Memoirs of an Amateur Chemist

Growing Up a Science Nerd in the 1960s

William B. Jensen

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Dedicated to my mother
Who put up with a hell of a lot

"Tell me – where now are all those teachers and masters whom you knew well while they yet lived and were eminent in learning? Already others hold their positions, and I know not whether they think back on them. In their lives they seemed something, but now there is no word of them." – *Thomas à Kempis, 1418*

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Preface

"When I was younger I could remember anything,
whether it had happened or not."

Mark Twain, 1877

I find as I age that I am increasingly subject to intense mental flash-backs, often dealing with the most trivial and random events of my youth, and I have further discovered that the best way to purge these nagging memories from my brain is to write them down. It gives me a sense of relief not dissimilar to having successfully scanned the contents of an old file folder into my computer and being able to finally throw away its increasingly tattered and fragmented contents, secure in the knowledge they are now safely stored elsewhere and I can quit worrying about their progressive deterioration.

I suspect that all of this may be nothing more than my accidental psychological rediscovery of the so-called "best method" of writing autobiography that Mark Twain claimed to have stumbled upon more than a century ago:[1]

... in 1904 I hit upon the right way to do an Autobiography: Start it at no particular time of your life; wander at your free will all over your life; talk only about the thing which interests you for the moment; drop it the moment its interest threatens to pale, and turn your talk upon the new and more interesting thing that has intruded itself into your mind meantime ... And so I have found the right plan. It makes my labor amusement – mere amusement, play, pastime, and wholly effortless.

The product of this method in Twain's case was, of course, a literary classic, even though it has proven over the years to be something of a

nightmare for those editors charged with arranging the resulting fragments and digressions into a coherent whole.

For obvious reasons Twain's life is of great interest to large segments of the public, whereas my own life is of no interest to anyone, save myself, my family, and a few indulgent friends. In addition, unlike Twain, my memory is almost exclusively limited to the visual. While I often cannot recall the names of persons from my past or the texture of their conversation, I am always able to call up very detailed mental pictures of their physical appearance and of the buildings and events which surrounded them, and one of my pleasures in committing these scenes to paper is the attempt to recall as much of this visual detail as possible – a tendency that often tempts me to violate Twain's injunction to drop a topic before it becomes tedious. And, unhappily, I am also enough of an historian that I cannot further resist a desire to try, whenever possible, to set these memories in some larger historical context, even when that context was largely unknown to me at the time when I first experienced the events in question. This tendency to indulge in too much detail is further reenforced by the fact that my mother almost obsessively saved every photo and scrap of paper relating to my childhood and adolescence – from report cards and homework to pay stubs, receipts, newspaper clippings, and award programs – thus allowing me not only to factually verify my own qualitative memories but to also attain a degree of detail far beyond the actual contents of my own brain.

Following Twain's advice to start "at no particular time of your life," the chapters in this memoir were originally written in random order as separate essays over a period of more than a decade. Only recently did it occur to me that, with some editing and elimination of redundant photographs and stories, they could be combined into a single autobiographical memoir. I further realize that the world described here is of little interest to the general

reader. I am not famous nor have I ever been associated with the famous or privy to their secrets, and even if the latter possibility was true, it would be irrelevant, since this is a memoir of childhood and adolescence and not of my later professional career. Nevertheless, I strongly suspect that the world I have described will be very familiar to that small select group who, like myself, experienced the pleasures and adventures of being amateur home chemists in their long vanished youth – a world that in our increasingly chemical phobic and litigation crazed society, few will ever experience again.

William B. Jensen
Cincinnati, OH
October 2013

I
Becoming an Amateur Chemist

To the best of my recollection, I first became interested in science while attending the 4th grade at Lincoln Elementary School in Wausau, Wisconsin (figure 1.1). This was not the result of a school science lesson however. Indeed, at this date I had no clear concept of science as a distinct subject. Though surviving report cards show that "Science and Health" were listed as a separate grade category from the 3rd grade on, whatever fleeting science or nature lessons we were given were apparently so intermixed with the rest of our rather eclectic grade-school curriculum, that they failed to draw attention to themselves as something unique or of interest. Rather the stimulus came from the "reading" book we used that year, which contained a lavishly illustrated chapter on the life of Louis Pasteur. I was absolutely fascinated – not by Pasteur's science – but rather by the book's colored illustrations of his laboratory and apparatus.

That same year our family was invited to dinner at the home of Don Simonson, a local Wausau policeman who served as the safety officer for the city schools and whom my father had met through their mutual involvement in cub scouts. On the shelves in his TV room I discovered a heavily illustrated children's "Golden Book" on the lives of famous scientists and inventors, including not only Pasteur, but Robert Koch, Marconi, Edison and others. Again it was the illustrations of their laboratories and equipment that held my attention and I spent the entire evening thumbing through its pages. Noticing my fascination with the book, Don gave it to me as a present at the end of our visit.

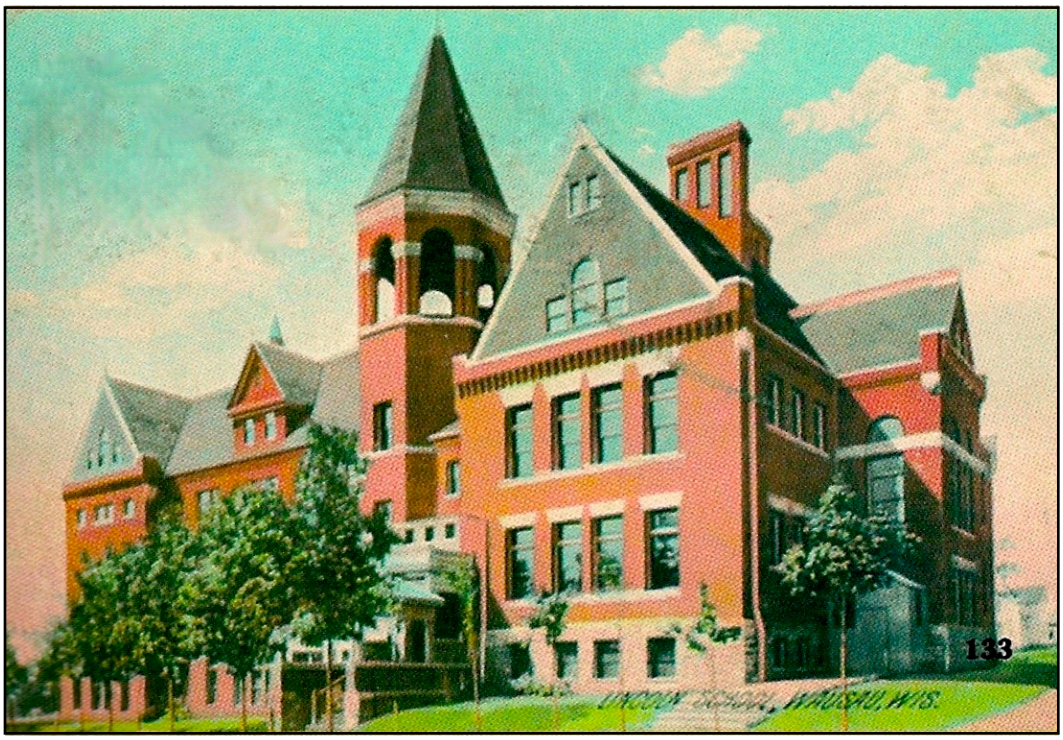


Figure 1.1. A period postcard of Lincoln Elementary School, which I attended from 2nd grade through 7th grade. The central section with the tower was built in 1892 and the two end wings were added in 1900.

Science Lessons Alas

It was only in 5th grade (figure 1.2) that science finally began to come into focus as something distinct and of intrinsic interest. My teacher that year was one Miss Florence Ridge, and she was a stereotypical spinster schoolmarm. I would guess that she must have been in her early 60s, though she seemed far more ancient to my 11-year old eyes. In any case, she dressed like my paternal grandmother and was full of stories of growing up on a farm in nearby Rib Mountain that were resplendent with references to horses and buggies, one-room school houses, wood stoves, crank telephones, and kerosene lamps. She also had the quaint 19th-century habit of keeping her handkerchief tucked in her bra and was constantly sticking her hand

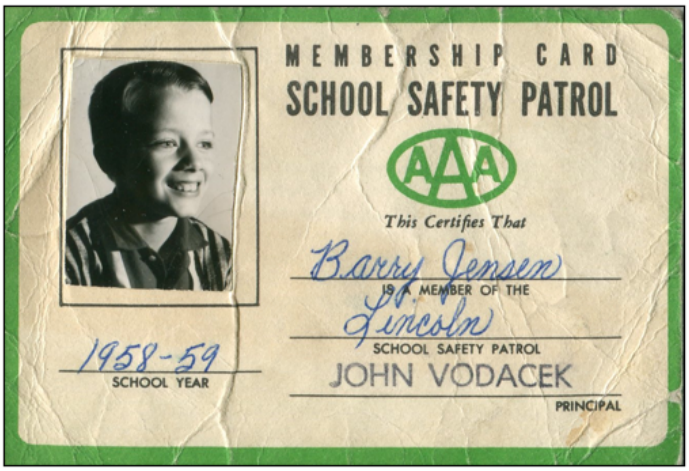


Figure 1.2. My appearance in 5th grade as revealed by my wallet-worn official "School Safety Patrol" membership card.

down the front of her dress in an attempt to retrieve it. When I told my mother about this habit, she claimed that, as a young girl, she also had a teacher with the same quirk, but that this teacher kept two, rather than one, handkerchief tucked in her bra – one on each side. One day, while talking to the class, she absentmindedly left one of the handkerchiefs on her desk. A few minutes later she reached into her dress for it and, unable to find it, began to frantically pat her front. When this did not produce the desired result, she pulled back the neck of her dress and peered inside, only to exclaim "My God, one of them seems to be missing!" I must confess that, on retelling this story, it now strikes me that my mother was really passing off a stock joke of the time rather than recounting a true personal experience.

But what really set Miss Ridge's science lessons apart was a large wooden box of science equipment that the school board had purchased for her use. Though its contents looked infinitely promising to me, I do not recall her employing them to make anything of interest. What I do recall, however, is seeing her run a piece of glass tubing, that she was trying to insert into a rubber stopper, into the palm of her hand

and the resulting contortionist act as she attempted to retrieve the notorious handkerchief with the opposite hand in order to stem the ensuing flow of blood.

I also vaguely remember performing an experiment in which we placed a charcoal briquet in a dish filled with a shallow puddle of water containing salt, ammonia, laundry bluing, and a variety of different food colorings. A few days later we found the surface of the briquet covered with efflorescent growths of various colors. On yet another occasion we made photographic images of leaves using old-fashioned blue-print paper. But my strongest memory involves the famous lesson on the reproductive cycle of the common potato. Halfway through, Miss Ridge was interrupted by someone crying at the back of the room. The person in question was a quiet blond girl named Mary Zietlow, and when Miss Ridge inquired what the matter was, Mary replied in a trembling voice, "I don't think I am suppose to learn about potato sex. I'm pretty sure it's against my religion."

Walt Disney and Werner von Braun

Coincident with Miss Ridge's science lessons were my first attempts to build up my own home laboratory. Truth be told, these were not inspired by her classroom antics but rather by at least three separate extracurricular stimuli – two of which dealt with science in general and one with chemistry in particular.

The first stimulus was the series of television specials made by Walt Disney, in collaboration with the German rocket scientist, Werner von Braun, in response to the growing space race between the United States and the Soviet Union. I believe there were three of these: "Man in Space," "Man and the Moon," and "Mars and Beyond." Though the first two were made in 1955 and the third in 1957, they were regularly rebroadcast as part of Disney's weekly

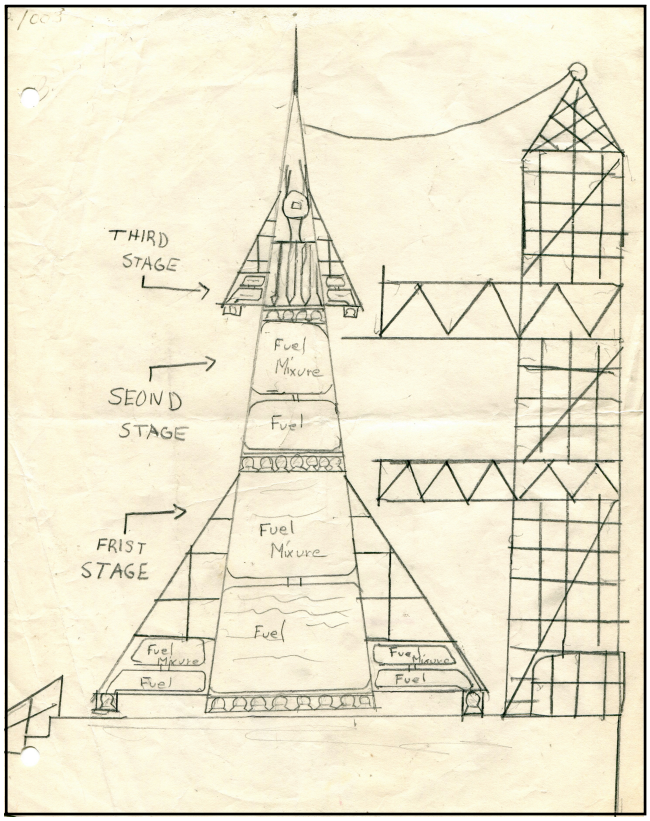


Figure 1.3. One of several drawings of multistage rockets I made around age 11 in response to Disney's animated series on space travel. Note the terrible spelling and the folded up Sputnik-like satellite in the nosecone. I also have no idea what I imagined the difference to be between "fuel," on the one hand, and a "fuel mixture" on the other.

television show. The result, on my part, was a series of drawings of rockets, carefully executed using a ruler and straight edge (figure 1.3), and a burning desire to have my own rocket laboratory.

For this latter project I managed to recruit my friend, Blair Peshak, whom I had known since the 2nd grade, and to convince my father to give us two large sign crates – which, by some miracle of levitation, we succeeded in carting from the sign company on 2nd Avenue up west hill to Blair's house on 10th Avenue and depositing in the empty

lot behind his house. These we nailed together to create a box, roughly 5ft x 8ft x 8ft, which we covered with cardboard and tar paper. One entered through a small trap door near the ground and, since there were no windows, I presume we used a flashlight when crouching inside. Though we were thrilled with our secret domain, it was hardly conducive to rocket research, as we quickly discovered when the first rainstorm demonstrated in no uncertain terms just how inadequate our choice of siding material was, and in the end we were forced to transfer our investigations to Blair's basement instead.

Our final rocket design was unconventional to say the least. There was no gunpowder, no cardboard cylinder with fins, and no nosecone. Rather our "rocket" consisted of a conventional medicine dropper bottle from which we had removed the glass dropper tube, leaving only the rubber dropper bulb protruding from the top of the screw-on cap. We would put some sodium bicarbonate in the bottom of the bottle, add some white vinegar, and quickly screw the cap with the attached dropper bulb back on. The evolving carbon dioxide gas would rapidly inflate the dropper bulb, after which Blair would insert his thumb nail under the rim of the straining bulb and, with an upward snap of his thumb, release it from the cap, thereby sending it shooting about 15 feet into the air.

We were so proud of our "invention" that we decided to demonstrate it in front of Miss Ridge's class. Here the rubber bulb, after hitting the ceiling and leaving an appropriate stain, quickly became lodged in one of the light fixtures. In addition, in our anxiety to guarantee a successful launch, we had overcharged the bottle, which not only ejected the rubber bulb, but also a column of white foaming vinegar and soda which splashed across the blackboard at the front of the room. To say the least, Miss Ridge was not amused and I think she decided then and there that Blair and I were troublemakers who needed to be closely watched. From this point on, I received the

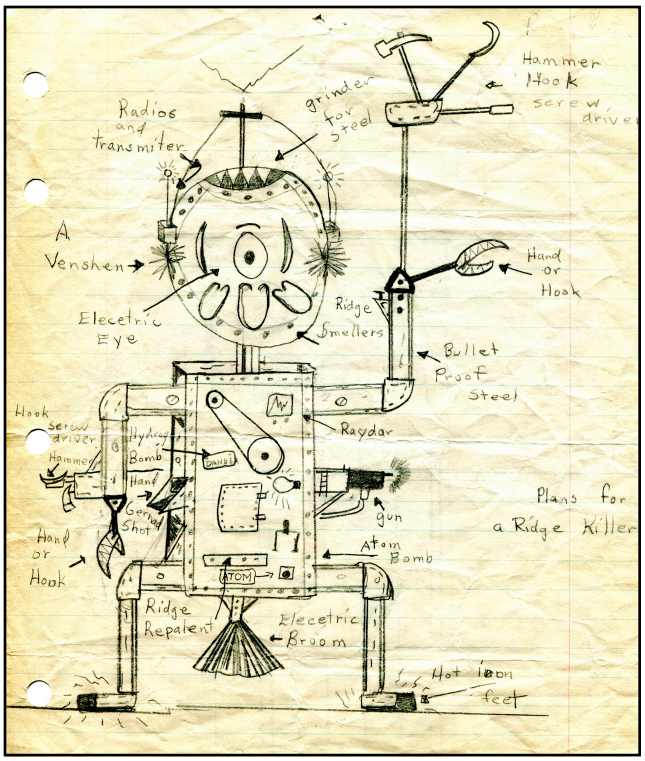


Figure 1.4. A crumpled doodle showing my imaginary plans for a robotic "Ridge Killer," indicative of my growing dislike of my 5th grade teacher.

definite impression that she did not particularly like me and, to judge from my surviving doodles of the period (figure 1.4), that dislike soon became mutual.

I had begun my academic career at Lincoln Elementary School in the second grade with straight A's, but by 4th grade had sunk to virtually all B's. With Miss Ridge, however, I reached my academic nadir when she gave me six B's and four C's. Yet, starting in the 6th grade, my performance began to improve once more, and by 8th grade I was again receiving straight A's in my purely academic subjects. I note in passing that this turn-a-round happened to coincide with a change in teacher gender. From K through 5, all of my teachers had been women, but from 6 through 12 an increasing percentage were

men. I am sure the issue of teacher-student gender differences and grade performance has been studied extensively by educational specialists and would be curious to know whether my personal experience in this regard was typical, atypical, or simply a coincidence of no fundamental importance. Whatever the case, the irony is that, just at the point when I was becoming excited about science, I encountered a teacher who might well have succeeded in turning me off to school altogether.

Robots and Erector Sets

My second stimulus also came from a TV program – in this case a half-hour black and white television series called "Science Fiction Theatre" that dated from the mid-1950s. The local TV station would rerun an episode each afternoon at 4:30 pm and I would hurry home from school each day to watch. There was not much chemistry featured in its story lines. Rather most of the laboratories it portrayed were crammed instead with microscopes, oscilloscopes, sparking Jacob's ladders and van de Graaff generators, and with primitive computers sporting endless arrays of blinking lights. Since several of the stories featured robots as well, I immediately decided that every up and coming mad scientist should own one.

To facilitate my new quest I asked for an "Erector" metal construction set for Xmas that year. This not only provided plans for building your own robot but, in keeping with my passing passion for rockets, also featured plans for constructing my own personal rocket launcher (figure 1.5). In addition, I also asked for a microscope set. The plans for the desired robot outlined in the instruction manual that came with the Erector set resulted in an impressive 2.5 foot tall creature that was self-propelled by means of four wheels and an electric motor mounted on its base, and whose arms waved back and

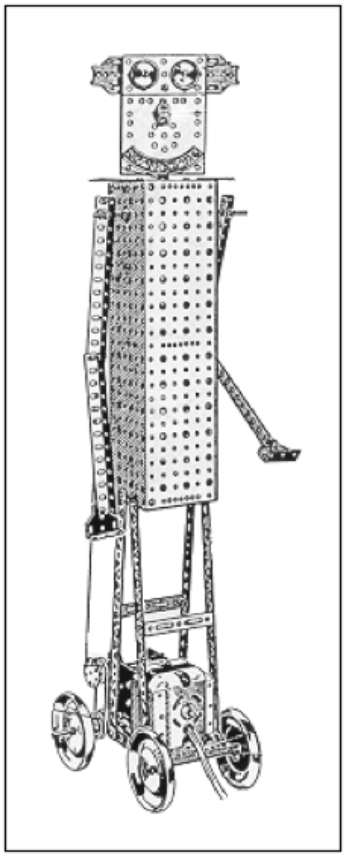


Figure 1.5. (Above): An Erector set similar to the one I received for Xmas in 1957 with a cover illustration showing the featured personal rocket launcher. (Right): A typical Erector set robot similar to the one I built, though I'm pretty sure I dispensed with the so-called ears, thinking them to be too "unscientific."

forth as it moved across the floor. The only problem – and to this day I cannot believe that I was unable to see this design flaw before wasting my time building it – was that the electric motor in question was not battery operated but rather plugged into the wall socket. This meant that the robot could move only about three feet before unplugging itself. I tried to compensate for this by plugging the motor into a 15-foot extension cord instead. However, this was so heavy that the robot could drag it only a few feet before flipping over on its back. And there it would lay, staring blankly at the ceiling while its wheels spun and its arms waved helplessly in the air.

Despite its disappointing performance, I kept the robot intact for several months in the bedroom I shared with my younger brother, standing next to the table on which I had set up my microscope, so I

could admire it each night before falling asleep. Unfortunately my brother was afraid of it, and to quell his nightly anxiety I was eventually forced to turn it to the wall so that he could no longer see its "eyes staring at him in the dark." Eventually, I tired of this and took it apart in order to be able to build that *pièce de résistance* of all Erector sets – the giant ferris wheel. But this likewise proved to be a disappointment since the motor and various pulleys and gears lacked any form of lubrication. As a consequence, the wheel did not freely rotate around its central axis. Rather it would be more accurate to say that it heaved itself around the axis in a series of shuttering, spasmodic jerks during which its entire structure was visibly strained almost to the breaking point.

Alas the microscope set also proved to be a disappointment. The lens were so cheap and so prone to chromatic aberration that everything I looked at was surrounded by a series of yellow and blue halos. I could never get the brine shrimp eggs that came with the set to hatch and ultimately discovered that the only thing worth looking at was a thin piece of plastic sponge that I had liberated from my mother's kitchen. There was obviously an important lesson lurking here about the inherent failings of commercial science toys, but it would take me yet one more Xmas before I would finally face up to it

Acetylene and Induction Coils

The third, and by far the most important, stimulus was a boy named Raymond Fraedrich (figure 1.6), as he was the spark that would finally and decisively steer me away from rockets and robots into chemistry *per se*. I knew Raymond through our mutual association with the Mormon Church in Wausau. Its local congregation or "Branch" – as it was called in official church parlance – was so small that, for most of my childhood, it did not own its own church building and we often

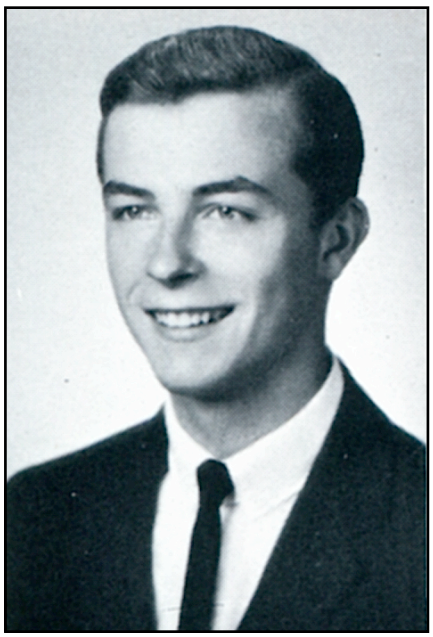


Figure 1.6. Raymond Fraedrich as he appeared in his high-school year book.

met instead in the homes of various members. Raymond's mother, Bernice, was in charge of the congregation's "Primary" program, which provided religious instruction to the preadolescent children in the Branch and which met once a week in her home – a small, four and a half room bungalow on the southeast edge of town near the Pittsburgh glass factory where Raymond's father worked.

As it turned out, Raymond had a small chemical laboratory bench in the basement and each week, after Primary was over, I would pester him to take me downstairs and show me his latest chemical acquisition. His speciality at the time was the generation of acetylene gas from calcium carbide, which one could buy for use in the acetylene lamps still employed by some miners and amateur cave spelunkers. He first showed me the reaction by simply placing a chunk of carbide in a test tube, adding some water, and then igniting the evolving acetylene at the mouth of the tube to give a wonderful sooty,

yellow flame that flared each time the carbide pellet released a fresh burst of gas.

However, Raymond soon elaborated on this performance. The next time I visited, he led me into the backyard. Here he put a few pieces of carbide in a small dish that he placed on the ground next to a protruding stick. He then added some water to the dish and quickly placed an inverted empty tin can over the stick such that it covered the dish and left only a slight opening to one side near the ground. After he had allowed sufficient time for the can to fill with acetylene, he would poke a second, lit stick through the opening to ignite the gas. This act was followed instantly by a loud explosion that shot the can about 20 feet into the air.

As it turned out, explosions were something of a specialty with Raymond. When we later learned how to make gunpowder, he would fill a small empty bottle with it and screw on the lid, having previously punctured a hole in it through which he inserted a short section of dynamite fuse. He would set this on the grass, light the fuse, and run. Later, when he acquired an old Model-A spark or induction coil, we would instead pound two finishing nails through the lid and wind a few strands of steel wool between the nails. After screwing this on the bottle full of gunpowder, we would connect the protruding nail heads to about 20 feet of wire and that, in turn, to the spark coil and a dry-cell battery with an attached knife switch. On closing the knife switch, the high-voltage AC current would fuse the steel wool and this, in turn, would ignite the gunpowder and produce a very satisfying explosion.

Ira Freeman and My Mother's Pantry

The initial stimulus toward chemistry provided by Raymond's pyromania was soon reenforced by yet others. Thus I soon discovered two

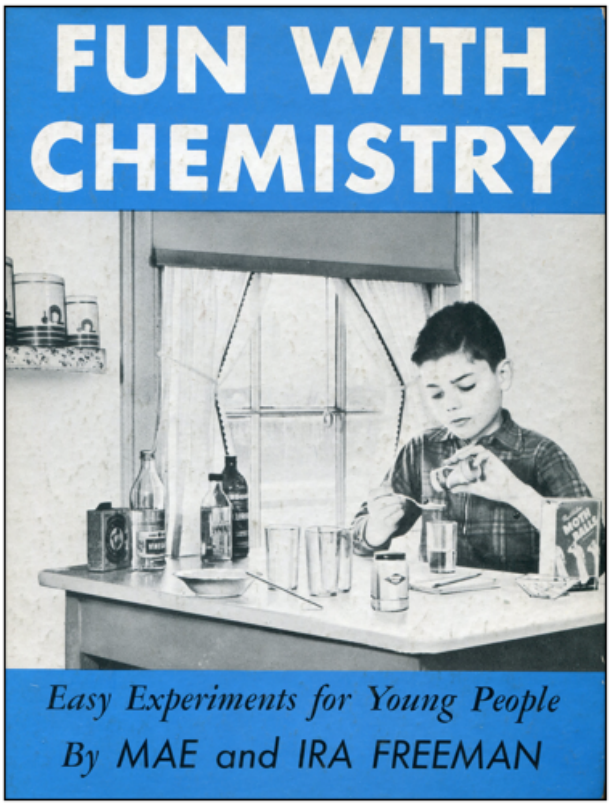


Figure 1.7. My first book of home chemical experiments.

books on chemistry in the small school library at Lincoln by an author named Ira Freeman. The first of these, entitled *All About the Wonders of Chemistry*, was a popular exposition of chemistry and its uses.[1] I remember it well because it was the source of my first scientific epiphany. This involved Freeman's molecular description of the process of distillation and its use in purifying water. It was my first experience with the reductive explanatory power of the atomic-molecular theory and I recall the sense of elation I felt as I rode my bike home from school that day and of being overwhelmed with the sensation that I had somehow gained an new and powerful insight into how the world worked. For weeks afterwards I would muse over such phenomena as the sensations of heat and cold and how the one was

merely due to an increase in molecular motion, whereas the other was not a thing at all but merely the absence of motion,

The second book by Freeman, coauthored by his wife Mae, was entitled *Fun with Chemistry* (figure 1.7) and dealt with a series of simple experiments one could perform with common household chemicals, such as vinegar, baking soda, washing soda, sugar, starch, table salt, epsom salts, bleach, tincture of iodine, steel wool, and household ammonia.[2] My mother provided me with many of these items from her pantry and I recall performing various experiments at the kitchen table under her supervision. I was particularly taken by the foaming reaction between vinegar and baking soda and I think this served as the origin of the dropper bottle rocket that Blair and I would later develop. My mother also produced a surprise not mentioned in the Freeman book – a small bottle of liquid mercury. I have no idea where she obtained this, but I was fascinated by both its appearance and behavior. Needless to say, I immediately collected small bottles of all of these chemicals and, along with my microscope set and my robot, they formed the nucleus of my ever-growing home laboratory.

Chemistry Sets and Radio Kits

For most of my childhood and adolescence my family lived in rented apartments. After our move to Wausau in 1955 we lived, during my time in 2nd and 3rd grade, in an apartment on North 2nd Avenue above the Wausau Sign Company, where my father worked. For 4th and 5th grade we lived in the downstairs apartment of a house on the corner of 5th Avenue and Elm Street owned by an elderly couple named Roeder, and in 6th grade we moved two houses further up 5th Avenue to the downstairs apartment of a house owned by a family named Leffine. Finally, at the start of 7th grade, we moved to the southwest side of town, where we rented an entire house on South

10th Avenue near the Wausau Iron Works that was owned by an elderly woman named Tracy.

Since the basement at Roeder's was shared in common with the landlord and his wife, who lived upstairs, I obviously could not locate my burgeoning laboratory there and so, as already mentioned, I set it up instead at a small table in the bedroom that I shared with my brother. The same problem existed at Leffine's as once again the basement was shared with the landlord and his family, who lived in the upstairs apartment. This house had in fact been a rather respectable middle-class Victorian home before it was carved, like many of its kind, into apartments in response to the housing shortage after the Second World War. This meant that my parents and infant sister slept in what was originally the front parlor and my brother and I in what was originally the dining room. This left only the kitchen; the second parlor, which served as a living room; and a bath room.

To compensate for this shortage of rooms, and possibly because of fire codes, the original main staircase had been left open. This was located between the ex-dining room and ex-front parlor and led to a narrow upper hallway and a small bedroom on the second floor that was also part of our allotted domain (the Leffines, whose apartment was carved out of the rest of the second-floor bedrooms, used the backstair case, which opened onto the backyard and also had a door to our kitchen). One oddity of this arrangement was that the original door to this third bedroom, which opened onto Leffine's apartment, had, for obvious reasons, been closed up and a new door knocked into the wall overlooking the upper front hallway. However this wall did not directly connect with the floor of the hallway but instead overlooked the open stairwell, and to bridge the gap, whoever had originally butchered the house had laid down a "bridge" of three loose boards that could be lifted out to isolate the room.

Figure 1.8. Xmas of 1958 at Leffine's. My first chemistry set and crystal radio kit.

I, of course, immediately appropriated this room for my laboratory. At the time I was still under a television-induced fascination with the "mad scientist" image and the chance to have not only a separate room for my laboratory, but one with a "drawbridge" to ensure privacy, was just too tempting to pass up. Eventually, I tried to transfer my bedroom there as well but, when the house had been cut up, they had neglected to provide this room with a separate heat register. As a result it was freezing cold in the winter and I had to revert once again to sleeping with my brother in the former dining room.

For Xmas that year I received a large "Chemcraft" chemistry set and a crystal radio kit (figure 1.8) but, like the Erector and microscope sets of the previous Xmas, they also proved to be a disappointment. In the case of the radio kit I found winding the miles of wire required to make the tuning coil tedious in the extreme and probably ended up

compromising the brittle shellac insulation on the wire several times before I was finished. The additional 20 feet or so of wire required for the antenna was yet a further disappointment and was always getting entangled. But, in the end, all of this was irrelevant, given that I could never get the damn thing to work in the first place.

In the case of the chemistry set, the additional (albeit often boring) chemicals were a welcome boost to my growing collection, but the accompanying apparatus was a different matter altogether. By then I had seen enough Hollywood renditions of laboratories and looked at enough photographs of actual laboratories to know the difference between real equipment and toy junk and the chemistry set contained only the latter. There were no beakers or flasks, just tiny undersized test tubes in undersized metal racks. There was no Bunsen burner, just a small alcohol lamp capable of holding enough alcohol for about 15 minutes of use. However, there was a so-called balance, but this exhibited so much friction that it was probably only sensitive to the nearest 10th of a gram and the crude punched metal discs that masqueraded as weights probably decreased its accuracy even further. Indeed, it wasn't even apparent why the set included a balance in the first place, since the accompanying manual of experiments never referred to it but rather doled out the required solid chemicals using a small metal spoon called a "measure" and the required liquid chemicals using a small plastic measuring cup calibrated in fluid ounces rather than milliliters.

And so, alas, I finally learned my first significant lesson as a nascent amateur scientist and chemist – commercial science toys were to be avoided whenever possible. Though they looked exciting in their pristine packaged splendor, in practice they were composed of undersized, awkward junk. However, the one saving grace of the chemistry set was that it came with a small newsletter/catalog published

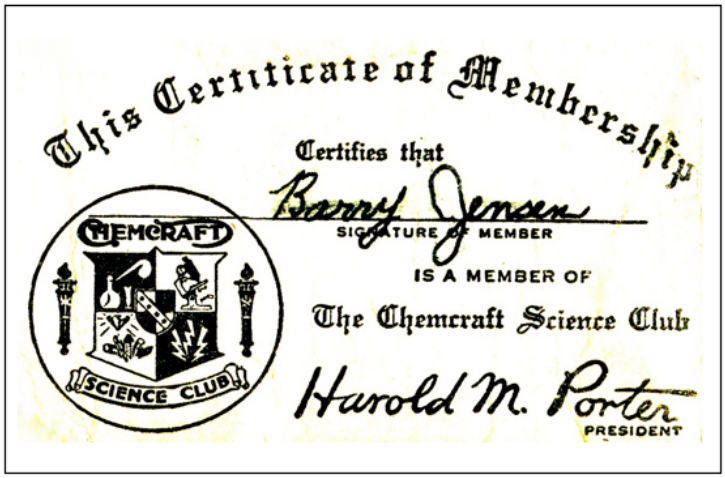


Figure 1.9. My membership card for the Chemcraft Science Club.

by the set's manufacturer – the Porter Chemical Company of Hagerstown Maryland. The former invited me to write to the company in order to obtain my official membership card for the Chemcraft Science Club (figure 1.9), which I immediately did, while the latter offered to sell me various additional chemicals and apparatus, some of which was the real stuff. I had received about $20.00 from various relatives for my birthday that year and I immediately ordered away for some proper beakers and flasks, a small glass mortar and pestle, a tripod, a wooden test-tube rack with normal sized test tubes, and small bottles of dilute nitric, hydrochloric and sulfuric acid.

Like all true amateur chemists, I was also becoming increasingly adept at identifying items in our local drug, hardware and grocery stores corresponding to relatively pure sources of interesting chemicals, including alum, boric acid, hydrogen peroxide, rubbing alcohol, and carbon tetrachloride, which one could buy at the time in the form of a spot cleaning fluid called *Carbona*. The qualifier "pure" is of more relevance than the casual reader might think. For example, I also extracted a quantity of manganese dioxide from several defunct size-D flashlight batteries. Luckily I never heated this with potassium chlorate

in order to duplicate the classic preparation of dioxygen gas (mostly because I had no source of chlorate). Unknown to me at the time, what I had assumed to be pure manganese dioxide was in fact heavily contaminated with powdered graphite and the resulting mixture would have most likely exploded on heating.

As already hinted, most of the chemicals that came with the chemistry set were boring and included such bizarre items as logwood and azurite, which I doubt most professional chemists have ever encountered. The only items that really held my attention were the solution of phenolphthalein indicator and the sample of ammonium chloride. With the former I could perform the classic "water into wine" chemical trick, and by subliming the latter on a spoon held over the set's tiny alcohol lamp, I was able to generate lovely billowing clouds of white smoke.

