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# A Personal Retrospective of the Early Years

Mike Bowers

Santa Barbara, CA, Spring 2005

My first scientific inklings were stirred when I looked at the student list in the cloakroom in third grade at St. Augustine elementary school in Spokane Washington. Our teacher, a Franciscan nun whose name is lost in the mists of time, had decided to “honor” students who excelled in one way or another. She initiated a system where a gold or silver star was placed following a student's name under several possible categories. I was somewhat astonished to find a gold star opposite my name in the Mathematics Category, one of only a few in that category and my only one in all categories. I hadn't yet figured out that school was something worthy of effort (a discovery I made about 10 years later) but the gold star did implant the idea I might have some hidden talent.

That talent remained hidden throughout elementary school where sports seemed to me to be the reason to gather all of us together in one place. However, my subconscious got another jolt on entering high school at Gonzaga Prep. In those pre-politically correct days they streamlined entering students by administering aptitude tests the week before school started. I showed my aptitude by carving my initials into the desk I used for the tests. I was puzzled when I was singled out and asked to return to G-Prep on Saturday following the exams. Of course they had figured out I had been responsible for the fresh initials (I hadn't penciled them over) so I spent the day sanding desks along with a few of my new classmates.

The streamlining had placed me in Room 1 along with other successful aptituders. The long range significance of this placement was the requirement to choose either a “Classics” or “Scientific” course of study. Since the “Classics” course required 4 years each of Latin and Greek as well as lots of ancient history and literature, I chose the “Scientific” escape hatch filled with Math, Physics and Chemistry. (Interestingly, given the focus of this Focus Issue, G-Prep didn't offer a Biology course and I've managed to avoid one ever since.) Of course I couldn't completely escape the Classics since every student took two years of Latin: “*Omnia Gaulia est divisa in tres partes . . .*” or something like that. My main classical achievement however, was incessant complete conjugation of the verb “*appropinquo*,” which means to approach, and is the longest Latin verb. Our first year teacher, Fr. Glancy, used it to get us to shut up. It got so he wouldn't even turn around from

the chalk board. He would just say “Bowers, *appropinquo*.” All my friends could mimic my voice.

In spite of spending time with the brighter students at G-Prep I managed to keep any visible achievement well in check and graduated dead center at 64th out of 128 students. Again sports, especially golf, and other activities like learning to smoke and discovering both beer and girls took center stage in my life. Oh, and to highlight the difference between then and now, getting caught smoking on campus was not good. That got you an appearance in Leash Court, run by the student group Knights of the Leash, and usually 10 hacks from the Sergeant at Arms. In my case I only got 5 hacks because he broke the paddle on my tush on the 5th one.

I graduated in June, 1957. That summer was eventful mainly because Sputnik was launched by the USSR. It is hard to imagine the shock waves that went through the country at that time, affecting even disconnected students like I was then. All of my friends and I decided to pursue science in college, which in my case wasn't a foregone conclusion (college, that is). My dad told me years later that he was sure I would join him in the cattle business given my demonstrated allergy to studying. Sputnik and my mom prevailed, however, and in fall 1957 I entered Gonzaga U.

I soon found out my newfound enthusiasm and patriotic zeal weren't enough at this level. My first semester at G.U. was a mini-catastrophe highlighted by an “F” in Sacred History (Old Testament). I found out when they assigned a paper they actually expected you to turn one in. To make matters worse, the teacher was an old classmate of my dad at Chewelah High, just north of Spokane! I'm not sure if that was the turning point, or getting excited about chemistry by taking the majors course out of Linus Pauling's book, or whether my natural competitive personality rotated from sports to the classroom. Whatever it was, starting fall of 1958 the original “extreme makeover” occurred. While I majored in chemistry, I proceeded to take all the physics courses offered, most of the math courses, seven semesters of philosophy and crammed in 20 to 25 units each semester. I also became more serious in other respects, taking pre-seminary Latin my last (5th) year since I was contemplating entering the Jesuit Novitiate following graduation. I got introduced to the “big time” when I went to the University of Washington my last summer as a Ford Foundation Fellow and took Advanced Calculus and Modern Physics, an experience that almost had me going to Seattle for graduate school. This marked the end of my blissful, naive, carefree life in

