Teaching Experiences**

My teaching at MIT focused on graduate courses including *Corrosion: The Environmental Degradation of Materials, Electrochemical Processing of Materials,* and *Solid State Surface Science*. I also taught the undergraduate course *Introduction to Solid State Chemistry* which served as part of the undergraduate chemistry requirement. In the early 1980s, I assembled twenty videotaped lectures titled *Corrosion Engineering* through MIT's Center for Advanced Engineering Study. This course was intended for practitioners in industry, and it served that purpose. I had always been interested in problem solving, and consulting with industry had been a regular part of my activity while at MIT. Not only in the U.S., but also in Japan, Venezuela, Argentina, Kuwait, Algeria,

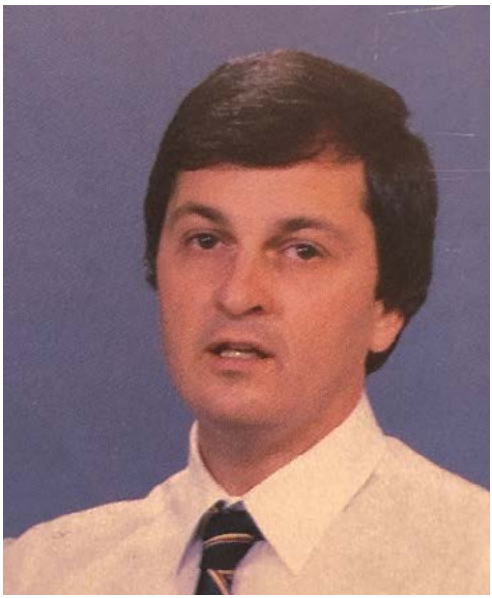
*Roger Staehle with a Fontana gradson, yours truly!*

*...and with a Fontana great gradson, Jerry Frankel (2012).*

Qatar, and other locations. So the video course was constructed with an understanding of the kinds of information that would be of value in the field.

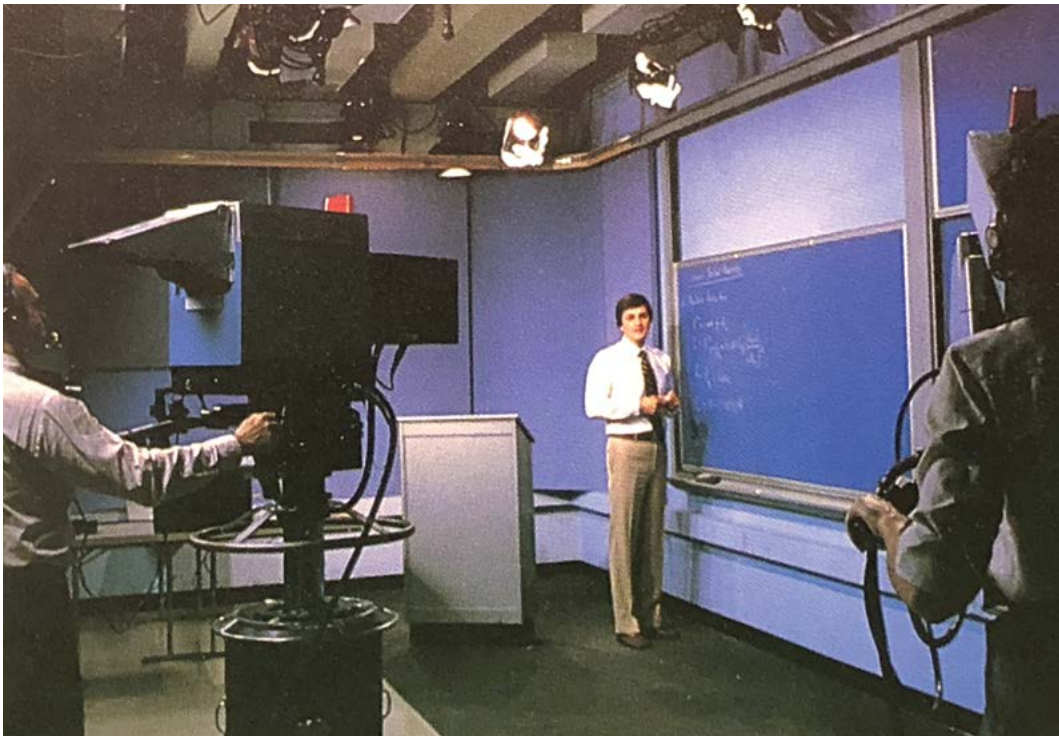
I think I was the prototypical nerd, especially early in my career at MIT. I used to always bring home jokes I picked up at work. As an example: "What does the transistor radio say to the 9-volt battery? You really turn me on!" Ivan and Sara used to squirm helplessly when I would begin telling jokes at the dinner table! Not hard to understand that!

I very much liked being in the classroom, but one of my greatest pleasures in having been an academic is watching the personal and professional growth of the extended family of students that have passed through the Uhlig Lab at MIT. I have followed their careers and, in as many cases as possible, provided both professional and personal guidance. When I decided to retire from MIT in 2002, my students held a party at the MIT Museum celebrating the Uhlig Lab. Among them was Noam Eliaz, a professor at Tel-Aviv University (TAU), who founded the Department of Materials Science and Engineering there after leaving MIT and who has become a world leader in research, education, and innovation. He is a member of the National Academy of Inventors and, in 2022, became the Dean of Engineering at TAU. Another student, Marius Kloppers, a South African, joined BHP Billiton, the world's largest mining company, and became its CEO. Jerry Frankel, one of my



*Lecturing in class (1982).*


*The Uhlig Lab t-shirt...we are rustbusters!*



*In studio, recording the corrosion video course (1983).*

first graduate students, is the Head of the Fontana Corrosion Center at Ohio State and an internationally recognized leader in the field. It is interesting symmetry to have one of my students leading the lab from which I graduated. Rear Admiral Clarke Orzalli became Commander of the Puget Sound Naval Shipyard among other assignments at sea and ashore. And Professor Pete Searson of Johns Hopkins University assembled a terrific program and a historical (and hysterical) slide show that made this a wonderful evening for me. All these folks are Roger Staehle's gradchildren. The academics like Noam and Jerry have produced gradsons and graddaughters of yours truly! I am blessed!!

