A Memoir

by

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Chapter 1

Immigrants from Eastern Europe

Note to the reader: My goal here is to provide a necessarily incomplete but decent account of our family history and my life.

On the night of the 12/13 September 1953 I was born at Chicago Lying-in Hospital (which was part of the University of Chicago) at 12:04 AM Central Daylight Time. At that time Cook County recorded births on Standard Time, so I was born officially on the 12th at 11:04 PM. My first birth certificate was incorrect, indicating September 13th. My parents obtained a revised birth certificate. Why would that ever matter? When I turned 18 I had to register for the military draft. I brought my two legal birth certificates to the local draft board. The man there said I could choose either day, but I could not change that after the lottery, which would take place the following February. I chose September 12th, which came out 43rd in the lottery. September 13th, which I could have had legally, came out 229th. Happily, the fact that I was going to college, and the draft was winding down, kept me from having to fight in Vietnam. By February of 1968, when I was $14\frac{1}{2}$, it was already clear to many that Vietnam was a quagmire. Distinguished CBS newsman Walter Cronkite went to Vietnam and produced an hour long documentary. After President Lyndon Johnson watched the show he said, "If we've lost Cronkite, we've lost Middle America." I was part of Middle America.

All of my grandparents grew up in Lithuania, though one of them (my maternal grandmother, Anna Serbenta) was born in Coal City, Illinois, in 1896. She died in 1972. Her second husband, Juožas (Joseph) Rudys (1885-1954), was my grandfather. My father's parents were Nakodimas ("Mike") Krisciunas (1894-1976) and Anna Nakvos (190[3]-1993). It turns out that Nakodimas Krisciunas was not my grandmother's first choice for a husband. According to my aunt, my future grandmother had first fallen in love with a shoemaker. Her brother (John Nakvos, 1890-1957) said, "Penniless shoemaker? Not an option. You marry this Krisciunas fellow. He and his brother built a house." The attic was eventually made into a second floor apartment that could be rented out. My great uncle drove home the point to my future grandmother, "If you marry Mike Krisciunas, you will never go hungry." My

Figure 1. One set of my great grandparents (my father's father's parents), Antonina and Vincentas Krisciunas.

Figure 2. *Top*: Members of the Nakvos family. From left to right, Violeta, Magdalena, John, and Anna. Anna was my paternal grandmother. John was her brother (my great-uncle). Magdalena was their mother (my great-grandmother), and Violeta was my grandmother's elder sister. This photo was made from multiple snapshots, ca. 1920. *Bottom*: My paternal grandparents, Nakodimas and Anna Krischunas. Taken on my parents' wedding day, June 2, 1951.

Figure 3. *Left:* My maternal grandfather, Joseph Rudys, in 1925 (age 40). *Right:* My maternal grandmother, Anna Rudys, and my mother, Ruth. This photo is from about 1942, when they were 46 and 12, respectively.

grandfather worked for 50 years rebuilding train cars on the South Side of Chicago. They never went hungry.

Information on my grandparents' siblings and their parents is somewhat approximate.[1] My father's father's parents were Vincent Krisciunas and Antonina Vasilauskas, who were born about 1850 and 1855, respectively. [I suspect that these two dates are too early by several years.] Fig. 1 was obtained from a large framed picture of them that used to hang above the player piano at my grandparents' house.[2] My father's mother's parents were Juožas and Magdalena Nakvos; the latter can be seen in the top picture of Fig. 2.

My paternal grandfather was the second youngest of five children. His eldest sibling, Jonas (John, 1881-1975), was a foot soldier in the Russian Imperial Army during the Russo-Japanese War of 1905. While stationed in Manchuria, one day he and a Japanese soldier came upon each other. According to my father (quoting his uncle), they both threw down their guns and ran in opposite directions.[3] He lived almost to his ninety-fourth birthday. My grandfather's younger brother Vytekas (b. ca. 1900) was lost at sea en route to the United States.[4]

When my grandfather and his siblings reached Ellis Island, the immigration people there said that Krisciunas was too hard to spell, so it was changed to Krischunas. They kept that spelling afterwards. But my father had it changed back to the traditional spelling, which is how it is on my grandfather's baptismal certificate.[2]

My mother's father Joseph Rudys was also drafted into the Russian Imperial Army at the time of the Russo-Japanese War. He never saw combat. He was a tailor. He made uniforms for nearly ten years, then came to the United States.

My mother's mother's parents were Jurgis (George) and Marijona (Marian) Serbenta. He died in his mid-50s during World War I of a stroke or heart attack. She was born in 1864 or 1865, and died in 1948 of old age. My grandmother was the third of eleven children, only four of whom reached adulthood.

My mother's father's parents were Frančiskus (Frank) Rudys and Marcella Moskalaitis. My maternal grandfather was the youngest of their four children.

I have an elder brother Keith (b. 1952) and a younger brother Ken (b. 1957). My mother, born Ruth Rudys in 1930, died in 2003. She was an only child. My father Alfonse (aka "Kriss") was born in 1926 and is 96 at the time of the last update of this document. He has one sister, Helen ("Kris," b. 1942); she and her first husband Jim Urbonas had two children, James (b. 1965) and Lisa (b. 1967).

The next generation of the family includes Krystal (b. 1984), the daughter of my brother Ken and his wife Laura Furio (b. 1958); Zak (b. 1989), the son of my brother Keith and his second wife Dorothy Dryden (b. 1951); Darren (b. 1993) and Brian (b. 1999), the children of cousin Lisa and her first husband Dan Rutledge (b. 1966); Molly (b. 2006) and Christian (b. 2009), the children of cousin James and his Jennifer Steinberg (b. 1977); and my son Matthew (b. 2009), whose mother, Sandra Rodriguez (b. 1974), was my second wife. She was born and grew up in La Serena, Chile. As a result, Matthew has Chilean and U. S. passports.

According to DNA analysis by ancestry.com, I am 92 percent "Baltic," 7 percent "other Eastern European, including Russian," and 1 percent European Jew. Another genealogy company indicates that my aunt is 3 percent European Jew, and that my cousin James is 2 percent Jewish. These numbers have some statistical uncertainty, perhaps as much as ± 1 percent. My father discounts the notion that we are part Jewish. To me it just means that somewhere about seven generations back a Jewish man made a baby with a Catholic woman whose descendants are a more direct part of my family tree.

Two significant people who were not blood relatives of mine were Ciro Abbate (1931-200[5]), my mother's second husband from 1963 to 1978, and Helen Kausic (1933-2019), my father's second wife, from 1967 until the time of her death. From fourth grade until after I graduated college my step-siblings (Ci's children) were Anita (1956-2016) and Vince (b. 1961). Ci's first wife, Antonette, died at age 31 of congestive heart failure.

NOTES

[1] On my father's side I rely on a four page printout prepared by my second cousin Pam Rietsch, with some corrections by my father and me. On my mother's side I rely on a four page document filled out by my mother and dated August 11, 1984.

[2] My paternal grandfather's baptismal certificate gives his name as Nakodimas Juozas Krisčiunas, and his birthdate as September 27, 1894. His parents' given names were Vincentas Krisčiunas and Antonina Vasilauskaite, which is the form of the surname Vasilauskas, but for women.

[3] Phone conversation of A. Krisciunas and Kevin Krisciunas, March 29, 2021.

[4] Email from A. Krisciunas to Kevin Krisciunas, March 15, 2021.

Chapter 2

My Father, the Met Lab, and Argonne National Lab

In addition to my having been born at the University of Chicago, both of my parents had significant connections to this institution. My mother earned her undergraduate degree from the University of Chicago in the spring of 1950, after which she went on the Grand Tour of Europe. My father worked at the Metallurgical Laboratory (1943-4) on the University of Chicago campus and at Argonne National Laboratory (1948 to 1996). It is an atomic energy research lab operated by the University of Chicago. Prior to the Argonne site, the lab was at Red Gate Woods near Palos Hills, Illinois, and prior to that it was on campus at the University of Chicago. The world's first self-sustained nuclear reactor became operational under the west viewing stands at Stagg Field on December 2, 1942. This was known as Chicago Pile-1.[1] See the book *The Pope of Physics* by Segrè and Hoerlin (2016). The success of Pile-1 proved that nuclear fission could be instigated and controlled. To make a long story short, it led to the design and testing of atomic weapons in New Mexico, and their deployment in Japan in 1945. An excellent book on the subject is *The Making of the Atomic Bomb* by Richard Rhodes (1986).

The following are excerpts from a talk presented by my father, Al Krisciunas, at an annual conference of the American Chemical Society on August 23, 1993. This was a session attended by students, teachers, and professional researchers. Some minor editing changes have been made to the original prose.

Young'ns at the Metallurgical Laboratory

The Metallurgical Laboratory was part of the Manhattan District Project, a World War II effort of gigantic proportions beginning in the early 1940's. To put the story in perspective, we need to describe the establishment of a most remarkable high school in Chicago in the same time frame.

Progressive educational planning by the Chicago Board of Education gave to Chicago [one of the] most advanced vocational trade education program in the country. At a huge piece of property bounded on the south by 71st Street, Jeffery Avenue on the west and a diagonal street, Anthony Avenue on the east, the Chicago Vocational School opened in September, 1941.

Applicants who had completed one year of standard high school could apply − only 670 students were accepted in that first semester. In addition, Carnegie-Illinois Steel Company apprentices attended one day each week. In January 1942, some 720 second semester students were enrolled. At that time the school was not coeducational. Some dominating sports teams were launched to the dismay of other schools in the area.

The teachers were magnificent. The courses of study were tough. The school day was ten *hours per day, five days a week!* Five hours each day were devoted to academic subjects and five hours each day to shop activities. Extracurricular activities were programmed after school or on weekends.

The curricula offered specializations in architectural drafting, automotive mechanics, aviation mechanics, electricity, machine drafting, machine shop, printing, sheet metal and wood pattern making. Academic subjects included three years of English, three of mathematics, the sciences of biology, chemistry and physics, civics, history, geography, music, and many others.

Plans for the expansion of the apprentice program and the vocational school were interrupted by the entrance of our nation in World War II, at which time the Board of Education made the building complex available to the United States Navy to become the training school known as the Naval Air Technical Training Center (NATTC). Thus, the U. S. Navy was provided with an ideal school complex and site at a critical time in our nation's war preparation. The unusual and extensive facilities were so adaptable to the NATTC training program that valuable time was saved in its organization and development.

Following one full schol year at its home facilities, the Chicago Vocational School was transferred to a different location for the duration of the war. Despite the necessary change in location, the original school curriculum was strictly adhered to and developed. Unusual achievements in trade skills, scholarships, and school activities were made by the students. Studies were very hard. Of the 1390 boys enrolled in the first sophomore class, only 193 (13.9 percent) made it to graduation three years later in 1944.

Of course, some students were drafted or joined the armed services before they were able to graduate. Many earned their diplomas either in service or after they returned. In addition, many of the graduating class took an active part in war production industries as part-time workers, which makes the connection with "Young'ns at the Met Lab."

The Met Lab was primarily located on the campus of the University of Chicago. Scientists, technicians and crafts persons commingled in the super secret facilities scattered about many of the university's buildings. Ryerson Hall and a facility known as Site B contained many machining operations. The nation's manpower needs were causing a great deal of consternation and losses of Met Lab skilled craftsmen to the services.

By 1943 the Lab's Superintendant of Shops had heard of the intensive training that was being imparted to students at Chicago Vocational School (CVS). A bright idea formed in his mind. If only he could hire some of the senior machine shop majors, his manpower problems could soon be mitigated to some extent. This indeed was an enticing idea.

To digress a bit: One of the machine shop teachers at CVS had designed a bench milling machine in the 1930s. He had the major structural components cast and on hand before such materials became unavailable due to the war effort. Also, he had a great deal of foresight to stockpile raw steel for making the machined components that would be necessary to assemble working machines.

The machine shop students were given machining assignments to fabricate the components. Students learned all the machining skills that apprentices had to acquire, including capabilities to hob gears, case harden steel, and do precision grinding of shafts, produce precision sleeve bearings, etc. By the time these students reached senior status, their skills were quite comparable to some machinists and instrument workers with many years of on the job experience. Thus, the interest of having selected for employment in this super secret project.

The Manhattan District Project nationwide and the Met Lab locally were under the jurisdiction of the U. S. Army Corps of Engineers. The Met Lab's Shop Superintendant had to inquire with the U. S. Army's security folks for permission to approach the Chicago Department of Education's Superintendant of Vocational Training regarding this idea. In time permission was granted and a program was inaugurated that is probably the first co-op program in any U. S. government facility.

By the fall of 1943 twelve seniors were hired. Students were given an option of working a five-hour shift, either morning, afternoon, or night. However, the students were required to attend the usual five hours of academic classes either in the morning or afternoon – and keep up their grades. Students were paid for their Met Lab work and received credit toward graduation for the Met Lab work. The war effort profited. The students benefited by earning money and experiences enjoyed by only a select few.

The program was working out so well that some 24 additional machine shop majors were hired by January 1944. The Met Lab also hired the school's student president and valedictorian as well as several machine drafting majors. These drafting majors were employed in the drafting and design sections. Ultimately, many of the the students were also drafted into service. Those who did not see service during the war stayed with the projct. Seven went to college. I was one of the latter group.

On January 14, 2017, I received a copy of the following document, in which my father continues his narrative about the Met Lab.

An Addendum: Commentary on the Early Days at the Met Lab to Retirement

In early January, 1944, Al Krisciunas was assigned to a one person special shop to machine a variety of items for metallurgists who also shared some of the laboratories in the Site B complex. Machining a variety of metals, especially the noble metals [those that show strong resistance to chemical attack even at high temperature], proved to be a challenging and interesting assignment. By spring it was determined that he would not be able to serve in the military due to a perforated ear drum. [This was as a result of contracting scarlet fever as a child.] Not wanting to remain a machinist, an opportunity came along to work with Drs. Irwin Rehn and Michael Cefola, heavy metals researchers, in the building's third floor penthouse. Those were the summer's glory days.

Still considering a career in medicine, specifically being a surgeon, it was off to the University of Illinois in Urbana-Champaign in the fall of 1944, and enrollment in that university's accelerated pre-med program. During WW II there was a shortage of doctors. This program allowed students to take full academic loads year round and in two years to be eligible to enter medical school without having acquired a baccalaureate degree. Medical school costs have always been enormously expensive. Though his parents had the funds, his short-sighted father would not put up the money for medical school, saying he was saving his money for retirement.

After 18 months of intensive studies Al took off some time from school and returned to the Met Lab for a few months. Working in the new chemistry building at 56th Street and Ingleside Avenue, chemistry as a career seemed like a good alternative since med school was not in the cards. Chemistry had always been a favorite subject as far back as his sophomore year in high school.

