

# **The Setting Sun: A Life's Adventure**

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*If I have seen further than others, it is by standing upon the shoulders of my students*

## **1.0 Introduction**

As I am now retired I am reflecting on my life and think about how my life tracked the way it has. How much is due to genetics? How much is due to my early up-bringing? How much is due to my own personal drive? How much is simply due to chance? These are questions which I seek to answer by documenting my life to this day. I begin by reviewing my early years followed by my college years and then life in Miami. From there I move to my life as a professor at Colorado State University and the directions that my scientific investigations have taken me. I also talk about non-science or pseudo science issues that I have explored. I discuss life in the mountains including building a cabin and life surrounding that era, followed by the yurt days, our cabin on the western slope of Colorado and life in Arizona. I discuss some of the fun things I have done, some kind of weird I must admit.

I write each chapter beginning with my science/professional work and then go into the “fun stuff”. For those readers who are not into the “science stuff”, I encourage you to skip those parts and jump into the “fun stuff”. On the other hand, if you are mainly interested in the “science stuff”, I will not feel bad if you skip the “fun stuff”.

## **2.0 My Early Years**

I grew up in Upstate New York outside the small town of Little Falls, N.Y. My parents were Ernest and Marian Cotton. My father was an auto mechanic specializing in body and fender work, and an all around Mr. Fix-it type of person. My mother took care of things at home including what I now think was a hyperactive son. She was a school teacher and taught in one-room country schools until she married my Dad at which time she was forced to give up teaching. In country schools at that time woman teachers could not be married.

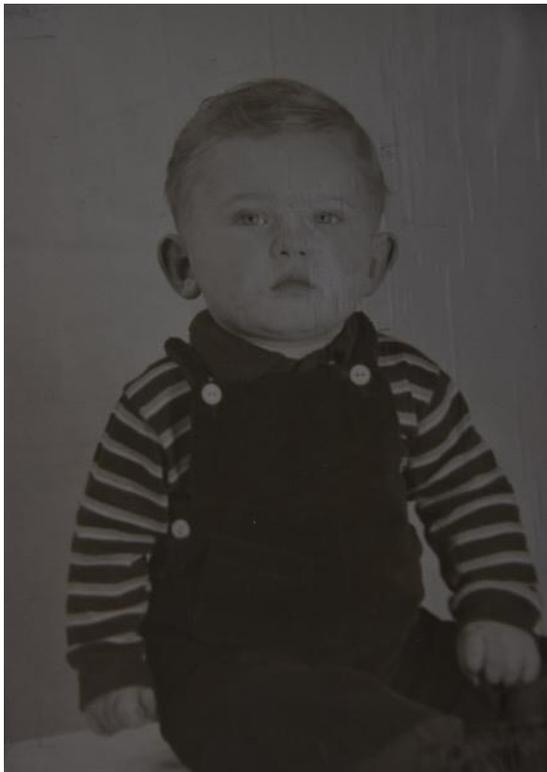
Both my parents were brought up on farms. I have traced the Cotton family back to my great-grandfather Allen who farmed near Cooperstown, NY. His parents migrated from England. The story my father told me is that Allen ran away from home at age 13 to join the Union Army in the Civil War. Because he was too young to go into battle they sent him out picking mullen plant leaves for the officers to use as toilet paper. My father claims his tombstone reads he was “Mullener of the Union Army”. I have recently tried to locate his tombstone in the Cooperstown area and verify this but could not find it.

My grandfather, William Pit Cotton, was also born in the Cooperstown area. He married my grandmother Sophia Maudrich and they served as share croppers growing hops for the Annheiser-Busch brewery. Grandpa Cotton loved horses and told about his experience working with the brewery Clydesdales. They eventually had to move elsewhere as the hops

were attacked by a blight in the area. My grandmother Cotton was borne in Germany and migrated to the Albany area with her parents in the latter part of the 19<sup>th</sup> century. She actually was confirmed in St. Paul's Lutheran Church in Albany which is the church Vollie and I were married and subsequently lived in for 3 years as janitors (formally called Sexton).

On my mother's side of the family my grandmother, Lydia Owens was born in the U.S. of parents of Welch descent. My grandfather Reuben Klock was also born in the U.S. from a family that settled in the Mohawk valley before the revolutionary war. There is a fortified family homestead east of Little Falls called Fort Klock. At one time we talked to the curator of the Fort who did a background check of the Klock family and found that the original name was von Gluck which means good luck. I never knew my grandfather as he drowned when I was a toddler while working on a dam on the Mohawk River near the family farm.

My recollections of life before I entered grade school are spotty. Born in 1940, those years were during World War II. I remember looking up to see the sky filled with aircraft that must have been on their way to Europe. My parents raised goats as part of the measures taken at that time to overcome food shortages. To this day I have a hard time eating goat cheese because I didn't like goat milk or the smell of goats. I remember a two-wheeled cart that my father made to be pulled by one of the goats. My main recollection is that it came off the goat and I flipped backward on my head!



*Figure 1: Me as a toddler*

The house was located in the bottom of the Mohawk Valley and was situated between the old Route 5, now called the River Road, and the "new" Route 5. A gravel connecting

Our house was quite small, especially by today's standards. The property used to be the "Shady Corner" gas station and my Dad converted the gas station building into the house. It had two small bedrooms a single bathroom, a small living room, and a kitchen. The kitchen and my bedroom was a shed-type construction added to the original gas station building. It also had a partial basement with less than 6' of head space. I guess the entire living area was less than 800 sq ft.; less than our small mountain cabin.



*Figure 2: Home near Little Falls, NY where I grew up*

road existed on the west side, and on the east was a large, brick house that dated back to the early 1800's. It had tall southern-style pillars in the front and very tall rooms with windows in which the glass had sagged with time. In the north side of the basement was a hidden room that was used as part of the "underground railroad" to hide runaway slaves as they traveled to Canada.

Across the road from our house was a large swamp area with lots of red-winged black birds and pheasants. In the summer, it was very hot and humid, with loads of mosquitoes. Perhaps that is one reason we often went camping during the summer months? Before I was school age we set up camp at Canadarago Lake which is out of the Mohawk Valley maybe 35 to 40 miles to the south. It is west of Otsego Lake where Cooperstown, NY is located. While this does not seem far by today's standards remember the roads were not as well maintained and the cars were not as fast either. I remember one time we had a Model A Ford that the bumper fell off on one side. My father took off his belt and used it to tie the end of the bumper back on.

First we had a small camping trailer, maybe 14 foot long and Dad set up a large canvas enclosure like an enclosed awning. The trailer was kept there year around. Then we moved up to this much larger converted bus that had the engine compartment removed. I remember we had rather small fishing boats, maybe 12 to 14' long and had something like 0.5HP outboard motors. These were not the most seaworthy craft as I remember one time waves spilling over the stern and my mom and dad bailing vigorously.

Fishing was one of the main activities at the lake. I remember once catching a pickerel that must have been 2' long! If I lifted it as high as I could the tail still dragged on the ground. I used to play with the grandson of the campground owners. One time the two of us went into the park store where there was this thing that one could purchase a chance to push this metal rod into holes and pull out a note that said you either won a prize or not. Well the two of us unknowingly kept busy punching in the holes trying to get a winning ticket. Boy did we get in trouble! I think my father paid half of the cost of those tickets.

I learned to swim at a very young age. I remember at the age of 2 running down to the end of the dock, diving into the lake and swimming out to the float some 50' away. One time some women screamed when I did it and I couldn't figure out what all the fuss was about.

Sometimes just my father and I would go camping as my mother was in a hospital in Albany, NY. We would drive to Albany and visit her there. I didn't realize it at the time but it was a mental hospital as my mother had frequent nervous breakdowns. I think the first time I realized how serious her mental problems were when in first grade in lunch line a boy told me my mother attempted to kill herself. It turned out he was the son of a nurse in Little Falls hospital and he had overheard them talking about my mother. I cried and told him she did not! But afterwards, I guess my father contacted the parents and told them what happened. They were very apologetic and even gave me a pair of cowboy boots. Throughout the years at home my mother had repeated episodes of nervous breakdowns where she would become sad, eyes water, facial features sag, cry, etc. I learned to detect the onset of a break down. This ability to detect serious depression later helped me in my role as advisor of my graduate students. Whenever I detected those symptoms in my students I backed off on putting the pressure on them to get their research done. One time at a holiday reception I talked to the wife of one of my graduate students. All my receptor bells and whistles turned on and I was still shaking when I got home that night. Several years later she committed suicide! In retrospect, my life of rather crazy outside of work activities, love of being outside, love of

being in the sun, running cycling, sailing and so forth was my attempt to avoid falling into chronic depression.

I actually started school in a one room country school with a single teacher that taught grades kindergarten through 8<sup>th</sup> grade. Two of my cousins, Gary and Paul Klock also attended the country school. At the end of kindergarten, Little Falls centralized the school system and all us “farmers” were moved to Little Falls Monroe Street School. This school was in the north side of town which was more the upper class part of town. The other kids there treated us as dumb farmers and there were a lot of fights resulting from their picking on us. I spent two years at Monroe Street and did quite poorly. For some reason I had trouble learning to read. I now suspect I had a mild form of Attention Deficit Disorder(ADD) or maybe I was “on the spectrum” as our son Chris would say. My first grade teacher even told my parents that I would never be college material. Then the school district moved a bunch of us to an old rickety brick school called Jefferson Street School. It was located in the Polish and Slav section of town right next door to a Lutheran Church. There I was fortunate to encounter Miss Bowen(later Mrs Babenec) as teacher. At the end of third grade she explained to me that she needed another year to work on my reading and thus I failed 3<sup>rd</sup> grade. It is interesting that every one of the country school students I knew failed at least one grade when moved into the centralized system. Even my cousin Gary who was an excellent student and went on to get a BS in engineering from Cornell and an MBA from Pitt. But that decision by Miss Bowen and the work she did with me was the turning point in my life. Up to that time I thought of myself as stupid. By the end of the second year in third grade I could read and by 5<sup>th</sup> grade I won awards for the top achiever in my class. I think that had I been just passed on as they would do nowadays, I might never have learned to read and would have been lucky to graduate from high school.

Growing up in the country there were few neighbors or kids to play with. There was a neighbor girl, Martha Geisler, who was a year younger than me. We grew up playing together much like brother and sister. We had fun playing together and fought over trivia just like brother and sister. I remember once we found a large clear Little Falls diamond that we fought over who would be its owner. We eventually threw this large stone in the bushes because we could not come to a decision on this matter. Martha’s mother, Margaret, was like a second mother to me. I still remember the wonderful cookies she would bake for us.

There were advantages and disadvantages to growing up with few neighbor kids to play with. On the negative side I did not learn to play sports like baseball, basketball, and football at a young age. But on the positive side I learned to be quite independent and do things like hiking and biking in the countryside by myself. I even cross country skied by myself around the area and on a few occasions after I turned 14, I did so while hunting small game.

Speaking of building independence, when I was 14 my parents let me stay at our cabin near East Creek Reservoir(I think it is now called Beitleman reservoir) all by myself for several weeks at a time. They would come up every weekend and re-supply me with food. I, along with my dog Penny, would take our small fishing boat out and motor up the lake where I would fish for small mouth bass. I usually did quite well, sometimes catching bass as large as 16 to 22 inches long. I would cook for myself and take long hikes in the area of the cabin. I even had a girl friend whose parents had a cabin near ours. They were from Rome, N.Y.

When I was 9 years old my father bought what we called a “doodlebug”. It was a 1939 Plymouth with a standard three-speed transmission that the frame had been shortened so the rear wheels were just behind the front seat. It had no rear suspension at all. It had no top or

doors. Since the gas tank had been removed the gas tank was a one gallon gas can mounted to the side of the forward section. We used it to take our outboard motors from our small cabin down to the lake which was about ½ a mile from the cabin. So on the rear was a mount to place our outboard motors on. I learned to drive it when I was 9 and was the main driver to take our outboard motors to the lake. On one occasion I slid off the road a bit and got a tree caught between the front wheel and the chassis. So I had my first auto accident at 9. In a neighboring cabin there were these cute blond twin girls about my age. I used to take them out for a ride along the dirt roads near the cabin. One time I ran out of gas(remember only a 1 gallon can). I was too young to appreciate the irony of running out of gas with these two blonds! When I was 10 years old I taught a 16 year old boy how to drive. He stayed with his grandmother in a cabin nearby and used to hang out with our family. I never met his parents but he did not have access to a car. But I trained him well enough that he passed his drivers test. I was a bit pissed off that he could legally drive on the road and I couldn't, even though I taught him how to drive.

My first girlfriend was a blond in my church and Jefferson Street School, Debbie Babuska. She was the love of my life in 6<sup>th</sup> grade. She was the smartest student in our class. I guess I have always been attracted to smart women!

I think it was in the 5<sup>th</sup> or 6<sup>th</sup> grade that I first developed an interest in science and considered becoming a scientist when I grew up. Those who know me might find it interesting to know that at one time I even thought of becoming a minister!

In fifth grade I got interested in playing music and was recruited to play the baritone horn. My parents must have scraped together the money to buy the instrument. I guess I learned quickly so by 6<sup>th</sup> grade the music teacher recruited me to play in the high school band. I guess they really needed baritone players! I used to drop off the horn when the school bus stopped at the high school and then walk across town to band practice in the afternoon. Another 6<sup>th</sup> grader from a different school, named Frank Wynuk played the saxophone in the band as well. Frank and I became good friends over the years. I remember the first marching practice with that horn. For me as a 6<sup>th</sup> grader that horn was big and heavy! I had a real hard time carrying the darn thing let alone playing it while trying to keep in step marching. I came home with my arms aching and crying saying I couldn't do it. But eventually I became strong enough and played with the band in football games and special occasion parades. Some of those late-season football games were really cold to be sitting on the bleachers. Moreover, I had to be careful to keep the mouthpiece in my pocket otherwise my lips would freeze to it. I continued to play in the band all the way through high school and even played in the ROTC band at the U of Cincinnati. In my senior year, and a few summers thereafter, I even played semi-professionally in the Little Falls City Band which played during parades and once a week in the summer concerts in the band shelter in one of the two city parks. We also played at county retirement homes. There was an annual clam bake where we could drink all the booze and eat as much as we could hold and was paid something like \$50 for the summer season!

I got a lot of hands-on experience with construction and repairing cars growing up with my family. I helped my parents build two cabins. Your first thought might be that we had lots of money but that was not the case. We built those cabins with used materials some of which came from buildings in Little Falls that were torn down. This included windows and doors and even wainscoting for interior finishing. I hated the wainscoting as it took forever to install those narrow tongue and groove boards. The main flooring beams and floor boards came from scavenging through the fields in my grandfather's farm which bordered East Creek

about 5 miles below the dam. Sometimes during high runoff, the upper retaining boards of the dam would break and wash downstream. We could find these large planks and beams strewn over the lowlands and found some even caught up in trees!

My father was an auto mechanic and supplemented his income working in an auto dealership, by buying fixer-ups and repairing them, painting them and then selling them at a modest profit. I used to help him work on those cars. When I was 14 I helped him fix up a 1948 Chevy sedan which for some reason became mine. At that time English style three speed bikes became the fad as opposed to those heavy, single-speed, slow fat tired bikes that have come back into style today. Well not being able to drive legally yet, I had little use for the Chevy so I sold it and bought a new English-made bike. I used to ride it all over the countryside including long uphill rides to my cousin Gary and Paul's house.

I began saving for college when I was in 9<sup>th</sup> grade. I worked a variety of jobs in the summers ranging from mowing lawns for the neighbors, to working as a grease monkey in the garage where my father worked, to working on the bull gang of a bicycle factory. In that latter job I had to push handcarts loaded with heavy bicycle parts and had to keep up with people working on the assembly line. Because they were paid for piece work as opposed to hourly, they were quite demanding that I got the supplies to them before they ran out.

When I was 15 Brent Scott who was a few years older than me, got interested in flying. His parents owned the camp on East Creek Reservoir across from ours. He gave me a stack of old flying magazines. After reading them cover-to-cover I really got excited about flying. So I bummed up to the local airport near Fort Plain, NY and began taking flying lessons. I used to take a small amount from my income at the bicycle factory to pay for the instructor time. But I paid the airplane rental by painting hangars and pumping gas. I was a quick learner and in October on my 16<sup>th</sup> birthday my instructor Jack Daniels signed me off to solo. The plane was a tandem-seated Piper J-3 Cub that you had to hand-prop-start. Jack was over 6 foot and must have weighed over 200lbs. So, on my first landing attempt, the lack of his weight resulted in the plane floating forever and forced me to make a second landing attempt. That landing went well and I continued instruction and solo flights.

One time I saw a cigarette advertisement on TV in which a test pilot for Piper Aircraft flew a Tripacer and demonstrated how to do a loop. He described step-by-step how he put his nose down and developed enough airspeed to reach near red-line, pulled full back on the yoke and when it came over the top chopped power and let her level out. He then got out of the plane and smoked a Pall Mall or some such cigarette. Well I decided that looked simple enough so I took the J-3 up to 3000AGL, put the nose down and reached red-line speed, hauled the stick back to my stomach, and proceeded to make a beautiful full loop. However, at the top the engine quit because the fuel was gravity-fed. Fortunately the propeller continued to wind mill and the engine started right up again. Remember this plane did not have a starter. I later learned that it was not a good idea to do this with a cub as had I stalled(wing stall) in the inverted position, the wings would have ripped off! I also self-taught myself to do spins with the cub. This was rather challenging as the cub was so stable that it was quite difficult to spin.

The following summer I could not find a job. I guess there was an economic slowdown in the area. What to do? My father suggested that I work out of the garage at home doing body and fender work. I also might be able to buy a few older cars that were rusted out and pretty them up for resale. My father had equipped the garage at home for auto repair and painting so all I had to do is learn the trade and get materials. Having no other choice at the age of 17 I went into business. The area in Upstate New York was part of the rust belt as they salted the roads

heavily with sodium chloride salt in the winter. Cars with low mileage, often less than 50,000 miles would have gaping holes in their sides and even in the floor boards. I learned to cut out the rusted areas back to good metal, sand it down and cover it with riveted-on metal. My father instructed me that riveting the metal on lasted longer than welding as the heat from the welding would destroy any remaining undercoat of the good metal. I then would cover the sheet metal with Bondo-fibre glass and sand it to make a smooth transition to the untouched surface. Then I would cover it with hand-sandable putty, then sandable primer, followed by painting. After only a few weeks I had enough customers to keep me busy for the summer. My first real disaster was a customer paint job on a 1955 Ford with metallic gray paint. This was my first experience with metallic paints. When I finished painting it, it looked pretty good. But when I came back 30 minutes later I was horrified to find that the metallic paint had sagged into waves of darker color. The added weight of the bits of glittering metal caused the paint to run well after normal paints would have set. I called my Dad at work and told him my experience and asked what to do? He said my only recourse was to sand it all down again and repaint it. Sanding that hard new paint was a lot of work and I was careful to not spray as much paint on the second time around and to give it a thin overspray at the end to bring out the metallic glitter.

In addition, to fill in blank time between customer jobs I bought several cars from the back lot of local auto dealers. These were cars that were too old for them to put the time and money into repairing as their resale values were so low. I remember once buying 5 cars from a dealer for \$125! I would then spend perhaps 2 to 3 days per car fixing them up and painting them and I would sell them for \$300 to \$350 each with only \$25 to \$30 in material costs. As a result I soon was making more than I could have working for someone else and in fact buying and selling cars was much more profitable than doing the same work for customers.

As an example I bought what I think was a 1952 Nash Rambler that had been in a head-on collision and totaled. This was one of the first small economy cars of the era. It even inspired a hit song called "Beep-Beep"! As a result they were a pretty easy car to sell. I bought it for \$35. I went to the local junk yard where I stripped another Rambler of its front bumper, grill, radiator, and windshield for something like \$25. I had to remove the windshield from the junkyard car and then install it in the car I bought without breaking it. That was a challenge as I had never done that before. It is interesting that the old windshield bore the head print and brown hair of someone who had put their head into it. My family and I drove that car for about 3 months and then I sold it for \$350.

Because I had all my previously accrued money tied up in cars and because I clearly needed to put away a lot more money for college, I suspended my flying activities. This was a hard decision but looking back I am amazed that I had the forethought at that age to make such a decision.

One of the benefits of buying and selling cars as a means of saving money for college was that I always had "wheels". In fact, the cars I sold were generally those that I drove for a while. I didn't even have to put up a for sale sign as people would come up and ask me if I wanted to sell that newly painted car. I think that by the time I graduated from high school I had owned something like 35 cars! One consequence of my having wheels is I was in high demand to take my buddies along for rides. This got me in with a rough crowd that included drinking. This began at the age of 16. How I survived that era I will never know. In New York State at the time, if you were under the age of 18 you couldn't drive after dark unless you took Drivers Education. But I could not find time in my school schedule to take Drivers Ed. My parents

would let me drive into town and park the car and then “do the town” with my buddies on weekend nights.

For a while we would try to get into local bars on the south side of town where the bartenders were more lenient in selling beer to minors. One time we were in this bar run by this short round-shaped Italian. We were in the back room playing cards when we spied a policeman coming into the bar. The policeman was the father of one of my buddies named Frank Wynuk, but Frank wasn't with us but his father new us well. I think there were about 6 of us and we all crammed into the men's and ladies restrooms. Shortly we heard a knock on the door and the owner said it was OK to come out. He lead us out through a small hidden half-door and we took off. After that we seldom visited the bars in Little Falls.

Instead we went up to neighboring towns such as Illion. We became regulars at a bar there, where we drank, played cards, and shuffle board. Because I was only supposed to be driving to the edge of Little Falls since I was not legally allowed to drive at night, I developed the practice of reaching down under the dash and removing the speedometer cable whenever we drove up to Illion. Years later I told my Dad what I had done and he said he got rid of that car because it had used so much oil for the mileage driven! Ooops!

In October 1958 I turned 18 and was then allowed to drive after dark. Shortly thereafter, friends in Luther League asked me to drive them up to neighboring Herkimer to participate in a visit to a Luther League group there. I had participated in Luther League since I was confirmed back in 6<sup>th</sup> grade and often enjoyed the field trips to other churches. So I agreed and filled up the car with 5 teenagers plus me. This adventure was to change my life forever. The person in charge was this lovely young brunette with a ponytail. We got talking and I found out she was a junior in high school and had been borne in Germany. Her name was Vollie which was a nickname her class mates had given her as her real name was Waltraud. I asked her to give me a tour of their church and even invited her to ride home with us even though there wasn't any space. She declined and I found out later she had a ride with her boyfriend at the time. My mother claimed that when I got home I said I met the girl I was going to marry.

A few months later, Frank Bucafurno, who had a desk across from me in home room, told me he was dating this German girl named Vollie. One evening when my buddies and I were out cruising town we spied Frank in his Jeepster driving around town with this girl. So we decided to follow him around doing what we called “ball busting”. It turned out Vollie was the passenger in that car. A few weeks later at a dance where Frank played in the band, he came up to me and asked me if I would be willing to keep Vollie busy as he had another girl that he wanted to try to make it with. This seemed interesting so I asked her to dance and we danced the night away. Later we went out for Pizza and parking. The parking was interesting because the heater motor in my car was broken so it became quite cold when the car wasn't moving.

After that I tried to stop by her house on my way to Herkimer to get auto parts. Her mother asked her who was that guy who keeps stopping by? Vollie had no idea who it could be. Some time after that we made contact and began dating. I told her about my car business and in the discussion mentioned that I had bought a totaled Nash Rambler and fixed it up and sold it for over \$300 profit. I then realized that she was the one who put her head through the windshield! Well Vollie's father became very upset because he loved that little car. He called me a darn liar and wouldn't let me in their house. But eventually I was allowed in the house

and I got along fine with her parents after that. By this time I was head over heels in love with Vollie.

I still would go out drinking with my buddies but Vollie wouldn't have anything to do with me when I was drinking. Eventually I moderated this behavior with her coercing. One time we were on a date and stopped by a hamburger stand to get Mexican Hots(hamburgers with hot chilis). We were sitting there in my newly painted 1952 Ford convertible with the top down. Along came this guy who asked if I would sell it. We made a deal right there and I practically sold it out from under us! This was only two weeks before the prom. I had a 1952 Pontiac convertible waiting to get fixed up. It was an ugly faded green color with ratty top, holes in the upholstery, a bashed in door on the left side, and no second gear. I drove it up to Vollie's house to go on a date and her mother took one look at it and said: you are going to take my daughter to the prom in dat(mit German accent)?

Well I went to work on it. I went to the junk yard and found a transmission. I fixed up the door and painted the car black with a red dash. I went to Utica and got a new top and seat covers. By the time of the prom that car looked striking, although it had new paint smells to it. Vollie's mother was impressed.

Generally I did well in school but with all the car business and dating Vollie, I had gotten behind in my classes, particularly advanced algebra. I did poorly on a pre-test for the New York State Regents examination. Vollie helped me study for this exam by giving me old regents tests. With her help I ended up getting the highest score of anyone in our class.

By this time I had decided what to do with my life and had applied to study aeronautical engineering at the University of Cincinnati. My goal was to combine flying and research as a test pilot. While I really enjoyed flying I could not see myself working as a bus driver(airline pilot). I chose Cincinnati because it had a coop program in which students went to school for a term and then worked a term in private industry. The first 4 terms were all school but after that I should earn enough that I could cover my education costs. I had saved enough from my working and my parents sold our little cabin near the lake for \$1700 so that should cover me until I got some income from working in industry.

### **3.0 College Years**

After graduation and a summer's hard work, working on cars, my parents, Vollie, and I drove my Pontiac down to Cincinnati. They left me down there without wheels for the first time in several years. They also left me without Vollie!

After a barrage of placement examines which I took seriously and did well on I was placed in the most advanced curriculum for the engineering students. I later learned that the more streetwise students didn't do well on purpose so they would be placed in a less demanding curriculum. Duh! I found that the academic load I was assigned which had 21 credit hours which included drafting classes and labs, meant that I was going to class over 30 hours a week! It meant I had to study and work on assignments until 2AM and then be ready for 0800 classes the next morning. I did OK on the classes but I decided I could have done better had I more time to really focus on the math and physics classes that I really enjoyed. I was also in ROTC and played my baritone horn in the ROTC band. My short stint in ROTC convinced me that I was not military material. Anyone that knows me knows that "I march to my own drummer" and really question authority. This is not the military style.

At the end of the first quarter I went home to visit Vollie and family and brought back my Pontiac. Yeh, I had wheels again! Vollie and I agreed that we would date other people as she was in her senior year in high school and here I was 700 miles away. I dated some but my heart was just not in it. Every time there was an opportunity like a 3-day weekend I would find buddies who lived in Upstate New York and off we would go making a 12-14hour drive both ways. You do the arithmetic but it meant we spent a day on the road for a 3-day weekend.

At the end of the spring 1960 term, Vollie came to visit. I put her up at a friend's aunt and uncles house in town. We "did Cincinnati", touring the city and going out dancing. We then made the 14 hour drive back to Little Falls and Herkimer. It was quite the time.

I only got a few weeks break in the summer because I was back in classes since they couldn't find me, nor over half my aeronautical engineering class, coop jobs. This was really taking a toll on my limited finances. I knew that if they didn't find me a coop job by the end of the fall term I would be out of money. Vollie had graduated from high school and entered Albany State in the fall of 1960.

At the end of the fall term, with no coop job prospects, whatsoever, and being totally out of money I dropped out of the University of Cincinnati and returned home. I went back to working on cars and in a shoe factory we locally nicknamed "Allegro College", while I applied at the only two schools I could afford. One was Utica College of Syracuse University which was close enough for me to live and work at home and commute to college. The other was at Albany State where I would have to live on campus but at that time there was no tuition. I was accepted in both schools and going to Albany was a no-brainer for me as Vollie was already enrolled there.

So in the spring of 1961 I entered Albany State Teachers College where I majored in math and physics. At the time of entrance Albany was only a teachers college so both Vollie and I were taking education classes. The transition to a more liberal arts college where my course program was not canned or pre-programmed was a welcome relief. It was a breeze taking only 15 credit hours a semester and this gave me an opportunity to really learn the fundamentals of math and physics and time to think. On top of that I got to see Vollie on a daily basis and we would go dating and hang out at the bars with college friends on weekends.

My early plans for becoming a test pilot were abandoned when I realized that life in the military was not for me and that while I found aeronautical engineering fascinating the engineering philosophy of solving immediate problems and not getting down to the fundamentals was just not my style. I now set my sights on either a teaching career or a science-based career, perhaps in a university where I could do both.

In the summer of 1961 I returned to Little Falls and lived at home. My father gave me a list of customers who wanted me to work on their cars and I never made it through the entire list before I returned to Albany. Life on campus was very different than now days. The men's and women's dormitories were physically separated and moreover, after 10:00PM there was no outside communication allowed for the women. My Dad always had a few CB radios around home so he loaned us a couple. We set them up so we could talk back and forth after hours. Naturally Vollie's friends also wanted to make use of this bootleg communication system.