## Research

My research interests are focused largely in the areas of materials processing and in the corrosion of metals and other materials in aqueous (ambient as well as high temperature and pressure) environments. I consider myself a specialist in corrosion science and engineering with particular emphasis on materials selection for contemporary and advanced engineering systems and in failure analysis. My expertise extends to electrochemical systems and processing technologies, ranging from fuel cells and batteries to nuclear electric generation, as well as supercritical water power generation and waste destruction. Stainless steels, nickel-based alloys and carbon steels have been of particular interest. I have published roughly 300 peer-reviewed research papers on subjects including environmentally assisted cracking (EAC) of metals and ceramics, water and ionic permeation through thin polymer films, photo-electrochemistry, and the study of aging phenomena/life prediction in engineering materials and systems. One of the favorite titles of a manuscript some of my students and I prepared on aging is *Aerospace Gerontology: Retained Austenite as an Aging Mechanism in Duplex Bearings*. The title of this one received a lot of comment!!

My early research was focused on surface effects on the properties of solids. Of course, those effects include the presence of environments, and so service environments that lead to corrosion in engineering systems is a natural trajectory. It has always intrigued me that some service environments (chlorides, for example) can catastrophically embrittle ordinarily ductile alloys such as stainless steels, while pure water can plasticize ordinarily brittle solids such as crystalline sodium chloride (the Joffee effect). To make this point in class, I would ask volunteers to assist me in live experiments during lectures. That was fun and, I think, enlightening.

With the support of the NATO Advanced Study Institute Program, I chaired and then served as senior editor of the proceedings from three major international conferences: *Surface Effects in Crystal Plasticity in the Harz Mountains* (1975), *Atomistics of Fracture in Corsica* (1981), and *Chemistry and Physics of Fracture in Bavaria* (1988). I also chaired the 1980 Gordon Conference on Corrosion at Colby-Sawyer College in New Hampshire.

I became Co-Editor-in-Chief of *Corrosion Reviews* in 2005, initially with Noam Eliaz and, more recently, with Dr. Raul Rebak of GE Global Research. Meaningful reviews assess the state of understanding of a particular subject, identify gaps in understanding, and, on this basis, develop a path forward for researchers in the field.

## My Deep Interest in Precollege Education

I have always had a deep interest in precollege education. Much of this derives from my personal experiences in growing up in Northeast Pennsylvania. I founded the MIT Science and Engineering Program for Teachers (SEPT) and the offspring, Network of Educators in Science and Technology (NEST), in 1989. SEPT is a weeklong program for teachers offered on the MIT campus each summer which continues today under the direction of Professor Eric Klopfer. Given that the teachers represent the long term in the education of young people, my vision for SEPT and NEST was focused on developing understanding and collegial relations among the teachers as well as with the MIT faculty. In 1991, I founded MIT's Council on Primary and Secondary Education which I then led for several years thereafter. Throughout all of this, I was fortunate to have the support of MIT alums, particularly Joe Scheller and Johan von der Goltz, who provided not only much needed fiscal resources but also wise counsel. Joe provided the resources to endow a career development professorship for Eric when he joined the faculty and then provided he resources to endow the Scheller Teacher Education Program at MIT.

Beginning in 1992, I served as a Co-Principal Investigator of the National Science Foundation (NSF) sponsored statewide systemic educational reform initiative in Massachusetts, Project PALMS (Partnerships Advancing Learning of Math and Science), along with the Deputy Commissioner of Education for the Commonwealth, David Driscoll; Professor Michael Silevitch of Northeastern University; and Dr. Penny Noyce of the Noyce Foundation, the daughter of Intel co-founder Bob Noyce. I served as an education advisor in Senator Paul Tsongas' 1992 campaign for the presidency. I hosted the annual Siemens Science and Technology Competition on the MIT campus for more than ten years,

beginning in 1993. Given the impact of my early educational experience in Northeastern Pennsylvania, commitments such as the above were a natural outgrowth. One additional comment: I have always believed education is the vehicle by which nations integrate young people into the culture of their community and the nation. However, this applies to people of all ages; hence, SEPT at MIT. Today we have millions of people, misguided by political forces, that we must redirect into civil society. Education, and particularly science education, has the potential to be an important vehicle for this purpose. I hope the current Biden science team and the President's Council of Advisors on Science and Technology (PCAST) will consider an educational approach to rescuing the social fabric in the US.