> Leaving the Lab to go back to school, ... later, ... returning to the Lab to work in the Chemistry Division on each return, ... became the norm.
>
> During eleven years in the Chemistry Division he did [very] little chemistry work as such, but was involved in instrumentation development for basic chemistry research. For example, the team developed a recording polarograph, a recording titrometer, and many years were spent developing a recording spectrophotometer only to have commercial models come on the market before all the kinks in the Lab's project were ironed out.
>
> Eventually working full time, being married and beginning a family, taking courses at night was the only practical alternative. Always liking mathematics, another educational detour was in the making. The reasoning: Math courses took less time than chemistry courses with their time consuming lab sessions.
>
> Enrolled at the Illinois Institute of Technology for some time, the school finally granted him a degree [in 1974] that encompassed four majors: chemistry, economics, mathematics, and zoology, with a minor in Russian. Later, for other reasons, he took some short-term graduate [courses] at the University of California at Berkeley on "Energy Systems and Fuel Cycles," and also at the University of Kentucky at Lexington on "Energy and Environmental Effects."
>
> In 1956, leaving the Chemistry Division for the Laboratory Director's Office provided new challenges and opportunities. During some 25 years in the Office of Public Affairs as Director of Tours, Visitors, and Coordinator of the Argonne Speakers' Bureau and Special Events, technical public relations was a reasonable description of what he did.
>
> Later, as Director of Community Affairs, additional responsibilities were assigned. Fielding most of the technical and non-technical requests from students, teachers and the general public, and being designated Curator of Historical Memorabilia and the unofficial Laboratory Historian, what else could this be called but "technical public relations?"
>
> Another aspect of his work at Argonne involved public speaking opportunities: some 500 to 600 talks and seminars about Argonne's research and development activities and several hundred talks and lectures about various energy and environmental topics were given. In the 1980s he was a traveling speaker for the American Chemical Society, also the American Society of Physics Students and the American Society of Metals (later called the ASM International).
>
> The last ten years of Argonne employment were less locally visible, but one that was more global. As Technical Administrator − Project Applications, in the Special Projects Office, the title could mean almost anything. Tasked to the U. S. Department of Energy in Washington, D. C., about 25 to 50 percent of his time was spent on special assignments such as the New Production Reactor Program both at the Savannah River location in South Carolina and in Washington, D. C. Later he did technology transfer outreach work in the DOE's Defense Programs.
>
> The last eight years before retirement he was tasked to DOE's International Affairs for Science and Technology Initiative programs for Eastern European countries and certain South American countries. These international activities created opportunities to travel to Argentina, Brazil, Chile, Estonia, Latvia, Lithuania, the Czech and Slovak Republics, Croatia, Slovenia, and Macedonia.

In my view one key thing is missing from this narrative. The term "special projects" is quite a euphemism. At the Savannah River lab what my father was helping to facilitate was the construction of another breeder reactor, which is designed to produce plutonium. And there are two principal uses of plutonium: 1) nuclear power for interplanetary satellites; and 2) fissionable material for nuclear weapons. Ever since the 1950s my father asserted that the purpose for Argonne Lab was − "peaceful uses of nuclear energy." I asked my father in the late 1980s, "If you've dedicated your whole career to peaceful uses of nuclear energy, how can you cap your career with a project to make more material for more nuclear bombs?" His reaction was, basically, "That's for others higher up to decide." This was part of the mindset during the Cold War. Somehow we were officially safer with enough weaponry to kill everyone in the Soviet Union hundreds of times over compared to just 10 times. It is estimated that 128,000 nuclear warheads were built between 1945 and 2010, all but two percent by the United States and the Soviet Union/Russia (Norris & Kristensen 2010, on p. 78). The number of nuclear weapons peaked at 69,368 in 1986 and is now under 20,000. Happily, the Cold War ended in 1991 after the demise of the Soviet Union, but I would contend that the weapons themselves are still a significant threat to the planet.

Since we are making reference to the Cold War, this would be the place to mention that, according to my father, in 1951 and again in the 1980s the CIA tried to recruit him to work with them, primarily because of his working knowledge of Lithuanian.[2] He told them No, twice, or at least that is what he told me. But what if he said Yes? Then the right title for a book about my father would be *Al Krisciunas: International Man of Mystery.*

Since my father worked at Argonne Lab for 48 years, just about everybody knew him there. As he mentions above, he gave a *lot* of talks. Many of them involved an Energy-Environment Simulator designed at Oak Ridge National Laboratory. The purpose was to get us to think about our energy resources: oil and gas, nuclear, hydroelectric. A reporter for a Chicago newspaper described one experience he had playing with the simulator (Pick 1980):

> Recently I played the game in a conference room at Argonne, which sits on old farmland southwest of Chicago. Though Krisciunas served as my coach, I hardly turned in a stellar performance.
>
> My method – a scattershot one – was to rely heavily on natural gas and hydroelectricity, reduce household and transportation demands and siphon lots of money into research for new types of energy. Trouble soon developed, however, and despite a last-ditch shift to chemical energy, I led the United States to energy ruin in a mere 116 years.
>
> My management techniques assumed worse proportions when Krisciunas reported afterwards that I had been relying not on America's energy reserves, but on the *world's.*
>
> "You always lose with this game," Krisciunas consoled me. "Understand that the world's resources are finite. Sooner or later, everybody loses. Who said this was a happy game?"

The energy simulator was in a way an analog computer designed to give easy-to-understand results. Most every computer program includes design constraints and relies on certain assumptions. My father asserted, after many runs with the simulator, that the only way to provide for our energy needs until the end of the 21st century was to build more nuclear power plants. Ah, but where do we store the waste nuclear material? How do we avoid nuclear disasters like Three Mile Island, Chernobyl, and Fukushima? Just as we will eventually run out of fossil fuels, we will also run out of uranium from the Earth's crust. In 1980 we had not yet pioneered hydraulic fracturing, which has liberated vast quantities of natural gas. Only recently have solar and wind power technology become more significant; the 1980-vintage energy simulator did not include them as viable options.

Here is my father's own summary of his career accomplishments:[3]

In the scheme of world events, my personal legacy to the future will be infinitesimally small compared to the minions that have preceded me and the minions that will follow. Realistically, my contributions in the making of music for 25 years, 40 or more years of technical public relations, popularizing many technical subjects to the tens of thousands of persons attending the more than a thousand lectures, seminars, demonstractions, etc., won't elicit a footnote in the history book ledgers of accomplishments. I take a practical attitude without rancor. "Dem's the fact[s], boy." And there's nothing I can do about it. However, I can take pride in knowing that whatever I've tried to do, I've given it my best shot. If I was convinced that the result was the best it could have been under the circumstances, then I can sleep peacefully. Nevertheless, I'm not so egotistical as to believe that improvements couldn't have been made. So, if I ever get (or have gotten) a chance to do something again, it's always been with the idea to improve the result.

NOTES

[1] See https://en.wikipedia.org/wiki/Chicago_Pile-1.

[2] Note dated February 21, 2004, in my 2003-2008 notebook. Confirmed in a phone conversation on March 29, 2021.

[3] Typewritten letter of A. Krisciunas to Kevin Krisciunas, September 7, 1989.

Chapter 3

Formative Years

When I was three days old my maternal grandmother came to visit my mother and me in the hospital. My grandmother entered the room, looked at my mother and said, “Well???” My mother held me up and said, “Say hello to your new grandson.” My grandmother looked at me, shook her head and said, “Ahem. Another boy who will grow up to be another man. And make another woman miserable.” But she was wrong. I’ve made dozens of women miserable.[1]

Now you may be wondering why my grandmother was so down on men. By the time I was born she had been married and divorced three times. Her first husband, whom she told me about only once, was named August Gričius. They were married in May of 1915 and divorced in 1922. Her uncle twisted her arm to marry this guy. The uncle said, “Anna, you are not a pretty girl. This might be your only chance.” Her comment to me on this was, “Hah. I showed him. I got married three times.”

But this guy Gričius was abusive. Once he knocked my grandmother down the stairs. It turns out she was pregnant at the time and she miscarried. His comment was, “What kind of woman are you? You can’t even give birth to a baby.”

My grandmother was married to her second husband (my grandfather), Joseph Rudys, from 1924 to 1940. She was married to her third husband, Walter Rage (originally Vladas Radžiukynas) from 1944 to 1952; he died in 1968 at the age of 72.

Multiple things contributed to my grandmother’s bitterness. When she and her family had returned to Lithuania from Coal City, Illinois, in 1901 or 1902 my grandmother went to school one day. Her father asked her where she had been. “I went to school with my brother.” Her father said, “No more of that. School is for boys. You stay home and take care of the younger children.” Later in life she vowed that if she had any children or grandchildren of her own, if it was in her power, she would give them the option of going to school as long as they wished.[2]

One of my mother’s first memories (ca. 1932, age 2) was getting dressed up in a little white dress. Her mother was going to asphyxiate the two of them with the kitchen stove.

Due to the trials and tribulations of life my grandmother wanted to end hers, but did not want to leave my mother behind to suffer.[3]

One time long after my grandmother died I had a dream that I could briefly talk to her. Not long afterwards I asked my mother over the phone, "If you could talk to your mother for just one minute, what would you say?" The response was, "I would tell her – You didn't have to love me with a closed fist." I asked what that meant. My mother said, "On a regular basis growing up my mother would haul off and sock me in the side of the head. Finally, one day when I was 16 she was just about to clobber me. I blocked her arm and said – Stop! Never do this again! – and that was the last time she tried."

A more pleasant story relates to the early 1930s and my grandmother's side job as a bootlegger. It was the depths of the Depression, and nearly the end of the Prohibition Era. My grandmother used to take my mother to the store in a wagon, to buy large quantities of sugar and other ingredients for making bathtub gin. The storekeeper knew what my grandmother was up to. My grandmother would put the supplies in the wagon, put a blanket over the supplies, sit my mother on top and pull the wagon home. Near their house was a speakeasy, and at least once they asked my grandmother if they could move all sorts of equipment into her basement, but only for a short time. Federal agents found nothing significant at the supposed speakeasy, and asked the neighbors what they knew. They came to my grandmother's house. With my mother in her arms, my grandmother said, "Oh, no, Sir, I don't know anything about that. I'm too busy taking care of my little girl." My mother told me that she had the strongest urge to say something about all the equipment in the basement, but suspected that if she spoke up, her mother would beat the living daylights out of her later. During the Depression they needed the extra income from liquor sales to make ends meet.

Decide for yourself if my family is typical. In my grandparents' generation two members were soldiers in the Russian Imperial Army in 1905. My great uncle Vytekas was lost at sea on the way to the United States a hundred years ago. My maternal grandmother's younger sister Adele married a fellow named Vincas Labanauskas, who was shot during WW II, but they never said by whom. My maternal grandmother to some degree had a death wish. She told me that when she made a trip back to Lithuania in 1927 it would have been better if the boat had sunk. Eventually, in 1972 she died by suicide in a mental hospital in North Aurora, Illinois. But my overall feeling about her is positive because of the significant financial help and encouragement she gave me during my college years.

To understand my mother's early life, know that she was born in 1930, two years after Shirley Temple. Many a mother in the United States hoped that her daughter would be another Shirley Temple. Think of all the money! My mother studied dance with a teacher named Gladys Benedict. My mother's father was a tailor, and he made many elaborate costumes for her (see Fig. 1). In one brochure for the dance studio my mother is described as a "Child Wonder." The most significant thing about this mentorship is that Miss Benedict was kind, and loving, and encouraging. This was sunshine and water for a growing girl. However, dance came to abrupt end for my mother when my grandmother discovered that to make it in show business, many a girl had to spent time on the casting couch.

Figure 1. My mother, age 6, posing in one of the dance costumes made by her father, who was a tailor.

My mother played cello in her high school orchestra. She also learned to play the piano. She finished fifth in her high school class of about 250 and went to the University of Chicago on a full scholarship, graduating in three years in 1950.

She and my father got married on my mother's twenty-first birthday, June 2, 1951. My parents, elder brother, and I moved to the village of Indian Head Park in 1956. My younger brother came along the following year. My earliest memory dates back to the spring of 1956 when some workers laid out the front lawn using many rolls of sod. One day we had dirt, the next day green grass!

In Indian Head Park our next door neighbors on one side were John and Evelyn Kilker. He was obviously older than she was. They had no children. One day when I was five I was out in the backyard, and a man came to visit Mrs. Kilker. Did he arrive on foot? In a car or truck? On a motorcycle? No, he showed up in a small plane! There he was, a hundred feet above the Kilkers' house in suburban Chicago, steeply banking left and carrying on a conversation out the side window. I came in and said, "Mommy, who is Mrs. Kilker's friend in the airplane?" My mother said, in a somewhat stern tone of voice, "Never mind." Many years later, when Evelyn Kilker was a very old woman, my step-mother ran into her in a store. Mrs. Kilker knew that Helen was my father's second wife. In that brief conversation Mrs. Kilker said, "Of course I remember the Krisciunas boys. They were so *wild*." Admittedly, we did some things we shouldn't have, but it sure seems like Mrs. Kilker needed some supervision too.

Figure 2. My parents, Alfonse Krisciunas and Ruth Rudys, on their wedding day, June 2, 1951.

The most prominent piece of furniture in our house was a Steinway mid-size piano (bigger than a baby grand, but smaller than a concert grand). While my mother had musical experience in high school, my father was the main musician in the family. He was somewhat of a piano prodigy, and at the age of 15 he became the choral director for the Catholic church his family attended. This came to pass one Sunday when the priest called my father on the phone to say that the regular choral director had shown up drunk, and could my father take over?

My first great ambition in life was not to be an astronomer, but to be a musician. At age 6 I started taking piano lessons at school with a man named Stefan [Stéphane?] Kaufmann. For some reason we did not talk about the basics: posture, hand position, counting the beats. When I would practice at home, I used to hear my father's voice from the other room, "You're playing it wrong." Finally, one day I asked him to show me how a particular piece went. When I got to my weekly music lesson, Mr. Kaufmann said, "You've had some help with this. Who helped you?" "My father." "Well, then, this week I'll give your father an A. But I'll give you an F." After that school year was over I needed a new piano teacher. Mr. Kaufmann's mother had died at the age of 75. He just could not endure life without her, and committed suicide. My second music teacher was an elderly woman I was required to address as Madame de Horvath. She lived in a large house reminiscent of the Addams Family, with many birds in cages. Since she never went outside her skin was very pale, sort of a pale green. Today we would call that "Silicon Valley tan."

I took third grade off from piano lessons but did one more year, in fourth. By then I was more interested in being outside to ride bikes, play baseball, and build tree forts. My senior year I played piano on my own and practiced quite a bit. I memorized the first movement of the Moonlight Sonata and a simplified version of Liszt's Hungarian Rhapsody Number 2. Strangely, in college, when I tried to take piano, I was told, "You know too much to benefit from a group class, but you don't know enough to take private lessons."

When I was $7\frac{1}{2}$ my parents split up. My brothers, mother, and I moved four towns to the west along the Burlington Railroad. Two years later my mother married my step-father Ci, and we (now a family of seven) moved even further west along the Burlington Railroad to Naperville. At that time the population was 15,000, but nowadays (2022) it is the third most populous city in Illinois, with nearly 150,000 people.

My mother was the boss of our family. She knew starting at age nine that her mother was not like other people's mothers. So she read various books on psychology, trying to figure out what constituted "normal behavior." My mother did not want us to be afraid of her. She was wise enough to realize that she needed five sets of rules to raise the five kids. What would work for one would not necessarily work for another. Our house had no Procrustean beds. Rule number one for the kids was: "You don't have to be *the* best. But you have to do *your* best." Another rule was, "If it's safe, and not illegal or immoral, then it's OK." The goal was to encourage us to be occupied, as opposed to bickering. As to illegal activities, my step-father's stated point of view was that stealing $100 was not worth it, but if you could get away with half a million, that was worth the risk.