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Published online May 23, 2005

Spokane and the beginning of a new adventure in Science. I'd gone from failing Sacred History to receiving the award for outstanding senior student in my five years at Gonzaga. I had lettered four years on the golf team and coached it my 5th year. It was a precious yet mysterious time for me and I had no idea of why I had changed so dramatically or what was coming next. I was both excited and afraid leaving Gonzaga where I knew every faculty member in every department. I do know that GU is responsible for both teaching me how to think and for developing the moral awareness that I should do something with the gifts I'd been given. Exactly how to make that happen wasn't very clear at the time.

Choosing a graduate school was, simply, an exercise in ignorance. I had spent a summer at the University of Washington so that was high on the list. Conversations with my teachers led me to apply to the top Ivy League Schools, Berkeley, Colorado and Illinois. While I was admitted to most of them, I ultimately chose Illinois both because of its outstanding reputation and because of the Ethyl Corporation Fellowship they offered. I had never been east of Coure de 'Alene, Idaho and only once ventured to California (to play in the 1961 National Amateur at Pebble Beach) so I wasn't distracted by a lot of in-depth information. There were no recruiting trips. You were happy when they answered your mail!!

I moved into the AXΣ (or AX) house (a chemistry fraternity at U of I) mid-September 1962. In those days new graduate students had to take four qualifying exams (physical, organic, inorganic and analytical). You had to get 75% in your major area and 50% in the others or you had to take make up courses and pass with a "B" or better. I had intended to play golf for the 2 weeks until school started but a half dozen new (mainly organic) first year students were at the AX house frantically studying for the entrance exams. I got sucked in and ended up helping them with the P-Chem while they taught me modern organic chemistry. Without them I would never have passed the organic exam. We were all very proud of ourselves when we managed to jump through the required qualifying hoops. Living in the AX house had another important consequence for me. I met Len Kaplan, an organic chemist who spent late nights at the lab like I did. One night I was telling him how disappointed I'd been on my GRE scores on the Chemistry Subject Exam (64%) I'd taken while at GU. I knew my course record and aptitude test scores were OK but felt the poor chemistry GRE showing had kept me from an NSF Fellowship. The study session for the entrance exams had shown me I knew little organic chemistry when I'd taken that first test. Len, who was an NSF Predoctoral Fellow, gave me some invaluable tips on how to prepare so I retook the test that year. This time I emerged from the exam feeling I'd done much better. I had the results sent directly to NSF in support of my renewal application (it cost an additional \$20 to get a personal response so I didn't request one). I

eventually was informed I had been selected for a Fellowship, a somewhat unusual occurrence since I was a second year grad student not a first year. Upon inquiry NSF told me I'd gotten a perfect score on the Chemistry GRE, something Len told me was possible (he'd done it) but I was skeptical and more than surprised.

Other than that, the highlights of my first year were winning the Pat Boone Award at the AX house Crock Trophy night (in honor of my white buck shoes) and choosing Bill Flygare as my research director. I had gone to Illinois to be a theoretical chemist, mainly because all experiments at GU gave a shotgun pattern regardless of the expected result. Flygare was just getting started and his incredible enthusiasm attracted me. I wasn't quite sure what the project was I'd agreed to try (matrix isolation spectroscopy) but suspected it wasn't purely theoretical! Bill turned out to be the defining scientific influence in my young scientific life. I had gone to Illinois to get a PhD and hopefully return to Gonzaga to teach. As the years unfolded at Illinois I saw how exciting research could be and that experiment could give deep insights into the "nature of nature" in spite of my GU experiences. Bill's enthusiasm and complete lack of fear in pursuing new projects became the scientific model for me. He also had some sayings I've never forgotten, like "the molecule is always right" and "the time to finish your degree depends exponentially on the number of others you depend on." Because I had to borrow an infrared spectrometer from another group I often worked into the early morning hours, quitting only when the liquid helium ran out. I would leave my results on my desk and usually return around noon. More than once Bill had looked them over and filled the chalk board in my office with complex interpretations. Only occasionally did these turn out to be correct but it taught me how to critically look at my data—and the best time to do that was now!!