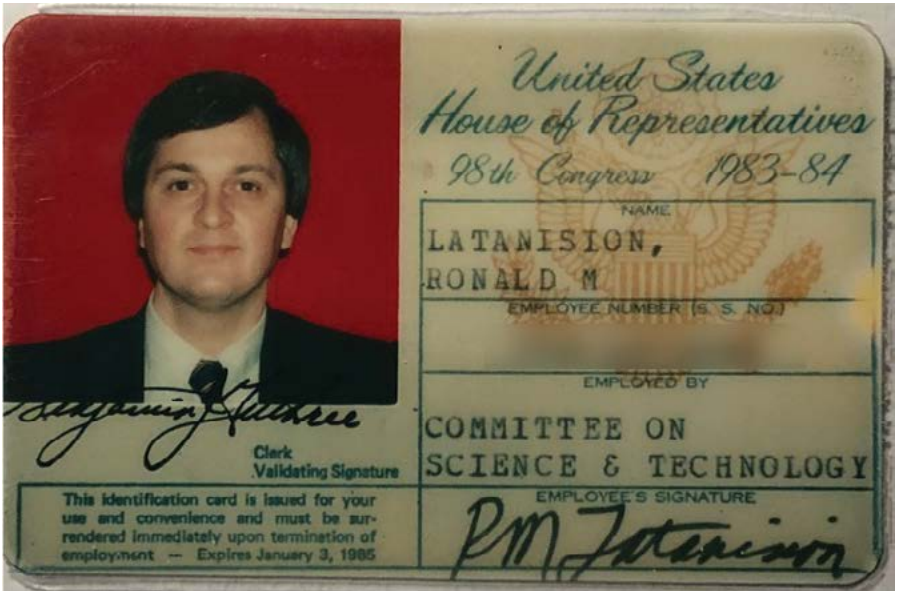
### The Attraction of Washington: Politics

During a sabbatical from MIT in 1982-1983, I served as a science advisor to the U.S. House of Representatives Committee on Science and Technology in Washington, D.C. Don Fuqua, George Brown, Al Gore, Ron Paul, and Dan Glickman were among the members. During this period, I also became acquainted with Massachusetts Senator Paul Tsongas and his staff. Based on this work with the Science Committee, I gave the 1984 Henry Krumb Lecture of the AIME titled *Prospects for the Development of a National Materials Policy in the 98th Congress*. I served as a member of the Advisory Committee to the Massachusetts Office of Science and Technology, an executive branch office created to strengthen the Commonwealth's science and technology infrastructure with emphasis directed toward future economic growth. I also served as a member of the National Materials Advisory Board of the National Research Council (NRC) and as a member of the NRC's Standing Committee on Chemical Demilitarization. In 1978-1981, I served as a member of the Corrosion Advisory Committee of the Electric Power Research Institute.

My persistent interest in technology and policy led me to consider a run for election to the US House of Representatives in 1984 following my sabbatical. I would have challenged then Congressman Ed Markey. I did have support from people I met in Washington during my sabbatical: Congressman Jim Martin (R-NC), an organic chemist and Davidson professor who became a two-term governor of North Carolina. He and I had a lot of common characteristics, but I could not run as a Republican in Massachusetts. I did speak with Speaker Tip O'Neill, knew Rep. Chet Akins (D-MA), and met Jim Roosevelt. They understood my interest in public life, but I did not expect them to support my challenge to an incumbent Democrat. There were other people in Massachusetts who

did and agreed to serve on an advisory committee. This was a group of business folks, academics, and some others. At one point, one of the committee members asked, “What would Carolyn say if a Boston Globe reporter asked her about your candidacy?” So that evening at dinner, I asked her. Her answer was swift and clear, “I would tell the reporter I wish he would stay at home and help me raise two kids.” Thus, in the Latanision household, where a “one woman, one vote” rule applies, Carolyn voted, “No!”

Similar phenomena occurred when I was offered the positions of Dean of Engineering at my graduate alma mater, Ohio State; Dean of the College of Earth and Mineral Sciences at Penn State, where I studied as an undergraduate; and President of the Michigan Technological University. None of these positions in academic administration that were of high interest to me were of interest to your grandmother. She is a very private person and does not enjoy the limelight, but she is a seriously good painter and a wonderful wife, mother, and grandmother! I realized how deeply she felt about all of this when I brought the Ohio State offer to her one evening while she was cooking. I described the offer for me and the companion offer for her to join the Arts Faculty. There was




*My House of Representatives ID.*

silence as she cooked, and then she turned to me, fully engulfed in tears. My reaction was similar. I knew then we would not leave Winchester. There is an important lesson in all the above. Married life is a balancing act. I have had a number of friends at MIT who, faced with comparable decisions about moving to another stage of their careers, chose to do that despite family reluctance–and lost a spouse in the process. Divorce was never an option for me or Carolyn, so we stayed in Winchester. I channeled my energies elsewhere and her art interests blossomed. That was the right decision for us.

In June of 2002, I was appointed by President George W. Bush to membership on the U.S. Nuclear Waste Technical Review Board (NWTRB) and was reappointed for a second four-year term by President Barack Obama. I think of the vetting process before my appointment by President Bush with some fondness: early in 2002, I was in my office at MIT when I received a call from then White House Counsel, Alberto Gonzales. He said I was being considered for appointment by the President to the NWTRB, and he wanted to have a conversation. I had not expected this, but I was pleased. At any rate, we spoke for about a half hour about my views on nuclear electric generation and, in particular, about the management of nuclear waste. Near the end of our conversation, he asked me if I had ever written or publicly said anything that would embarrass the President. I answered with confidence I had not. In fact, I had not voted for Mr. Bush, but at that time, I had far too much respect for the Office of the President and for the incumbent to do that. Then, Mr. Gonzales asked about my party affiliation. I told him I was a registered Democrat. There was a seemingly endless pause, and then he said nuclear waste was not a partisan issue in any case, so my party affiliation did not concern him. So I became a member of the NWTRB. This was one of my greatest technical and collegial pleasures. The Board was magnificently chaired by John Garrick and the comradery among the ten members was extraordinary. It still is!

One of the most interesting memories of the NWTRB was an invitation to the White House by the Obama's for a reception. This was in the period leading up to the 2012 Presidential Election. Carolyn and I were both present, as were the other Board Members and many of their spouses. When Barack and Michelle Obama walked along a receiving line greeting folks, we had a short conversation. Barack immediately noticed Carolyn's glasses and said, "Cool glasses!" She responded with a thank you and then said, "You need to win this election against Mitt Romney!" He applauded! I recorded this on my iPhone. As an artist, Carolyn always finds the most interesting and colorful eyeglass frames.