Naperville is where I went to junior and senior high school. I got an excellent education. In high school I had biology, two years of chemistry, one of physics, four years of German, one of Russian, and four years of math, including calculus senior year. My high school chemistry teacher, Ed Schap, was an important mentor to me. I learned a lot from him and he encouraged me long after I graduated high school. He and I kept in touch with each other until his death in 1993 at the age of 90. Curiously, when I was in junior high and high school he worked for my father part-time at Argonne Lab, giving tours on the weekends.

My high school courses prepared me very well for the University of Illinois in Urbana-Champaign, which I chose over the University of Chicago. (You should know that nowadays some students at the University of Chicago wear T-shirts with the message: "University of Chicago, where fun comes to die!") The U of I had a 120-ft steerable radio telescope and a 40-inch diameter optical reflecting telescope out in the country. I could get experience with those as an undergraduate. University of Chicago people said that if I wanted to become an astronomer I should just study physics courses as an undergraduate and wait until I was a graduate student to get my hands on large telescopes. Waiting did not appeal to me.

I spent three years in Urbana-Champaign and earned a Bachelor of Science degree in astronomy, with a minor in physics. My course work included third semester calculus, advanced calculus, differential equations, statistics, introductory modern physics, thermodynamics, two semesters each of electricity and magnetism, mechanics, and quantum mechanics, a radio astronomy independent study project, two semesters of galactic astronomy, and a course called Practical Astronomy, in which I learned how to use a sextant and also learned spherical trigonometry. I also took a programming course in FORTRAN.

In retrospect maybe I should have taken the standard four years. It might have been more fun. If I had taken the upper division physics course in optics I would have earned a double major in astronomy and engineering physics. I would have been better prepared for the Graduate Record Exam in physics. But I was, as the saying goes, "a young man in a hurry."

Thanks to a suggestion by one of my college professors, Jim Kaler, I applied to the University of California in Santa Cruz for graduate school. In 1965 UCSC became the headquarters of Lick Observatory, the first mountaintop observatory in history (1888), which is situated on the 4200-ft ridge of Mt. Hamilton, above the Santa Clara Valley. I had also applied to Indiana and Wisconsin. Here I made a mistake. To give myself the widest choice of where to go I should have applied to Santa Cruz, University of Arizona, University of Hawaii, University of California (Berkeley), and other places with access to large telescopes. Still, I got accepted by Santa Cruz. This changed my life. On Wednesday, September 18, 1974, I flew from Chicago to San Jose and drove over Highway 17 to Santa Cruz, pulling over along the way to experience the aroma of the redwood trees. I had spent essentially my whole life in the Midwest. I was *very* impressed with Northern California.

Academically and financially, Santa Cruz did not work out. I was slated to have a research assistantship with one professor, but his grant did not come through. I could not figure out how to get a teaching or research position. More than once a faculty member said to me, "You don't have any financial aid? Let me look at my funds and see what I can do." But nothing happened. I should have gone to Dave Rank and said,"I understand you are building infrared detectors for astronomy. That's going to be a significant thing in the future. I want to be part of it."

I was only in Santa Cruz for a year. There were some positives. In the fall I played on an intercollegiate soccer team. We had two teams actually. I played center halfback on the junior varsity team. Thanks to a suggestion by Prof. Sandra Faber, I wrote and published my first paper in 1975.[4] I found it tremendously exciting to make a *bona fide* contribution to science. If you keep doing that you can map out of a career for yourself. Well, maybe. But in science refereed papers are the coin of the realm.

One thing I did not realize as a freshman in college was that I had about one month to establish my social circle. As I lived in the first co-ed dorm at the University of Illinois, I did make a lot of friends, but once we all moved into apartments and were buckling down on academics, we did not see each other often. When I was in my last year of college, one day I met this young woman I thought was attractive, and was trying to make it clear that I was interested in her. But she said, "You look like you'd be an interesting person to have as a friend. But I already have enough friends." I inhaled and was about to say one thing, but then paused and, with a wave of my hand, said "Have a nice life."

When I moved to Santa Cruz I wanted to expend a lot more energy on social connections. There I met three of my best friends, David Hanlon (who was best man at my first wedding), Sheree Nash and Nick Suntzeff. Sheree grew up in Monterey County, California. She still lives there and is the head of the Sex Assault Response Unit for the county. I believe that three of her four children were conceived when I was staying at her house (when she was married to her first husband). It seems that my presence raised the hormone levels of one or both people. She and I have long wondered what life would have been like if we had been a couple instead. She is now married to her second husband. I have been married and divorced twice. In the spring of 2019 Sheree and I hiked the Camino de Santiago de Compostela in northern Spain. She and her friend Chris did the whole French route (900 km) from Saint-Jean-Pied-de-Port. I joined them in Astorga. We hiked the last 268 km together.

Nick Suntzeff and I were in a class of seven that started graduate school in astronomy in 1974. Eventually, all seven of us earned PhD's. Six were in astronomy and one was in optics. Nick eventually became known as the world's most careful photometrist of supernovae. But in May and June of 1975, when he had his first two observing runs at the 24-inch photometric telescope of Lick Observatory, with me as his observing partner, he was a neophyte observer. Nick was my supervisor at Cerro Tololo Inter-American Observatory (2001-2003) and then the head of our astronomy group at Texas A&M University, starting in 2006.

The next academic year I spent at the University of Chicago, where I earned a Master of Arts degree from the Graduate Library School. I took courses in calculus-based statistics, multi-variate statistics, took a computer course, learned how to be a reference librarian and how to catalogue books. I figured that if I did not manage to get a job in technical science, maybe I would end up working for the Smithsonian or the National Air and Space Museum.

On the first Saturday of October, 1976, I was talking to my friend David Hanlon, whom I had met two years earlier in Santa Cruz. He asked me where I really wanted to live. I said, "Northern California." He said, "Well, then, why not move back?" I thought for a minute and said, "OK, see you in two weeks." I was following in the footsteps of my aunt and uncle, who moved from Illinois to Boulder, Colorado, in their early twenties to seek their destiny and to put some space between them and their parents.

I arrived in California on October 16th. David and I shared a studio apartment in Burlingame, near the San Francisco airport. He was a bank teller at a nearby branch of Wells Fargo Bank. But in three months he only balanced five times, so he got fired and then moved to the Canal Zone in Panama to work at an import-export company run by the family of his friend Samson Wu.

My biggest problem was that I did not know how to find a job. I applied at Hewlett-Packard and the Burlingame Public Library. I had one interview at Lockheed and another at Stanford Research Institute (as a Russian translator). Shortly before Christmas I was staying in Orinda with the parents of a friend from high school and I saw a want ad placed by a NASA contractor in the San Francisco Chronicle: "Wanted: person to fly on NASA research aircraft. Must know FORTRAN. Must be willing to work at night. A knowledge of astronomy would be helpful." Great horny toads! It seemed that my fairy godmother was really on the ball. I applied for that job. What they were looking for was a dyed-in-the-wool programmer, but the wife of the first guy they offered the job to did not want her husband working at night. I was offered the job and on Friday the 7th of January I started working for NASA's Kuiper Airborne Observatory, which was based at NASA/Ames Research Center and Moffett Field at the south end of San Francisco Bay. My starting salary was $240 a week, or $12,500 a year. But gas was 57 cents a gallon and my rent was $165 a month. Life had *potential!* And it turned out that this was the start of 44 years of gainful employment in the field of my choice. For that I feel very grateful.

NOTES

[1] Just kidding. But my grandmother really did say what I quote here.

[2] In fact, with the money I inherited from my grandmother (about $16,000) I paid my university expenses for five years, did my own Grand Tour of Europe, and bought my first car, a used 1971 VW Bug, for $1066.

[3] I have no written account of this by my mother, but this story is recounted in a letter I wrote to my cousin Lisa, dated March 3, 1985, some 18 years before my mother died. I am sure my mother and I discussed this in person or on the phone.

[4] See Krisciunas (1975).

Chapter 4

My Career in Astronomy – Part I

One of the most significant astronomers of ancient times was Claudius Ptolemy, who lived in Alexandria, Egypt, in the second century AD. He wrote this epigram for himself: "I know that I am mortal and the creature of a day; but when I search out the massed wheeling circles of the stars, my feet no longer touch the Earth, but, side by side with Zeus himself, I take my fill of ambrosia, the food of the gods."[1] If ever there was someone who was destined to be an astronomer, it was Ptolemy. But to a large extent I also felt this way.

The Kuiper Airborne Observatory (KAO) was a four engine jet, a Lockheed C-141 military transport plane reconfigured to carry a 36-inch diameter telescope to altitudes as high as 45,000 feet. You may be saying to yourself, "You can't point an airborne telescope steadily at a star." It turns out that you can. The telescope was in its own enclosure, in the thin atmosphere, and it was attached to a 16-inch diameter air bearing that had 3000 pounds per square inch of air presure producing a near-frictionless surface, like an air hockey puck in one of those games in the lobby at the local cinema. The light of the primary telescope passed through a hole in the air bearing to the astronomical instrument, which resided in the pressurized, heated cabin. The main telescope had a guide scope attached to its side, and the image of a star in the tracker was rapidly digitized and used to move the tandem telescopes up, down, left and right. We could guide to an accuracy of 3 arc seconds (1/1200 of a degree). Most of the instruments flown onboard operated at infrared wavlengths. Due to the absorption of many infrared wavelengths by molecules in the Earth's atmosphere (primarily water vapor and carbon monoxide), you cannot detect that radiation at sea level or even on medium-high mountains. You have to get above as much of the atmosphere as possibile. We frequently flew higher than the tropopause, where there might be only 10 microns of precipitable water vapor.

A typical KAO flight lasted $7\frac{1}{2}$ hours. The beginning and ending half hours were used to get to altitude and to land back at Moffett Field. In between we flew various curved paths over the Earth, making sure we did not fly over any restricted zones (where we would have been chased out or shot down by military fighter jets). The telescope looked 92 degrees to the left of the airplane's azimuthal heading and could track between 35 and 75 degrees

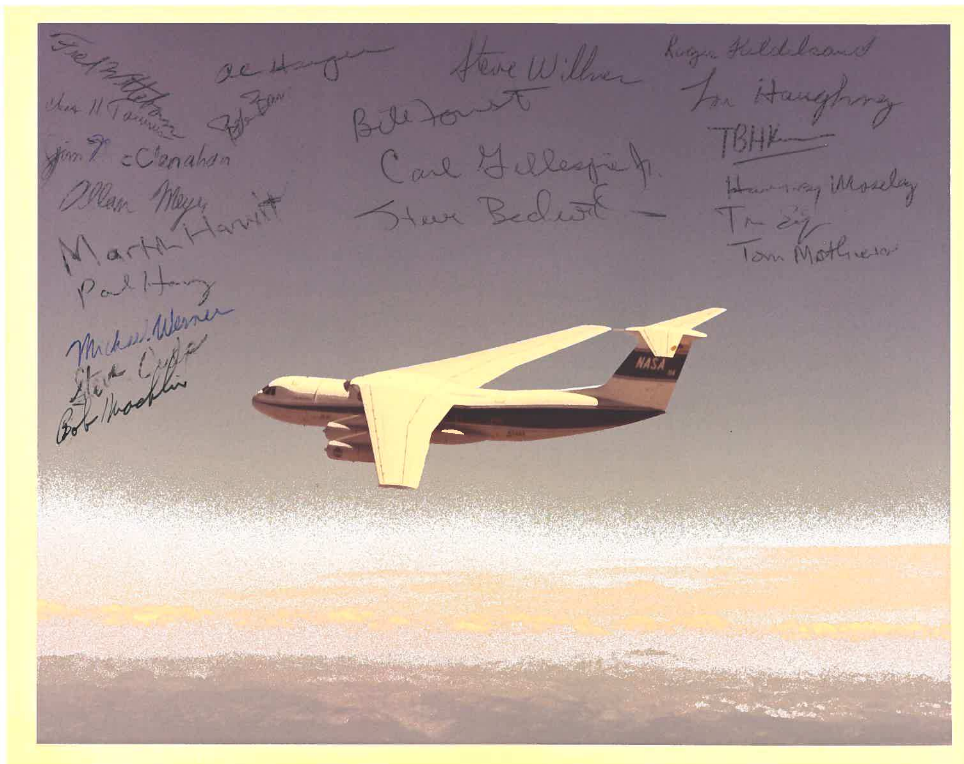

Figure 1. NASA's Kuiper Airborne Observatory, which operated from 1975 to 1995. The telescope was situated in its own compartment just in front of the wings. Part of the fusilage would retract for observing. For posterity's sake I passed this photo around during a KAO users meeting (ca. 1980). The photo was signed by people I worked with from 1977 to 1982 – astronomers, NASA employees, and fellow contractors. From left to right and top down: Fred Witteborn (NASA/Ames), Charles H. Townes (UC Berkeley), Jim McClenahan (NASA/Ames), Allan Meyer (Northrup), Martin Harwit (Cornell), Paul Harvey (Univ. Arizona), Mike Werner (Caltech), Steve Culp (Informatics), Bob Macklin (Northrup), Al Harper (Univ. Chicago), Bob Barrow (Northrup), Steve Willner (Harvard-Smithsonian Center for Astrophysics), Bill Forrest (Univ. Rochester), Carl Gillespie, Jr. (NASA/Ames), Steve Beckwith (Caltech), Roger Hildebrand (Univ. Chicago), Lou Haughney (NASA/Ames), T. B. H. [Tom] Kuiper (Jet Propulsion Lab), Harvey Moseley (NASA/Goddard Space Center), T [?], and Tom Mathieson (Informatics).

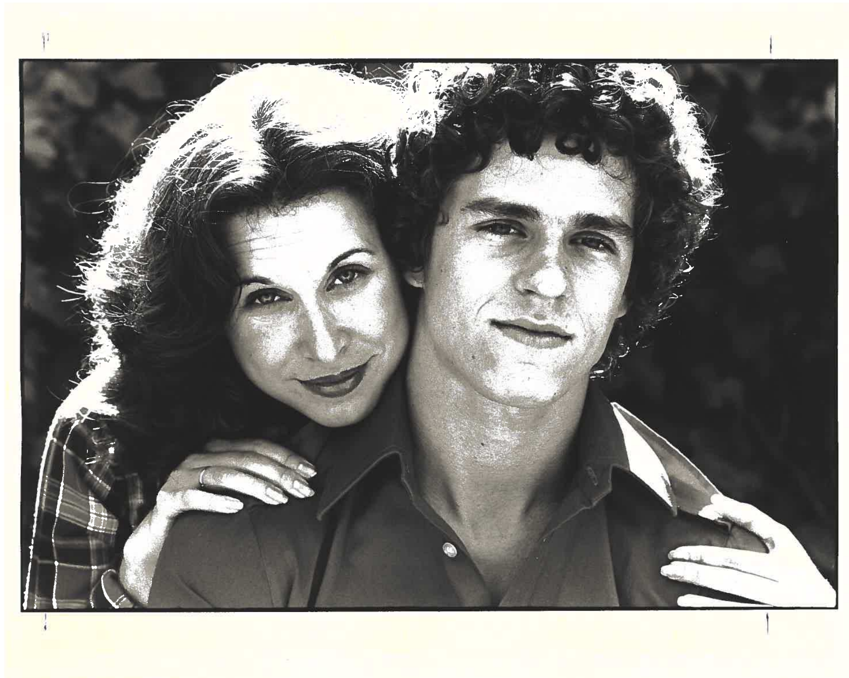

Figure 2. Kevin Krisciunas and Carmen Torres, autumn 1977. I was 24. She was 26.

above the horizon. The tracking system functioned as long as the air turbulence was "low" or "medium." To minimize occurences of loss of track the telescope needed to be centered in its observing window (about ± 2 degrees). We devised a system to have our Executive Computer calculate the desired heading of the plane every ten seconds and to slightly bank the plane left or right to keep the telescope centered in its window. As long as the pilots "trimmed the gyros" prior to takeoff, the system worked quite well. Avionics engineer Pat Atchison built the hardware interface between the Exec Computer and the flight controls. I was in charge of the computer program that made the decisions about if and when to send a left- or right-bank signal to the flight controls and was greatly aided in this endeavor by having learned spherical trigonometry in college from Jim Kaler.