In fact, I was so taken with the phenolphthalein trick that I decided to innovate and develop a chemical trick of my own. One of the experiments described in the chemistry-set manual involved precipitating a black iron complex with tannic acid and then completely dissolving and decolorizing it again by adding a solution of oxalic acid. That summer the neighborhood boys were heavily into having squirt gun fights and so I prepared two squirt guns, one filled with a suspension of the black iron-tannic acid complex and the other with oxalic acid solution. I then picked out one of the boys who was wearing a white T-shirt and proceeded to spray him with the black mixture. He immediately went into hysterics – his shirt was brand new, his mother was going to kill him, etc., etc. "Have no fear," I assured him, with my superior chemical knowledge I would save him from disgrace. I then sprayed the black streaks on his shirt with the oxalic acid solution, but to my horror, instead of the black color magically disappearing, as it had in the test tube, it turned instead into a pale yellowish brown stain, which further applications failed to eradicate. I

have no idea what the boy told his mother as I have no recollection of being punished for this prank. Perhaps she thought that his story of the stains' origins was too fantastic to be believable. Though I had successfully escaped punishment, I did, however, learn a valuable lesson and, with a single exception that I will relate elsewhere, never again attempted to perpetrate a chemical trick on another person.

A final source of equipment for my laboratory was my father's sign company. This was associated with a sheet-metal shop and at some point I got him to build me a three-foot tall sheet-metal rocket. Though it did not fly and looked more like a metal chimney pipe with fins and a conical smoke deflector on top than like a real rocket, I nevertheless kept it for several years as a prop, since I imagined that it made my laboratory look more scientific. I also got Mac Madison, who made the neon signs for the company, to blow me a glass Hofmann electrolysis apparatus, which we wired to a plywood stand using the same glass insulators employed to attach neon tubing to metal signs. Indeed, my initial reason for taking apart the burned-out size-D flashlight batteries was not to retrieve the manganese dioxide but rather to scavenge the carbon rods for use as electrodes. This particular piece of equipment also led to numerous fights between myself and my brother as I kept stealing the DC transformer to his electric train in order to power my apparatus. Finally, I should mention Joe Cole, who did most of the grunt work around the sign company. One day he presented me with a circular metal test-tube rack and about a dozen test tubes that he had rescued from the city dump, where he had gone to dispose of some old signs. I suspect these had been discarded by a local clinical laboratory. In any case, this act was indicative of the increasing interest that the adults around me took with my new obsession and of their willingness to facilitate it whenever possible.

Fireworks and Rocket Launchers

It was about this time that Raymond and I discovered the books of Alfred P. Morgan in the public library. Born in 1889, Morgan was educated in electrical engineering at MIT. From 1910-1927 he operated a company (the Adams-Morgan Co. or AMCO) that manufactured radio construction kits for amateurs. However, beginning about 1913, he also began writing a series of "hobby" books for young boys dealing with such subjects as radio, electronics, carpentry, mechanics, chemistry, and fish aquariums, which he illustrated himself. These illustrations (figure 1.10) were simple line drawings done with a draftsman-like precision that no doubt reflected his training as an engineer.

Many of his books continued to be reprinted well into the 1970s, but with certain necessary changes. Morgan had four sons and had originally written his books with their interests in mind, as reflected in such title choices as *The Boy Electrician, The Boy's First Book of Radio and Electronics, Things a Boy Can Do with Electrochemistry*, etc. However, as early as the 1950s many of these titles were becoming politically incorrect and were changed in the later reprints. Thus *Things a Boy Can Do With Electrochemistry* became *Adventures in Electrochemistry*, *A First Electrical Book for Boys* became *A First Book of Radio and Electronics*, etc. In addition, though Morgan's drawings of inanimate objects were crystal clear, his renditions of young boys, usually dressed in circa 1930 suits and ties, left much to be desired and in the reprints were often replaced by more contemporary drawings by professional commercial artists and altered to include girls as well.

The two books that most attracted the attention of Raymond and myself were Morgan's 1940 volume, *Things a Boy Can Do With Chemistry*,[3] and its 1941 sequel, *Simple Chemical Experiments*.[4]

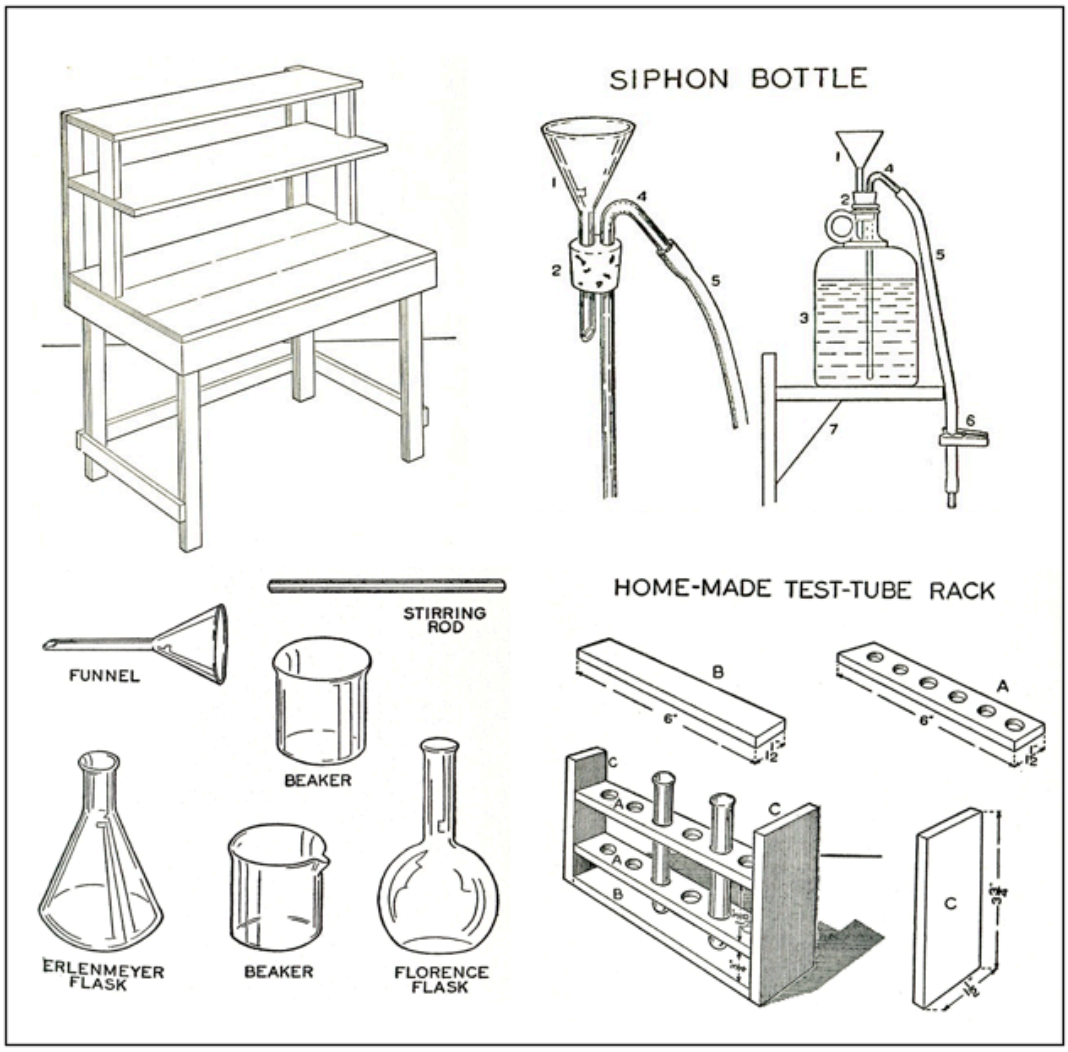


Figure 1.10. Typical examples of illustrations from Morgan's 1941 book *Simple Chemical Experiments*.

By now I had looked at dozens of library books dealing with home science experiments, but none seemed as explicitly focused on chemistry as Morgan's books and, more importantly, unlike Morgan, none chose to include an entire chapter devoted exclusively to the compounding of homemade fireworks! And thus it was that Raymond and I learned to make gunpowder and I learned my second lesson about the resources available to the amateur scientist – the older a

book the more interesting and adventuresome the experiments!

I have already recorded some of Raymond's adventures with our new-found knowledge, but they were just the tip of the iceberg. About this time Raymond's parents were able to buy a large, rambling, turn-of-the-century, farm house which they moved to the western edge of Wausau and reset on a new cinderblock basement. As part of this move Raymond got a new lab bench and a substantial upgrade in his working conditions due to an old-fashion wood cookstove that had been salvaged from the kitchen of the farmhouse and installed opposite his lab bench. This was used by Raymond's mother for the fall canning, but it could also be fired up during the cold Wisconsin winters to provide heat when working in the basement. It was here that we developed our long-distance method of detonating bottle bombs using the Model-A spark coil. Unhappily we first tested this, not in the large empty field behind the house, but in the front yard, where a fragment of the bottle hit the picture window for the living room and left both a large jagged hole and Raymond in deep doodoo.

When I think of it, this was pretty much the standard scenario for most of our chemical collaborations. On yet another occasion I went with my mother to her Relief Society Meeting, which happened to be held at that week in the Fraedrich home, so I could work with Raymond in the basement. Relief Society was the Mormon equivalent of a Women's Church Auxiliary and, like Primary, usually held its weekly meetings in various members' homes. Raymond had just acquired a can of finely powdered aluminum metal from the local paint store and we were anxious to explore its chemical properties. For this purpose we selected the seemingly innocuous experiment in Morgan's book entitled "Making Aluminum Sulfide," which consisted of strongly heating a mixture of powdered aluminum and sulfur in a hard-glass test tube. Both the instructions and illustration cautioned us to plug the end of the test tube with a wad of asbestos "to keep out the

air" but we had no wad of asbestos handy and so falsely concluded that this was an unnecessary embellishment. About five minutes into the heating, the mixture caught fire and came pouring out the end of the test-tube like molten iron from a freshly tapped blast furnace, accompanied by a massive cloud of white aluminum oxide and pungent sulfur dioxide fumes that immediately shot up the cold-air ducts. This was quickly followed by a collective bellow of protest from the women upstairs and by a violent scraping of chairs as they abandoned the kitchen table, where they had been working on crafts, and made for the fresh air of the backyard. And so once again Raymond was in deep doodoo.

The final episode that I recall was potentially much more serious. In occurred on a Saturday when Raymond's parents were gone and he had been left in charge of his much younger brother John. I would guess that John was about five at the time and was what can only described as aggressively, if not obnoxiously, curious about everything. Though he was normally not allowed anywhere near Raymond's lab bench, we had to take him with us into the basement if we were going to do any chemistry. Predictably he immediately began jumping up and down and grabbing at various bottles and flasks on the lab bench, so in desperation Raymond tied him to a chair. However, he soon began yelling that he was sitting too low to properly see what we were doing. Finally, Raymond agreed to tie him to the chair standing on the seat so he could see our activities. This was, of course, a grave mistake as he immediately began bending foreword to see more clearly and soon tipped over. I can still recall in all its terrible detail the sight of him hitting the floor, tied straight as a board, and the sound of his head bouncing with ever diminishing rebounds on the cement. Though Raymond was once more in deep – well by now you know the drill – this incident apparently did little harm to John as he soon recovered

and is today a highly successful Professor of Business Ethics at Southern Illinois University in Carbondale.

In my own case, I found I could purchase the necessary ingredients for making gunpowder at a local drug store that carried a line of chemicals specifically intended for veterinarians and which happened to include both sulfur and potassium nitrate (used as a horse laxative). For charcoal I simply substituted powered coal from our coal bin. Unlike Raymond, I was always leery about packing potential explosives into confined spaces. Though I would often make up colored fireworks for the entertainment of the neighborhood kids by adding lithium chloride (red), sodium chloride (yellow), copper sulfate (blue), etc. to the basic gunpowder mixture, I always lit these in the form of small conical piles on top of an iron plate that I had salvaged from the sign company and never in the form of a firecracker or cherry bomb.

There was, however, a single exception to this rule and that involved the plans for the so-called rocket launcher that had come with my Erector set (recall figure 1.5). This turned out to be nothing more than a metal track made from assorted girders from which one launched a small plastic rocket using a stretched rubber band as the power source. This rocket was basically a hollow tube with fins that was closed at the top but open at the bottom. I promptly decided that this was the ideal situation in which to employ my newly acquired command of gunpowder and so I opted to dispense with the rubber band and instead pack the rocket with gunpowder in order to propel it into space in the proper manner. As with the earlier robot, this plan had an unforeseen design flaw – namely the fact that plastic is inflammable. When I lit the gunpowder, the rocket did not go zooming off the end of the launcher as I had anticipated, but instead caught fire and melted into the metal girders. I was so disillusioned by this turn of events that a few months later I traded the Erector set to a neighbor kid for a pile of comic books.

Fire Extinguishers and Film Strips

I do not recall that 6th grade itself contributed much to my extra-curricular chemical activities. My teacher that year was a small effeminate man by the name of Gordon Kraemer and I can remember only two events of chemical interest. The first of these was my attempt to demonstrate to the class a so-called fire extinguisher I had invented that used alum and baking soda as the active ingredients, and the second was a film strip on combustion that Kraemer showed the class. Much to my surprise this explicitly stated that the reason objects burn was because they contain carbon. I already knew enough chemistry to know that this was nonsense and I then and there decided to experimentally prove my point.

In art class we had been making designs on copper foil using a stylus and I purloined a small piece of this foil for my experiment. Once at home I placed a small pile of sulfur on top of the copper foil and lit it. It burned just fine even though both the sulfur and copper were pure elements that by definition contained no carbon. For some reason I did not bring the results of this experiment to the attention of Mr. Kraemer. Perhaps I sensed that it was not politic to contradict a teacher. I did however pester a girl in the class by the name of Ester Anderson with my results. I had a slight crush on her at the time and hoped to impress her with my scientific erudition, but she was not interested and instead dismissed me as weird, if not excessively irritating.

Indicative of the fact that my interest in science at this date was still not exclusively chemical, was my brief flirtation with electricity during which I constructed a model of a household electrical fuse. In retrospect this was far more dangerous than any of my chemical adventures and consisted of a lamp cord and plug connected to two short sections of stiff hanger wire that I had poked through an inverted plastic cup. I would push each section of the stiff wire through the

ends of a strip of aluminum foil and plug the entire affair into the nearest wall socket. Much to my repeated delight, the surge of current would quickly melt the aluminum foil and break the circuit.

It was also during the summer of 1960 that I took to religiously watching a short-lived television show, starring Patrick O'Neal, called *Diagnosis Unknown*. This was not exactly about chemistry but rather about a medical pathologist named Dr. Coffee who solved crimes. Nevertheless, it featured scenes of Coffee in a laboratory filled with microscopes and plenty of glassware and that was all that mattered to me. This would hardly be the last influence to come from TV and the movies, and in later years I would also greatly enjoy both of the Fred MacMurray films – "The Absentminded Professor" (1961) and the "Son of Flubber" (1963) – about an eccentric chemist at a small college who makes an antigravity polymer in a laboratory located in his garage.

Pet and Toy Hobby

After our move to Tracy's in 1960, I continued to locate my laboratory in my bedroom. Initially this was a small room under the eaves with a dormer window and a slanting ceiling (figure 1.11). Indeed this room had originally been intended to serve as a large walk-in closet, but because it was accessible not only from the adjacent bedroom but from the hallway as well, my family always used it as a small bedroom instead. The house, which was built in a classic bungalow style, dated from 1919 and when old Mrs. Tracy went to live with her daughter and began renting it to others, she left much of the original period furniture behind. This included a small oak library table, which I immediately commandeered as my lab bench, and which I carefully covered with a piece of white oil cloth to protect the finish. I also divided the table with a shelf that ran down the center, like the lab benches I had seen in photographs, so one could work from either side.

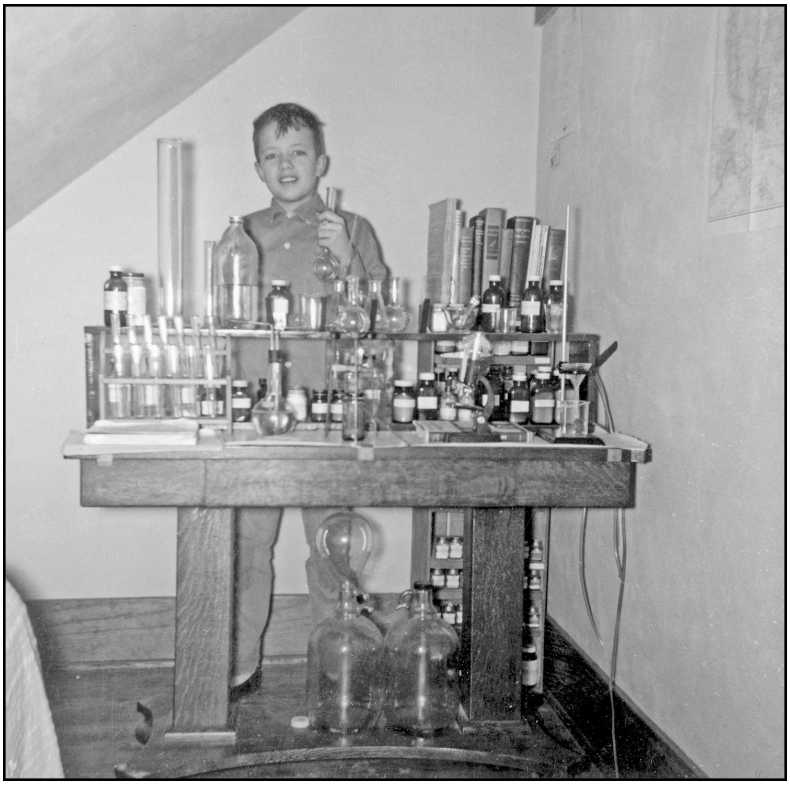


Figure 1.11. My bedroom laboratory as it appeared in 1960. Because of the slanting ceiling, one had to crawl to the far side of the table. The large glass bulb resting on one of the bottles under the table was actually an empty container for neon gas that had been discarded by Mac Madison at the Wausau Sign Co. It looked cool but otherwise proved to be useless.

About this time my laboratory began to rapidly grow due to a newly discovered source of chemicals and apparatus. A store known as "Pet and Toy Hobby" had just opened on the westside of town and, among its many wonders, was a six-foot tall display cabinet of chemicals and laboratory apparatus intended for sale to the amateur home chemist and sold under the brand name of "Perfect." The cabinet was divided into two sections. The upper half of the left section contained trays of chemicals sold in small square bottles at 35¢ a pop (figure 1.12), whereas the upper half of the right section contained

Figure 1.12. A small collection of "Perfect" brand chemicals and a box of test tubes (Oesper Collections).

mounted samples of laboratory glassware and ironware. The bottom portion of both sides contained drawers filled with boxes of the displayed equipment for purchase. The selection of chemicals was essentially identical to that found in your typical chemistry set, but, with few exceptions, most of the glassware and ironware was the real thing. A glance at figure 1.11 shows that by the beginning of the 7th grade I already had availed myself of this new resource and had added a ring-stand, a ring, and a funnel and wash bottle to my growing collection. The store also proved to be a source of other useful laboratory items, such as Tygon tubing, which it sold for use with fish aquariums.

By the end of the year, as indicated by a surviving floor plan and sketch (figure 1.13), it was necessary to rearrange my bedroom in order to add yet a second laboratory bench, which I adapted from an old worktable I had found in the garage. My sketch of this table

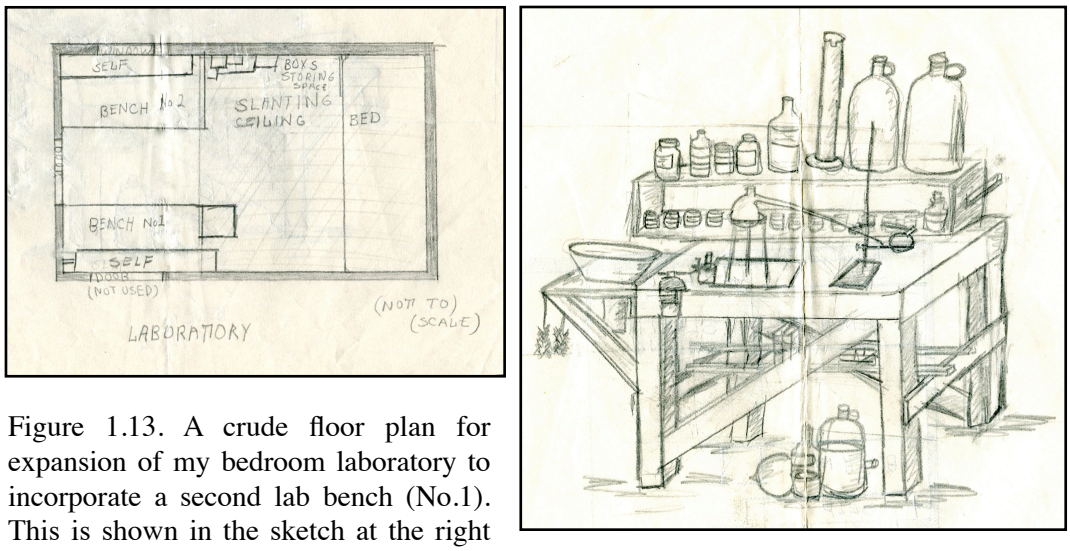


Figure 1.13. A crude floor plan for expansion of my bedroom laboratory to incorporate a second lab bench (No.1). This is shown in the sketch at the right and was made from an old worktable I found in the garage. Note the retort.

reveals that by this time I had also purchased a small "Perfect" glass retort which, for many years, I considered to be the pride and joy of my collection.

Collecting and Networking

The reader will note my use of the word "collection" several times in the previous section, and this brings me to a terrible confession. Though I would like to claim that my obsession with chemistry was driven by an unquenchable thirst for knowledge, the truth is that it was primarily driven by an innate passion for collecting. Just as most boys compulsively collect marbles, comic books, insects, minerals, etc., so I, and most of my fellow amateur chemists, collected chemicals and laboratory equipment. It was the building up of a home laboratory rather than the chemistry itself that was exciting and any science that we happened to learn along the way was, in a very real sense, a mere by-product of this collecting instinct.

In my case, one of the consequences of this acquisitive passion was that I would never perform an experiment, however interesting, that would permanently damage my apparatus. Hence, even operations requiring the sacrifice of a lowly test tube – such as the destructive distillation of wood or coal – were off limits. Here I need to give Raymond credit as he was always ready to risk equipment if the experiment was spectacular enough and we destroyed many a test tube and crucible during our joint ventures. In particular, I remember the loss of a lovely, thin-walled, antique lime-glass retort that he had inherited from an older cousin. At the time we had no idea that there was such a thing as non-Pyrex glassware and the moment we began heating it with our propane torch, the bottom fell out.

Our constant quest for new sources of chemicals and apparatus to collect sometimes led to rather questionable behavior. At the time *Popular Science Monthly* often carried ads for companies willing to sell chemicals and apparatus to home amateurs. Some of these, however, carried age restrictions and to get around this Raymond made up letterhead stationary for an imaginary company called "Fraedrich Laboratories Inc.," which he used when ordering materials through the mail. On yet another occasion, when we discovered that the copy of Morgan in the Public Library was checked out, we hiked over to the County Library to check out its copy. This library was located in the county courthouse and was concerned more with operating bookmobiles for the surrounding rural communities than with the walk-in public. It was located on the first floor of the courthouse and consisted of a small room containing the card catalog, the checkout desk, and a staircase leading to the basement floor where the actual stacks were located. Not only was there seldom anyone else present in the basement, the stacks themselves were generally chaotic, as the floor was covered with book boxes that were either being loaded or unloaded from the various bookmobiles.

Raymond and I dutifully looked up the call number for the Morgan book and asked permission to descend into the basement to retrieve it. I finally found it in a pile of books that had been stacked on the floor in front of the shelves where it was normally located. Meanwhile, Raymond had observed that there was a set of open double doors leading to the basement hallway and a second staircase, and the moment I handed the book to him he bolted out the door with it! I was stunned. I used this library regularly and the librarian was well aware that we had gone to the basement. If we didn't reappear again she would certainly suspect that something was amiss. In the end, I went back upstairs by myself, told her I couldn't find the book, and left. Needless to say, I never went to a library again in Raymond's company.

The only time I recall trying similar questionable tactics myself was when I called a local pharmacy to enquire about something or other and noticed that the pharmacist, in response to my high-pitched adolescent voice, kept calling me "Mam." So the next week I called the same store and informed the pharmacist that I was sending my teenage son to the store to pick up a bottle of sulfuric acid that I needed to clean rust off some pipes. Regrettably I can no longer recall whether or not this pitiful ruse was successful.

Not surprisingly, this collecting mania also meant that the relationship between myself and my fellow amateur chemists was always tainted by a certain element of competition. Though from time to time I would hear rumors of boys elsewhere in the city with large home laboratories, only once do I recall being taken to see one. This was located in the basement of a house on Harrison Boulevard and was quite extensive. However, the boy in question was several years older than myself and most of the lab was devoted to radio and electronics rather than chemistry, so we never developed a relationship. Rather my competitive world consisted solely of Raymond and, after my

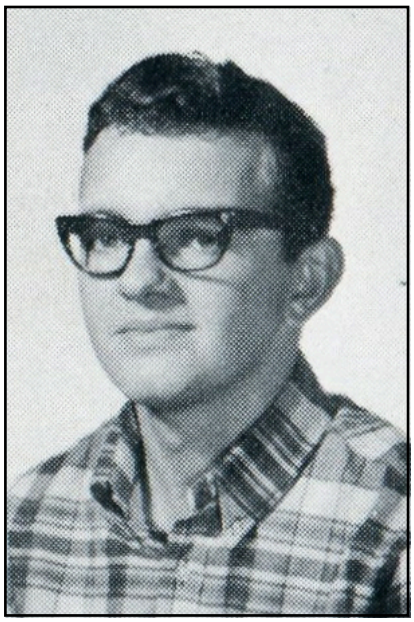


Figure 1.14. Fellow amateur chemist, Pat Chrouser, as he looked about the time we first became friends.

family's move to the Tracy house in 1960, a boy by the name of Pat Chrouser (figure 1.14).

Pat actually lived on the northwest side of town but, since both his parents worked, he spent most of his time at his grandparents' home, which was located on South 11th Avenue about a block from our house, and where his grandfather operated a shop in the backyard that cut and polished tombstones. After seeing my laboratory, Pat became interested in acquiring one of his own and one day I received a phone call from him asking me to come over to his grandparents' house to see his latest acquisition. When I got there, I found the dining room table covered from end to end with over a hundred containers of chemicals, many in blue cardboard cylinders, as well as a sizable collection of chemical apparatus.

It seems that Pat had discovered an ad in a magazine called *Science Experimenter* for a company known as "National Scientific" (figure

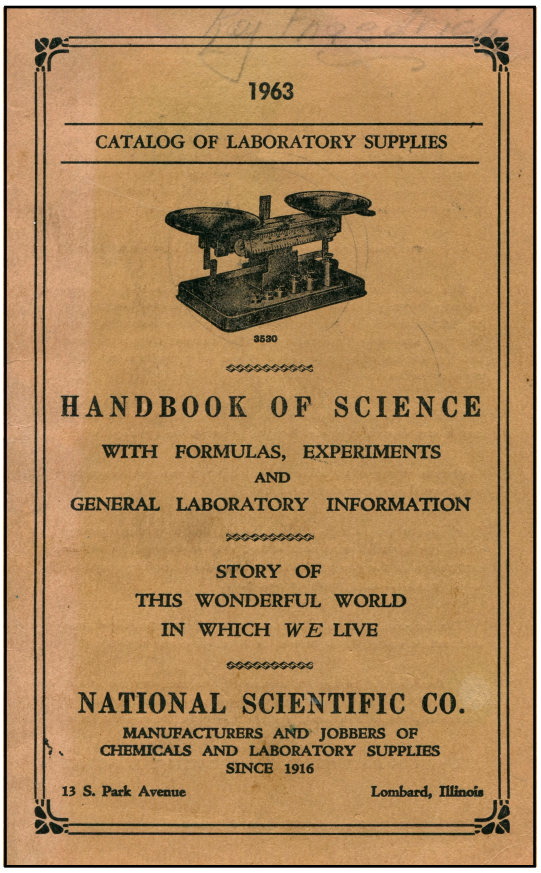
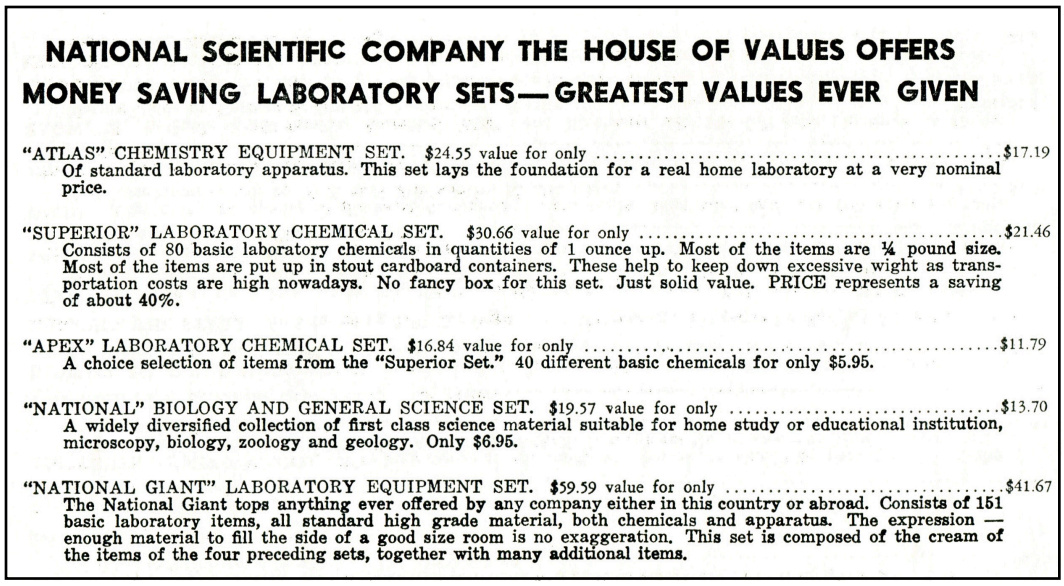


Figure 1.15. A catalog for the National Scientific Co. of Lombard Illinois which specialized in mail-order sales to amateur chemists and which advertised regularly in *Popular Science Monthly* and other science magazines for the home amateur.

1.15). This was located in Lombard, Illinois, and specialized in selling chemicals and apparatus to home chemists, including special sets or collections of selected items (figure 1.16). For the astounding sum (to me at least) of $41.67, he had purchased their "National Giant Laboratory Set," which included 151 basic chemicals and laboratory items. Thus, in one fell swoop, Pat managed to acquire what it had taken me years to collect. To put it mildly, I was positively green with envy.

Ballpoint Pens and Silver Nitrate

Seventh grade was my last year at Lincoln Elementary. In reality it was really the first year of junior high but, because of overcrowding, students on the westside of town were allowed to remain at their



NATIONAL SCIENTIFIC COMPANY THE HOUSE OF VALUES OFFERS MONEY SAVING LABORATORY SETS—GREATEST VALUES EVER GIVEN

"ATLAS" CHEMISTRY EQUIPMENT SET. $24.55 value for only $17.19
Of standard laboratory apparatus. This set lays the foundation for a real home laboratory at a very nominal price.

"SUPERIOR" LABORATORY CHEMICAL SET. $30.66 value for only $21.46
Consists of 80 basic laboratory chemicals in quantities of 1 ounce up. Most of the items are ¼ pound size. Most of the items are put up in stout cardboard containers. These help to keep down excessive wight as transportation costs are high nowadays. No fancy box for this set. Just solid value. PRICE represents a saving of about 40%.

"APEX" LABORATORY CHEMICAL SET. $16.84 value for only $11.79
A choice selection of items from the "Superior Set." 40 different basic chemicals for only $5.95.

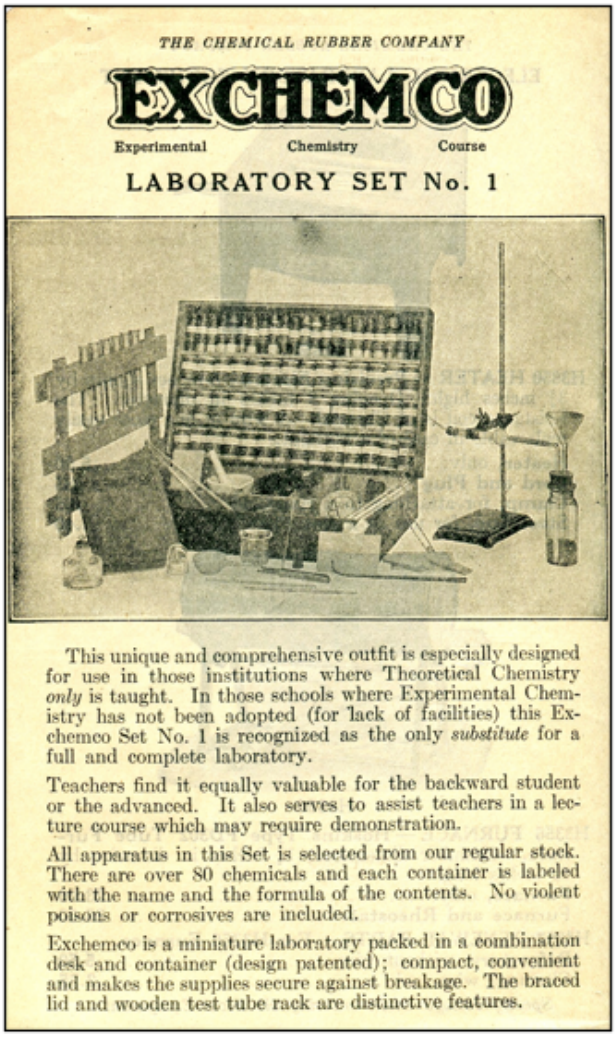
"NATIONAL" BIOLOGY AND GENERAL SCIENCE SET. $19.57 value for only $13.70
A widely diversified collection of first class science material suitable for home study or educational institution, microscopy, biology, zoology and geology. Only $6.95.

"NATIONAL GIANT" LABORATORY EQUIPMENT SET. $59.59 value for only $41.67
The National Giant tops anything ever offered by any company either in this country or abroad. Consists of 151 basic laboratory items, all standard high grade material, both chemicals and apparatus. The expression — enough material to fill the side of a good size room is no exaggeration. This set is composed of the cream of the items of the four preceding sets, together with many additional items.

Figure 1.16. An advertisement for the various "chemical sets" sold by the National Scientific Co. of Lombard, Illinois, to amateur home chemists.

elementary schools an extra year, albeit with certain important changes in the curriculum, as I will describe in greater detail in the next chapter. My teacher that year was one Mr. Klinker and our science resources suddenly expanded from the single box of equipment used by Miss Ridge to an entire floor to ceiling cabinet of delights, including a projection microscope, a vacuum pump, dry-cell batteries, test tubes, a few beakers and flasks, and a small assortment of chemicals, mostly in wooden vials, that were probably purchased in the 1930s as a teaching kit from the EXCHEMCO company (figure 1.17) – an unmelodious acronym for "experimental chemistry course."

I immediately began exploring these items during our free periods. Extending my earlier experiments with my electrical fuse, I quickly cooped the vacuum pump and dry cells in an attempt to make an electric light bulb using the spring from my ballpoint pen as the filament. Though I could get the spring to glow a dull orangish-yellow, the vacuum was so poor that the spring burned out after a few minutes operation. My fellow students enthusiastically supported my idea and



THE CHEMICAL RUBBER COMPANY

EXCHEMCO

Experimental Chemistry Course

LABORATORY SET No. 1

This unique and comprehensive outfit is especially designed for use in those institutions where Theoretical Chemistry *only* is taught. In those schools where Experimental Chemistry has not been adopted (for lack of facilities) this Exchemco Set No. 1 is recognized as the only *substitute* for a full and complete laboratory.