I soon joined a fraternity called Kappa Beta. This was somewhat of a departure from my lifestyle as I have never been much of a club person. But the fraternities at Albany were not

**national organizations and provided a mechanism for cheap entertainment. My closest friends were members of Kappa Beta and some of them I still remain in contact with.**

**After three years of dating and close contact, oops!, Vollie became pregnant. Today this wouldn't be a big deal but in those days it really changed our lives. Vollie wanted to drop out of school but I insisted that she should continue and that with her scholarship and my jobs we should both be able to continue our studies. After a rushed marriage we moved into a small firetrap apartment. The apartment was so small that in the bathroom there was not enough room for a bathtub so part of the wall had been cut away so that part of the bathtub extended under the wallboard. Moreover the water tank was suspended from the ceiling with a long pull-chain. The worst was the bed which was a double size with a queen size mattress. If you rolled too much to the side, oops, you would fall out of bed!**

**We spent the summer of 1962 living in a converted chicken coop at my parent's home. Both our parents were very supportive and even provided us a small living allowance which was difficult for them. Vollie helped me working on cars sanding and masking them before painting. Again my list of people who wanted to work on their cars was longer than I could accomplish in one summer.**

**In the fall of 1962 we returned to Albany with Vollie being very pregnant. We found an apartment not far from campus on a slum street, called Elberon Place. At least it was roomier than our first apartment. The first floor was divided into two apartments with the rear one separated with a double-sided locked door. This was a rough neighborhood with police cars and sirens blaring several times a week. We hardly got settled into the apartment when Vollie began having labor pains and I took her to Albany Medical Center. In those days the husband was kept totally out of the loop. So I had no idea what was going on but the doctors found out at the last minute this was going to be a breach birth. Being a teaching hospital Vollie became quite a celebrity with the interns. But "everything came out well" and we began our new life as a family.**

**Life as an undergraduate family was quite challenging. First of all Vollie got kicked out of her Spanish class as the old maid professor said "that she made her bed and must now lay in it". Vollie only missed less than two weeks of class to have our son Billy. Later on she took that class and got an A in it and maybe won back some of her teachers respect. As for me I worked two jobs. For one I cleaned the homes of a couple of professors. This was good work and I enjoyed listening to their classical music while working. The other job was not so pleasant. I worked in the student union and had to wear a suit and tie while working. I handed out game boards and sporting equipment like ping pong paddles. But the worst part of the job was that I had to meander through the lounge breaking up couples necking—Ugh! Back to ball busting!**

**We attempted to arrange our class schedules so that only one of us was in class at the same time. We often passed each other walking back and forth from classes. Sometimes coming home to diapers full of you-know-what! But we both did well academically. As a mathematics major and physics minor I especially enjoyed taking classes like E&M, nuclear physics, and thermodynamics. On a whim I took an elective introduction to meteorology class from Narayan Gokhale. The course used calculus and I think it was based on a book by Horace Byers. It is not clear to me what the program was formally at that time or if it offered an undergraduate degree. I don't recall any undergraduate atmospheric science majors during the time I was at Albany. Dr. Gokhale taught in a formal, methodical manner and I really enjoyed the class. I found that Atmospheric Science combined my interest in physics with**

that of aviation as I had become acquainted with meteorology in ground school flight training. As a result in my senior year(I believe my first semester) I took a newly offered course in Physical Oceanography that a newly hired faculty member, Jon Scott, taught. I enjoyed that class as well. Both of those classes were offered in the Atmospheric Science Research Center(ASRC) building that was a converted warehouse on Central Avenue.

In my senior year(1964) I decided to apply for graduate studies in Physics at Albany. I was accepted and offered an assistantship. Then Jon Scott and Narayan Gokhale started recruiting me to do graduate work in atmospheric science in the newly-formed graduate department in atmospheric science. It was clear that Atmospheric Science interested me, and that it was an up-coming field so future job prospects were good. Moreover, they offered me \$500 more on the assistantship including the opportunity to work summers in Dr. Gokhale's laboratory. Being married with an infant son, financial considerations were very important.

In my senior year, I acquired the job of Sexton, or janitor of St. Paul's Lutheran Church. This job had been passed down from married Kappa Beta fraternity brothers for years. It was ideal for us as it provided a base income of \$1700/year as well as an apartment in the third floor of the rear of the church where there were classrooms and meeting rooms as well as the church office. The apartment overlooked Washington Park. The apartment provided adequate living space for the three of us plus all utilities(heat, electricity, and telephone) were paid for. The work involved cleaning the entire main church sanctuary on Saturdays, cleaning up the meeting rooms after weekday meetings, as well as the office, opening and closing the church on Sundays and other days such as lent and funerals, and ringing the bell. The work schedule was ideal in that it did not interfere with class schedules too much and much of the cleaning was done as a family operation with Vollie and I splitting the tasks and Billy playing in the church. Once a year or so the main floors of the sanctuary had to be sanded down and refinished which was a big task. One of the main challenges was keeping the little old ladies happy as they would complain if they found a bit of dust or got their white gloves dirty on the railings. Lent was always a challenge as there were mid-week services which conflicted with class and sometimes there were repeated snow storms where we had to shovel out the main entrance and rear entrance. One year there were a series of such Lent snow storms and one in particular started mid-afternoon and went on through the evening church service. At least 15 inches of snow fell during the period and could have been more. Vollie took the rear entrance and I the front or main entrance. I shoveled and shoveled and still couldn't keep the wide staircase open, only a three foot wide path up the steps. The old ladies complained anyway!

As a toddler, Billy learned to get around the entire church including climbing up the stairs to our 3<sup>rd</sup> floor apartment. Some of the old ladies had a fit seeing him going up step-by-step on his hands and knees. Our extended family in the church included the church pastors. Pastor Chuck Kuhl was just out of divinity school and served as assistant pastor. The head pastor left to another church and he had the job of running things until a new head pastor arrived. It was quite a challenge for this young and inexperienced pastor, but he did well. We gave him as much support as we could. We became close friends and I even acted as his best man at his wedding. We remain in contact to this day. Subsequently, near the end of our sexton tenure, a new head pastor was hired. It was Pastor Yingling who had quit his job as a scientist at GE, attended divinity school, and became the head pastor. Owing to our common scientific background we got along well.



Figure 3: Family photo left to right: Opa (Vollie's father), family friends, son Billy, Vollie, Grandma (my Mom), Oma (Vollie's Mom), Grandpa (my Dad), and Great granddad (my Grandfather).

I especially remember being in the church office when we heard on the radio the news about the assassination of President Kennedy. It was shocking to us all. Looking back, I wish I had responded by ringing the church bell in a toll for hours after I heard the news.



Figure 4: Family photo: Vollie, me, and Billy

Because I was in the teaching program at Albany (that was all there was when we started out), I had to student teach. In the fall semester I student taught in Schenectady in a school which was about 50% black. My cooperating teacher selected me because I was male and I was built like a football player. It was a rough school to teach in. It was also frustrating to see these obviously very smart boys who didn't want to display their smartness in front of their friends. As a result their performance was good but not as good as it could have been. That was a

challenging semester as I had to commute to Schenectady and we had to find baby sitters to cover the time I was not available to look after Billy. But this was nowhere near as challenging as the spring semester when Vollie student taught. Again we had to find baby sitters to cover the time Vollie was teaching (fortunately it was in Albany) and I was in class. Moreover, Vollie had to find the time to prepare her lecture notes in triplicate (she is a lousy typist) as required by her cooperating teacher, as well as the more normal mommy things, and help with cleaning the church. Moreover, her cooperating teacher was a non-native German speaker that required all class lessons not only to be done ahead of time in triplicate but she was reluctant to take on a student teacher the spring semester to begin with. Vollie, on the other hand, is a native speaker who could prepare a day's lesson in a few minutes by jotting down a few ideas on a 4X5 card and going at it. She is a natural in the class room. But the two did not hit it off and a few weeks before the end of the semester she pulled Vollie from student teaching. This meant that Vollie wouldn't graduate as planned in June as she was a few credits short of what was needed for graduation. This was after we had prepared graduation announcement cards with both our names on it. She was able to graduate after taking a class during the summer semester, but it naturally put a black cloud over my graduation ceremony.

In the fall of 1964 I entered the graduate program in Atmospheric Science and Vollie took a much needed breather from going to school. The department at SUNYA was located in the renovated office building on Central Avenue. That part of the city looked a lot better than it does now. During that first year Roger Cheng and I were the only graduate students. Drs Gokhale and Scott were joined by the newly hired Dr. Ulrich Czapski. I don't recall all the classes that were offered but it included cloud physics, and basic dynamics. I don't think Roger took the dynamics class so I alone took it as a more or less reading class from Dr. Czapski. I remember deriving almost every equation in Haltiner and Martiner's text.

I enjoyed Dr. Gokhale's teaching style, while Jon Scott was still a bit green in teaching he did all right. His visual contact with the audience left a bit to be desired. I remember one time Jon was writing away at the blackboard and not turning to the two of us at all, when I had to go to the bathroom. I left in the middle of his lecture and returned shortly after. I asked Roger if Jon had noted my absence and he said not at all. Now that is something when half your class walks out and you don't even notice it!

Ulrich Czapski, on the other hand, was consistently poorly prepared for class, no matter what class I took from him. I first attributed it to his lack of experience with the variety of new courses he had to cover.

For research, I was assigned a project by Dr. Gokhale to work on a vertical wind tunnel that was based on Duncan Blanchard's original wind tunnel he built at the GE research laboratory. Because of my experience getting my hands dirty working on cars this project fit me well. The tunnel I was given to work with had a lower box with a fan in it and a flat section at the top with a square tube in the middle that was the main wind tunnel working section. From the pictures I had of Blanchard's tunnel I realized it needed a back pressure cap above the main working section. So I ran home and asked, Vollie, for our colander which became the back pressure cap. The tunnel still did not produce a steady flow through the working section but instead experienced chaotic oscillations. Owing to my experience in aircraft and aeronautical engineering I quickly diagnosed the problem as being due to turbulence induced by corner flow along the flat top transition to the lower part of the working section of the chamber. I then redesigned the tunnel so that it had a smooth flow transition into the vertical tunnel and that worked fine. I was able to carry out experiments on raindrop collision and breakup that led to my MS thesis and my first reviewed publication.

During the summer Narayan hired several local high school students to work in his laboratory in the ASRC building in Central Avenue. One of these was Bill Taffe who subsequently went on to get his PhD at the University of Chicago under Dr. Heinze and went on to form the meteorology department at Plymouth State College in Massachusetts and then to become department head in Computer Science there. Bill and his wife Betty-Jo remain good friends and are enjoying retirement life now. We frequently meet them at a campground in Arizona as they travel west to visit their kids in California.

During my second year (fall 1965) in graduate study Dr. Harry Hamilton joined the faculty. He was an excellent lecturer. We also had about 6 new students. One of these was Bob Ryan who I knew as a hell-raising undergraduate at Albany who was a member of the heavy drinking SLS Fraternity. Bob went on to become a TV personality on the Today Show and still is active in a DC-area TV station. He was also president of the AMS at one time. I am having trouble remembering the names of the other students. One was Eric Walter who the last I heard worked for the Museum at the U of Northern Arizona in Flagstaff. There was Jim Drappo who I have run into occasionally at conferences. He works for PNNL, a DOE National Laboratory. Then there was Jim Gould that worked with Narayan on contact nucleation studies. In fact, I had read an article by Bob Knollenberg on the nucleation of ice by urea. We replicated Bob's work by dropping urea dust on supercooled drops on a cold-stage used to study homogeneous and immersion-freezing nucleation of ice. Then Narayan suggested dropping sand onto the supercooled drops which also promoted freezing. This led to the pioneering work on contact nucleation by Narayan and students. There was a student named Rich Nelson who worked on giant aerosol, now called giant cloud condensation

nuclei(GCCN), who loved outdoor life. I think he became the live-in director of Camp Dippykill for some time. John Spengler was also a member of that second year class. He now works for Harvard University and is the son of the late Ken Spengler the former AMS Executive Secretary. He did work on contact nucleation using a much larger vertical wind tunnel than the one I worked on. I am not certain if Jim McTaggart-Cowen was also a member of that class. He may have come in after I left. He also worked for Narayan.

It is interesting that much of the work in Narayan's group on GCCN and contact nucleation was pioneering and is the basis of a lot of active research today.

During my first year Ulrich Czapski and I got along well. One time he took me out downhill skiing for my first time ever. Using my old homemade cross country skis it was a bit of a disaster as I fell more than I stayed up on those icy Vermont mountainsides! But in my second year Ulrich and I had a bit of a falling out. As I said, I was disappointed that he came to class ill-prepared but attributed it to his being dumped into classes that he was not familiar with. Then I took his micrometeorology class which was his area of specialization. When he came to class as ill-prepared as in the other classes and presented some of the poorest lectures that I have ever had in my undergraduate and graduate training over 10 years, I became totally disillusioned with him. I apparently displayed my disgust with his lectures in some ways that I can't remember. But I remember that he gave me a B in the class(the only one in my graduate study at Albany) because of my "bad attitude", even though I received the highest score on each examination! I don't know if it ever sank in what the reason was for my bad attitude. Nowadays students would have protested such a grade!

As the senior graduate student in my second year I volunteered or was coerced into teaching an instruments laboratory which was as much a learning experience for me as it was the other graduate students. At the time Vince Schaefer ran field projects at Yellowstone National Park for several years. I was disappointed that he never invited any of the graduate students at Albany. He did invite a number of students from around the country including a friend of mine, Ward Hindman. Ward later received his MS from Colorado State University and a PhD from the University of Washington and then became a professor at CCNY until his retirement. Since none of the graduate students at Albany participated in the Yellowstone field campaigns I decided to organize my own field campaign at Whiteface Mountain where ASRC has a cabin for carrying out field research. I proposed to carry out dry ice seeding experiments using hand-made metal baskets filled with chunks of dry ice that we would suspend from the chairlifts. I got the approval and financial support for travel from Dr. Gokhale and got the approval from the Whiteface Mountain ski authority. So a number of us graduate students(maybe all) spent a long weekend at Whiteface and stayed at the ASRC log cabin. It was an enjoyable weekend where we snowshoed in the moon light, and did some downhill skiing. The desired cap cloud that the chair lifts moved through never materialized but one cold morning we did get the dry ice to homogeneously nucleate a plume of ice crystals in the ice supersaturated air. It was something to see a plume of glittering ice crystals trailing behind the chair lifts in the morning sunshine!

When writing up my masters thesis I was faced with the dilemma that the SUNYA library and the department had virtually nothing on atmospheric science. I used to bike downtown to the New York State Library to find some limited material. Dr. Gokhale suggested I contact Vince Schaefer so I did. He invited me over to his house to peruse through his personal library. So I drove over to his home in Schenectady where I would sit on the floor going through abstracts and other material I needed for my research. Vince would be working at his desk and we would chat about a number things including his early experiences while

working with Irving Langmuir at GE. He asked me my future plans and I told him I would like to go on for a PhD at a university that had the facilities to carry out field programs in cloud physics and cloud dynamics using aircraft. This would combine my cloud physics interest with my aviation interests. Vince mentioned that the three schools that did that were the University of Chicago under Roscoe Braham, Colorado State University(CSU) under Lew Grant, and Penn State University under Charlie Hosler and a new young professor, Larry Davis. The next thing I knew was that Vince called all three schools and I had telephone calls from the likes of Roscoe Braham. In the end I decided to go to Penn State because they were active in cloud modeling which I had a budding interest in, and it seemed like a location where I could “safely” bring my family(in contrast to Chicago). Penn State also had a mature graduate program whereas Colorado State at that time was still a fledgling graduate program much like Albany’s. In addition, after some negotiations, Penn State offered me a full-time research assistantship which is similar to what we call a research associate position at CSU.

In summary, the initiation of the graduate department in Atmospheric Science at Albany in 1964 fortuitously came at a critical time in my studies and gave me the opportunity to study in this cutting edge, exciting field. Had this not happened at the particular time in my studies I doubt that I would have become involved in atmospheric science as a field of study nor become a professor and researcher in the field. The department prepared me well for going on for a PhD and becoming a leading researcher and academician in atmospheric science. I would like to acknowledge the contributions of Narayan Gokhale for his efforts in forming the department and doing all the legwork in getting the department organized. While Vince Schaefer may have been the instigator in getting things started, Narayan clearly did all the hard stuff of formally getting a department organized, and recruiting the core faculty, and graduate students. I really appreciated his expert guidance during my MS studies at SUNYA.



*Figure 5: Vollie—Wow!*

While at SUNYA all was not work, though at times it seemed like it. Vollie, Billy and I always enjoyed playing in the park across the street from the church. We also managed to fit in some boating. At first we had a powerboat with 25 HP outboard. The boat was a 17’ wooden boat that I refinished. We used to go up to Sacandoga Reservoir and take it out water skiing. But this was the beginning of my slow conversion from motor boating to boating sans engines. I got fed up with always having to work on that old Johnson outboard. So we sold it and I bought a 17’ Grumman canoe with sailrig. I thus began the learning process of sailing. A canoe without amas is not a forgiving boat to sail and I learned the hard way several times capsizing it and filling it with water. It wouldn’t sink but it was embarrassing sitting out in the water with a boat filled with water. We also used the canoe on several canoe camping trips. This was an ideal way to get out into the back country with a young child(as compared to backpacking). I remember one trip we took where we paddled the length of Long Lake where we camped at a lean-to shelter and were overwhelmed by blackflies. Poor Billy was bitten so many times on his face that his eyes nearly closed up and he looked oriental. We then paddled down the Racquet River where we had to carry around a waterfall. We again camped in a lean-to shelter and were visited by a porcupine who woke us up gnawing on the toilet seat of the privy.

On another outing we canoed along this series of lakes where you paddled from one to another, carried a half mile or so and paddled to another in which we did a large loop. The name was Fish Creek Lakes. That was great fun and I remember catching a very large trout while trolling behind the canoe. Little Billy seemed to enjoy canoe adventures as he played in water at our campsite beaches and attempted to assist with some paddling. Vollie seemed to enjoy these camping trips as well.



*Figure 6: Vollie and I canoeing Fish Creek Lakes with son Billy and dog Wuffy.*

We also did some hiking in the Adirondacks. One time we hiked up Mount Marcy (the highest mountain in the Adirondacks) and got in a thunderstorm at the top. Hail came down, the rocks made this clicking sound and we hid under them as lightning struck near us. Yikes!

In the summer of 1965, we arranged for a high school student, named Walter Glock who always hung out at the church, to cover for us in our Sexton duties while we took a two-week whirlwind tour of the western US.

Part of the motivation was to check out possible locations for PhD studies. The tour passed through Fort Collins, CO, Socorro, NM and ended in State College, PA. My father loaned us his 1959 Pontiac and we pulled an Apache, small folding tent camper that we had somehow managed to purchase. Incidentally, having the church job where I earned \$1700/year and apartment with all utilities, plus an assistantship at \$2500/year, I was better off financially than I had ever been in my life! I actually made more than my father did as an auto mechanic. Back to our road trip, we drove westward to Wyoming where we camped between snowdrifts near Jackson Lake. Now this was early June so we did not expect to find snow. We visited Yellowstone National Park for a quick viewing of the geysers, and headed south towards Colorado. It was either raining or snowing and cloudy all the time. When we arrived at Fort Collins we found we could not get across the bridge on Highway 287 that crosses the Poudre River into the town. The heavy rains and snow plus runoff had brought the Poudre up to the level of the bridge. So we backtracked to LaPorte where we overnighted in a rundown trailer park next to Cashe LaPoudre Junior High School. That trailer park is still there and looks just as crappy as it did then!

Finally the river came down and we headed through Fort Collins and then drove along the Peak-to-Peak highway where we camped at a nice site but it was rain mixed with snow all the time. Then we headed south and west and camped at Colorado National Monument where we enjoyed warm, dry sunshine for the first time since arriving in the Rockies. From there we visited Arches National Park, Mesa Verde National Park and then stopped at Socorro, NM where we set up camp in a very primitive campsite (compared to today's facilities) in Water Canyon. Leaving the trailer behind we drove the rough road up to Langmuir Observatory. In a very narrow part of the road with a steep hillside next to the road we had a flat tire. But there was no traffic and I was able to change the tire in the middle of the road.

After our NM visit we headed east towards PA. One time when I was taking a break, Vollie was driving along a two lane highway when she attempted to hit the break and instead hit the accelerator of this powerful V8 Pontiac. The car did a power spin dragging our camper behind it. When we stopped in the middle of the road facing the opposite direction there was

our camper in front of us on its top like a turtle. With some help from passersby we up-righted it and headed back east.

After a brief visit of some friends in Cincinnati, OH we ended up in Pennsylvania where we camped at Black Mashanon State Park not far from State College, PA. Our evening there was quite interesting as we were visited by a raccoon in the trash can, a skunk, and a black bear! The next day we visited Penn State where I met Charlie Hosler who was then the Dean of the College of Mineral Industries where the Meteorology Department resided. He was to become my formal major PhD advisor, although two faculty members, Larry Davis and then Ron Levoie actually did the day to day supervision.

#### 4.0 Summer 1966

During my final semester at Albany I applied for a summer aviation meteorology training program at NCAR in Boulder, CO and was accepted. So with my father's help we purchased a 16' camping trailer and hauled it out west. We set up camp in Eldorado Springs south of Boulder. At that time it was all privately owned and they ran a small campground in the upper part of the canyon. It is now a Colorado State Park. It had natural hot springs feeding a swimming pool. A creek ran down through the canyon which Billy managed to fall into at least once.

I commuted to Boulder where I attended the training program. It was mostly classroom style lectures given by Fred Bates a professor at St. Louis University. He and his two students would take the NCAR Queenair out in search of tornadoes. He had a remarkable ability to forecast where tornadoes would be and came back with many photographs of tornadoes. He had a rather strange theory that the tornadoes were driven by a manifold much like the manifolds on automobile engines.

I actually was somewhat disappointed in the course because of the lack of hands on contact with aircraft operations. Only the last day did they take class members for a flight in which we flew down a narrow turbulent canyon and most of us got air sick!

I did test the feasibility of using a high speed camera much like I used in the laboratory for sampling hydrometeors. Pat Squires loaned me the equipment for me to test out the design I had in mind. Pat was a great mentor and was recognized for his pioneering contributions to aerosol impacts on clouds and precipitation.

When not busy attending the short course we spent weekends car camping and backpacking in the Colorado Mountains. We really fell in love with Colorado.

#### 5.0 The Penn State years

After a delightful summer in Colorado we moved to State College, PA. Actually we moved to Boalsburg, PA which is about 5 miles east of State College. We lived in a neighborhood composed of pre-fab or what would now be called manufactured homes. These were thin-walled with little insulation and single-pane windows which became covered with ice in the winter. But at least it was in the country and we could have a dog, named Wuffy by son Bill.

I commuted to campus by a variety of means including driving a Honda 50 motorcycle, driving a dune buggy which I built, and carpooling. We often carpooled with the neighbors who had this flimsy Citroen Deuxcheavau which is so named because it had a 2-cylinder

engine. One time I came home and Vollie asked, “where is the car?” I had forgotten that I had driven in that day! On another occasion when Vollie and I were both squeezed into the back seat of the Deuzcheavu the discussion turned to first names. Of course Vollie’s name, Waltraud came up. The neighbor said, well I know of a name that is stranger than that. It is Gisela! Vollie, with tears running down her cheek in laughter said, “that is my middle name”! Everyone in the car screeched with laughter.

Penn State’s graduate program was just what I needed. Not only did it have courses in cloud physics and cloud dynamics (more a seminar level) but also high-powered courses in numerical weather prediction (John Hovermale), small-scale dynamics and mathematical theories of turbulence (John Dutton), climate theories (Hans Panofski), and in Computer Science, and Fortran programming. Albany when I left did not have a single computer science course or student access to computers. I also served as a teaching assistant to Hans Neuberger in Physical Meteorology. It was a great experience and really wet my appetite for teaching in college. Hans was an old school observer who pointed out the jet contrails and hypothesized their potential climatic impacts on our walks to and from class.

As a full time research scientist under Larry Davis, I got to experience a number of field campaigns as a flight meteorologist including lake effect storms over Lake Ontario and warm cloud seeding in St. Croix (actually Larry had left before that field program but he originated the funding). In my first summer at Penn State (1967) Larry took off to a field program at Flagstaff, AZ and left me in charge of the research aircraft (an Aero Commander 580). Having no experience with airborne field operations it was like throwing me in a lake to learn to swim. The pilot, Dick Day, had little interest in flying but rather spend his time building a replica of a WWI Sopwith Camel airplane. I did get him out one day with the plane loaded with AgI flares and decided to seed some towering cumuli in the area. Penetrating those clouds was like driving into a mountain and exiting it on the other side. I seeded this one cloud and it immediately glaciated leaving a plume of ice crystals. “My God, I destroyed a mountain!”

Because I have a tendency to get airsick when not flying regularly, I decided to complete my training for a pilot’s license. The PSU training school was at University Park Airport where our research plane was hangared. I took lessons in Cessna 150’s and 152’s and got my license that summer. I then flew Cessna 172’s and a Piper Tri Pacer owned by the husband of a friend of Vollie’s. The time in the air certainly helped with my airsickness problem.

The lake effect storm study was another matter. I remember on one flight, the data system went down and I fiercely took notes of the air temperature, flight altitudes and other cloud properties. I got terribly airsick bouncing around in those clouds. These notes were used as the basis of a schematic model of a lake effect storm that was much publicized and that I reproduced in my Storm and Cloud Dynamics book. Ron Lavoie, who was then a PhD student on leave from the U of Hawaii constructed a clever dynamic model of a lake effect storm which was designed to replicate those observations! On another flight, Helmut Weichman of NOAA, who was our project manager, asked us to penetrate the cumulus cloud band from the north or Canadian side of Lake Ontario through the cloud band to the US side of the lake near Jamestown, NY. About 10 minutes in the penetration we experienced what I would call now severe icing conditions. The JW hotwire liquid water content meter read negative, ice built up on all probes as well as the aircraft airframe. In fact a cloud droplet sampler designed and built by Jim Jiusto, had a long tube in which the air was to flow to the section where a modified camera projector with glass slides in the photo frames was exposed to the airflow, was completely frozen shut when we got on the ground! We experienced so

much icing that the pilot made final approach at almost full throttle to keep the plane in the air! This was one of my near-death experiences as an aircraft observer.

The Davis research group had a modeling section in which the then famous Weinstein-Davis cloud model was constructed. It was a one-dimensional parcel model with bulk cloud physics. I got acquainted with the model code, and immediately began cleaning up some of its bugs and clumsy programming. This was my introduction to cloud modeling and I really got into it! I also organized a student independent study class in which we explored the details of cloud models of the time. I also got the code for Ed Barry's bin cloud model. I later used it for developing parameterizations of autoconversion of cloud droplets to raindrops.

Because I needed to have two semesters as a regular graduate student, I took a leave from my full time research scientist position in the 1968/1969 terms and served as a regular graduate research assistant. As part of the leave, I spent the summer of 1968 at NCAR working in Doyme Sartor's group. Also, because of reduced income, Vollie began investigating job prospects in the area. Not being much of a typist, really limited her opportunities. So I stopped in the German Department and asked if there was anything she could do. They said that if she enrolled in the graduate program, there was a graduate research assistantship available with one of the professors. So Vollie began her study toward an MS degree in German. When the professor's money for an assistantship ran out she was offered a teaching assistantship. With some trepidation, after her Albany student teaching experience, she took on the GTA position and really did very well. That was not at all surprising to me.

In the spring of 1968 I learned that my mother had terminal cancer of the liver. She was only 56 and went downhill rapidly. We would fly up to the Mohawk Valley in a burrowed Piper Tripacer, about a 2.5 hour flight. As the summer approached I had to make the decision of what to do as my appointment at NCAR began in early June. I really needed that job to support my family as I didn't have summer employment at PSU. My father convinced me to go ahead and make the move and to keep in touch regarding my mother's condition. In actual fact, we barely made it to Colorado when I called and found out she had passed away. So, I got Vollie and Billy settled in Boulder and I flew back for her funeral.

Once back in Boulder, Doyme Sartor allowed me to do any form of research I wished to do so I began the development of the cloud model which became the basis of my dissertation. Doyme's group was mainly an experimental laboratory studying cloud electrification. But, he also worked with an eminent theoretician, Bill Davis who developed some of the pioneering theoretical studies of cloud droplet collision efficiencies. One time I put my foot in my mouth when Paul Eden told me about participating in a sports car rally. I asked who was the navigator? He said Jane, who was a married administrative assistant in the laboratory. Well Doyme overheard Paul's reply and waved his large finger (he had a growth hormone problem) admonishing Paul and Jane. Jane was fired after that. Soon after Paul found a job with the U of Miami and he and Jane married. When we moved to Miami, Jane and Paul became lifetime friends with us.

But, when in Colorado, we did what Coloradoans do. We enjoyed camping, hiking, and canoeing the Colorado mountains. Our friends, Bill and Betty Jo Taffe also spent the summer at NCAR so we shared many experiences hiking and paddling with them. I remember one time we all camped on the east side of Lake Grandby. Bill and Betty Jo had to leave earlier than us so I let them paddle our canoe while we hiked a mountain trail. On our return, we could not find the canoe. I looked around and way out in the water was our canoe stranded

in a shallow sandbar. I was able to walk out to it but the water was so cold that I could not feel my feet when I got to it. It turned out they had pulled it way up on the shore and turned it over. But a wind gust must have come along and blew it into the lake!