*Reception on The White House Lawn.*

*Cool glasses...*

## The NAE

One day in 2011, I received a phone call at my Exponent office from former MIT President and then President of the National Academy of Engineering (NAE), Chuck Vest. I had many interactions with him at MIT, principally on the K-12 teacher education initiative I led. He said he had an offer for me I could not refuse. He invited me to serve as Editor-in-Chief of the NAE Quarterly, *The Bridge*. When I asked if I could give some thought to this offer, he replied that was not an option! I have been grateful ever since and remain so today. Chuck was one of my favorite people, and I knew I could not say no! I miss his presence today. *The Bridge* is the flagship quarterly of the National Academy of Engineering.

Its focus is on science and technology policy; engineering research, education, and practice; and the roles of engineering and technology in society. These are all subjects that have been of interest and concern to me throughout my career. *The Bridge* is distributed to NAE members, members of Congress, schools of engineering, university and public libraries, relevant federal and other agencies, professional organizations, and interested individuals and institutions all over the country and world.* *The Bridge* celebrated its 50th Anniversary as a publication in 2020. In recognition of this event, we published a celebratory issue that included 50 essays which addressed expectations for the next 50 years of engineering.†

The 50th Anniversary issue of *The Bridge* has been of service to the people of my Winchester, Massachusetts, hometown. Here's how: As I mentioned earlier, the agenda of the Wilson Science and Technology Forum that meets every two weeks in town includes both presentations of local technological interest and talks on broad national and international issues. Therefore, we decided to make the 50th Anniversary Issue a guide to our discussions on a regular basis. In our first such conversation earlier this year, the NAE President's Perspective from John Anderson and the Keynote by Sheila Jasanoff were discussed. We will work through the entire volume in time. And thanks to COVID (I never imagined saying that!!) and Zoom, we can and have reached out to speakers and participants from beyond our community in Massachusetts. Among those, Dan Metlay of the NWTRB met with the Wilson Forum from Bethesda, Maryland; Joel Myers, the Founder and CEO of AccuWeather, spoke with our group from State College, Pennsylvania; Ali Mosleh of UCLA spoke with us about risk assessment; and the DOE's Eric Miller spoke with us about hydrogen as an energy source. Recordings of their appearances and others are on our website.‡ In early 2023, the town TV station, WinCAM, began showing our recordings twice a week. We live in a technologically intense world, and it is important the public at large be informed of science and technology issues that impact their lives. This should include high school teachers and, particularly, students, who can and will shape our technology future.

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* *The issues are freely available on the NAE website. Visit www.nae.edu and click on The Bridge.*

† *http://www.nae.edu/244832/The-Bridge-50th-Anniversary-Issue*

‡ *https://jenksst.blogspot.com*

There is a genuine wealth of conversation included in the 50th Anniversary Issue. I continue to think that more than the current handful of engineers should be in policy making positions (aka the U.S. Congress) in a technologically intense civil society. I am hopeful Biden's science team will be a match for our world today. Eric Lander, the former Science Advisor to the President, and Maria Zuber, the current co-chair of the


*Hosting of The Wilson Forum on Science & Technology.*

President's Council of Advisors on Science and Technology (PCAST), are MIT colleagues of mine. Both have spoken often to the teachers who attend MIT's *Science and Engineering Program for Teachers* each summer. Frances Arnold, the other current co-chair of PCAST, is a Nobel Laureate and the daughter of a friend with whom I served on the NWTRB for ten years. Most interesting to me is the appointment of a social scientist to PCAST: Alondra Nelson is now at Princeton but was the Dean of Social Sciences at Columbia University. My point is that it is important for people all over the world, and in communities such as Winchester, to have an appreciation of and willingness to understand the current context in which science, engineering, and technology serve social purposes. The Anniversary Issue provides a vehicle for that to happen. And I really do hope going forward, our Anniversary Issue may also serve to direct some of that conversation for policy makers as well as for my neighbors.

### Technology Policy Interests

In order to live life to its fullest on this planet, we all need clean air, edible and clean food, and drinkable water. Housing, transportation, health care, heat and electricity, the infrastructure of highways and bridges, water treatment facilities, and, today, the availability of broadband services, among others, help us to manage our existence and to improve the quality of our lives. As engineers, we design, build, operate, inspect, and maintain engineering systems that serve society. We make new scientific understanding useful to people. The engine of economic development is the innovation which leads to new engineering systems that serve a social purpose and that find their way into the marketplace. When I was a kid, I was very impressed with Dick Tracy's two-way wrist radio, which later became a two-way wrist TV! Tracy fans will remember the wrist radio was developed by the son of Diet Smith, the health-conscious engineering genius. The wrist radio first appeared in Chester Gould's comic in 1946 and then as a wrist TV in 1964. There was nothing like it in the marketplace at the time it appeared in the comics, and it seemed to me so improbable there would ever be such devices. At any rate, I now wear a wristwatch that does all Diet Smith envisioned and more. Though not an engineer (he earned a degree in Commerce and Marketing from Northwestern), Gould had a remarkable fertile sense of engineering and technology and of innovation. And, yes, I loved to read Dick Tracy!

In the following, I discuss just a few technology-derived topics that are of particular interest to me and which are of contemporary importance at the time of this writing in 2023. It will be interesting to see where the future leads and whether my thoughts now have merit along the way–or not!

#### Climate Change

Growing up in Northeast Pennsylvania, my interest in coal as an energy source, along with nuclear and renewables, persists–though not in the current mode. During the last century, we have built an economy on this planet based on fossil fuels. As an energy source, this has led to great achievements in electric generation, transportation, and our quality of life in broad terms. But it has come with an unanticipated price: greenhouses gases that create peril in our future on planet Earth. It can no longer be acceptable to globally pump $CO_2$ relentlessly into the atmosphere if we want to mitigate climate changes that have now become conspicuous.