Teachers find it equally valuable for the backward student or the advanced. It also serves to assist teachers in a lecture course which may require demonstration.

All apparatus in this Set is selected from our regular stock. There are over 80 chemicals and each container is labeled with the name and the formula of the contents. No violent poisons or corrosives are included.

Exchemco is a miniature laboratory packed in a combination desk and container (design patented); compact, convenient and makes the supplies secure against breakage. The braced lid and wooden test tube rack are distinctive features.

Figure 1.17. An ad for an EXCHEMCO chemistry kit for teachers similar to the one I found in the science cabinet at Lincoln School. The Porter Chemical Co. also sold similar teaching kits.

soon began donating the springs from their pens for further experimentation. By the time free period was over, so many pens were no longer operational that Klinker had to pass out pencils for the next lesson. I also recall showing my fellow students how to make hydrogen gas using the zinc dust and dilute hydrochloric acid that came with the EXCHEMCO kit, but a startled Klinker soon put a stop to this when I caused a loud popping sound after applying a lit match to the mouth of the test tube in order to verify the nature of the gas.

Another item I discovered in the science cabinet was a small bottle

of silver nitrate. I had been reading about the chemistry of photography and decided to make photosensitive paper by precipitating the nitrate as silver chloride. Unfortunately I got more of the silver compounds on my hands than on the paper and when I went home that noon for lunch I discovered that my fingers were black with photochemically reduced silver – a result, no doubt, of my bike ride in the bright sunlight. When these stains failed to wash off, my mother became worried. I tried to assure her that they probably weren't poisonous, but to be on the safe side I agreed to wear a pair of gloves while eating my peanut butter sandwich and continued to do so at meals until the stains finally wore off, which took nearly a week. I also brought some silver nitrate solution home to experiment with and promptly succeeded in leaving a permanent gray stain of silver on the white porcelain sink in the upstairs bathroom which upset my mother even more than my impending death from silver poisoning.

But perhaps the most important event of the year was the fact that I finally got a library card for the adult section of the public library. The books of popular home science experiments by Morgan and others had all been located in the children's library but, with my new library card, I now had access to high school and college-level chemistry textbooks as well. As the British chemist, J. W. Mellor, once observed "Once one advances beyond the pyrotechnic or kindergarten stage, chemistry can be a fascinating subject," and this was the transition I was about to undergo as a result of my discovery of two library books: the lavishly illustrated *Discovery of the Elements* by Mary Elvira Weeks, which planted the seeds of a life-long love of history of chemistry; and *Qualitative Chemical Analysis* by Louis Curtman of the City College of New York, which finally introduced me to systematic chemical theory and laboratory practice.

I also checked out a rather dated high-school chemistry textbook with plenty of photographs of chemists working in laboratories and

proceeded to teach myself to balance chemical equations and work simple stoichiometry problems. This led, however, to a conflict with Mr. Klinker, as he would later teach us to balance simple equations as well. Unfortunately, while doing so, he kept claiming that the molecular coefficients in the equation represented the number of atoms present in a compound. I knew this was wrong and made the mistake of raising my hand and correcting him. It was the small subscripts in the formulas that represented the number of atoms, I insisted, whereas the large numbers in front of the formulas represented the number of molecules. I could see immediately that he was not pleased with my correction and he proceeded to finesse the situation by pointing out that it was the product of these two numbers that actually gave us the total number of atoms present. This was true enough, but did not really excuse his conceptual error.

I was not punished for my impertinence, but it put Klinker on alert for any future infraction. This came a few weeks later in art class when he showed us at the blackboard how to approximate the shape of a human body using overlapping circles and ovals. When the overall shape was finished, he began erasing the unnecessary overlapping lines within the body of the figure, at which point I quipped "Oh don't erase the hair on his chest." I thought I was being extremely witty but, to my great surprise, Klinker took offense and I was immediately given a half hour of detention after school. I of course spent this playing with the equipment in the science cabinet and after about 15 minutes Klinker decided I was having too much fun for a proper punishment and told me to go home. On a more positive note, I also recall him teaching us the rudiments of biological classification. Like my earlier encounter with the kinetic molecular theory, I found this fascinating. I loved this ability to organize and label the world around me and spent hours drawing and redrawing elaborate classification charts of animals and plants.

My final memory of 7th grade has nothing to do with science, but I venture to relate it because it casts light on how much social mores have changed in the last half century. We had no permanent music teachers at Lincoln. Music lessons were either broadcast once a week over the state radio station or were taught by a visiting music teacher who moved from grade school to grade school. For 7th grade this was a nervous young woman who seemed to have trouble maintaining discipline among some of the older and more aggressive boys in the class. At one point she announced that we would each have to come up with a musical act and perform it in front of the class. I was in a panic. I had begun cornet lessons in 5th grade but had dropped out when I was told that I would have to perform at a school program in front of a room full of parents, and I was no more happy about having to sing or play an instrument in front of my fellow classmates. My mother finally saved the day by suggesting that I play a tune using a "comb and tissue paper" which required only that I hum the melody in question.

The problem came when three of these older boys decided that for their act they would mouth the lyrics to a popular 45 record. Their choice was the then popular hit "She wore an Itsy Bitsy Teenie Weenie Yellow Polka Dot Bikini." No sooner had they gotten to the first chorus than the music teacher ran to the front of the room, yanked the plug to the record player out of the wall, and began yelling that never in her life had she heard such "utter filth" She then began crying and ran out of the room, never to be seen again. Whatever her shortcomings as a teacher may have been, I must confess that she succeeded in making a lasting impression.

II

I was a Science-Fair "Ringer"

In the fall of 1961 I was among the first group of students to attend the newly completed junior-high school (John Muir) on Wausau's far westside. Like other students on the westside of town, I had attended 7th grade at my elementary school due to overcrowding of the older eastside junior high (Horace Mann). In an attempt to prepare us for what was to come when the new junior high was completed, the 7th graders at Lincoln Elementary, unlike the students in grades K-6, actually had their school day divided into periods, different instructors for some of their courses (most notably for English and Social Studies), and different subjects taught in different rooms, though admittedly this involved little more than walking across the hall or one or two doors further down the hallway. In addition, our course titles were upgraded to "adult" status. Thus, instead of "Arithmetic," we now took "Mathematics" and instead of "Language," we now took "English."

Nevertheless, the changes on moving from the old grade school to the new junior high were both striking and profound. The most obvious of these was the sharp contrast in the architectural ambience of the two buildings. As noted in the previous chapter, Lincoln School had been built in 1892 and was last expanded in 1900. It had 12-foot ceilings, tall narrow windows, old-fashioned cloak rooms instead of metal lockers, slate blackboards with outdated speaking tubes and long charts illustrating cursive handwriting running along their tops, and, of course, lots and lots of heavily varnished, creaking wooden floors. John Muir, on the other hand, was the latest in ultramodern

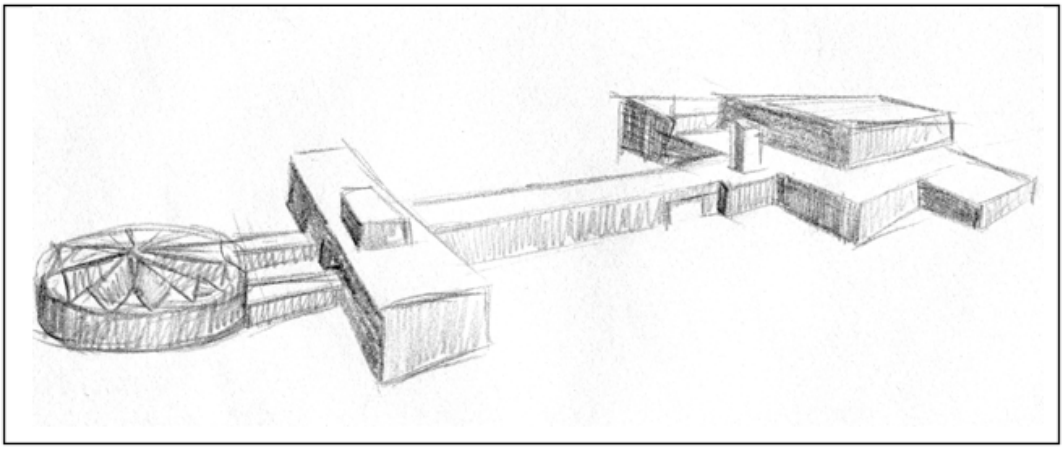


Figure 2.1. A crude preliminary perspective of John Muir Junior-High School as seen from the north which I probably did for a 8th-grade art project. Section A, containing music and the school auditorium, is the circular structure to the far left. This is followed by the two-story section B, containing administration, the library, humanities and mathematics; then by the long narrow section C, containing science and industrial arts. On the far right are sections D and E, containing the two-story gymnasium, the swimming pool and the cafeteria. The short projection on the north end of section E housed the Wausau School for the Deaf.

60's chic, with metal moldings and hard terrazo flooring instead of varnished wood, and tile and cinderblock walls instead of plaster and bead-board. Whereas Lincoln was tall and compact, with an average of only six classrooms per floor, most of John Muir was spread out on a single floor and seemed, to my inexperienced eye at least, to contain mile upon mile of endless hallways and lockers (figure 2.1).

Two days before the new school was officially dedicated on 01 March 1962, the *Wausau Record Herald* published a special, heavily illustrated, eight-page insert with the boisterous headline "John Muir School – A Thing of Beauty!" One of the articles in the insert pointed out that, whereas the seven oldest city schools – most of which dated from the 1890s – had cost a grand total of $225,000, the new junior-high school had cost a whopping 2.6 million dollars!

Now, not just a few, but all of our classes were held in different rooms with different instructors (a total of 35 for the entire school) and

the rooms in question were devoted solely to the subject being taught. Thus I was delighted to discover that science was not confined to a storage cabinet in one corner of a single classroom, but occupied a total of five classrooms arranged along the southern side of section C of the building, which connected the two-story section B, housing the administrative offices, library, humanities and mathematics classrooms, with sections D and E, containing the swimming pool, gymnasium, and cafeteria. I was even more thrilled to discover that each of these science classrooms was equipped with its own demo desk, student work stations, stock room, and prep room.

Enter Mr. Klipstein

Indeed, so large was the new school by the standards of Lincoln Elementary, that for the first week or so I carried a floor plan of the school with me on which my mother had carefully circled and labeled the rooms for each of my classes. Following this roadmap, I found myself each morning in room C-108 attending Mr. Klipstein's third-period, general-science class (figure 2.2). A tall, trim man with glasses and reddish-brown hair, Klipstein was probably in his early 40s and sported a short crewcut or flat-top haircut.

Though I would receive an A in his class, for some reason I have no memory of what textbook we used or even if we ever did any experiments. However, I can vaguely recall learning about the classification of clouds and rocks, and some homework survives in the form of drawings of a cross-section of the earth's crust, of the parts of a cricket, of a lilac stem and an onion bulb, and of the electromagnetic spectrum. Just how I cued Klipstein into the fact that I was obsessed with chemistry has also escaped my memory, though I suspect that he caught me reading an outdated chemistry textbook from the public library in class. In any case, I was soon given the run of the chemicals

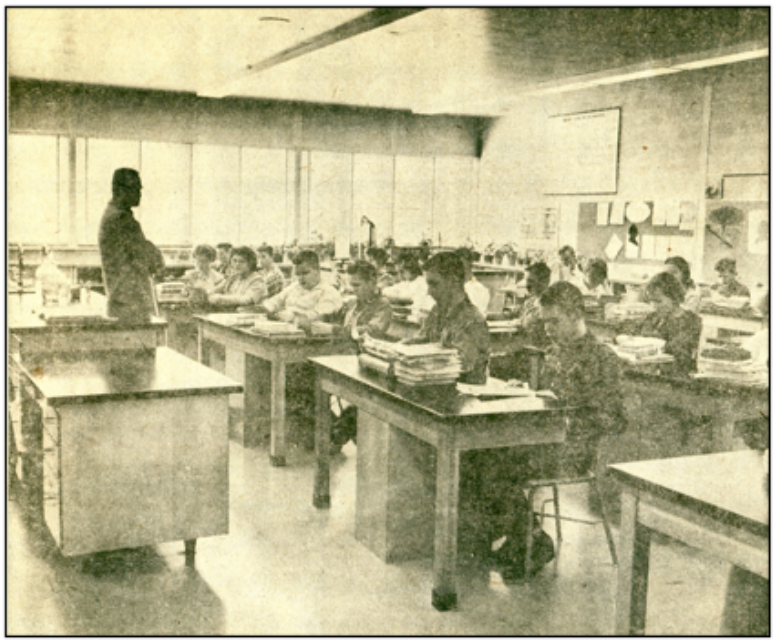


Figure 2.2. A badly stippled and yellowed newspaper photograph from the special *Record Herald* insert showing Mr. Klipstein's 8th grade, general-science class in room C-108. Unfortunately, because of the intense light from the windows, Klipstein is little more than a dark silhouette. Though dressed in a plaid shirt, I am barely visible, fourth head from the left, in the group closest to the windows.

and equipment in his stock room and allowed to perform chemical experiments on my own after school in the adjacent prep room.

Why I suspect this scenario is because I had already used this ploy in my math class. On the basis of an entrance exam, some students were allowed to take algebra in 8th grade, whereas the rest had to take one more year of general math, and I had failed to make the initial cut. My mother had noticed how upset I was by this and one evening she presented me with a used algebra textbook that she had bought at a yard sale on her way home from her job at the public library. I was very determined to teach myself algebra and began working my way through the book. One day I was caught by my math teacher, Mr. Luthanen, working algebra problems in class. He began questioning

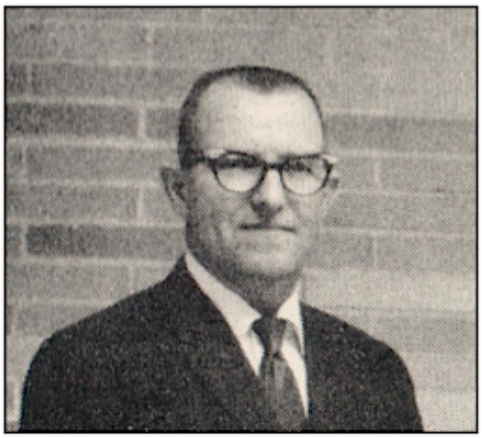


Figure 2.3. A fuzzy photo of John H. Klipstein, Head of the Science Department at John Muir Junior-High School and my 8th-grade science teacher.

me about my progress and what book I was using, and the next day officially transferred me from general math into algebra, where I did quite well.

My First Science Fair

John H. Klipstein (figure 2.3) – to use his full name – was not only my general science teacher, he was also director of the science department at John Muir and was intent on making a name for his new dominion via various academic competitions with other local schools. Thus it was that, sometime in the winter of 1961/1962, he suggested to me and several other students in class that we should prepare science projects for entry into the forthcoming regional science fair sponsored by the Wisconsin Junior Academy of Science and scheduled to be held that May at the local University of Wisconsin Extension Center.

The previous year, while still at Lincoln Elementary, I had discovered an old textbook on qualitative chemical analysis in the

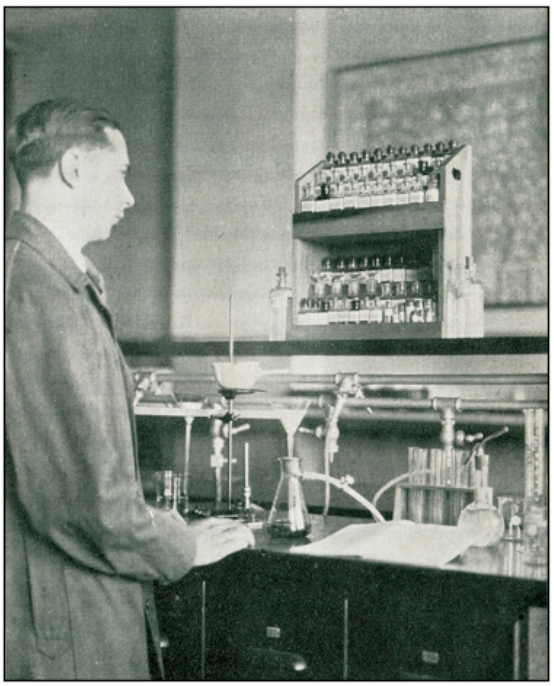


Figure 2.4. The frontis piece to the 1932 edition of Louis Curtman's *Qualitative Chemical Analysis From the Standpoint of the Laws of Equilibrium and Ionization Theory* showing a standard student laboratory setup for qualitative analysis at City College of New York.

public library by Louis Curtman of the City College of New York.[1] I confess that I was probably initially attracted to this book by the frontis piece, which showed a photograph of a student working at a lab bench with all of the requisite reagents and apparatus neatly arrayed in front of him (figure 2.4). There was something that I found fascinating about the compactness and self-containment of this setup – or perhaps it was some residual nostalgia for what a chemistry set might potentially be rather than the disappointing toy it actually was. In any case, I was strongly attracted to the book and soon discovered that I found its contents interesting as well. I had become bored with the kinds of experiments described in the typical chemistry set manual and in the various home laboratory experimentation books found in the public library. Their so-called "experiments" seemed fragmentary and unconnected with one another – mix A with B and get this color or that precipitate, etc. Indeed the entire enterprise seem to lack purpose and scientific validity. In contrast, the reactions used in

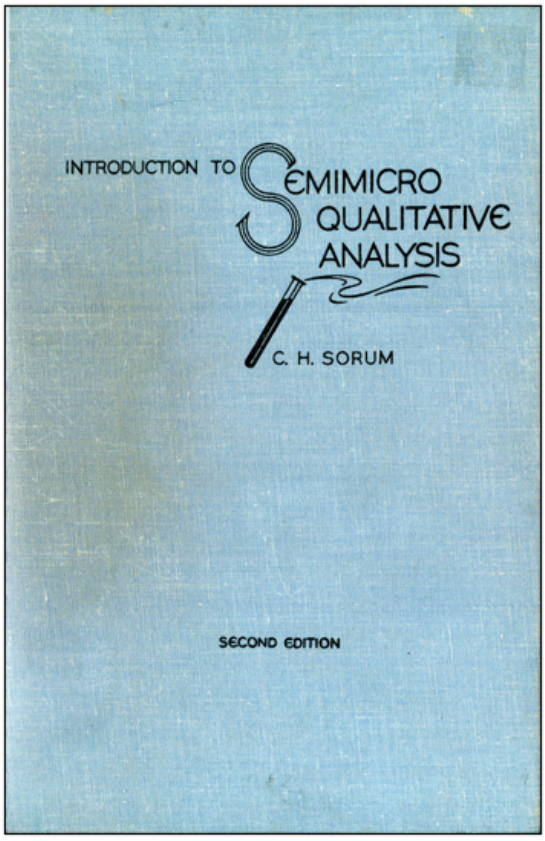


Figure 2.5 The cover to the 1953 edition of Harvey Sorum's *Introduction to Semimicro Qualitative Analysis* which served as the basis for my 8th-grade science fair project.

qualitative analysis were all logically interconnected and directed toward the scientifically significant goal of determining what elements were or were not present in a substance.

Even though Curtman's book contained a lengthy and detailed treatment of ionic equilibrium, I found I could follow much of the text and soon became desirous of trying to work through the laboratory procedures as well, only to discover that my home laboratory lacked many of the necessary chemicals. Klipstein's proposal seemed like the ideal opportunity to remedy this defect. I would do a science project related to the study of qualitative analysis and leave the problem of coming up with the necessary chemicals to him. As I later summarized the situation in the introduction to the handout that accompanied my final project (albeit with exaggerations as to how long I had been a

student of the subject in question):

The idea of finding what a substance is composed of has long fascinated me. When one studies chemistry, he finds it necessary to make tests to prove the results of his experiments or to find out what some unknown material is. To accomplish this we have the sciences of qualitative and quantitative analysis. I became familiar with qualitative analysis a few years ago, but was unable to perform all of the operations because of a lack of equipment and chemicals. This year has been my first chance to renew my unfinished study of qualitative analysis.

I had more recently acquired a used copy of the 1953 edition of the textbook *Introduction to Semimicro Chemical Analysis* by Harvey Sorum of the University of Wisconsin (figure 2.5).[2] Logging in at only 198 pages, this was a far more compact and manageable treatment of the subject than Curtman's 539-page tome, and I decided to use it as the basis for my science project. So I presented Klipstein with both my proposal and the list of required chemicals and equipment given in the appendix of Sorum's manual.

About a month later I received a summons to report to Klipstein after school was over for the day. There I discovered, on the laboratory island at the back of the classroom, an array of small vials and bottles containing all of my requested chemicals. I was ecstatic. Never one to pass up a PR opportunity, Klipstein took a photograph (figure 2.6) to commemorate the occasion which later appeared in the school newspaper with the caption "What is Bill cooking now? Watch out Jensen!" To obtain these materials, Klipstein had contacted Roger Bauer. I'm uncertain just what Bauer's job entailed. His official title was "Science Specialist for the Wausau School System" and I know that he had a small office at Horace Mann. I think he inspected the

Figure 2.6. A posed PR photograph of me with my newly acquired treasure trove of the chemicals required to work through Sorum's lab manual. Since the various reagent solutions would have to made using distilled water, I also set up a distillation apparatus for the photograph.

science programs at various schools and provided special equipment and advice where needed. In any case, by scrounging among the various city schools, the university extension center, and some local industrial laboratories, he had managed to come up with the necessary chemicals. Later, during my high-school years, he would also play an important role in providing me with local industrial contacts.

Initially I thought I would work at the laboratory island at the back of the classroom as this had both running water and gas. However, it was also accessible to other students during the day and soon proved impractical. In the end, Klipstein allowed me to use his prep room instead (figure 2.7), though for some odd reason this lacked both a gas

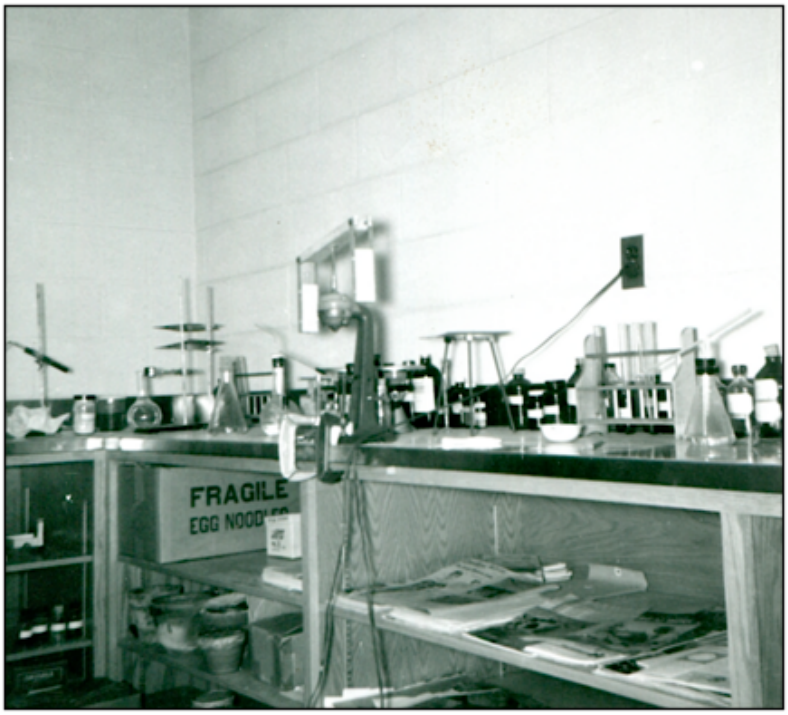


Figure 2.7. A fuzzy snapshot of the qualitative analysis laboratory which I set up in the prep room to Klipstein's classroom. The object in the center that is fastened to the bench with C-clamps is my home-made centrifuge. The test tube clamped to the ring stand on the far left is my hydrogen sulfide generator.

outlet and a hood. Nevertheless I survived by using a propane torch mounted in a horizontal rack as a heat source instead.

As may be seen from figure 2.4, the procedures described in Curtman's book, though sized down from earlier 19th-century versions, still made use of filtration and conventional-sized apparatus. In contrast, Sorum's book, as stated in its title, was based on a semi-micro approach. This employed significantly smaller quantities of chemicals, small test tubes, and used a centrifuge rather than vacuum filtration for separations. Bauer was unable to obtain the necessary centrifuge, so my father built one for me at the sign company, following my blueprints, using an old malted-milk mixer. He reversed the motor and mixing rod and added a wooden rotor arm and two

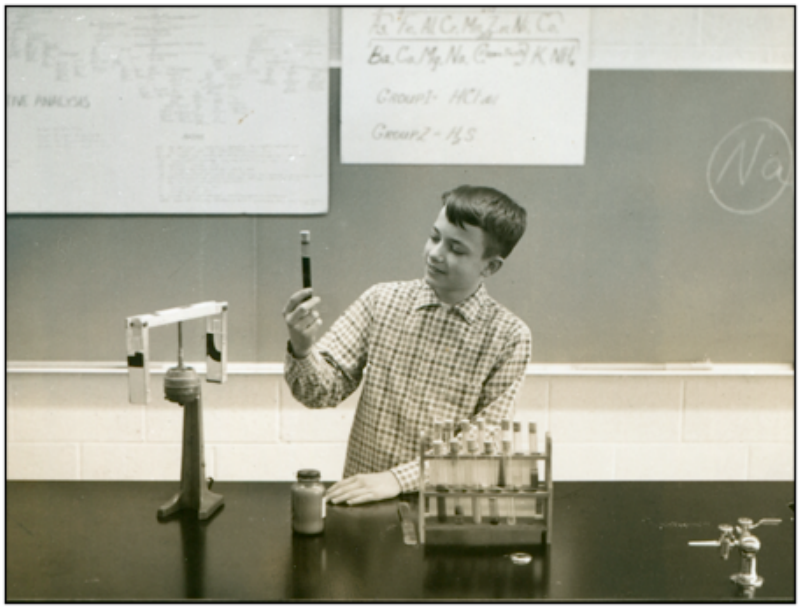


Figure 2.8. Another PR photograph, this time showing me practicing my presentation for the science fair. My home-made centrifuge is to the left and my flowcharts are visible on the back wall. I believe the test tubes contained various colored metal sulfide precipitates.

wooden tube holders hung using sheet-metal straps. These holders consisted of blocks of wood cut from an old sign with holes drilled for the test tubes. Though it hardly produced the clean separations expected of a commercial instrument, it worked well enough for my purposes. It can be seen in the center of figure 2.7 and even better in figure 2.8. When in use it was fastened to the bench top with C-clamps since it was both top heavy and, when spinning, was constantly threatening to take flight. The strange markings on the tube holders are actually fragments of the lettering on the old sign from which they were cut.

Figure 2.8 is a second PR photograph taken by Klipstein, this time showing me practicing my presentation for the science fair at the demo desk in room C-108. In addition to my home-made centrifuge, one can see the flowcharts for the qual scheme on the back wall,

which I made using a magic marker and poster board, and a test-tube rack containing various colored metal sulfide precipitates. As I recall, I attempted to inject a little history of chemistry into my practice presentation and at one point made a reference to the famous French chemist, Antoine Lavoisier. Having no idea how to pronounce French names, I parsed his last name into three separate English words "Lavo" - "is" - "here." This was immediately followed by my twisting of Henri Le Chatelier's name into Henry Le Chandelier. I thought Klipstein was going to have a bird. He of course immediately corrected my Wisconsin French and I think the most nerve-racking part of the following weeks was having to practice over and over the proper pronunciation of Lavoisier. As is often the case with unfamiliar words, the more I consciously thought about it, the worse the result when it finally came out of my mouth. In my defense, my bizarre parsing of Lavoisier's name meant that, to this day, I have no trouble remembering how to spell it.

The metal sulfide precipitates in figure 2.8 also raise the question of how I managed to generate the hydrogen sulfide (H_2S) gas required for the precipitation of the group 2 ions in the qual scheme. Not only does this gas smell like rotten eggs, it is also highly toxic and, as already noted, the prep room in which I was working had no hood. An examination of Sorum's manual and figure 2.6 reveals that I produced the gas by heating a mixture of asbestos, paraffin, and sulfur in a test tube with a cork and attached delivery tube – a concoction that was actually commercially sold for this purpose under the trade name of "Aitch Tu Ess." I assume the odor problem was dealt with by requiring me to work only after school. One of the unforeseen side effects of my semester of dabbling in poisons and obnoxious odors was that the severe adenoid problems that had plagued me throughout childhood disappeared for good.

The science fair was finally held on Saturday 12 May 1962 in the

main lecture hall of the University of Wisconsin Extension Center, just a few blocks down Steward Avenue from John Muir. A surviving program indicates that there was a total of 16 participants from six different public and parochial schools. Rather than individual booths, each participant was required to give a 10-minute talk summarizing their project in front of the judges and general audience of parents, teachers, and fellow participants. My presentation, entitled "A Semi-micro Qualitative Analysis of Known and Unknown Substances," was the third one on the schedule and, as a supplement, I also gave each of the judges a seven-page mimeographed summary of the project that I had painfully pecked out on an antique, circa 1916, Remington type-writer that my mother had purchased at a yard sale.

This contained a very brief introduction (quoted earlier), a list of the required chemicals and equipment, a summary of the preliminary experiments, unknown analyses (samples provided by Mr. Klipstein), and alloy analysis (steel wool) that I performed, as well as a conclusion and outline of future hopes:

With the preliminary experiments and the unknown and alloy analyses I have completed the course offered in the book which I used, but as mentioned before, the book contained tests for only a fraction of the elements. In the near future I hope to obtain a sample of ocean water and a book with a complete analytical course (i.e. tests for both common and rare elements), and continue from there.

Also attached were the individual report sheets for the four unknown salt samples and alloy that I had analyzed, modeled on those given in Sorum, and a one-page preface entitled "What is Semimicro Chemical Analysis?" On rereading the latter after more than 50 years, I was struck by the fact that it was an impressive and insightful performance for a 14-year old, or at least until I took a closer look at Sorum's book

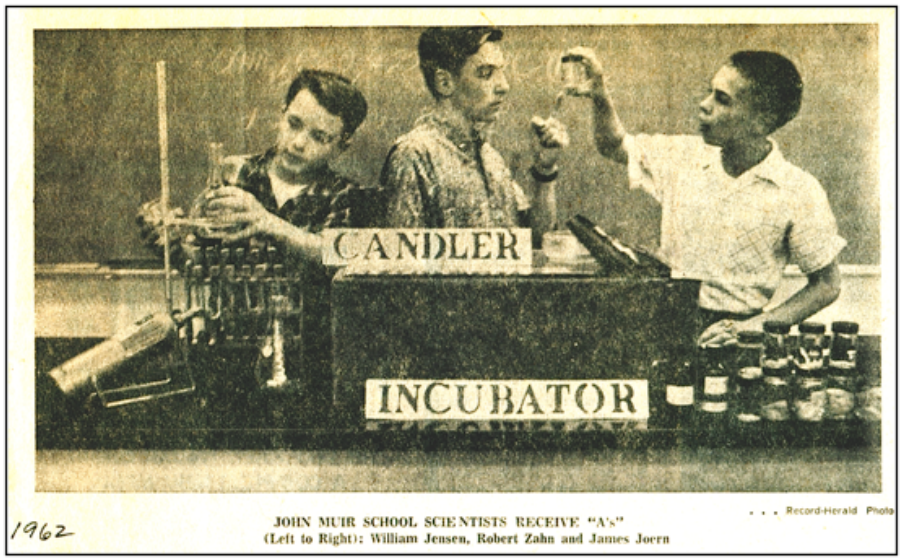


Figure 2.9. A yellowed newspaper photo of the first-place winners of the 1962 Wisconsin Junior Academy of Science regional science fair. I am to the left with my test tubes and propane torch and Robert Zahn and Jim Joern are to the right with their pickled chicken embryos.

and discovered that I had cribbed most of it from his introductory chapter.

The judges awarded two of the projects a first-place or A rating and two a second-place or B rating. To Klipstein's delight, both of the first-place winners were from John Muir – myself and a joint project by Robert Zahn and Jim Joern entitled "Incubation, Fixation, and Preservation of Chick Embryos" (figure 2.9). One of the second-place awards went to a student at Merrill Junior High for a project on blood typing and the other to a student at a Catholic school in Superior for a project on bacteriology. Though Horace Mann Junior High on the eastside of town had five entries, it had – once again to Klipstein's delight – no winners. As a prize I was given a free subscription to a science magazine of my choice. I chose *Chemistry Magazine*, a publication directed at high-school chemistry students, originally produced by the Science Service of Washington DC and later by the American Chemical Society. All of the John Muir participants,

winners or not, were also given certificates of achievement at the school awards ceremony later that spring, thus illustrating that the current egregious practice of declaring every child a winner, irrespective of true performance, has a long precedent.

But not everything was sweetness and light. Part of the judging process involved the use of evaluation ballots distributed to various teachers in the audience, though many were biased toward their own student entries. Interestingly, after the meeting was over, these were given to each of the participants as input for future improvement. Mine reveal that I did not always make the most favorable impression and contain comments such as "Don't sway – move around a bit instead" or "Don't speak so fast, don't be too sarcastic" or "Sure of himself – posture very casual" and "Try not to monopolize the time," etc. Luckily the three actual judges were more impressed than the teacher evaluators, though perhaps my case was helped by the fact that two of them, Elwin Harris of American Can Co. and Harry Johnson of Wausau Senior-High School, were both chemists.

The Horace Mann participants also did not "go gentle into that good night." After the meeting I was cornered by three of their 9th graders – Tom Larson, Steve Weiner, and Jim Smit – who had coauthored a joint project entitled "Studies in the Behavior of White Mice" and told in no uncertain terms that I had won unfairly since my project did not involve original research and had merely been a rehash of a textbook course. This was an incredibly naive view of student science-fair projects. Hundreds of students and biology textbooks had traced the development of the chick embryo in the past; hundreds of students and scientists had built a van de Graaff generator, like one of the other participants from Horace Mann; or had learned to type blood, like the winner from Merrill and, of course, studies of the behavior of white mice in mazes were legion. The whole point was to encourage students to explore some area of science in greater depth

Figure 2.10. Robert Gifford, my 9th-grade biology teacher.

than found in their textbook, not to pioneer some new field of scientific research. I was at least aware of what the scientific literature had to say on my subject, whereas the three participants from Horace Mann seemed to be blissfully unaware of the literature related to their own. I would later get to know both Smit and Weiner in high school, though I would never become close friends with either.

Enter Mr. Gifford

For 9th grade I took biology from Robert Gifford (figure 2.10) just down the hall in room C-112. Since this room was also my homeroom, I had known Gifford since 8th grade and was quite comfortable with my new course. Shorter, more heavy-set, and more laid back than Klipstein, Gifford also sported a crewcut or flattop. Indeed, now that I think of it, this was the haircut of choice for most of my male teachers and, along with a sports coat and tie, appears to have been part of some sort of idealized fashion code for male teachers of the time.

Once again I have no memory of the textbook we used, though I

Figure 2.11. Pen and ink drawings of common weeds done for 9th-grade biology. *Clockwise:* black nightshade, daisy fleabane, bitter nightshade, Jimson weed.

recall with great vividness the dissections we were required to perform – an earth worm, a starfish, a fish, and a frog – and the day that Gifford demonstrated to us how to properly kill a live frog for dissection by grabbing it by the hind legs and sharply whacking its head against the edge of the desk. Surviving homework reveals nothing striking – a drawing of a microscope and its parts, a report on my fish dissection, a series of drawings of low-power microscopic views of plant spores and pollen grains, and a series of drawings of common weeds carefully done with a straight pen and india ink (figure 2.11).