Returning to PSU, Vollie and I were quite busy, me working on my dissertation and Vollie working on her MS in German. My return saw a change in my research supervisor. Larry Davis had left PSU for a life in the commercial world, and my fellow graduate student, Ron Lavoie, now Dr. Ron Lavoie took over as the director of the cloud projects Larry had started, and became my graduate advisor. The difference between Larry and Ron was like night and day. Larry was a C&G gunner getting bigger and bigger grants. I only saw him occasionally. Ron, on the other hand, was a classic example of an academic advisor/mentor. He was there to discuss my research on a daily basis. Officially Charlie Hosler was my major professor and chaired any formal committee meetings because Ron had not been “blessed” as a member of the graduate faculty yet. “Think of seeing me make the sign of the cross ☺”. Charlie was then Dean of the college so I did not see him that much. He did give occasional guest lectures in cloud physics which were often amusing if not all that technically informative.



*Figure 7: Son “Billy”, Wuffy, and me firing rockets across the road from our Boalsburg rental.*

Meanwhile, back to being a full-time research scientist. In the summer of 1969 I participated in a field program in St. Croix where the objective was to enhance rainfall by seeding the clouds with salt powder. So Vollie, Billy and I packed our bags and flew down to St. Croix where we found a rental unit near the beach and near a rain forest. The unit was converted from an old Dutch plantation building with walls that were about 3 feet thick. It was open like a screened in porch with no air conditioning. Being in a humid rain forest local climate regime and in a wind

shadow, it was hot and humid. We would wake in the morning with a wet shadow of our bodies on the bed sheets.

But on time off, we enjoyed walking across the road and swimming amongst the coral reef nearby. One time we chartered a 21 sailboat out to Buck Island which is an underwater National Park. The reef was fantastic with huge corals to swim over and through. They were beautiful and large colorful fish swam through the reef. Once, I dived with a chicken bone and fed it to a large barracuda! Years later I briefly visited St. Croix to observe a field program down there. I again chartered a boat out to the reef and it was extremely disappointing. The entire reef was dead; looking more like cadavers than the vibrant reef we had earlier swum through.

As I said the project goal was to seed the cumuli over the island to enhance rainfall. I quickly realized that the time between selecting a cloud and getting the seed plane to penetrate it and release its payload (about 10 minutes) was too long as the cloud would be raining heavily before the seeding plane entered the cloud. The whole concept of seeding these clouds to enhance rainfall was total nonsense! These clouds are what are called “colloidally” unstable in the vernacular of Pat Squires. They clearly did not need any assistance from us to make them rain.

One day after filling the seed plane hopper we could not find any suitable clouds. We had to get rid of the salt load in the plane, otherwise it would turn to a solid block of salt. So I decided to try something. We went upwind of the island and I selected an area that was totally cloud free, and had the seed plane dump its load. I hypothesized that when the salt deliquesced it would release enough latent heat to cause ascent and cloud formation. Sure enough, a wispy looking small cumuli formed! While not statistically significant, and being anecdotal in nature, it appears I made my first and only cloud from scratch! No other cloud formed in the entire area.

Our little cabin had a visitor called a kinkajou which is a south American monkey- like creature (actually in the bear family) with a long tail that would hang out on our roof. One time when it was looking at us from the roof I put my hand out like you would with a dog. But this animal grabbed my hand and took a healthy bite of it. Unfortunately in the tropical climate the bite was not so healthy and my hand rapidly became infected. I had to go to the locale hospital where I got a heavy dose of antibiotics. This gave me a case of the runs which grounded me from flying for at least a week.

One thing that happened in the summer of 1969 was this was the summer of the moon landing. So we visited Ron and Jan Lavoie's upscale rental where we watched the first moon landing! It was quite a thrill and to do so in this remote tropical setting.

Thanks to Charlie Hosler coming up with some discretionary money, I directed the construction of an airborne high speed camera system to sample raindrops. This required cutting a hole in the top of the fuselage at the rear of the cabin and inserting about a 4" diameter tube through the hole. We had everything set up to run in St. Croix. Unfortunately, the camera did not have single lens reflex capability so there was no way to make sure the camera was properly aligned. So I made arrangements to have the film processed and projected at a TV studio in Puerto Rico. So Vollie, acting as interpreter, and I flew to Puerto Rico to check it out. It turns out there was a bit of an alignment problem which we adjusted upon our return. We collected enough data to allow a MS student, named Ron Greiner, to perform the analysis as part of his MS study. I don't recall any major findings but did observe raindrops actually undergoing wake capture and breakup much like I had observed in the laboratory tunnel.

Returning to Penn State, Vollie worked on finishing her MS, Billy went to grade school, and I worked on finishing my dissertation. The year of 1969/1970 was a busy one. At that juncture, I actually could have written a dissertation on any of three different topics; lake effect storm analysis and modeling, St. Croix convection analysis and modeling, and simulations of AgI dynamic seeding of cumuli. I chose the latter topic. I completed the implementation of the ice-phase microphysics with a detailed representation of ice particle growth and crystal habits, autoconversion formula derived from Ed Berry's bin microphysics model, and parameterizations of rain, graupel, and hail, all within a one dimensional Lagrangian parcel model. Joanne Simpson later referred to the model as being like "putting a jet engine on a trolley car!!" In retrospect, she hit the nail on the head. I really appreciated Ron Lavoie's supervision of my research and dissertation writing.

The thrust of my dissertation was that warm rain processes greatly influenced the susceptibility of supercooled cumulus clouds to dynamic enhancement by AgI seeding. Clouds which contained high concentrations of cloud droplets were less susceptible than those with low cloud droplet concentrations. This was because the presence of drizzle drops and raindrops greatly accelerated the glaciation process, which would enhance the latent heat in

the cloud, leading to invigorated cumuli with a greater chance of precipitation enhancement by seeding. This theme of the interplay of aerosol, warm cloud physical processes and ice phase precipitation processes has haunted me throughout my career.

While at Penn State it may have seemed like all work and no play. But we were young and managed to burn both ends of the candle. We had a close group of friends that we would get together with and have drinks. They consisted of Denny Deavon and his wife Barry, the Perkey's, Don and Nadine, and the Pielke's, Gloria and Roger. We have remained friends with all but the Deavon's through the years, as Denny passed away a number of years ago owing to his exposure to asbestos on a submarine in his younger years. I remember one time Roger brought a bottle of Muscatel which Vollie had too much of. She rushed to the bathroom and came out singing, "wine is fine but muscatel is hell!"

We also enjoyed canoeing in the lakes around State College and even did a few whitewater runs in the upper Susquehanna River.

By spring 1970 I began looking for a job for fall 1970. I interviewed at the Illinois State Water survey, with the NOAA Experimental Meteorology Laboratory (EML) under Joanne Simpson, and by phone with Peter Hobbs and offered jobs with all three. I remember my interview at the Water Survey with Stan Changnon and Dick Semonin. They wined and dined me and I was really impressed. Now you have to realize that I am not much of a card player. Vollie always reminds me of the time that Nadine and Don Perkey tried to teach us how to play bridge. Well I fell asleep on the floor during our training session! Anyway back to my Water Survey interview and I asked what do you all do for entertainment in the winter months? Stan responded that "it is a great card playing town!" That pretty much did Illinois in and I accepted an appointment with the EML.

## 6.0 The Miami Years

### *Professional life*

In August of 1970 we packed up and headed south in our big old Pontiac Catalina without air conditioning. While searching for a place to rent, we camped out in the Everglades at a little lake. One could swim in the lake with alligators joining us for a swim. We spent a hot, humid night in our tent listening to the alligators croaking much like giant bull frogs, some sounding darn close to the tent.

We found a small one-bathroom house not far from the U of Miami campus where the NOAA Experimental Meteorological Laboratory was located. In the back of the house was a large screened-in porch or Florida room and in the back yard was a tangelo tree. Our landlords were our neighbors, the Marshalls, who allowed us to use their clothes washer and drier. A few years ago we returned to that neighborhood and found the house gone and the whole area was a yuppi neighborhood with expensive shops and bars.

Life in Miami was very different from Pennsylvania or Upstate New York. But we quickly adapted to the lifestyle, spending a lot of our time in that Florida room, and biking to and from work as well as for fun, canoeing in the Everglades and occasionally in Biscayne Bay.

Working for Joanne Simpson was a pleasure as she was not your stereotype NOAA administrator. She operated our laboratory much like a university professor. She allowed me to teach several courses at the U of Miami as well as supervise graduate students. Incidentally, the building that we were located in included our lab on the 3<sup>rd</sup> floor, the

department of Atmospheric Science of the Rosenstiel School of Marine and Atmospheric Science on the 2<sup>nd</sup> floor, the NOAA National Hurricane Research Laboratory(NHRL) on the 4<sup>th</sup> floor, and NOAA National Hurricane Center(NHC) on the top floor. This is an arrangement that many universities have sought and established around the country. Unfortunately, a few years after we left the area, each unit moved to a separate location with NHC moving across Dixie Highway from campus, the Atmospheric Science department moving onto Virginia Key, and NHRL(now the Hurricane Research Division, NRD) also moving to Virginia Key but across a busy highway.

Joanne provided the ultimate example of a mentor which I attempted to model all my professional life. She allowed me to teach and supervise graduate students at the U of Miami, supported publication of my dissertation material in two papers, provided many opportunities to increase my professional visibility including attending conferences and spending time visiting CSIRO in Australia(more on that later), heading up the Numerical Simulation Group, and providing support for me to hire a scientist within the group(more on that later). She protected us from all the BS of NOAA management, and went to bat for us with NOAA management whenever that was needed.

As I progressed at a snails pace with 3D cloud modeling, I suggested to Joanne that it would be good to initiate a larger-scale modeling study that would investigate the mesoscale circulations responsible for cloud organization over the Florida peninsula. I envisioned at that time that one day we could have a coupled mesoscale and cloud scale model. She gave me the green light and found a NOAA position for my small group to hire someone to work on the mesoscale model. I am sure this was no small task and would be nearly impossible today. After some thought I called Roger Pielke back at Penn State. He had recently passed his prelim exam and was ready to start working on a thesis. He informed me that he and Gloria were having difficulty making ends meet and that the project I described sounded ideal for his dissertation and working full time in Miami would solve his financial problems as well. So, Roger and I became office mates surrounded by stacks of computer printer output. Roger and I worked well together with Roger developing his 3D hydrostatic mesoscale model of the Florida seabreeze and me working on the 3D nonhydrostatic cloud model. We took lunch hour breaks swimming in the U of Miami Olympic-sized pool, doing about 1000 yards a day. We also got together as families and sometimes camped in the Everglades with rather disastrous consequences!

After only one year at our little house, we were informed that the Marshall's sister who owned part of the house would be moving into it that fall. The timing was not ideal as we had not had sufficient time to save up for a down payment on a house. But after some searching we found a fore sale by owner house in which we would take over the primary mortgage and the seller would carry a 2<sup>nd</sup> for our down payment. The house was a corner lot on a cul-de-sac with large ficus trees. The center of the house was a screened in patio with the living area shaped like an "L" and a carport on the opposing side. An open faced decorated concrete wall provided some privacy in the patio area which also was the main entrance to the house. Glass sliders faced the patio in the living area. It was a nice home in a relatively quiet neighborhood and was about a 30 minute bike ride to my office.

Once we settled into the new house, we bought a 21' MacGreagor trailable sloop which we sailed on Biscayne Bay. We were often accompanied by Rick Anthes and his family, and Pete Black and his family who sailed similar sized boats. We often dragged a lore behind us and occasionally caught some sizeable fish. Occasionally we would take our canoe out into the

Everglades where paddling along narrow canals we would spy large alligators, cottonmouths in the low-lying overhanging branches, and lots of water fowl including flamingoes.

At the office, I developed a one-dimensional time-dependent cloud model along the lines of the Asai and Kassahara model. I added a non-hydrostatic pressure gradient term and used an “up/down” pressure solver suggested to me by Stan Rosenfeld. Of course I migrated much of the cloud microphysics in my dissertation model into this model as well. I also began the formulation and implementation of a fully 3D nonhydrostatic model which eventually became the dynamic core of RAMS.

At that time Joanne Simpson and Jack Warner were having a fierce debate about entrainment in cumulus clouds. Jack had published a paper which criticized the basic lateral entrainment model. The essence of his argument was that if the entrainment rate were adjusted to predict the observed cloud top height, the model over-predicted the amounts of liquid water content compared to observations. A series of rather heated comments and rebuttals followed in the reviewed literature.

In 1971, I along with Joanne attended a weather modification conference in Australia. This was a great experience for me as I had never been to Australia before nor overseas for that matter. At the meeting Joanne and Jack got together and tried to resolve their differences. It was decided that it would be a good idea to send someone(me) from Joanne’s group to interact with Jack’s cloud physics group in CSIRO Sydney. So I was invited to spend 5 months working in Jack Warner’s group in Sydney. Joanne agreed to continue to pay my salary and Jack agreed to cover my travel expenses including that of my family! Because there was an international cloud physics conference(ICCP) in London at the end of our stay, we purchased around-the-world airline tickets. On the flight down we spent a few days in New Zealand, flying into Christ Church. We rented a car, and did a loop drive across the plains of eastern South Island, camped with a view of Mt Cook, over a pass and along the west coast which is a rain forest with glaciers down to the coast, and huge tree ferns. Then we drove back over another pass to Christ Church camping in our backpacking tent the entire way.

We arrived at the airline terminal in Christ Church and were told that we were supposed to confirm our flight to Sydney at least 48 hours in advance. Being quite naïve about international flight requirements and moreover being out of touch with phones for several days, we had no idea this was required. We were told that coach was full. Yikes! But they had open seats in first class and put us in it with no extra charge! Imagine this today? We enjoyed wine and an excellent meal plus comfortable seats on our 2000 mile flight to Sydney.

Arriving in Sydney we were temporarily housed in about a 20’ travel trailer or what the Aussie’s call a caravan in a nice RV park not far from the Sydney harbor bridge. After that we stayed in a suburban Sydney single family residence owned by a university professor on sabbatical. The house was made out of prisoner bricks and overlooked open space in a canyon in the backyard. It was very nice and I could use public transport to get to the CSIRO laboratory. We then bought a 1963 Holden EJ which looked like a ¾ size version of US GMC cars of that era. We had great camping adventures driving through the outback of Australia. Besides visiting the CSIRO Cloud Physics Laboratory I was also set up to spend two fortnights in Melbourne where I gave lectures on cloud modeling at Monash University. Since the visits there were on two separate fortnights, we drove different routes from Sydney to Melbourne and back. Also while in Sydney, son Bill attended a public school there. He seemed to enjoy the experience, dressed up in his uniform of short pants and knee socks.



Figure 8: Billy and a kangaroo.

At the Sydney laboratory I got to work with the Australian greats in cloud physics including Jack Warner, the laboratory director, Shaun Twomey, Keith Bigg, Stan Mossup, and Brian Ryan. While at Monash I got to work with other Australian big names like Bruce Morton and Mike Manton. In Sydney I continued developing cloud models and had an opportunity to join in a short field program at Bunderburg, Queensland. We stayed in Bunderburg for

about two weeks where I flew in the CSIRO DC-3 equipped with state-of-the art cloud sampling instrumentation. The neat thing about that plane was it was equipped with an observation bubble just behind the cockpit in which the observer(me) stood on a stool with an excellent view of the clouds to be penetrated. I remember directing the plane to penetrate a relatively small towering cumulus in which we experienced a 17m/s downdraft that left me briefly curled up inside the dome!

I selected that case study for subsequent simulation. I used both the 1D Lagrangian cloud model and the 1D time dependent model to simulate the case. I concluded that neither model, both of which were based on Joanne's entrainment parameterization, could not simultaneously predict cloud top height and cloud liquid water content. This was Jack Warner's contention so these results did not put me in the good graces of Joanne Simpson! My interpretation is that the cloud updraft, averaged across the cloud width, does not have a dominant influence on the entrainment process in such clouds. It is the smaller-scale updrafts and downdrafts that control entrainment processes.

Following our 5 month stay in Australia, we began the remainder of our round-the-world trip with stop-overs in Greece, rented a car in Rome and then drove through Switzerland and on to Calais, France where we turned the car in. It was the trip of a lifetime with too many adventures to describe herein. Bill and Vollie fondly recall many of our adventures and it positively influenced his subsequent school learning back in the US. From Calais, we took the ferry and then a train on into London where I attended the ICCP conference.

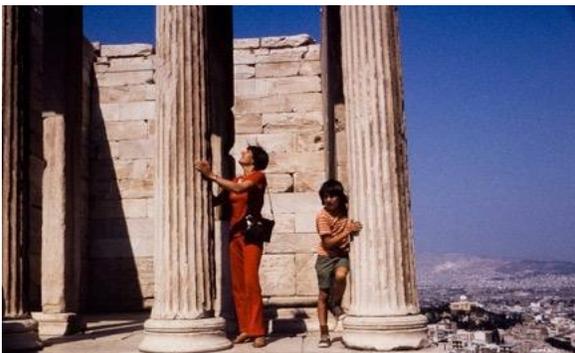


Figure 9: Vollie and Billy visiting the Parthenon; all fenced off nowadays ☹️

Back in Miami we returned to a busy life with me not only involved in modeling but also participating in the Florida Area Cumulus Experiment(FACE) field program, and Vollie teaching German at the U of Miami. Before heading to Australia we made a family decision to adopt a child. We put that on hold, however, until we returned from the round-the-world trip. Soon after our return we reactivated the process and shortly we had this rascally six month old,

blond curly-haired, blue eyed, bi-racial child named Christopher James. On the same day we picked up a new-to-us 25' sloop which we named "Cotton's Tale". So from the start, Chris experienced boating and water sports. I remember once when Chris picked up Vollie's

pocketbook which she had left in the cockpit and dropped it over side. Fortunately, I was fast enough to grab the handle before it hit the water! Chris loved the water and I taught him to swim in Jane and Paul Eden's (the couple from Boulder) swimming pool. Chris was even baptized in Biscayne Bay! We had become friends with the Lutheran Campus minister, Galen Hora. So we sailed down to Elliot Cay and stood in knee deep water as Galen baptized Chris.



*Figure 10: Cotton's Tale on Mooring and Billy in dingy.*



*Figure 11: Billy and Chris.*



*Figure 12: Wuffy, Vollie, and Billy with dune buggy I built.*

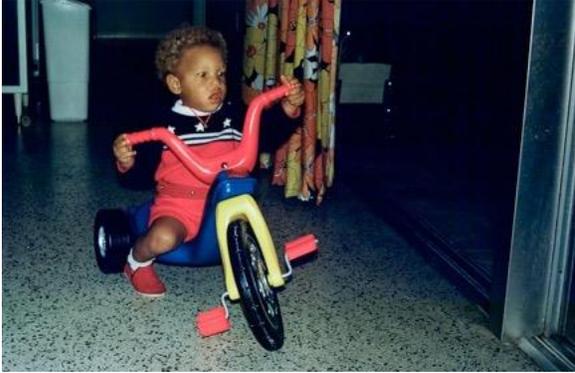


Figure 13: Toddler, son Chris.

### *Sailing adventures*

The most adventurous sailing trip was in November 1973 when we (Vollie, Bill, and Chris), along with Paul and Jane Eden, and Hank Poor and wife, set sail for Bimini in our three boats. Our thinking of making the trip in November was it would be after the hurricane season and before major frontal passages (not!). The Florida current is notorious for developing steep high seas following a frontal passage as the northerly flow pushes against the northward flowing current. We left No-Name harbor in Key

Biscayne in our Coronado 25 named "Cotton's Tale" about 10PM so that we would arrive in Bimini in daylight. Our main navigation aid was a compass and a direction finder which shows the direction to Bimini, but nothing else. We arrived in Bimini with no problems and did our passport entry. Then we sailed to a small island anchoring on its north shore(it might have been Cat Cay). We enjoyed snorkeling and playing on its sandy beach. Near dark, Paul yelled he heard on the radio that a strong cold was approaching. Because the small island was to our lee, we decided to motor into Bimini harbor. The front came through as we were in the narrow channel and the winds were so strong(about 35kts) that our 5 HP outboard could not push the boat up the narrow harbor. I had to tack back and forth turning downwind and looping back with each tack. Remember it was dark and the narrow channel was not lighted. Finally, we got into the protection of Bimini harbor and dropped an anchor. The wind was screaming through the rigging so it was challenging for me to communicate with Vollie up front dropping the anchor. We got one anchor down OK but when trying to drop a second anchor the line got tangled in the propeller. Fortunately, the first anchor held, and I cleared the prop the next day.

After a couple of days of "doing Bimini" it was time to head back to Miami and work. The winds had settled down to 20-22kts out of the southeast. But it still piled up some high seas. Most of the way back we sailed downwind, wing-to-wing with the main out one side and the jib the other. We would rise up a wave and surf down the other side putting out spray on each side. It was an exhilarating sail for me; a bit like running white water in our canoe but for 8.5 hours! Vollie was not so enthusiastic! Controlling the boat running downwind required me to be vigilant all the time and working the tiller to prevent broaching. In fact, Vollie could not handle the tiller long enough for me to pee. She went below and found a coffee can which she held for me to pee into! Finally we entered Biscayne Bay and I was so tired that Bill took over and sailed Cotton Tale back to our harbor. Just to give you an idea how dangerous it was, the Eden's also sailed downwind and at one point Paul let the boat jibe and when the boom came across it almost knocked him into the sea. He grabbed a lifeline just as he went over the side. If he had gone in, there was no way that Jane could have brought the boat about, tacked into the winds and seas, without losing sight of Paul.

Back on land, we were one of the first to have a bike trailer to carry a child. We had this trailer called a "Bugger", which is not a very nice word in British slang. We would bike to work transporting Chris to the baby sitter in the Bugger. One day, a Miami Herald reporter took a picture of Vollie pedaling Chris to the sitter. A big picture appeared in the next issue of the paper. This is after a number of years before, we had one of the first baby backpacks ( a Boulder based Gerry backpack) and Vollie had her picture taken by an Albany Times

Union reporter while she rushed to a baby sitter with Billy. I guess we were always on the cutting edge!

### *Research at EML*

Meanwhile back at work, I continued developing a 3D cloud model. Computer resources were limited in NOAA Miami. The NOAA administrators thought it was a big deal when they acquired the cast-off “super computer” from NOAA GFDL after they had a major computer upgrade. The computer was a Univac 1108 with 64,000 words of central memory. Moreover, the operating system took up nearly half of that memory. Many of you are used to having laptop computers with 10’s of gigabytes of memory. To help me get my cloud model running on the system I hired a graduate student in physics, Otis Brown, and his long time friend, Bob Evans. Otis by the way, is now the retired Dean of the U of Miami RSMAS. They designed an asynchronous input/output(I/O) scheme for the model which would I/O to the drum external storage device. What was in central memory was just a 5 column stencil. This was a very clever design that allowed me to perform cloud simulations on that memory limited computer. Because the computer was very busy on weekdays and it was sitting there unused on weekends, I arranged to set up test runs on Friday night that were supposed to run through the weekend and pickup output(printed on paper) on Monday morning. A run through the entire weekend would get me through about 5 minutes of simulated time! Unfortunately, I rarely got the model to run through an entire weekend. I attributed the failure to the fact that I exceeded the frequency of errors in the I/O device and once an error occurred I would lose the pointer in my grid and the model would crash. I could never convince the NOAA administrators that this was a hardware error as no one else experienced such problems. Of course, no one else was pushing the limits of the I/O device either!

One of the virtues of working for Joanne was that she advocated that a modeler should not only work on computers but also get in the field and get their hands dirty. So during the summer field studies of FACE, I ran a sub-program in which we flew the NOAA DC-6 below cloud base back and forth across the Florida peninsula. We had two goals: (1) to sample the rainwater from the clouds attempting to identify silver in the precipitation which should indicate a cloud seeding origin from silver iodide and (2) to sample the turbulent fluxes in the boundary layer feeding the clouds over the peninsula. To achieve the first goal I hired an MS student in Atmospheric Science at the U of Miami named Joe Wisniewski. Joe flew with me for over 200 hours in the DC-6 where he collected the rainwater samples, sent the samples to a chemistry laboratory and analyzed the results for his MS thesis. In that study we could not identify silver that could be attributed to silver iodide seeding. Using back trajectory analysis, we found that the highest concentrations of silver arose from flow aloft that originated over open pit mines in southwestern Arizona!

To achieve the second goal, I enlisted the support of Brad Bean and his NOAA Boulder group to come down to Florida with their turbulent gust probe system which they had installed on the NOAA DC-6. With this system we were able to sample the fluxes in the boundary layer. Although nothing much came from the analysis of those data, Brad Bean seemed to be impressed with leadership as chief airborne meteorologist for those flights. The main idea of FACE was that one would seed the towering cumuli with large doses of silver iodide in order to promote the premature glaciations of the clouds, achieve enhanced updrafts in the clouds, bigger longer-lasting clouds and thereby enhance rainfall from those seeded clouds. The experiment was randomized so on any given day we did not know if the clouds were actually seeded or a placebo was used. After many hours of looking aloft from below cloud base, I found I could predict if the clouds were seeded or not by the number of cut-off towers I

observed. My hypothesis was that in many seeded clouds, the glaciated torrents would rapidly rise and create enhanced lateral entrainment behind the accelerated cloud bubble resulting in the tower being cut-off from the main cloud body below. Years later, 3D cloud simulations of seeding often exhibited such cut-off tower responses.

Besides his mesoscale modeling study, Roger Pielke got Joanne to support the implementation of a number of surface weather stations across the peninsula to be used as verification of his model. Most of the stations were accessible by car on back roads but a few required the assistance of the National Park Service who took us into the Everglades in a boat to install and service the gauges. One time, a day or so after I had had a vasectomy operation, we drove back in to check on the gauges when we drove through a large water puddle and soaked the distributor. Owing to my recent operation, I stayed with the car while Roger walked out in the heat and humidity about 5 miles or more to get help. A few days later we were on the small boat in the Everglades with a ranger pounding away through the waves in Whitewater Bay when I popped a stitch from my operation. That really hurt!

One day I got a call from the well-known theoretical small-scale dynamicist, Doug Lilly, who invited me to write an article on cloud dynamics in *Reviews of Geophysics*. Since I was developing a cloud model, I was on top of the theory on clouds at the time, so I agreed. I suspect that having written that article helped me get the academic position at CSU. Another factor was that I got acquainted with Lew Grant a professor at CSU. He and I attended a weather modification conference in Santa Barbara, CA. We met over breakfast at 5:30 AM. Lew, being a farmer, was used to getting up early, so he was quite impressed that I was an early riser. I don't think he took into account that I had flown in from Miami where the time was 08:30AM when we met! Nonetheless, I am sure Lew played a major role in my getting hired at CSU.

There was a major drought in South Florida while we were there. One day Joanne called an executive meeting that included me, Bill Woodley, and Rob Sax. Joanne suggested that we should offer our assistance to the State by applying the dynamic cloud seeding principles operationally over South Florida to ease the drought. Bill Woodley, and Rob Sax enthusiastically supported the idea. NOAA administrators in Boulder also enthusiastically supported the idea. I was the only one that objected to the idea on the basis that we were carrying out experiments to test the dynamic seeding concept and by performing operational seeding, we were destroying our credibility as objective scientists. In spite of my objections, the lab carried out operational seeding for one summer. The only thing I remember about the campaign is that we were sued by an individual for causing hail damage to his car which broke his windshield. Hail is a very rare occurrence in South Florida! NOAA settled the lawsuit out of court and replaced his windshield.

In 1974 I applied to an announced faculty position in Atmospheric Science at CSU. After an interview, I was hired to begin as an assistant professor starting in December 1974. That spring I was asked by Brad Bean, of NOAA Boulder, to come out to the GARP Atlantic Tropical Experiment (GATE) and serve as airborne meteorologist on the NOAA DC-6 to spell him. So, the summer of 1974 I flew out to Dakar, Senegal which was the base, for the GATE. I got off the plane in Senegal and there was Brad Bean who would not talk to me. I had no idea what the problem was. I found out from others that Brad was PO'd because I had taken the CSU position. Apparently he had plans for me to transfer to his group in NOAA Boulder. So there I was for several weeks with nothing to do. I did manage to bum flights on several planes including the NCAR C-130 in which Steve Cox served as lead meteorologist and on

the NASA 990. I remember the NASA 990 flights because it was flying high enough that I got a really good view of the clouds in the area. Through the middle troposphere convective clouds were disorganized and looked like just a mess of cumulus and their debris. But occasionally out of this mess would rise a hard bubble of cloud that would rise through our flight level right up to the tropopause. Updrafts in the bubbles that we penetrated were over 15-20 m/s while updrafts in the lower level clouds were only a few meters per second.

Finally, someone must have gotten through to Brad and I was given the job of flying as lead meteorologist on one flight in the NOAA DC-6. I only remember the early period of that flight as it began with an instrument comparison among the NOAA DC-6 which was the lead plane, the French DC-7 on our right, and a Russian Allusion XX?, on our left. As we flew in that configuration we encountered some small boundary layer cumuli. So our pilot began a slow climb out to get out of the clouds. However, the three aircraft could not climb at the same rate. Apparently the French plane lost sight of us and instead of breaking formation and peeling out to the right, began a search for us. I heard the engines of their plane and called on the intercom that a plane was coming up on our right, crossing our flight path. It flew right in front of us and we could feel the turbulence from its wake! That was the second incident as airborne meteorologist that I almost bought it!