Eventually it was time to write up and leave the corn fields of Champaign-Urbana. This was more complicated than usual. In those days post docs weren't as common as now and most PhD's went straight into a job, either in industry or academics. Since I wasn't positive what I wanted to do I began interviewing both places. But that wasn't the complication. While at Gonzaga I had decided to go through advanced ROTC (every male had to do the first 2 years). They paid me \$39/mo for years 3 and 4, which in 1960 was a generous stipend to someone with no money (comparable to \$400 or \$500/mo. today). At the time the world was a quiet place with Korea a fading memory and Vietnam not yet on the horizon. Hence, I was commissioned a Second Lieutenant, and immediately deferred for graduate school. The idea was to finish my PhD, spend a few months on active duty and serve my time in the Reserves. However, in 1965/66, when I was getting ready to leave U of I, Vietnam had become more than a hotspot. Subsequent to obtaining my commission I'd

discovered I had frozen arches in my feet that offered little support. I would get severe pain in my legs and lower back and needed special orthotics in my shoes. This was a condition serious enough to keep me out of the Army but perhaps not serious enough to get me a medical discharge once I was in the Army. Hence, while I pursued a medical discharge I also interviewed at duPont, Kodak, Syracuse University and Northwestern receiving offers at the first 3 and was still under consideration at Northwestern. As insurance I had also lined up a post doc with Herb Broida in Physics at UCSB. The Air Force Colonel at Rantoul AFB near the U of I examined me and recommended discharge from the Army. However, the Army wanted a second look and flew me to Ft. Benning, Georgia where an Airborne Ranger Major looked at me, declared me fit as a fiddle without an exam and told me how much I would enjoy combat in Vietnam. Well, the job interviews ended and I prepared to enter Armor Officer Basic at Ft. Knox in September, 1966.

In Spring 1966 a young faculty member at USC, Bob Beaudet, visited Illinois to give a seminar. I got a chance to talk to him and he told me about a program where PhD scientists in the Army would be officially stationed at Ft. McArthur in San Pedro and detailed to the Jet Propulsion Laboratory in Pasadena. Obviously, this got my full attention. My mom worked for a lawyer in Spokane who was active in the Democratic Party and at that time the two senators from the State of Washington were Harry Magnuson who headed the Space Committee and Scoop Jackson, number two on the Defense Committee. Well, through Beaudet (a JPL consultant) I got in touch with people at JPL who supported my transfer to JPL and mom's boss worked on Magnuson and Jackson. My last week of Armor Officer Basic I got telegrams from both Senators Magnuson and Jackson telling me I would not be going to Aberdeen Proving Ground (a launching pad for Vietnam) on graduation at Ft. Knox but would be sent to Ft. McArthur and detailed to JPL. Sure enough, on assembly our last day at Ft. Knox I heard the CO bark: "Change of Orders: Bowers, Michael T. from Aberdeen Proving Ground to Ft. McArthur." Looking back, that transfer had more to do with my future in science than any other factor. I also have to say that three months training to be an Armor Officer had me fully prepared and willing for combat. I have never quite gotten over the realization that many of my Armor Officer Basic buddies were put in harm's way and I wasn't. The most difficult walk on earth for me is through the Vietnam Memorial where some of their names are chiseled in the granite.