My Second Science Fair

As winter approached, Klipstein became anxious to repeat the previous year's success and began to once again solicit student science projects for the upcoming 1963 Junior Academy of Science regional science fair – not only from his own general science class but also from the classes of the other science teachers, including Gifford's biology class. I did not follow through with the suggestions for future work outlined in my previous project. Unknown to me at the time, a complete scheme of qualitative analysis for all of the known metals had in fact been worked out by Arthur Noyes of the California Institute of Technology back in the 1920s,[3] but even if I had been aware of this work, its complexity and the large number of chemicals required would have precluded any significant applications on my part. Rather I chose to pursue a project related to quantitative rather than qualitative analysis – in other words, I chose to learn not only how to determine what elements were present in an unknown sample but also their relative amounts expressed as a percentage by weight.

Unhappily the exact details of what I did for my repeat performance are mostly missing. In sharp contrast to my first project, there are no surviving handouts, no memory of what textbooks I used, nor of what materials I analyzed. The title of my project – " A Practical Use of Chemical Analysis" – provides no clue as to what I did. However, since I lacked access to desiccators and to both combustion and drying ovens, I think I chose to learn volumetric analysis rather than gravimetric analysis and that I applied it to the analysis of silver content of various coins. I say this because I do have a vague memory of teaching myself to do calculations based on molarity, normality and formality and because the local newspaper photograph of that year's winners (figure 2.12) shows one of my posters in the background labeled "Analysis of Metal B." Nevertheless I am puzzled as to how I was

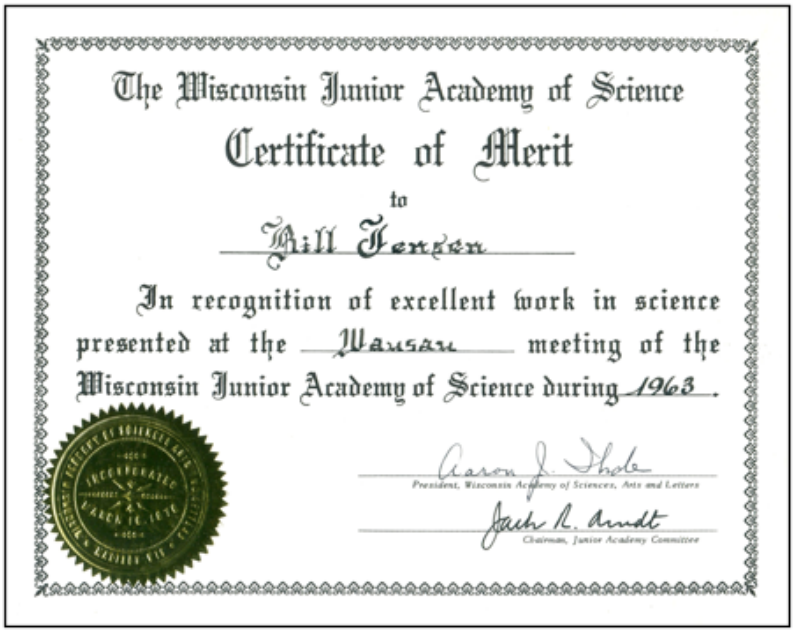
Figure 2.12. A faded newspaper photograph of the winners from Wausau of the 1963 Wisconsin Junior Academy of Science regional science fair, *Left to right:* Pat Chrouser (John Muir), Kathy Konwinski (Horace Mann), Donald Raddatz (John Muir), and myself. The other winners were from Stevens Point, Tomahawk, and Merrill.

able to do such a project without access to an analytical balance. I'm pretty certain that Klipstein did not own one, and it may be that Bauer once again came to my rescue by providing me with several liters of a standardized solution obtained either from the local university extension or from the chemistry teacher at the local high school. To the best of my knowledge, I continued to work in the small laboratory I had set up in Klipstein's prep room the previous year, since the corresponding room in Gifford's classroom was devoted to biology instead.

As per usual, the science fair was held in the main lecture hall of the University of Wisconsin Extension Center on 18 May 1963 with 24 participants from six different public schools. Again each participant was required to give a 10 minute summary in front of the judges and general audience. This time I was 11th on the schedule and, if I am to judge from the newspaper photograph (figure 2.12), I sported my new three-piece suit and a series of summary charts painted by my father using his best "showcard" lettering technique, rather than my previous crude effort done with magic marker and poster board.

This time the judges awarded four, rather than two, first-place winners: myself, Pat Chrouser (John Muir) for a project on "Effects of Glue Sniffing on White Mice," Kathy Konwinski (Horace Mann) for a project entitled "My Attempts at Modifying Cold Light," and Susan Buchholtz (Merrill Junior High) for a project on "Chick Embryology." Four second-place awards were also given: one to a student from John Muir, one to a student from Merrill Junior High, one to a student from Tomahawk, and one to a student from Stevens Point. Once more, my win was probably helped by the fact that one of the three judges was a chemist named Robert Kusel, who worked at the Marathon Battery Co., and another was none other than Mr. Bauer himself.

Though not quite the clean sweep it had been the previous year, Klipstein was still pleased with the results since no other school had garnered so many winners. As for my free magazine subscription, this time I chose *Scientific American,* since I had found *Chemistry Magazine* rather disappointing. One new twist was the giving of an official award certificate, complete with a gold seal, signed by the President of the Wisconsin Academy of Sciences, Arts and Letters (figure 2.13). I must have given this directly to my mother without looking at it, as I was quite surprised on examining it 50 years later to discover that it was signed by none other than Aaron J. Ihde, whom I would later


The Wisconsin Junior Academy of Science

Certificate of Merit

to

Bill Jensen

In recognition of excellent work in science presented at the Wausau meeting of the Wisconsin Junior Academy of Science during 1963.

Aaron J. Ihde
President, Wisconsin Academy of Sciences, Arts and Letters

Jack R. Arndt
Chairman, Junior Academy Committee

Figure 2.13. My award certificate for the 1963 Wisconsin Junior Academy of Science regional science fair signed by Aaron Ihde.

come to know as a prominent historian of chemistry and who would also play a key role in my future career.

Marathon County Youth Conservation Day

The Wisconsin Junior Academy of Science wasn't the only annual competition that Klipstein was intent on winning. Yet another was the annual Marathon County Youth Conservation Day held at the fair grounds in Marathon Park. This consisted of brief sessions on various topics related to conservation and farming along with a series of short competitive exams. Though obviously directed primarily at students from the surrounding farming communities and related in some fashion to the 4H movement, Klipstein nevertheless decided to enter a group of "big city" John Muir science students in the competition (figure 2.14). Some of these were genuinely interested in the subjects

Figure 2.14. Klipstein's 1963 competitive team for the Marathon County Youth Conservation Day. I am in the back row, second from the left. I knew only two of the other team members: Knute Alstad, (back row, far left), who would go on to become a mechanical engineer, and Michael Kluetz, (back row, far right), who, like myself, would go on to become a professor of chemistry.

at hand, but others, like myself, were selected solely on the basis of our classroom performance. Klipstein even prepped us for the competition by giving us a series of tutorials after school on such subjects as crop rotation and contour plowing. Since I was neither interested in conservation nor in farming, I was in effect serving as a "ringer" who had been placed in the competition solely to ensure victory against the less academically inclined students from various rural and small-town schools. And, not surprisingly, once again John Muir Junior High walked away with most of the blue ribbons.

Persistence, Trust and the Home Laboratory

Obviously junior high was an exciting time for me. It corresponded to

an explosive awakening of my intellectual interests and academic self-confidence. The sudden switch from my rather lackluster academic performance at Lincoln Elementary to my straight-A status at John Muir, coupled with my increasing efforts to self-instruct myself on various advanced subjects using university-level science and math textbooks obtained from the public and county libraries, would all seem to suggest that I had become increasingly bored with the grade-school curriculum, though I have no conscious memory of this being the case. Some support for this conclusion also comes from the surviving record of my performance on something called the Metropolitan Achievement Test, which I was required to take at the beginning of the 9th grade. This showed that my basic academic performance (spelling excepted!) was somewhere between the 11th- and 12th-grade level. Yet I would not put too much emphasis on such test results. I was always aware that I had classmates who did far better than I on exams of this sort, including IQ tests, and if, in the end, I seemed to go a little further than they, I think it had far more to do with persistence and monomania than with inherent brilliance.

Of far greater importance in my case was the incredible freedom that my teachers gave me to play with so many different chemicals and apparatus that present-day schools would ban. Later, during my university career, I would volunteer to judge several Cincinnati city-wide science fairs and was immediately struck by the total absence of any projects related to chemistry. School administrators are now afraid of even the most mundane chemicals and, largely for legal reasons, simply refuse to allow students (and even teachers) access to them, however closely supervised. Though the number of students injured in chemistry classes is minuscule compared with those seriously injured or even killed each year while participating in school sporting events, politicians and lawyers have, as usual, gone after the easy target. When combined with the current widespread association of

Figure 2.15. One of many preliminary sketches of possible arrangements of my basement laboratory at Tracy's. The Bunsen burner and propane tank are at the end of the second table.

the word "chemical" with addictive and dangerous street drugs, with pollution and time-delayed cancers and, most recently, with bombs and terrorism, we now have a public relations nightmare which, not only common sense, but such organizations as the American Chemical Society have proven powerless to combat. The result is a tragedy for both American science education and for the American chemical profession.

Indeed, not only was I trusted to work with a wide variety of chemicals at school, at the end of the 9th grade I was even allowed to take home the stash of chemicals I had accumulated over the previous two years in Klipstein's prep room in order to augment my home laboratory! By the end of the 8th grade this had become too large to fit in my bedroom and surviving sketches (figure 2.15) reveal that I had

Figure 2.16 (above): Colored slide taken by my uncle Bart in the spring of 1963 showing me posing in my three-piece suit in my basement laboratory at Tracy's. Note the dropper bottles in the background containing reagents for semi-micro qualitative analysis. Not shown is the large library table which my uncle is leaning on.

begun playing with the idea of moving it to the basement instead. Since we were now renting the Tracy house, this space was no longer shared with the landlord, as had been the case at both Roeder's and Leffine's. It was divided into three rooms: a laundry room with a cement floor and sink, a furnace room/coal bin with a dirt floor, and a storage room for canned goods with a crude wooden floor. I initially chose the laundry room and located my laboratory in the space beneath the basement stairs (figure 2.16). In addition, I replaced the tables I had been using previously with three newly custom-built laboratory benches, loosely based on the design given in the Morgan books, and a large oak library table that was donated by my friend Tom Schwartz. I also note that my crude preliminary sketch reveals that by this time I had purchased a Bunsen burner, probably from the

Pet and Toy Hobby Store, and that I had connected it with a rubber hose to a conventional propane torch from which I had removed the burner nozzle.

Sex and the Science Nerd

But as exciting as this intellectual awakening was, I should perhaps also say a few words about one of the more negative aspects of my impending transformation in junior high into a hardcore science nerd, especially since this aspect forms a central theme of the current hit television comedy, "The Big Bang Theory," which is predicated on present-day stereotypes of science nerds. As a comparison of figures 2.6 and 2.8 with figures 2.12 and 2.14 reveals, junior high not only corresponded to a significant change in my academic performance but to a significant change in my physical appearance as well. In the former, which show my appearance in 8th grade, I still look like a young boy, whereas in the latter, which show my appearance in the 9th grade, I look like a young teenager. Every grade-school and secondary teacher knows that the onset of puberty can easily derail a promising student. Once the hormones start raging and the pressures of dating and social climbing set in, the purely intellectual can be quickly overwhelmed. In my case, however, the exact opposite occurred.

Throughout grade school I always had a favorite "girlfriend" in the childhood sense of the word. In kindergarten and 1st grade it was a pretty blond named Karen Peterson. This ended when my family moved from Marshfield to Wausau and Karen was replaced by an attractive brunette named Vicki Rose Bristol. When Vicki's family moved at the end of second grade, she was, in turn, replaced for most of the rest of grade school by a vivacious, little blond girl named Lynn Gilbertson. All of these childish flirtations, though innocent enough, were apparently mutual, as revealed by surviving valentines and notes, or even by a

class photo showing Karen and myself shyly pressing our shoulders together.

With the onset of puberty, however, everything changed. In both junior high and high school I continued to have crushes on various girls, but now there was no reciprocity or even social contact other than the superficial interactions of the day to day classroom. I had suddenly become shy and awkward around girls I found attractive and could only worship them from afar. The situation was not helped by the fact that both of the girls in question were cheer leaders and I was a science nerd. According to the social code of both junior high and high school, this meant that we were, for all practical purposes, "different species."

But, to be honest, even if these girls had expressed an interest in dating me, I would not have known what to do. I had no car and what little spending money I acquired was used to buy chemicals and laboratory equipment. I detested dancing and sporting events, and could not even take them home to meet my family, as the behavior of my alcoholic father was too erratic and unpredictable And, to top it off, my understanding of the facts of sex and reproduction was pretty vague until I was well into high school. The boys I hung out with were, like myself, girl shy and did not engage in talk about sex, trying to gain access to pornography, or even gossip about loose girls at school. We were all about science, math and academic competition.

Curiously, I had briefly hung out with a very different kind of boy my first few years at Lincoln Elementary. His name was Bradley Shannon and I swear to God he must have gone into puberty at age 9. He was girl nuts and would spend each recess period trying to look up the skirts of the girls playing on the swings and monkey bars. When, in the fourth grade, all of the girls were taken out of class and marched down the hall to watch a film on "the miracle of menstruation," he

became frantic in his attempts to discover what great sex secret had been revealed to them. A few days later I observed the boys during recess whispering something to one another, followed by snickering and laughter. Eventually one of them approached me and whispered in my ear "Tampa!" followed by the usual snicker. I was greatly puzzled and could not fathom what was so funny about the name of a city in Florida. Only many years later did I realize that Bradley had apparently gotten one of the girls to divulge the word "tampon," which the boys, through word of mouth, had somehow managed to distort into the more familiar "Tampa," thus illustrating the great truth that virtually anything can be made the object of sexual innuendo.

Though, during my brief grade-school flirtation with Lynn, she had occasionally hinted that she knew a great deal more about the facts of reproduction than I did, I continued to remain unenlightened, if not thoroughly confused, for several more years. At one point I was examined by the family doctor to determine whether my testicles had properly "fallen." From the ensuing conversation between the doctor and my mother, I inferred that this was required in order to successfully make babies. Since I also knew that, as part of this process, the male injected something into the female, I immediately concluded that this something was one of these much valued testicles. While unsure whether I fully thought the matter through, I think I also assumed that once you had expended your initial two shots, a new set of testicles would descend to take their place. Since it was obvious that a testicle was much larger than the opening to the penis, I further inferred that the injection process was quite painful and that this accounted for all of the grunting and groaning that accompanied the sex act.

When I finally broached my new theory with my mother, she was horrified and immediately decided that it was time that someone had "the talk" with me. Since it was obvious that my father wasn't going

to voluntarily play this role, she obtained several books on sex education for teenagers from the public library, which she gave me to read. However, while I avidly read the sections on the sexual development of young girls, hoping no doubt to find the key to their growing mystery, I totally ignored – much to my mother's irritation – the sections on boys.

A final source of confusion was the film on sex education that we were shown in 8th-grade health class. This showed a girl and boy standing about five feet apart. As the narrator droned on in vague euphemistic terms, an arrow emerged from the boy's left pant leg and proceeded along the floor and up the girl's leg, where it disappeared under her dress. And that was it! What did it mean? For weeks after I was leery of getting too close to a girl for fear my arrow would begin unravelling down my pant leg.

In the end, I just rationalized away my ineptitude when it came to girls and dating. Starting in the 8th grade, my school advisors had begun mapping out the courses I would have to take through the end of high school if I wished to become a chemist, and I was further aware that I was also facing at least another eight years of college if I was going to obtain a Ph.D. and be able to afford marriage and children, which, given my strict Mormon upbringing, was the only relationship between a man and a woman that I could conceive of at the time. It seemed pointless to become prematurely enmeshed in relationships that could not possibly survive the end of high school. Of course, all of this meant that in my 20s I would, in true nerd fashion, have to go through all of the initial awkwardness and anguish of dating that most teenagers experience when they are 16.

III

My Drug-Store Days

As noted at the end of the previous chapter, by the end of the 8th grade diligent school councilors had noted my determination to become a chemist and had dutifully mapped out what science and math courses I was destined to take through the end of high school in order to prepare for a successful major in chemistry in college. As the oldest of three children of an alcoholic sign painter and a public librarian, I knew my parents could not afford to send me to college since, on many an occasion, they could barely afford to pay the rent. Having at that time no concept of scholarships or student loans, it finally occurred to me, as the school year drew to a close, that I would have to get a job and begin saving. The optimal choice was, of course, to get a job that was in some way related to chemistry and, given the limited chemical horizons of Wausau, Wisconsin, in the early 1960s, the most obvious choice – or so I thought – was to seek employment in a drug store.

This choice was also reenforced by a number of other factors. My youngest maternal uncle, Clyde Tracy (no relation to our landlady), functioned as a role model for me when I was growing up. He had gone to college, so I would go to college; he had worked for the post office as a student, so I would later work for the post office; and, as a young teenager, he had worked in a drug store. By this time I had also begun reading history of chemistry, and especially Mary Elvira Weeks' lavishly illustrated *Discovery of the Elements*, and knew that several famous chemists had worked in drug stores – most notably the Swedish chemist, Carl Wilhelm Scheele, in the 18th century, and the

Figure 3.1. A period postcard showing the bridge to the westside business district as it looked in 1918. The Curtis and Yale plant is to the right. Straight ahead in the center is the building that housed Young's Drug Store and the building for Place Clothiers. In my day the building to the left was painted white and housed a tire store.

German chemist, Carl Friederich Mohr, in the 19th century – so I erroneously reasoned there must be something inherently chemical about such an environment and, indeed, something that might even prove pertinent to my own education as a future chemist. Lastly, I had just finished reading a semi-autobiographical book by the American humorist, Richard Armour, entitled *Drug Store Days*, which dealt with his own adventures as a young boy working in a typical small town, turn-of-the-century, drug store and had enjoyed it enormously.[1] Being naive about the liberties taken by most authors with the naked truth, and especially by those dedicated to making it seem humorous, I imagined that I was destined to have similar memorable adventures. In retrospect, I forgive Armour his exaggerations, and in honor of the pleasure his small book gave me, I have decided to purloin its title for this chapter.

The Pradel Drug Store

On driving west on Scott Street in the 1960s, through downtown Wausau and over the bridges to the Wisconsin River, one would encounter the main, albeit rather small, business district for the westside of town (figure 3.1). On the right was the huge, sprawling Curtis and Yale woodworking plant, where my future father-in-law worked, and on the left a line of small businesses in a row of tottering wood and brick 19th-century buildings, including a tire store, a key and lock store, a Buster Brown shoe store and, most famously, the original location of Sam's Pizza. When one came to the end of the Curtis and Yale plant, the way was blocked by the imposing early 20th-century building for the Palace Clothiers store, in front of which the street forked to the left and right and changed its name to 1st Avenue. Going right, around the intervening block on Callen Street, one encountered a series of bars, a phone company, a chiropractor's office, a dry cleaners, and, on coming to 3rd Avenue, a gas station and a used car lot. Circumventing the intervening block to the left instead on Clarke Street, one encountered several filling stations on the corner, a farm implement store and M&J hardware on the left, and a drug store and hobby shop on the right, followed by Citizens' State Bank (with doctor's offices on the 2nd floor), Krambo's supermarket, and then 3rd Avenue once again with yet another filling station, a store specializing in takeout fried chicken, and the local labor temple and bar.

My family was intimately familiar with this business district, since for many years our various rented apartments were within walking distance. We frequented all of its stores and availed ourselves of its professional services, including banking, doctors, dentists, chiropractors, and, in my father's case, many of the bars. The local Mormon congregation to which my mother and siblings belonged

Figure 3.2. The building that housed the Pradel Drug Store for almost 60 years as it looks today. Like most of the few remaining older buildings in Wausau it has been architecturally raped. The drug store occupied the space between the first two doors on the left and Pet and Toy Hobby the space between the second and third door. The entrance to the drug store was centered in its space rather than being at the far left. The door on the far right is to a one-story addition and the new facade above it is fake. The Historical Society reports that it has no photographs of the original building.

was, for a several years, also headquartered in this neighborhood. As mentioned earlier, this was too small to have its own church building so instead it rented the labor hall above the bar at the corner of Clarke and 3rd Avenue for its Sunday services, though weekday functions, such as Primary and Relief Society, continued to be held in the homes of individual members. Given these facts, it is not surprising that it was in the drug store, known as Pradel's, located at 112 Clarke Street, just around the corner from Palace Clothiers, that I found my first job (figure 3.2).

I am no longer clear on just how this opportunity came my way. My mother seems to think that she either saw it posted at the public library, where she worked, or was told of it by our teller at the Citizens' State Bank. I am dubious of the first explanation, as I was to

later learn that the job was usually passed from one boy to another by word of mouth rather than advertised. The second explanation is more probable, as most adults in my world, including even bank tellers, were well aware of my interest in science and often helped and encouraged me whenever possible.

In any case, I was hired in the summer of 1962, just after I completed the 8th grade. Since I was 14 at the time, I had to file for a special work permit from the state and could only work half time, which meant that I worked 20 hours per week. I was paid 75¢ per hour and thus made a whopping $15.00 per week. Every Friday I would turn right on leaving the drug store and march next door to Citizens' State Bank to dutifully deposit $10.00 of my weekly check in my newly established college fund. This was often hard for me to do, as I dearly wanted to turn left instead and spend it in the "Pet and Toy Hobby Shop" which shared the building with the drug store. This wasn't because I was an avid builder of airplane models or a collector of model trains, but because, as already discussed in Chapter 1, the hobby shop carried a line of laboratory apparatus and chemicals under the brand name of "Perfect", which specifically targeted the amateur home chemist, and I would have infinitely preferred to spend my newly acquired wealth in building up my home laboratory instead. In retrospect, of course, the entire scheme seems ridiculous, since, at the rate of $10.00 per week, I would have saved a mere $2,080 if I had managed to stick with the job until graduation from high school four years later – a sum that would have barely gotten me through a year at a large out-of-town university at the going rate in the late 1960s.

Learning the Routine

As I recall, I worked from 6:00 pm to 9:00 pm Monday through Thursday,

4:00 pm to 9:00 pm on Fridays, and from 9:00 am to noon on Saturdays, though, from time to time, I would work Saturday afternoon instead. I was trained in my duties by an older boy named Chuck Giese, who had already worked there for some years and was a favorite of the owner. Indeed, to the best of my knowledge, he continued to work there for some years after I had left and also trained my eventual successor. My duties consisted of tending the cash register, restocking shelves, dusting, sweeping the floor each evening after closing, and occasionally delivering prescriptions to elderly shut-ins on my second-hand, English, three-speed bicycle, which I rode to work each day after school when the weather permitted.

There were also occasional special duties. Every Friday, shortly before closing, it was my job to steam the cigars in the display case near the front door. This required that I heat a pan of water to boiling in the back room using an outdated electrical heating device that was dropped directly into the water and which I always suspected of being fully capable of electrocuting me should I be foolish enough to test the water with my finger while it was still plugged in. Once it was boiling, I was required to carry the pan of scalding hot water the full length of the drug store and place it carefully on top of the open cigar boxes in the case without spilling any. I would then close the back of the case, wait to see whether the glass top, sides, and front had properly clouded over with steam, and then leave it overnight.

When I worked Saturday afternoons, I was usually required to spend my spare time wrapping the boxes of women's sanitary napkins kept in the display near the front counter in brown paper – a quaintly Victorian service that we proudly provided to our female customers under the pretense of preserving their privacy. Whether this really worked is debatable since every one concerned knew what was really in the plain brown packages. I distinctly recall working one Saturday afternoon when a girl I went to Junior-High School with came into the

store to make such a purchase. I knew what she wanted the moment she entered. Spotting me behind the counter and no pharmacist in sight, she immediately froze and her face took on a look of sheer panic. There was a long case of greeting cards and birthday cards to the immediate right of the center aisle that extended the entire length of the store, from the front door almost to the service counter, and to this she stumbled. She consumed a full 15 minutes slowly making her way up one side and down the other, picking up one card after another, and looking around every few minutes in the desperate hope of spotting the pharmacist, who, unknown to her, was probably sleeping at the desk in the back room. Finally, all hope gone, she proceeded to the display of ominous brown boxes, picked out one, and set it on the counter in front of me, while mumbling in a barely audible voice – "It's for my mother."

The special job I hated the most, however, was cleaning the front windows on Saturday morning, both inside and outside, with a bucket of hot soapy water, a sponge, and a squeegee on a pole, especially in the winter. Every missed speck of dirt and every streak of unremoved rinse water were clearly visible on a sunny morning from the darkened interior of the pharmacy and, try as I might, I never mastered the art of removing all of them.

The Wrong Role Model

The building at 112 Clarke Street that housed the Pradel Drug Store was built around 1900. It contained two store fronts and, according to the Wausau City Directory, by 1912 a young pharmacist by the name of George William Pradel was operating a drug store in the left side of the building, even though a larger, more established, pharmacy owned by William Albers was located just around the corner on 1st Avenue next to the future site of Palace Clothiers.[2,3] Pradel main-

tained his store until his death at age 54 in 1934,[4] after which his widow apparently continued the business for some years by relying on a variety of hired pharmacists. However, sometime in the 1940s, she finally sold it to a pharmacist in her employ named Ewald C. Schulz, and it was Schulz who was still running it under the Pradel name in the 1960s and who was responsible for hiring me.

When writing the first draft of this chapter I could not, for the life of me, remember Schulz's first name, probably because I was required to always call him Mr. Schulz and so never knew what it was in the first place. Luckily, I later discovered an old tax return which gave his full name. When I first met him, he was a heavy-set, bald man in his late 50s who lived in a ranch-style house on the west hill and who drove a Cadillac. Since he employed two other pharmacists – one in his 30s, who was actually a nephew, and the other quite elderly, whom he may have inherited from the widow Pradel – he seldom worked in the store himself. This arrangement suited me just fine as I soon came to loath the man.

If I had expected some kind of mentoring from Schulz in the science of pharmacy, let alone chemistry, I was soon to be disappointed. As far as I could determine, he had no interest in either subject, but had instead degenerated into a petty, local businessman obsessed with maximizing his profits by any means possible, and it was only the latter wisdom that he was willing to impart to me. Thus he proudly explained to me that he had cleverly retained the Pradel name for the store so as not to lose the loyalty of its original customers. Sometime after purchasing the business he had paid a firm of manufacturing chemists in Chicago to make up a large variety of generic products (mostly in the line of hair care) which we sold under the Pradel label in order to save on overhead and of which we had many additional cases in storage in the basement.

I doubt whether either of the other two pharmacists were paid

much. Schulz had helped finance his nephew's sojourn in pharmacy school and I think the nephew accepted low wages as part of a scheme to pay him back. As for the elderly pharmacist, I was once asked to deliver a package to him at his home on his day off and was shocked to discover that he lived in a run-down, single-story, working-class house on the southwest side of town that was definitely substandard compared to my own home.

The same desire for extreme economy was also apparently behind the practice of hiring underage boys to perform the grunt work around the pharmacy. Indeed, in searching the internet for references to the Pradel Drug Store, I discovered the 2010 obituary of a former Wausau resident named Gordon Graveen which stated that as a teenager he had worked at the Pradel Drug Store.[5] Based on his birth date, this was probably between 1945, when Graveen turned 14, and the early 1950s, when he was drafted to fight in the Korean War. Given the starting date, Graveen may well have been the first in a line of teenagers hired by Schulz after acquiring the business from Pradel's widow. The obituary also stated that he was paid $6.00 per week, or roughly a third of what I was to receive nearly two decades later.

The true turning point in my relations with Schulz came, however, with my discovery of the shelves on the landing to the basement. These contained a collection of older bottles of chemicals and drugs, some old pharmacy and chemistry texts dating from around 1900, and about a dozen fancy, glass-stoppered, pharmacy display bottles with hand-painted labels (figure 3.3) – the pitiful remnants of the original pharmacy. I dearly wanted these for my home laboratory, but when I asked Schulz if I could purchase them, he refused. He explained that, after purchasing the business he decided to modernize it, so he ripped out the original dark oak shelving, drawers and counters and replaced them with its current, circa 1940, fixtures done in a sort of blond, fake, birch-bark finish. He then took the antique display bottles, of which

Figure 3.3. Typical 19th-century or early 20th-century pharmacy display bottles, also called furniture bottles, like those I discovered on the basement landing at Pradel's Drug Store.

the original pharmacy literally contained hundreds, out behind the store and smashed them with a sledge hammer. Only about a dozen were left when he discovered that they were probably worth a great deal of money to antique dealers. He had no interest in using the few survivors to decorate the store, but was squirreling them away on the theory that, the longer he kept them, the more they would be worth when he finally decided to sell them. To say the least, I was totally appalled by this story, though Schulz seemed to take pride in it as yet another example of his extreme business acumen.

The few occasions when Schulz stood in for one of the other pharmacists produced additional stress. When either the nephew or the elderly pharmacist were on duty, they generally remained in the back room unless specifically called upon to consult with a customer. There they would busy themselves making up prescriptions, reading

the newspaper, or dozing, and I was left to my own devices while I performed my appointed duties. When Schulz was in the store it was an entirely different story. He seemed obsessed with the idea that he wasn't getting his money's worth from his employees and was always noting how much time it took me or one of the other pharmacists to perform this or that task, and would admonish us if he thought we were taking too long to complete it. This was particularly the case when I was sent to the basement to retrieve items for restocking the shelves. If he thought I was down there too long, he would shout down the stairs or even come down himself, apparently in the hope of catching me red handed in the act of either napping or drinking up our surplus stocks of wine.

He was also not above interfering when one was in the act of waiting on a customer. Friday evenings were particularly busy as many of the workers at the nearby Curtis and Yale plant would come into the store to cash their pay checks and to purchase cigarettes and liquor. One such Friday, when the store was particularly packed, one of the plant workers asked me for a package of Trojan brand prophylactics. I had sold these before when working with the other two pharmacists and knew that they were kept in the back room in an old, white, metal, ice-cream cooler that no longer worked, and so I went back and pulled out a box. Schulz was sitting at the desk in the center of the room watching me and, as I walked past him with the item in question, he suddenly shouted at me, "What the hell do you think you're doing?" I explained that the item had been requested by a customer, whereupon he grabbed the box from me and stormed out to the cash register, where he began haranguing the man by shouting "What the God-damn hell do you mean asking a kid for something like that?" while the poor man shriveled up from embarrassment and the rest of the customers stared in disbelief.

At age 15, I was not even sure "what a thing like that" was used

for, though I later formulated a theory on the matter, only to be thoroughly confused once more when I discovered, while dusting, that we carried an entire line of prophylactic hair brushes. In light of my tentative theory, I could not even begin to imagine what these might be used for. Little did I know at the time that the word "prophylactic" simply meant "sanitary" and, being a typical teenager, it never entered my mind to look the word up in a dictionary. One might think that an attentive teenager would have learned more about the facts of sex working in a drug store than I did, but in actuality the opportunities were rather limited and often created more mysteries than they solved. Why, for example, did we keep the money from the sale of prophylactics and cigarettes in a separate drawer next to the cash register? This was never explained to me, though I was admonished, on pain of death, never to mix the two sources of income. It may be that it was illegal for the drug store, let alone an underage boy, to sell the prophylactics and that Schulz was merely protecting himself – though yet again none of this was ever explained to me.

The only other source of information – and a highly unreliable one at that – was the magazine rack to the right of the front door. This featured several disreputable publications having front covers showing women in skimpy garb being tortured by middle-aged men in Nazi uniforms. Though I was in charge of renewing the magazines on the rack as new monthly issues came in, the unsold older issues were carefully counted and returned to the distributor and I did not dare look inside. However, on one occasion I did discover some older copies in the basement and, since this allowed for greater privacy, I did peek, only to find that the contents did not live up to the promise of the covers.

The Unintended Fruits of Modernization

Being located in a typical late 19th - early 20th-century store front,

the space which the pharmacy occupied was narrow and deep. It was divided into just two rooms, with the front two-thirds serving as the store proper and the back third as the dispensing area for the pharmacists. The wall separating the two rooms had two openings, one on each side of the front service counter, and each aligned with the outer most aisles of the store. The side walls of the back room were lined with home-made shelving and held large gallon-sized, brown-glass bottles of various commercial elixirs, mostly from the Parke-Davis Company. These bottles were not unattractive and the pharmacists later gave me some that had been emptied for use in my home laboratory, though I doubt that I ever owned a gallon of any chemical other than water.

The notorious ice cream cooler occupied the back wall of the dispensing room and was located in front of two windows that looked out on the parking lot behind the store, and I believe there was also an aging refrigerator for the storage of insulin and other perishables. In the rear left-hand corner of the room was the door to the basement and in the right-hand corner a matching door that opened onto the foyer for the back door to the building and the backstairs to the apartments located above the pharmacy and hobby shop. On Sunday morning we would use this back door to sell liquor to various local ministers. I was once taken upstairs to the unoccupied apartment above the pharmacy, which contained only the crates of liquor that Schulz was storing in the various empty rooms. The apartment above the hobby store, on the other hand, was still occupied by the elderly woman who owned the building, though I cannot recall whether this was the widow Pradel herself.

In the center of the dispensing room was a desk and several chairs for the pharmacists and, along the wall separating the two rooms and filling the entire space between the two openings, was the only surviving section of the pharmacy's original oak cabinetry, though

Schulz had painted it, as well as the shelving on the side walls, a sickly, yellowish cream color. The upper shelves of this imposing fixture contained the bulk stock bottles of various commercial pills and capsules, while the lower drawers were filled with a variety of empty bottles for use in preparing prescriptions. On the counter itself was a scotch-tape dispenser, a typewriter for printing the labels for the prescription bottles, and a series of plastic pill-sorting trays provided gratis by either Parke-Davis or Upjohn. These consisted of a plastic square divided into smaller areas to facilitate counting. The pharmacist would select the proper bulk bottle of pills, dump some onto the tray, and use a spatula to count out the required number. These he would flick into a plastic gutter that ran along one side of the tray and which he would then close with a plastic cover that created a cylinder that terminated in a funnel-like opening at one end. Removing the unwanted excess pills from the sorting area, the pharmacist would then tip the cylinder opening over the mouth of an empty prescription bottle and dump the counted pills into it.

I cannot recall whether there was also a small glass-enclosed torsion balance. However, there was a collection of two or three glass measures and a glass funnel for dispensing liquid prescriptions from the large bottles along the side walls – but that was all. I never saw the pharmacists actually make anything themselves. Their lives seemed to consist entirely of moving commercially prepared pills and liquids from large stock bottles to smaller prescription bottles and typing out labels. Many years later, when I became a Professor of Chemistry at the University of Cincinnati, I prepared a display for the local section of the American Chemical Society in connection with the Bicentennial of Cincinnati dealing with the history of chemistry in the city. Many of the early members of its various local chemical societies had been pharmacists who owned actual manufacturing pharmacies. In one of the captions to the display, I observed that the design and preparation

Figure 3.4. The interior of the Palace Drug Store (not to be confused with Place Clothiers) in downtown Wausau, circa 1900, illustrating the arrangement of counters and shelving typical of 19th-century businesses. Pradel may have clerked in this store before starting his own. Both the store and the building were long gone by my day.

of new drugs had long since passed from the hands of the commercial pharmacist to the hands of university-trained research chemists. The Dean of the University's School of Pharmacy took great umbrage at my comment and I received a note from him inviting me to visit the School of Pharmacy and learn just what a modern pharmacist really did. I sent him a reply, observing that, as a teenager, I had actually worked in a pharmacy and knew exactly what they did, or rather what they did not do.