Following GATE I flew up to New York City and then on to the Mohawk Valley where I met up with Vollie who had driven up from Miami in our new Toyota Land Cruiser FJ-40 with two kids, a dog and cat, camping all the way. From there we drove west to Colorado where we were to meet up with the Perkey's who lived in Boulder at that time. So we headed west camping along the way and near Springfield, IL we lost our cat. We left notes around the campground with contact info for the Perkey's. When we got there the Perkey's knew we were coming as they got a message that someone had found our cat. So after visiting, hiking and camping in the area and visiting Fort Collins, we headed back east by way of Springfield, IL to pick up our cat; not exactly the shortest route from Boulder to Miami.

In December 1974 we loaded up the Land Cruiser, put canoe on top, and drove to Colorado with me driving a UHAUL truck loaded with all our furniture. Besides furniture we had a number of tropical plants. When we got to Springfield, CO we stopped at a motel where they let us put our tropical plants in the lobby since it was freezing outside. We made it to Fort Collins on New Year's Eve and stayed at the Grants home in town while we searched for a place to rent. This was the beginning of a long stay in Fort Collins.

## 7.0 The early years at Fort Collins

Where to begin and how much do I include in my professional life and personal life? In December 2014 I received an award for my 40 years of service at CSU and a CSU blanket to keep this old guy warm. Can you imagine that; 40 years? We have lived in the Fort Collins area longer than anywhere else; and my, has Fort Collins changed!

I have never regretted making the move to Fort Collins and to CSU Atmospheric Science. It was the perfect fit both professionally and personally. Throughout my time at CSU the department has been a vibrant professional environment, attracting leading professors and having the pick of the top graduate student applicants. The mix of teaching and research was perfect for me.

Looking back I am amazed that I could do what I did both professionally and socially. To begin with we almost immediately started hunting for a house or land in the foothills to the

west of town. Not finding an existing home to our liking, we found a 9 acre lot up Rist Canyon on the Davis Ranch Rd. It was heavily forested with ponderosa pine and some aspen and Douglas fir and at an elevation of 7300'. It had a fantastic view into Redstone Canyon facing southeast. As soon as we could we had a driveway put in, we worked with a local log house contractor on the design of a two-story log house with full basement. In the summer of 1975, we had the basement excavated and Vollie and I began putting in the basement, concrete block by concrete block, after we had the footings installed. The log house was cut and assembled in Montana by a company called Lincoln Log. Early in September, the trucks with the cut and labeled logs arrived and the whole basic structure was set in place in 3 days! Then we began the finishing work. I served as contractor and worked with neighbors in the construction business who either did some of the work, like plumbing and electrical wiring, or taught us how to do it. They also put in the roof. Meanwhile Vollie and I began the process of studding out the rooms and finishing off the rooms, and chinking. We had the chimney installed and had the fireplace finished in lichen-covered native rocks. The outside of the chimney was just concrete blocks left for me to cover with our own lichen-covered rocks I found around our yard. I barrowed a set of scaffolding from the department that had been used for an instrument tower. I built temporary scaffolding on the house for access to chinking using 2X12's nailed to the logs coming out the side of the building. Unfortunately there was a 2" step up between planks and while chinking the outside, Vollie tripped and fell about 15 feet to the rough ground. It turned out she had broken her back in the process and had to lie flat on her back for several weeks. On the afternoon that she fell we went to a new student reception where Vollie stood up the entire time and socialized, while in extreme pain. The next day she went to the doctor who said, young lady you broke your back! That gives you some idea what a tough woman she is.



*Figure 14: Logs going in over the basement we put in and with my students help poured the cement floor.*

Since we had to renew our lease in the Fort Collins house by the end of August (typical of a college town) we moved up to our house site in Rist Canyon. I purchased a 15' camping trailer which had a cooking stove and the kids stayed in it. Vollie and I set up a military surplus tent that was octagonal in shape and had a tree with about an 8 inch diameter at its base as the center pole. In it we had our refrigerator, our double bed, TV, and a stainless steel Sheppard's stove which we burrowed from our neighbors, the Cox's. The rest of our furnishings were stored under tarps and an old tent loaned to us by Lew Grant.

By the 22<sup>nd</sup> of October, we had much of the chinking done on the outside, we had a working shower(a big celebration for that), and  $\frac{3}{4}$  of the roof finished. Son, Bill had installed his bed under the finished roof in a loft that he build above his bedroom. I came home the evening before the 22<sup>nd</sup> and said that I expect over 20 inches of snow that night. So, Vollie and I moved into the house under the roofed over section with our bedding. The next morning we found 22 inches of snow on the ground and the tent pole had broken bringing the tent down on everything remaining in it. Good thing we moved into the house that night!

One day, I believe about the middle of September while I was at work, Vollie prepared lunch for three year old Chris. But she looked about and called; no Chris. Thus began a search for Chris with neighbors going out on horseback or walking throughout this forested mountain area. It was important to find him quickly as nights dropped to around freezing and there were mountain lions in the area. After several hours of searching, son Bill and a friend came home. Bill thought about taking him for a walk down towards an overlook into Redstone Canyon. There he found Chris without his jacket and brought him home. That was a close one!

After putting in a full day of work at the office, I would come home and have dinner, we had lights running along the length of the house and I would work on the place until 10PM or so. Weekends were also major construction days. By early February 1976 we had the place finished enough to have an occupation permit approved by the county and our permanent mortgage activated. Of course, there were many years of work on the place but at least it was live-able at that time. Perhaps I should say here that after 28 years of mountain life including being active members of the Rist Canyon Fire Department, we sold out in 2003 and moved into a house in Fort Collins which we had purchased in 1995 and rented out. In 2011 the house we built burned to the ground in the High Park fire. All that work gone up in flames!  
☹

### *Early professional Life at CSU*

Meanwhile back at work, I began settling into my new job of teaching, advising graduate students, writing proposals, and performing research. In addition, I served as student counselor for several years which mainly involved recruiting new students. As to teaching I taught the first year graduate class in Cloud Physics, my specialty class in Cloud Dynamics where the notes from that class formed the basis of the book "Storm and Cloud Dynamics" co-authored with Rick Anthes. I also occasionally taught the undergraduate survey class for non-majors, and a graduate class in Micrometeorology. For about 20 years I routinely taught an undergraduate survey course based on the book by Wallace and Hobbs. About half the population of the class were majors in forestry and environmental studies. The students were required to take the class and they hated it because it contained what they called advanced mathematics. Actually the level of mathematics was the same as I had in an introductory physics class as an undergraduate. After about 10 years the students complained enough that the class was dropped as a requirement and that pretty much led to the death of the class as the enrollment became so low. I did have a number of physics, mathematics, and engineering science majors decide to do graduate work in our department after taking the class. That conduit to our department unfortunately ended when the class was dropped from the curriculum. I also introduced an advanced cloud physics class in the curriculum which for some reason was not offered until that time.

As to research, I had written a proposal to perform cloud simulations of thunderstorms and to simulate dynamic seeding of clouds. With that support I was able to pay expenses to get Otis Brown and Bob Evans out to Colorado for a couple of weeks to help me get the cloud model code running on the NCAR CDC 6600. Finally, I had access to a computer that would actually support the cloud simulations I wanted to do. During the first couple of years I tried to write the computer code, run and analyze model output along with teaching, writing proposals, and supervising graduate students. It quickly became apparent that I needed assistance in model development and applications. At that time, Greg Tripoli contacted me about working full time and doing his PhD with me. Greg had a MS from Florida State and worked at GFDL with Kurihara's hurricane model. He was an ideal person to support the

modeling needs for my research. Thus began nearly a decade of collaboration between Greg and me. With his help, we modified the model to work with non-dimensional pressure, and introduced the thermodynamic variable Theta-IL which was conservative under liquid and ice-phase transformation. Also during that period, I had a visiting scientist on sabbatical from Monash University in Australia, Mike Manton, and we developed the warm-cloud microphysics parameterization which was used in RAMS and a number of other models for many years. Greg and I applied this new cloud model to simulations of entrainment in cumuli, to simulations of Florida thunderstorms, and even simulations of dynamic seeding of cumulus congestus.

I was fortunate during those first couple of years at CSU to be invited to participate on the NCAR Field Observing Facility(FOF) advisory panel. Being a panel member I became acquainted with the facilities supported by FOF as well as the Aviation Facility. This included two C-Band Doppler radars, the Portable Automated Mesonet(PAM), and the NCAR instrumented Queen Air aircraft. I also learned when there were open periods in which access to those systems might be obtained.

Now it turned out that two of Lew Grant's students Kel Danielson and Arlin Huggins had performed an exploratory study in South Park, CO in which they had set up an S-Band radar to investigate thunderstorms in the area. So, that gave me the idea to write an NSF proposal to perform a field campaign in South Park to investigate the impacts of mountain convection on convective storms in the High Plains. I had no idea at that time just how far that idea would go. First, I made an application to deploy NCAR facilities in South Park including the C-Band Doppler radars, the PAM, and the NCAR Queenair. I also arranged for funding in the proposal to include support to deploy the CHILL multiparameter radar in South Park. CHILL at that time was managed by the U of Illinois. We also, upgraded the CSU S-Band radar that Kel and Arlin had deployed.

So, in the summer of 1977 we operated the South Park Area Cumulus Experiment(SPAC-77). In a sense this was the last of an era of single investigator lead field programs of this magnitude as after that most field programs of this scale were multi-investigator programs often under the leadership of NCAR. But this project came off quite well with Kel and Arlin providing the day-to-day field leadership, and I flying as lead meteorologist aboard the NCAR QueenAir. Almost all components of the observational program operated very well. Daily summaries of the field operations and notes were put in SPACE LOG77. This was the first field deployment of the NCAR Portable Automated Mesonet(PAM) that was not lead by NCAR staff. In fact I wrote a conference paper entitled "A summer with PAM". As a side note, Arlin Huggins went on to have a lifetime career in atmospheric science at the Desert Research Institute of the University of Nevada, Reno. Kel Danielson, made a major career change and went into medical school where he specialized in radiology. I often joked that he was doing the same thing and just changed frequencies from radar to X-ray. Kel established an outstanding career in radiology and often consulted with the U of Arizona Medical School. Unfortunately, Kel died of a heart attack while shoveling snow at his 2<sup>nd</sup> home in Telluride, CO. He was an extremely fit individual.

Data obtained during this field study provided new insights into the behavior of the mountain boundary layer and formed the basis on the MS thesis of Mark Stephens and the PhD dissertation of Bob Banta( first PhD I solely supervised). Bob went on to have a life-long career in NOAA Boulder and is one of the leading authorities on the mountain boundary layer. Also several interesting convective storms were sampled, one of which was a left-moving counter-clockwise rotating supercell which was a mirror image of the classic right-moving supercell storm frequently observed over the High Plains and central US. Owing to

the impacts of terrain on the regional flow, the environmental wind hodograph was counter-clockwise rotating compared to the clockwise rotation of a typical plains supercell. Analysis of this storm was the basis of Kevin Knupp's MS thesis and then Greg Tripoli and I simulated that storm quite well with our cloud model. Then Kevin Knupp continued the analysis of Doppler radar data from several SPACE-77 storms as part of his PhD dissertation. His emphasis was on downdrafts in convective storms. One of the major findings from that research was, besides the long recognized downdraft branch that initiated from mid-level inflow of dry low theta-E air, another downdraft component which originated in the moist inflow air, rose to mid-levels of the storm where the air encountered heavy precipitation loading and melting of hail, then rapidly descended to the surface. Kevin labeled this downdraft component as an "up-down" downdraft. Even to this day, this downdraft component is "under-appreciated" by the scientific community. Owing to the fact that the mid-level downdrafts originate rather high in the cloud and often in regions of light to moderate precipitation, their descent produces relatively weak downdrafts since the air is undergoing adiabatic warming through a deep layer during descent. The "up-down" downdraft, on the other hand, originates lower in the storm and forms in a region of heavy precipitation and melting leading to a more intense downdraft.

Another major finding from SPACE-77 observations, was that the convective storms that formed in the region of the SPACE-77 network, often propagated eastward onto the High Plains. Now this was expected and was a major focus of the original proposal. But what surprised me was that these storms participated in the formation of mesoscale convective systems(MCSs) which Bob Maddox labeled mesoscale convective complexes(MCCs). We were fortunate in that during SPACE-77 a major 10 day episode of these MCCs occurred and several of these systems made their way across the US and one intensified when it encountered the Gulf Stream. I hired Pete Wetzel as a postdoc(I served as co-advisor of Pete on his PhD committee and became his defacto advisor) where he analyzed one of these systems. Subsequent to his leaving for a career position at NASA Goddard, I hired Ray McAnelly. Ray was experienced in radar and satellite analysis which we used in the analysis of several MCCs. As part of that research, we had acquired stacks of satellite infrared photos of MCCs. I served on Bob Maddox's PhD committee and at the time, he had implemented an analysis technique called the Gandine analysis which could be used for compositing all sorts of meteorological data. I remember Bob showing us his progress with this analysis technique. I immediately ran up to my office and brought down satellite pictures which showed several examples of these large convective systems that formed over the High Plains often preceded by mountain convection moving onto the plains. He immediately dived into the analysis of these storms and the rest is history as Bob became well known for his analysis of what he called MCCs. He defined an MCC based on the physical dimensions and lifetime of the storms observed by satellites.

We continued the analysis and simulations of MCCs for many years afterwards. This included the papers with Pete Wetzel and Ray McAnelly analyzing one of those long-lived MCCs observed during SPACE-77, but also combined radar and satellite analysis of several of those systems with Ray McAnelly. Then there was Greg Tripoli's two-dimensional simulation of an MCC beginning with convection over the mountains and following the system out onto the High Plains. The total domain was over a 1000km making it one of the largest storm simulations ever performed at that time. While being two-dimensional, these simulations were also unique in that they included the earth's rotation. As a result a balanced circulation evolved with cyclonic flow at mid-levels and anticyclonic flow in the upper troposphere, consistent with observations. Greg's research introduced me to the concept that MCSs consisted not only of the well-known fast manifold dynamics associated with

convective-scale updrafts and downdrafts and gravity waves, but slow manifold dynamics associated with cyclonic motions in the middle troposphere and anticyclone motions in the upper troposphere and slantwise ascending and descending motions driven by stratiform-anvil cloud diabatic heating. I think that a large part of the scientific community still has a hard time accepting the idea of the importance of slow-manifold dynamics to the characteristics of MCSs. Most of the community think that MCSs are just large thunderstorm systems driven by thunderstorm-scale dynamics. Moreover, they view the stratiform-anvil cloud is driven primarily by the outflow from the embedded thunderstorms as depicted by early schematics by Bob Houze and colleagues. The dynamics of squall line systems, for example, is viewed in terms of the fast-manifold theory commonly referred to as RKW theory. Certainly during the early stages of an MCS, the merged anvil is fed mainly by outflow from thunderstorms, and the dynamics of the system, especially squall lines, is dominated by fast-manifold dynamics like RKW theory. But as the MCSs become large enough and last long enough, the role of the balanced component of the system becomes increasingly important, and the stratiform-anvil cloud is fed largely by slantwise flow originating 3-5km above ground level. This was shown by using back-trajectory analysis in a 1995 paper on cloud venting, for a number of simulated MCSs. Moreover, in the late 1990's Peter Olsson developed a balanced model and applied it to a case simulated with a full numerical prediction model(RAMS) and showed that many of the features of the MCS could be represented by the balanced model driven by the latent heating profile associated with the stratiform-anvil. Likewise, in search of a more dynamically-based definition of an MCC, Jack Linn(now deceased) performed a more extensive composite of MCCs and we showed that an MCC was a system which exhibited balanced dynamics and which were larger in size than the Rossby Radius of Deformation. Peter Olsson and I later concluded that “ a mature MCC represents an inertially stable MCS that is in a nearly balanced dynamical state and whose horizontal scale is comparable to or greater than a locally-defined Rossby radius of deformation.”This does not mean that smaller-scale MCSs are not driven, in part, by balanced flow dynamics, but that the balanced circulation is dominant for MCCs.

During this period, I somehow found the time to work on the “Cloud and Storm Dynamics” book with Rick Anthes. Rick, who was my former sailing buddy back in Miami was a member of the faculty at Penn State. We decided to work on this book with me focusing more on the small-scale processes and Rick more on the large-scale dynamics. During the writing of this book, Rick moved from Penn State to NCAR where he became director of NCAR and then director of NCAR's administrative oversight organization called UCAR. Each level of promotion resulted in Rick having less and less time to work on the book. As a result Rick contributed to 2 out of the 12 chapters of that book. I did the writing by getting up early, and each morning researching and writing for a couple of hours before going into the office or playing on weekends.

*The fun stuff*

*Flying*

While it may not seem like it, life was not all research and teaching. My office at the time overlooked the CSU owned Christman Field where a university endorsed flying club was located. I soon joined the flying club and flew there Cessna 150/152's, 172s, and 182. Most flights were local but a few were cross country flights, one to a conference outside of Seattle, Washington. I had an incident in that flight in which being used to 5000' long air fields in the west, the airport at Bellvue was less that 2000' long. I landed long and stopped just beyond

the runway, just short of a freeway. Everything was OK, had I not tried to taxi out of the rough ground and the propeller tip hit the ground and I had to have it replaced! Subsequently I joined in a partnership on a Cessna turbo 210 with Tom Vonderhaar and two other guys. This plane had retractable gear, and was the highest performance airplane I ever flew. I enjoyed many cross country flights with that plane. The most memorable was a flight (with commercial pilot along) to Banff, BC. On the way we flew over Glacier National Park and landed at a small grass strip runway right on the edge of town. After a few years flying that great plane I realized that I was getting only 25 to 30 hours a year flying it, which is not enough to be proficient in such a high performance plane. Moreover, the expense of operating it pushed our budget. For example, a major overhaul on the engine was anticipated with a cost of \$25,000. As a result I sold my share in the plane for \$1 and retired from flying for the time being.

### *Mushing*

While I gave up one hobby for the time being, I took on another one. This was much weirder. It was the sport of mushing. It all began when our son Chris who was getting big enough (3 years old plus) that it became challenging to tow him behind me in a sled when X-country skiing. So I enlisted the help of two Samoyeds to help me pull us along through the snow. Well one thing led to another and I got a sled, and acquired a couple of more sled dogs. Pretty soon I joined the Rocky Mountain Sled Dog Association and began racing. My first year was a disaster, but by the second year our team became competitive. This was due in part because I was lucky in purchasing two male Samoyeds that were small by Samoyed standards. Note that big is not good for sled dog racing. Then a neighbor's dog jumped into our dog pens when one of the females was in heat and we ended up with Samoyed-German Sheppard cross breed males. The winter of 1978 began with heavy snowfall at our house, and I had left much of our firewood in piles back in the woods. So I used those dogs to pull the sled loaded with firewood to our driveway where I could pile the wood in our truck. Those dogs were tough! Finally, since I was running a lot at that time, I was in good shape and started a new trend of running sled dog races in my running shoes so that when the team encountered a steep hill I would get off the sled runners and run up the hill. This meant the team did not become so fatigued in a race. Lastly, I trained the dogs by having them pull me standing on a three-wheeled converted golf cart and had about 700 miles on them at the beginning of the racing season. As a result, the winter of 78-79 I came in first in all but one 3-dog class race and 2<sup>nd</sup> on one. The one I came in 2<sup>nd</sup>, I was held up by a malamute dog on another team that grabbed my lead dog and pinned him to the ground. After punching the dog (and accidentally the female driver) I finally got the team free and came in 2<sup>nd</sup> place anyway. I won the club point system to be named Musher of the Year! Over a nearly 10 year period I expanded the team to running 7-dog class, evolved to a team of Seppala Siberians, and ran both sprint races and a few 100 mile moderate distance races. I was known as the "weather" team because the dogs had names like Cumulus, Nimbus, Lightning, Thunder, Chinook, etc. We took the team on overnight camping trips with me running 5 dogs and Vollie following behind with 5 dogs. The following team would go like hell trying to keep up with me. One time going down a hill called Calamity Pass, Vollie tipped over, but held on, and slid all the way down the hill on her knees! She followed the important rule to never let go of the sled!

I ran races in the ski resort communities of Colorado, races in Wyoming, Montana, and even took the team during my sabbatical year back to the northeast where I ran races in Upstate New York. One of the races in NYS was near Cooperstown and was practically within sight of the place where my father was born. It was on the hillside above the lake, but I doubt the house is still standing. The other race started near Mayfield, NY and crisscrossed through

the Adirondack State Park following forest service roads. This was a 100 miler and I would suddenly arrive at a lake that by main roads was like 100miles from the start and it would be a place that I had been when I was a kid. It was a weird experience. I also got lost in that race and went 20 miles out of my way with much of that distance on dirt roads with little snow on them. As a result I could not stand on the sled runners and had to run beside the sled wearing heavy insulated boots for as much as 15 or 18 miles! About 3AM I was pooped and stopped, tied off the lead dog to a tree up front and the sled on another to the rear, fed the dogs, and slid into a sleeping bag on the sled. The race organizers got worried about me not arriving at a check point so while I was sleeping snowmobiles were out looking for me. Eventually I made it to the finish line but then both Vollie and I came down with the flu. That was not exactly the funniest race I ever ran!

I actually enjoyed the most, training runs in the backcountry in Colorado, especially when I was well away from noisy and smelly snowmobiles. The team was so quiet that I could come up on X-country skiers and had to yell that I was overtaking them as they didn't hear me. In spite of what you might gather from the movies, sled dogs do not bark when working. I remember running the team under very cold conditions and seeing a plume of ice crystals form on the vapor exhaled by the team. Also, running the team up a narrow canyon at night with my headlamp on I encountered a graupel shower. Almost immediately, thunder and lightning occurred. What was strange was I had a headlight on that produced this narrow beam of light ahead of us. When the lightning flashed the view opened up to display the entire canyon walls, and immediately thereafter the view went back to that narrow beam. I suspect that working with the team of dogs was something I had to get out of my system. My grandfather loved working with a team of horses and often referred to driving a team of Clydesdales in the Cooperstown, NY area when he worked for Anheiser-Bush. I guess my dog team was a substitute for a team of horses! Incidentally one uses the same verbal commands with a dog team as with a horse team with "gee" to turn right, "haw" to turn left and "whoa" to stop them.



Figure 15: Mushing near Gould, CO.

By the mid-1980's I traveled a lot to conferences, workshops, etc around the world. This left poor Vollie to take care of 15 to 20 dogs! Since she was working then teaching German, Spanish, and even English in the Fort Collins schools, she was not a happy camper having to get up before dawn, break the ice in the water buckets, water and feed them, and clean up dog poop. It reached a point where it was *dog team or wife* and I chose "wife". So we sold off the dog team to mushers except we kept the lead dog "Hail". I did some skijoring with Hail in the winter and he carried a pack when we did backpacking in the summertime. From the proceeds of the sale of equipment and dogs we invested in Telemark backcountry skiing equipment. In retrospect, it probably would have been better to not expand to a full team but just go skijoring. When I visited Fairbanks Alaska and went out skiing to State Forest Service cabins with former student, Jerry Harrington, we often saw campers carrying their gear in a sled attached to the skier and one or two dogs pulling them along. They could make a much faster pace than the two of us carrying our gear in backpacks!

*Life in the Foothills*

Wintertime living in the foothills outside of Fort Collins, was often characterized by long periods without hardly any snow with occasional major upslope snow storms. These were generally cutoff lows that tracked eastward through the four corners area and when they made it out on the plains, southeast upslope flow would funnel up Redstone Canyon and dump large amounts of snow. The table below shows some of these storms that I called “Big Ones”. The total snow for the 1979 to 1980 snow season was 204”. The largest single storm event was the March 18 to March 20 2003 period where I measured 69”. During that event I stayed up there and had the driveway open in a couple of days with my John Deere tractor with 5.5’ wide snowblower. But the 2.7 miles of road to the county maintained Rist Canyon Rd was not open to our house for 5 days. The neighborhood association contracted with a neighbor with D9 caterpillar which moved at about 0.5mph and had over 100 miles of road to clear!



Figure 16: After a “Big One”



Figure 17: Snow in the Foothills.



Figure 18: Vollie shoveling the car out after a “Big One”.

DATE	PRECIPITATION (inches)	SNOW DEPTH (inches)—ENSO?
5/5 - 5/6/78	5"	45"
3/18/79	3.7"	30" Marginal El Nino
10/29/79	2.3"	22"
11/19 - 11/21/79	4.5"	44"

3/3 - 3/4/81	2.5"	24"
3/15 - 3/16/83	3"	30.5"
4/3 - 4/4/83	3"	28" El Nino
5/17/83	2.99"	23"
4/3 - 4/4/86	4.25"	34.5"
3/31/88	1.2"	23"
3/6 - 3/7/90	<u>6.74"</u>	54"
3/9/92	2.7"	28" El Nino
4/24 - 4/25/97	2.29"	44"
10/25/97	2.98"	42" El Nino
4/22 - 4/23/99	3.37"	25"
3/18-3/20/03	6.03"	<u>69" El Nino</u>
*Note: Total snowfall October - December 31, 1979 - 110"; Total for calender year '79 = 239"; Total precipitation 1979 = 34.69"		
*Note: Total snow for '79-'80 snow season = 204"		
*Note: Total snowfall March '83 = 71"		
*Note: '82-'83 season snowfall total = 154"		
*Note: March '90 total snow 70" and 8.31" precipitation		

We occasionally got rain in the Foothills. Once in the summer of 1976 we attended a party at Lew Grant's house on the plains northwest of Fort Collins where some people attending conferences down in Boulder joined in. I remember remarking that the air was so humid that it felt like Miami! On the way back up the canyon after dark, it started raining heavily and lightning briefly lit up the canyon walls showing water running like waterfalls off the rocky cliffs beside the road. The road was covered in water running across it and we had to dodge rocks in the road. But we got home safely(luckily). The next morning I ran down our dirt road to pick up the newspaper in our mailbox. The lower end of the dirt road was eroded badly. As to the newspaper, our mailbox was gone! I jogged down the paved road a bit and found big sections of the road were entirely gone! It took several weeks before a temporary road could be built, before that we had to drive an extra 25 miles over hill and dale to get to town. It took 2 years before the paved road was built. We had over 9" of rain that night. We found out later that we experienced just a little bit of what is called the 1976 Big Thompson Flood where 143 people were killed in the Big Thompson Canyon!



Figure 19: Trying to make it down Rist Canyon to meet with student Bob Banta and attend a conference in Boulder. I gave up in the narrow canyon when the water got waste high!

Throughout my early career at CSU, Greg Tripoli was a major contributor to our modeling research. He and I would debate scientific issues sometimes heatedly, pounding our fists on tables and the like. My administrative assistant at that time, Polly Cletcher, could not understand how we could get into fierce debate like that, and then a few minutes later we would go out for a jog and be quite chummy. Moreover, for a number of years, Greg was our neighbor living up Rist Canyon and he built his house from a kit, pretty much all by himself with wife Bonnie's help.

But all good things have to come to an end, especially in the revolving door of academia, and Greg completed his PhD and went on to have a very successful career at the University of Wisconsin. At this time he is department chairman there.

While I was busy professionally, so was Vollie. She taught German, Spanish, and even English in the Fort Collins public school system. Sometimes she had to drive down off the mountain on her own, which meant slipping and sliding on the snowy roads sometimes sliding into a ditch! Balancing work and family life was often a challenge. Son Chris was diagnosed as being hyperactive, which would today be called Attention Deficit Disorder(ADD). He was always getting into trouble with classmates and teachers. Sometimes he would come home from school very upset and angry. We couldn't figure out what was going on. Finally we got a call from the school bus driver that Chris was being bullied on the school bus. Some rednecks from Stove Prairie were picking on him daily including spraying his hair and lighting it on fire! They even stuffed our mailbox with straw and nasty notes saying "nigger". We found out that in school he was being continually harassed including being shoved and tripped in the hallways. Of course when Chris over-reacted he was the one who got in trouble. We told the principal and teachers about the racism that was going on and they said, not in Fort Collins! So I wrote an article in the Fort Collins Coloradoan called "racism is alive and well in Fort Collins" and outlined what Chris was experiencing and encouraged people if they see such things going on don't just look the other way. Well we were both surprised by the response we got(actually amazed!). We got many telephone calls supporting us. In school some of the jocks came up to Chris and told him if he had any more trouble just let us know and we'll take care of it. That immediately ended the racist bullying!

In contrast, son Bill's life seemed almost normal. That is if you call at age 15 driving our old tank of a 1966 J-40 Toyota Landcruiser pickup truck all over the steep mountain slopes normal! He would cut firewood with his own chain saw, load up the truck and drive it up to the house and either Vollie or I would drive it down to town where he would sell it at various homes. One time I was busy so Vollie and Bill headed down the icy canyon road and slid into a 180 spin landing on its side with the truck roof on one side of a ditch and the wheels on the road side. Somehow she got a call to me and I rushed down with logging chain. A neighbor came by and we hooked our logging chains on the truck and flipped it back on its wheels. There was not even a noticeable scratch on that tank! For some reason Vollie was not enthusiastic about driving the truck on down to town so Bill and I loaded up the wood and went on down to town and delivered his fire wood.



Figure 20: Our 1966 J-40 Toyota Landcruiser pickup after I painted it, in front of our home.