The two years I spent at JPL allowed me to establish an independence in science that was unusual for one at my career stage. I couldn't interest the powers that be at JPL in a matrix isolation spectroscopy project on "prebiotic" planetary atmospheres, a hot topic in those days given the Miller-Urey experiments. Consequently I had to find other things to do. I ended up doing some original work on the assignment of J-J coupling con-

stants in NMR with Stan Manatt (at JPL) and microwave spectroscopy on some small ring systems with Bob Beaudet (at USC). However the breakthrough change was initiated by a seminar at JPL on ICR given by John Baldeschweiler, a seminar I didn't even attend. The work was so new, and compelling, that my JPL colleagues Jim King and Dan Elleman built an ICR from spare parts in the JPL warehouse! Once Dan had put the instrument together he wasn't sure what to study being trained in physics. He knew I was looking for something to do so he recruited me. Of course I was a spectroscopist but at least I was a chemist. Knowing nothing about mass spectrometry and less about ICR, I did the logical thing. I leafed through the latest issue of the *Journal of Chemical Physics* and found an article by Pierre Ausloos on the radiation chemistry of ethylene. The authors theorized that the radiation-ionized ethylene and the chemistry they observed was due to ion-neutral reactions. Triumphant I announced to Dan we would study ethylene! What transpired was the blind leading the gullible. Sparing you the details we ended up withdrawing a Communication accepted in JCP since our publication urge outpaced our knowledge of ICR. Fortunately we had a reasonably steep learning curve and happily Jack Beauchamp was just beginning his storied career at Cal Tech. Jack discovered we were working on ethylene, one of the Aldrich catalogue of molecules he'd looked at during his PhD thesis, and suggested we collaborate. Dan and I graciously agreed and a lifelong competitive and collaborative friendship was born. Our collaborative paper was my first in ICR/Mass Spectrometry.

One of my highlights at JPL was being selected by the army as one of 10 officers to be featured in a "Prestige Brochure." As you can imagine the army had an image problem in 1967 and this was their response to it. They hired a Madison Avenue advertising agency to produce the brochure. On the chosen day the advertising executive from New York, Riley Brown a syndicated columnist from Atlanta and a top Hollywood photographer all descended on JPL. They took shots of me with instruments, with satellites being constructed, on top of the tallest building surveying JPL as if I ran it: all in my army dress uniform! This was the only day I wore it after leaving Ft. Knox. Following this shoot they took pictures of me lolling around Bob Beaudet's pool and finally at dinner in the fanciest restaurant in Pasadena. This latter event was supposed to be aloof and professional (they sat at a separate table snapping pictures) but that all disappeared after the second or third martini. (At this point in my life I don't think I'd had even one martini.) I'm not sure what happened after that but I was very glad I wasn't driving! When the brochure came out it was all very slick and if I hadn't been there I wouldn't have recognized the 2 or 3 pages devoted to my "typical" army job.

All good things come to an end and it was time to find a real job. In those days academic jobs were not advertised. You had to get information about openings

any way you could. One of my contacts was Herb Broida at UCSB even though I hadn't been able to accept his post doc position. Being in Physics he couldn't be too helpful but he did mention the Chemistry Department at UCSB was looking for people. Somehow I found out the University of Oregon and the University of Texas at Austin also had openings so I applied to all three. Being conservative I also checked out industrial jobs and interviewed at W.R. Grace, Exxon and Kodak, all just before Christmas 1967. I had given my parents my travel schedule since I was going directly to Spokane for Christmas following the interviews. This turned out to be fortuitous in a surprising way. At the end of my last industrial interview I was sitting in the Vice President's office at Kodak. They had made me an offer 2 years prior and my matrix isolation spectroscopy background was appealing to them. The Vice President was in full recruiting mode when the phone rang. He picked it up, frowned and handed it to me. On the other end of the line was Roger Millikan, the Professor in charge of recruiting at UCSB. He wanted me to come for a visit and suggested some dates. He had somehow located my parents in Spokane and got my travel schedule. Someone in Kodak located me in the VP's office. I mumbled a date and handed the phone back to the VP whose look requested an explanation. I simply said it was a confirmation of a seminar date and left it at that. The VP shifted his recruiting into high gear!