In addition to the service counter in front of the dividing wall, the original store area had also been lined along both walls with counters behind which resided most of the store's stock, arrayed either on shelves that reached to the ceiling or in the drawers that composed the lower part of the cabinetry. This left only a narrow area in the center for the customer, who did not serve himself, but rather

Figure 3.5. The famous N. C. Wyeth painting of a boy in his basement laboratory, a poster of which hung in Young's Pharmacy and which so fascinated me as a boy.

asked the clerk for each item (figure 3.4). The original Albers Drug Store next to Palace Clothiers was still organized in this fashion, though in my day it was called Young's Drug Store. I use to buy chemicals for my home laboratory from the elderly pharmacist who owned it and recall being fascinated by a large cardboard poster of a famous N. C. Wyeth painting depicting a young boy in his basement laboratory (figure 3.5) that resided on top of one of the store's cabinets. The same was true of the Ploss Drug Store on Main Street (using this term generically, as it was actually labelled 3rd Street) and the Hoffman Drug store in the small town of Gresham, Wisconsin, near where my aunt Kathy lived, both of which retained their original layout and ambience well into my college years. Nor was this layout particular to 19th-century drug stores. The original Janke Book and Stationary Store on Main near Ploss Drug was laid out in the same manner (figure 3.6), as were many of the local neighborhood corner grocery stores that were rapidly disappearing during these years under

Figure 3.6. The interior of the Janke Book and Stationary Store in downtown Wausau, circa 1925, illustrating the persistence of the 19th-century arrangement of counters and stock shelves.

the onslaught of the large commercial supermarket chains.

When Schulz modernized the store, he replaced the side counters with small, shoulder-high, shelves for customer self-service, and he did the same with the original wall cabinets, thus creating three aisles for the store. Since the wall shelving also had to be customer friendly, and so could not be as high as the original cabinets had been, space had to be optimized. As a result, the new wall shelves ran the entire length of the store and covered the door to the rest room, which was located on the right-hand wall near the center of the pharmacy under the stairs to the overhead apartments. This door had originally been behind one of the side counters, but to provide access under the new arrangement, Schulz had to contrive that the shelving section in front of the door was mounted on casters and could be pulled out to access the rest room when necessary. To keep this shelving section as light as possible, it held hair care products, including my old nemesis, the

prophylactic hair brushes. It was drilled into me that we were never, under any circumstances, to reveal the existence of this contrivance to the customers. Hence, when one of the employees went to the rest room, the other rolled the section back into place. When finished, the rest room occupant would knock loudly on the door, and, if the coast was clear, his fellow employee would once again roll the section away from the door and release him

One evening when I was working the store with the younger pharmacist, we experienced a long lull and so he decided to use the rest room. I had no sooner rolled the false shelving section back into place then the store began to fill with customers – there must have been four or five. Half way through checking the first one out, I heard the pharmacist knock. Of course all of the customers also heard the mysterious knocking coming from the hair products section and I cannot recall what bogus story I invented to explain it. I think it took me a full 15 minutes to check out all of the customers by which time the knocking had become a furious pounding with the fists. When I finally succeeded in freeing him, the pharmacist was livid with rage and I had to remind him that I was merely following company policy. Such are the unintended fruits of modernization.

Boredom, Cough Drops, and Patent Medicines

Earlier I stated that the part of the job I hated most was cleaning the front windows on Saturday mornings, but this is not completely true. What I really hated most were the bouts of sheer boredom. Even when not admonished by Schulz to do your job at twice the normal speed, the fact remained that there were often long periods of down time after you had finished your prescribed tasks and during which no customers appeared. Unfortunately it was absolutely verboten to acknowledge this fact. God forbid that you read a magazine or a book,

Figure 3.7. (Left): A period ad for *Pine Brothers Glycerin Cough Drops*. (Right): A period box of *Sen-Sen* licorice squares.

or do home work, while waiting for a customer or for the day's closing routine to begin. You had at all times to look as if you were doing something to earn your precious $15.00 wage. As a result I took to pacing the store with a feather duster and to chewing on cough drops.

Thank God the store had no soda fountain, nor did we sell candy as such, or else I would have ballooned to my present weight 50 years earlier. However, a small case between the greeting cards and the front counter held a selection of cough drops, breath fresheners, and antacids and I took to purchasing these and chewing on them during my pacing. *Ludens* and *Smith Brothers* cough drops were in reality little more than candy in disguise, with an occasional added dose of menthol, but ultimately I seized upon a brand called *Pine Bros*. which was sweetened with glycerin instead (figure 3.7). These had a chewy texture, not unlike gummy bears, and were much longer lasting than the candy drops, so I got more pacing for my quarter.

However, my cough drop habit did lead to at least one strange adventure. One ungodly, long, boring Saturday afternoon, we seemed to hit the Bermuda Triangle of all customer lulls. A salesman had dropped off a large box of free samples of a brand of throat lozenge

Figure 3.8. (Left): A period ad for *Carter's Little Liver Pills*. (Right): A period label for *Lydia Pinham's Lady's Tonic*.

called *Cepacol* which, unlike the candy cough drops, contained a topical anesthetic for the treatment of sore throats known as benzocaine. They looked close enough to normal cough drops to suit me and they were free, so by the end of the day I had probably consumed 25 samples, could no longer feel my tongue, and was stumbling around in what can only be politely described as a total mental fog. It took me two hours to walk home instead of the usual half hour. Even to this day I have no idea what I did along the way to consume all that time.

Among the breath fresheners were rolls of peppermint *Lifesavers*, *Dentine Gum*, etc. and two antique looking products – small red boxes labelled *Sen-Sen* (figure 3.7) and brown paper rolls labelled *Carter's Little Liver Pills* (figure 3.8), both of which I had heard my mother mention. For the historical experience I bought and tried a box of *Sen-Sen* but found the intense bitter licorice taste repulsive and, after reading the list of ingredients on the roll of the liver pills, I decided that my own liver didn't need any improving. What this product was doing among the breath fresheners and cough drops is still a mystery to me. Possibly its claim to also cure acid stomach had earned it a

Figure 3.9. A period ad for Alpenkrauter stomachic tonic and laxative – though one not so Germanic as the box it came in.

place next to the *Rolaids*.

Any real drugs and pharmaceuticals were kept in the back room, though we did allow various patent medicines in the outer store – apparently under the theory that they were both ineffective and harmless. Many of these I found charming because of their antique looking labels. Thus I can recall selling bottles of *Lydia Pinkham's Extract for Change of Life* (figure 3.8), a product my mother recalled her grandmother and aunts using and whose efficacy, or so she always claimed, was due mostly to the large amount of alcohol that it contained. We also carried such well-known products as *Geritol* for "tired blood," but perhaps the most exotic patent medicine on our shelves was a tonic called *Alpenkrauter* (figure 3.9), which roughly translates as "Alpine Herbs." This came in a green box with half the

box labelled in English and the other half in German. It was still a favorite among some of the elderly German-Americans in town and I was taught to count their change out in German when they bought a bottle. My school councilors had told me I would have to learn German if I wanted to be a chemist and I was scheduled to take my first course when I entered high school the next year. As a consequence I was quite proud of having gotten what I unrealistically imagined to be a significant head start. On checking the internet, I am quite surprised at how many of these questionable products are still available.

Escape and Demise

By the end of the 9th grade I was thoroughly bored with the job and wanted out. It consumed all of my spare time, leaving me with none for work in my home laboratory or for reading, and I was thoroughly disillusioned with the realities of drug store life – disillusioned because, as I now realize, I had brought so many unrealistic expectations to the job in the first place. Though I had gotten straight A's in my academic subjects in the 9th grade, I was going to enter high school in the fall where I knew that the competition was much stiffer and the grades more important relative to college. My fellow amateur chemist and competitor, Raymond Fraedrich, was a year older than me and had just completed his sophomore year in high school. Despite his intense interest in the subject, he had experienced a difficult time in the high-school chemistry course and, with more than a definite whiff of *Schadenfreude*, he rather unkindly predicted that I too would soon meet my chemical Waterloo.

So rationalizing that I needed to concentrate on my school work, I turned in my resignation. I felt guilty doing this because, when I was hired, I had sort of promised that I would stick it out until the end of high school. However, in order to soften the blow, I had the inspired

idea of recommending Raymond as my successor. In the end we were both happy. I got my A in high school chemistry and Raymond got my job, where he was trained, as I had been, by Chuck Giese. While I had detested Schulz and his business ethics, Raymond flourished under his tutelage, stayed with the store until the end of high school, and eventually went on to pharmacy school (whether with Schulz's financial assistance, I do not know). He even married the daughter of a pharmacist and today operates a chain of drug stores in Utah. Though I have not seen him for more than 40 years, the few tales that have come my way suggest that he has also faithfully emulated Schulz's business practices.

On a sadder note, the Pradel Drug Store is no more. By the late 1960s Curtis and Yale had gone out of business and the plant was torn down and replaced by a shopping mall. In addition, the city, feeling that it needed a major feeder road from the new westside belt line into downtown, widened Steward Avenue and diverted its lower end to the bridges, thereby wiping out all of the businesses across from the Curtis and Yale site and opposite the drug store. Some of the surviving area businesses moved into the new mall, leaving their original buildings deserted, others moved to the suburbs, and Clarke Street became a *cul de sac* just a few feet beyond the hobby store. All of this began to progressively kill the drug store's business, so a few years later it moved into much smaller premises in a tiny strip mall down the street. However, the fate that had overtaken the small neighborhood grocery store was rapidly overtaking the local neighborhood pharmacy as well, and within a few more years the newer national pharmacy chains had put even this pitiful remnant out of business.

As for myself, I did not quite learn my lesson when it came to my illusions concerning the chemical relevance of commercial pharmacy. Throughout high school I continued to acquire pharmacy books, such as the *National Formulary* and various editions of the *United States*

Pharmacopoeia, all of which I found to be dull collections of recipes. Less disappointing was an 1889 edition of Remington's *Practice of Pharmacy,* which I discovered in a secondhand store located behind the old Sears and Roebuck building on Washington Street.[6] This was resplendent with woodcuts of chemical equipment and operations and was the very antithesis of what I had seen at the Pradel Drug Store. I even acquired a substantial collection of those glass-stoppered, pharmacy display bottles that Schulz had so ungraciously refused to sell, thanks to the generosity of a pharmacist in the local Mormon Church named Beth Soukup.

When I transferred to Madison my junior year of college and finally had access to the various history of science courses offered there, I took Glenn Sonnedeker's course on the history of pharmacy.[7] Because it was required for all pharmacy majors, the class was actually quite large and met in the main lecture theater of the old chemistry building. But once again both the lectures and textbook proved disappointing. There was little or nothing on the various famous pharmacists who had made substantial chemical discoveries or on the rise of pharmacology and modern molecular theories of drug design and action. Mostly the course consisted of a drab recital of the various legal battles between grocers, medical doctors, and pharmacists over who had the monopoly to sell this or that item, the drive for standardization of pharmaceutical recipes and education, and the rise of national pharmacopoeias. One came away with the impression that much of this had more to do with restricting commercial competition than with legitimate concerns of professional competence.

Though I did not know it at the time, much of this missing scientific history was being written by a young historian associated with Sonnedecker and the American Institute for the History of Pharmacy in Madison by the name of John Parascandola, but I would not discover his work until many years later.[8] After becoming a

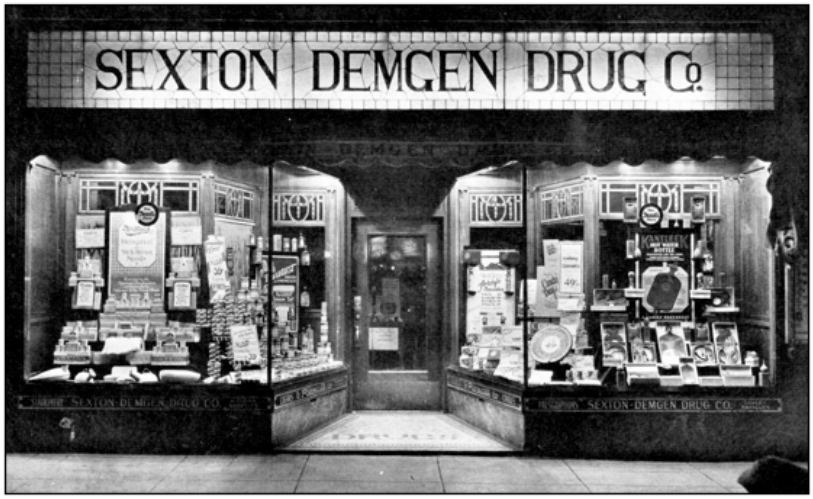


Figure 3.9. The exterior of the Sexton Drug Store in Marshfield, Wisconsin, as it appeared in the 1930s before its final remodeling in the late 1940s.

professor at Cincinnati, my interactions with the history of pharmacy continued. I made the acquaintance of a retired, and very disillusioned, historian of pharmacy by the name of Alex Birman, who had specialized in the history of 19th-century French and Swiss pharmacy. As a result of several lengthy conversations with him, I was able to greatly clarify my thoughts on the role of pharmacy in the rise of chemistry as a distinct profession. And, over the years, I have also had several fruitful contacts with various historians of pharmacy connected with the Lloyd Library in downtown Cincinnati.

Comparing Notes

I mentioned earlier that my uncle Clyde had also worked in a drug store as a teenager and, as might be expected, we have often compared notes over the years on our respective experiences. Certain aspects are remarkably similar. Clyde worked in a drug store in Marshfield, Wisconsin, about 45 miles west of Wausau, that dated from the late 19th century and had been founded by a pharmacist named W. A.

Figure 3.10. My uncle, Clyde Tracy, as he appeared in 1952 at age 13, the year before he began working at the Sexton Drug Store in Marshfield Wisconsin.

Sexton (figure 3.9). It was located on Central Avenue in what was called "the doctor's block" because of the large number of doctor's offices located in the apartments above the stores.

Like the Pradel store, the Sexton store had been remodeled in the late 1940s, and like the Pradel store, it had been sold to a new owner, who continued to operate the store under its original name – in this case a man named Benjamin Wing, who also owned a competing pharmacy located further down the street. Like myself, Clyde was 14 when he began working there in 1953 (figure 3.10), but unlike me, he continued in the job for five years and thoroughly enjoyed his work experience, becoming close friends with some of his fellow employees. He was paid 50¢ per hour and worked part time during the school year and full time during the summers. Since this routine often violated state laws about the employment of minors, he was paid any overtime beyond the state-allowed maximum out of a separate cash drawer so that there would be no tax record.

Unlike the Pradel store, the Sexton store had a lunch counter, as well as several booths for its diners, and unlike the Pradel store, it employed, in addition to my uncle, a woman as a full-time cosmetologist and only one full-time pharmacist. Since we are dealing with the 1950s, or nearly a decade earlier than my own experience, this pharmacist still compounded many of the prescriptions and, when overwhelmed with orders – mostly for various "powders" used by the elderly residents of the local old folks home – would allow my uncle to assist him. More of the original oak cabinetry had survived the remodeling at Sexton's than was the case with the Pradel store, but like Schulz, the new owner had painted it a cream color. My uncle also recalls that more of the old fashion glass-stoppered display bottles had survived the remodeling, as well as several antique balances, and that these were used to decorate the prescription area.

Clyde has similar stories about selling hard liquor out the back-door to the priest who lived in the rectory on the street behind the store, wrapping sanitary napkins in brown paper, steaming cigars, assorted adventures in the basement store room, the quaint bottles of patent medicines, the women who worked as operators at the nearby phone company coming in on Friday night to cash their weekly paychecks, and trying out the various free samples left by the ever-present salesmen. In his case, this did not involve getting tanked on *Cepacol* throat lozenges, but rather trying out various hair dye samples, which for a period left him with bright red hair rather than the blond color that had been advertised. He also has unpleasant memories of having to learn about the pros and cons of various breast pumps, enema attachments, trusses, and other highly personal paraphernalia that should never have darkened the mental horizons of a 14-year old. When he finished high school, the owner offered to help send my uncle to pharmacy school in Madison, but he declined and became, much to his credit, a college English teacher instead.

IV

Remembering High-School Chemistry

Though I had first met Harry Johnson in the spring of 1962, when he served as a judge for the regional science fair, it was not until the fall of 1963, when I registered for his fourth-period chemistry class my sophomore year at Wausau Senior-High School, that I finally came to know him. I had been looking forward to this event for some time. Despite the exciting opportunities provided by John Muir Junior High, by Mr. Klipstein, and by the Wisconsin Junior Academy of Science, they had all begun to look like small potatoes as 9th grade drew to a close. From my limited perspective, it now seemed that it was high school that was really the big time – no more general science classes taught by general science teachers with only a passing knowledge of chemistry, but a real chemistry course taught by a trained chemist. Of course, given Raymond's dire predictions concerning my impending academic doom, this anticipation was also understandably mixed with a certain amount of anxiety.

Curling and Exploding Milk Cartons

When I first set eyes on Harry, he was in his mid-sixties (figure 4.1). Short and bald, with narrow, slightly crossed eyes, he had the aura of a mischievous, albeit not necessarily benevolent, elf about him. He appeared to have only two modes of dress: either a short, light-brown lab jacket, which he always wore when teaching, or a combination

Figure 4.1. Left): My high-school chemistry teacher, Harry A. Johnson (1899-1992). (Right): Harry in his curling regalia. He coached the curling team for 17 years.

plaid jacket and oversized beret covered with badges and medals won by the high school curling team – a sport which only those driven to despair by the long, dark, frigid days of a Wisconsin winter could come to know and love, but which Harry had coached with great enthusiasm for nearly half of his teaching career (figure 4.1).

Born in 1899 in Stetsonville, Wisconsin, he had been trained in chemistry at Ripon College, where – or so he repeatedly told us – he had been a classmate of the future film sensation and heart throb, Spencer Tracy. By 1963 Harry had been teaching chemistry at Wausau Senior High School for nearly 40 years, having taken the job in 1923. He was something of an institution, and it seemed that all of the

parents of my friends who had been raised in Wausau remembered having had him for chemistry at some time in their long-vanished youth.

For the first few weeks of class, it seemed to be a toss up whether Raymond's dire predictions would come true. The first day Harry had appeared with two cheap, cartoon-like, plastic dolls with puckered lips – one male and one female – which looked like they had been purchased at a novelty shop sometime in the 1940s. He placed them on the demonstration desk about six inches apart and let go of them. They obviously had strong magnets in their heads and they immediately slid together in a plastic lip lock. "That," Harry proudly announced, "is chemistry!" Then, as if to emphasize the significance of this remark, he made a sweeping gesture with his right hand and proceeded to accidentally knock several pieces of glassware into the sink.

A similar ambivalent message was conveyed by the first examination on which Harry asked us to use the metric system to calculate the volume of dirt contained in a hole 50 centimeters x 1 meter x 800 millimeters. We all dutifully sweated through the necessary conversions only to find, when the exams were returned, that we had all gotten the answer wrong, because, as Harry proudly announced to us, everyone knows that there is no dirt in an empty hole. This was profoundly disturbing, not because we didn't appreciate the joke, but because Harry was constantly making mistakes on his exams and, for the rest of the year, we could never be certain whether we were dealing with an unintentional typo or with another trick question.

The first week Harry also requested that each student bring three empty wax milk cartons to class. The purpose of this odd request became apparent as the year progressed. It turned out that Harry dearly loved explosions, and any gas – methane, hydrogen, ethene, acetylene, nitrous oxide, or carbon disulfide vapor – that could be mixed with oxygen to form an explosive mixture, was duly demonstrated (figure

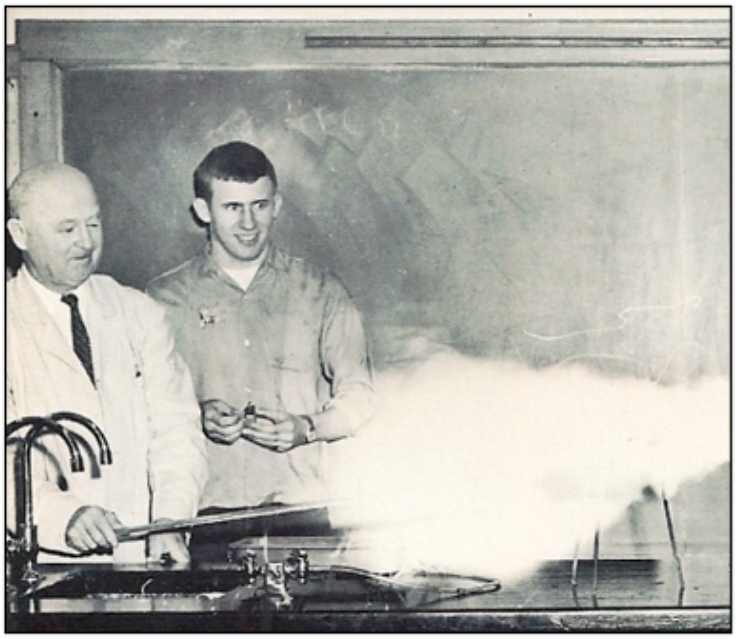


Figure 4.2. Harry with lab jacket, meter stick, and explosion.

4.2). The usual drill was to mix the gas or vapor in question with oxygen in one of the empty wax milk cartons, place it on a metal tripod inside a packing crate set on one end with the open top facing the students, and ignite it with a burning splint taped to the end of a meter stick. If the ensuing explosion was particularly violent, Harry would tape two meter sticks together and crouch behind the demo desk wildly waving the burning splint in the general direction of the packing crate while the class cowered at the back of the room. Often he would do two of these explosions per period, six times a day. I still remember sitting in English class, when, for at least the tenth time that day, a muffled explosion came from the third-floor chemistry laboratory. The English teacher stopped midsentence, slammed her book down on the lectern, and bellowed, "That God damn fool is at it again!" We all sat there stunned. In the 1960s teachers never used phrases like "God damn fool," or at least not in front of students.

The exploding milk carton, however, was not Harry's *piece de resistance*. That was his device for demonstrating how an internal combustion engine worked. It consisted of a six-inch length of iron pipe, one end of which was welded to a metal plate. Half way down the pipe an automobile spark plug was set into the wall. Harry would fill the pipe with a few drops of gasoline, cork the open end, and warm the outside cautiously with a Bunsen burner to ensure vaporization. He would then set the device on its side with the cork aimed down the center of the room (the class having pressed itself against each of the classroom walls), and touch the spark plug with an induction coil. The result was a violent explosion followed by a cork firmly embedded in the back wall of the room, where the numerous matching holes provided mute evidence to the continuing success of the device.

Not all of Harry's memorable demonstrations involved explosions. Bleaching was another favorite topic, whether done using chlorine gas, ozone, or sulfur dioxide. On these occasions he would wear a very broad, and very ugly, necktie dating from the 1940s to class, and each period would snip off a piece of it using a pair of scissors and proceed to bleach it. By the end of the day he was running around with only an inch or two of cloth dangling beneath the tie knot. Indeed, many of his nonexplosive demonstrations were of the practical household hints variety and involved such topics as the electrolytic cleaning of silverware and the making of tooth paste. He always maintained that the commercial versions of the latter product were a sham and a rip-off as the active cleaning and polishing ingredient was actually fine sand, and he further claimed that he was going to make a fortune when he retired by manufacturing it in his basement.

His few attempts to directly involve students in these demonstrations were not always a resounding success. On one occasion Harry had a student come to the front of the class and taste a very dilute solution

of hydrochloric acid. When he asked the student what it tasted like, the student replied "horrible." "Wrong," said Harry, who was looking for the textbook pronouncement that acids taste sour, "Try again." Back came the answer "terrible," then one more try and the answer "bitter." By this time the student could barely talk, so Harry had him rinse his mouth out with lime water and they started over again. After another four incorrect adjectives and another rinsing with lime water, the now incoherent student was finally allowed to sit down and Harry, his mind no doubt filled with black thoughts concerning the academic decadence of the younger generation, provided the missing adjective himself.

As things turned out, Raymond's predictions of my impending academic doom proved false. I easily got an A in Harry's class and soon became, as I now retrospectively realize, the teacher's pet. On several occasions Harry even allowed me to lecture to the class, though he kept this to a minimum, no doubt realizing that I was risking death at the hands of my fellow students. Most of the time, however, he allowed me to skip class and to spend the hour in the back room instead. This was a small combination office and stock-room separating the two chemistry classrooms on the third floor of the 1937 wing of the high school. The south classroom was Harry's domain and the north classroom belonged to Arthur Hagemann (of whom more in a bit).

Despite the date of the building, this back room had a definite 19th-century feel to it, since most of the bead-board cabinet work and chemicals – virtually all of them in corked or glass-stoppered bottles purchased from Germany before the First World War – had been transferred from the older 1898 high school building, which was still being used and which was connected to the newer section by means of an enclosed walk over (figure 4.3). Here I would spend the class hour, as well as after school, conducting experiments of my own devising or

Figure 4.3. The officers of the chemistry club for 1965 hanging out in Harry's back room. I'm on the far right and my friend Jim Wicke is on the far left. Note the bead-board shelving from the original 1898 building.

reading the various advanced chemistry texts belonging to Harry and Art that were stored there. Harry was also aware that I was an avid home chemist and would often give me chemicals and old equipment for my home laboratory, much of it dating from the late 19th century. Fortunately many of these items survived my home experimentation and are now preserved in the Oesper Museum of Chemical Apparatus in Cincinnati. At the end of the year, he made me a present of an inscribed copy of the mathematical tables from the *Handbook of Chemistry and Physics*, which I still own and use in my own teaching.

CHEM Study and Monads

My junior year was Harry's last year of teaching and, when he retired

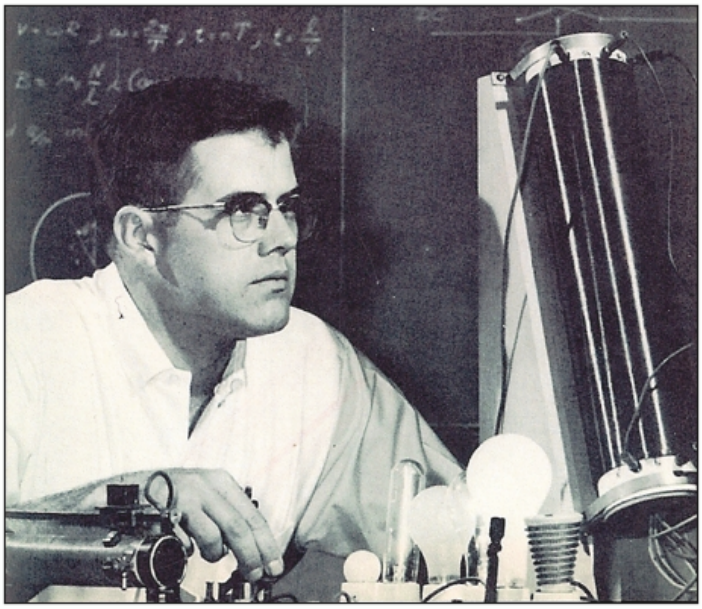


Figure 4.4. Art Hagemann posing with a nonsensical arrangement of physics apparatus for the student yearbook.

in the spring of 1965, I inherited many of his books and files. These included his personal copy of the 1931 edition of Charles Dull's *Modern Chemistry*, which Harry had used, in one form or another, as a textbook for most of his teaching career at Wausau Senior High. First published in 1918, the book had been kept in print for more than 40 years through a process of continual revision and updating, and we had used its direct descendent, the 1958 text, *Modern Chemistry* by Dull, Metcalfe and Williams, the previous year.

This traditional approach to chemistry, with its emphasis on industrial and household applications, stood in sharp contrast to the modern *CHEM Study* course taught by Art Hagemann (figure 4.4). Cobbled together by the American Chemical Society to undercut the challenge of the truly innovative *Chemical Bond* or *CBA Approach* to high school chemistry, *CHEM Study* was essentially a watered down college course with extensive doses of the inductive laboratory approach inserted. The textbook was relentlessly dull in a way that

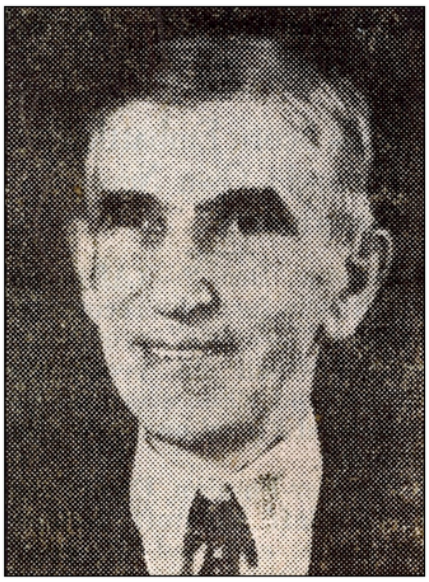


Figure 4.5. Harry's predecessor, Anton P. Minsart (1870-1938).

can only be achieved when something is put together by committee mandate, and the inductive exercises were insultingly artificial. I remember my former nemeses from my junior-high science fair, Steve Weiner and Jim Smit, making fun of the course in debate class. One of the laboratory exercises involved the examination of a small black box with several unknown objects inside (either pennies or paper-clips, I believe). By shaking, weighing, and otherwise fooling with the box (but without opening it), the students were suppose to construct a feasible model of what the objects inside might be like. The idea was to parallel the process of inductive model building with respect to atoms and molecules, which were likewise inaccessible to direct observation. As members of the Lyceum philosophy club, founded by my friend, Tom Schwartz, Steve and Jim were bored by this game and instead contrived a laboratory report in which they purported to have deduced that the box contained Leibnizian monads. Rumor had it that Art was not amused by this satire.

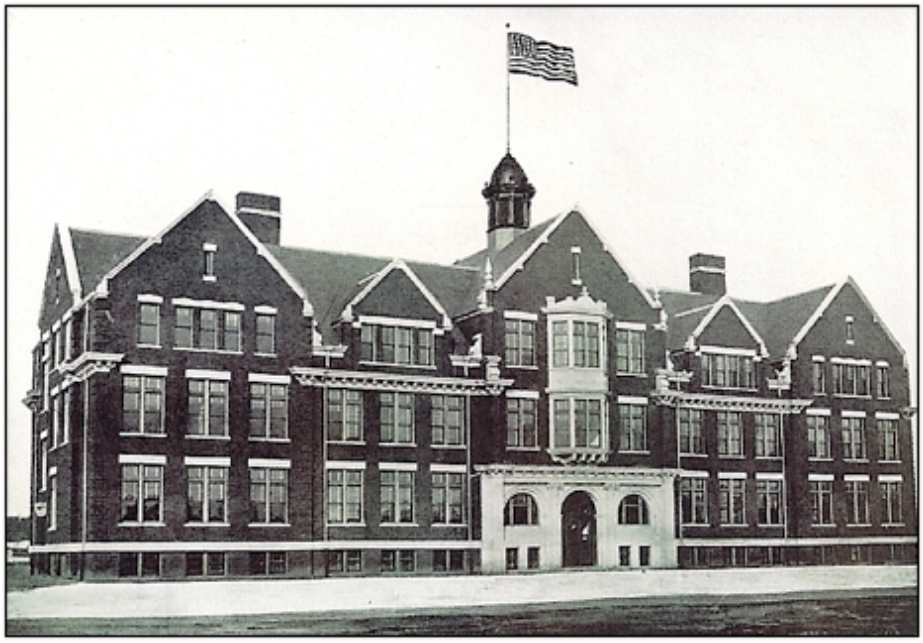


Figure 4.6. The original 1898 high-school building. Chemistry and the other sciences were originally located on the third floor and shared an elevated lecture hall located in the large dormer above the main entrance.

My younger brother also took *CHEM Study* from Harry's successor the first year I was in college. I can still remember him asking for help and, each time I gave him the answer, his plaintive wail of "But we're not suppose to know that yet." I doubt if any student ever worried more about what he was not suppose to know at any given time than did my poor brother during that year of inductive chemical hell.

It turned out that, among the items given to me when Harry retired, were many of the books and files (including an obituary) of his predecessor, Anton P. Minsart (figure 4.5). Born in 1870 in Brown County, Minsart had taught at several Wisconsin high schools before obtaining a degree in chemistry from the University of Wisconsin at Madison. In 1918 he became head of the science department and chemistry teacher at Wausau Senior High, where he remained until his retirement in 1936. At that time the chemistry department was located on the third floor of the 1898 high school building and sported an

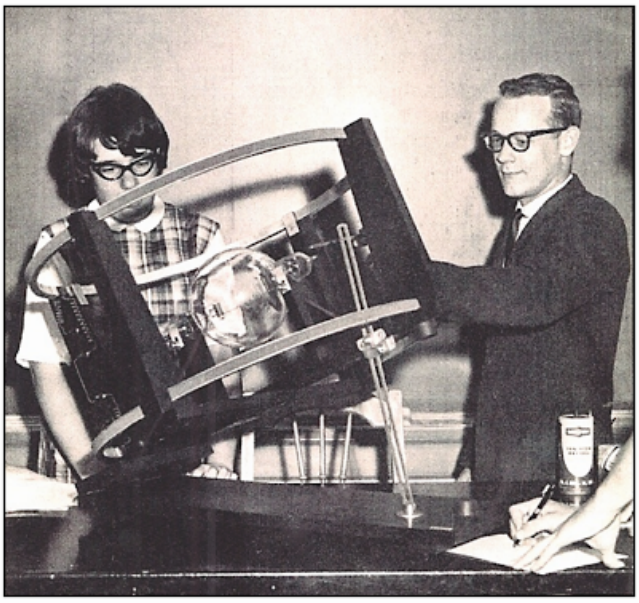


Figure 4.7. Jon Harkness demonstrating J. J. Thomson's apparatus for determining the charge to mass ratio of the electron.

elevated lecture hall located in the huge dormer directly above the main entrance (figure 4.6). Most of the chemicals and equipment that Harry gave me for my home laboratory had been purchased by Minsart and, like them, his books now reside in the Oesper Collections in the History of Chemistry at the University of Cincinnati.

High-School Physics and Collapsing Doors

Though I continued to haunt the back room of Harry's classroom in my guise as president of the chemistry club, the official academic commitment for the junior year was to the physics course taught by Jon Harkness (figure 4.7). Somehow Newton's laws of motion did not lend themselves to the spectacular exhibitionism that Harry had specialized in, and the anecdotes for this year are correspondingly muted. I do recall, however, that Karl Stahmer tried teaching himself

calculus that year, though apparently with little success, as Jon would repeatedly chastise him for trying to use his newly discovered art on his physics exams.

In the physics classroom we sat at small tables that faced the front of the room. These were originally designed to seat two students, one on each side of a small central storage cabinet located beneath the table. However, due to overcrowding, a third student had to be seated in front of the cabinet door at many of the tables. At one of these tables, this third student developed the habit of wedging his chair at a 45 degree angle between the cabinet door and the table immediately behind. One day, as a joke, several of the students unhinged the cabinet door on this table before class and then set it carefully back in place. When class started, the student in question rotated his chair back into its familiar 45 degree position. I believe it took a full five minutes for the door to finally give way and for the student and chair to slam loudly on the floor. It was a brilliant demonstration of the law of leverage, though one that was thoroughly unappreciated by Jon and, in retrospect, an extremely dangerous prank. The distance between tables was not great and the fall snapped the back of the chair. Why it didn't break the student's back as well is a mystery to me. It is a wonder that any of us survived the stupidity that passes for adolescent male humor.

The best opportunity for applying the chemical wisdom imparted by Harry came, however, not in Jon's physics class, but in Brian Bennett's "American Problems" course our senior year. The realities of the Vietnam War and the impending countercultural revolution were still distant rumbles in Wausau, Wisconsin, in the early 1960s, and Bennett's views on politics and teaching were considered a tad too liberal by our rather limited standards. It was Bob Vorwalske, I think, who first suggested – shortly after Bennett announced that we would be reading the *Communist Manifesto* for his class – that we should

rename the well-known acid-base indicator, phenolphthalein, "Brian Bennett Pink" in his honor. This was enthusiastically endorsed by all concerned. Performing a titration soon became known as "conducting a Congressional hearing," and titration to the endpoint – the point at which the pink color of the indicator no longer faded – became known as the "smearpoint." I hasten to add that there were no heartfelt political convictions behind these euphemisms. It was nothing more than opportunistic adolescent sarcasm and was applied indiscriminately to both ends of the political spectrum.