This was a unique facility in the world, and it was expensive. Time was only granted to groups that proposed research that could *only* be done at altitudes higher than Mount Everest. In the years I worked on the plane (1977-1982) most experimenter groups built their own instruments. I met many accomplished scientists, such as Charles Townes from University of California, Berkeley, who shared the 1964 Nobel Prize in Physics; Martin Harwit, a Cornell Professor who went on to become Director of the National Air and Space Museum; Caltech Professor Eric Becklin, one of the founders of infrared astronomy; and Jim Elliott from Cornell. His group (which included Ted Dunham and Doug Mink) discovered the rings around the planet Uranus in March of 1977. The key observations were taken on a flight out of Perth, Australia. It was this discovery that made the KAO world famous in the world of astronomy.

Figure 3. My last flight on the Kuiper Airborne Observatory, 8/9 September 1990.

I flew 159 flights on the KAO during my years there, and also one final flight in September of 1990. Perhaps my greatest contribution to a flight series was to have written the data acquisition package and some preliminary analysis software for the solar eclipse expedition of July 31, 1981. We flew out of Yokota Air Base near Tokyo. The observations were made at 43,000 feet above the Kuril Islands. The results were published by Lindsey et al. (1986).

The KAO flew roughly 80 flights a year and was in operation from 1975 to 1995. It has now been replaced by the Stratospheric Observatory for Infrared Astronomy (SOFIA), which is a Boeing 747-SP aircraft carrying a 2.5-meter telescope.

During these California years I was married to Carmen Torres (b. 1951), whom I started dating in April of 1977.[2] I would say that the first year and a half we were together was the best romantic time of my life. However, things changed once she and I became greatly over committed in too many directions.[3] She quit working in order to go back to school to work on a Master's Degree at San Jose State University, so we suddenly had 60 percent of the income we had previously. In addition to my NASA job I started teaching astronomy classes one or two nights a week at West Valley College, a junior college in Saratoga.

One of the young astronomers I worked with on the KAO, Ian Gatley, earned his PhD from Caltech. He then took up a job with the United Kingdom Infrared Telescope (UKIRT) in Hawaii. It was then the world's seventh largest optical or infrared telescope. Now it is twenty-eighth largest. Sometime in 1980 Ian asked me if I might be interested in working there. It would be a similar job to my NASA job, writing software for astronomical data acquisition and analysis. Instead of flying at high altitude, I would work at the summit of Mauna Kea, the only place in Hawaii where they operate a snow plow. From its base on the ocean floor to its summit, 13,800 feet above sea level, Mauna Kea is the tallest mountain on Earth.[4]

I moved to Hawaii on Saturday, March 13, 1982, which is to say that I moved there by myself. The last time we discussed the issue, Carmen said, "You don't understand. I can never even *visit* the Big Island." I never understood that. But she had said that for her an acceptable place to live was somewhere between Monterey and San Francisco, and nowhere else. She found it unfathomable that a person would consider moving far away to get one step higher on the career ladder. I pointed out to her that I conceived the notion in junior high school that if I worked hard I might be able to get paid to do my hobby. That would be the ultimate job. She said, "All right, so some people actually do what they really want to do. Why should *you* be one of those people?" That reminded me of a statement made to me one day in college: "Why are you working so hard on coursework? There's no *guarantee* that it will get you anywhere." Well, sure, there's no guarantee. But if you do not try at all, that certainly guarantees you will not accomplish your goal. My point of view was: "No one else has to do the work. Just don't dismiss my efforts as hopeless or pointless."

Hawaii is known as the "Land of Aloha" but there is ongoing resentment against outsiders. The word *haole* means "foreigner" but in effect it means white person, and it is often used derogatorily. In 1893, with the encouragement of various Republican businessmen, the U. S. Navy overthrew the Hawaiian monarchy. The U. S. government wanted to control the Pacific, and that involved the acquisition of Pearl Harbor.

How did this play out in my case? Occasionally, someone I did not know would just come up to me and say, "You took a job away from me, *haole* boy." Or, "You overthrew my kingdom in 1893." (In 1893 my great-grandparents were in Lithuania, hoeing cabbage.) On the whole, though, most people had the *aloha spirit*.

When I interviewed for my job in Hawaii I asked, "Will I have a chance to be involved in research?" The response was, "If you didn't want to be involved in research, we wouldn't want to hire you." This meant that 10 percent of my official work time could be spent on my own research, and they would pay my expenses to attend a meeting, observe at Mauna Kea, or even observe at some faraway observatory.

The most extreme weather I ever experienced at Mauna Kea occurred during one shift in April of 1982. The temperature was 15 deg F, the wind was 75 mph, and we had white-out conditions. One reason why one parked the 4 WD vehicle close to the door was to be able to find it during a snowstorm. We left promptly to avoid the fate of three colleagues, Sidney Arakaki, Chris Impey, and Peredur Williams, who were snowed in at the summit for three days in 1979 until a snow plow could reach them. It was not a life and death situation, however. They had heat, water, electricity, and some things to eat, if you consider Spam to be real food. The worst feature was no showers and no beds.

From 1982 through 1990 I was involved in various observations and research papers concerning the Galactic Center. (See Geballe et al. 1984 and Gatley et al. 1986.) It

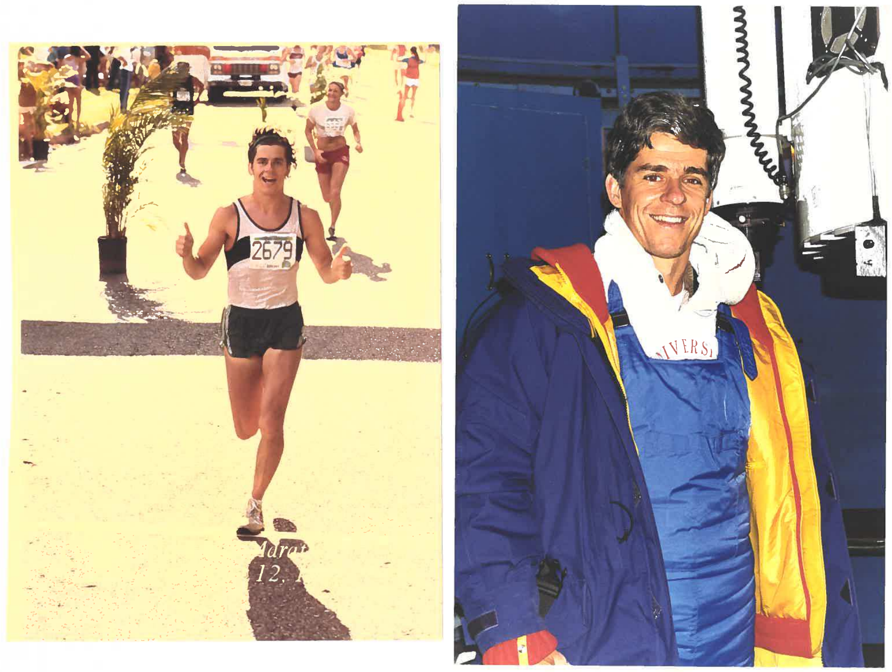

Figure 4. *Left*: One-quarter mile to go in the Honolulu marathon, Sunday, December 12, 1982. *Right*: All bundled up for another night observing in the dome of the University of Hawaii 24-inch telescope (date uncertain, but sometime between 1992 and 1995).

took 25 years to do it, but the efforts of hundreds of astronomers proved that there is a multi-million solar mass black hole in the center of our Galaxy. In 2020 this resulted in the award of the Nobel Prize in Physics to the American astronomer Andrea Ghez and the German astronomer Reinhard Genzel. The solid proof of the black hole nature of the object in the Galactic Center came from mapping out the orbits of bright stars close to a compact radio source in the constellation Sagittarius. Ghez and her colleagues used the W. M. Keck telescopes at Mauna Kea, while Genzel and his colleagues at European Southern Observatory used the Very Large Telescope at Cerro Paranal, Chile.

One of the things you learn as an observational astronomer living in an out of the way place is that you have to be involved in your own entertainment. People who visit astronomers in Hilo, or La Serena, Chile, or Coonabarabran, Australia, ask them, somewhat aghast, "What do you *do* here for fun?" A good answer is, "Here we have to make our own fun."

You might not think training for a marathon or running one would be fun, but I ran the Honolulu marathon six times, Maui once, and the Big Island marathon twice. My best time was 3 hours and 18 minutes, the first time I did Honolulu (December, 1982), at the age of 29. It was the last personal record I ran at any distance.

I also played a lot of golf. Most of my 18 hole scores were in the eighties, but I shot in the seventies over a hundred times. Twice I shot even par. Here is a golf story. Shortly after I turned 30 some friends asked me if I was depressed on my thirtieth birthday. I told them, “No. I got a sign from God.” It being my birthday, I took the morning off. Ian Gatley and I played a round of golf at the Hilo Municipal Golf Course. We were walking down the fifth hole and I said to him, “Why have so many bad things happened this year? I'm getting divorced. The people I'm sharing a house with are being passively aggressive and manipulative. Our boss is making things difficult. Did I ask for it? Or are other people going out of their way to make my life difficult?” Ian said, “It's none of those. It's just fate.” I said, “Fate? That doesn't mean anything.” Then I walked up to my ball and, judging the distance to the green, I pulled an 8 iron out of the bag. I mis-hit it badly on the bottom edge of the heel of the club, resulting in a very low, slicing shot that I pulled left. But the ball rolled the last 60 yards along the ground, reached the green, and rolled along the green into the hole for an eagle. This was immediately after saying, “Fate? That doesn't mean anything.” Ian and I looked at each other, then simultaneously straight up into the sky, then back at each other. What can I say? I would rather be lucky than good.

After giving many public talks about Comet Halley in 1985/86, some dressed up to look like Edmund Halley, I went to an audition at the University of Hawaii, Hilo, in the summer of 1986 and was cast in a production of *Jesus Christ Superstar*. Thus began my new hobby of community theatre and musical productions. The following June I played the Lord High Executioner in a production of Gilbert and Sullivan's *The Mikado*. Later I was in productions of *West Side Story*, *Camelot*, and (in Volcano) *The Music Man*. I sang in the UHH chorus for eight years and took private voice lessons with three different teachers. I sang in a concert of Handel's *Messiah* four times and three times sang a solo. More than once during these years the UHH chorus sang with the Honolulu Symphony when they performed in Hilo.

In 1991 there was a total solar eclipse. The path of totality passed over the Big Island. I was able to take some excellent photos of the eclipse at the summit of Mauna Kea using a 6-inch diameter telescope. Two weeks before the eclipse the thespians at UH Hilo put on a production of *Total Eclipse: a Musical Comedy*, written by my first voice teacher, Margaret Harshbarger, and myself.[5,6]

Have you ever wondered when you hit your peak? My most publicly visible year was probably 1991. In April I appeared in episode 1 of the PBS series *The Astronomers*, produced by KCET in Los Angeles. There was an article about the series in *TV Guide* and *Sky and Telescope* magazine; each had a picture of me, together with the narrator, actor Richard Chamberlain. We did the eclipse play. A sound bite from the musical was shown on the NBC National News. I took some good photos of the eclipse from Mauna Kea, and I wrote an article for the December, 1991, issue of *Sky and Telescope* called, “Eclipse science from Hawaii.”

In high school my elder brother Keith was famous his senior year (1969/70) because he owned a 1968 Dodge Charger. It had a 442 cubic inch engine and needed high octane gas. I only drove it twice and I could swear you could watch the gas gauge move as you drove down the road.. I once asked him how fast he ever drove it. He said, “I don't rightly know.

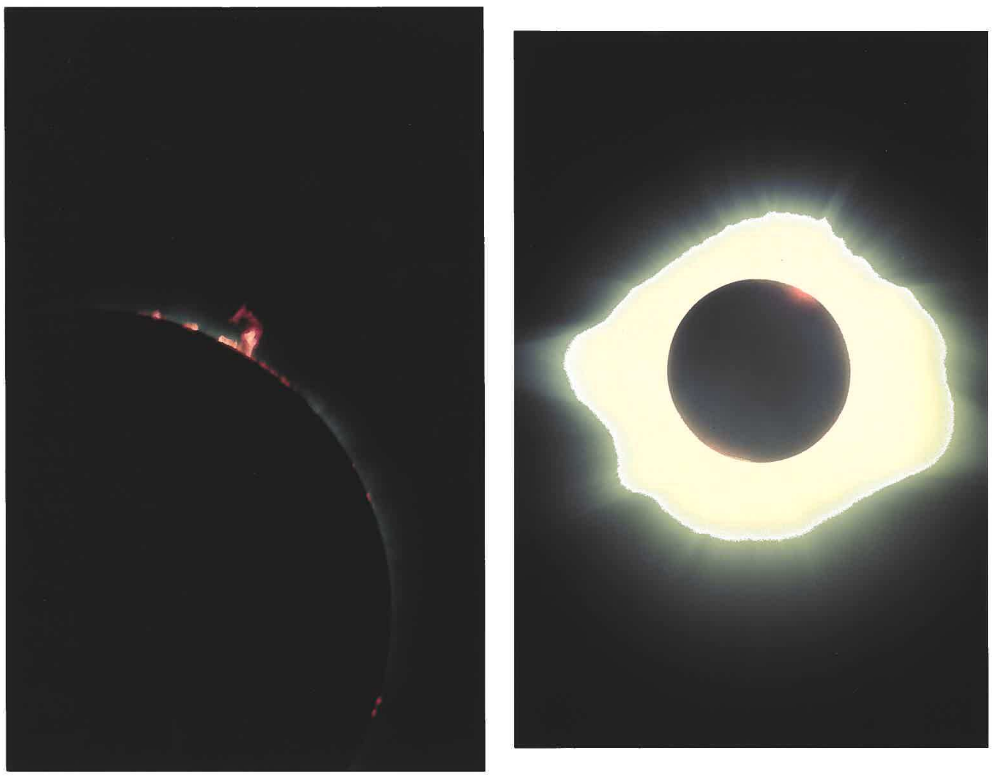

Figure 5. Two photos of the July 11, 1991, solar eclipse, taken by me at the summit of Mauna Kea using a 6-inch f/6 reflector and a Russian-made single lens reflex camera. The left-hand exposure was 1/500 of a second, while the right-hand exposure was about one second.

It was past the end of the speedometer, which was 140. I slowed down to 75 for a stop sign." (I hear the voice of our mother saying, "It'll be a miracle if any of you reach adulthood.")

More recently, Keith was featured in a WGN TV story about his role as the "Unknown Gardener."[7] Since 1988 he has been taking care of the grass and flowers along the embankment of a commuter rain line across the street from his house on the North Side of Chicago. He has made some artwork for the garden too.