What seems clear to me is there are positions on both sides of the issue of climate change that are important but are being dismissed by the other side. That is truly regrettable in my view. Climate changes are occurring: it is demonstrably clear sea level is rising, glaciers are melting, and global temperature is rising. Those are facts! Whether this is the consequence of natural climate oscillation or climate change that is accelerated by anthropogenic activity is the subject of much scientific debate and even more political discourse. In any case, engineered solutions are necessary to manage all of this going forward. If sensible people could come together and have reasonable conversations, that would be constructive. But as long as both sides try to make points with the public with excessive claims and rhetoric, there will be no progress, and we will all pay a price. This is one of those issues where reasonable people should be able to "disagree without being personally disagreeable," but that does not seem to be the nature of public discourse at this point in history. Our political leadership (those two words together seem increasingly no longer appropriate) seems incapable of getting beyond the politics of any decision, even those that are in the interest of the people who live in their districts– and on our collective planet! We may never be able to get to the point of a political solution, but smart–as opposed to just intelligent!– scientists might find one despite politics.

One of my very good friends in Japan, Prof. Koji Hashimoto, is working to commercialize a technology he developed and demonstrated to recycle $CO_2$. His motivation is not unique, but his technology is very compelling: hydrogen, produced by water electrolysis, is reacted with captured $CO_2$ to synthesize methane which is in turn used to generate electricity, the released $CO_2$ again captured and recycled, producing, in principle, no net increase in the level of atmospheric $CO_2$. This may be of value when we become serious as a nation in combating global warming. This has been the passion and focus of his research since about 1980. He recently published a book: **Global Carbon Dioxide Recycling** *for Global Sustainable Development by Renewable Energy* (Springer, 2019). I know there is much research underway regarding recycling and sequestering, but I personally find Hashimoto's work to include a serious dose of realism.

I also believe nuclear electric generation should remain an important part of our energy mix in the future. It is safe, reliable, and green. But the U.S. failure to deal with nuclear waste is a great regret and may lead to the end of nuclear electric generation. During my term as a member of the U.S. Nuclear Waste Technical Review Board, I became deeply familiar with the existing policy and technology associated with managing

nuclear waste. But as a nation we have not shown the public or political will to implement that policy. The waste should be buried in a deep geologic repository at Yucca Mountain. My opinion is we should impose a moratorium on the construction of **any** new fission-based nuclear power plants until the License Application is back on track at the NRC, Congress approves the funding for construction of a repository, and construction begins. This may seem draconian, but it is not. With an identified site and a policy road map in place, what is required is the will to go forward. That could happen in a fraction of the time required to design, build, and commission a new nuclear power plant. There are technical and social challenges that can be solved (the latter with the involvement of social scientists), but the major obstacles have been and remain political. Nuclear fusion based electric generation has much appeal, since it mimics the sun as an energy source, but the technical advances required to produce working systems have been, and seem likely to, remain distant.

In the context of a long-term solution to our energy needs and the current geopolitics that affect the distribution of current fuels, I have hope that someday a president of the United States will stand before a microphone and say something like the following, "I am going to commit this nation to a hydrogen economy going forward. In order to do so we will need a photoelectrode that is durable, efficient, and cheap in order to split water into hydrogen and oxygen. Sunlight and water are both free and know no national or geopolitical boundaries. This is a means of energy independence for both the legacy and non-legacy nations of the world. I therefore call on the Materials Genome Initiative to develop such a material." And, shortly afterwards, a spokesman from the Materials Genome Initiative (MGI) will come to a microphone and say, "Madam President, MGI is up to this challenge, and we will develop and deploy that photoelectrode." I know there are really two major goals in this short story, but I have four granddaughters, and I have great hopes for these kids and their generation. I find women look at issues through a different and often clearer lens than do men–on all sorts of topics. Consider the mess a few of my gender are making of the world at this point! That is why I really do hope to see a woman in the White House soon! In addition, I am a materials engineer and an optimist at heart! There is a collective solution to the planet's climate and energy needs going forward that has received almost no attention that I am aware of: desalination on a global scale and the transition to a hydrogen economy, mentioned earlier. The former is practiced widely in the Middle East and could be scaled up globally. This would produce freshwater for human consumption and irrigation or drought-ridden farms. Likewise, some of

that water could be split using sunlight to produce molecular hydrogen and oxygen. This can be done. What is required is the public and political will to do it. This will require a planned and orderly transition as has been the case historically with any monumental technological advance: the automobile, the airplane, etc. We are blessed with nature's most abundant and persistent energy source: the sun. And the earth's surface is largely covered by water. We need to use both resources to our advantage and well-being.

**Artificial Intelligence**

I am deeply concerned engineers and technologists have abdicated on social issues. We have become an utterly divided nation, and, to my mind, technologists bear a large responsibility for the current state of affairs but are seemingly incapable of self-correcting. I know that sounds melodramatic but look at what we have become as a nation with the introduction of the Internet which has morphed into something that had not been expected (often harmful social media). Nothing will change until technologists begin to step up.

It is true some technical advances driven by artificial intelligence (AI) are exciting and can be implemented meaningfully and usefully. But there are important social and ethical issues associated with various applications of AI. For example, there is a growing sense in the AI community that AI can simulate human consciousness. I wonder if it is more likely that AI can mine data it curates and then construct what appears to be human thought by assembling a mirror of the data it curates. That is not so much creative or thoughtful as it is, in my view, machine plagiarism in the guise of wisdom. With a population that is now so seemingly easily misled and misinformed, this seems a crucial point in our technological history.