Like myself, Bob was one of several students who wrote for *Subversive*, a student-produced magazine of local and national political satire which we published intermittently throughout our high school days in the attic of Doug Johnson's house on McIndoe Street, initially using a gelatine hectograph and later using a circa-1930 mimeograph machine that Ken Maaske and I had purchased for $10.00 at Mr. K's Junk Shop, which was located behind the Sears Store just off main street.

Integrated Science and Astronomical Objects

By their senior year, the science nerds of the high school had run out of science courses. We had all taken biology in Junior High School, chemistry our sophomore year, physics our junior year, and nothing else was in the offering. To meet this challenge, Jon Harkness and Art Hagemann put together an advanced course for us entitled "Integrated Science." Just off the huge study hall (306) at the north end of the third floor there was a metal door labelled 308. After a jog through a small entry way, this led into a long, very narrow, room that spanned the entrance to the school auditorium. This we were given for our new course. The room, when we inherited it, was empty save for a single object – a large marble-fronted box with a coil projecting from the

Figure 4.8. Members of the integrated science class look on as Gary Meyer draws a spark from the Odin Resonator. Blair Peshak is on the far left and I'm on the far right. Visible between Blair and Gary are Bruce Maaser (holding the slide rule), Richard Koch, and Bob Vorwalske. Barely visible between Gary and myself is Tim Swanson.

top. Labeled an "Odin Resonator," it looked like something left over from the set of the original 1931 movie version of Frankenstein. It had been apparently donated to the physics department by the telephone company sometime in the 1920s and was designed to generate high-voltage electrical sparks several feet in length.

We had two electrical prodigies in our class, Blair Peshak and Gary Meyer, who immediately began vying for control of this device. I recall them taking it apart to clean and discovering an enormous oil capacitor inside and the fact that the circuits were formed of quarter-inch solid copper tubing rather than wire. An article in the school newspaper entitled "Special Classroom, Special Class, Accommodate

Future Science Wizards" shows a photograph of the class gathered around this device as Gary draws a foot-long spark from the coil and Blair watches from the side with a look on his face far more lethal than the spark that Gary is coaxing from the resonator (figure 4.8).

As suggested by its name, integrated science was intended to be one third advanced biology, one third advanced chemistry, and one third advanced physics, with a few weeks of history of science thrown in. But, aside from a talk by one of the biology instructors on the role of induction in science, during which he was challenged by several Sherlock Holmes fans in the class, who claimed that science was really deductive, I have no recollection of anything but the physics portion of the course. I recall repeating J. J. Thomson's measurement of the charge to mass ratio of the electron, the Millikan oil-drop experiment, and the famous Michelson-Morley ether-drift experiment, of playing with ripple tanks and confirming Newton's laws of motion using frictionless metal "hockey" pucks that traveled on a layer of carbon dioxide gas provided by a chunk of dry ice placed on top. And I recall watching a three-minute movie made by a physics teacher in Brooklyn of a flea dragging one of these two-pound frictionless pucks across a table top.

And then, of course, there was our brief fling with astronomy. Several evenings a week Jon (figure 4.9) would come into school to grind mirrors for a project related to his master's degree, and he would allow several of us – as members of the school's astronomy club – to accompany him so that we could take the departmental telescope up to the roof of the school. After looking at the moon, at Jupiter, and at the rings of Saturn, we soon discovered that one star basically looked like another, at least at the magnification available to us. It was at this point that someone remembered that one of the school cheerleaders lived in a house across the street. Since such creatures were as far removed from the realm of science nerdom as were the stars we had

Figure 4.9. Jon Harkness caught in a typical teaching posture.

been looking at, it was immediately decided that she qualified as a legitimate astronomical object. As it turned out, all we could see from our position was the top of the house and one attic window. Nevertheless, it was while we were engaged in this fruitless search for more interesting objects of observation that Jon appeared on the roof to check up on us. Having been caught in *flagrante delicto*, so to speak, our telescope privileges were immediately suspended.

The last part of the integrated science course was spent on individual research projects. Building on my continuing interest in qualitative analysis, I worked with Art on developing a sulfide-free qual scheme based on the use of hexacyanocobaltates, and can only remember one of the other projects. For some reason that escapes me, Richard Koch decided to do a study involving the use of sterilized

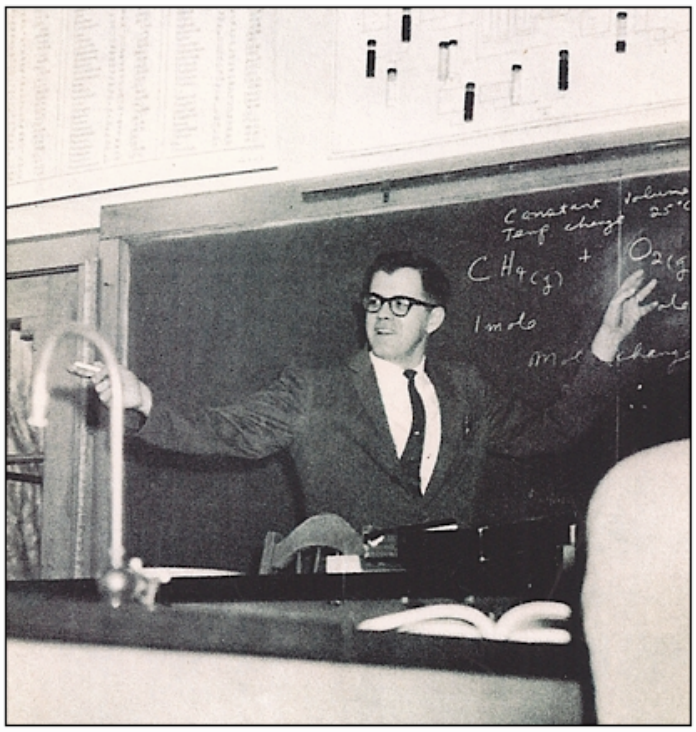


Figure 4.10. Art Hagemann in his hallmark, blue, double-breasted suit holding forth on the stoichiometry of methane combustion.

female white mice. Unfortunately it is not easy to determine the sex of white mice by external examination only and Richard, who wore very thick glasses, ended up removing the intestines from several male mice under the mistaken impression that he was removing the ovaries from female mice. I am sure it comes as no surprise that the project was not a resounding success due to an abnormally high mouse mortality rate.

Art Hagemann was nearly 30 years younger than Harry (figure 4.10). Born in 1931, he had received his chemical training at the University of Wisconsin, after first serving in the Korean War. Like Harry, he seemed to have only one mode of dress – a somewhat dated dark blue, double-breasted suit, which he always wore unbuttoned, though he usually preferred to teach in his shirt sleeves. He smoked a

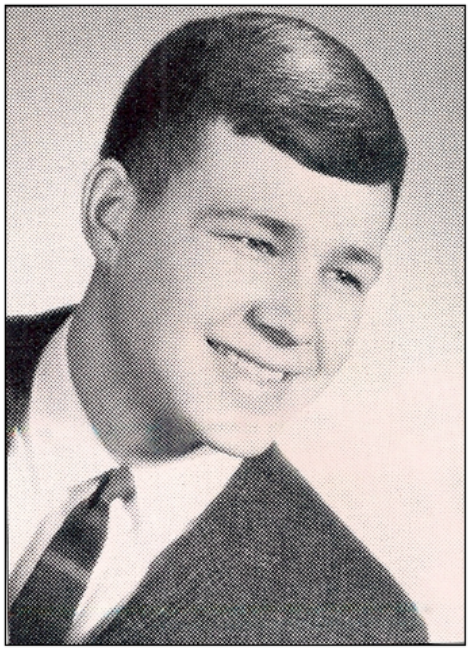


Figure 4.11. John A. Ihde, Harry's successor.

pipe; wore an angler's hat with the brim turned down; drove around in a tiny, beat-up, blue Renault; and raised honey bees as a hobby.

Though I never saw Harry again after his retirement, I did keep in touch with Art. During my years in Madison, I would occasionally visit him at the old high school and later at the newer high school on the west side. In this way I also got to know Harry's successor, John Ihde (figure 4.11), who was the son of Aaron Ihde, the person who had signed my award certificate for the 1963 science fair and who was an internationally known authority on the history of chemistry, as well as one of my future professors at the University of Wisconsin. The last time I saw Art was in the summer of 1988 when he, John, and Aaron Ihde all attended the 10th Biennial Conference on Chemical Education at Purdue University, where I was chairing several sessions. We had lunch together and thoroughly enjoyed reminiscing about former times. Three years later, John informed me that Art had driven home

during the noon hour to have lunch as usual and had died of a sudden heart attack. He was 60 years old. Harry, as I later found out, actually outlived him, not dying until 1992 at the age of 93.

Looking back on 30 years of my own teaching, I now realize how lucky we were to have been high-school students in the 1960s. We were the end product of the Sputnik era and benefited by a brief period of government-sponsored emphasis on excellence in science teaching. Looking at the yearbook for my senior year, I find that three of us – myself, Michael Kluetz, and Paul Wollenzien – all listed chemistry as our future occupation. All three of us attended the University of Wisconsin at Madison, all three received doctoral degrees in chemistry, and all three became university professors. I also find that Ben Sternberg listed science as his future occupation and Blair Peshak listed electrical engineering. Ben earned a doctorate in physics, and Blair not only completed an engineering degree at Wisconsin, but went on to play an important role in designing some of the first IBM personal computers.

When interviewed after his retirement in 1936, Harry's predecessor, Anton Minsart, made two observations about his experiences as a chemistry teacher: 1) the students in his early days had been better than those later on, and 2) the girls were generally better students than the boys. I wonder what Minsart would have thought of our integrated science class. Would he have revised his opinion, at least with respect to his first observation? As for the second, we would have been of no help whatsoever. In the 1960s, at least, science nerdism, like autism, was still a predominantly male affliction.

Organic Chemistry and Zimpro

High school saw a new strand added to my chemical activities in the form of a growing interest in organic chemistry, and with it a corre-

sponding expansion of my home laboratory. In actual fact this interest had already begun in the 9th grade when I discovered the 1941 edition of Louis Fieser's laboratory manual, *Experiments in Organic Chemistry*, in the public library.[1] Here was a new world of reflux condensers, fractionating columns, distillation flasks, three-necked reaction flasks, electric stirrers, and dropping funnels that exceeded in both complexity and fascination the simple world of test tubes and beakers I had known from my work in qualitative analysis. But there was a problem – such apparatus was unavailable at John Muir, or indeed at any junior high for that matter, and the same was equally true of most of the required organic chemicals. In addition, the preps described by Fieser were macro in the extreme and sometimes required as much as 25-30 grams or 100-200 mL of starting material – close to the total amount of almost every chemical I had managed to acquire for my home laboratory.

A partial resolution of the apparatus and quantity problems occurred shortly afterwards when I purchased a copy of a small book by Burton L. Hawk entitled *Organic Chemistry for the Home Laboratory*.[2] This was published by the Science Service of Washington DC and I had seen it advertised in the *Chemistry* magazine that they also published and which I had selected as my prize for winning the 1962 Wisconsin Junior Academy of Science regional science fair. Most of the organic reactions described by Hawk were scaled down. As a result they required far smaller quantities of starting materials and could be performed in a conventional test tube or flask. This was possible because the emphasis was no longer on the isolation, purification, and yield of the various products, as in most academic lab manuals, but rather on their detection via a characteristic odor or color change. In keeping with this shift in emphasis, Hawk included instructions for the preparation of a large number of dyes and odiferous esters, as well as a section on synthetic polymers.

However, because of the continuing lack of organic chemicals, I was able to try only one of Hawk's preparations while still at John Muir – the synthesis of a polysulfide polymer called Thiokol made possible by my discovery of a stray bottle of dichloroethane in one of the stock rooms. This synthesis was performed in the back room of another science teacher by the name of Mr. Leffin. He had caught me reading the Fieser lab manual in study hall and, after talking with me about my new interest, had offered me the use of his room. I was assisted by my friend Blair Peshak and we performed our work during our free period, even though Leffin was simultaneously teaching a regular science class in the adjoining classroom.

The preparation itself was successful and we actually obtained a small sickly-white ball of polymer. However, part of the process required the preparation and use of a solution of sodium polysulfide made by dissolving sulfur in hot sodium hydroxide solution. Unbeknownst to me at the time, hydrogen sulfide or rotten egg gas is often formed as a byproduct in this step, though this fact soon became glaringly apparent not only to Blair and myself but to Mr. Leffin and his students in the adjoining room – a revelation that was amplified by the fact that this back room, like that of Mr. Klipstein, had no hood. Suffice it to say that Blair and myself were never invited back again to continue our pursuit of organic chemistry.

We had actually taken an earlier free period to transfer the chemicals and set up the apparatus we would need in Mr. Leffin's back room. Since we finished this task before the period was over, we passed the remaining time in the adjacent office watching Mr. Leffin through the plate glass wall, perform demonstrations. He was using a van de Graaff generator to electrify a female student volunteer with a large head of hair. He asked her to sit on a stool, but suddenly decided that he should first insulate her from the floor. Winging it, he proceeded to place each leg of the stool inside of a large glass beaker. Apparently

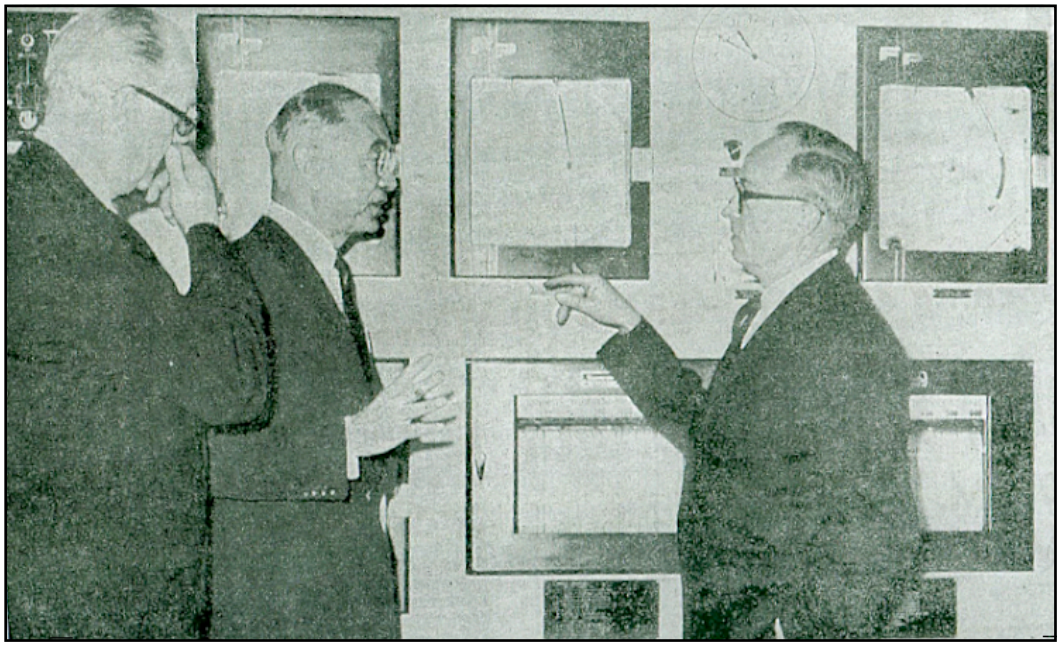


Figure 4.12. A badly stippled news-paper photograph of F. J. Zimmerman (second from left) taken on the occasion of the dedication of two Zimmerman sludge reactors at the Wausau Sewage Treatment Plant in 1961.

he had never observed that the bottom of a beaker is not flat, but rather slightly concave, and predictably, the moment the student climbed onto the stool all four beakers shattered with a loud snapping sound. Given my obsessive need to collect and preserve laboratory glassware, I considered this loss to be far more tragic than the possible electrocution of the student volunteer.

Once I began high school, I was able to gain access to all of the organic chemicals I needed to perform the experiments described in Hawk's book and its heavily stained pages testify to the fact that I used it frequently over the next few years. Though many of these came from the collection of pre-World War I German-made chemicals in Harry's back room, a second source of both chemicals and apparatus unexpectedly became available near the end of my sophomore year via the intervention of my old mentor Roger Bauer. I was sitting in Mr. Lee's world history course when Bauer appeared at the door with

a note excusing me from class for the day. He then drove me down to Rothschild to an industrial research laboratory owned by a company called Zimpro. The company's president, a British-born chemical engineer by the name of Frederick J. Zimmerman (figure 4.12), had expressed a desire to mentor a student in the public school system who was interested in pursuing chemistry as a career and Bauer had decided that I was the most likely candidate.

I had a very pleasant interview with Zimmerman, who affected the manner of a proper British gentleman, during which he told me of his exploits as an amateur boy chemist back in England. When he discovered that I was currently into dye chemistry, he further confessed that this had also been one of his favorite subjects and that while still a teenager he had amassed an extensive dye collection. Afterwards I was taken on a tour of the laboratories, most of which were empty – rows and rows of gleaming new lab benches but not a chemist nor piece of glassware in sight. There was also a small library and a pilot plant.

The purpose of Zimpro was to develop a new high-pressure wet oxidation process for the disposal of sewage sludge that would eliminate the fuel intensive steps of first drying and then incinerating it. Known as the Zimmerman process or "zimpro" for short, it could be applied, with proper modifications, not only to human waste but to such materials as discarded plastic bottles and other unwanted substances.[3] Unlike the research laboratories, the pilot plant was fully operational and I was shown before and after samples, whereby an entire barrel of waste plastic was reduced to a small handful of limpid grey powder. I have since learned that Zimmerman had earlier gained success by developing a method for the industrial synthesis of vanillin using the waste lignin from the adjacent Marathon Paper Mills and this success was apparent to anyone living nearby, since the entire Rothschild area reeked of vanillin.

Finally, I was taken to the analytical laboratory and introduced to a small group of chemists. These men were not dressed in white lab coats and ties like the scientists I had seen on TV or in the movies, but rather in loafers and sports shirts. They were very informal and I suspect that few of them held degrees beyond the B.S. level. They were told that I would be contacting them from time to time with requests for chemicals and apparatus and that they should comply, if possible, with these requests. Thus it came about that every few months, having phoned ahead my order for, say, red phosphorus or isopropyl iodide, I would take the city bus down to Zimpro to pickup my latest contraband. This was about an eight-mile trip and consumed at least 45 minutes each way. I was often the only passenger on the bus and would sit there clutching my box of chemicals or a new reflux condenser as the aging vehicle lurched back and forth over the potholes. I cannot even imagine what would happen today if someone tried to enter a city bus with an armful of chemicals and chemical apparatus, but in truth I knew many of the bus drivers by name as the same city buses also took me to school each morning and, like most of the adults I encountered, the drivers were more than happy to encourage my passion for science.

As already mentioned, Zimpro also maintained a small chemical library just off the main lobby and I was allowed to occasionally check out books. Many of these were in German and dated from before World War II. I later learned that these were from the private library of a German chemist in the employ of Zimpro by the name of Eugene W. Schoeffel, who, like Zimmerman, held numerous patents relating to both the wet oxidation process and the earlier vanillin process.[4,5] In his later years, Schoeffel became something of a local Wausau "character." He lived in a large log cabin on Rib Mountain filled with oil paintings, statues, and books on the occult; had gone through numerous wives; sported both a walking stick and a checkered

Figure 4.13. View of one wall of my relocated basement laboratory as it appeared my last year of high school. Not visible are the floor to ceiling shelves for chemical storage and most of the double-sided lab bench I made from the large library table. Note that the screw-top dropper bottles for my qual reagents have been replaced by professional Barnes dropping bottles.

cape and hat more in keeping with the moors of Scotland than the streets of Wausau; and specialized, as my mother will testify, in terrorizing the librarians at the public library with his demands for access to the latest patent literature, always made using his most exaggerated German accent.

In later years various members of my family would also become associated with the Zimpro facility. For several years my brother Stephen designed computer systems and circuit boards for them, and two of my paternal cousins, Tommy and Davy Jensen, were also briefly employed there – Tommy as a civil engineer and Davy as a plant operator. Even the young woman who managed the library was

Figure 4.14. Mr. Jinx, the family tabby cat, whose antics led to the final relocation of my basement laboratory. The bow tie was our short-lived attempt to make him conform to his cartoon namesake.

known to me, as she was a cousin of Tommy and Davy on their mother's side whom I had met many years before at various Jensen family get-togethers.

Cats and Law Suits

My junior year of high school I moved my home laboratory once more, this time from the basement laundry room to the adjacent store room (figure 4.13). This move was prompted by the antics of our family cat. A stray male tabby cat whom we had acquired while living at Leffine's, he was cursed with the name of "Mr. Jinx" in honor of the cartoon cat ("I hate mices to pieces") on the Huckleberry Hound show, which my siblings and I used to watch, for lack of anything better, each day at 5:00 pm (figure 4.14). On a cold, frigid evening in January he succeeded in getting into the basement laundry room and, on attempting to jump up into the basement window above one of my lab benches, proceeded to knock a quart of formaldehyde onto the cement floor, where it promptly broke and flooded the house with teargas-like fumes, driving us all out into the freezing winter night. Finally my

mother and I worked up enough courage to reenter the house and mop up the spill using plenty of water to dilute the offending chemical.

It was primarily to prevent a repeat of this incident that I agreed to move my laboratory, since the store room had a door that could be kept shut in order to prevent any further transgressions on the part of Mr. Jinx. In addition, all four walls of this room were available for shelves and lab benches in contrast to the two corner walls beneath the basement stairs that I had been using in the laundry room. The only disadvantage was that I was now cut off from the heat given off by the main furnace pipe which passed through the wall separating the furnace room from the chimney in the laundry room. As a consequence, my lab was frequently so cold during the winter months that it was unusable and I sometimes had trouble with my liquid chemicals freezing. I particularly recall the loss of a lovely antique amber, glass-stoppered bottle of glacial acetic acid – one of the few items I had convinced the miserly Schulz to part with during my employ at the Pradel Drug Store. One day I found it frozen solid and the bottom of the bottle shattered by the expanding crystals.

One of the few laboratory accidents I ever had also occurred in this new location. My friend Blair Peshak was working with me on some organic synthesis and I had assigned him the task of preparing a small quantity of nitrobenzene. Following the instructions in Hawk, this was done in a narrow test tube filled about one fourth full of a mixture of benzene, nitric acid, and sulfuric acid and gently heated over a small alcohol lamp. Though benzene is flammable, the narrow tube, if held with its opening away from the flame, presented little danger of catching fire. I was busy with a separate preparation at another lab bench and, unbeknownst to me, Blair decided to innovate and to instead heat the mixture in a wide-mouth beaker which he hand-held over the open flame. Predictably it burst into flame and burned the back of his hand. My mother treated the burn as best she

could and he was sent home, where his father went into a rage and threatened to sue my family. Luckily Blair was aware that it had been his fault for not following instructions and was so embarrassed by the incident that he talked his father out of the suit and nothing further came of it.

Books, Journals and Notebooks

During my high school years I also began collecting antique chemistry books. As I will relate in the next chapter, this began the summer of my sophomore year when I attended a Chemistry Institute in Minneapolis, and greatly accelerated my senior year and during my first two years of college at the local University Extension Center, due in large part to the fact that my friend, Tom Schwartz, who was two years my senior, was by then living in Madison. I would accompany his mother and sisters whenever they visited him and was soon a regular customer at Paul's Used Book Shop on State Street, a habit that would continue throughout my own time in Madison as an undergraduate student, graduate student, and instructor. Here I first acquired about 20 volumes belonging to the library of a 19th-century German-American chemist by the name of Julius W. Tiemann, including works by Berzelius, Wöhler and Mohr. I would later learn that Tiemann had been associated with his older brother and nephew in the operation of a paint and pigment company in New York City known as D. F. Tiemann & Co. Color Works.

Later, on attending a used-book sale at the local Universalist Church in Wausau, I acquired about a half dozen, circa 1900, chemistry monographs that had belonged to a German-American chemist named O. E. Ruhoff, including works by Ostwald and Harry Clary Jones, though I was never able to obtain any information about their former owner. At this same sale I also picked up a 19th-century Anglo-Saxon grammar that had belonged to the famous American philosopher,

Charles Pierce, while still a student at Harvard. What this book was doing in Wausau Wisconsin is a total mystery to me. Just a few years ago I donated it to the Charles Pierce Edition Project at Indiana University / Purdue University in Indianapolis, which is attempting to reassemble Pierce's personal library.

These collecting activities extended not only to antique books, but to both current books and journals as well. Thus in 8th grade I used the birthday money given me by my paternal grandmother to purchase my own copy of Weeks' *Discovery of the Elements*, and by high school I had a closet full of unbound issues of *Chemical Abstracts* and *Industrial and Engineering Chemistry*, though I can no longer remember who gave these to me. Both journals were in absolutely pristine condition and the issues of *Industrial and Engineering Chemistry*, most of which dated from the Second World War, were of double interest for their colorful covers which frequently featured either violently anti-Japanese or anti-German war cartoons. As if this collection wasn't eclectic enough, I later added to it a pile of circa-1910 chemical journals published by a Swiss-based perfume company, and some copies of a Japanese pharmacy journal. The latter were actually printed in Japanese and, save for an occasional name or chemical formula in English, were totally undecipherable. They had been given to me by an elderly widow in the local Mormon Church by the name of Lucille Empey, whose son had acquired them for some unknown reason while serving in the army in occupied Japan, along with two small delicate porcelain evaporating dishes, now residing in the Oesper Apparatus Museum.

I mention Empey's small gift only because it once again illustrates how virtually every adult in my immediate environment took an interest in my preoccupation with chemistry and encouraged that interest whenever possible. Nor, I might add, was this generosity restricted to older adults. My senior year of high school a fellow

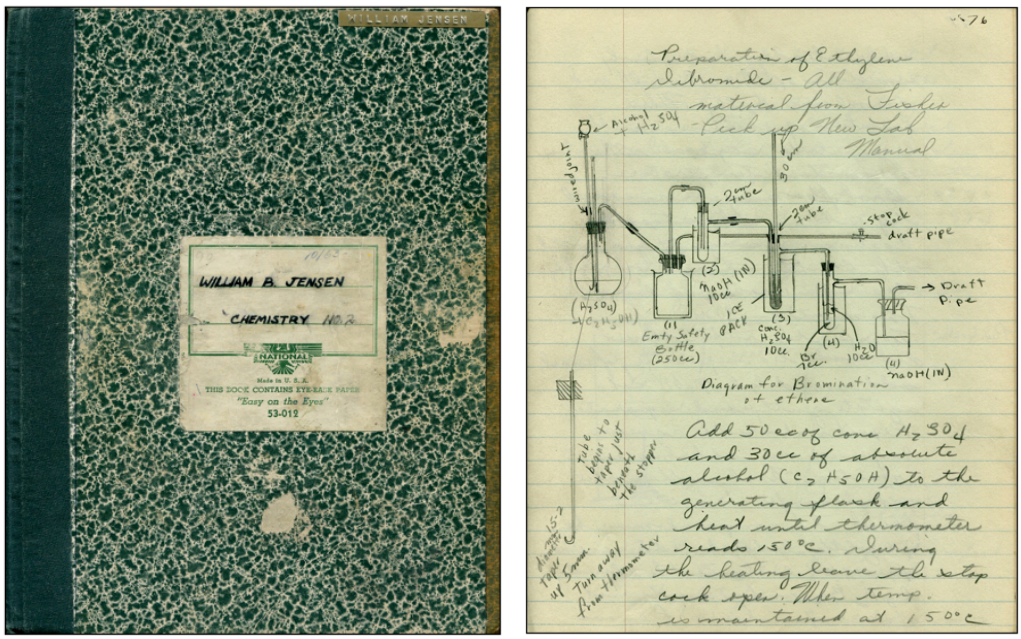


Figure 4.15. (Left): Cover of my high-school chemistry notebook in which I copied instructions for various chemical tests and preparations of interest. (Right): A typical page from my high-school chemical notebook. The more elaborate the apparatus the better.

student by the name of Steve Foreen gave me two large boxes of antique chemical equipment that his older brother had obtained from a small college that had gone out of business and, like the two Japanese evaporating dishes, many of these items now reside in the Oesper Collections.

Since these motley collections were the only chemical journals I had immediate access to during my high-school years and I knew that a truly professional chemist was obligated to read the chemical literature, I actually thumbed through the various issues and took occasional notes on items that happened to attract my attention. Starting in the 10th grade I had begun keeping a personal chemical notebook (figure 4.15) in which I copied down either various chemical tests or various chemical syntheses of interest that I had come across in the issues of *Chemical Abstracts* in my closet or in the various

textbooks I obtained from the public and county libraries. Only occasionally did I note an actual experiment that I had performed in my home laboratory and, on these few occasions, my brief comments could be surprisingly laid back, as in the following entry:

Tried a batch of plastic using hexamethylenetetramine-phenol resin. Book neglected to note its inflammability. In the course of heating it to the proper temperature (150°), the mixture exploded in flames – better luck next time.

Kipp Generators and Gardening

My interest in qualitative analysis also continued unabated. Not only had I completed Sorum's qual course as part of my 8th grade science project, I would repeat it once again the summer of my sophomore year in high school as part of the Chemistry Institute I would attend in Minneapolis, and which I will describe in the next chapter. In addition, I would also TA the course my senior year at the university in Madison (which was, I believe, the last year it was taught to freshmen). In between the latter two events, I also tried teaching it to a group of my friends the summer of my senior year in high school. This somewhat abortive teaching project was inspired by a parting gift, on the part of Harry, of an antique Kipp gas generator. I knew that these generators had been used in 19th-century laboratories to produce and store the hydrogen sulfide or rotten-egg gas required to do qualitative analysis and I was anxious to try out my new acquisition. Since this generator would not only produce, but also store, quantities of hydrogen sulfide way beyond anything I had used in the past, I decided to take the precaution of teaching my course, not in my basement laboratory, but in the garage, where we could keep the doors open to the fresh air in case of any gas leakage.

My students consisted of my childhood friends Blair Peshak and Bob Vorwalske and of Bob's first cousin, Kim Walters, and to accommodate them I moved two lab benches to the garage along with the requisite chemicals and apparatus, including my home-made centrifuge. At first everything went along swimmingly. Blair even bragged to a kid in his neighborhood, who had a home lab of his own, about what we were up to and this kid decided to challenge us by giving Blair a sample of an unknown salt for us to analyze. I don't know who the boy was, but he definitely knew what he was doing. After obtaining a negative test for every cation in the book, we finally decided by the process of elimination that the unknown was a potassium salt of some sort (being partially color blind I always had great difficulty in seeing the so-called violet flame test for potassium and I did not have access to the special reagents required to precipitate it). However, no matter what we tried, we could not figure out what the anion was. As it turned out, the boy had given Blair a sample of potassium chlorate and chlorate was one of the few anions for which Sorum had provided no test.

Our troubles did not start until the fateful day I finally decided to charge up my newly acquired Kipp generator. This was a relatively small and inelegant example, as such generators go, and held only about 350 mL of HCl and about 15 grams of FeS. There was no ground-glass joint connecting the acid reservoir with the base but rather a cork friction sleeve, and I had to use a piece of rubber tubing with a Mohr pinch clamp for the valve as I did not own a glass stopcock. Nevertheless it seemed to work well enough and at the end of the day I left it fully charged in anticipation of the next day's work. About 3:00 am that night I was shaken awake by my mother with the anxious query "My God! What did you do in the garage?" It was one of those hot, muggy, summer nights without any breeze that are so common in Wisconsin in August, and this being before home air

conditioners were common, I had fallen asleep with my window wide open in the forlorn hope of getting some relief. I was not awake long before I realized that, in addition to the humidity and heat, the entire neighborhood reeked of rotten eggs.

Thus it was that I found myself in the wee hours of the morning in my underwear digging a hole in our garden in order to bury my new Kipp generator while my mother in her housecoat held the flashlight. In retrospect this doesn't seem like the best response to the situation but, with my mind muddled by heat, humidity and lack of sleep, I could think of nothing better to do with the offending object. When I dug it up the next morning and cleaned it out, I discovered a crack in the stem of the reservoir I had not noticed previously and which was probably the source of the gas leak. Of course, I never charged it again and it now resides on the shelves of the Oesper Apparatus Museum at the University of Cincinnati. In 1945 Betty MacDonald published a highly popular autobiographical memoir entitled *The Egg and I* which became the basis of one of the well-known Ma and Pa Kettle movies. Given my numerous misadventures with hydrogen sulfide over the years, I probably should have considered entitling this memoir *The Rotten Egg and I*.

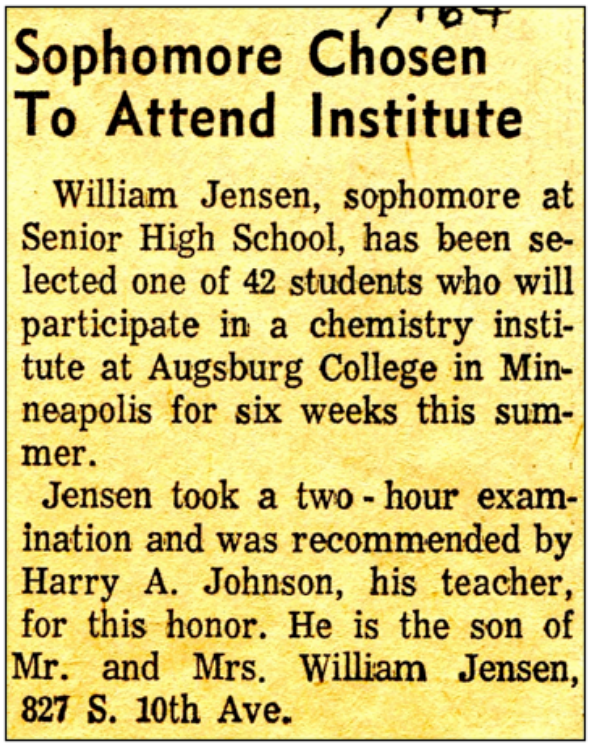
V

Attending Chemistry Boot Camp

AS recorded in the pervious chapter, I took my first formal chemistry course my sophomore year at Wausau Senior-High School under Harry Johnson. I did quite well and soon became something of a teacher's pet. This was during the 1963/1964 academic year and the height of the fallout from the so-called Sputnik scare of the late 1950s. Frightened that the United States had somehow fallen behind the Russians in science and technology, the government had begun pouring funds into educational programs designed to upgrade the teaching of science in America's high schools and colleges. As part of this campaign, the National Science Foundation (NSF) also began sponsoring both summer workshops for science teachers and summer institutes for promising high-school students.

Sometime in the spring semester of 1964, Harry must have received a flyer soliciting applicants for a NSF Summer Institute in Chemistry to be held at Augsburg College – a small undergraduate Lutheran school located near downtown Minneapolis – and he decided that, as his prize student, I should apply. Acceptance was based on a competitive two-hour exam for college students sponsored by the American Chemical Society (ACS). I have no recollection of having taken this exam, though I recently discovered a brief reminder to myself in the chemistry notebook I kept during high school:

Remember to take the Chemistry Institute Exam on Tuesday.



Sophomore Chosen To Attend Institute

William Jensen, sophomore at Senior High School, has been selected one of 42 students who will participate in a chemistry institute at Augsburg College in Minneapolis for six weeks this summer.

Jensen took a two-hour examination and was recommended by Harry A. Johnson, his teacher, for this honor. He is the son of Mr. and Mrs. William Jensen, 827 S. 10th Ave.

Figure 5.1. A yellowed clipping from the *Wausau Record Herald* saved by my mother and announcing my successful admission to the 1964 Augsburg College Summer Chemistry Institute.

In any case, according to a short newspaper clipping saved by my mother (figure 5.1), I apparently did well enough to be accepted, along with 51 (not 42 as stated in the clipping) other high-school chemistry students scattered throughout the United States, from Maine on the east coast to California on the west coast.

The Institute was six weeks in length and was scheduled to run from the last week of June through the first week of August. Acceptance may well have been an honor, as claimed by the newspaper clipping, but attendance was not free and required the outlay of about $150.00 to cover the cost of food, housing, textbooks, and miscellaneous day to day expenses, though we were given a $50.00 stipend at the end of the six-week course. These costs may seem trivial by today's standards, but it was a sizable expenditure for my family at the time.