## 8.0 Mid-career at CSU

One day I got a telephone call from Roger Pielke who was on the faculty in Environmental Sciences at the University of Virginia. He said "Help, I want out of here!!". Apparently, while the small atmospheric group including Joanne Simpson dominated contract and grant funding in the department, the remainder of the faculty felt very threatened by them and made life very uncomfortable(actually miserable!). I told Roger I would see what I could do. I told Tom VanderHaar, who was department head at the time, Roger's plight

and he immediately went to work going through the process of getting a position for him. It was quite amazing that Tom could pull it off as there was not a faculty line that was open for Roger. As a result Roger, wife Gloria, son Roger, Jr and daughter Tara made the move from Virginia to Colorado. Thus began our second phase of collaboration. I thought, this is an opportunity to move forward in forming a modeling system with both cloud-scale modeling attributes and a mesoscale modeling capability. We named this new modeling system, the Regional Atmospheric Modeling System(RAMS) in keeping with RAMS being the mascot of the CSU athletic teams. While Greg Tripoli was preparing to leave for Wisconsin he put the nonhydrostatic cloud modeling code in shape to become part of RAMS. Meanwhile Roger and I jointly hired one of my PhD graduates, Craig Tremback, and Bob Walko to do the major leg work in assembling RAMS. Bob got his PhD under Bob Gall at the U of Arizona and had worked at the U of Oklahoma before coming to CSU. Bob is a bit of a perfectionist(an understatement) and has strong physical insight as well as mathematical skills which he applied to RAMS physics modules.

It wasn't long before RAMS became extremely popular and providing support to outside users of RAMS began taking up a lot of time and effort for Bob and Craig. It was decided to form a company which we called Atmospheric Simulation and Testing Research(ASTeR). We were advised by the Colorado State University Research Foundation(CSURF) to license RAMS and market it through ASTeR. Soon, ASTeR became very busy both in supporting RAMS and doing some contracts that were non suitable for University research. RAMS became distributed worldwide and was used in support of operational forecasting and for basic and applied research. Countries in Southeast Asia, Australia, Europe(mostly Greece), and Brazil became active participants in the RAMS family. Brazil called their modified version of RAMS, "BRAMS". Eventually ASTeR became such a success that some of the faculty in Atmospheric Science complained about the activity even though Roger Pielke and I supported more students(in the department) and had the largest amount of contract and grant activity. Moreover, the level of business in ASTeR became so large that part time management by Roger and me was not sufficient. At that time we were contacted by Mission Research Inc about their interest in buying ASTeR. We agreed to a price and sold ASTeR with several employees like Craig Tremback becoming Mission Research employees.

While it was nice having the additional cash flow from ASTeR which enabled me to purchase sailboats and sailplanes over the years, in retrospect, I wish we did not license RAMS. While the idea of licensing RAMS was initiated by CSURF, it cast a shadow over RAMS since NCAR developed the competitive mesoscale WRF model and provided support to users through the base funding NCAR received through NSF. Although it has been more than a decade since RAMS has become "freeware" people still comment to us that they will not use RAMS because it is licensed.

During my mid-career period, funding to support research in weather modification almost completely dried up. The reasons behind the collapse of funding in weather modification was discussed at length in the book by Cotton and Pielke on "Human Impacts on Weather and Climate". As a result, my research branched out into a number of different directions. Sometimes the research paths were motivated by the interests of my students. One new direction was in the physics and dynamics of marine stratocumulus clouds. It started with the dissertation of Chaing Chen who implemented a higher-order closure model which he applied to a rather comprehensive study of marine stratocumulus clouds. Subsequently, PhD student Bjorn Stevens working in collaboration with Graham Feingold, performed Large Eddy Simulations(LES) of marine stratocumulus clouds including using a full bin microphysics model and examinations of aerosol impacts on cloud properties including cloud albedo and

drizzle formation. Then, research scientist Hongli Jiang and I examined how modulations in drizzle by aerosol pollution can lead to unexpected feedbacks including a reduction in the intensity of the circulations in marine stratocumulus clouds and reductions in cloud albedo, in opposition to the general view at that time that aerosol pollution would enhance cloud albedo.

Motivated by Piotr Flatau's interest in mid-latitude cirrus, I also ventured into modeling studies of cirrus clouds.

One of the motivations for writing the Human Impacts book was that I noticed many parallels between weather modification and climate change. This included the tendency to "over-sell" the science, to suggest a localized rain event was due to cloud seeding or in the case of climate change, regional events of severe weather and hurricanes was surely related to climate change. Both are examples of exploiting science for political gains.

Another new area of research involved the application of RAMS to real-time prediction running on inexpensive high performance workstations. For almost a decade RAMS was run in real time with grid spacings of 3km over the State of Colorado. That research supported the MS research of Greg Thompson and Brian Gaudet. We learned a lot from those studies including that 3km grid spacing was not sufficient to make reliable forecasts of convective precipitation. I also quickly learned that "forecasting is a very humbling experience"! At that time the department held brown bag luncheons in which faculty members would present summaries of their recent cutting edge research. Well I gave a talk on our realtime forecasting with RAMS. At the end of the talk, several faculty members asked if it was going to snow that day. I said RAMS did not have any snow in its predictions. Well before we finished our lunch, we had 3" of fresh snow on the ground! They gave me crap about that for many years! Thus I concluded that "forecasting is a very humbling experience". That is why when I produce forecasts for my old soaring club nowadays I lead off with the title, "your fearless forecaster"!

Motivated by Louie Grasso's interest in tornado genesis, a series of papers investigating tornado genesis began. This included modeling studies by not only Louis Grasso, but Cathy Finley, Brian Gaudet, and Dave Lerach. One thing that came out of those studies is that in almost all of them the simulated tornado genesis process began near the surface as opposed to descending from the storm-scale mesocyclone as prevailing wisdom argued. Crucial to the tornado genesis process was that incipient tornadic vortices grow upward and couple with the mesocyclone aloft. Thus an optimum cold-pool intensity was needed with too intense a cold-pool inhibiting the coupling of the mesocyclone aloft and the near ground vortex, and too weak a cold-pool not being optimum to form surface-based vortices.

Continued analysis and modeling of MCSs occurred during this period. The observational studies by Ray McAnelly, Jerry Schmidt, and Jason Nachamkin provided considerable insight into the structure and evolution of MCSs. The modeling of derecho-producing MCSs by Jerry Schmidt and later Ligia Bernardet revealed that the source of the air producing strong surface winds in a derecho event was not the descending rear-to-front mid-level jet, but air ascending and then plunging in what Kevin Knupp called an "up-down" downdraft. Crucial to this process was a storm-scale mesoscale cyclone that lifted near ground level air(beneath the nocturnal inversion) by an upward-directed pressure gradient force and then when the air was cooled by melting and evaporation of precipitation it rapidly descended to the surface to produce severe intensity winds. Later studies by Michal Clavner further refined those concepts and showed how aerosols can modulate those processes.

Also during this period, Mike Fortune analyzed an MCS case whose structure resembled its much larger scale cousin, an extra-tropical cyclone, in that on the mesoscale scale it exhibited features like a warm conveyor belt, a cold conveyor belt, and descending middle tropospheric air.

Finally during this period, the 1995 paper on cloud venting stands out. First this invited paper was published in a rather obscure journal so its readership was rather low. But it involved a team of people from my group (Dave Alexander, Rolf Hertenstein, Bob Walko, Ray McAnelly, and Mel Nicholls) that included the use of a number of MCS and thunderstorm simulations over the years. Back-trajectory analysis was performed in order to examine the source air entering the upright convection as well as slantwise ascending air entering the base of the stratiform-anvil of MCSs. Contrary to the wisdom of the times, much of the air entering the stratiform-anvil did not have its origins in air detrained from upright convective cells during the storm mature and dissipating stages. Instead, the air ascended in slantwise air originating 3 to 5km above ground level and thus did not directly vent surface air. Using the output from 3D thunderstorm, MCS, tropical cyclone, and extratropical cyclone simulations, we estimated which of these storms contributed the most, globally to venting of low-level air. This showed that extratropical cyclones dominated venting globally owing to their high frequency and size. But for convective systems, although ordinary thunderstorms exhibit a large frequency of occurrence, MCSs dominate venting of boundary layer air because of their size. On the other hand, while tropical cyclones individually vent large amounts of low level air, their frequency is low enough that globally they do not vent as much air as MCSs. The same can be said about rainfall and latent heating in that owing to their greater size than ordinary thunderstorms, the frequency of MCSs is great enough that they dominate global estimates of rainfall and latent heating by convective systems. Even by 2019 GCM models do not represent MCSs properly and thus their role in the general circulation.

### *Homes*

In 1995 we bought a house in Fort Collins. The motivation was two-fold. (1) Vollie thought we should plan ahead to a time when we would be too old to live in the Foothills. (2) Son Chris needed a place to live. Chris had just graduated from U of Northern Colorado(UNC) and owing to his financial situation, wished to move back in with us. But, he only had a motorcycle which is not year-around transportation in the Foothills. Moreover, because he had so many accidents, our insurance company would not let him drive any of our cars. So, we bought a 1956 ranch-style house with a separate apartment in the basement where Chris could live. The upstairs was rented out at the time to a middle-age couple associated with CSU. So we continued that arrangement and Vollie became a landlady.

### *Hiking, biking, running*

As in earlier years, I continued an active outdoor life including running, biking, hiking, and boating. First I'll relate to you a rather amusing backpacking adventure that led to a reviewed published paper. It was on the 4<sup>th</sup> of July weekend of 1993. It started with my plan to drive down to the north rim of the Grand Canyon. It was a rather foolish plan given the rather limited time available. We were to leave first thing Friday morning and drive down to near the canyon that day. But, Vollie is notorious for not getting things done ahead of time nor getting going early in the morning. So, by noon we still were not underway so I cancelled that idea and went for Plan B. Vollie insists I chose Plan B to spite her for not being ready. It wasn't true but I won't go there! Anyway, Plan B was to take our backpacks and hike up to some lakes up the Poudre Canyon which I have seen on a map and heard there was good

fishing there too. The problem was there was not a developed trail to the lakes. This was in the early days of GPS navigation and I attempted to get the coordinates of the lakes off a map and then “go to” the lakes by climbing up the mountain side on the east side of the Big South trail. Well we never did find those darn lakes! We did on another attempt following a more established social trail. So we got up on top of this relatively flat heavily forested area. Getting towards dark, we prepared dinner and rolled out our bivouac bags(sans mosquito netting). To keep our weight down I did not bring a tent. We spent the night with shirts over our heads trying to keep the mosquitoes off us! The next morning, we got up and I looked to the west towards Cameron Pass. What I saw astounded me. All along the west side of the Front Range was a Chinook arch cloud just like what one would expect in the wintertime during a severe downslope windstorm event. I said to Vollie that we have to get down off of here now because it will be blowing and snowing like crazy! So we packed up and made our way back down the steep mountain side to the Big South trail. By the time we got to the trail it began snowing. When we got to the car, winds were really blowing hard. In fact, as we drove down the Poudre Canyon winds were picking up water from the river and blowing it on the car to the extent that I had to run the windshield wipers. I estimated winds over 90mph which was later verified. Subsequently, working with Brian Gaudet and John Weaver, we analyzed available data and ran RAMS, including sensitivity studies, using the same model configuration as the realtime forecasting version. We published a paper on this “Unusual downslope wind storm event on July 3, 1993” in the Bulletin of the American Meteorological Society. This episode gives you a glimpse of what poor Vollie had to put up with!

In 1977 I attended a 6 weeks long workshop at the Cloud Physics division of CSIRO in Sydney, Australia. Also attending for the entire period were Terry Clark of NCAR and Martin Miller(he became director of research at ECMWF). Occasional attendees included a PhD student, Graeme Stephens. Almost daily Terry, Martin, and I along with the occasional visitors would get into the Australian scene and go out for beers after work. Well, as a consequence I reached an all-time high weight of 195 lbs! I thus began what has become a lifelong process of running or jogging almost daily. Naturally I had to do this in a big way and worked up to running the Denver Marathon and the 16 mile race up 14,000’ Mt Evans! In preparation for those events I ran about 120 miles per week! This included runs from my house down Red Stone Canyon around the southern edge of Horsetooth Reservoir and down the dam to the office, a distance of 22 miles. Or another run would be to head east down in Strawberry Canyon up to the Foothills ridge and down into Lory State Park and across the north end of Horsetooth Reservoir and down the dam to the office, a distance of about 15 miles with elevation gains up to 1500’ on the way. Another run was the 13 mile road run up Rist Canyon to our house with an elevation gain of over 2000’! On that occasion, students John McBride and Ray George joined me. Vollie had prepared a nice meal for all of us and neither of them could eat a thing! I am still running daily but only 3-5 miles and except for the 2014 Fathers Day 5K with sons Bill and Chris, and grandson Galen, I no longer run races. Often Vollie joins me in what we call a WOG where she walks and I jog! I have slowed down a wee-bit!

### *Biking*

I also was into biking, both street and mountain biking. My first mountain bike was a pre-mass production mountain bike that weighed about 40lbs. But I used it on the roads and trails around our mountain home. For a time I would commute by bike a couple of times a week. It would take me about 45 minutes to go the 13miles down to the office with 2000’ of elevation loss, but 1 hour and 45min to get home. I also joined in some group road bike tours including doing the loop up Hwy 14 to Walden, south over Willow Creek Pass, and then into Rocky

Mountain Park, and over Trail Ridge Road. We did it with two over-nighters with Vollie bringing the camping gear. One time Greg Holland and I did a day trip up to Estes Park, along the Peak-to-Peak Highway down through Ward, to just north of Boulder and back to Fort Collins. Out of Estes Park we got into a hailstorm and hid under the roof of a sign. After the hail ended we got on the road only to find out the melting hail on the road resulting in our bikes spraying us with ice water. This led to mild hypothermia so we pulled off and had hot drinks and lunch at a guest ranch. Meanwhile our wife's driving sag wagon's lost track of us (note this was before cell phones) and Greg's wife became rather upset with us (a bit of an understatement!).

On a mountain bike adventure outside of Gould, CO with Hans Verlinde and about 5 others, we did a 55 mile ride that went over Calamity Pass twice, over Illinois Pass, and Willow Creek Pass all over 9500'. We were all quite tired after that ride!

### *Boating*

Having given up flying for a while, I went back into boating in a big way. First we ordered a tandem Klepper 17' folding kayak which we had delivered to my father and step-mother's home in Clear Water, FL. We flew out, rented a car, assembled the boat and paddled it amongst the islands near Clear Water Beach. We then headed north to a conference in Tallahassee, FL where besides attending the meeting we paddled on the rivers in the area. We still have that old Klepper and took it on airlines to several places including Mazatlan, Mexico. There, I managed to broach the kayak while returning to the beach through surf and ended up rolling the boat losing sun glasses and other things. I learned never to depend on the rudder in the surf as the stern is lifted enough that it is clear of the water!! These were the days when airlines did not charge for luggage or even over-sized luggage so the boat, paddles, life vests could easily be carried as luggage on flights. We also car tripped with the Klepper with the most memorable experience was when we went out to the San Juan Islands in the State of Washington. There we shore-camped on San Juan Island and toured along its coast. One has to be very careful with the tides as sometimes the tidal flow between islands can produce Class 3 rapids! While paddling along the island one day, with dog Donner lounging on the cloth deck between us, we had an orca sound about 50' from us. I still remember Donner's eyes open wide in surprise. I'll tell you an orca looks quite large 50' away when you are sitting in a kayak!

Then we got back into sailing. First I bought a Hobie 17 catamaran. We sailed it on the local lakes. One time son Bill and I took it out on Carter Lake on a windy day. I remember Bill pushing us off as I pulled in the main sheet. It took off dragging Bill in the water! Finally he got aboard and we headed towards a mooring area. The moored boats destroyed our maneuvering ability and we ended up capsizing with the boat totally upside down! With a lot of effort Bill and I got it up-righted and sailed it back to shore where we warmed up as the lake water was quite cold and the wind did not help either!

So I sold that and bought a Catalina 22' which is a small cabin monohull just like what Pete Black used to sail down in Florida (I think he still owns two of them, sitting and decaying in Florida). We sailed it mainly on Horsetooth Reservoir. The problem was that Horsetooth is notorious for gusty winds. I would set up enough sail to tack our way down the long narrow lake (or back) in relatively light winds. But when we would cross the area with canyons coming down from the foothills to the west, we would encounter strong winds coming down the canyon that would put us down on our rails (eg. tipping strongly). Vollie didn't like this rapid tipping of the boat. Note, this sort of thing did not happen much in south Florida except

an occasional thunderstorm downburst. But one could see the storms and prepare for the downburst. At Horsetooth situated right next to the Foothills, one could not see the thunderstorms coming so the downbursts coming down those canyons were a surprise. I then decided to get a stable trimarran. After some research, I decided to buy a folding trimarran designed by Ian Farrier. I found a home built, 22' Trailertri 680 in Vancouver, BC. I flew up to Vancouver to see if I would like it. The boat was well built but was just a bare boat with nothing but a place for a portapotti in the main cabin, and a bare little aft cabin. It was solid white with no attempt to pretty it up at all. I figured out why the guy decided to sell it after putting all that work in building it. My perception is that the sailing community in Vancouver is quite conservative and thus took a dim view of a trimaran and particularly when the almas(outrigger hulls) are folded with the akas(beams) sitting straight up in the air, which makes it rather strange looking. It is easy to unfold and fold on the water but all the neighboring boaters looked on with a strange look on their faces. I think he was embarrassed about the boat. So I bought the boat for \$7500US.

A few weeks later, Vollie, son Chris, and I headed to Vancouver with our pickup truck. Somehow I was able to get Colorado plates for the boat trailer(can't do that now as an official vin inspection by the Colorado State Patrol is now required for out-of-state purchased trailers). We loaded the boat on the" like new" trailer and decided to travel east in Canada along the US border. It was a pleasant drive and even saw a bear cross the road in front of us. Eventually we tried to enter the US at the border crossing near the west entrance to Glacier National Park. Previous to that I had called a US customs agent in Denver and asked what paperwork we needed to bring the boat into the US. So, I thought I had gotten all my paperwork in order. But the US customs officer at the Canadian border looked over my paperwork and said I needed a US Coast Guard inspection showing that the boat was sea worthy. I asked where can I do that? He said back at the coast. Ugh! What do I do now? He said I could get a bonding agent to put up big bucks to cover what I think was a \$25,000 bond. So I called a bonding agent and when he found out the boat was home-built he wouldn't touch it. Now what? I decided to drive back into Canada. After a few miles I pulled over and went over the trailer and sailboat and removed anything that showed its Canadian origins, like maple leaf decals. Fortunately I had a Colorado plate on the trailer so that was in our favor. So we drove north and east and entered the Customs station near the east entrance to Glacier National Park. When the customs agent asked where the boat originated, I told him I built it in Fort Collins. He said fine and we drove into the US. *I smuggled a 22' sail boat into the US!*



Figure 21: Trailertri 680

Back in Fort Collins, I went through that boat and built a small galley and table, sleeping bunks in the main cabin, put in running lights and cabin lights, spiffed it up by putting racing strips on the hull, and bought a 5 HP Honda 4-cycle outboard for it. It was a pretty boat after I got through with it and it sailed really well. One time we got caught with a downburst coming down one of those canyons in Horsetooth and Vollie was out hanging on the windward hull. She said she

could look down under the main hull as the boat was practically flying! We sailed the Trailertri 680 on the lakes around Fort Collins and even up on Lake Grandby. After several years of sailing it and having sold out ASTeR, Inc I had enough money burning a hole in my pocket to upgrade to another Ian Farrier designed boat called a Corsair F-27. So I sold the trailertri 680 for \$17,500(I had about \$12,000 in it by then) which is the first boat I actually made money on! Most boats are “a hole in the ocean in which to pour your money!”

The F-27 is a 27' long trimaran with a nice-sized after cabin, and main cabin with bunks that can make a double bed in the main cabin, a V-berth up front and a small bathroom in which we had a portapotti. I named it “Triple Point” which is a play on words as it is a three-hulled boat and triple point is the temperature for which the three phases of water(ice, liquid, and vapor) are in equilibrium. It was set up with winches, etc which assisted in rigging the boat and folding and un-folding it. I could actually launch it from a trailer and set it up for sailing all by myself! It is a fast, stable boat. It has the rather novel feature for a sailboat that the main hull can plane and when it does it feels like a jet afterburner is turned on! In fact, it was the best boat I have ever sailed in, let alone owned. It didn't take much wind to have it moving over 10kts. We sailed it in Horsetooth Reservoir, Boyd Lake, Bear Lake in Utah, Yellowstone Lake, and down in Biscayne Bay near Miami. A few excerpts from the log of Triple Point 11 are in Appendix 1.

Eventually Vollie admitted that she could not sleep on the boat owing to the water splashing against the hull, worrying about dragging an anchor, and the boat rocking. I actually found it relaxing. Anyway, since having a 27' boat for day sailing in Colorado lakes didn't make sense, I decided to sell it. As part of that process, I decided to go back into flying but this time in gliders or sailplanes. The agreement with Vollie is that she would not be asked to join me flying. More on flying gliders later.



Figure 23: Triple Point under sail in Biscayne Bay south of Miami.



Figure 24: Triple Point in No Name Harbor, Miami.

## 9.0 The last decades as a professor

### *Professional Life*

My last few decades as a professor were quite active professionally. I continued to teach the first year graduate student cloud physics class every other year, and my specialty class in cloud dynamics every other year, as well as the advanced cloud physics class which I initiated, every other year. Likewise, my research activities were at their peak. My research involved continued mesoscale convective system studies with Ray McAnelly, Jason Nachamkin, and Ligia Bernardet, tornado genesis research with Louie

Grasso, Cathy Finley, Brian Gaudet, and Dave Lerach, aerosol impacts on clouds and storms with Sue van Den Heever, Gustavo Carrio, Ting Wu, Will Cheng, Jerry Harrington, Steve Saleeby, and Randy Borys, and urban impacts on convective storms with Sue van den Heever and Gustavo Carrio. Gradually my research shifted to a greater emphasis on aerosol impacts on clouds, precipitation and storms. This was associated with a shift in emphasis in the community from storm-related research to climate change studies. Since aerosols appear to have a major impact on climate and generally act in opposition to greenhouse gases(aerosols cooling vs greenhouse gases warming), funding in that line of research was easier to obtain. In a sense, my research returned to my roots in my PhD studies where the emphasis was on aerosols from a cloud seeding perspective both in terms of seeding aerosols and of cloud condensation nuclei affecting the response of cumulus clouds to seeding. In fact, my PhD studies were on aerosols affecting the dynamic behavior of cumuli or what is called “dynamic seeding” wherein seeding cumulus congestus can lead to explosive growth of the clouds by transporting more condensate aloft, leading to freezing of greater amounts of supercooled water, greater latent heating, and a longer living heavier raining cloud. Research with Sue van den Heever and subsequently Gustavo Carrio suggests that a somewhat similar phenomena can occur due to aerosol pollution. My interpretation of our modeling results at that time, were that high concentrations of hygroscopic aerosol pollution can suppress the warm rain collision and coalescence process, leading in some cases to more liquid water being transported to supercooled levels, where it can freeze and release additional latent heat of freezing, and contribute to deepening and intensification of a storm and enhanced rainfall. This process was also independently proposed by Danny Rosenfeld and colleagues. But, as I will discuss later, my view on this has changed!

A spin-off of the study of aerosol impacts on deep convective clouds was the study of aerosol impacts on tropical cyclones (TCs). This area of research was motivated by a student at the University of Illinois, Henian Zhang, who wanted to study aerosol impacts on TCs using RAMS. So, I helped her get started with RAMS and as a result she asked me to serve on her PhD committee. In her research she found that pollution-sized hygroscopic aerosol led to a weakening of a TC. Her interpretation was that high concentrations of aerosols led to invigorated convection as a result of enhanced condensational heating. During her defense, committee members including Greg McFarquar (chair), Bob Rauber, and me all said that interpretation was nonsense as supersaturations in cumulus clouds is very low regardless of aerosol/droplet concentrations. As I will discuss later, I now think she was right! Subsequently we obtained funding(for less than one year) from the Department of Homeland Security(DHS) along with Danny Rosenfeld of Hebrew University, and my old colleagues from Miami days, Bill Woodley and Joe Golden. Administrators in the Department of Homeland Security wished to investigate the possibility of weakening hurricanes and reducing their damage. But when the Obama administration took over, the people who supported the idea in DHS were fired and our funding was curtailed after less than one year of support! Independently Danny Rosenfeld and I had concluded and published papers in the same year that seeding the outer rainbands of TCs would weaken the storms. Gustavo Carrio and I carried out simulations of an aircraft flying in the outer rainbands of an idealized TC seeding the storm with small hygroscopic aerosol, which led to a weakening of the storm. Subsequent research by my MS student Geoff Krall along with Gustavo Carrio simulating an actual TC over the tropical western Pacific(NURI) in which aerosol emanating from the Chinese mainland crossed paths with the storm. That work suggested that at first encounter the simulated storm actually became more intense but subsequently weakened. Our interpretation was at first the aerosol entered the core of the storm which lead to invigoration of the TC and subsequently only affected the outer rainbands. This was supported by research by Steve Herbener, a then-student of Sue van den Heever who also found TC

intensification when the aerosol reached to the storm core. As we will see my research on aerosol impacts on TCs continued through 2019.

Another line of research during this time was examining the impacts of aerosol on hailstorms. First Adrian Loftus spent the better part of his 7-year PhD research on designing and implementing a triple-moment hail model in RAMS. He along with Gustavo Carrio and I then applied that scheme to the investigation of how pollution aerosols would affect the size and amount of hail in some convective storms. The simulations suggested that high concentrations of hygroscopic pollution-sized aerosol contributed to larger hail sizes and greater amounts of large diameter hail, but the overall gross storm dynamics were little affected by aerosol. Subsequent research suggested that only hailstorms with cold or high cloud bases were significantly affected by aerosol, those with warmer or lower cloud bases were insensitive to high concentrations of aerosol.

*The fun stuff.*

*Homes/yurts/cabin*

On the home front, after 28 years living in the foothills outside Fort Collins, Vollie and I decided it was time to move into town. This was partly motivated by our being members of the Rist Canyon volunteer fire department and had experienced and fought a number of wild fires in the area. Some of those were quite close to home! One time we were out of town and had a cat sitter looking after the place. A fire broke out not far from the house and heeding an evacuation order she left the area, sans cats. Our son Bill being a member of search and rescue was allowed to get past the sheriffs officers and found our cats. As a consequence we became rather paranoid about wild fires. Vollie also thought it was time for us old folks to get closer to emergency services. So, in 2003 we sold our log home and moved to the house across from the CSU campus which we had purchased in 1995. One plus of this move is that it was only a 5.5 mile bike ride to the office. Post note: The High Park fire destroyed the house, garage and boat shed. The owner of neighboring land bought it and bulldozed everything under including the tall chimney I faced with native rock. The entire place has gone back to nature!

But, “you can take the boy out of the country but you can’t take the country out of the boy”!!! So we began searching for a place to get away from town in the mountains. We decided a yurt would be a good thing. We soon found out that most subdivided lands of a few acres or so, had covenants which did not permit setting up a yurt for extended periods. Laws in Colorado would not allow subdividing lands to less than 35 acres without extensive and expensive partitioning including roads, electricity, and other things. So, smaller mountain parcels are rare in the state. Lands of 35 acres or more would cost \$350,000 or more. After some searching we found a 7 acre Patent Mining Claim lot outside of Creede, CO. It was a 10,200’ with a beautiful view to the south down a steep canyon and across the upper Rio Grande valley. We purchased a yurt kit from Oregon and had a builder who lived in South Fork install a deck and help us set up the yurts. Yes, yurts, because we bought two, one was the main living quarters with a diameter of 16’ and the 2<sup>nd</sup> one attached to the main one of 12’ diameter. The small one served as our bathroom with a incinerating toilet, and a shower stall, as well as a guest room. The shower stall was a regular fiberglass unit but the shower consisted of a chrome tube that contained a thermometer and a hand pump to pressurize the unit. We would fill it with water and then put it on the stove top and heat it too the desired temperature.

*Figure 25: Son Bill on deck of yurt.*

The main room contained a double bed, kitchen cabinetry including a sink(no



Figure 26: Our yurts near Creede, CO.



Figure 27: Wine and snacks on yurt deck with the Thompson's.



Donner, became ferocious around bears and chased it up the mountainside. He had previously treed a bear at our Foothills home outside of Fort Collins.

But after about 5 years, son Bill and wife Vicki said they would visit more often if it were say 3 to 3.5 hours away instead of 6.5 hours. So we sold the yurt and began the search for a closer mountain site. Post note: We visited the yurt site in recent years and the owner neglected to put in the roof supporting "T" to take the snow load and the whole main tent collapsed and it like our old home in the Foothills it is also going back to nature.

running water) but a drain, and a small fridge and a small gas stove. It also had a wood-burning heating stove. It had a large deck to enjoy the view and underneath there was a large prospectors hole that served as a basement storage area. We also built a sturdy bear box to store food. Later we put in a construction type portapotti to back up the incinerating toilet which was raised enough to accommodate a camper blackwater dolly. The yurt was a great place to visit in the summer, fall, and winter, spring—not so much! From the yurt one can look across the valley at snowshoe mountain. We explored many of the mountain trails in the area in the summer including hiking 14'er San Luis Peak and 13'er LaGarrita mountains, viewing water falls, and trails into the Samanuchi Wilderness area. Visiting Creede, a funky restored mining town, is also fun with our favorite painter Steven Quiller having a gallery there, there is a repertoire theater, and several good restaurants. In the fall the upper Rio Grande valley is spectacular with fall colors. In the winter there are many great places to back country ski. But it did get cold there! One time it got cold enough to totally destroy all the batteries in the yurt and the outside thermometer broke with a minimum temperature to read of -52F! We did have some bear issues with one repeatedly damaging our folded pop-top camper and once attempting to enter the yurt while we were in it. Our small terrier-poodle mix,



*Figure 28: Inside of yurt*

There are several subdivisions within an hour drive of Steamboat Springs that were developed before the under-35-acre law went into effect. These were developed by speculators in anticipation of their being a winter Olympics centered in the Steamboat Springs area in the mid 1970's. But the state voted against that and the speculators went under. One of these is the Old Park Subdivision which is about 12 miles NW of Kremmling, CO and about 2 miles NE of Gore Pass and 3.5 hours from Fort Collins.