I got interview offers at all three schools I applied to. First up was Texas, followed immediately by UCSB in early January and two weeks later Oregon. My priorities going in were Oregon, UCSB and then Texas, based almost exclusively on location. Getting to Austin was quite an adventure as Braniff wheeled 3 different colored planes to the jet way in Dallas but all of them had mechanical problems. I arrived in Austin 5 hours late, no one met me and fortunately I had the name of the motel booked for me. Someone did collect me the next morning and the interview went OK. After my seminar everyone disappeared and I didn't know what to do next. I ran into one of the faculty, Bill Gardiner, as I was looking for the exit and he was embarrassed to find out no one was taking me to dinner. After a few calls he graciously took me to a nice restaurant and we had a good, and personal, conversation during our meal. Texas had not moved up my priority list(!) but Bill Gardiner had.

Two days later I was at UCSB (a Thursday). It truly poured down rain the whole time I was there. Amazingly I had never been to Santa Barbara since the route to Spokane from Pasadena was straight up I-5, not coastal highway 101. They kept telling me how nice it was if I could only see it! One great improvement was 5 or 6 faculty came to dinner with me and two of them (Dave Harris and Glyn Pritchard) took me to a local hangout after dinner. I also had a thorough chat with the Chairman, Clifford Bunton (who still is very active

as an Emeritus Professor) and got the idea they were interested in me.

I drove home late Thursday night in the rain assessing my two very different visits. It was a good thing I did because the next day Chairman Bunton called and offered me a job! I had one week to decide. Period. I really wanted to interview at Oregon but that was 2 weeks away. My criteria wasn't which was the better opportunity but which was closer to Spokane and my comfort zone. In the end I thought a bird in the hand was better than none in the bush and I accepted the offer at UCSB. After all, I could always leave if I didn't like it! (The offer, by the way, was for \$8,000 for 9 months which was substantially less than I was making in the army and less than half the Kodak offer. I was comforted, however, that Prof. V, the top of the UC scale, was \$25,000/year which seemed like a million dollars at the time.)

I started at UCSB in Fall 1968. I now have spent significantly more than half my life here and many interesting and (to me) important things have transpired. However, I am only going to mention a couple of things since this part of my (professional) life is documented in my CV and publication list. Besides, this is when I began to meet and interact with the Mass Spectrometry community so many of you have heard me speak, went to dinner with me, reviewed my papers and proposals, collaborated with me and otherwise encountered and formed an opinion of me and of my science. My CV and publication list are found on the group website (<http://bowers.chem.ucsb.edu>) along with lots of other information. I'm going to discuss the first students that joined my group and then move forward 25 years to the most rewarding event of my career at UCSB.

In my first year at UCSB four students joined my group. This was an incredible boon to a new faculty member who had no grants and only an empty lab to show them. My "start up" was about \$40,000 which didn't appear the first 6 months and had me threatening mayhem with the chair. It finally did arrive and we could get going building the 3rd or 4th ICR in existence at the time. Anyway, back to the students. Paul Kemper was a bright, talented experimentalist who probably came to UCSB so he could live in Isla Vista next door and avoid the horror of getting a job. He was definitely a child of the 60's and came to work with me because he didn't "fit" in my senior colleague Dick Martin's group. Paul is still working with me, has a Research Professor appointment at UCSB, and has become one of the premier instrument builders in mass spectrometry. It was a growth process. But today we couldn't function without him.

Hugh Webb was an Organic Chemist working jointly with my colleague Don Aue and me. One night about midnight he came into my office complaining the intensities of two protonated bases remained constant over a wide pressure range (he was trying to determine their relative proton affinity). He showed me the data

and a light bulb went off: equilibrium had set in and a new era of quantitative gas phase (intrinsic) basicities and acidities was born. After a post doc with Jean Futrell, Hugh (eventually) returned to UCSB to run our Mass Spectrometry Lab. He retired a few years ago.

Vince Anicich was someone who could build anything from a roof on a patio (at my house!) to an ICR machine. He and Paul put together our first machine and Vince really deserves the credit for getting it to run at full speed. Without his energy we would have taken much longer to get going. He went on to a very productive career at JPL and has recently retired.