My younger brother Ken has asked that I not say anything about him until after he is dead. But his life story involves achieving the rank of seventh degree black belt in Chung Moo Quan, a martial arts discipline developed by Korean-born John C. Kim (d. 2016), who was controversial.[8]

Our first cousin James Urbonas got significant attention as a bicycle racer.[9] As an amateur he lived at the U.S. Olympic Training Center in Colorado Springs, Colorado, and was an alternate for the 1988 Summer Olympics in Seoul, South Korea. From 1990 to 1993 he rode as a professional.

In February of 1995 I went on a long trip, equivalent to one lap around the planet, from Hawaii to Los Angeles to Zurich to Cape Town, South Africa, then to London and Cambridge, and finally back to Hawaii. The prime purpose was to go to a stellar pulsation meeting in Cape Town. I was invited because I had been involved in the discovery of a new class of pulsating stars. That story is told in the next chapter.

Even though I did not have my PhD yet, wherever I encountered astronomers on this trip I was treated as if I was "one of us," even dining at high table at St. John's College, Cambridge. This was something new for me, because in the world of astronomy programmers and telescope operators are lower down on the totem pole than astronomers. Never mind that my first boss on the airborne observatory, Don Wilson, pointed to an astronomer on my first day on the job and said, "There is an astronomer. Treat him with distain!"

I began to hatch a plan to go back to graduate school to earn my PhD. Given that I had worked with the Brits for 13 years at that point and knew people at Cambridge University, I figured that should be one place to apply. I applied to the University of Arizona, my previous astronomy grad school (University of California, Santa Cruz), UC Berkeley, and the University of Washington. I was *only* accepted by the University of Washington. That surprised me, given that I had been working with astronomers since I was 23, I had dozens of publications to my credit, more than one book, and I had programming and statistics skills. But – there could have been another reason. Chris Stubbs at UW later explained to me that he was on the committee to select new graduate students in the fall of 1995, as was Woody Sullivan. I already knew these two people. There was a third person on the committee whose identity I do not know or care to know. When they got down to my application in the stack this third person said, "What about this Krisciunas guy? He's kind of old, don't you think?" I was 42 at the time. Stubbs said, "Granted, he is older than most graduate students. But I've met him at Cerro Tololo Observatory. I think he could do the work. And, besides, what you are implying is against the law." Yes, indeed. We cannot discriminate against someone on the basis of race, gender, ethnicity, physical handicap, religion, sexual orientation, or *age*.

On September 25, 1996, my cat Boris and I moved to Seattle. We take up this story in the chapter after next.

NOTES

[1] Heath (1991), p. lvii.

[2] Her first name was Esther, but she preferred to go by her middle name. We were married from April 8, 1978, to October 28, 1983. Her father was from Puerto Rico. Her mother, of Mexican heritage, was from Bastrop, Texas.

[3] Once I said to Carmen that I wanted to make some changes in our life together. Before I said anything specific she said, "When you make changes, things get worse for a while before they get better, and I don't want to experience that worse part. So no changes will be allowed." I said, "If small changes are not allowed, big changes might happen." I did not mean it as a threat, just as a statement of reality.

[4] Chapter 8, pp. 222-237, of my book *Astronomical Centers of the World* describes how telescopes came to be built at Mauna Kea.

[5] For a duet from our musical see https://www.youtube.com/watch?v=a_tLYxJMwPg.

[6] See http://people.tamu.edu/~kevinkrisciunas/opera.html for the libretto and some pictures.

[7] See https://www.youtube.com/watch?v=-ai35bW4fIQ.

[8] http://www.martialtalk.com/threads/john-c-kim-dead-at-82-chung-moo-quan-martial-arts-master-cult-leader.125261/

[9] http://www.cyclingarchives.com/coureurfiche.php?coureurid=6976

Chapter 5

The Discovery of a New Class of Variable Stars

One of the perspectives of the ancient Greeks was that the realm of the stars was "immutable" (unchanging). From night to night and from year to year each constellation kept the same shape, and even to an experienced observer the stars seemed to be constant in brightness. But over the centuries some stars were noticed to vary in brightness. The star o Ceti (Mira) is sometimes easily visible to the unaided eye, while at other times it is too faint to be seen without a telescope. Algol (β Persei) was known to medieval Arabic astronomers as the "demon star." It is an eclipsing binary, a double star whose components eclipse each other on a timescale of 2.86 days. In 1784 astronomer John Goodricke discovered that the star δ Cephei varies regularly from apparent magnitude 3.5 to 4.4 on a timescale of 5.4 days. This star is the prototype of a class of pulsating stars called Cepheids, which are very important for determining distances to star clusters in our Galaxy, and also for determining distances out to 300 million light-years using the Hubble Space Telescope.

We have identified many thousands of variable stars. Some vary in brightness by a few percent, while others are exploding stars that become as luminous as billions of Suns. How a variable star changes brightness (and color) is related to its stage of evolution. Though the timescale of evolution of stars can be measured in millions or billions of years, the study of variable stars allows us to determine what is happening to many different kinds of stars as they evolve.

To an amateur or professional astronomer, the discovery of a new variable star is a relatively straightforward endeavor, or just the result of serendipity. With photographic plates or arrays of solid state CCD detectors one can image chosen areas of the sky and use software to identify some variables. The whole sky amounts to 41,253 square degrees, and while all of it can theoretically be scanned from a site on the Earth's equator, as a practical consideration one must have telescopes in the northern and southern hemispheres. Furthermore, to determine accurately any periodicities of variable stars one may need telescopes situated at a number of longitudes, for reasons that will become clear shortly.

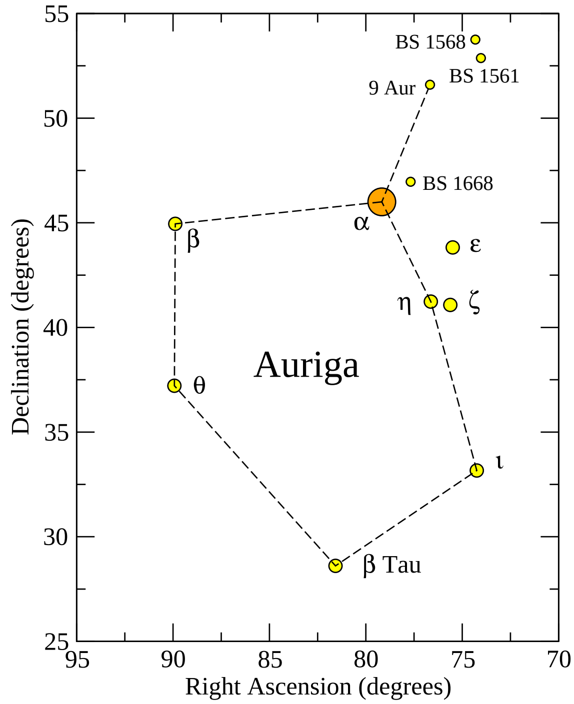

Figure 1. Several of the brightest stars comprising the constellation Auriga, and four fainter stars barely visible to the unaided eye. We used BS 1561 as the principal comparison star to investigate the unusual light variations of the star 9 Aurigae.

In this chapter we discuss a star called 9 Aurigae. It is the ninth star (ordered by increasing right ascension) in the constellation of Auriga the Charioteer according to a catalogue compiled by the first Astronomer Royal, John Flamsteed (1646-1719). My colleague Ed Guinan (a professor at Villanova University) and I discovered it to be variable on the basis of observations carried out from September 1988 to April 1990 (Krisciunas & Guinan 1990). It took until 1995 for us to explain why it behaves the way it does. It turns out that we did not just discover a new variable. We discovered a new *class* of pulsating stars.

In Fig. 1 we see a cartoon diagram of the constellation Auriga. Capella (α Aurigae) is one of the brightest stars in the sky. It is actually comprised of two stars so close together that they appear as a single point of light. High resolution spectra reveal that Capella is a "spectroscopic binary." As the two stars orbit each other, their respective spectral lines shift back and forth in wavelength owing to the Doppler effect. From spectroscopic evidence we surmised that one of the components of Capella might be a variable star. What this meant in practice was that we had to measure the apparent brightness of Capella (the variable, or "var") under clear sky conditions and then measure a constant star of known brightness (the principal comparison star or "comp"), then, just to be safe, measure a second constant star of known brightness (the "check" star). To eliminate any variations in the transparency of the atmosphere due to humidity or thin, wispy clouds, we might take the data like this:

comp-var-check-comp-var-check-comp-var-check-comp

We also need to make measurements of the brightness of the sky. These can change from night to night and during the course of the night, especially if the Moon is up. Since each measurement of a star obtained in a circular aperture is really star-plus-sky, we must subtract the sky readings to get the star-only readings. Finally, we might take data through a series of standard filters. Two popular ones are a yellow-green filter called V and the blue filter called B.

In Fig. 1 we are looking at several hundred square degrees. Even with a wide angle camera this may not be the best way to make the most accurate measurements of any star in Auriga. It is effective to measure one star at a time if the sky is clear. If the comparison star and check star are close in angular distance from the supposed variable star, then everything comes out in the wash, and it is possible to obtain measurements as accurate as 0.5 percent. Starting in the 1980s it became possible to implement robotic telescopes that could be programmed to observe a sequence of stars, further increasing efficiency and accuracy. This also allows the astronomer to sleep comfortably in bed at night instead of staying up all night observing.

How might we guess which stars might be good comparision stars? They may have been observed previously as part of some project. Or, from a star's age, temperature, and luminosity, we can make an educated guess. For example, 9 Aur is a main sequence star of spectral type F0.[1] It is like the Sun, but a little hotter and more massive. Our original thinking was that it had no reason to be variable. It is too hot to have large spots on it. It does not have a combination of temperature and luminosity like Cepheid stars, so it should not radially pulsate. It is not an eclipsing binary.

A sanity check can be made from actual data one obtains. If the *ratio* of apparent brightness of two stars vs. time is constant, or, equivalently, the *difference* of their apparent magnitudes, then both of the stars are demonstrated to be constant in brightness. But here is the trap. If the ratio of apparent brightness of two stars varies with time, then either one star is variable, or the other one is variable, or *both* are variable. Usually, by including one or more check stars in the observing sequence, we can determine which stars in the general direction of the variable are reliable comparison stars. This takes time, but it allows one to make more robust conclusions.

On seven nights in February of 1980 to March of 1981 I measured Capella using 9 Aur as the comparison star (Krisciunas 1984). This was from my backyard observatory in San Jose, California. The differential photometry revealed that the two stars were constant at the level of ± 2 percent. I stopped observing them, but then resumed data taking from January of 1987 to April of 1988. Ed Guinan began measuring Capella with the Villanova 38-cm telescope using three narrow band filters called b, y, and r. His principal comparison star was BS 1668 (Krisciunas & Guinan 1990b). My new data implied that Capella was variable, but Ed's data showed no variations. This meant that I had fallen into a trap! By not using a check star I was attributing variability to Capella, when in fact it was my comparison star 9 Aur that was the real variable. From September of 1988 to April 1990 Ed and I obtained more observations of 9 Aur, using BS 1561, BS 1668, and BS 1568 as comparison and check stars. Ed had arranged for data to be taken with a 10-inch robotic telescope on Mt. Hopkins, Arizona. I observed with the same 6-inch telescope and homemade photometer I used in California, but now my observing site was the parking lot of the visitors center at the 9200-ft level of Mauna Kea, Hawaii, at that time possibly the best site in the world for "amateur" astronomy.

In August of 1990 we published the first reliable photometry of 9 Aur (Krisciunas & Guinan 1990a). The data appeared to show some low-amplitude variations with a period of 36-39 days. But what we did not realize at the time was that the data obtained with the robotic telescope actually demonstrated variability with a period of $\approx$2.9 days, and that the $\approx$37 day variations might be the result of the beat pattern of two close frequencies. In any case, Ed and I had discovered a new variable star, and felt it was our responsibility to determine *why* this star was behaving as it does.

Because stars are made of compressible gas, they can pulsate in various modes and on different timescales. A Cepheid-type star pulsates radially, like inflating and deflating a beach ball. Cepheid periods range from about 3 days to 80 days. This is confirmed by measuring radial velocities derived from stellar spectra. Compared to the mean velocity of such a star with respect to the observer on Earth, the hemisphere of the star facing us alternatingly approaches us and recedes from us. These pulsations are correlated with the changes in brightness of the star.

There are also stars that pulsate non-radially, such as δ Scuti stars and certain types of pulsating white dwarfs. In such a case a star could compress and expand along the axis of rotation, while the equatorial zone bulges in and out at the same time. Or, a star could be divided up into sections, like a peeled orange, wherein every other section is bulging out while every other, other section is bulging in. Delta Scuti stars exhibit variations of brightness of a few percent on a timescale of an hour or two. Such a star can pulsate with more than one period. Physically, the restoring force is the acoustic pressure of the gas.

To demonstrate the existence of particular periods one must sample the light of the star at some optimal sampling rate. But you can not know the optimal sampling rate unless you know the periods of variation − a Catch 22. To narrow down the parameter space we next observed 9 Aur up to 54 times over the course of a night using two robotic telescopes (Krisciunas et al. 1991). This showed that the timescale of the variations was at least several tenths of a day.

How does one find the period or periods of variation of a star? You take measurements over days, weeks, or months and then analyze them with a computer program that relies on something called a Discrete Fourier Transform algorithm. If you observe with one telescope at one site for 8 hours a night, you may obtain the correct period(s), but you will also get spurious periods that are "aliases" of the true period(s). What you really need are observers at three longitudes spaced by 120 degrees, so that the star is in view 24 hours a day. You would also do well enough with two observers 180 degrees apart in longitude keeping the star in view for 16 hours a day. Consider also that ground based observing has interruptions due to clouds, so there are inevitably gaps in the data even with observers distributed around the globe. This complicates the aliasing challenge.

In the 1992/3 and 1993/4 observing seasons we obtained more 9 Aur data by means of the robotic telescope in Arizona, amateur astronomer Ken Luedeke in New Mexico, and my observing from Mauna Kea, Hawaii (Krisciunas et al. 1995). By this point most of my measurements were being taken with a 24-inch telescope operated by the University of Hawaii at the Mauna Kea summit. We found periods of 1.26 and 2.90 days. Furthermore, our colleague Roger Griffin obtained contemporaneous spectroscopic data, which showed radial velocity variations that correlated with the 2.9-day photometric period. We were able to prove that the light variations were due to non-radial pulsations. A Belgian expert on stellar pulsations, Connie Aerts, was able to determine the gory details of these non-radial modes (Aerts & Krisciunas 1996).

A subsequent multi-longitude observing campaign was carried out from October of 1994 through February of 1995 by observers in Lithuania, Spain, New Mexico, Arizona, and Hawaii (Zerbi et al. 1997). Some of the data from that observing campaign are shown in Fig. 2. We found evidence for three periods: 1.258, 1.302, and 2.916 days. The first and third periods are revised values of what we found in our 1995 paper. The two closely spaced periods give a beat period of 37 days, similar to what we found in the original paper on 9 Aur photometry.