We explored many of these subdivisions but found Old Park to have nice views and easy access to a number of lakes and to hiking areas like the Flattops. So we first bought a 5-acre lot with a nice view and put in a driveway, put in a deep well, had the basement excavated, and had a leach field installed. We designed a two-story cabin and in December 2003 we drove up to sign a contract with a local builder. But on the way to his house we drove by a cabin for sale by owner that sat on a ridge with a great view of the valley below and mountains in the area. We talked to the owner and made a deal buying the place and stopping the construction plans for the other lot. We put the lot up for sale and because of all the improvements we had made easily sold it at a profit!

So the Old Park cabin became the place to satisfy the urge, "you can take the boy out of the country but you can't take the country out of the boy"! The cabin was on a 5-acre lot and we subsequently bought the adjacent 5 acre lot as a buffer against development in our back yard. It is a small tongue and groove log cabin having about 600 sq feet on the main floor and another 400 sq ft in the stand-up loft, with a single bedroom and single bath on the main floor. The loft serves as a large, but not so private, bedroom with room for another guest bed and TV. We immediately went to work on the place and as with our Fort Collins home built in 1956 we replaced all single-pane, steel-framed windows with double pane vinyl windows. We also replaced all carpets in the main living area and bathroom(ugh!) with good quality laminate and vinyl(bathroom). We expanded the window area on the south side of the living room to provide more light. We also installed a Vermont Castings red efficient wood stove and put a wall gas furnace in the dining area as the cabin only had electric baseboard heaters. We painted the outside logs with a California copper color to brighten it up and expanded the deck to get more afternoon sun. Then we had a porch roof installed on the north door entrance to prevent snow build up there. In the first winter a vinyl garage the previous owner had installed, collapsed when the snow drifted over it, so we built a metal roof, hard sided garage.

The cabin has been a fun escape from busy-busy-busy Fort Collins. We enjoy having breakfast, lunch, and dinner on the deck in the warmer months. In winter, we can dress to ski, and ski right out of the cabin on trails in the neighborhood. In summer it is a base for hiking in the Flattops and Gore mountain areas. The Flattops are particularly striking with waste-high flowers, and in the early fall the aspen colors are phenomenal. It is also a base to go sea kayaking on nearby Wolford Reservoir, on Lake Grandby, Grand Lake and Shadow Mountain, and Lake Dillon. It is great for viewing wildlife like bears, moose, deer, elk,

**bobcats, and occasionally mountain lions. Son Bill and family use it as a base to go downhill skiing with a 45min drive to Steamboat Springs and Winter Park.**



*Figure 29: Winter at the cabin.*



*Figure 30: Fall view off cabin deck.*



*Figure 31: Cotton family circa 2010; left to right: Bill R, Vollie, grandson Galen, son Chris and ex-wife Sarah, Bill's wife Vicki, son Bill, and in foreground Kochia*



*Figure 32: Cabin in the summer.*

**Unfortunately, after only a couple of years owning the place, we had a major invasion of pine bark beetles. They killed something like 90% of the lodgepole pine trees on our land. Ironically, after only a few years at our Foothills mountain home we had an invasion of pine bark beetles attacking ponderosa pine. We lost maybe 30% of those trees. Son Bill, cut those trees to sell as firewood in Fort Collins. For some odd reason, he seems to enjoy doing that and has led the charge in cutting those killed lodgepole pines at the cabin. Then in the summer of 2018 a major fire broke out in the wilderness area NW of the cabin. It was not fought there and eventually made its way toward Old Park where costs of fighting it went into the millions. For much of July through September the neighborhood was either under pre-evacuation notice or actual evacuation. During the first pre-evacuation son Bill and I raced up to the cabin and loaded valuables and paintings, along with snow blower, and tractor with snowblower and brought them down to Fort Collins. Only after the snow and heavy fall rains**

**occurred was the area open to normal life.**

***Flying***

**Back to flying! After I sold the F-27 sailboat I returned to flying with Vollie's support as long as I didn't invite her to join! I made the transition from power to sailplane under the tutelage of Fred Herr, who had something like 15,000 hours flying gliders. I learned to fly in a side-by-side motor glider (a Grob 109B) and got my glider rating. Then during Spring Break we went down to Turf Soaring where I got my aerotow sign-off. My first licensed flight in the Grob did not go so well. After passing the flight examination in Boulder, I returned to Fort Collins-Loveland airport with ¼ tank of gas showing which should have been plenty of gas. But not far from the airport I ran out of gas! I landed in a muddy field where we had to disassemble the plane and load it on a truck to take it to the airport. It turned out the tube that the gas tank float floated in had swollen and stopped descending as it got below half tank giving me the miss-reading of ¼ tank! This was all very embarrassing, especially when a reporter from the Fort Collins Coloradoan newspaper came out and took pictures of me standing in the muddy field alongside the plane and ran an article about glider lands out but safe. A day or so after the incident I went off to a conference and when I returned my office had these figures of pilots with parachutes hanging from the ceiling and many copies of the newspaper colored photo of me in the muddy field—Grrr!**

**Following this incident I bought a ¼ share in the Grob "after the gas gauge was repaired". I had some great flights with that plane. It was not that good for thermalling but it sure was good for wave soaring. I would motor up to 9000' or so, work my way behind the rotor cloud and let it lift me into the wave. The rotor sits beneath the main wave crest and it is the most turbulent place to fly, anywhere! Once after a mechanic worked on the plane Rolf Hertenstein and I got into strong enough sink in a rotor that a wrench appeared floating in front of me! I grabbed it so that it did not break the wind screen. But once in the wave, the transition to extreme, non-turbulent flow is amazing. The variometer which has an audible tick-tick sound, virtually screams as the plane ascends at 8 to 12kts or so. Unless special arrangements are made with FAA, one cannot fly about 18,000' as it is controlled airspace. Once, I ascended so fast that I put my spoilers full open and I still was swept slightly above 18,000'!**



*Figure 33: Grob 109B*

**Owing to some quirks in that plane I eventually sold my share and bought another two-place side-by-side motor glider called a Ximango. It had retractable landing gear and was a better plane for thermalling and faster for cross country powered flight. I had some great flights wave soaring with it and even ridge soaring. Once with Ward Hindman we did some thermalling, caught some wave, and worked our way to the west side of the Medicine Bow Range where we ridge soared following the mountain side contours something like 100' or so from the mountain. We wrote an article in Soaring magazine called something like, "One if by thermal, two if by wave, three if by ridge lift". I had some great powered cross country flights with it and once flew with the former owner, Denise Michaud, all the way to St. Petersburg, FL. On another flight, I took my little dog Donner on a flight to Creede, CO. You should have seen his wide open eyes when he looked out the window and didn't see the ground! We landed at the 8500' altitude airstrip in Creede where I had left our Suzuki Samurai and had fun up at the cabin. Our return flight was uneventful. Eventually I found that the maintenance costs of the Ximango were quite high and sold it.**



Figure 35: Bill and Ximango.



Figure 34: Soaring Australia.

I then joined the Colorado Soaring Association(CSA) located at the Owl Canyon Gliderport, north of Wellington, CO. There I learned the art of “real” soaring in non-motorized club planes. But I bought a self-launching motorized glider called a DG-400. In flight the motor was hidden in a cavity to the rear of the pilot, so it was a pretty clean plane to fly. But one could push some levers and lift the entire motor into the airstream or self-launch from the ground and stow the engine. I had many good flights with it around Colorado and even in Arizona. Owing to my back problems(I have angolysin spondylitis) my flights were generally limited to less than 2 hours otherwise I would stiffen up so much that I had to be practically lifted out of the plane. Some of my most memorable flights were in the Tucson area where I towed the plane in trailer during spring break. Once I flew down over Kit Peak and Baboquivari peak and back. On another flight I flew from El Tiro gliderport near Tucson to Estralla gliderport SW of Phoenix and returned. Normally when flying in thermals, one finds a thermal when the wing lifts and turn into the thermal, feeling your way into the thermal core and turning tight circles while rising in the thermal. I have often thermalled with hawks until they would get upset about this big bird! If the thermal conditions are ideal, one can do another form of soaring called porpoising. In this mode, one feels thermal lift and slows down to minimum sink speed and when out of the thermal one puts the nose down and flies at high speeds, often 100kts or so until the next thermal is encountered. Well the time I flew from El Tiro gliderport to Estralla and back(without landing) was such a day. It was like flying a power plane as I porpoised along in a straight line at something like 100kts! Wow! Another memorable flight was motivated by Nilton Renno who at the time was a faculty member in Atmospheric Science at the University of Arizona and a former glider champion in Brazil. I asked Nilton if he had ever flown to the top of Mt Lemon? He said yes, he flew to the top of the Tortilita Mountains and glided east where he picked up the lift along the mountain side and up to the top of Mt Lemmon. So I followed Nilton’s instructions and headed to the Tortilitas. Along the way I encountered three military jet fighters heading down and towards me. I kept lifting my wing to make me more visible as they swept over me. I have no idea if they ever saw me but they scared the crap out of me. Eventually I thermalled to the top of the Tortilitas and headed towards the Catalina Mountains. As I passed over a golf course I encountered massive sink and was forced to get my iron thermal out and motor to the mountainside. There I found this thermal shoot that lifted me up the mountainside like a powerful elevator. I crested over the observatory on Mt Lemmon turned and glided all the way back to El Tiro. Upon my return

I described my flight to Nilton including the massive sink over the golf course. He said “oh yes, I landed out there once”! He neglected to tell me about that beforehand! Grr! ☹

During this period I began providing soaring forecasts to CSA. We were running RAMS with 3km grid spacing over CO and so I introduced code to help predict soaring conditions. This including a mapping of something like a lifted index based on forecast surface temperatures and forecast soundings. I also displayed vertical east-west cross sections across the Front Range mountains to help in predicting mountain wave lift potential. I found that even at the course grid of 3km, it did a pretty good job of forecasting wave lift potential. After we shut down the high resolution RAMS realtime forecasts due to lack of funds to support maintenance of the system, I had to resort to more classical methods of making soaring forecasts. For thermals I use on-line forecast sounding products for the nearest site to the gliderport. Since I make the forecast on Friday morning I use soundings obtained from the GFS forecasts out to 60 hours. There are higher resolution models available on line from NCEP, like the NAM, but it is a piece of crap! Wave forecasts are even more crude as I use the forecast wind strength and direction at 500mb to indicate a potential for good wave lift. Generally strong winds perpendicular to the barrier(SW flow for the Front Range) the better the chances of good wave lift.



Figure 36: DG-400 self-launching glider.

I decided to sell my DG-400 as it was getting to be hard to find parts for the aging 2-cycle self-launching motor. I bought a newer sustainer sailplane called a Discus 2T. Instead of having a starter and power to self-launch as with the DG-400, it only had power to save my butt when in sink miles from the gliderport. Like the DG-400 the engine was hidden in an enclosure behind the pilot that could be easily lifted into the airstream. The fan, hence the name turbo in 2T, was designed to windmill and start without the aid of a starter. It didn't have much power but would slowly ascend or slow down descent in sink when deployed and get one back to the port. I had many great

cross country flights with it, especially flying over the Front Range mountains and even over 14er Longs Peak which I enjoyed immensely. Once passing over the peak, I would just begin a long slowly descending glide back to the gliderport.

One might ask, why did I nearly always fly with some power available. Aren't there many glider pilots who fly sans engines? The answer is clearly yes. But remember that I started flying gliders in my mid-50's and I have found I don't have the cajones I had in my youth, so a backup iron thermal felt good! ☺

### *Boating*

I realized that running and bicycling was mainly working my legs. So I decided to take up more regular kayaking to work my upper body. I am not a fan of working out in a gym so I like to do things that get me out in nature. I bought a 17' plastic Dagger Apostle. It is a heavy kayak but is quite good performing. Once the lakes around Fort Collins thawed out enough I would go out at least once a week and paddle for an hour or so while viewing birds and enjoying open views of the Front Range. I even attempted paddling in Horsetooth Reservoir in winter wearing a wetsuit. Horsetooth is so deep that even on cold winters it doesn't freeze over until February. But the bays where there were launching sites quickly froze in. But fisherman would launch their boats and cut their way through the thin ice. So I would put it at the same place and follow their opened paths. It was a bit tricky because if I ran up on an

ice sheet I found the kayak became tippy! I also had built a Chesapeake Lightcraft (CLC) tandem kayak with sailrig including akas and almas (outrigger hulls). I had a guy who worked in the department build this kit for me as I didn't have the time to do it. This was a very fast and stable kayak for the two of us to paddle. We had many fun trips with it including paddling around parts of Isle Royale with son Bill, Vicki, and Galen. Poor Bill mainly paddled the tandem Kepper with grandson Galen who didn't help much. The tandem Klepper does not perform as well as the CLC, so he had to work hard to keep up with us!



*Figure 37: Tiki 21 on beach.*

For paddling at the cabin I bought a single-place Klepper A-2000 folding kayak which was easy to handle and performed quite well. Vollie would join me once in a while and we would paddle the two-place Klepper folding kayak that we bought quite a few years ago. I made the mistake of letting Vollie paddle the A2000 and she loved it! She much preferred paddling in the single place kayak than the tandem. I lost my little Klepper! From then on we mainly paddled together but in our separate kayaks. For me, I found a used CLC 17' single-place wood kayak covered in fiberglass cloth in Fort Collins for \$550. Note that the kit cost around \$1000 and someone put over 400 hours building this kit! I sanded it down and painted the

hull and varnished the mahogany deck over a weekend. It looks really nice and I frequently get favorable comments when I launch and retrieve it. It is also a stable, yet fast kayak. So the two of us would paddle our single-place kayaks on the many lakes not far from the cabin. Eventually I made the mistake of leaving the A-2000 assembled hanging in the garage at the cabin for the summer. This was a big mistake as the cotton decking material became hard and brittle which made it vulnerable to poking holes in it. I checked into having it recovered but the cost was more than I paid for the used original boat. So I searched and found another CLC 17 which I sanded, painted and varnished. Now both Vollie and I paddle our own single place CLC kayaks.

As it was originally set up the CLC Tandem sail was great for paddling but not so great for sailing. So I found a used single-place Hobie Adventure Island sailing kayak. It was about 15' long and was a sit-on-top kayak with attachable akas and almas where the akas could be swung out to full extension. The kayak was designed for peddling with foot pedals driving flipper-like things underneath the hull. Because ones leg muscles are stronger than arm muscles one can move this along at a good pace. However, I found pedaling that in a recumbent position was hard on my old knees. Moreover if one ran aground with those flippers they were prone to be damaged and I often had to repair them or replace them at quite a cost. One could paddle it like a normal kayak but as a kayak it was a barge. It was a fun boat to sail however. It had a single mast with a sail with battens that were designed to wrap around the mast so the sail could be roller reefed. This was a very clever design. Sitting on my kayak trailer, it took me only 20 minutes to launch the kayak, swing out the almas, and unreef the sail, and peddle out to the open water. Once under way it was fun to sail but I didn't like sitting in a puddle of water all the time as the peddle gear left a hole in the floor! So I sold it and ordered an Adventure Island mast, sail, and mast step assembly, which I had

a local craftsman install in my 22' CLC tandem sail. This was a beautiful boat when it was setup to sail, but it did take 45 minutes to assemble and disassemble.

I then decided to buy a sailboat that I could put on a mooring on Boyd Lake for the summer with occasional sorties sailing elsewhere. I first bought a James Wharran designed Tiki 22. The hulls actually had two coffin-sized cabins, not suitable to sleep in but great for storing gear. It had a large platform for sitting; big enough that one could hold parties on that big platform. It was a fine boat to sail, not too great to point into the wind but quite fast on a reach or downwind. Wharran designed all his boats to resemble Polynesian style kayaks. The hulls were laced to the akas or cross beams with no hard points so that it would flex under stress rather than break at the hard points. I thought that was a great idea! One down side of that was that it took forever(3 to 4 hours) to assemble for launching or take it apart when retrieving. First you put the hulls on dollies, then placed the akas in place, and began the lacing process. Then you put the seating platform in place, and put the mast up. After a couple of years of doing that, I got tired of the entire assembly process and sold the boat.

Then I began the search for a sailboat easier to rig than the Tiki 22. After some searching I found an Ian Farrier designed Trailertri 720. The design actually preceded the F-27 so it didn't have a planning hull nor did the shrouds support the mast during lifting. So it took two people to rig it. With two people it took about 1.5 hours to rig the boat and launch it. Getting the boat to Colorado was what I will call "a trip from hell". I flew down to Fort Lauderdale, FL where I inspected the boat and found it in good shape. Unfortunately, the boat was in the water and I did not inspect the trailer. A few weeks later I drove down to Florida with my pickup truck and got the boat. I found it sitting on this extremely rusted trailer. Fortunately I arranged ahead of time to have the wheel bearings greased. I then began the long drive north to Fort Collins. About 2 hours east of Tallahassee I noticed the boat was listing to one side on the trailer. Upon close inspection I found that one of the trailer leaf springs had broken. Yikes what to do now? I found this semi-truck repair shop that said they could replace the springs. So waiting only a few hours, they removed the old rusty leaf springs and put in new ones. I was amazed they could find replacements! So I continued west on I-10 and drove through Tallahassee after dark. Only about 30 minutes out of Tallahassee I noticed smoke coming out of one of the trailer tires. Upon close inspection I found that the trailer axel had broken! Ugh! I called AAA and a big tow truck with platform arrived. He winched the boat and trailer on the rig and I followed him back to Tallahassee where he unloaded the whole thing outside a boat repair and maintenance shop he knew of. I spent the night sleeping in my pickup and about 0800 the shop opened up. I told them my plight and they took some measurements of the axel, called a shop down by the bay about an hour away and had a new axel made up. I can't imagine being able to have that done in the land-locked west! So I drove down to the shop where they had my new axel built and I returned with it to Tallahassee. By 4PM I was underway heading west to Colorado. I would drive until I would get sleepy and sleep in the truck and stop for dinner at diners along the way. I finally made it back to Fort Collins with no further problems. After launching the boat, I took the trailer to a welding shop in Loveland, CO where they welded metal plates strengthening the trailer. I suspect that trailer is still being used! I sailed that boat for about 5 years at Boyd Lake mostly with Vollie or son Bill. Son Bill really liked that boat. But being dependent on a crew to sail it, I didn't get as much sailing time in as I would have liked. I could pretty much single-hand the boat once out in open water, but with its wide beam and weight it was a bit tricky for me to sail it off and on a mooring and through the marina all by myself. So to son Bill's displeasure I sold it and went to a different form of sailing.

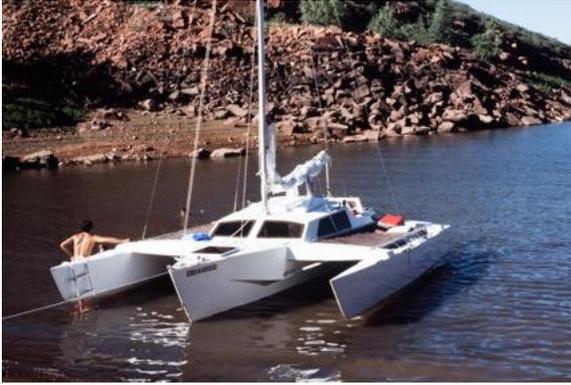


Figure 38: Trilertri 720 at Horsetooth Reservoir.

### *Hiking*

Throughout our married life and even before, Vollie and I enjoyed hiking in the mountains. In Massachusetts we hiked Mt Greylock, an easy days drive from Albany. We also hiked Mt Marcy in New York State(highest mountain in the state) as well as lesser known mountains. Mt Marcy was a bit more exciting than we had planned as a thunderstorm rolled in when we were a short distance from the top. The rocks made a sizzling sound and the lightning struck all around us as we hung out beneath a rock out cropping. In Colorado we tend to stay away from the 14ers as they are “attractors” which means they were crowded with hikers. Instead we often hike un-named mountains which we have to ourselves and the wildlife, and flowers. Sometimes we would backpack near the summit of places like Montgomery Pass and the Flattops. Most of our hikes are day hikes either driving from Fort Collins, or our cabin, or yurt. One time I told my then student Sue van den Heever about the hike shown below of Vollie. She and her husband Steve, loaded their two kids on backpacks(who are now adults) and headed up to the saddle bush whacking through open meadows and steep forest climbs to the top. We often saw elk and deer along the way and once 4 bull moose just below the summit. They made it to the summit just fine but on the way down they didn’t follow their up route and ended up about 3 miles east of their car!



Figure 39: Vollie at the top of a ridge about 11,000’MSL southeast of Cameron Pass.

### *Guns*

When growing up I lived in a culture of guns. My father always had a number of guns, some being collectors’ items. I remember one time a neighbor found out that someone had broken into their home. They detected that the thief was still in their basement. So what did they do, they called my father who went to their house and held the thief at gun point until the police arrived. I also had guns in my life and when son Bill was in his early teens I bought him a lever action 22 caliber rifle and taught him how to handle it, and shoot it at targets. When my father was 77 he committed suicide by gun. For those left behind, one always wonders if I should have recognized the symptoms and done something about it(he lived in Florida by that time). Since then I have not touched a gun! Part of the reason, though, is that Vollie hid my classic LaFeaver 12 gauge shotgun from grandson Galen and neither one of us can remember where or find it!

### **10.0 Retirement years**

## *Professional life*

At this juncture in life I began the slow transition from a very active career teaching, advising graduate students, and running a very aggressive contract and grant program, to a less active professional role. No longer would I advise 15 to 20 graduate students, have 4 to 8 contracts and grants, and publish 3 to 4 reviewed papers per year and write books. I first went into a 5 year transitional retirement period in which I only taught one class per year, but did continue with research and advising graduate students. Then in 2010, at age 70, I fully retired and no longer taught classes. But I continued a moderate amount of research and supervised a few students. I did begin and complete the second edition to the book “Storm and Cloud Dynamics”. I tried to get Rick Anthes, my original coauthor, to work on it with me but he declined. I asked Sue van den Heever to update the main chapter on mid-latitude cyclones that Rick had written in the first addition and she agreed. Sue was a PhD student of mine and now a very active award-winning faculty member at CSU who taught courses on that subject. I was pretty much burned out on the theory of small-scale dynamics, so I asked a recent PhD graduate of Penn State, George Bryan to update those chapters and he agreed to do so. George had independently developed his own storm scale model so was up to speed on small scale dynamics.

My plan was to update material in all chapters and introduce a thread of aerosol impacts on clouds including marine stratocumulus clouds, Arctic stratus, wintertime orographic clouds, cumulus clouds, ordinary cumulonimbus clouds, severe convective storms including tornadoes, hailstorms and intense rainfall, and tropical cyclones. In the case of tornado genesis, I focused on the concept that tornado genesis is not just a mesocyclone aloft that descends to the surface forming a tornado, what can be called a *top-down* process. Instead, I argue that the tornado genesis process begins at the surface often along surface boundaries such as the rear flank downdraft gust front, or other convective downdraft boundaries. These near surface vortices merge and build upwards where they can merge with the rotating thunderstorm aloft. This can be called a *bottom-up* process. A key ingredient to the coupling of the near surface vortices and the storm-scale rotation is the relative speed of these vortices and that to a large degree is determined by the strength of the storm-induced cold-pool. If the cold-pool is too cold, then the low-level boundary and associated low level vortices move away from the parent rotating storm aloft and tornado genesis is curtailed. On the other hand, if the cold-pool is not cold enough then the low-level vortices are less likely to form. Thus there is an optimum strength of low-level cold-pools for tornado genesis. Aerosols which affect the strength of cold-pools alter this process, but a more important contributor is the amount of low level moisture. Moderately strong low-level moisture, reduces the strength of the cold pool, which in turn enhances the coupling between low-level vortices and the storm scale mesocyclone. This explains the often observed correlation between strong low-level moisture and tornado genesis. It also explains why tropical cyclones can be prolific producers of tornadoes. This subject remains controversial today.

I also attempted to make it clearer that mesoscale convective systems(MCSs) are not just a cluster of thunderstorms that spew water vapor into the upper troposphere and produce a large stratiform-anvil as a result. Instead, once a thick anvil cloud forms, latent heating/cooling in the anvil drives slantwise ascending and descending flow with the low-level roots of the slantwise ascent being above the boundary layer. This is associated with near-balanced dynamics of the storm rather than just upright convective heating and cooling. As a result MCSs are long-lived convective systems, often 12 to 16 hours or more, have a heating profile that is distinctly different from ordinary thunderstorms, and produce extensive rainfall not only from the upright convection but also the slantwise ascending/descending

motions. As pointed out in the last chapter of Storm and Cloud Dynamics, on the role of clouds on climate, I note that MCSs are the dominant contributor to warm-season rainfall in many regions in mid-latitudes as well as in the tropics where they dominate in driving such important circulations as the Hadley cell (*not hot towers!*). It is also important to recognize that climate models or general circulation models (GCMs) do not properly represent MCSs. That is they do not represent the balanced component of the MCS and the associated heating, momentum transfer, and rainfall. This is partly due to the fact owing to their large size and lifetimes, MCSs move in or out of grid volumes in a GCM grid, a process that is not represented in those models. Even so-called “super-parameterizations” do not represent MCSs properly as they simply represent the old conceptual model of an MCS being composed of a cluster of upright convective cells spewing moisture and cloud debris into the upper troposphere.

Missing in that book is my altered view of aerosol-induced convective invigoration. That tells you how long it has taken me to turn the corner on that concept. My original interpretation of our modeling results was *that high concentrations of hygroscopic aerosol pollution can suppress the warm rain collision and coalescence process, leading in some cases to more liquid water being transported to supercooled levels, where it can freeze and release additional latent heat of freezing, and contribute to deepening and intensification of a convective storm and enhanced rainfall.* But there is also modeling and theoretical evidence that high concentrations of pollution-sized hygroscopic aerosol can invigorate the updrafts of purely warm clouds. *The theory is that high concentrations of cloud droplets formed on numerous pollution-sized aerosol exhibit greater net surface areas upon which condensation occurs, thereby enhancing net vapor deposition rates which leads to enhanced latent heat release by condensation in cumuli. This concept is called “condensational invigoration”. Recent studies suggest that at heights above 3km above cloud base where droplet collection can be prevalent, cloud droplet collection reduces the concentrations of cloud droplets, thereby supersaturations can exceed nominal near-cloud-base values, which can lead to appreciable enhancement of condensation in a polluted cloud relative to a clean cloud. This process is facilitated by the coexistence of very hygroscopic particles and lesser hygroscopic particles in high concentrations. Thus latent heat by condensation of droplets can be enhanced enough to invigorate updrafts, lead to greater amounts of condensed water, produce broader, longer-lived cumuli and thereby enhance rainfall.* Recent modeling studies by Lebo and Seinfeld (2011) and Fan et al (2018) support the concept of “condensational invigoration”. Bob Walko and I have completed a series of LES numerical experiments (in 2019) which further supports the *condensational invigoration* concept. Moreover, the latent heat of condensation is some 7 times greater per gram, than the latent heat of freezing. It also is prevalent at lower levels in a cloud where environmental moisture amounts are large. Thus any invigoration of convection at low levels will have appreciable effect on the intensity of convection and rainfall. I gave two talks at conferences in 2018 arguing that seeding of convective clouds with high concentrations of hygroscopic aerosol of sizes 0.1 micrometer and smaller would result in much greater enhancements of precipitation than conventional hygroscopic seeding with much larger size hygroscopic aerosol, or mixed-phase dynamic seeding. I even wrote a proposal to the UAE rain enhancement program to investigate the potential of rainfall enhancement by the condensational invigoration methodology. This was rejected because a reviewer said this was nothing new. Duh!