I do have much expectation for machine learning as a valuable tool for scientists and engineers. As a case in point, new materials are needed for advanced engineering systems. The Materials Genome Initiative allows materials folks to design and produce new materials which meet specific needs from first principles using an informative database that is curated, authentic, and trusted. So instead of the traditional trial and error approach, machine learning can guide the evolution of a new material from first principles and then guide experimental verification the material works as intended for the identified need. All this can be done in much less time and cost than trial and error. Likewise, the Human Genome Initiative was a model, in my judgment, for the productive use of data. Both initiatives provide insight and speed but do not claim to

be original thought. But this concept only works if humans guide the process and think through questions that may arise. Some questions may not have occurred historically, and so machines will not have been trained to respond correctly. So my concern is AI machines are likely to always reply with an incomplete deck! This is a way of expressing my long-held view that machines can be useful, but we spend too much time and effort trying to develop thinking machines when we already have the most effective and plentiful thinking machines in the brains of humans. What is the AI endpoint? To replace humans? If so, why? That is not AI's best use in my view.

Here is another example of interest to artists and people who appreciate the arts: AI can produce art by collecting data (images), curating them, and then "learning" from this data. This is not creative in my judgment. Some people may like the product, but it should (1) not be confused with original, creative art, and (2) be examined for copyright infringement. The analog in materials science and engineering, the Materials Genome Initiative I described above, is more true to form. It is not original or creative, it is just using machine learning for a meaningful purpose based on all the verified data collected. That is not what is happening with the arts, as I understand. In the latter, machine learning just mirrors original art and produces images from that process that do not reflect creativity, originality, etc. Without the database of images, machine learning would not be able to do anything that could be considered painting.

I believe the implementation of AI is an extremely important topic that needs to be addressed. Corporate America could set the standard for AI technological transparency, accountability, and responsibility in a way that considers its impact on our social fabric. Both the European Union and the White House have recently introduced legislation that would provide some guidance for AI safeguards.

### Reflections

The above experiences shaped my thinking as a technologist, as a person, and as an American. I am more than old enough to remember when Everett Dirksen and Jerry Ford, both Republicans, could get together on *The Ev and Jerry Show* and have civil conversations and find solutions to just about any issues that concerned the public. Despite being a Republican Senator, Dirksen more often than not seemed to agree with then Democrat President, Lyndon Johnson. Imagine that! I grew up and have practiced every day of my adult life the philosophy, described earlier, that being civil and respectful are attributes that solve

problems and develop useful relationships. And reasonable people can disagree without being personally disagreeable. In fact, as a scientist, disagreement is not an unusual part of my life. We observe, hypothesize, debate, and disagree as a rule and as a means of understanding what nature provides. But we can also put these debates aside and get together for a social evening.

My good friend, Roger Pearson, a card-carrying conservative CPA, and I have vastly different political views, but we never leave our conversations colored by personal disagreement or animosity. This has become almost impossible in the era of Donald Trump. I have always expected the President of the United States should be a model of personal stability and civility. Donald Trump was and is neither. It is often said that what motivates people is fear and greed. Sputnik is a prime example of the former. The U.S. public and our national leadership were deeply concerned about the potential threat represented by the then-USSR in space. With political and public will, we did overcome that fear, or at least learn to manage it. On the other hand, Mr. Trump seems clearly driven by greed, in my opinion. Mitt Romney famously described Trump as "a con man and a fraud". I would add that this description includes fraud in business, politics, and personal behavior. Oxford Languages describes a con man as "...a man who cheats or tricks someone by gaining their trust and persuading them to believe something that is not true." Romney seems right on target in his assessment! As we approach the 2024 primary election cycle, I cannot believe Trump has any support from the people, but it appears there are many people, almost 40% of the voting population, who consider him their man for president. We are becoming a strange nation that reflects his values, and it is not very comforting for me to think that our grandchildren may have to live in such a country. Prior to the 2020 elections in the U.S., I wrote to my friend Koji Hashimoto, "I pray that Biden will be able to muster the voting support to remove Trump from office. But, even then, he will probably claim that the election was a fraud and refuse to leave the White House." This is exactly what he did following the election and on January 6th. He cultivates friction all over the planet, and it is not in the interest of the global community but in his own self-interest–aka, money! I really do believe that history will include Donald Trump among the most dangerous and, likely, despicable people ever to inhabit the Earth.

We are at a turning point in America–and maybe on this planet broadly–and reasonable people, especially young people, must regain the momentum to carry the day, lest we fall deeper into to a troubling spiral

of public discord that continues to exceed public harmony. I am personally very concerned about this. I really do worry that my generation may have lived through the best of the United States of America and that the constant barrage of disinformation coupled with extreme polarization will spiral out of control. What will it take to stimulate Americans to think about where **their** country is headed and begin the process of righting our course? History does tend to repeat itself, and so some of the current political and personal discord has occurred in the past. I find the almost-daily column written by Heather Cox Richardson, *Letters from an American*, provides a wonderful historical perspective to the daily news. There are differences in our world today, namely omnipresent social media, a product of the science and engineering communities behaving as if making a profit is the only goal. This allows disinformation, and the attendant divisiveness, to be distributed seemingly unfettered and without a social conscience, stimulating and encouraging people to communicate in toxic ways.

In sum, it is clear to me advances in science and technology have historically provided us with great benefits in terms of economic growth, health care, travel, etc., and, in short, the quality of life on this planet. These same advances, however, have often presented challenges in terms of unanticipated, or better yet, unintended, consequences. From the Internet to genomics to air travel, the unintended consequences are among our greatest headaches today. Going forward, engineers, in a broad sense, should consider how to addresses such issues. For example, we should not judge new technologies solely based on marketability or profitability but whether these technologies genuinely serve a **useful** social purpose. That leads me to conclude engineering ethicists and social scientists must be included in decision making regarding moving new technologies to the marketplace. We have not done a very good job of this in the past. I cannot see how this can come about without the incorporation of social science into the engineering curriculum at our universities. This would serve the best interest of future generations of engineers and, especially, the best interests of the public at large.