While Ed Guinan and I were scratching our heads over the case of 9 Aur starting in the late 1980s, other astronomers were also finding low-amplitude variable stars with spectral types similar to 9 Aur. In the 1960s the South African astronomer Alan Cousins had found that the fourth magnitude star γ Doradus was not constant in brightness, and by 1992 he showed that it had two closely spaced periods near 0.75 days. In January of 1994 and again in November of 1994 Luis Balona observed this star from South Africa while I observed it from Cerro Tololo Inter-American Observatory in Chile. Coordinated spectroscopic data

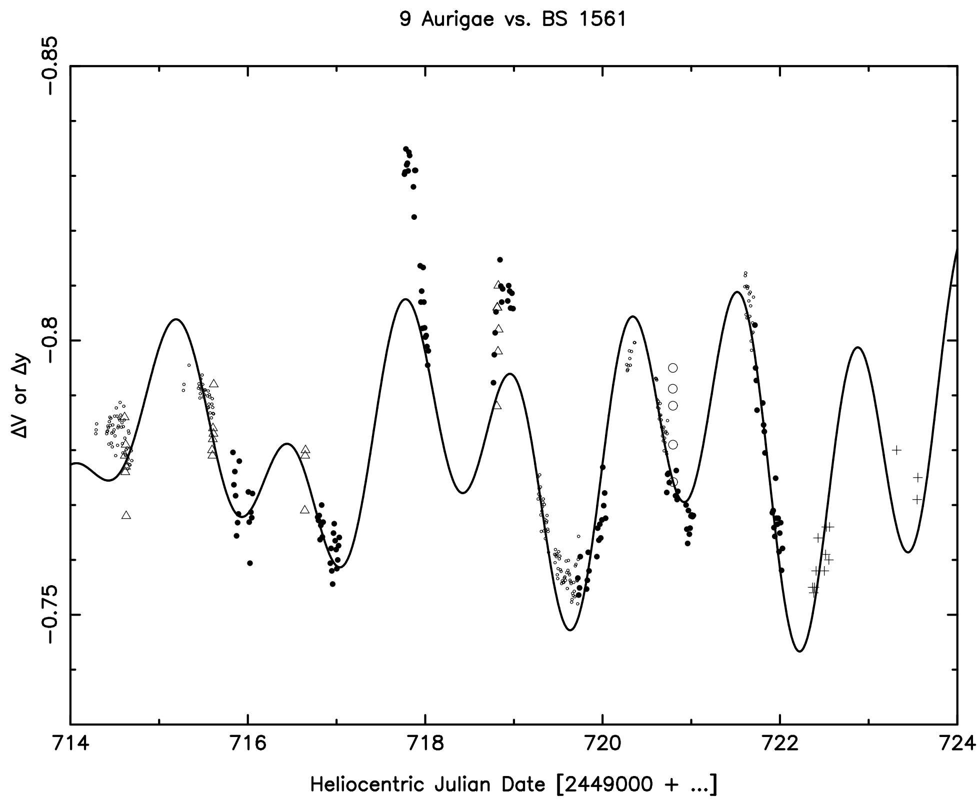

Figure 2. Light curve of 9 Aurigae using BS 1561 as the comparison star, during part of the 1994/5 campaign. We fit the three periods found by Zerbi et al. (1997). Small dots represent data by Garrido, Rodríguez, and Zerbi at Sierra Nevada Observatory, Spain. Larger dots represent data by Krisciunas, Roberts, Crowe, and Pobocik at Mauna Kea, Hawaii. Other data are by Luedeke in Albuquerque, New Mexico (triangles), Guinan and McCook from Mt. Hopkins, Arizona (open circles), and Sperauskas in Lithuania (+'s). Note that even from day to day the amplitudes are irregularly variable.

were taken at European Southern Observatory (La Silla, Chile), Mount Stromlo Observatory (Australia), Mt. John Observatory (New Zealand), and at the South African Astronomical Observatory (Sutherland, South Africa). This allowed us to correlate photometric changes with variations of the spectroscopic line profiles (Balona et al. 1996). We were able to prove that γ Doradus is a non-radially pulsating star.

In 1995 Gerald Handler and I published a list of 17 stars similar to 9 Aur (Krisciunas & Handler 1995). At a stellar pulsation meeting in Cape Town, South Africa, in February of 1995 five of us decided that the new class of variable stars should be known as "gamma Doradus stars" after the prototype discovered by Cousins in the 1960s. 9 Aurigae is the northern prototype of this class.

At International Astronomical Union Symposium 185, held in Kyoto, Japan, in August of 1997 I gave an invited talk on this subject (Krisciunas 1998). By the end of the decade stellar astronomers agreed that we had discovered a new *class* of variable stars (Kaye et al. 1999). Given the timescale of their non-radial pulsations, we deduce that the restoring force is the gravity of the star, as opposed to the gas pressure in the stellar photospheres (as with δ Scuti stars). Thus, we speak of γ Dor stars as having "non-radial gravity mode pulsations." Solar astronomers have sought evidence for such pulsations in the Sun.

The ultimate tool for research in *asteroseismology* (the detailed study of pulsating stars) is a dedicated telescope outside the Earth's atmosphere. Three such facilities have been successfully operated in the past 20 years: 1) MOST (Canada, 2003-2019); 2) CoRoT (European Space Agency, 2006-2014); and 3) Kepler (USA, 2009-2018). Gamma Doradus stars and other low amplitude variables were observed with all three, though Kepler's prime mission was to discover extrasolar planets that transit in front of their host stars. Given that it is never cloudy in outer space, and one can observe 24 hours a day (so no more aliasing!), these spaceborne telescopes have been able to push the data acquisition and analysis leaps and bounds beyond our modest initial efforts of late 1980s. For example, Li et al. (2020) recently analyzed 611 γ Doradus stars discovered by the Kepler mission. Now the TESS mission (launched in 2018) is taking data. Like Kepler, it was primarily designed to find extrasolar planets, but it will observe many kinds of variable stars.

On the theoretical side Warner, Kaye, and Guzik (2003) ran stellar evolution models for stars between 1.45 and 1.75 solar masses and were able to determine at what age these stars pulsate like γ Dor. For example, a 1.45 solar mass star exhibits these pulsations from an age younger than 32 million years to 1.45 billion years, but a 1.75 solar mass star pulsates in a much narrower range of age from 1.12 to 1.32 billion years.

That is our discovery, with some context and some (but not all) of the details of the story. Suffice it to say that it is not every day you discover a new class of objects in the universe. I could not have predicted that, from start to finish, I would spend 15 years observing a nondescript fifth magnitude star, and that the study of that star and others like it would take me to Hawaii, Chile, South Africa, England, and Japan.

NOTES

[1] Dating back to the 1890s, the traditional Harvard spectral classes are O (the hottest), then successively cooler types B, A, F, G, K, M, and finally three special classes R, N, and S. There are numerical subclasses, 0 through 9. Main sequence stars are all converting protons into helium nuclei in their cores.

Chapter 6

My Career in Astronomy – Part II

At the University of Washington I was required to take two years of graduate astronomy courses. The expectation was that a student would pass a comprehensive exam after the end of the second year of classes. You could take it after the first year, just for practice. Sometimes people managed to pass it on the first try. To me *that* was the big hurdle to get over. Had I stayed at UC Santa Cruz for a second year, I had no confidence that I would pass their comprehensive exam. That was one reason I did not stick around for that second year. I passed the UW exam on the first try, a year ahead of schedule.

The University of Washington is part of a consortium that operates Apache Point Observatory (APO) in southern New Mexico. The largest telescope there is a 3.5-m reflector. While a telescope operator is in the control room at APO each night, observers can command the instruments and take exposures from remote control rooms at the home bases of member institutions of the consortium. Starting in early 1999 our team, composed of Chris Stubbs, Gene Magnier, Alan Diercks and myself, began regular observations of supernovae at APO.

Though Chris never explicitly said this to me, I surmised that our purpose in trying to publish a paper on supernovae as quickly as possible was twofold: 1) to show the world that the APO 3.5-m was functional and useful for taking optical and infrared images; and 2) to show the world that we were competitors in the supernova game. At that time optical imagery and rare infrared data were primarily being obtained by a small number of groups − those at Cerro Tololo and Las Campanas in Chile, the Harvard group, and those at UC Berkeley and Lawrence Berkeley Lab.

At APO we observed with an optical imager called SPIcam built by the University of Washington and an infrared imager called Grim II, built by the University of Chicago. UW also operated a 30-inch diameter telescope near Ellensburg, Washington. It had an optical wavelength CCD camera.

Here I must elaborate that there are two basic kinds of supernovae. Single, massive stars with masses greater than 8 times the mass of the Sun develop an iron core, at which point nuclear fusion ceases in the core, the outer layers compress the core tremendously, and the layers outside the core explode. If the remnant that results has between 1.4 and 3 solar masses, it become a neutron star. If the remnant has more 3 solar masses, it become a black hole.

The other kind of supernova is an exploding white dwarf star in a close binary system. The companion is either another white dwarf, or perhaps a main sequence or giant star. These are known as Type Ia supernovae.

Supernovae are important because they produce most of the iron in the universe, and many other elements as well. Type Ia supernovae have garnered a lot of attention since the 1990s, when Mark Phillips (1993) discovered that the intrinsic luminosity at maximum light of such an object is correlated with the rate at which it fades away. This holds for observations in the optical B (blue), V (visual), R (orange), and I (red) filters. Type Ia supernovae are an example of what are called "astronomical standard candles." Since the maximum luminosity of Type Ia supernovae observed in optical bands depends on the decline rate, we often call these objects "standardizable candles."

Once we deduce how much light certain types of objects give off, we combine the apparent brightness of such an object with the intrinsic luminosity, and derive the distance to the object. This allows us to measure the expansion rate of the universe and to address questions of the highest order, such as: What is the ultimate fate of the universe? Will it expand forever? Or perhaps galaxies will reach some maximum separation, then the universe will recollapse.

On September 5, 2000, I defended my PhD thesis, entitled, "RR Lyrae Stars and Type Ia Supernovae: Discovery and Calibration of Astronomical Standard Candles." The next month I accepted a postdoctoral position in Chile. I would work with Nick Suntzeff at Cerro Tololo Inter-American Observatory (CTIO) and Mark Phillips at Las Campanas Observatory. My first task would be to clear up a two-year backlog of optical and infrared imagery of supernovae and their host galaxies. Of course, we also had to make a diligent effort to monitor supernovae going off in nearby galaxies that were within reach of 1-m class telescopes.

On the 17/18 of December 2000 I once again made a long distance one-way voyage in pursuit of a career in astronomy. This was the longest move so far, from Seattle to La Serena, Chile, 6229 miles, or one-fourth of the way around the Earth.

While I had visited many foreign countries already, living in Chile was my first experience living outside the US. At the age of 47 I had to learn Spanish. The wife of one of the astronomers at CTIO was my teacher for a semester. We got through most of a fat textbook. The extreme speed at which many Chileans speak, coupled with the amputation of many final consonants of words is what makes listening to Chileans a huge challenge. One time I was at the house of my future in-laws a brother of my future father-in-law Pedro asked him, "What's the deal with Sandra's boyfriend Kevin? Is he retarded or something?" Pedro said, "No, why would you ask that?" His brother said, "It's ... because ... you ... are ... speaking ... to ... him ... like ... this."

I finally realized that I could speak and understand Spanish reasonably well about 15 months after I moved to South America. I was in Peru on vacation with my friend from Hawaii, Ray Bolkan. The Peruvians speak much more slowly, and with much better pronunciation. The Colombians and Venezuelans do too.

From 2000 to 2013 I was primarily responsible for reducing the data and writing a dozen or more papers on Type Ia supernovae.[1] Our most important finding was that in the near-infrared bands at 1.25, 1.65, and 2.2 microns there is a characteristic luminosity at maximum light that is largely *independent* of Mark Phillips' decline rate parameter. (Only the fast decliners that peaked in the near-infrared *after* the time of B-band maximum were subluminous in the infrared bands.) This meant that Type Ia supernovae in the near-infrared were better than standardizable candles. They were almost perfect standard candles. Not only that, observations in the infrared are much less subject to systematic errors due to the dimming effect of dust along the line of sight. This has already become important in observational cosmology, and it will continue be so in the future with the launch of the Nancy Grace Roman Space Telescope.

In August of 2001 I made a month-long visit to Australia to work with Brian Schmidt of Mt. Stomlo Observatory (near Canberra) and the Australian National University. In 1993, when he finished his PhD in astronomy at Harvard, working on the "expanding photosphere method of core collapse supernovae," he could not find a job in the United States or Europe. He got a job offer in Australia, with an annual salary of \$35,000.[2] His girlfriend, who earned a PhD in economics at Harvard on a Fulbright Scholarship, had to return to Australia. She said, "Brian, come with me to Australia. We can get married. You can have your own winery." After little hesitation he agreed.

In 1994 Brian and Nick Suntzeff had founded the High-Z Supernova Team. "High-Z" means high redshift − objects we know to be far away owing to the expansion of the universe and Hubble's Law.) Using observations of exploding white dwarf supernovae discovered by them with the 4-m telescope at Cerro Tololo Inter-American Observatory (CTIO), the High-Z Team expected to measure the *deceleration* of the universe caused by the mutual gravitational attraction of all the matter in the universe. They published a key paper (Riess et al. 1998) that surprisingly showed that the universe was *accelerating* in its expansion. The cause for this has been dubbed Dark Energy. It is attributed to a property of the vacuum energy of the universe. A rival group, the Supernova Cosmology Project (SCP), working at Lawrence Berkeley Lab, published a similar result in 1999. The implication of cosmic acceleration was designated the "breakthrough of the year" for 1998 by *Science* magazine.

Brian, Adam Riess (the first author of the key paper of the High-Z Team), and Saul Perlmutter, the head of the SCP, began winning international awards for the discovery of the acceleration of the universe. First they won the Shaw Prize in 2006. Then both high-redshift supernova *teams* shared the Gruber Cosmology Prize in 2007. Finally, Brian, Adam, and Saul shared the 2011 Nobel Prize in Physics. (For details of the story see the book by Robert Kirshner and the book by Richard Panek.)

When I visited Australia in 2001, the High-Z Team's data for supernovae discovered in 1998 had not yet been reduced and published. The data reduction was delegated to

Figure 1. Sandra Rodriguez, age 27, June 2001.

me, using software developed by Brian. Nick Suntzeff was the first author of the resulting paper, entitled "Precision Photometry of High Redshift Type Ia Supernovae." One of the nuts-and-bolts aspects of this paper was to show that there were no significant systematic differences in the data taken by the High-Z Team with ground-based telescopes and data taken with the Hubble Space Telescope. After much re-reduction of data and months of writing the paper, all we needed to submit the paper to the *Astronomical Journal* were a few spectroscopically-derived corrections that depend on the redshifts of the objects. However, the paper was never published.

Though I lost my chance to be a coauthor on what was expected to be the final research result of the team, Adam included some of the objects observed in 1998 in another key paper published in 2004. He headed up a new "higher-Z project" with the Hubble Space Telescope to discover supernovae so far away that, to observe them, we were looking back 10 billion years into the past – before the universe had started accelerating. In my opinion it was this paper that convinced the Nobel Committee to choose Adam as "the third man" for the Nobel Prize.

Back in Chile I settled in to a life of fine dining and fine parties with a lot of pisco sours and Chilean wine. I had met the woman who would become my second wife, Sandra Rodriguez. During the day she worked for a trade school called Inacap, and during the evening she was working on a Bachelor's Degree in accounting. We traveled all over Chile, to places such as San Pedro de Atacama, Viña del Mar, Valparaiso, and Torres del Paine

Figure 2. Hugo Schwarz and Claudia Sanhueza, on their wedding day, December 4, 2004.