Overall, this goes to show that “you can teach an old dog new tricks”! ☺

Also during this period Michal Clavner, under the joint supervision of me and Sue van den Heever, performed simulations of a major derecho event. A derecho is characterized by

severe surface winds, a long duration(over 9 hours) and very large damage swaths exceeding 400km in length and over 100km in width. Using the GEOS-Chem global model for aerosol estimates, she performed simulations using current aerosol estimates and estimates of aerosol prior to anthropogenic wide spread sources. She examined the impact of anthropogenic pollution aerosols on rainfall and the severity of surface winds. She found that high concentrations of anthropogenic aerosols invigorated upright convective cells and enhanced convective rainfall. On the other hand, high concentrations of pollution-sized aerosol lead to a reduction in droplet collision and coalescence growth and ice particle riming in the stratiform-anvil, thus reducing precipitation in those regions. Overall precipitation in the total region was little affected. As far as surface winds were concerned, the results were quite complicated. It was found that severe surface winds were produced both by a descending rear inflow jet(RIJ) and an “up-down” downdraft as defined by former PhD of mine, Kevin Knupp. During the intensification stage of the MCS, high aerosol concentrations resulted in a shift from a RIJ downdraft/severe surface wind regime to an “up-down” downdraft regime which exhibited strong surface winds over a smaller area. In the dissipation stages of the MCS, strong surface winds were modulated mainly by the “up-down” downdraft, whose strength was controlled by an elevated mesoscale vortex that was smaller in scale than the MCS. The strongest winds were found in the polluted simulation in which the mesovortex and “up-down” downdraft were the strongest. It is interesting that this research cut through my career in research on convective systems going back to the early work in the late 1970’s and early 1980’s on “up-down” downdrafts with Kevin Knupp, research during mid-career on derechos ,and MCSs, and the more recent research on aerosol impacts on convective storms. But this study preceded my conversion to a “born again” believer in “condensational invigoration”. ☺

During this period we wrapped up over a decade of research examining the impact of aerosol pollution and dust on wintertime orographic precipitation over the upper Colorado River Basin. This line of research was motivated by Randy Borys of the Desert Research Institute(now retired). Randy had trouble getting funding through NSF to follow on to his research at the Storm Peak Laboratory showing that during polluted air conditions the ice crystals were unrimed low fall velocity crystals while under more clean conditions the ice particles were often more heavily rimed, faster falling ice crystals. So he asked us to join him on a follow-on proposal. So Steve Saleeby and I participated in field studies at the Storm Peak Laboratory located at the top of the Steamboat Springs ski area. We also began a series of modeling studies that supported the hypothesis that aerosol pollution contributed to the formation of low fall velocity ice crystals which would blow over the higher mountains across the continental divide into the Atlantic basin instead of the Colorado basin. Gustavo Carrio and I carried out some idealized wintertime orographic cloud studies that revealed that as the depth between cloud base and the melting level increases, the potential for drizzle or warm rain formation increases such that at some point increased CCN concentrations can suppress drizzle formation leading to greater amounts of supercooled liquid water contents and enhanced riming with high aerosol concentrations. This result implies that one cannot generalize that aerosol pollution reduces precipitation, especially for warmer-based wintertime orographic clouds. At about the same time, my then PhD student Vandana Jha undertook snow season long simulations over the Colorado mountains to examine the combined influence of aerosol pollution and desert dust on precipitation in the Colorado River Basin(CRB). We did so for the 2004-2005 snow year which was a relatively wet year. We estimated the amounts of aerosols produced by anthropogenic activity versus non-anthropogenic sources by running the GEOS-Chem global atmospheric chemistry model for the entire snow year twice, one with anthropogenic sources and one without. Sensitivity studies revealed that while anthropogenic pollution tends to reduce precipitation in the CRB,

desert dust, which primarily acts as an ice nuclei much like cloud seeding aerosol, tends to increase precipitation. But aerosol pollution dominates so that the net response is a reduction in precipitation. Overall, we estimated that the combined influence of aerosol pollution and dust over the CRB for the 2004-2005 snow year resulted in a reduction of precipitation by 2.56% or 5,380,000 acre feet. To put this in perspective, this loss in precipitation corresponds to roughly 72% of total allocated water resources in the CRB! For some reason we are still struggling to get these results published in a reviewed technical journal. If this work had focused on greenhouse warming influences on CRB water resources, I am confident we would have had no problem publishing that work! ☹

As of October 2019, I currently have one remaining NSF grant. This is a collaborative NSF grant with me as PI for CSU and Bob Walko of the U of Miami as the collaborative PI. The 3-year grant began with Gustavo Carrio as Research Scientist, and a PhD candidate (who I shall not name). This has been the most frustrating project I have ever supervised. Recognizing I would soon be retiring, after one year Gustavo left to work in a private company in Boulder. I previously supervised the unnamed student about 12 years ago and he had passed his preliminary examinations and was essentially an ABD(All But Dissertation). He is quite a bright student. At that time he and his new girlfriend(also a student of mine) got into “partying” and he became an alcoholic. I didn’t get any research out of either of them and fired them both. Fast forward to about 5 years ago, and I met the unnamed student in Tucson where they were living with his parents. I asked him quite bluntly if they were still in the partying scene and he said they were done with that 4 years before. So I naively mentioned I have a proposal out for review and if funded why doesn’t he come back and finish his degree. He and his parents were ecstatic! Well things didn’t work out so well. After 2.5 years on the grant he had not met a single project goal. So I fired him for the second time. ☹ I don’t know if he returned to being an active alcoholic or that he had developed a lifestyle that was not consistent with that necessary to complete a PhD. I arranged to have the remaining funds that supported him transferred to Bob Walko and obtained a 1 year no-cost extension on the grant. So Bob and I are now trying to complete 3 years of research in one year. The aim of the research is to examine further the effects of aerosol pollution on tropical cyclones. We are simulating hurricane Harvey which intensified prior to land-fall and wandered around the Houston area for several days creating massive flooding. Now Houston is one of the most polluted cities in the US. Not only is the large population driving automobiles and heating/cooling homes producing high concentrations of pollution aerosol, but the major oil refineries located there are prolific sources of these aerosols. At the time of this writing(October 2019) we have already accomplished more on this research than in the previous 3 years!

Overall, I am very pleased on how my career has gone both in teaching and in research. I have supervised and mentored 44 PhD’s and a similar number of MS students. I believe the number of PhD’s I have supervised exceeds the number of any current or previous faculty members in the department. Many of these former students have gone on to be professors and even directors of major research institutions. Having given up my large office of many years I now have a small office with wall-to-wall “trophies” of the research accomplished by my students in the form of dissertations and theses. I have not filled up the poster board with ties that I have cut following their successful defenses, however. I adopted this reward to students following the procedure of cutting the shirt tails of pilots who have completed their first solo flight. I think that “cutting the ties” with my students is an appropriate reward. ☺ Appendix 2 lists the PhD students I supervised and their dissertation titles.

*Back to the fun and not so fun stuff.*

## *Homes*

For a number of years prior to retirement, Vollie and I escaped the cold in Colorado for our late January anniversary or the spring Front Range snows in April and taken the less than 2-hour flight to Tucson or Phoenix. Often we would take our backpacking gear and rent a car and camp and hike in the desert. We especially enjoy the ecology of the Sonoran desert with its green appearance, saguaros, cholla, barrel cactus and early season flowers. When I moved into transitional retirement I only taught in the spring semester, so we were more mobile during the fall. With the electronic age of communication, I could keep track of my graduate students on a daily basis almost as well as being in the office. I often tell that I had 4 students in the office next to mine, yet about 90% of our communication was by email!

So, we decided to buy a town house in Tucson to escape from Colorado's winters. We purchased a place in an older townhouse community called Ventana De Sabino. It is in walking distance to Sabino Canyon National Recreation Area. It has many amenities like swimming pools and hot tubs, tennis courts, and beautiful flowers and plants and Arizona Cypress trees. We had frequent visitations of javelinas who walked the nearby washes, occasional citing of bobcats and once a neighbor spied a mountain lion! We enjoyed hiking the trails nearby, and I jogged most of them in the early morning. We met many hiking couples on those hikes and some of them have remained close friends to this day. The townhouse was a two story unit with a galley kitchen, an inefficient fireplace, single-pane windows and metal frames. The latter cannot be upgraded to more thermally-efficient double pane windows or vinyl frames owing to the Home Owners Association(HOA) restrictions, and moreover we are not permitted to put out bird feeders in the yard! Parking was only under a ramada, and to park our camping trailer we had to take it to a RV storage facility some distance away. Another issue was that to paddle kayaks we stored two folding kayaks like the Klepper A-2000 in a closet. Every time we would go kayaking we would load up the kayaks and when at the lake spend 30 minutes or longer, per kayak, assembling them and a similar time dis-assembling them. So, when it was time to end my transitional retirement and move to full retirement at age 70, I asked Vollie if she wanted to spend more time, about the same, or less in Tucson and she said "more"! That being the case, I informed her that I wanted a place with a real view of the mountains(only a peek-a-view at Ventana), a garage to hold my toys, and where putting out bird feeders and the like would not be restricted by an HOA!. We began the search.

Steve Rutledge a department colleague at CSU suggested we look up Art Rangno who he worked with at the U of Washington and is a real weather nut. Art had a place in Catalina which is on the northwest side of the Santa Catalina mountains. Art and wife Judy Rossman guided us on a hike near their place along with our Ventana friends the Vana's. But on the way back, Judy pointed out a house that was for sale by owner. The house is located on 1 acre of land, bordering Arizona Land Trust open space, and has a \$1M view of the Catalinas! Moreover, the house has 3 garage stalls; plenty of space to store truck and car, a camper, and some non-folding kayaks! Yeah! The house was another matter. It is a manufactured home built in 1991 and was plenty big with even an attached mother-in-law apartment. But, aside from a nice metal roof, the house was in pretty rough shape. Everywhere but the kitchen, the floors were worn-out carpets including the bathrooms. Ugh! The windows were single-pane, metal framed, and the walls needed painting, and interior doors and cabinet were vintage manufactured home stuff. The eastern deck facing the Catalinas had a porch roof that hung too low to see the mountains from inside the house. Moreover, the owner had built a studio

on the deck for his wife to do her hobbies which totally blocked the mountain view! The separate apartment was cute and had its own dishwasher, and washer and dryer. But the walls had ugly peeling wall paper and worn out carpet. Moreover the place reeked of smoke as their son who lived there in recent years must have been a chain smoker. Yuck! But, given the views, garages, and being sort of in the country, we bit the bullet and bought the place for \$151,000. Remember, “you can take the boy out of the country but you can’t take the country out of the boy”! A place with this view on it and this size in Fort Collins would be a \$2M home. Actually in Fort Collins the place would be a “scraper” and totally torn down and replaced with a whole new Santa Fe style house. I wouldn’t be surprised if that happens after us. So, after closing in May of 2013, we had a contractor work on the place during the summer tearing back the eastern porch roof and removing the studio so that we could see the mountains from inside the house. Moreover, we replaced all the windows and slider in the main house with double pane vinyl framed windows. We also had a small window(that was blocked) removed and installed another slider in the large master bedroom so that we can actually lie in bed and see the mountains, sometimes snow covered! Then we had all the carpeted floors torn up in the house and apartment, and had tiles installed there, except for the guest bedroom and study(optional guest bedroom), where new carpet was installed. Outside we had most of the walls in the house covered in stucco and the main house was painted red and the apartment and garage beige to given it a Mexican look. When we got back to Arizona in October, Vollie painted the living room, two bathrooms, and study as well as removed wall paper and painted to apartment. Meanwhile, I worked on painting the huge decks and did repair work inside and outside, as needed as well as cleaned up the yard a bit. We hired a neighborhood husband and wife team to replace kitchen counters and cabinet faces, and hired our neighbor, all-purpose fixer-upper, to redo the walls and popcorn ceiling in the kitchen and guest bathroom. He also installed Mexican style tiles as back splashes in the kitchen and both bathrooms. Finally we had the original 1991 propane furnace and air conditioner replaced with a modern electric heat pump by our local Mexican all-around fix-it person. We could still do many projects on the place but have stopped for now.



Figure 40: View of snow-covered Catalina mountains from backyard.



Figure 41: Escaping ☺ Colorado snow in Arizona February 2019

Back in Fort Collins, things have been fairly stable in the home following our major renovations in the late 1990’s. But that is not true for Fort Collins! First CSU decided to tear down the old stadium on the western edge of town and replace it with a \$25M stadium across Prospect street from our house. Besides the inconvenience during the construction phase, this has changed the entire dynamic of our once-relatively quiet neighborhood, not only on game days and special events, but on a more or less regular basis. For one thing, the neighborhood



Figure 42: Front view of Fort Collins home when crab apple tree is blooming. Note garage on right which I had built to house my toys. Vollie calls it the “garage with house attached”!

does not have street lights so there is some opportunity to see stars, moon, and planets. But for some reason CSU keeps a lot of lights on in the stadium even when there are no events. At least we are better off than some of our neighbors who get direct lighting from the stadium. In addition, CSU continues to increase total enrollment which means more dormitories, more construction, more traffic! Across Prospect from our home there used to be single story ranch houses but they have or are being replaced with multistory dormitories and offices. They are also a source of light pollution. In our neighborhood houses have been bought and the single story ranch houses replaced with

two-story bed and breakfast places. Overall traffic has increased in Fort Collins enormously and it is getting very hard to get out of our neighborhood onto the only access street, Prospect Road. If we didn't have family in the Fort Collins area, we would sell out once I cut all ties with CSU (really retire). But, where would we move to? Summering at the cabin would make economic sense, but it is too far from adequate medical facilities or even adequate grocery shopping.

### Soaring

I continued soaring in my Discus 2T, enjoying thermalling over the plains and the Front Range. I don't recall recent mountain wave flights nor ridge soaring, though. But, I decided to retire from soaring at age 70. This was motivated by the fact that I noticed my ability to quickly mentally process what needed to be done in situations such as wind shifts during final approach, or loss of lift in rather hazardous terrain. It is commonly recognized that we lose our rapid “reflex” abilities as we age. But reflex is a response on time scales of a few seconds. What I am referring to is a mental decision making process that involves tens of seconds to



Figure 43: Backyard of Juniper Lane home.

minutes, and it is the ability to analyze and process a given situation, decide a course of action, and properly carry it out; that degrades with age. This rapid mental processing is something often needed when flying. It is also needed when driving a car or sailing but at least those processes are two-dimensional, not three-dimensional! The decision to retire at age 70 was also motivated by my association with Fred Herr. Recall that Fred was my mentor who oversaw my conversion from power to gliders. Like me, Fred eventually joined the Colorado Soaring Association. By this time Fred was in his early 80's. I noticed that

Fred began making mistakes. One time Fred took off with a plastic dolly used to ground handle a glider attached. Now a sailplane does not handle well with that dolly attached. To

his credit, Fred recognized the symptoms, kept his airspeed high and landed without incident. There were a number of other such incidents and the club grounded Fred from flying their equipment. But Fred once asked me to fly as pilot-in-command of the club's higher-performance two-place glider. So we took off and were being towed to the northeast across I-25 and out over the plains when the tow plane got into sink a bit. My reaction was to wait it out and see what happens. All of a sudden the tow line was released. I asked Fred if he did that and his answer was "I don't know"! Fortunately, we were a couple of miles out over the treeless prairie and out-landed safely with no damage. It was just very embarrassing! The glider had to be disassembled and a truck with trailer came out and made two trips bringing the plane parts back to the gliderport. It took the rest of the day to bring it back and another half day to assemble it! Subsequent to that Fred bought a single-place older, but good performing glider. He flew that for several months without incident. Then on a nice sunny day with little wind Fred bored it in and was killed instantly, within sight of the port. To this day we don't know what happened. Did he lose consciousness, did he forget something as he assembled the glider, or was it suicide-by-glider? I have read in the Soaring Magazine about a number of very experienced glider pilots of Fred's age who bored it in and died with no indication of the cause. This reinforced my decision to retire from soaring. It was cold-turkey retirement as I have not been in a glider since. But I continue to provide our club with weekly soaring forecasts.

### *Boating*

Following the sale of the Trailertri 720, I moved into mainly paddling kayaks and sailing kayaks. We paddle kayaks in most of the lakes in the Fort Collins area and in the mountain lakes near our cabin in Colorado. We also took our kayaks up to the Boundary Waters area north of Grand Marais, Minn where we camped at a campground near the Canadian border and day-paddled from there. We had nice weather for paddling but the mosquitoes were fierce! We did have a few oops and almost oops. First we put in near our campsite and headed up a channel into the main lake where we encountered a narrow channel where the water was flowing out of the main lake at 3.5 kts or more. I made it through and looked back and Vollie was paddling for all she was worth. But she finally made it through. What a tough woman! Upon our return we heard approaching canoers in aluminum canoes banging into the rocky shores as they were driven to the side in that narrow channel. I did have an oops when attempting to exit my kayak on a rocky outcropping. As I stepped out of my kayak my foot slid off a ledge and I fell into the lake sans kayak. The kayak rapidly drifted away and called to Vollie who was already on shore to help me get the kayak. I attempted to catch it but it was being blown away faster than I could swim with my life vest on. Eventually Vollie caught up with it and halting its speeding away and I got hold of it and dragged it to shore where I got in, very wet and cold! I was very embarrassed. We did have another oops when we put-in, at another launching site into the lake which avoided that narrow, fast flowing channel. I went out first and looked back and saw Vollie talking to a Ranger. We had thought we didn't need permits as I had called a local outfitter and they said they were not needed! Not! We were lectured and given a fine. Our nearest place to get permits was in Grand Marais about 30 miles away. So we broke camp and headed to town and got our permits. We then headed south a bit and went to a different lake and paddled a lake with many islands. It was quite pretty although navigating was a challenge!



Figure 44: Vollie paddling CLC 17 in Colorado.

Back in Arizona, with the new-to-us, house and large garage, I did some web searching and found two CLC wooden kayaks, a CLC 17 and CLC 16, in Chandler, AZ which is just east of Phoenix. The guy who had built them then lived in Massachusetts, but after they moved to Chandler they no longer used them. They were beautiful! I got the two of them for \$1700 and I didn't have to do anything to them. We have enjoyed paddling them mostly on Patagonia Lake but also Roosevelt Reservoir, Canyon Lake, Apache Lake, Parker Canyon Lake, and even in the Gulf of California near Baja Kino, mostly in estuaries.

I mentioned earlier we had upgraded the sail, mast, and mast step on our tandem CLC kayak with almas and akas. When I did so, the added sail forced me to add a metal plate when sailing to increase rudder power. Anyway, we decided to spend a few days sailing and kayaking in Lake Powell. We hooked up our Aliner camper with custom-built kayak racks, and loaded the tandem kayak and mast and sail on the camper trailer, and the almas and akas on the truck roof rack. We headed southwest in what I will call another "trip to hell and back". Just after passing the Eagle, CO exit and driving at 65mph, a car passed us with the passengers waving their arms and pointing to the camper. So I pulled onto the shoulder, got out and looked to see what could be wrong. Yikes! Our kayak was gone! A strap had broken. We looked back up the road; no kayak in sight. So we continued to drive west to the next exit (about 10 miles) and then drive back to the Eagle exit and then west again. I envisioned finding bits of kayak scattered all over the interstate. We soon found the kayak off the side of the road, mostly in tack. It had a 6" diameter hole in the bottom and a few scratches on the deck and the post where the rudder slid in kind of bent a bit. So we loaded it back on the camper and headed west again. About 10 miles down the road it dawned on me that I had strapped the mast and sail on top of the kayak. Ugh! So we exited at the next exit, back east to the Eagle exit, and west again and found the mast and sail further off the road in the bushes at about the same place where the kayak was located. So with all our kayak and sail now with us, we again headed west and stopped off at West Glenwood Springs. I found an auto parts store where I assembled an emergency field repair kit composed of fiberglass cloth, epoxy resin, and sandpaper. We eventually made it to Lake Powell and set up camp on a beach. I then immediately went to work doing my field repairs. Once all the epoxy had dried we were able to do paddle the kayak. We also attempted to do some sailing but the winds were very strong and the rudder post was sloppy after the accident so it didn't handle all that well. Once back in Colorado I did a major repair on the kayak hull and painted it up so it looked almost as good as new except for the "battle scar" on the mahogany deck. I also reset the rudder post so the kayak could now be sailed well. That is, until the kayak rudder with my metal plate to enhance rudder performance totally broke off due to metal fatigue. I then had to buy a rudder kit from CLC and install a new rudder system.



Always in search of the optimum compromise for sailing, I bought a 15.5' carbon fiber Warren sailing kayak. If this kayak is built only for paddling it weighs only 28 lbs. But when constructed to also be used for sailing the added strengthening in the hull and mast step, and so forth brings its weight up to about 34 lbs, still light enough for this old man to easily carry it from the kayak trailer or truck roof rack to the beach. This kayak is a delight to paddle. It is not quite as fast as the CLC 17 but close enough and it is a very comfortable kayak to paddle. So much so, that I bought Vollie a 12.5' Warren kayak that weights only 22 lbs. She loves it and

proudly carries it from truck or kayak trailer to the beach all by herself! For such a short kayak she really paddles quite fast and has no problem keeping up with me. Back to the Warren 15.5 kayak for sailing. It has a main and jib, plus a screecher or asymmetric spinnaker. Owing to its light weight it has amazing acceleration, tacks well, and is quite fast on all points of sail. One can also paddle it when set up to sail much like when set up to just paddle, albeit a bit slower owing to the added drag of the almas. It can reach speeds of over 10kts and when sitting that close to the water it really feels fast! It does get a bit wet when sailing that fast as it picks up spray that hits the pilot! The main down side of sailing this kayak is that it takes about 30 minutes to load the kayak and all the sailing bits stored in the garage on my kayak trailer. Then when at the beach or put-in it takes another 45 minutes to rig it and get it into the water. As a result I found that I was not sailing it as much as I wanted to and moreover, Vollie and I were only sailing the CLC tandem about once or twice a year.

So I found on-line a used carbon-fiber 20' Warren Tandem Sail. This came equipped with trampolines and an electric outboard motor. Set up like that I should be able to put it on a mooring and cut the rigging time to 20 minutes or so, instead of the more like 1.5 hours before

and after sailing with my current set up. I could single-hand sail off the mooring or sail with Vollie, or one of our sons, or a friend. So I sold the Warren 15.5 sailing kayak and the CLC tandem sail to some guys that flew out from North Carolina and rented a SUV and bought a used kayak trailer and hauled them back east. I made a deal on the Warren Tandem sail, and after Vollie and I viewed the eclipse in western Nebraska with son Bill and family, we headed east to Upstate NY. The kayak was located at the last exit before Canada on the Northway. After picking up the sailing kayak we visited family in Upstate NY(My cousins and 92 year old aunt near Little Falls, NY and Vollie's niece and family near Syracuse NY). I think the total round trip drive was about 5500 miles! We launched the Green Thing in May 2018 and immediately broke the rudder post. Fortunately the replacement was almost ready. It did require some adjustments involving back and forth with Felkers and got it working just fine.

*Figure 46: Vollie carrying Warren 12.5 carbon fiber kayak.*

We got it on a mooring on Boyd Lake and as planned I could sail it off the mooring by myself. As a result I got a lot more sails in that summer than in previous years. However, to sail off a mooring required use of the trampolines. But the trampolines required using the outboard motor as they blocked access to convenient paddling. The electric outboard pushed the boat as fast as 6kts for over 2 hours. But it is heavy; weighing about 52 lbs. A 2 HP 4-cycle motor weighs about 38 lbs, and a 2-cycle OB weighs about 28 lbs. The added weight wouldn't be much of a problem except its mount is on the port aka so the boat lists to port. This means at the mooring the port hull is submerged about 3 or 4" and under sail on a starboard tack the port hull barely lifts out of the water. This significantly degrades its sailing performance. But the boat is still quite fast and handles much like my Warren 15.5 sailing kayak except the added weight of the longer boat and 2 passengers means it doesn't accelerate quite as fast. In August we hauled the kayak and found the port hull was half full of water because the drain plug let water seep into the under-water hull. Not good! So I decided to do any further sailing that summer by going through the full rigging/derigging procedure and sail it sans trampolines and motor. Once rigged and launched the boat sailed much better and Vollie and I could paddle it under sail using our regular kayak paddles. So when the wind quit or was weak we could paddle-sail. On our last sail of the season I had a rudder line guide come unglued and lost my rudder control. That was easy to fix but in the process I noticed the rudder lines showed considerable wear. So I bought new metal lines, and made a nice wooden tiller to be used during sailing as well.



Figure 48: Vollie getting ready to launch the "green thing"

This led me to think about a sailboat that I could more reliably sail off a mooring. After much on-line searching I decided a 15 foot CLC Pocketship would be an optimum choice. First, of all it a monohull, which means I won't have to deal with setting up almas and akas, and it is easier to maneuver in the tight quarters of a marina. Second, it has a gaff rig which means it gets its sail area aloft without the need for a long(heavy) mast. One person can rig this easily(at least the CLC president can do it easily as shown in his video)! Finally I have a soft spot for wooden boats and especially the CLC kits. So I began an on-line search. By the way, these kits cost about \$3500 and it takes an experienced builder 750 hours or more to

build it. Then one has to buy not-cheap marine hardware that can total the cost of these to as much as \$14,000! I found several for sale, one near Annapolis, MD for about \$14K, one in northern Montana for \$7200. The one in Montana looked very nice with many nice finishing touches like brass lantern fittings in the small cabin. So I put the Green Thing up for sale with the hope of getting enough out of it to buy the Montana Pocketship. But the interest in the Green Thing has been minimal. Then in November 2018 another Pocketship came on-line. This was located in Stillwater, OK. The builder, Dana Cole, has built a number of CLC kits. On-line photos suggested the boat was built well, and he had bought a \$30,000-plus sailboat so was anxious to sell. He was asking \$5000 and I offered \$2500 and he responded with \$3000, contingent on my inspection of the boat and trailer! So we took the long way north to Fort Collins for the holiday and drove a bit out of the way. The normally 1000 mile drive became 1750 miles. The boat was indeed very nice and the trailer was like new. So for the winter, we stuffed in our garage in Fort Collins, one Pocketship, two single-place kayaks,

one Green Thing hanging from the rafters and mast, akas, and amas, hung from the side walls, and two small cars, a 2002 Toyota MR-2 Spyder and a 2017 Toyota Prius-C!

I spent the summer of 2019 sailing Gaia, mainly with son Chris and some friends. The first time I took it out with Vollie we had a knock down to the rails from a wind gust and she didn't like that! She has not gone out since. It has been a learning experience going from stable multihulls to a rather tender monohull. One has to be careful to reef the main sail as the gaff rig puts a lot of sail high. Choosing the right amount of sail is the most important aspect of sailing Gaia.



Figure 49: Fort Collins garage filled with toys October 2018.



Figure 50: Gaia, a 15' CLC Pocketship on Boyd Lake slip.

Regarding those single-place kayaks, one is Vollie's 12.5' Warren, the other is my replacement for my selling my Warren 15.5' kayak which was my main Fort Collins paddling kayak. Again I went on-line searching for a CLC or similar wooden kit boat. I found a Pygmy Coho in the north Denver area. Son Bill and I were very impressed with it. It is 17.5' long and weighs about 46 lbs. It is built of narrow 3 to 4" strips instead of the CLC wider planks (note easier to build that way) which gives it a very pleasing streamlined look. I got it for \$600 and have found it to be faster, but slightly less stable than the CLC 17. For example, using high power levels I can cruise for 20 to 30 minutes in the CLC 17 at about 4mph. With the same level of effort, I can cruise with the Coho at about 5mph! However, it is a bit squirrely with a following sea. So I purchased a skeg which I installed and it makes downwind paddling in high seas much better. Just for the heck of it I web-searched to see if there was another Pygmy Coho in the area and found one in Longmont, CO! I looked at it and it was even prettier than the first one so bought it for \$650. As I drove out of the builders yard, I noticed tears running down his face. ☹

Note ones as nice as this in a coastal area like the Seattle area or along the east coast would be selling for nearly \$1500. So now I have a Pygmy Coho in Fort Collins and the cabin, and

son Bill now has the CLC 17 at his home in Fort Collins. I know, you now think this guy is boat crazy and you are right! ☺



Figure 52: Paddling the Pygmy Coho sea kayak.



Figure 51: Son Chris paddling my CLC 17.

### *Hiking/WOGing*

Since 1977 I have been running and now jogging nearly every day. In recent years my speed has decreased to the point where a fast walker can keep past with me. ☹ So I suggested to Vollie that she try walking with me as I jog or what we call WOGing, Vollie walks with a Prussian march at over 3 mph which is about my jogging speed. So now in Colorado and in Arizona we do nearly daily WOGs of 3 to 4.5 miles. Besides that we do hikes of 4 to 8 miles or so, and sometimes longer at least once a week. In Colorado we follow the flowers and begin in the Foothills west of Fort Collins in April and May, then migrate to higher elevation hikes, to eventually hikes from our cabin to the Flattops, Lower Cataract Lake, Elliot Ridge, and sometimes the Gore Range mountains with trail heads near Frisco, CO. In the Tucson area we hike right out of our back yard on many un-signed trails in Arizona Land Trust Lands and National forest lands. These hikes are generally in the 4 to 7 mile range. When we were hiking Sabino Canyon we got acquainted with hikers JoAnn and George Vana, and John and Carol Daily while on the trails and have since become close friends hiking many times a month on trails in the Tucson area. Likewise, neighbors near our Catalina area home Art Rangno and Judy Rossman, as well as Rick and Nora Bowers join us on hikes around here. Sometimes fellow weather weeny Mark Albright and wife Nancy, come across town to hike with us.



Figure 54: Hiking with JoAnn and George Vana, Art Rangno, and Vollie.



Figure 53: Hiking with John and Carol Daily (deceased).