Rather surprisingly, my mother not only got my father to cough up

Figure 5.2. A group snapshot taken in late June of 1964 shortly after our arrival at Augsburg College for the opening of the NSF Summer Chemistry Institute. We are standing on the boulevard across the street from the main academic building. *From left to right:* myself, my friend Tom Schwartz, my brother Stephen, my father, and my sister Linda. My mother, as usual, is behind the camera.

the necessary funds but to also drive us to Minneapolis in order to deposit me at the Institute. The entire family went along for the ride, as well as my close friend Tom Schwartz. The combination of six people in a used car sans air-conditioning, a four-hour drive, and the frustration of trying to locate the college in the unfamiliar labyrinth of downtown Minneapolis, must of stressed my father to the limit. Yet a slightly fuzzy snapshot taken by my mother testifies to our safe arrival (figure 5.2). This shows us lined up along the grassy boulevard opposite the main academic building on campus. All of us are dressed in our Sunday best, though, in deference to the summer heat, the

Figure 5.3. "Old Main" at Augsburg College as it looks today.

males have all shed their suit jackets.

I not only have on a white shirt and tie but also a vest with a watch chain and watch-fob. This, I blush to confess, was my so-called "Eliot Ness" suit. At the time I was an avid fan of the television program "The Untouchables" and had developed a fascination with circa-1930 dress styles and with Model-A automobiles. Consequently I was delighted when I was able to purchase my first three-piece suit and took every available opportunity to wear it in public. The only person in the photo who appears worse for the wear is my younger brother, Stephen, who has affected the stance of someone struck dumb by the sheer boredom of the entire affair – indeed so exaggerated is his pose that one can almost imagine a trickle of drool issuing from the lower right-hand corner of his mouth.

That afternoon the students and their parents all attended an introductory orientation held in the original, circa-1901, college building known as "Old Main" (figure 5.3). By age sixteen I had already developed an abiding fascination with old buildings and was intrigued by the prospect of having lectures in this one. However, as

Figure 5.4. "Science Hall" at Augsburg College as it looks today. Though I can no longer remember for certain, the chemistry department was most likely located on the third floor, since this would have minimized ventilation problems with regard to the laboratory hoods.

events turned out, I would never see its interior again as the entire Institute would instead be held in a circa-1955 building known as "Science Hall," which housed the chemistry department on its uppermost floor (figure 5.4). After completion of the orientation, students and parents said their goodbyes and we were taken across the quad to an L-shaped array of circa-1938, four-story, red brick, dormitory buildings (one wing for the boys at the Institute and one for the girls) and assigned rooms and roommates (figure 5.5).

This would prove to be my universe for the next six-weeks – Science Hall at one end of the quad and the dormitory at the other – since the rest of the college was shut down for the summer. This shutdown would prove to be the first of many disappointments as I had been looking forward to using the school's library. At the time, both Tom and I were avid readers of the horror stories of H. P.

Figure 5.5. A fuzzy snapshot of the old dormitories at Augsburg College. Dating from 1938 and originally known as Sverdrup-Oftedal Memorial Hall, their current fate could not be determined from the College website.

Lovecraft and we had determined that one of my first tasks at Augsburg would be to look up the dreaded *Necronomicon* of the "Mad Arab Abdul Alhazred" in the college library. In retrospect, I do not know which of our assumptions was the most naive – that the *Necronomicon* was a real book rather than a fictional creation of Lovecraft, or that the library of a small, inner-city, undergraduate college would actually own a 15th-century Latin book on demonology.

Adjusting to the Big City

From this point on I can trace events in some detail, since, for the first time in my life, I became a regular correspondent, sending my mother weekly letters and exchanging occasional letters with both Tom Schwartz and with Glenn Davis – all of which have survived thanks to my mother's obsession with preserving the most minute trivia of both my childhood and adolescence. Glenn was my Sunday School teacher at the local Mormon Church back in Wausau and was to become something of an intellectual mentor to me. Though a lowly cab driver by profession, he was the only adult I knew who actually read books and who appeared to have a private intellectual life of his own. Our correspondence, begun that summer, would continue, off and on, for the next 20 years.

These letters reveal that I had some initial adjustment problems

when it came to the realities of life in the big city. These began almost immediately when my father became temporarily lost while attempting to locate the college campus. At one point we ended up driving through a very seedy business district and I can recall gawking in disbelief at the abandoned and boarded up buildings and at the drunken derelicts sleeping on the sidewalks and bus benches. Though Wausau did have a small dilapidated neighborhood known as the "hollow," located just south of downtown in the flood plane of the Wisconsin River and inhabited by what were called "white-trash, welfare families," there was nothing comparable to this.

Augsburg was basically an "inner-city school" and, when I later became comfortable enough to explore the surrounding region, I would occasionally chance upon an Afro-American neighborhood and be stunned by what I, with my very limited experience, considered to be its terrible squalor – though I suspect that the Minneapolis version of this was almost benign in comparison to the realities in other large American cities. Most people today cannot imagine how segregated America was in the 1960s, and I do not mean just segregated by neighborhoods and schools, but also by entire towns and cities, at least in the Midwest. Though Wausau had a population of roughly 33,000, up to that point in my life the only encounter I had ever had with living Afro-Americans was when, at age four, I was taken by my parents to see the Harlem Globetrotters at the local Catholic High School in Marshfield. I was actually selected by them from the audience to come out onto the floor of the gym to participate in some sort of stunt, but was so terrified that I refused to leave my mother's side. The 1960's were, of course, the height of the Civil Rights Movement, and the resulting riots, marches, and peaceful sit-ins were on the news almost daily. But, like the escalating war in Vietnam, all of this seem to be happening elsewhere and to have little relevance to life in Wausau, Wisconsin.

One minor adjustment to the big city involved the continuous nighttime roar of traffic from the downtown district and nearby freeways, which I was not used to and which, for the first week or so, made it difficult for me to sleep nights. However, by the end of the Institute, I fancied myself a hardened veteran of the big city and, as revealed in a letter of 26 July, offered to give my family a proper city tour when they came to pick me up:

The Institute ends at 3:00 pm on Friday, 07 August. Wish you would write me as to when you are coming. Steve and Linda should come along and possibly we can talk Dad into driving around so they can see the real city (I have discovered that Augsburg is located in what is actually classified as the slums). Remember the University of Minnesota? Well, in Saint Paul there is one just as large, only it is just an agricultural school. Steven would enjoy it.

Knowing my father, I doubt very much that he agreed to the suggested tour. Like all fathers of that era he was hell bent on driving from point A to point B in the shortest possible time and with the minimum number of interruptions. I can still recall his barely veiled disgust whenever he was forced to make a pit-stop to accommodate our seemingly unending need as young children to pee during family road trips.

Adjusting to Dormitory Life

Adjustment to life in the dormitory proved to be even more challenging than the culture shocks of the big city. My roommate was a boy from Chaska, Minnesota, named Dana Kamerud, and we shared a small room on the third floor containing a bunk bed, two desks, a dresser, and a metal closet. The room had no direct access to the hallway.

Rather one entered through an even smaller adjacent room containing a single desk and bed and whose occupant was, I suppose, also officially our roommate, though I can no longer remember his name. At the foot of our bunk bed was a door that connected directly with the communal bathroom for the floor, so we were treated to an unending medley of flushing toilets and running water taps.

However, the noisy bathroom was the least of my distractions. Though two chemistry seniors at Augsburg, who worked as lab TAs and graders for the Institute, also resided in the dormitory and presumably acted as House Fellows, life in the dorm was basically a free for all, with all of the problems associated with a group of teenage boys temporarily cut loose from adult supervision. Thus, in a letter written on 04 July, I complain to my mother that:

Study in the dorm is quite impossible. One of the kids down the hall is addicted to playing the radio as loud as possible. There is a group of Luther Leaguers staying at the college. Yesterday ten boys were almost kicked out of the Institute for throwing water bombs and fire crackers off the roof at the Luther Leaguers and five for trying to break into the girls' dormitory.

and on 09 July I further complain that my lab partner was spending more time in our room than in his own and that the implied expectation of socializing made it difficult to study properly.

Regrettably this same lack of proper supervision sometimes extended to the labs as well. I can recall one hot, sticky afternoon in the qual lab when, in a desperate attempt to cool off, several boys got into a water fight using pipettes and pipette bulbs. The lab was lit, not with florescent lights, but with huge tungsten filament light bulbs. The lighting was indirect and was bounced off metal reflectors that surrounding each bulb, save for the very bottom of the bulb, which

was silvered and projected out a hole in the center of the reflector shield. At one point, one of the boys, in his unbounded enthusiasm, directed a stream of cold water upwards which hit the projecting bottom of one of the hot light bulbs, causing it to explode with a loud bang into a shower of glass shards. Everyone immediately ducked below the lab bench as a panic-strickened TA came frantically running into what appeared, at first glance, to be a deserted laboratory filled with the faint smoke of an oxidized bulb filament. I can also recall one of the boys later destroying a toilet in the restroom adjacent to our dorm room using a bomb made from cane sugar and potassium chlorate, the ingredients of which he had purloined from both the cafeteria and the chemistry laboratory.

As might be expected from its date of construction, the dormitory lacked both elevators and air conditioning and the latter defect proved to be the biggest single obstacle to proper study, since July of 1964 proved to be one of the hottest on record for the Twin Cities. Already in my first letter to my mother on 01 July I began to complain about the weather:

It has been above 95° since Sunday and it is most miserable. Everyone is thirsty for milk, seeing as there is no refrigerator [in the dorm] so one can't keep it cold and you may have only one glass per meal in the cafe.

And again on 18 July:

It has been in the 90's ever since I got here (it rained only once), but this week it is unbearable. It is impossible to study and I sweat so much I think I may have a small fever.

Likewise at the end of the same letter:

P.S. 90° tonight. I feel so enervated that I ate a quart of sweet pickles for supper ... The local Police Report said that 450 people fainted from the heat today.

In case you are wondering why a sixteen-year old would use a word like "enervated" in his letters, there is little doubt that this was an affectation I had picked up from reading too much Edgar Allen Poe and H. P. Lovecraft, both of whom had excessively wordy prose styles, though to the best of my knowledge neither was addicted to sweet pickles.

The reference to the "cafe" was to the college cafeteria, located in the basement of the dormitory, where we purchased our breakfast and lunch five days per week. For suppers and weekends we were on our own and had to rely on nearby fast food joints and convenience stores (whence the quart of sweet pickles). In retrospect, I am uncertain whether the cafeteria was really called the "cafe" (which strikes me as a bit too trendy for 1964) or this was just my way of evading the fact that I didn't know how to spell cafeteria. Like most teenagers, it would never have occurred to me to look up the spelling of a word in Webster and, in any case, whenever I was told to do so, I had what, at the time, I considered to be an iron-clad counterargument. "How can I look it up if I don't know how to spell it?"

My craving for cold milk is also interesting. This was not because I was a fanatical citizen of "America's Dairy State," but because it was my mother's beverage of choice for growing children. We never drank soda pop at home (my mother believed it would dissolve your bones), nor did we ever have dessert with meals. When our demands for sweets became insistent, my mother would whip up some bizarre – albeit supposedly healthy – alternative, such as wholewheat angel-food cake, frozen fruit-juice bars, or a horrible sticky, diarrhea-brown, substitute for fudge made with powder milk

that she had gotten from the cookbooks of Adelle Davis, whose views on nutrition she followed religiously. She was particularly fixated on the virtues of yeast powder suspended in milk, acidophilus culture, fried liver, and massive doses of vitamin C. And, of course, there were the "healthy" commercial alternatives – Graham Crackers were better for you than cookies and Ovaltine better than chocolate milk, etc. Predictably, when I complained of feeling rundown from the summer heat, she promptly mailed me jars of both yeast tablets and vitamin C.

In any case, it was not until the 26th of July, about two weeks before the end of the Institute, that I finally reported a successful resolution of my milk craving:

I found a dairy store nearby and now can buy cold milk by the quart. However, if I am unable to down it in one meal, I must throw it out for lack of refrigeration.

My letters also reveal that, for the most part, I actually liked the food in the "cafe," which surprises me, since I was a finicky eater. Thus on 01 July I write:

The food is pretty good (we had french toast for breakfast and ham for dinner), but I'm getting pretty tired of hamburger.

And again on 04 July:

The food in the cafe is really good. So far we've had turkey, fish, and beef stew.

As revealed in a letter of 09 July, my complaint about hamburgers was because the only inexpensive place I could find off campus for

suppers and weekend meals was a local hamburger chain, though I occasionally rebelled and attempted an alternative:

Suppers are fairly good and I average about 75¢ each (since I'm never very hungry because the food is so good at dinner) ... Tonight my roommate and I got sick of Hartee's hamburgers, so I found a discount bakery shop and bought two-dozen rolls for 15¢. Then we went to the dairy store and bought some sandwich meat and a couple of pounds of seedless grapes.

and, finally on 18 July, I report an escalation of food costs:

You realize, of course, that I don't have to pay for any of the cafeteria meals until the end of the Institute, hence money sent goes for supper (I now spend approximately $1.00 per meal).

Making Friends

My first letter home suggests that my initial impression of my fellow students at the Institute was not very favorable:

I find a great deal of competition among the participants (almost all of whom are seniors), and most of them quite freely brag about how much they know. Others know very little, even some of the simplest chemical basics, while others have had physics.

However, as might be expected, I gradually began making friends. I naturally spent considerable time with my assigned roommate, though less for reasons of shared interests than shared living space. My first real friendship came about a week after the start of the Institute, when, suffering from television deprivation and desperate for entertainment

of any sort, my roommate and I hiked over to the University of Minnesota and bought tickets to the first movie theater we encountered. This proved to be an art theater that was playing a French film with subtitles and this was probably the first foreign film I ever saw. It was here that I also met another boy from the Institute by the name of Merle Vandeputte:

Friday night my roommate and I got sick of homework and vowed to go to the first movie we could find, which happened to cost $1.25. It was a movie in French entitled "Sundays and Cybele" and one that I surprisingly enjoyed. I also met one of the members of the Institute whom I didn't know before. His name is Merle Vandeputte and he looks almost exactly like Clyde [my youngest maternal uncle]. He and I both enjoyed the movie (my roommate doesn't care for abstract French films).

Merle (figure 5.6) was from Milroy, a small town in southwest Minnesota, and the two of us began exploring Minneapolis together the very next morning, as described later in the same letter:

Saturday morning Merle and I got up at 8:00 am and walked over the the University of Minnesota. We spent the entire day lining up bookstores, but were disappointed because all were closed on account of the 4th. We plan to hike over again after school on Monday. About 2:00 pm we walked five miles uptown and back again, making a total of 25 miles that day. He is learning German by himself and we spent the rest of the day translating the Hamburg Daily.

I can recall the two of us exploring the old chemistry building at the University of Minnesota from top to bottom and discovering, on one of the upper floors, graduate students working at lab benches that,

Figure 5.6. The participants in the 1964 Augsburg College Chemistry Institute. Dr. Courtland Agre is on the far left in the second row and Dr. Earl Alton on the far right in the front row. The two senior chemistry majors who functioned as lab TAs and dormitory councilors are on the far left in the last row and the far right in the second row. I am third from the right in the front row. All of the boys with whom I became friends are looking toward me rather than at the camera, which suggests that I had just made a sarcastic comment of some sort. Standing immediately behind me is Merle Vandeputte. In the center of the second row are Manning Butterworth (Hawaiian shirt) and Norman Henderson (white shirt). The boy standing third from the left in the front row may be the mysterious "boy from Maine" whom I mentioned in my letters but never named. I am uncertain, but I think the second boy from the left in the front row was the classical pianist, whose rendition of Gershwin's *Rhapsody in Blue* so entranced me. As may be seen, in keeping with the almost total dominance of science nerdom by males during this period, only three of the 51 participants were girls, and I blush to confess none of them made any lasting impression on me.

because of overcrowding, had been placed in the hallways and, even more astounding, groups of students working at benches that had been placed outside on the roof of the building in the hot July sun!

However, I reserved my most exciting discovery for my letter of 18 July:

I have already worn out my shoes since I walk about 15 miles each Saturday ... Last Saturday I spent the entire day at the University of Minnesota chemistry library – most unusual in that I wasn't suppose to be there. A large sign stated that only graduate students with special permission were allowed. Evidently I resemble a graduate student (I haven't shaved for a week – ha, ha).

Here I discovered classic volumes on the history of chemistry by such authors as Kopp and Ladenburg. Though I still did not know enough German to read them, I knew of both their existence and iconoclastic status through my reading of Mary Elvira Weeks' *Discovery of the Elements* – a book which I first encountered in the 7th grade at the Wausau Public Library, and I thrilled at the realization that, unlike the fictitious *Necronomican* of Lovecraft, such volumes really existed and were even available in the United States. Little did I realize that many years later I would spend many an evening in this library during my brief sojourn teaching high-school chemistry in the Twin Cities.

Yet another friend was my laboratory partner mentioned earlier, though for some odd reason I never mentioned his name in my letters and instead always mysteriously referred to him as "the boy from Maine." Thus on 04 July I report:

At 7:00 pm the boy from Maine (who is my lab partner) invited me and my roommate to a fireworks display. Just got back and in fact it is 12:00 am right now.

And again on 26 July*:*

Yesterday one of the boys in the dorm lent me his bicycle and the boy from Maine and I rode uptown. I am very disappointed though. Both

the Minneapolis and Saint Paul libraries, and the State Historical Society, are closed on weekends and on weekdays at 5:00 pm. Hence, not only is the Institute no fun, it is planned so that we can have none in any other way.

Despite my repeated failure to access most of the libraries and museums in the Twin Cities, the Institute did offer some compensation in the form of a small reading nook located at the far end of the laboratory hallway. This contained some chairs and low bookcases populated by castoff chemistry textbooks provided by the professors and a large pile of unbound issues of the *Journal of Chemical Education*. On those afternoons when I finished lab early (as I frequently did during the qualitative analysis phase of the course), I would spend time there paging through the issues of the journal and avidly reading any articles dealing with the history of chemistry.

Yet a third friend was a boy from the Twin Cities by the name of Norman Henderson (figure 5.6). Since he was local, he had the luxury of going home on weekends and on one occasion invited me to join him and his family for Sunday dinner. While I was disappointed by the menu, for dessert his family introduced me to yet another wonder of the big city which I felt merited a detailed description in my letter of 09 July:

Sunday I was invited to dinner by Norman Henderson, who lives in a suburb of Minneapolis called Edina. Unfortunately we had hamburgers for dinner, exactly what I had been living on all week. After supper we went to a place called Bridgeman's. This is a large chain of ice cream parlors. This particular one happened to carry 37 flavors, such as pink bonbon, mint, orange ice, peach, and butter brickle (I had English toffee).

I can also recall the two of us sitting in the family living room that evening, ostensibly writing up our lab reports on Faraday's laws of electrolysis that were due on Monday, while simultaneously being distracted by the television set, which, after three weeks of viewing abstinence, seemed almost infinitely fascinating.

My fourth encounter was briefly recorded in my last letter of 03 August:

Spent the weekend on a farm in southern Minnesota. Will tell you of the details on the way home.

Though I did not mention the boy's name in my letter, I had no trouble identifying him in looking at a list of the Institute's participants nearly 50 years later. After all, who can forget a name like E. Manning Butterworth? With a moniker like that you might expect someone from a private school on the East Coast, but in fact, as noted in my letter, he was the son of a prosperous farmer from Minnesota. The farm itself was located near the tiny town of Eagle Lake, about 83 miles south of Minneapolis, and was surrounded by endless flat fields of corn. The farm house was a large, rambling structure from the 1920s with a walkup attic filled with antique toys and science equipment. Manning (figure 5.6) was also a fanatic reader of science fiction and must have owned every issue of *Analog Magazine* ever published. However, his major hobby was model rocketry and we spent much of the weekend firing off rockets in the corn field behind the house. These consisted of a wooden nosecone and a cardboard tube body with fins into the bottom of which you wedged a commercially prepared cylinder filled with gun powder and ignited with a fuse. The rocket body had a small sleeve attached to the side which you slipped over a stick pounded into the ground and positioned so as to determine the rocket's approximate trajectory.

A fifth encounter involved the nameless boy who occupied the room adjacent to Dana and myself, though we never became close friends. However, at some point we discovered that he was a competent classical pianist. I can recall that we managed to gain access to a grand piano in the nearby college auditorium and that I sat in utter amazement as he pounded out, by memory, the complete score to Gershwin's *Rhapsody in Blue*. I was so fascinated by this performance that I think I must have cajoled him into repeating it on at least two more occasions before the end of the Institute.

Chemical Antiques and Books

One of the advantages of the big city was that it gave me access to second-hand book stores and antique shops containing treasures well beyond anything I had previously encountered and thus planted the seeds for a life-long addiction to collecting and preserving historic chemistry books and apparatus – an addiction that would culminate many years later in my appointment as Curator of the Oesper Collections in the History of Chemistry at the University of Cincinnati.

Most of the book stores were located in a small business district on the north edge of the University of Minnesota campus known as Dinkytown, where, as mentioned earlier, I would later live for four months while student-teaching high-school chemistry in the suburbs of St. Paul. As my letter of 09 July indicates, Merle and I lost no time exploring the local book offerings:

Merle and I finally got to the bookstores and I have some very nice chemistry books (one dating from 1858).

and once again on 18 July:

I bought an 1858 chemistry book, and some chemicals with my $5.00. Would you please mail my chemical balance. It has a blue base, a set of brass weights, removable pans, and is very light (shouldn't cost much to mail). The reason is that I can sell it to one of the students here (it originally cost me $14.00) and with the money (if sold for $6.50) I can buy a much better balance which I have found.

The book in question – the first antique chemistry textbook I ever purchased – was the 1858 edition of David Wells' *Principles and Applications of Chemistry*, and it still resides on my office shelves. My reason for requesting the balance from my home laboratory was that I was hoping to sell it to one of the boys at the Institute in order to recover the cost of an antique balance I hoped to purchase. This was an 1890 marble-topped box-balance manufactured by Henry Troemner of Philadelphia and, like the Wells textbook, I still own it, though it now resides on the shelves of the Oesper Apparatus Museum at Cincinnati.

By the 26th I had begun a two-way traffic in used chemical apparatus:

Saturday I found an antique shop. Not a second-hand junk shop mind you, but an actual antique shop. Some lady runs it as a hobby and it looks like a shop straight out of one of those revolutionary-style New England towns (It even has a picket fence). Will you please call Pat Chrouser and tell him I can get him a photographic balance like mine, only a little older, with weights for $6.00. Please send his reply before Friday. If so, I can purchase it and he can pay me back when I come home.

What I didn't mention in this letter was that in this same shop I had also purchased a circa 1860 boxed assay balance with tiny concave

pans for weighing cupel buttons. However, a few days later I discovered roughly a dozen unused antique analytical balances gathering dust in the stockroom at Augsburg and, rather surprisingly, I had the hutzpah to ask if I could purchase one. The answer was yes but, before the deal could be completed, several of the other boys at the Institute with home laboratories got wind of it and began clamoring to purchase balances as well. This created a dilemma, since the balances were of varying quality and complexity, and there were squabbles over who got which one. In the end, in the interest of fairness, it was decided that we should draw lots – the boy with number one having first choice, the boy with number two having second choice, etc. Unhappily I drew number twelve and so ended up with the least desirable choice. To even things out we were allowed to choose among the available sets of analytical weights in the opposite order, so I ended up with the fanciest weight set. Both items still reside on the filing cabinet of my study at home.

Though I was strongly attracted to the brass and wood of the antique balances, I was still thinking in terms of items for practical day to day use in my home laboratory rather than in terms of museums and collectibles. As a consequence, I felt I no longer had any use for the assay balance and so returned it to the antique shop in exchange for several antique pharmaceutical measuring glasses, though these, to my great anger, were later damaged by another boy in the dormitory who took to playing with them in my absence. In retrospect, I greatly regret this decision, since the assay balance was in fact far rarer than my rather mundane analytical balance and I would dearly love to have one today for inclusion in the Oesper Collections.

One of the wonders of Dinkytown at that time was a shop run by a German who sold refurbished microscopes to students at the University Medical School. Some of these were late 19th- and early

20th-century models made of brass and were truly stunning examples of craftsmanship. Though reasonably priced at between $75 and $100 each, they were still well beyond my means and I could only look and admire from afar. Many years later, when I briefly lived in Dinkytown and was much better funded, I discovered to my regret that both the German and his antique microscopes were no more.

All told, my poor mother must have spent most of her time that July at the Wausau Post Office, since, in addition to my repeated requests that she mail me books and laboratory equipment, I was also sending a box of laundry home each weekend. Being a typical spoiled male adolescent, it simply never occurred to me to look for a laundromat, whether in the basement of the dormitory or elsewhere.

Rebelling Against the Curriculum

The organizer and director of the Institute was an Augsburg faculty member by the name of Courtland Agre (figures 5.6-5.7). Born in South Dakota, the grandson of Norwegian and Swedish immigrants, Agre had received his undergraduate and graduate training in chemistry at the University of Minnesota. During the Second World War he worked as a polymer chemist for the 3M Company in St. Paul, after which he joined the faculty of St. Olaf College in Northfield, MN. Following a sabbatical at Berkeley, Agre joined the faculty of Augsburg College in 1958.

A forceful personality, he had the habit of removing his glasses whenever emphasizing a point and holding them just off his face by the hinge with his pinky finger pointing in the air – a characteristic gesture that was usually accompanied by the equally characteristic phrase “People we are cognizant!” spoken in a oddly pitched voice that one could only reproduce by hardening the palate and inhaling while speaking. Needless to say, many of the boys at the Institute soon

Figure 5.7. A rather out of focus snapshot of Courtland Agre as he appeared in his younger days when teaching at St. Olaf College.

learned how to imitate these foibles with uncanny accuracy.

The rumor quickly spread among the Institute's participants that Agre was filthy rich due to a number of key patents he held on the adhesive used on 3M's best known product – Scotch Tape – and that he only taught at Augsburg as an act of charity. I doubt if this was really the case, but two events did occur during the Institute that seemed to lend credence to these rumors. Thus, during the final week, we were all invited to his home for a lawn party and cookout. As it turned out, he lived in a huge, rambling, circa 1930 imitation half-timber Tutor mansion located on the shore of Lake Nakomsa and complete with a wood-paneled study and library – hardly the type of house one could afford on the salary of a teacher at a small inner-city undergraduate college. If I recall correctly, his sons were also present at this gathering, though they were younger than the Institute participants. To my surprise, when doing an internet search for information on Agre, I discovered that one of these boys, by the name of Peter Agre, would later go on to win the 2003 Nobel Prize in

Figure 5.8. The 3M research complex in Maplewood north of St. Paul as it appears today.

Chemistry, though I have no clear memory of having been personally introduced to him at the party.

The second piece of evidence occurred when we were taken for an afternoon field trip to visit the 3M research laboratories (figure 5.8) in St. Paul, where it rapidly became apparent that Agre was well-known.[1] This was briefly described in a letter of 26 July to my mother:

Wednesday it finally rained, or at least for a half hour. We all went to visit the 3M laboratories that day. Brother! What a setup! The man who talked with us earns $20,000 a year, has his own private laboratory, and can come and go as he pleases!

I particularly remember one of the research projects we were shown involving the photoconductivity of zinc oxide. This had been sprayed onto a sheet of aluminum metal which was then placed under a photographic enlarger and exposed to the image of a conventional negative. The 3M chemist then attached one terminal of a lead storage

battery to the aluminum plate and the other to a squeegee that he dipped in a solution of ionically conducting dyes. When he ran the squeegee over the plate, out popped a beautiful positive image – and in color no less! I was absolutely fascinated by this and after returning to the dorm recorded as much as I could remember in my chemistry notebook. When I got home after the end of the Institute, I immediately confiscated my mother's roll of Reynolds Wrap and the much-disputed DC transformer from my brother's electric train and tried to replicate it in my basement laboratory, but without success, since, of course, many of the necessary technical details had not been revealed to us during the tour.

The second Augsburg faculty member connected with the Institute was Dr. Earl Alton (figure 5.6). However, he was so quiet and unassuming that, unlike Agre, he failed to leave any lasting impression beyond, of course, his failure to leave a lasting impression.

This brings us to the question of just what the purpose of the Institute was in the first place? One might imagine, for example, an Institute in which precocious high-schools students were given the chance to work in a real research laboratory or in which they listened to a series of guest lectures by various chemists on advanced topics not covered in a typical high-school chemistry course. Such, however, was not the case with the Augsburg Institute. Its sole purpose was to cram us through a complete 30-week introductory college chemistry course in just six weeks, including laboratories, quizzes (40 in total), and hourly exams (12 in total) – and not just a typical college course, mind you, but an advanced course! As spelled out in Agre's characteristic prose style on the mimeographed summary given to parents at the end of the Institute:

This was a very demanding Institute and essentially covered more than a year of college chemistry on a very high plane of demand.

Ordinary college students would not be able to maintain the high demands on the participants.

After an 8:00 am breakfast in the "cafe," we began each morning at 9:00 am with three hours of lecture, followed by a quick lunch in the "cafe" and a two and a half hour afternoon laboratory session, from 1:00 pm to 3:30 pm. Besides a lab apron, we were required to purchase an introductory college textbook (whose name, for reasons that will soon become apparent, I can no longer recall) and a copy of the 3rd edition of C. H. Sorum's *Introduction to Semimicro Qualitative Analysis*.[2] For the first three weeks, half of the Institute did qualitative analysis during afternoon lab and the other half did a series of watered down physical-chemistry experiments that were provided as mimeographed handouts, and vice versa for the last three weeks.

Of course, since I had been studying qualitative analysis since the 7th grade and had won two science fairs based on this subject, I knew Sorum inside and out and had no trouble with either that part of the lectures based on his book or with the labs themselves. Unfortunately the introductory college text that Agre had selected was a very different matter altogether. In the high-school chemistry course I had taken in Wausau, we had used the 1958 edition of *Modern Chemistry* by Dull, Metcalfe and Williams (figure 5.9). This was the 8th edition of a text by Charles Dull dating back to 1918 that was now in its multi-authored "lets try to revise and preserve a best seller that has seen better days" stage.[3] On examining the copy on my office shelves, I find that it was largely a descriptive inorganic text. The only quantitative calculations involved the ideal gas law and basic stoichiometry. The book still used the Bohr model of the atom and Lewis diagrams and made no mention of Schrödinger, s-, p-, d- or f-orbitals, wave-particle duality, probability models of electronic structure, hybrid

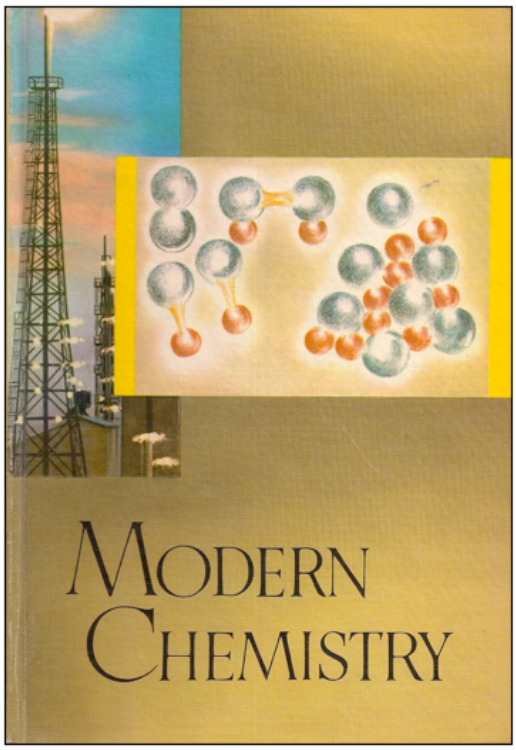


Figure 5.9. The cover of my high-school chemistry textbook.

orbitals, or molecular orbitals. Nor, aside from the ideal gas law, did it contain a single mathematical law or equation.

In fact, our high-school textbook was not unique in these omissions. Since the early decades of the 19th century, virtually all introductory chemistry courses –whether at the secondary or college level – were conceived of as being introductory courses in the descriptive inorganic chemistry of the common elements. However, the 1960s were the beginning of a radical change in the content and emphasis of introductory chemistry courses. Spurred, as noted earlier, by the Sputnik scare of the late 1950s, there was a widespread movement in the United States to "upgrade" the content of science courses at both the high-school and college levels. In the case of chemistry, this led to a progressive change from the traditional descriptive inorganic course to a watered-down baby physical chemistry course, with a large added dose of physics and mathematics

– and the textbook selected by Agre was an extreme example of this new emphasis. One consequence of this change was that both chemistry homework and exam success were now reduced largely to the art of mathematical problem solving rather than the mastery of chemical concepts, facts, and vocabulary

Already in my first letter of 01 July, I gave hints that things at the Institute were not exactly as I had anticipated:

I'll be up until 12:00 pm again tonight. The homework is unbelievable. Sunday I was up until 11:30 pm and I am still a day behind on reading assignments ... I find the qual course easy but the general chem. course is a different matter. It seems to reteach everything in a different manner and jumped into physics the first chapter. (Do you know that 1 gm cm^2/sec^2 = 1 erg = 1/10^7 joules?).

In my second letter of 04 July, I inserted a call for assistance:

Please send my two books on chemistry problems, which are in my large bookcase. One is a gray paperback and the other a large paper-bound manual which will be found among my lab manuals.

However, I would soon discover that the requested books were actually keyed to the older chemistry curriculum I had experienced in my high-school course and provided little assistance in dealing with the quantum increase in physics and mathematics competency now demanded of me.

By my third letter of 09 July I was actually expressing a glimmer of confidence that I was up to the challenges ahead:

I no longer find ergs and joules hard. The problem sets now incorporate integral and differential calculus (which we covered in two

days) and such things as determining how much energy is required to raise an electron from one energy level to another based on Einstein's version of quantum mechanics and the Bohr atom. The equation is:

$$I, II = -2\pi^2 e^4 m Z^2 / n^2 h^2$$

I do average on the oral check tests, which are based on the daily reading assignments, but finals are a bit different. We had our first major test on Monday and the top 15 grades were listed on the blackboard. In the qualitative analysis course I was second, but I was 15th on the general chem test. The No. 1 student was the only one who had taken physics ... Please send my "Handbook of Chemistry and Physics" (the large one with india-paper pages and the gold covers), plus the books I requested in my second letter. I am learning more here than I did all year in high school.

I am uncertain what happened in between, but by the time I sent my fourth letter home on 18 July, my momentary bubble of optimism had burst and I immediately launched into a long and rambling critical inditement of the entire Institute:

The lectures are unbearable, most of them having to do with physical chemistry and math, both of which I find quite boring as study material. Sitting in a room about the size of our living room with 50 other people in 90° weather talking about thermodynamics is not my idea of a pleasant morning. I find I am not mature enough to tolerate chemistry 18 hours a day (7:00 am to 1:00 am) and it got so bad that I went out to the nearest second-hand book store and bought three second-hand "Mad Magazines" to read.

Reading this 50 years later, stimulated a latent memory of sitting in

one of Agre's early morning lectures. The room is literally packed from wall to wall so that the first row of chairs is less than three feet from the front of the lecture bench. I am sitting in the center of the second row. Though the science building, unlike the dormitory, had a few window air conditioners, it is nevertheless unbearably hot and humid in the lecture room due, in part, to the large number of bodies. I am exhausted from lack of sleep and, as Agre drones on, I begin to nod in and out of consciousness. At some point, in the far distance, I hear Agre's oddly pitched voice loudly demanding that "Someone please wake up the boy in the second row!" And thus I gained the reputation of being the only participant daring enough to fall asleep during class.