National Park; to Bariloche and Buenos Aires in Argentina, and to Punta Cana in the Dominican Republic. On the San Pedro trip one morning long before dawn we drove up to the Chile-Bolivia-Argentina border to El Tatio Geyser at 14,173-ft elevation (slightly higher than Mauna Kea). Sandra got altitude sickness. She threw up three times on the way up and three times on the way down. She slept the rest of that day back in San Pedro and felt all right the next day.

In 2001 I became very close friends with a Dutch astronomer, Hugo Schwarz, and his girlfriend Claudia Sanhueza. He was tall, a bit scraggly-looking, witty, mischievous, very well read, and fluent in four languages. Being with Hugo caused Claudia to radiate happiness and beauty in equal measures.

Hugo, an expert on planetary nebulae, obtained his undergraduate and graduate education in Glasgow. He originally moved to Chile in 1986 with his first wife Catriona, who was Scottish. At first he spoke no Spanish, but he was learning. One time at the dining hall of La Silla Observatory he noticed a large bowl of fresh figs (*higos*) as one of the dessert options. By the time he finished his dinner the figs had disappeared, so he said to one of the cooks, "Disculpe, señor. Tiene usted *hijos*?" The cook was puzzled. "Si. Por qué?" Hugo said, "Quiero comerlos." Hugo had mistakenly asked the cook if he had children. When he was asked why he wanted to know, he said, "I would like to eat them." Subsequent to that Hugo was in a store in Santiago and saw jars of fig jam, but they were labeled "Mermelade de hijos" (puréed children).

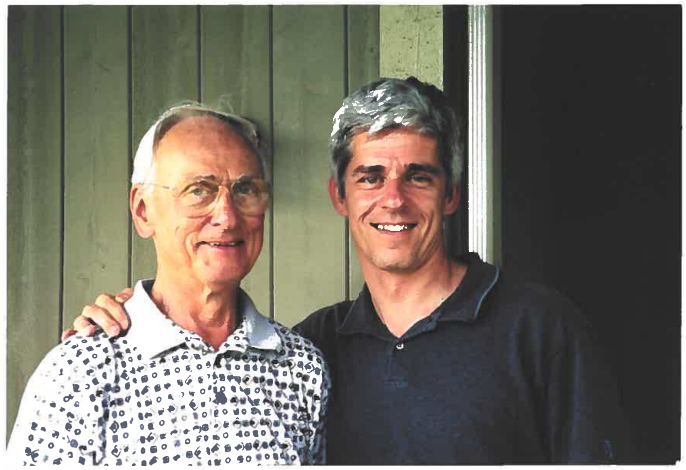

Figure 3. This photo of my father and me was taken on his seventy-fifth birthday, July 7, 2001.

Another time Hugo was at La Silla he was talking to a young astronomer who was just about to get married but had a serious case of cold feet. Hugo said, "Getting married is like jumping off a diving board into a swimming pool. What's the worst thing that could happen?" Three weeks later Hugo saw the newly-married astronomer and, with a twinkle in his eye, asked, "So, have you had your first fight yet?" The other guy was incredulous. "Wait. You encouraged me to get married, knowing full well that we'd have a fight almost immediately?!"

One evening I was at home in my apartment in La Serena. The phone rang. It was Hugo: "What are you doing this evening?" "Some reading. Watching some TV." "Would you like to go out for a drink?" "What time are you thinking?" "I am passing the German school as we speak." "Ah. You've already decided you're going out. You're just wondering if I want to join you. OK. Where should we go?" "Any place there aren't any women. See you in four minutes." So we went to Bohemia, our usual hangout. He ordered a gin and tonic. I ordered a Campari and tonic. Hugo started to tell me about an argument he had had with Claudia. At one point I interjected, "I've heard women say that too." He said, "Shut up. You are not here to talk. You are here to listen."

In June of 2001 a new golf course opened at the north end of La Serena. Club de Golf La Serena was a private course, but non-members could play for the equivalent of about $50 US. Mark Phillips and I were two of the first people to become members. At the end of 2002 the first club championship was played. It was a match play tournament. I made it to

Figure 4. My mother in her late fifties.

the final against Mark's 16 year-old son Nico, who had recently played a round at the other course in town that included *four eagles*, something even professionals do not do. I figured I had no chance. Nico beat me easily, six holes up with five to play. The next year I played Nico in the quarter-finals. I was playing well, and he was having some back problems. I eventually found myself one hole down with one to play. On the eighteenth hole of play I hit my tee shot in the fairway. He outdrove me by 40 or 50 yards. The wind off the ocean was strong and against us. I hit a solid three wood to within 10 feet of the hole. Nico missed the green, then chipped on within $4\frac{1}{2}$ feet. My birdie putt hit the left half of the hole, but lipped out. He sank his putt to tie the hole and win the match, one hole up. It was the best match I ever played that I lost.

My position in Chile was funded for two years by a National Science Foundation grant that Nick Suntzeff had at CTIO. The last year and a bit I officially worked at Las Campanas Observatory and was funded by their parent organization, the Carnegie Institution. I kept the same office at CTIO. My funding ran out in January of 2004, at which time I was hired by Peter Garnavich, another former member of the High-Z Supernova Team. At the end of January I moved to South Bend, Indiana, to join Peter at the University of Notre Dame.

Notre Dame is a private Catholic university. My friends asked me,"Is there a lot of pressure at Notre Dame to be Catholic?" I said, "In my case it would be pressure to be Catholic *again*. You see, I was baptized Catholic, had First Communion, and went to Catholic school for a while. I feel like I can't be Catholic. I'm too far behind. The last time I went to confession was 1961. Since then I've probably broken all nine of the Commandments. I've never killed anyone, but occasionally I derive pleasure from reading the obituaries."

Many members of the High-Z Team joined a new project called ESSENCE. Whereas the High-Z Team had discovered 10 high-redshift Type Ia supernovae and the Supernova Cosmology Project had found 42, our next goal was to discover more than 200 of them with the CTIO 4-m telescope and try as best as we could to observe them all with the same telescope, same camera, and same two filters. This would logically cut down on systematic errors in the photometry and lead to smaller uncertainties in the derived values of interest to observational cosmologists, such as the Hubble constant, the total mass density in the universe, the Dark Energy density, and something called the "cosmic equation of state parameter." We accomplished our goal and discovered 213 spectroscopically confirmed Type Ia supernovae using imagery obtained from 2002 through 2007 (Wood-Vasey et al. 2007, Narayan et al. 2016). Nine of the objects were also observed with the Hubble Space Telescope (Krisciunas et al., 2005).

One of the best features of my job at Notre Dame and my involvement with the ESSENCE project was that in early October, when the weather was rapidly becoming wintry, I would switch hemispheres and fly to La Serena, where spring was rapidly unfolding. I spent the last three months of 2004 and 2005 in Chile. Four days before Christmas in 2005 I found myself playing again in the finals of the club championship at Club de Golf La Serena. My opponent was Alejandro Silva. I was two holes down after five, but pulled even at the ninth. On 14 my opponent's chip shot rattled the pin but did not drop. I rolled in a 13 foot birdie putt to take a 1 up lead. On 15 I chipped in for par, the second time in the match I had holed out from off the green. But he rolled in a six foot par putt to tie me. He made mincemeat of the par 3 sixteenth and conceded the hole. He was now two down with two to play. I was in the driver's seat but knew that in his semi-final match he was in exactly the same situation against the previous year's champion. In that match Alejandro won 17, 18, and the first hole of sudden death to win. In spite of being in trouble on number 17, the most difficult hole on the course, I nearly holed out for par from 45 yards. We both made bogey and I won the match, two holes up with one to play. This was the best match I ever played that I won. A large trophy sits on the shelf in my guest bedroom.

At the end of the third week of October, 2006, Sandra flew to Chicago. The next week we departed South Bend, Indiana, to drive to College Station, where I started a new job at Texas A&M University on November first. We figured it would be better if both of us were there to choose the first place we would live. On Friday, October 20th, we received the news that Hugo had died as the result of a motorcycle crash. He hit a speed bump while going 100 mph. He flew off the bike and collided head-on with a pickup truck traveling 50 mph towards him. It broke his neck, and he died instantly. I wrote Hugo's obituary for the American Astronomical Society.[3]

How many times had Hugo and I talked about "just in case" things? Before he and Claudia got married in 2004 I pressed him on details of his divorce from his first wife, Catriona. He assured me that his Dutch divorce was totally valid. How many times over a drink did we talk about retirement accounts and other assets? It turned out that Hugo was *not* legally divorced from his first wife *in Chile* at the time he and Claudia got married. He

Figure 5. Matthew, age 7 (at right), with Bastian, the half-brother of his two Chilean cousins.

did not have a legal will. He did not even have a handwritten list in which 100 percent of his estate was designated to beneficiaries. He had property in La Serena, Chile, La Palma in the Canary Islands, and in Glasgow, Scotland. Since I was on speaking terms with Cat and Claudia I helped facilitate the paperwork. This took six years. While Cat was legally entitled to one-third of Hugo's estate, she gave up her share to Claudia so that their two kids would each get their shares. Cat only asked to be reimbursed for legal and accounting expenses. Whatever negativity some of Hugo's friends had about his first wife, the evidence is clear that she took the high moral road. Hugo's death, however, completely ruined Claudia's life.

Sandra and I got married by a judge on December 9, 2006, in La Serena, Chile. My father and step-mother flew down for the wedding. We went to Easter Island for our honeymoon.

Texas A&M University had strongly recruited Nick Suntzeff to head up an astronomy group within the Department of Physics. He arrived in March of 2006 as a tenured full professor. He was later promoted to Distinguished Service Professor. When he arrived he was allowed to offer jobs to two other astronomers, without the usual year-long process with 50 to 100 applicants. He offered one associate professor position to Lifan Wang from Lawrence Berkeley Lab. I was offered a position as an instructor. My job description stated I would spend 70 percent of my time on teaching and 30 percent on service. The head of the department insisted that this was the only job description he could give me. This is curious,

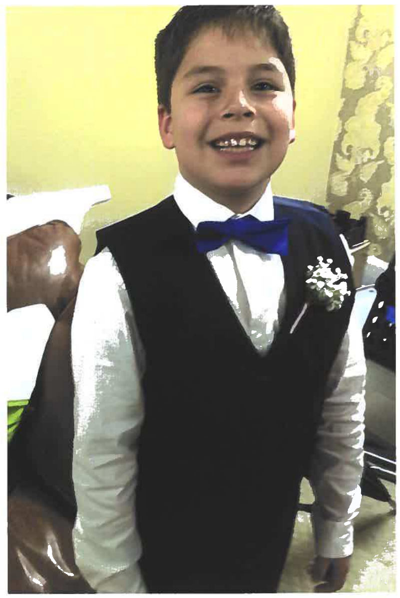

Figure 6. Matthew Krisciunas, age 8, at the wedding of Lara Suntzeff and Patrick McMahon, January 27, 2018.

because I had to have a PhD to get the job and had to have a research history to show that I had "street credentials."

The bottom line here is that it is good to be employed. In academia it is better to be "on the tenure track" or to have a tenured job. My thesis advisor Chris Stubbs told me in 2000 that he thought I would never make the short list for a tenure-track job, owing to age discrimination, and he ended up to be right. A contrarian might say, "Well, maybe you just weren't very good!"[4]

I worked at Texas A&M for 14 years and two months, during which time my monthly salary rate went up 85 percent. In September of 2013 a new job description for me was approved by the head of the department, George Welch. This allowed me to spend 30 percent of my work time on research. My final career job title was Instructional Associate Professor. At the time of this writing the faculty in the department have voted in favor of my getting Emeritus status; my high school chemistry teacher, Ed Schap, would be proud.

During my time at Texas A&M I taught roughly 4800 students. This involved 63 sections of basic astronomy, three junior-level classes, and a summer school physics class for 14 Saudi engineering students. Except for 2007 and 2009 I taught every summer.

Most of my students took astronomy class as a science elective. If they did not learn the material, it did not significantly affect their intellectual foundation. (By contrast, if an engineering student did poorly in beginning physics, how could he do well in advanced physics? Engineers have to build bridges and buildings that do not fall down!) As a result, I taught astronomy somewhat as a combination science and theatre arts class. For many it was the last science class they would ever take. Many were business majors or psychology majors. Many had had incomprehensible or really boring science classes. I wanted them stumbling out of my class thinking,"I hate to admit it, but that was actually kind of fun." In 2013 I wrote a book of supplementary reading called *A Guide to Wider Horizons*. In 20 short chapters it touches on astronomy, physics, mathematics, statistics, economics, history, ethics, biology and genetics, and literature. The seed for this book was planted in my head by a University of Arkansas physicist who said that *every* college class should require writing, mathematics, physics and other topics that are part of a broad liberal arts education.

In my classes when we talked about Galileo's trial by the Inquisition I would wear my Renaissance Faire costume. When we talked about cosmology and the crrrrritical density of the you-nee-verse, I would invoke the head of the Astronomy Department at the University of Illinois when I was a freshman, George Cunliffe McVittie, and my friend who was once the Astronomer Royal of Scotland, Malcolm Longair, and wear a full and proper Scottish outfit. When I could see that people were getting fidgety or sleepy, I would set aside the astronomy lecture material and sing them a song, such as one with the 88 constellations in it. Or Tom Lehrer's version of the same Gilbert and Sullivan patter song, with the periodic table of elements. Or, something silly I had learned from the Dr. Demento Radio Show. It is my firm conviction that we listen to spoken language with one part of our brains, and we listen to rhythm and melody with another part. After singing a song to my students, they were wide awake again and there was room to put more astronomy into their heads.

Before Sandra and I were married we had a serious discussion. She had always imagined she would get married in a Catholic church and have three children. I reminded her that if one gets married in the Catholic Church, one must sincerely promise to follow all their rules and raise the children Catholic. I told her I could not in all sincerity promise that. So, if she just had to get married in the Catholic Church, she would have to marry someone else. I also said that if we got married, we would have to live where my job was. No setting her up in an apartment in La Serena and visiting her twice a year. She was all right with these two conditions. She said she was totally fine with moving to China or Australia, wherever astronomy might take us. What about having three children? I said I could promise her one child, and we would see how things go. But I could not promise her three.

Our son Matthew was born on September 24, 2009. Towards the end of Sandra's pregnancy the baby was becoming large enough that a C-section might be needed. Sandra's doctor decided to induce labor ten days before Sandra's due date. When Matthew was born I was 56, the oldest first-time parent in my family's history.

A few stories will suffice to illustrate how Matthew's personality was developing at an early age. One time when he was 3 years old I was sitting on the living room sofa. He sat down next to me and started petting the side of my head. I asked him what he was doing. He said he was "be-nicing me." I asked him what that meant. He said, "You told me to be nice to people. So I'm be-nicing you."

One day, shortly after he turned 4, we were sitting across from each other at the kitchen table. He said, "Daddy, what's 24 times 25?" I thought for a moment and said, "600." He looked at me seriously and said, "That's correct." The next day I said to him, "Matthew, do you remember what 24 times 25 is?" He hemmed and hawed and said No. So he was a BS artist from the age of 4.

One day when he was $4\frac{1}{2}$ we were driving in the car. He said, "Daddy, if you eat a person from another planet, are you a cannibal?" I said, "Let's see. He would have different DNA. Could be super intelligent, but *really* delicious. So, no, I don't think you'd be a cannibal." He agreed.