*Figure 55: Hiking with son Chris.*

Then there is the “hike to hell”! Our friend and neighbor handyman, Roger Thonvold, when working on a project in our house, mentioned he always wanted to hike from our area, across the Charouleau Gap to the town of Oracle. Roger said he did it in his jeep and it was about 12 miles. The walk followed a rather serious 4X4 driving road. I said, “let’s do it!” So I enlisted Vollie, Art, Roger H, and a veteran hiker from the Sabino Canyon area Mike Welbourne to hike it. Art’s wife Judy and Rick Bowers agreed to pick us up in Oracle in their vehicles. So on a warm sunny day in February we began our hike to Oracle. Not long after crossing Charouleau Gap, Mike W disappeared. He walked on ahead, never keeping voice or ear contact with group. He broke a basic group hiking no-no! I will never hike with Mike again! He had hiked ahead, called his wife on his cell, and went home with no contact with any of us. Further on the trail, after hiking about 10 miles, we were over-taken by a group of 4-wheelers. We asked them how far it was to Oracle and they said about 10 miles! Yikes! Roger had greatly under estimated the hike length! After crossing C-Gap we descended about 1000’ and the road followed the upper Canada Del Oro(CDO) wash where we walked in the stream in calf-high water for over 3 miles. Then it ascended about 500 to 800’, descended and ascended again. By this time we were getting pretty tired. Vollie, Roger, and I were doing fine, but Art, not so much. His legs were cramping up and moreover he had run out of water even after Vollie gave him some of hers. Art followed the “jocks” way of doing things and gorged on water ahead of an event and then drank heavily afterwards. Unfortunately this process makes for inefficient assimilation of water. Thus his water consumption is far greater than Vollie or I, as we frequently sipped water from our water packs and thus kept hydrated with less total water consumption. We were able to make cell contact with Rick Bowers who burrowed a friend’s Toyota Takoma 4X4 and attempted to meet us on the trail. Unfortunately Rick had virtually no 4-wheeling experience and without our knowledge due to spotty cell coverage, chickened out and waited for us to get to him. Eventually Art lay down and said he could go no further and would wait for Rick to pick us up. By this time it was after 3PM and when the sun sets in the desert it gets cold, maybe even freezing temperatures! I told him he had to keep moving and that if he didn’t he could die of exposure. So I bullied him along at what became a slower and slower, and slower pace. At one time he said to me that I was worse than Peter Hobbs! Peter was his supervisor at the U of Washington and is well known for his aggressive, bullying style of management! At this point and speed, I figured it would be well after midnight before we arrived at our pickup point. Fortunately the group of 4-wheelers who had passed us earlier, had pulled off on a side road and eventually overtook us. They invited us to ride with them to the trailhead which we enthusiastically agreed to. Most if not all the vehicles had only one extra seat so one-by-one

we got into their cars. Vollie, who hates riding in 4-wheelers, held off until the last one overtook her. We eventually found Rick, and Art got in with him, and then we got to the trailhead well after dark and very tired.



Figure 56: Hiking toward Charouleau Gap on the “Hike to hell”.

## 11.0 Beyond science

In this chapter I discuss some of my life’s activities which do not represent the scientific/academic work, nor the “fun stuff”. I begin by discussing my involvement with:

### *Water Witching*

The “art” of water witching involves searching for underground water veins using some sort of divining device. In my case my grandfather and father taught me to search for water veins using a “Y-shaped” stick cut from a willow branch. Holding the arms of the branch tightly, the end of the branch will dip down sometimes strong enough to strip the bark from the branch where it is being held when a water vein is sensed. I remember demonstrating its use in my 5<sup>th</sup> grade class where I walked and mapped out a water pipe running along the ceiling of the classroom below us. We all went down to that classroom and sure enough there it was. I also mapped out our septic system drain line when it had a break. It was dug up and repaired right where I mapped it. I also located a place to dig a well at our home after the main well dried up, and hand dug a replacement well. I also located wells at our family cabin and at our homes in Colorado. Once, we had a group party at our mountain home where about 8 of my graduate students attended. Somehow we got on the topic of water witching and I cut a willow stick and let them try to find the water vein feeding our well. Only one female student of the 8 students could get a response. In her case the response was so strong that she screamed and dropped the stick when the tip dipped! How does it work? I have no idea. But “ I believe” that it really does work. It is clear that not everyone can do it. What percentage of the population can do it is unknown. I suspect it is related to an individual’s body chemistry. Back in the days of windup watches, the cheaper ones did not have antimagnetic construction. I could not wear one of those watches for more than a few hours before it would quit altogether. Is that an indication of something in my body chemistry that is tied to my water witching ability? Note this is an example of “belief” vs “science”.

### *Arthritis treatment*

Beginning in my late 20’s I began experiencing severe back pains and later sometimes accompanying pains in my knees and hands. This progressed to causing stiffness in my back. On Thanksgiving 1979 I had a severe attack after having a large dinner. At that time we had a water bed and the pain was so bad I couldn’t get out of that darn water bed. We had a couple of feet of snow that day(I had noticed these episodes were often correlated with bad weather). The weather was so bad that even if I was able to get out of bed, we couldn’t have driven to town. Fortunately our next door neighbor was an MD and he gave me pain medication and recommended I see a specialist in rheumatology. So, I began treatment with Dr Garvin Murray. Without much hesitation, he diagnosed that I had Ankylosing Spondylitis(AS). He began prescribing anti-inflammatory drugs. One of these, called Indocin, gave me “interesting” side effects. Basically it

made me bipolar! Sometimes I would be hyper talking fast and sometimes I would become depressed to the point of tearing up. Vollie rushed me into the doctor's office where I went from an upper to a lower state right in front of him. He said, well we had better get you off that stuff! Subsequent medications did not have those symptoms but they suppressed my immune system so that I would frequently get colds and flu. Moreover, I still would get flare ups like taking on fluid in my knees and even uveitis in my eyes. All he was doing was chasing down symptoms and not getting down to the fundamental cause of the inflammations.

While participating in the 1981 CCOPE project in Miles City, MT I had dinner with Dr Paul Lawsen who I used to run with when he was at CSU. At that time Paul was a vegan and he suggested that maybe going on a vegetarian diet might help me. I began doing research on the subject and found a book called "There is a cure for arthritis" by Paavo Airola. He outlined procedures used in European health clinics. First they put their clients on an extended fast, of about 7 days. Then they began adding foods like potatoes and celery. After a few days adding something new to the diet. Thus I began my experiment with diet and found that I could not tolerate meat; all meat! I couldn't even tolerate chicken broth. I found that I could eat fish and sea foods, eggs, milk, and butter. Thus I became a pescatarian and still remain one. All those roving inflammations totally disappeared. Of course the damage that was done by AS could not be reversed so that many of my vertebrae in my back and neck remained fused. But, I can run, hike, and bike with little problems. In fact, exercise is important. I frequently say, "use it or lose it"! This is another example of non-science. It is not based on a scientific study using a randomized, double blind experiment. It is totally anecdotal in nature.

#### *Pressure changes and arthritis*

I decided to write this after seeing a Weather Channel discussion on how people find their arthritis symptoms flare up when a storm system passes. They explained this was due to pressure changes. This is total nonsense! When we lived in the Foothills outside of Fort Collins I also experienced flare-ups of arthritis symptoms with a passing storm system. The problem is, in my daily commute of over 2000' of elevation change, I experience much greater pressure variations than with the passage of a storm system at a specific location. I should have felt arthritis flareups every time I drove home! My "theory" is that when a storm passes and the pressure falls, the earth's surface breathes and releases higher concentrations of allergens into the air which triggers arthritis symptoms. Strong winds associated with a fropa also stir up a lot of dust, some of which could serve as allergens. Remember that arthritis is an autoimmune disease such that certain allergens can trigger an arthritis type of inflammation.

#### *Climate change*

I introduce the subject of climate change here in the non-science section more or less "tongue and cheek". But there are many aspects of this subject that is non-scientific and in fact is "corrupting science". My direct involvement in climate change studies has been mainly in the development of cloud parameterizations that are still in use today in General Circulation Models(GCMs) even though we abandoned those schemes in RAMS almost 40 years ago. But, my main role has been a critical reviewer of climate change research. This I have done mainly in our book Human Impacts on Weather and Climate, co-authored with Roger Pielke, SR. I was motivated to write that book because I saw many parallels between the weather modification community and the climate change community. In particular the weather

modification community often attributed the explosive growth and heavy rainfall from a particular storm to the effects of cloud seeding even though there was little scientific justification for the assertions. Likewise we see climate change scientists asserting that a particular major land-falling hurricane, or flash flood event, or major cold air outbreak to be the direct result of global warming, again with little scientific support for their assertions. It is interesting that in his BLOG Kevin Trenberth, an NCAR climate modeler, attempted to discredit me by pointing my links to the weather modification community. It is ironic because the weather modification community has not been all that fond of my critical reviews. Even so, the Weather Modification Association honored me with the Schaefer Award for my research accomplishments related to weather modification.

In summary, climate change has evolved more into a “belief” system than a hard science-based endeavor, and is more like a “religion”. This is unfortunate because it tends to reduce the credibility of all science. The scientific process is based on replication, critical independent evaluation, double blind randomized experiments, but climate change is mostly based on very coarse resolution global models whose physics is crude at best, and often incorrect. Some of their greatest weaknesses are associated with the processes I have focused on throughout my career, especially clouds and aerosols.

For whatever it is worth, personally I “believe” that planet Earth is experiencing a period of global warming and that human activity is responsible for a part if not all that warming. As to what will happen in the future on time scales of decades to a century, it is a crap shoot. There are so many factors affecting climate variability that are either not predictable, like volcanic activity and major collisions with asteroids, or are poorly represented in GCMs like ENSO(El Nino/Southern Oscillation), Pacific Decadal Oscillation(PDO), Atlantic Meridional Oscillation(AMO), that meaningful long term predictions of climate variability is not likely. Then there are even longer term factors such as changes in the Earth’s axis and orbit around the sun, called the Milankovitch theory which can override any human-induced variability. As I have stated before, weather and climate prediction is a “*humbling experience*”.

### *Population*

I also “believe” that we are over-populating planet Earth. In the unlikely event that we actually reduce carbon emissions or aerosol pollution, the human “footprint” on the Earth’s surface is huge which changes the surface energy budget, places huge demands on food and fiber production, and most importantly impacts water resources. We are decimating wildlife species, not only vertebrates including birds, but even insects! I am skeptical that the human species can do anything to “humanely” control global population growth.

### 12.0 Summarizing remarks

Both Vollie and I were fortunate to have very supportive parents who helped us through our early years and undergraduate school. Likewise we are fortunate to have such great sons who participated in many of our adventures and continue to provide support in our later years. For me, I am fortunate to have my partner in life, Vollie,

who participated in many adventures and supported me in my professional life. She is a real trooper!



*Figure 57: Vollie and Bill hiking near Sedona, AZ on our 56th anniversary.*

At Colorado State University, I really enjoyed the faculty and staff in the Department of Atmospheric Science. Most of all, I always looked forward to coming to work to interact with my students. Some of the students were my jogging partners and even participated in a few adventures. Most of all I really appreciated my MS and PhD students. I have been fortunate to have many outstanding students who have had outstanding careers. Appendix 2, is a list of my PhD students and their dissertation topics.

*Figure 58: Grandson Galen.*



## **Appendix 1**

### ***Selected entries in the log of F-27 Triple Point***

12/12/90 Beginning of trip to S Florida. Brought boat down from house in the foothills of CO before snow.

12/15/90 Began the long drive to Florida. Visited the Knupp's in Huntsville, AL on the way down. A winch eye broke near Tallahassee, FL but it was easy to replace.

12/18/90 Arrived at Clearwater, Fl. Gas mileage down was 6 to 8 mpg.

12/23/90 Drove from Clearwater to Miami. Put in and rigged, loaded gear, etc in about 1 hour. Winds calm, and motored to NO NAME harbor arriving just after sunset.

12/24/90 Motored to Matheson Hammock where we shopped for more air tanks. Boat is fully loaded with 5 adults(Vollie and me, Bill and Julie, and Chris), and all our gear including diving equipment. Had enough wind to tack back to No Name Harbor at 4-5kts. Boat was sluggish but handled OK. Had Christmas lights out including a Christmas tree brought down from our land in CO and had a neat Christmas Eve.

12/25/90 Had great Christmas present as we saw a manatee in No-Name. Then we had a great spinnaker run from No-Name to Elliot Key. Winds were 6-8kts. Bill and Julie camped on Elliot Key. We took a walk on Elliot Key but it was quite buggy.

12/26/90 Picked up Bill and Julie and sailed south to the end of Elliot Key making 6-8kts on a beam reach. Returned on a single tack with winds 15-18kts gusting to over 20kts. The sail was exciting at speeds over 10kts. Broke mainsheet horseshoe bracket and replaced it and cut sail to working jib and reefed main . We anchored at Sands Key, Pete Black, Clair, and son Mike arrived about 5PM. We rafted together on my two anchors. Had a great time drinking wine and chatting about old times.

12/27/90 Took the Black clan for a total of 8 adults and gear for an exciting sail in 20kts plus winds with reefed main and working jib. Even with that load we still made 10-12kts; Pete was quite impressed!

After the Black clan departed we sailed south to Pumpkin Key in lighter air(8-10kts) but still made 6-8kts with full mail and genny. Ended up in a rain shower.

12/28/90 Woke to a pleasant morning with no rain.

Surprise, surprise an F-27 came in after dark with 2 adults and 4 kids. The owner is Charles Andrews who is sailing south from N Carolina. With 4 kids it has to be more challenging than our crew.

We ran aground in Card Sound as a result of miss-reading the chart.

Had a fast run through Barnes Sound. Then we hit a rain squall and had to dump the jib briefly in heavy rain.

We powered through Jewfish Creek where we saw lots of birds(cormorants, pelicans) and stopped at Gilbert's resort and marina. We refueled, restocked ice, dumped the potti, and Vollie, Bill, and Chris took a taxi to Winn Dixie to get food.

Then we sailed south to Blackwater Sound and anchored for the night in Sexton Cove. Bill Cooked a supper of rice, Salmon, and spinach.

12/29/90 Sailed south to Ron's Marina on Key Largo. There we rented an 80HP runabout and went out to John Pennecamp State Park. Seas were rough and visibility in the water was about 1 ft! Not so great for diving. Oh well! Fairly typical for winter here.

We sailed north to Jewfish Creek and anchored in Thursday Cove in Barnes Sound. We saw lots of birds including Osprey, Pink Ibis, great blue herons, both in the mangroves and along Jewfish Creek. Great birding!

12/30/90 Left Thursday cove about 0915 and on a single tack made it to Sands Key. We averaged over 8kts and sometimes over 13kts. Going through the channel north of Pumpkin Key we passed a big stinkpot! We sailed right up to our anchorage and made the run from Thursday Cove in 2.5 hours, a distance of over 21 nmiles.

Bill left a beer can on the aka near the after cabin entrance which I kicked wetting the bunk with beer. We decided to sleep on the tramp that night in our bivy sacks. We still slept well. We paddled our inflatable kayak over to Sands Cove where we walked to the beach.

12/31/90 We motored to Boca Chica Key which is pretty but very crowded. When we lived down here it was privately owned but is now owned by the State.

We had a spinnaker run back to Matheson Hammock where we prepared to fold the boat, hauled it and gave the boat and trailer a thorough hosing.

Postlog:

Our return back to Colorado was uneventful until we got to the Texas Panhandle. There we encountered light freezing drizzle making the roads slippery. My crew member(Vollie) threatened to mutiny if I traveled further. So I contacted Roger Pielke for a forecast and he predicted that we would get out of the icy roads about 50 miles north. So with some coercion we headed north and verified Roger's forecast.

### **Sailing Yellowstone Lake**

8/4/9 For years I have wanted to sail in Yellowstone Lake. Situated in the heart of the caldera of Yellowstone in a large pristine wilderness with bear, elk, moose, and birds around it should be a wilderness experience without the congestion of organized campgrounds. Staying on the boat, we should not have to worry about Grizzlies raiding our tent.

On Thursday morning I decided to haul Triple Point out of Horsetooth Reservoir. The plan was to get to the boat about 0730 and have plenty of time to get to a 10AM project meeting I had organized.

When I attempted to start the 8HP Nissan I noticed a strange click when I pulled on the choke. After numerous attempts to start it with the electric starter I decided the choke must have stuck on when it made that click. After pulling the solenoid that worked the electronic choke I finally got the OB started. It was now 0830.

I drove Triple Point to the dock folded and loaded it on the trailer. When I attempted to put the fulcrum bar across the top of the beams I found I could not get it into place. Then I realized that I had not set the locking pins into the beams(akas) properly so I had to back down into the water and reset the pins. By this time it was 0920. Finally after a number of times back to the winch and up on the boat to clear the shrouds, I got the mast down. It was 0950. I wanted to get this far because leaving the F-27 folded on the trailer with the mast up if a big wind started blowing. I left the boat with the mast down but a very untidy state and raced off to the office for my project meeting.

About 1600 I returned to the boat and tidied it up and hooked it on my truck and left it in the office parking lot. That evening I began packing to be ready for early departure for the 9-10 hour drive to Yellowstone. The plan was to meet Peter Olsson, a graduate student of mine and his wife Cindy on Monday morning at the lake. I would drive up on Friday and launch Triple Point by myself and go it alone until Monday.

Vollie said she had enough of hauling the boat around the country and sailing in mountain lakes. The 4-day drive after our Christmas holiday sail in South Florida with freezing drizzle covered roads still burned bright in her memory.

But Thursday evening she proclaimed she wanted to go. Her decision was based on a combination of fearing she would miss out on the adventure and that I would get into

trouble all by myself(I have a track record of doing that!). There is a bit of history to this that I won't go into!

By noon on Friday(Vollie is notorious for a slow start in the morning) we got to my office and hooked up the trailer. When I attempted to start the truck it made a few grunts and wouldn't start. The battery was dead! After a roll start I took it to the GMC dealer to get a frozen pollution pump replaced which caused the generator belt to slip.

By 1600 we finally got underway arriving at a small private campground in central Wyoming. We popped the top on our pop-top truck camper. When I attempted to turn on the camper lights, guess what; no power! I found that the fuse had blown and didn't have a spare so put in a piece of metal to get us through the night.

By this time I was beginning to wonder if someone was trying to tell me that this trip should not be.

The drive to Yellowstone was uneventful and we arrived at Grant Village about noon, After waiting in line to get all the park passes and backcountry permits including assignments for the next 5 nights we got underway about 1330. The Park Service restricts overnighing to a very few anchorages and docks. Naturally instead of anchoring alone in the wilderness we had to share the limited number of permitted spots.

The sail up West Thumb bay was a pleasant beat to windward in 8 to 10kts of wind. I got us underway with the help of Buckley our electronic autohelm, while Vollie stowed all the gear we had just stuffed into the boat at the dock. As we sailed into the main lake and headed south to our assigned anchorage in Flat Mountain Arm, we saw numerous flying and nesting bald eagles. We also saw a few white pelicans. It was a beautiful afternoon with only a few scattered cumuli and no afternoon showers or strong winds which Yellowstone Lake is infamous for.

As we approached the arm winds weakened to the point we were drifting at 1-2kts. Just as we were about to start up the Nissan the winds backed from easterly to southeasterly. They picked up to 15kts with gusts to over 20kts. We tacked our way up the Arm in those gusty winds. By 1930 we sailed into Grizzly Bay, our assigned anchorage. We anchored off the shore accompanied by a powerboat.

That evening the winds died and we enjoyed our wine and scalloped potatoes while viewing the setting sun with surfacing trout all around us.

The next morning we awoke to a beautiful red sunrise and no wind. I got out the inflatable dinghy and trolled up the Arm in the region designated for hand-propelled craft only.

Returning with no fish I rowed to the shore near a small inlet where I spied numerous trout feeding and spawning. I donned my waders and fly fished catching four 12 to 16 inch cutthroat trout in about 30 minutes. The rules are you can keep two cutthroat trout under 15 inches.

By 1500 regular thunderstorms hit and we battened down the hatches and waited out the storm.

8/5/91

We motored down the Arm and sailing into Yellowstone main lake in light winds. We set the spinnaker and ran into west thumb to meet with Peter and Cindy at Grant Village. About half way there a ranger hailed us and informed us that Peter and Cindy left a message that they couldn't join us because Cindy was sick.

So we dropped the spinnaker and tacked our way back in diminishing winds, eventually motorsailing up Flat Mountain Arm with thunderstorms all around us where we anchored

for the night. I took out the dinghy and proceeded to fish for our supper. I caught a 11-12 incher and then a 15 incher. I thought it was a keeper but Vollie looked it up, and said 13 inches was the maximum to keep. I also caught and released about an 18 incher.

Following a gourmet supper of fresh caught trout, scalloped potatoes and wine, we rowed up to the end of the Arm in hopes of seeing some big game. But so far we haven't seen any.

8/6/91

We awakened to a beautiful clear, calm morning with hardly a sound in the forest. I decided to make a pancake breakfast. Vollie dug around in the lockers to find vegetable oil for the mix and frying. The labels had fallen off the glass jars and what looked like vegetable oil was actually dish soap! It doesn't make for the tastiest pancakes!

We sailed out of Flattop Mountain Arm and attempted to sail up the South Arm. Shortly after entering the Arm the winds weakened and a thundershower developed right over us. I elected to head to our assigned dock in Wolf Bay. After several hours of showers we had supper at one of the picnic tables. Following that I did some fishing with no luck, We met a couple where the guy was a United Airlines pilot and had an enjoyable time chatting around their fire.

8/7/91 The next morning we awoke to clear skies. We were entertained by a group of 7 otters which swam across the bay and scampered across the sound into the main lake.

About 0930 we decided to go sailing and took the United pilot and friend around Frank Island in light air. We spied numerous osprey as the island is a sanctuary. We returned on a spinnaker run as storm clouds built and winds became gusty.

After lunch and a nap I went fishing and caught 4-5 nice cutthroat with one over 19 inches, I returned to a spaghetti dinner with wine and enjoyed viewing several deer one of which strolled through the campground,

Earlier in the day a ranger mentioned that a couple let their dog run loose (strictly forbidden in the park) on the shore of Grizzle Bay where we camped earlier and the dog was eaten by a grizzly.

That evening we had Wolf Bay to ourselves.

8/8/91 We awoke to a calm morning. I tried some fishing but the fish were not feeding. Just as we were about to depart for West Thumb a group of Boy Scouts canoes arrived. We escaped just in time!

In light air we drifted back and I trolled. I caught a 15 incher and promptly returned it to its home.

About half way back to West Thumb the winds quit entirely so I started the iron wind (made by Nissan) and we motored back to our truck then folding up the akas and derigging.

We drove out the east entrance to Yellowstone along a curvy, bumpy road but it was quite pretty. We camped along a stream for the night. Next day we drove back to Fort Collins where we put Triple Point back on her mooring in Horsetooth Reservoir.

A note looking back: This was the last major outing with Triple Point. After that Vollie refused to sleep on the boat and I figured there wasn't much sense having a 27' boat on this 7 mile long lake for day sailing only.

## **Appendix 2—My PhD students**

**As mentioned previously, my most rewarding accomplishment has been the supervision and mentoring of 44 PhD students. The following is a list of those students and their dissertation titles:**

## **Appendix 2**

### **PhD's I supervised and dissertation titles:**

Peter Wetzel, 1978: A Detailed Parameterization of the Atmospheric Boundary Layer.

Robert M Banta, 1982: An Observational and Numerical Study of Mountain Boundary Layer Flow

David A Mathews, 1983: Analysis and Classification of Mesoscale Cloud and Precipitation Systems

Kevin Robert Knupp, 1983: Precipitating Convective Cloud Downdraft Structure: A Synthesis of observations and Modeling

Chaing Cheng, 1984: The Physics of the Marine Stratus Cloud Capped Mixed Layer

David Paul Jorgensen, 1984: Mesoscale and Convective-Scale Characteristics of Mature Hurricanes.

David C Bader, 1985: Mesoscale Boundary Layer Development over Mountainous Terrain.

Ming-Sen Lin, 1986: The Evolution and Structure of Composite Meso-Alpha-Scale Convective Complexes.

Gregory J. Tripoli, 1986: A Numerical Investigation Of an Orographic Mesoscale System.

R. Ananthakrishna Sarma, 1986: Numerical Simulation of the Formation and Transport of Sulfate in Convective Clouds.

Melville Nicholls, 1987: A Numerical Investigation of Tropical Squall Lines.

Mark Gregory Hadfield, 1988: The Response of the Atmospheric Boundary Layer to Surface Inhomogeneities.

Michael A Fortune, 1989: The Evolution of Vortical Patterns and Vortices in Mesoscale Convective Complexes.

James E Bossert, 1990: regional-Scale Flows in Complex Terrain: An Observational and Numerical Investigation.

Craig J Tremback, 1990: Numerical Simulation of a Mesoscale Convective Complex: Model Development and Numerical Results.

Jerome M Schmidt, 1991: Numerical and Observational Investigations of Long-Lived, MCS-Induced, Severe Surface Wind Events: The Derecho

Michael J Weissbluth, 1991: Convective Parameterization in Mesoscale Models

Keeley R Costigan, 1992: Large Eddy Simulations of the Atmospheric Boundary Layer East of the Colorado Rockies.

Piotr J Flatau, 1992: Scattering by Irregular Particles in Anomalous Diffraction and Discrete Dipole Approximations.

Johannes Verlinde, 1992: Fitting Microphysical Observations to a Numerical Model Through an Optimal Control Theory Technique.

Davis O Blanchard, 1994: Jet-Induced Instabilities and the Growth of Mesoscale Convective Systems.

Michael P Meyers, 1995: The Impact of a Two-Moment Cloud Model on the Microphysical Structure of Two Precipitation Events.

Peter Q Olsson, 1995: Evolution of Balanced flow in a Simulated Mesoscale Convective Complex.

Jeffrey H Copeland, 1995: Impact of Soil Moisture and Vegetation Distribution on July 1989 Climate Using a Regional Climate Model.

Lewis D Grasso, 1995: Numerical Simulation of the May 15 and April 26, 1991 Tornadoic Thunderstorms.

Rolf A. Hertenstein, 1996: Evolution of Potential Vorticity Associated with Mesoscale Convective Systems.

Scot C. R. Raftin, 1996: development of a Cumulus Parameterization suitable for Use in Mesoscale Through GCM-Scale Models.

G. David Alexander, 1996: The Use of Simulations of Mesoscale Convective Systems to Build a Convective Parameterization Scheme.

Bjorn Sevens, 1996: On the Dynamics of Precipitating Stratocumulus.

Ligia Ribeiro Bernardet, 1997: Multi-Scale Evolution of a Derecho-Producing MCS.

Jerry Y. Harrington: 1997: The Effects of Radiative and Microphysical Processes on Simulated Warm and Transitional Season Arctic Stratus.

Jason Edward Nachamkin,: 1998: Observational and Numerical Analysis of the Genesis of a Mesoscale Convective System.

Ting Wu, 1999: Numerical Modeling Study of the November 26, 1991 Cirrus Event.

Alexandre Araujo Costa, 2000: Cloud-Resolving Modeling of Air-Sea Interactions over the Western Pacific.

Susan Clair van den Heever, 2001: The Impact of Several Hail Parameters on Simulated Supercell Storms.

Jean-Christophe Golaz, 2002: A PDF-Based Parameterization for Boundary Layer Clouds.

Brian Gaudet, 2002: Rapid Development of Tornado-Like Vorticies by Simulated Supercells.

William Y.Y. Cheng, 2002: Sensitivity of the Soil Moisture Initialization in the Genesis of Two Simulated Mesoscale Convective Systems.

Israel L. Jirak, 2005: Observational Analysis of the Predictability of Mesoscale Convective Systems.

Elizabeth M Page, 2007: Post-Fire Impacts on Microclimate and Convective Precipitation..

Daniel S Ward, 2010: Cloud Condensation Nuclei in Western Colorado: Observations and Model Predictions.

Adrian M. Loftus, 2012: A Triple-Moment Bulk Hail Microphysics Scheme to Investigate the Sensitivity of Hail to Aerosols.

David G Lerach, 2012: Simulating Southwestern U.S. Desert Dust Influences on Severe Tornadoic Storms.

Vandana Jha, 2016: Examination of the Potential Impacts of Dust and Pollution Aerosol Acting as Cloud Nucleating Aerosol on Water Resources in the Colorado River Basin.

Michal Clavner, 2016: The Response of a Simulated Mesoscale Convective System to Increased Aerosol Pollution.

**PhD's I mentored at other than CSU:**

Henian Zhang, 2008: Impact of Saharan Dust Acting as CCN on the Evolution of an Idealized Tropical Cyclone. The University of Urbana-Champaign.

Parthasarathi Mukhopadhyay, 2004: Prediction of Thunderstorms and heavy Precipitation Events Over Indian Region. Indian Institute of Tropical Meteorology, Pune.

**I adopted the ceremony used with pilots after their first solo in which their shirttails are cut, but where I “cut the tie” after the successful defense of my PhD students. Here are a few examples (Sorry for those of you not pictured but these are all I can find). In one case, I cut the tie with Dave Mathews, whose wife (at the time) had bought him an expensive silk tie for the occasion. She was not happy with me!**



*Figure 59: Cutting the tie with Sue van den Heever. Chris Golaz in background.*



*Figure 60: Cutting the tie with Ligia Bernardet.*



*Figure 61: Cutting the tie with Mike Myers.*



*Figure 62: Cutting the tie with Dan Ward.*



*Figure 63: Cutting the tie with Chris Golaz.*



*Figure 64: Cutting the tie with Bjorn Stevens.*



*Figure 65: Cutting the tie with Brian Gaudet.*



*Figure 66: Cutting the tie with Greg Tripoli.*



*Figure 67: Cutting the tie with Will Cheng.*

**A more formal ceremony is the graduate school “hooding ceremony”. An example below:**



*Figure 68: A happy Vandana Jha being hooded.*