# Part 4:
# Transitions

## A Transition

I have always enjoyed working on practical engineering problems. This was important in the sense that there seemed to be an expectation at MIT that a faculty member at the leading edge of his or her field should be in demand by industry to provide advice on various levels. In 1992, I was a founder of Altran Materials Engineering (AME) Corporation along with MIT colleagues Reggie Pelloux and Ron Ballinger, and former Westinghouse engineer, Tom Esselman. That company, an engineering consulting enterprise, was acquired by the Altran Technologies Group of Paris in 2000. One of the great mysteries to me is how our essentially fabricated name, Altran, was also the name of a wholly independent and much larger company in France, Altran Technologies. However, I did not feel comfortable with the direction the new owners of AME wanted to pursue. I remember describing all of this to Roger McCarthy, then the CEO of Exponent and one of the team of experts, including yours truly, engaged by Westinghouse in defending itself in the massive steam generator litigation in the 1990s. I mentioned the latter earlier. Roger suggested if I ever decided to test the consulting waters full-time, I should let him know. I did, and in 2002, I joined Exponent on leave from MIT. My thought was to determine if life in the business world as a

*At MIT Great Court just before joining Exponent (2002).*

consultant would be agreeable. It was–and is! I had begun to feel after nearly thirty years of teaching engineers, it was time to practice as an engineer.

I really did feel ready to make this change. It sent shock waves through MIT and elsewhere. A full professor leaving MIT to go into the business world?! However, I had been at MIT for nearly 29 years, and I will always have a deep affection for (and, as an honorary alum, a long-term relationship with) the Institute. But it felt like it was time to open a new chapter in my life. The irony is I never really expected or intended to be at MIT for so long. Had Carolyn been more agreeable, I would likely have either gone into politics, or I would have become a university president. Both options were real and tangible. However, Carolyn is a very private person who is deeply committed to her art, and the prospect of raising two teenagers with an absentee husband was not in her plans at the point when politics and/or academic administration were on my front burner. Interestingly, over the years, many people had become aware of this latent interest and had encouraged me to revisit this matter. The university presidency also represented more exposure and commitment than she could accommodate. It may seem odd, but I don't regret any of this. Carolyn has a remarkable sense of such issues. She and I both saw my Altran experience as a major transition for me and with Exponent, I found my next career! We were right!

Joining Exponent was a very good decision I wish I had come to earlier. The firm has been superbly managed throughout my experience. I do like to point out when I joined in 2002, Exponent stock was trading at $13 per share. A few years later it was trading at over $50 and split. Later, it split a second time and is today trading at about $100. Maybe my presence during this growth is just a coincidence! 😊 The staff of more than 1,000 people represent virtually all of the science and engineering disciplines including medicine, environmental science, and more. The company has offices in the US, China, the UK, and Germany among others.

Subsequently, I served in various roles at Exponent: as a Principal when I joined the firm; as the Director of the Mechanics and Materials Practice, then Exponent's largest practice; as Corporate Vice President; and, ultimately, as the firm's first Senior Fellow. The latter, particularly, has allowed me to wind down my consulting activity and to pursue interests that had been on my mind for some time. For example, I have always liked to write but that has been almost exclusively technical, of course. When our grandchildren were very young, I thought of writing

*Winton Club Casino Night in Winchester (January 2023).*

children's books but never really got too far with that. They did give me a lot of material, however! As they grew up (now 19, 17, 16 and two at 15 years old), I realized I knew very little about my grandparents, and I would like them to know more about theirs. Then the stars aligned, and I discovered the Nita Regnier Memoir Writing Group at MIT, which was enabling in terms of my writing this personal essay. I have written short pieces on the arts, Editor's Notes for *The Bridge*, letters to the editor of the *Boston Globe*, and have other writing plans. My first novel–not there yet!

At any rate, the chapter of my life as a consultant has been everything I could have hoped for: challenging, exciting, rewarding, and a personally very agreeable experience. If any of you become consultants at any point in your lives, the following may be helpful.

My consulting experience has been very broad. As I described earlier, all engineering systems perform in some service environment: prosthetic devices in the human body, airframes in the atmosphere, cargo ships in the ocean, heat exchangers in pressurized water reactor nuclear power

plants in high purity water, etc. Corrosion engineers have a role in all aspects of the evolution of such engineering systems–design, assembly, operation, inspection, and maintenance–and so, over the years, I have been engaged in all the above and more. But I found it was very important in terms of developing my practice to invest in myself and, accordingly, to become known for some particular part of technology. For me, that was the materials of construction of nuclear power plants. Though I did consult on a wide range of topics, from the smallest medical devices to the largest container ships, I became best known for my work in nuclear materials and their performance in nuclear power plants (NPPs). My presidential appointment as a member of the US Nuclear Waste Technical Review Board in 2002 added significant visibility.

So, let's stroll through some NPP history. In the late-1980's, a breach of warranty lawsuit was filed by the Washington Public Power Supply System (WPPSS) against, among others, General Electric (GE). GE was contracted to provide the Nuclear Stream Supply System for one of the five NPPs being considered for construction by WPPSS. GE was the manufacturer of boiling water reactors (BWRs). I was engaged by Mayer Brown in Chicago on behalf of GE in the context of my experience with the many materials of construction of BWRs. This nearly billion-dollar case, heard in Phoenix, became very complicated by claims and counterclaims that led to the State Supreme Court.