The final member of this extraordinary class was Walt Chesnavich. Walt was very bright but troubled. The turmoil of the 60's had left him with a burning need to do something relevant. In those days, relevant usually meant "environmental" and Walt left the group in frustration after his first year. This was a very chaotic time at UCSB and throughout the country. Walt fell into the protest movement and drifted away from his science roots. In 1971 he was accused of burning the Bank of America in Isla Vista but was never formally charged and was later shown not to be involved even though some of his buddies were. He hit a low point later that year when someone suggested he use his "chemistry" talents to make them some drugs. To Walt's credit the "chemistry" reference struck an old nerve. He realized he was a chemist, and he got up the courage to ask me for a job. I was interested in doing RRKM calculations at the time so I hired him to do some programming. He showed up, worked hard, and 3 years after he left he was reinstated in the PhD program. I gave him an experimental project to work on and then left for my first sabbatical with Keith Jennings at Warwick University in the UK.

In those days sabbaticals were great. There was no e-mail, transatlantic phone calls were very expensive and the mail took at least a week. You really could get away and learn something new and I was loving it. One day I got a letter from Walt. He said he'd burned out 6 filaments on the ICR in a single week and the group had banned him from the instrument. However, the good news was it gave him time to think and read the literature and he'd discovered John Lights papers on phase space theory on neutral diatomic molecules and some approximate efforts by Eif Klots to apply them to ion-neutral reactions. He had an idea on how to develop a general theory and wondered what I thought. I read the papers, looked over his notes and said go for it. Of course since he was temporarily barred from the instrument neither of us had much to lose!! The rest is history and Walt's great work on phase space theory has stood the test of time. He went on to a post doc with Eric Heller at UCLA and a Faculty job at Texas Tech until his untimely death fifteen years ago.

One last item before I fast forward. I was fortunate early on to get several grants funded and decided to

hire a post doc. In retrospect it was one of my best decisions. I hired Tim Su from Larry Kevan's group at Wayne State and we set out trying to quantify some ion-dipole experiments going on in the group. Before long Tim had developed the average dipole orientation (ADO) theory which, along with a series of improvements, put ion-neutral collision theory on firm ground. The combined theoretical work initiated by Walt and Tim formed the basis for the Distinguished Contribution Award presented to me in Nashville, May 25th, 2004, and is responsible for this overly long retrospective you are reading! Tim is still enjoying a successful career at the Dartmouth campus of the University of Massachusetts.

The last thing I want to mention before signing off is the Faculty Research Lecturer Award I received at UCSB in 1994. This is a singular honor at UCSB since only one faculty member is selected each year campus-wide. The highlight of the award is a public lecture on a topic of the lecturer's choice. I chose "Science and Serendipity" as a topic and greatly enjoyed rummaging through science history for examples for the audience. Among those I selected were x-rays, Teflon and Velcro, each discovered or invented by curious people who followed up on unexpected events. The real reason I chose the topic, however, was to highlight "major" advances in my own research group. Almost without fail these were the result of recognizing important signposts in puzzling experimental data. I have already mentioned the midnight discovery of proton transfer equilibria. Equally "unintended" was the discovery and characterization of  $H_4^+$  (and  $H_6^+$ ,  $H_8^+$  . . .) and the fact pulses of transition metal ions exhibited bimodal arrival time distributions (ATD's) drifting through He gas—an experiment that was designed only to measure residence times for kinetic studies. This latter discovery led us to develop the whole field of ion chromatography/ion mobility as a powerful tool in obtaining conformations of complex systems. This method has led my group to the edge of biology and, possibly, to obtaining an antemortem test for mad cow disease and potential contributions to the molecular basis for Alzheimer's disease. My early mentor Bill Flygare was on target: "the molecule is always right" especially when one is willing to jump into new pools seeking the elusive answers the "molecule" promises us. I am appreciative and thankful for the recognition and honor the Distinguished Contribution Award has brought to my extended research group and for this Focus Issue of JASMS that resulted from it. I am happiest, however, that my research group is still breaking new ground in this exciting scientific time. My scientific buddies know full well I never let the fact that I didn't know or understand something stop me from enthusiastically commenting on it! This same enthusiasm keeps me poking new "molecules" hoping they will reveal their secrets. You simply can't have any more fun than this.