A week after that we were driving past a place in town where a bridge over the main highway was being rebuilt. The project had been ongoing for nearly a year. There were men in big boots, piles of rebar, and cement trucks nearby. Matthew furrowed his brow and said, "Daddy, I understand how you build a bridge. But how do you build a person?" I said, "Well, do you remember I told you that your mother and I made you?" He said, "Yeah, yeah, yeah. But did you have to use *instructions*?" I said, "No, but I swear some people do need them." He commented, "Right. Like they're really bad with Legos."

A couple months after that, on a May afternoon, we got home from his pre-school and it was not too hot outside. I asked Matthew what he wanted to do. He said we should go down to the grassy area at the end of the street to practice golf. So we got one of his little golf clubs, one of mine, a few tees and balls and were walking down the middle of the street. He asked if he could hold my hand. I said, "Sure." So we were walking down the street holding hands and I said, "You know, Matthew, since your mother started teaching, you and I have spent a lot of time together." He said, "You're right." He stopped, looked at me, and said, "Do you know why? It's because we love each other."

My life almost came to an abrupt halt on February 27, 2013. After doing a challenging workout at the indoor track, I was driving back to the North Side Garage on the Texas A&M campus. The backs of my hands were sweating, there was a pain between my shoulder blades, and I felt like I was picking up one 40 pound box of books after the next. My breathing was labored. In less than five minutes I pulled into my parking place, grabbed my cell phone, got out of the car, sat on the ground, and called 911. Within five minutes an ambulance appeared. I asked the EMT what was happening to me. He said, "You are having a heart attack." I had blocked out the words "heart attack" from my brain prior to this moment, but this made it real. My son was only $3\frac{1}{2}$. It occurred to me that if I should die, Matthew would quickly forget the sound of my voice. That thought made me indescribably sad and I started to cry. The EMT said, "Just try to relax and breathe the oxygen. We'll be at the medical center very soon."

By the time we got there a whole team was suited up and ready to go. They first injected some radioactive mixture into my bloodstream, flouresced it with ultraviolet light, and found that my left anterior descending (LAD) artery was 100 percent clogged. This produces what is known as the "widow maker" heart attack. Men who have it tend to just drop dead on the spot.

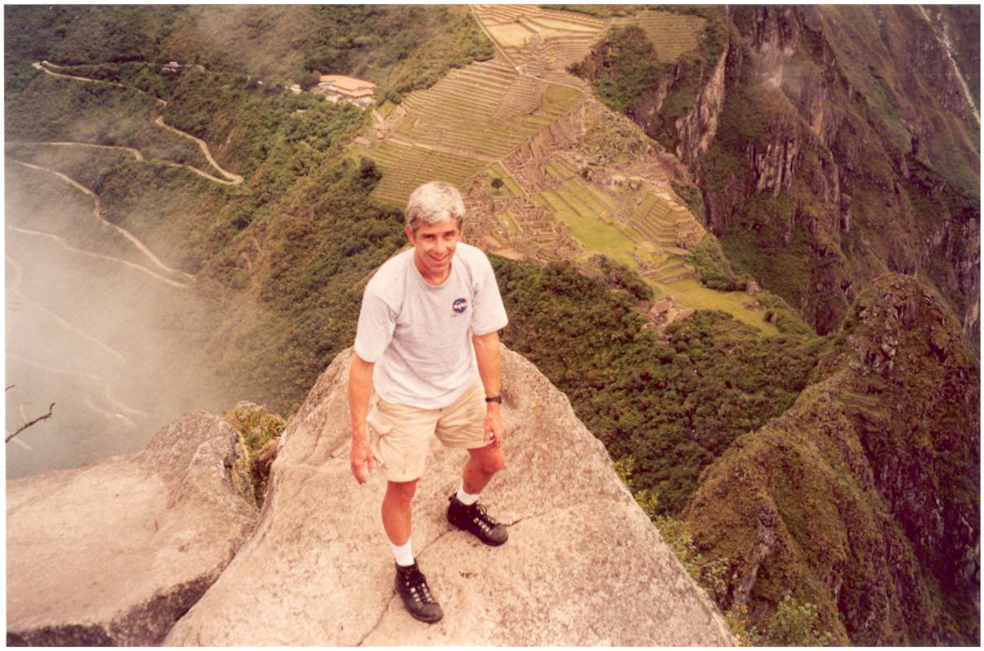

Figure 7. Strive for the heights! Here I am on top of Huayna Picchu in March of 2002. Machu Picchu is behind me and way down below.

They went in through my right femoral artery, unclogged the LAD and installed two stents. An EMT told me later that I was first person he had ever met who had a 100 percent clogged LAD and *survived*. Why did I survive? The cardiologist (Dr. Rocky Bilhartz) believes there were two reasons: 1) the speed with which I was in the hands of medical professionals; and 2) as a lifelong runner who pushed himself into the red zone on a regular basis, my body manufactured collateral arteries that delivered more oxygen to the part of the heart that needed it as my LAD was clogging up.

To my surprise Dr. Bilhartz said, “I want you walking the first month. I want you jogging the second month. And I want you back to running the third month.”

For a few months after my heart attack I was uncomfortable being out on a hiking trail by myself. What if I passed out and was alone in the woods? Four months after the event Dr. Bilhartz said that my body had repaired whatever damage was done on the critical day. I took a blood thinner for a year and have been taking a cholesterol lowering drug, a low dose beta blocker, and a low dose aspirin each day since my heart attack.

On the good side, the confrontation with my mortality made every new day a blessing. It also replaced the BS filter in my head. I let go of certain injustices at the office and no longer got mad on the golf course when I fouled something up. You hit it out of bounds? Big deal. Better than hitting a speed bump going 100 mph on your motorcycle or dying of a heart attack.

Returning to the world of astronomy, I was always trying to think of experiments that my students might be able to do with a minimum of equipment. One involved a thin piece of cardboard with a quarter-inch hole punched in it that slides up and down a yardstick. Such a device can be used to measure the angular size of the Moon. With measurements over many lunations I was able to demonstrate that the angular size of the Moon varies in a regular way owing the Moon's elliptical orbit around the Earth (Krisciunas 2010).[5] The other experiment used a cross piece that slides up and down the ruler. With that you can measure the angular separation of two celestial bodies. This allowed me to derive the eccentricity of the orbit of Mars (Krisciunas 2019). Famously, Johannes Kepler was able to do this in 1609 using many years of observations by Tycho Brahe and his assistants, and this led Newton to accomplish a huge leap forward in our understanding of mechanics and planetary motion. My observations were not nearly as accurate as Tycho's, but I was able to get the right answer for the eccentricity of Mars' orbit, within experimental error.

Another experiment allowed the determination of one's latitude and longitude using the shadow of a vertical stick (Krisciunas et al. 2012). I used two such positional determinations (in South Bend, Indiana, and College Station, Texas) to measure the circumference of the Earth. In this paper we also determined the distance to the Moon using the geometry of a lunar eclipse. This method dates back to Aristarchus in the third century BC.

During my last semester teaching at Texas A&M one of my students asked me what I thought was my greatest accomplishment. I said, "As a college teacher and scientist, probably the most significant was the unknown long-term influence I will have on my students." I tried to plant the seed in the heads of my students that they should take on challenges and that they should want to learn forever. Their lives will be more interesting as a result, and they will be more interesting people.

Occasionally, I receive email messages from former students, a few years after they were my students. Here is one such message of July 11, 2020, from a student who earned a Master's degree in International Affairs.

> Dr. Krisciunas,
>
> I have recently graduated from The Bush School of Government and Public Service, and I want to take the time out to formally thank you for your service to your students at Texas A&M University. Having you as an instructor in the past contributed significantly to my success as a graduate student.
>
> If you recall, I took your Basic Astronomy course in the Spring of 2015. Your class was incredibly thought-provoking and engaging. Your instruction of the material and the readings you assigned were such a fulfilling part of my education. To this day, I still have the assigned readings in my personal library. By taking your course, I can genuinely say that you planted seeds of scholarship that led me to complete my graduate program.
>
> I genuinely appreciate the time and effort you put forth to assist the students of Texas A&M University, and I cannot thank you enough...
>
> All The Best,

Eric M. Washington, M.I.A.
Texas A&M University Class of 2016
The Bush School of Government & Public Service Class of 2020

Here's a Valentine's card I received [in 2017?] from another student not actually enrolled in the course:

To: Professor Krisciunas

From: Madison Beidleman (The student who attends your Astronomy lectures because I enjoy both the subject and the way you teach it, even though I'm not actually enrolled in the class)

Enjoy this Guardians of the Galaxy Valentine's card to remind you that you teach Astronomy in a way that makes it exciting to show up and learn, even when the material itself doesn't seem like it should be quite so captivating.

Of course, you can not please all of the people all of the time. I was a teaching assistant in the 1996/97 school year at the University of Washington. One student in the spring term included this comment in his course evaluation: "Kevin is a gigantic pool of completely useless astronomical information. He would ramble on and on and lose the class."

At the start of his book *The Road to Character* (2015), *New York Times* columnist David Brooks reminds us there are résumé virtues and there are eulogy virtues. The former help you advance in your career. The latter are spoken of at your funeral. Other than the undetermined influence I had on most of my college students, what else have I done for others in my life, dedicated so much as it was to the pursuit of astronomy?

From the time I was in college until I had my heart attack in 2013 I donated a pint of blood once or twice a year. In 1994 or so, when I lived in Hawaii, I was slated to be a bone marrow donor for an eight year-old girl with leukemia. As you may know, this is a last ditch effort to save someone, with only a 15 percent success rate. It turned out that the girl's doctor decided that she was too weak to undergo having her bone marrow killed off prior to getting mine, and the transfer never took place. She must have died a long time ago.

When I was married the first time, my wife Carmen quit her job working in the fashion industry in downtown San Francisco to pursue a Master's degree at San Jose State University. I supported that endeavor financially for two years. My girlfriend in Hawaii from 1982 to 1987, Dana Bairey, was an undergraduate at the University of Hawaii, Hilo, for the entire time we were together. I supported her financially. And at the time I met my future second wife Sandra in Chile (2001), she was at the start of an undergraduate program in accounting. She had evening classes while working full-time during the day. I covered a significant fraction of her school expenses until the end of 2006. Once we lived in Texas after we got married, I paid the expenses related to her teaching credential. Each time I thought I was doing something noble for another person, to allow her the chance to make new opportunities for herself.

Here is a related story. One time after a round of golf with my father at the course near their second house in northwest Illinois we were driving out of the parking lot and passed a parked Jaguar sedan. My father said, "Look. There's a Jaguar. I'm thinking of getting one." I said, "It's your money. You can do anything you want with it." He said, "This is another way of saying that you and your brothers won't be receiving any inheritance from us." He continued, "I know you'd only squander it." I said, "Are you talking to me, or to my elder brother, who spent his inheritance from Grandma Rudys on a Dodge Charger when he was in high school?" He said, "Ah, I suppose you're right, but think of all the women whose college education you paid for. You didn't stay with them long enough to reap a significant financial benefit. *It would have been cheaper if you had hired hookers.*"[6]

Another thing I did on the good side was that in June of 2003 I loaned Sandra's father the money to buy a car parts store in downtown La Serena, Chile. His take home pay went up by a factor of four. He told me simply, "You changed my life." Within two years he paid me back with interest.

Then there is the case of my step-brother Vince. Once upon a time, in his thirties, he had a *big* salary as a salesman for Tellabs, ten Armani suits in the closet, an attractive wife and two kids. But by the summer of 2019 he was living in homeless shelters in suburban Chicago or sleeping on Friday and Sunday nights in a car parking garage. He had lost his car the previous January after a DUI accident. This was due to pills, not alcohol. He was addicted to the anti-anxiety drug Xanax and the painkiller morphine sulfate. Due to his legal problems, he was not able to leave Illinois. I invited him to live with me. Finally, at the end of January, 2020, he was able to travel by Greyhound bus to Bryan, Texas. I arranged health insurance for him. I got him into drug rehab, which lasted nearly three months. Without health insurance, rehab would have cost more than $70,000. But no sooner did he get out that he was looking for a psychiatrist to prescribe Xanax (or something like it). He lied to the psychiatrist about alcohol use, and to me about financial matters. In August he moved to Phoenix to live with his friend Mark from high school. From July, 2019, to September, 2020, I spent more than $16,000 on his expenses. I do not regret helping him try to get out of the hole he was in. The problem is that he is slipping back into the hole.

As I write this at age 67, of course, I cannot know how much longer I will live. Multiple people on my father's side of the family (including my father) have lived into their nineties. Soon we will be handing over the running of the world to my son, his cousins, his second cousins, and everyone else of that generation.

What have I learned? That before two people get married they should have honest discussions related to the question – What are our common values? If you do not share a lot of common values, there will be arguments that could kill the relationship. Topics include, but are not limited to: sex, money, work vs. play, "our lifestyle," alcohol and drugs, religion, having children, and "your relatives."

I have learned that a life with meaningful work *can* be a meaningful life. Also, if you can balance work and play, life is a worthwhile experience, sometimes a grand experience. If you put yourself in a position to have adventures, you will have them. Usually, they will turn out differently than your expectations. The challenge is to ride the current when it takes you in an unexpected direction.

NOTES

[1] For a review see: https://arxiv.org/pdf/1205.6835.pdf (Krisciunas 2012).

[2] According to a web item by *The Australian*, on May 13, 2018, when Brian became Vice-Chancellor of Australian National University in 2016 he turned down an annual salary of nearly $1 million because he thought it was too much! He accepted a salary between $610,000 and $625,000.

See also https://www.smh.com.au/national/lunch-with-anu-vice-chancellor-brian-schmidt-20190318-p5157j.html

Brian told me [or maybe he told Nick, who told me] that when he turned down the initial million dollar salary, they said, "But you will be meeting and negotiating with people that have million dollar salaries. They won't respect you." He said, "I have a Nobel Prize. I think they'll respect me."

[3] https://baas.aas.org/pub/hugo-schwarz-1953-2006/release/1

[4] One measure of a scientist's productivity and influence on his field is the number of refereed publications on which he or she is listed as a coauthor. As of November 11, 2020, that number for me was 134. I was first author or sole author of 37 of those articles. Another measure is the number of citations that those papers have received in the scientific literature. As of the time of this writing, that number was 11,772. Yet another metric is the "Hirsch-index" or *h-index*, which is the number of publications (N) an author has that have been cited at least N times. My number is 50. The world record in astronomy, as far as I know, is held by Alex Filippenko at UC Berkeley, with 846 refereed papers (51 as first author), 125,806 citations, and an *h-index* of 148. Jim Gunn at Princeton has 389 refereed publications (39 as first author), 120,888 total citations, and an *h-index* of 163. In the field of entomology T. D. A. Cockerell (1866-1948) published 3904 papers over a span of more than 50 years (Price 1976, on p. 300).

[5] The 2010 paper is based on data from seven cycles of the Moon's phases. The result of 39 cycles of the Moon's phases (1145 days) is shown in chapter 8 of my book *A Guide to Wider Horizons*.

[6] Some careful thought and strategic digging through my archives indicates that this discussion took place on Saturday, May 28, 2005. Contrast my willingness to support the further education of Carmen, Dana, and Sandra with my father's comment about not being able to go to medical school (p. 13 above).

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