The GE case provided me with visibility as an expert and quickly led to my being retained by Weil Gotshal in New York to represent Westinghouse in a massive, multi-billion-dollar collection of utility derived lawsuits which alleged Westinghouse had sold defective pressurized water reactor steam generators to a large number of electric utilities in the US. Westinghouse circled the wagons in Pittsburgh and went to trial with Duquesne Light. The allegation focused on the use of Inconel 600 as the material of construction of steam generator tubes, claiming Inconel 600 was a defective material. I mentioned this litigation earlier in describing the conversation in court between Roger Staehle and myself before opening arguments. Roger McCarthy and Charlie Rau of Exponent also represented Westinghouse, and it was at that point Exponent came on to my radar screen. The jury decided for Westinghouse, at which point all the remaining lawsuits were dropped or settled.

After joining Exponent in 2002, one of my early projects involved the pressure vessel leak at First Energy's Davis Besse NPP in Ohio.

Exponent was retained by Morgan Lewis to support the insurance arbitration between First Energy and the nuclear insurer, Nuclear Electric Insurance Limited, regarding damage to the Davis-Besse reactor pressure vessel head in 2002 due to leaking control rod drive mechanism (CRDM) nozzles. This was brought about by a unique combination of a large, rapidly-growing crack in CRDM Nozzle 3, leakage from that crack at a rate and at a location that caused a unique thermal hydraulic environment to develop in the nozzle annulus, and that in turn caused the wastage cavity to develop at not just an unusual, but an unprecedented, rate. This project involved 12 of our staff from five offices. In the end, the First Energy Board of Directors withdrew the claim with little explanation. While I could speculate on their motivation, I don't think that would be productive.

In any case, our association with Morgan Lewis during the Davis-Besse work has led to major follow-on projects: the Motiva insurance litigation in Texas, for example. This case involved the unanticipated cracking of components of the crude distillation unit (CDU) in the new Motiva refinery in Texas. The cracking was the result of an unexpected caustic intrusion. While caustic (NaOH) is a known corrosion inhibitor for carbon steels, in low concentrations and while the component is under load, premature cracking may occur. Caustic cracking, in my judgment, is much like the embrittlement of alloys by hydrogen or liquid metals and involves the adsorption of the embrittling species on stressed solids. This phenomenon is often incorrectly identified as stress corrosion cracking. In this case, although we presented that argument, the client field staff referred to the failure as stress corrosion cracking, and the arbitration panel considered "corrosion" to be excluded by the insurance as ordinary wear and tear! They were wrong, but they were empowered to make a decision.

Despite this unwelcome conclusion, other projects have followed with the Morgan Lewis law firm, and, in many ways, this is the product of a relationship of civility, respect, and trust with that law firm. In addition, the attorneys and Exponent staff became friends as well as colleagues in litigation.

All the above lead to a message: visibility is important, and it may come in many forms. In my case, this was my research while at MIT and appointment to the NWTRB. But other paths lead to similar positions. Some of my most successful Exponent colleagues have become the go-to people on Li-ion batteries, others on fire suppression systems, polymer chemistry, failure analysis, etc. My point is recognition and visibility are

important, not only to technology-related consultancy, but to any career path. You must invest time and energy in making yourself visible in whatever path you follow. Your grandmother is an internationally known painter, and her work is on display in the US and elsewhere. That is not without a considerable investment on her part in developing her skills, exhibiting at prestigious shows, and becoming recognized for her work. So whatever career you choose, be prepared to invest yourself in moving forward. Nothing useful will come to you without commitment and effort.

I think it important to recognize that any career path involves **interaction** with other people. This interaction should be thoughtful, civil, and respectful, especially in today's polarized world. If you can influence your own sphere of interactions positively, that might lead others to respond in the same way. You could light a useful fire!

Finally, I realize at this stage in my life that if I could do it all over, I would like to have become an attorney with a technical orientation. I really do enjoy debating in court and, immodestly, I think I am pretty good at it!!

**The Next Chapter**

I have recently accepted appointment as a *Neil Armstrong Distinguished Visiting Professor* at Purdue University. This is not a full-time appointment, but a three-year agreement to spend a month a year on campus. As such, we will not move, but we will integrate into a new campus culture. The attraction of this new venture is a long-time friend, Srinivasan Chandrasekar in the Industrial Engineering Department at Purdue, and I have been using some of the early research from my work at Martin Marietta to revolutionize metal cutting, and it has been very fruitful. I would like to continue working with him and his staff, and this is a perfect way to do it. Also, the Nuclear Engineering Department would be a secondary host. Nuclear waste is still a big item on my agenda.

I spoke at Purdue University in April of 2022 as part of the *Purdue Engineering Distinguished Lecture Series*. It was in the Atrium of the Armstrong Building and about 50 feet above me as I spoke was an Apollo 11 module. It was all really very moving. Someone once pointed out to me that Neil Armstrong was perhaps the only person who could claim a one sentence resume: "I was the first person to walk on the Moon." Nothing more need be said. He and other Purdue alums have filled this nation with pride in their courage and accomplishments. To have my name included among the Neil Armstrong Distinguished Visiting Professors at Purdue is a distinct honor. This is an irresistible path to bringing a long career to a useful conclusion.


*Speaking at Purdue Engineering Distinguished Lecture Series (April 2022).*

## A Closing Thought

When I look back over the years, my overwhelming reaction is to marvel that a kid from the coal fields of Northeast Pennsylvania grew up to become an MIT professor, a member of the National Academy of Engineering, a founder of a company... I did not become the world's richest person, but I really enjoyed the ride, and we lived comfortably. If I can do this, so can you. I am always reminded of the quote I first heard from Rev. Jesse Jackson: "If you try you may fail. If you don't try, you're guaranteed to fail." But the greatest marvel to me is being the grandfather of five kids. Just remember I love you all very much. I have enjoyed every minute of being your grandfather.