The main culprit in this unfolding farce was, as I went on to explain, the textbook selected by Agre:

After being here for three weeks I can say that I am quite disappointed in the Institute. I gain no advantage from the laboratories as I have as much equipment at home as we are allowed to use here and just as much guidance, since the only time the professors are around is during lectures. The large chemistry text that we now solely use (we have no lectures on Sorum) is not a first-year book, as was implied. Neither Augsburg nor the University of Minnesota use it, simply because, as Dr. Alton said, the college students can't understand it. Unfortunately neither can we. To top it off, it is arranged so that our reading assignment per night (40 pages) and our problem assignments (an average of 4.5 hours per night) give you one of two choices: either read the assignment or do the problems. Unfortunately most of the students choose to do the problems by memorizing all of the equations in the book while I rant and rave over how the book got the formulas and what they mean.

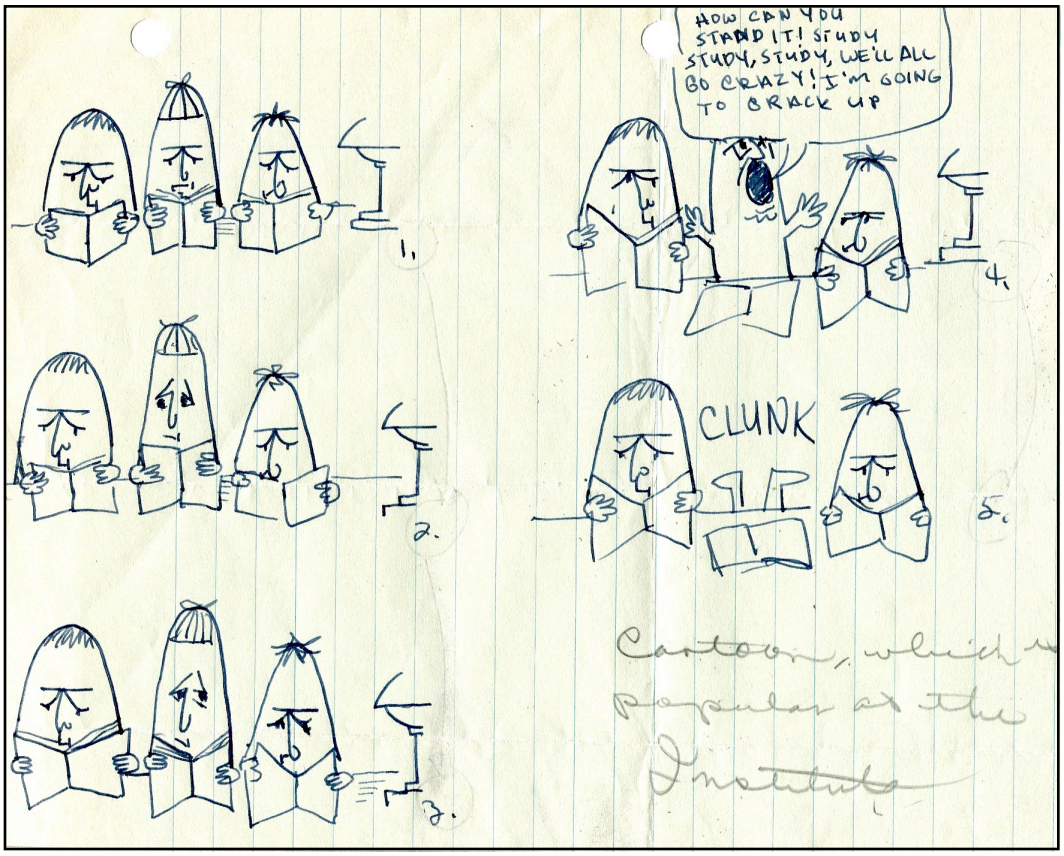


Figure 5.10. A crude cartoon which I appended to one of my letters, expressing my increasing revulsion with the unending regimen of study and homework at the Institute. It is not original and was probably based on something I saw in a student newspaper at the University of Minnesota and crudely redrew from memory. In any case, it made my point not only to my mother but, to judge from my penciled comment, to my fellow students as well.

To emphasize my point I even attached my crude version of a cartoon I had seen somewhere (figure 5.10).

By the end of the Institute I so hated the general chemistry book we had used that I immediately disposed of it – thereby giving it the dubious distinction – as friends aware of my almost pathological bibliomania will readily testify – of being the only chemistry book I ever voluntarily parted with. Hence also the reason why I can no longer recall either its title or its authors, though I am certain I would

instantly recognize it should I ever come across a copy. Yet, in spite of a life-time of book collecting and the massive collection of textbooks found in the Oesper Collections, I have never encountered another copy, thus suggesting that it was as much of a pedagogical disaster at other schools as it had been during the Augsburg Summer Institute.

But my diatribe was far from over and, in conclusion, I now launched into a series of excuses, complete with an egregious appeal to sonorous platitudes on the true nature and value of education, in an attempt to prepare my parents for possible disappointment:

The diligence of my fellow students doesn't go unrewarded. On our exams memorization gives unbelievably good results. To me, however, this is a gross sin. Education should entail comprehension not memorization and unless the Institute operates on this principle – which it doesn't – I think it a failure. The student will leave with vague, fleeting memories of some entangled formulas which he can't apply until college chemistry, and which, by then, he will recall only in nightmares. No matter how hard I try, I just can't waste time in this unbearable heat (It was 105° all yesterday in the lab) memorizing equations about things I don't understand or, for that matter (I hope), anyone else. I fear my test grades will suffer accordingly.

You might console father that his money will, in my opinion, be put to good use (education has a fixed price but knowledge has infinite value). However, I may possibly never figure it out. Perhaps I am one of the insufficient IQ, creative types. But in any case the chance to see Minnesota is worth the money.

I had obviously gone from being a big fish in a very small pond to being an average fish in a much larger pond and I was not happy with my change in status. In reading this letter a half-century later, I am

somewhat embarrassed to recognize that both my change in attitude and my list of excuses are virtually identical to those that I would encounter in later years among some of my own chemistry students.

On the other hand, my friend, Tom Schwartz, had a more balanced view of the matter. I had obviously bombarded him with a series of similar complaints and, in reply, had received a letter satirically – albeit humorously – chastising me for my incessant whining, as well as for the earlier Lovecraft/Necronomicon fiasco:

To the mad Arab, Abdul Alhazard. To the abysmal possessor of ghoulish wonders. To the most insidious mind on either side of Transylvania. Greetings!

It sounds as if Augsburg is crawling with slime. Imagine their audacity trying to make a grade-monger out of you. We'll fix their wagon on Halloween. What's all this about calculus, thermodynamics, etc., etc., etc.? It (or they) doesn't (or don't) have the wholesome, quenching sound of necromancy, alchemy, mesmerism, animal magnetism, astrology, or that most dreaded practice – catalepto-clairvoyance. Anyway, while I call up familiar spirits (you know – conjure, conjure), you study on! I bet physics class is really going to be a tough grind for you next year after this temporary purgatory.

As with the five stages of dying of Kübler-Ross, by 26 July I had apparently passed from the stage of "anger" to the stage of "resignation:"

Sorry my handwriting is so messy, but I'm in tough shape. I can hardly stand to do even the simplest homework. I now understand people who have no work incentive. I don't know what the Institute's secret is, but it sure beats communism.

and, like T. S. Eliot's *Hollow Men*, I would end, in my final letter of 03 August, with a whimper rather than a bang:

Just a brief letter, since it is 1:30 in the morning. My only thought now is to get home. I no longer care about anything, not even homework. I went to a free concert last Tuesday and will go again this Tuesday. I have just enough money until Friday and will break even ... Two cats wandered into the dorm tonight, both as thin as skeletons. Fed both with a pint of whipping cream and let the big one go. The other one, which wandered in approximately an hour after the first, is sleeping under my bed [I had the lower bunk]. He is a kitten and about as big as my hand. I haven't the heart to turn him out so I must hide him from the councilors (can't keep pets in the dorm). Must get some sleep now.

When I awoke the next morning the kitten was gone, having apparently wandered out of the dorm on its own accord.

The first week of August finally brought an end to my agony. I had already summarized the final financial accounting for my mother in my letter of 26 July:

Dr. Agre will collect money on Tuesday, August 4. I owe $35.00 for dormitory, $12.00 for books, $1.00 for a laboratory apron, and $52.50 for food – $50.00 from the school leaves $50.50 which I must have by then. I hope I have given you sufficient notice.

and, on the last day of the Institute, we were each given a two-page mimeographed academic accounting for our parents. This listed all 51 participants and their grades and relative rankings on the various quizzes, exams and labs. It makes unusual reading in this era of privacy laws, when teachers are forbidden to make student grades public, but then the spirit of the Institute was, from its very beginning,

one of intense competition. These rankings, which indicated how many students received higher scores, reveal that, though I was listed as first in that portion of the Institute dealing with qualitative analysis, I was near the middle of the pack (29th) when it came to the general chemistry portion.[4]

This document also reveals that we were required to retake the ACS exam that we had taken previously in order to gain admittance to the Institute. As explained in Agre's characteristic prose style, this retake was intended to evaluate the impact of the Institute:

Each student took a 2-hour examination at his high school before selection for the Institute. This is the 1960 ACS General Chemistry Exam for COLLEGE students with the percentile ratings based on college students after one year of college chemistry. Thus this exam was a demanding one for high-school students but necessary to discern the best of the students. Oncoming college freshman average under the 5-percentile while the lowest student for the Institute produced about 40% [actually 38%] for selection ... The same exam was taken after the Institute on the last day. The difference between the initial and this result represents possible gain.

The recorded results show I received a 53% on the initial exam, which once again placed me, along with several others, in the 29th ranking or near the middle of the pack. On retaking the exam at the end of the Institute I received a 93%, which, though the 8th highest grade category, still placed me in only the 24th ranking, since so many others had improved as well.

Lessons Learned

The purpose of military bootcamp is partly legitimate training and

partly initiation – the latter often bordering on meaningless harassment. Ultimately it seeks to psychologically divest trainees of their individuality and to replace it instead with blind obedience and loyalty to the group. It is not intended to be enjoyable but is still something that one is supposed to be proud of having survived. I, however, cannot recall being proud of having survived the Augsburg Chemistry Institute. When it was finished, I put it out of my mind as quickly as possible. Though I would return to the Twin Cities my second year of graduate school to briefly teach high-school chemistry and would also return several times in later years to visit friends and to give lectures at various colleges, I never again revisited Augsburg and the scene of my summer of discontent.

I suppose that one could argue that, in spite of my intransigence, I was well trained by the experience. As predicted by Tom, I had no trouble earning an A in high-school physics the next year, nor in passing the college equivalence exam my senior year which allowed me to skip introductory college chemistry and to proceed directly to organic chemistry. However, the advantage of having done this was quickly nullified by the fact that I remained at the local extension campus in Wausau for two years, though it had no chemistry courses left for me to take my second year. So, by the time I transferred to the main campus in Madison my third year, I was back in sequence with everyone else. My reasons for remaining in Wausau for the first two years of college were two-fold – one financial and one having to do with a now defunct rule that all freshmen and sophomores on the Madison campus were required to live in the dormitories. It seems that the one lesson I did take away from my experience at Augsburg was an extreme loathing of dormitory life and a firm vow never to live in one again.

One of the unspoken goals of the Institute was doubtlessly to encourage outstanding high-school students to pursue careers in chemistry.

However, I strongly suspect that, in this regard, it had little impact. Though, like myself, my friend Merle Vandeputte was seriously interested in chemistry as a career, many of the other boys at the Institute were indifferent. They were simply very good and highly competitive students who excelled at anything connected with science and math, and the Institute was just one more opportunity to exert their academic dominance. Thus, for example, Manning Butterworth was one of the top students at the Institute, yet to judge from what I observed during my weekend visit to his family farm, he was far more interested in aerospace science than in chemistry *per se*.

Not only was there no official followup with regard to career choice, there was unfortunately also no personal followup. Though either Norman Henderson or the mysterious boy from Maine (I cannot remember which) happened to be passing by Wausau the following October and made a point of stopping at the house for an evening visit, none of the friendships survived the end of the Institute itself and there would be no future correspondence, exchange of Xmas cards, or reunions.[5] I recently read somewhere that a followup study of the winners of the famous Westinghouse Science Fair – a highly competitive national event that was widely publicized in the 1960s and 1970s – showed that very few went on to earn college degrees in science and engineering. Once again they simply proved to be very good students who thrived under the encouragement of enthusiastic teachers, but who, nonetheless, lacked both an intrinsic interest in science and a sustained commitment to its pursuit.

However, in thinking it over, I now feel that I may have also come away with a few more lessons than just my newly acquired loathing of dormitory life – albeit lessons that were largely subconscious and which only gradually revealed themselves over the course of my teaching career. The first, and most obvious, of these was to always strictly limit the amount of material covered, not only per lecture but

in the course as a whole. Overwhelming students with massive amounts of information and homework is both counterproductive and dispiriting.

The second lesson was not to substitute mindless mathematical problem solving for conceptual understanding. Most of us mentally process and retain concepts qualitatively and pictorially, not quantitatively and mathematically. A chemistry course, and especially an introductory course for nonchemistry majors, should always be about the concepts and facts of chemistry rather than about the tricks and techniques of solving algebraic story problems. Of course some mathematical work is necessary, but it should always be illustrative and selective and never be allowed to dominate the course.

The third and final lesson was to never introduce an equation or theory that was not justified by a preliminary discussion of the experimental facts it was designed to rationalize. In this regard I recall being particularly bent out of shape that summer by the textbook's introduction of molecular orbital (MO) theory. Previous to this, I had never heard of this theory. Up to that point every chemistry textbook I had ever read dealt with only Lewis diagrams and VB theory. The relationship of these to the facts of molecular structure and classical valence theory were almost self evident. But MO theory seemed to jettison all of this. Instead we had abstract energy diagrams, counterintuitive distributions of electron density (e.g. π-bonds), and antibonding as well as bonding electrons. Had anyone bothered to explain that this theory had evolved out of the needs of molecular spectroscopy and shown me a Berlin force diagram rationalizing why placement of electron density in certain regions about a molecule could actually weaken rather than strengthen a bond, I think my reaction would have been less violent. But the textbook made no attempt to justify the model and I became convinced that I was being asked to rote memorize chemical nonsense – albeit nonsense that the

textbook never referred to again once the exam on the subject was over.

Of course, with the exception of the inappropriately massive quantities of information covered per unit time, most of the pedagogical failings of the summer course at Augsburg were fairly typical of what I would encounter in my university undergraduate and graduate chemistry courses and, in this sense, it prepared me for the many disappointments to come. As for my attempts to incorporate these lessons into my own teaching, I flatter myself that I was moderately successful for the first 20 years, but ultimately failed as the university administration began to interfere more and more with what we taught and how we taught in its drive to make the curriculum as uniform as possible throughout the state. In the end, I found myself forced back to where I had started 25 years earlier and, not wishing to be part of this educational abortion, I finally gave up and chose to take early retirement instead.

VI

Other Jobs I Hated

My first job after leaving the Pradel Drug Store at the end of the 9th grade was with the United States Post Office in Wausau, Wisconsin, during my senior year of high school. You would think that my negative experience at Pradel's would have cured me of trying to mix a serious commitment to school with the distractions of a part-time job. Since I neither dated nor owned a car, I had no immediate financial incentive for such a step and the only reason I can imagine for having ignored the lesson of my previous job was the continuing worry over how to finance my college education – a problem that was now looming on the immediate horizon. My choice of job was once again dictated by my emulation of my uncle Clyde, who had paid his way through college in Corona, California, by working at the local post office.

This job came my way through the man who operated the physical plant for the building that housed both the post office and the federal court house, and who knew of me through my mother and her job at the public library across the street. I sincerely regret that I can no longer remember his name, but I do remember that he took me on a tour of his domain in the bowels of the building, which dated from 1937 (figure 6.1), and that the massive heating system, which one looked down upon from a surrounding catwalk, was quite impressive. The various underground levels of the building were anything but oppressive. They were all brightly lit and very clean, with light-brown, ceramic-tile walls. Afterwards I was taken upstairs to meet the postmaster, briefly interviewed, and both finger and palm

Figure 6.1. A circa 1960 postcard of the 1937 building for the Wausau Post Office and Federal Court House as seen from 1st Street. Now listed on the historic registry, the building has recently been converted into artists' lofts.

printed. My appointment, as a temporary "Postal Assistant (Subclerk)," was officially dated the 12th of May, 1966, and the starting wage set at $2.50 per hour.

As already stated, the post office was located on 1st Street on the east side of town, directly across from the public library, where my mother worked, and hence about 2.5 miles from our home on the southwest side of town. My mother walked this distance twice a day for her job, winter or summer, and I often did the same when walking home from high school, which was located even further away on 7th Street. However, my new job required that I report at 4:00 am in the morning and work until 7:00 am, after which I would change clothes in the postal locker room and report to high school for the rest of the day. I don't know if every human has his or her own innate natural sleep cycle, or if there are really so-called day and night persons, but if so, then I discovered long ago that my preference for the arms of

Morpheus was from 4:00 am until noon. This meant that it had been hard enough for me to get up at 7:00 am to catch the morning bus to high school, and pushing this starting time back to 3:00 am was the best I could manage. Since, by the time I had dressed and had breakfast, it was at least 3:30 am, this did not leave me sufficient time to walk the required distance, so I took my trusty three-speed English bike instead.

Traffic Lights and Moral Dilemmas

At 3:30 am in the morning the city streets of Wausau, Wisconsin, were totally deserted, save for an occasional street sweeper or a city road crew, and most of the traffic lights were operating in blink mode. I say most, but not all. About a year earlier, the city had embedded sensors in the roads at the intersections of major streets with minor cross streets so that the lights facing the major thoroughfares remained on green unless tripped by a rare car on the side street. My first night out I encountered such a light in front of Sippel's grocery store on 3rd Avenue. I waited and waited on the side street for the light to turn green in my direction. Finally it dawned on me that I was dealing with one of those new fangled traffic lights and, sure enough, a few feet back from the intersection I spotted a rectangle of newly-laid asphalt in the right-hand lane marking where the sensor was buried. I proceeded to drive back and forth over it with my bike, but to no avail. The combined weight of the bike and myself was simply insufficient to trip the sensor. What was I to do? If I didn't get across the street, I would be late for work and yet it was against the law to cross a street against the traffic lights. In the end, I solved my moral dilemma by moving a block further down to an intersection with no traffic light and crossed there. The fact that, at 3:30 am in the morning, with not a soul or car in sight, it never entered my mind to

break the law and cross against the traffic lights, speaks volumes about my naivete at the time. Apparently I still believed that God was lurking somewhere about the quad or, at the very least, some unseen policeman.

About a week later I encountered yet a second obstacle to my transport when a stray German Shepherd began to put in a nightly appearance a few blocks from home and proceeded to chase me, while loudly barking and nipping at my heals. I finally solved this problem by carrying a squirt gun filled with ammonia water, which I used to liberally dose his nose and eyes.

Chicks and Honey Bees

My first job of the day was to assist in unloading the mail trucks that began arriving at the loading dock about 4:30 am. These were not the cute little vans with "US Mail" printed on the side that you see your local mailman driving, but rather unmarked commercial semi-trailers that had privately contracted to haul the out-of-town mail in from various regional sorting centers. These trailers were usually piled to the ceiling with large, heavy, 50-pound, canvas bags containing everything from first-class letters to packages of varying sizes. These we would drag to the opening and toss down to other workers on the dock, who would then load them onto metal carts and drag them into the post office. The trailers were unventilated and stank of musty canvas, and one soon became overheated from the exertion despite the chill of early morning. In addition, the bags were filthy, having not been cleaned since they were first manufactured sometime back in the 1940s. As a result, by the time the truck was unloaded, you were as filthy as the canvas bags and would have to wash up in the employee locker room before moving on to the next task.

But the worst part of this job were the nights when some thought-

ful person would decide to ship boxes of either live baby chicks or live honey bees. Invariably one of the boxes of chicks would get crushed and one would have to disentangle their mangled bodies from the maze of canvas bags, or a box of bees would burst and they would become scattered among the folds of canvas. At 4:30 am it was still so cold that the bees were essentially dormant. The trick was to locate and dispose of these inert bodies before the sun began to rise and they began to warm up, after which one risked sticking one's hand among the canvas bags and being stung by a very confused and angry member of the order of *hymenoptera*.

Voyeurs and Nudists

After the unloading was finished, I would spend any remaining time sorting, along with three or four other workers, the daily pile of parcel post at a large metal table near the south end of the work area. Indeed, once one passed beyond the wall separating the customer lobby from the postal clerks at the various service windows, the post office was essentially one large room with a 20-foot ceiling, though it was partitioned into various specialized work areas at floor level by the furniture and letter casing boxes. In the center of this space was what appeared to be a very heavy ceiling beam that spanned the entire length of the post office. It extended about eight feet down from the ceiling and was about four feet in thickness. If one looked closely, they could observe that this beam also contained a series of small slits covered with dark glass located at intervals of every four feet or so and set at a height of roughly five feet above its bottom. As it turned out, the beam was hollow and was designed to allow a postal inspector, hidden inside, to view the activities on the sorting floor through the observation slits in order to detect any theft among the workers.

Once I had figured this out, you can understand my further trepidation when I discovered a similar observation slit at the back of each of the bathroom stalls in the employee locker room, placed there apparently for the purpose of catching a thief in the act of sorting his ill-gotten gains. However, closer inspection soon revealed that the glass in these slits had been painted over, apparently at the insistence of the postal workers' union, or possibly in deference to the increasing numbers of women that were being hired about this time.

Occasionally sorting parcel post could prove interesting. This was certainly the case one Saturday afternoon when a package, addressed to a farmer outside of Ringo, burst open on being dumped onto the sorting table, only to reveal that it contained a large quantity of nudist literature. This excited considerable interest among the older men at the table. Whether the same was true of the postal inspector in the overhead beam, I do not know, though I am certain that, despite his watchful eye, some of the scattered nudest literature failed to make it into the bin for repackaging.

More Comparisons

As it turns out, my postal adventures pale in comparison to those of my uncle Clyde. Like myself, he recalls encounters with mashed baby chicks and burst boxes of semi-conscious honey bees, but is able to add to this list escaped lady bugs purchased to control aphid infestations in the orange groves of southern California, and escaped ants from a broken ant farm that was being mailed to some local children by their thoughtful grandparents. Even more curious was the reeking box of dead owls addressed to the local hospital. Apparently they had originally been frozen for transport but had accidentally been sent to the wrong city. By the time they were rerouted back to Corona they had done more than just thaw out. Why the local hospital

needed dead owls remains unexplained. And, finally, there was the incident of the box with the damaged corner that began leaking sand onto the sorting table – or at least they thought it was sand until someone read the shipping label and discovered that it had been mailed by a crematorium. They poured as much "sand" as possible back through the hole, scotch taped it shut, and delivered the package to the unsuspecting recipient. And these tales do not include my uncle's adventures actually delivering the mail itself, an aspect of the postal enterprise that I was happily spared.

Final Escape

My job at the post office overlapped with my final semester of high school by only a month, though in retrospect it seemed like forever. Even though I was working only 18-20 hours per week and bringing home a salary of $30-$42 per week after taxes, I found the early morning schedule exhausting and resented having to go to bed each evening by 8:00 pm. And so, after graduation in early June (figure 6.2), I continued in the job for only another two months before finally submitting my resignation in late July. The acceptance form, dated 25 July 1966, listed the reason for my resignation as "funds for his education no longer required from Post Office employment, now met by scholarships."

Throughout high school I had jokingly claimed that I wanted to attend either Oxford or Cambridge University, but the economic reality was such that, starting in the fall of 1966, I would instead be attending the local two-year campus of the Marathon County Extension Center for the University of Wisconsin, which was located about five blocks from my home. Living at home saved the cost of both meals and rent and, with a tuition of only $105 per semester, the projected expenses were well within my means. And, I would

Figure 6.2. Posing in my high school graduation robes in the spring of 1966. I did not attend any of the graduation parties that evening because I had to report to my job at the post office at 4:00 am the next morning.

hasten to add, after more than 40 years in academia, I can truly say that I have no complaints about the education I received there. It may have lacked the prestige and historical glamor of Oxford or Cambridge, but it was more than competitive when it came to both its quality and quantity. Also, by early June the Extension Center had awarded me a $450 tuition remission scholarship for the upcoming academic year and I had also collected another $250 scholarship from the local American Legion Post. These were more than adequate to meet my needs for the near future and thus make possible my escape from the post office that July. But my most intense memory of this entire episode was how wonderfully delicious it felt to sleep until noon the day after my resignation took effect, with neither the demands of school nor job to vex my dreams.

The Brokaw Paper Mill

My second job after leaving the Pradel Drug Store was as a lab

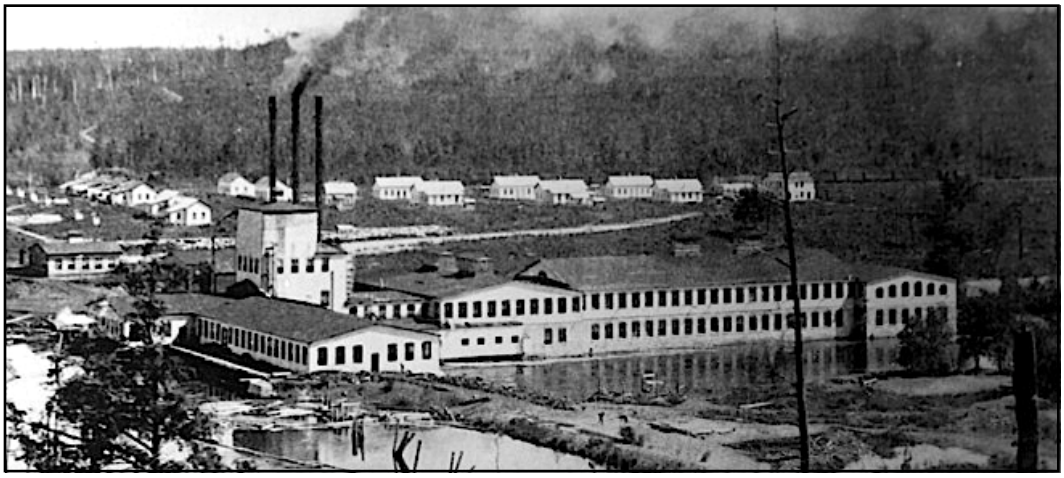


Figure 6.3. The Brokaw Paper Mill and the village of Brokaw as they appeared in 1903. By my day an eclectic menagerie of additional structures had sprung up between the original buildings and the road in front of the houses in the background.

technician with the Brokaw Paper Mill (figures 6.3 - 6.4) during my second year of college at the local University Extension Center. This job came my way via a chemical engineer by the name of Chuck Soukup, who worked at the mill and who was also a member of the local Mormon congregation and the husband of Beth Soukup, whom I mentioned earlier in connection with my brief flirtation with the world of pharmacy. The only catch was that the paper mill, as indicated by its name, was not located in Wausau proper but rather in the village of Brokaw, about seven miles north of Wausau. As already stated, I possessed neither a driver's license nor a car and the required daily commute was well beyond the limits of my English three-speed bike, especially when in the grip of a cold Wisconsin winter. So what was to be done? Fortunately both Soukup and the mill proved to be highly accommodating.

I was, for example, given the freedom to determine how many hours a week I would work, up to a prescribed maximum, as well as the times at which I would work, so as to minimize any conflicts with my college courses. Not unexpectedly, this meant that I would often

Figure 6.4. A circa 1970 colored postcard showing an areal view of the Brokow Paper Mill as it looked when I briefly worked there.

have to choose to work weekday evenings and Saturdays, and this, in turn, further meant that I would often be alone in the laboratory. Because both common sense and safety concerns dictated that it was best that a second person should also be present in case of an accident, the mill agreed to split the job and to hire a second technician to work with me and, because this person not only had to match his hours with mine, but also provide me with a source of transportation, they further agreed, at my suggestion, to hire my close friend Bob Vorwalske (figure 6.5), whom I had known since the third grade.

As the only child of older, doting, middle-class parents, Bob was often provided with financial benefits and gifts well beyond my wildest imagining and thus became, on acquiring his driver's license during his junior year of high school, the proud owner of a brand-new, bright blue, Volkswagen beetle and the sole source of transportation

Figure 6.5. Bob Vorwalske as he appeared in 1966.

for our immediate group of teenage friends. This included, in addition to myself and Bob, an electronics nut named Blair Peshak, whom I had also known since the second grade; Kim Walters, who was Bob's first cousin and a decent classical violinist; and a neighbor of Bob's by the name of James Degner, who had a fine Irish tenor singing voice which he employed exclusively for the purpose of repeatedly performing the lyrics to an old Vernon Dahlhart tune from the 1920s entitled "The Prisoner's Song," with special emphasis on the refrain:

If I had the wings of an angel,
over these prison walls I would fly.
I would fly to the arms of my darling,
And there I'd be willing to die.

Thus it was that, during the late fall and winter of 1967/1968, we found ourselves most weekdays in Bob's Volkswagen speeding up old Highway 51 to Brokaw, Wisconsin, in the blackness of early evening

(for darkness came early in Wisconsin once daylight savings time ceased in late October). In my memory all of these commutes are frozen, both metaphorically and literally, in the frigid cold of a late Wisconsin January. Though certainly an improvement over my bicycle, the original Volkswagen beetle was not exactly known for the effectiveness of its heating system. The absence of a hot motor in the front of the car meant that the winter winds came whistling through its empty front trunk and out every seam and crack in the dash board. And, of course, the window defrosters were also not the best known to mankind and Bob often found himself hunched over the steering wheel trying to make out the road through a narrow slit in the encroaching window frost.

By the time we arrived at the mill it would be pitch dark and all that was visible were the bright lights in the parking lot and those attached to the various smoke stacks, as well as the clouds of white steam that seem to leak from every crack and chimney of the aging plant, as though it was emitting its own winter breath in imitation of our own. Curiously, though I remember the mill with great vividness, I have utterly no recollection of the village of Brokaw itself. This is perhaps not surprising since it was really nothing more than just a few, small, worker's bungalows that had sprung up around the mill after its founding in 1899. As of 2012, it consisted of less than 150 houses and had a population of only 251.

The Brokaw mill was one of three paper mills located on the Wisconsin River within a few miles of Wausau. Six miles to the south was the Marathon Paper Mill in the village of Rothschild, which dated from 1909, and 17 miles to the southwest was the Mosinee Paper Mill in the town of Mosinee, which dated from 1910. All three mills made paper from wood pulp. Wood consists of cellulose fibers dispersed in a matrix of a phenolic-based resin or polymer known as lignin and the cellulose must be separated from the lignin before it can be made

into a high quality paper – the more complete the separation, the less prone the resulting paper to browning and embrittlement with the passage of time. In the 1960s the most common technology used for this purpose was chemical in nature and was known as the sulfite process because it employed various sulfite and/or bisulfite salts to convert the lignin into a separable product known as lignin sulfonate.

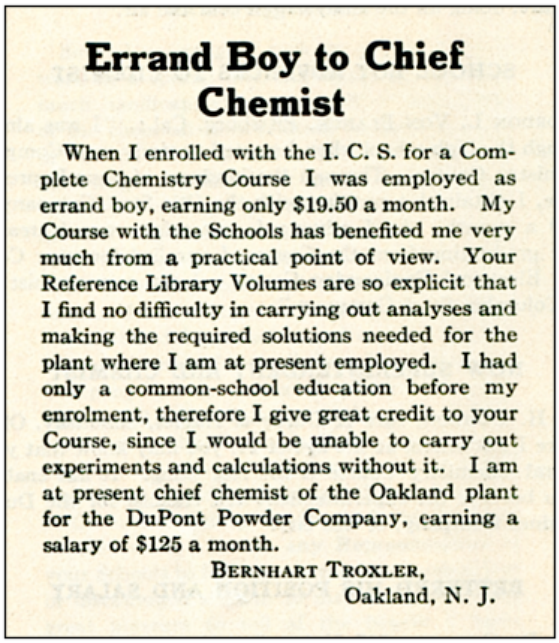
Each mill seems to have had its own distinctive odor that could be smelled for miles when the wind was just right. The mill in Mosinee, for example, which used an alternative deligninification process known as the kraft or sulfate process, always seemed to me to smell like bad sauerkraut, whereas the mill in Rothschild smelled of vanillin, the active ingredient in vanilla extract. This was because, starting in the late 1920s, the mill had established a research laboratory and subsidiary company, known as Marathon Chemicals, for the express purpose of discovering and developing new commercial uses for the lignin sulfonate by-product produced by the sulfite process. Originally this had been thrown away by discharging it directly into the Wisconsin River in the form of a waste stream known as brown liquor. One of these uses was a new process for the synthesis of vanillin developed by a British-born chemical engineer named F. J. Zimmerman, whom, as already described, I had met my sophomore year of high school. Under the name of Salvo Chemical Co., a small plant for its production was built next to the paper mill proper and, by 1940, it was producing 70% of the vanillin used in the United States.[1, 2] Though the odor of the vanillin was strong enough to mask the odor from the mill itself, in high concentrations it could be quite oppressive, particularly on a hot, humid, Wisconsin summer day, and not nearly as pleasant as the odor emitted from the bottle of vanilla extract found in your mother's kitchen cabinet.

As for the odor of the Brokaw mill, the only thing that comes to mind is the smell of a wet dog. And this odor stuck to everything,

including your clothes and hair. As a consequence, Bob and I wore a special set of old clothes to work, which our mothers would wash every few days so that the odor wouldn't contaminate our homes, and we also had to wash our hair each evening before going to bed. Indeed, I can recall my younger sister complaining of how bad I smelled whenever I returned home from the mill.

The laboratory at the mill was located just off the "beater" room. This was a massive multi-storied space located on top of an enormous tank containing pulp slurry that was being continuously agitated by huge paddles in order to prevent settling. The room had numerous openings in the floor through which the technicians could take test samples and add dyes, fillers, and other ingredients before the slurry was fed into the paper machines next door, where it was squeezed, pressed, dried, and collected into massive rolls of finished product. Perhaps it is more accurate to say that the laboratory was a single story affair that had been constructed along one wall within the beater room, since the ceiling of the latter was much higher than the roof of the lab itself.

The laboratory space was divided into three sections, each separated from the others by floor to ceiling wood and glass partitions typical of those found in offices dating from the 1930s. The southern-most section contained the chemical laboratory, the center section the pulp and paper testing facilities, and the northern-most section the offices for the chemical engineers. The chemical laboratory, in turn, contained two, circa-1930, lab benches, a single antique 3 x 3 x 12 foot wooden fume hood of the same vintage and of dubious reliability, and two smaller side rooms, one of which served as a stock room and the other as a furnace room in which resided a huge and very intimidating gas-fired muffle furnace. That portion of the central section devoted to pulp testing consisted of a single bench-sink combination extending the length of the outer wall



Errand Boy to Chief Chemist

When I enrolled with the I. C. S. for a Complete Chemistry Course I was employed as errand boy, earning only $19.50 a month. My Course with the Schools has benefited me very much from a practical point of view. Your Reference Library Volumes are so explicit that I find no difficulty in carrying out analyses and making the required solutions needed for the plant where I am at present employed. I had only a common-school education before my enrolment, therefore I give great credit to your Course, since I would be unable to carry out experiments and calculations without it. I am at present chief chemist of the Oakland plant for the DuPont Powder Company, earning a salary of $125 a month.

BERNHART TROXLER,
Oakland, N. J.

Figure 6.6. A typical testimonial for the chemistry course offered by the International Correspondence School (I.C.S.) of Scranton. Pennsylvania.

on which resided numerous devices for mechanically squeezing and otherwise manipulating samples of the pulp slurry taken at periodic intervals from the beater room in order to approximate how the slurry would behave on being fed into the paper machines. Along the opposite wall was a smaller room that was both temperature and humidity controlled and which housed various devices for testing the mechanical strength and optical opacity of the finished paper products.

There were also at least two older chemists working in the lab, who functioned as my direct supervisors, though I use the term "chemist" advisedly, as I doubt that either had college degrees in chemistry and I know that at least one had been hired 20 years earlier directly out of high school. At best they may have completed a mail order course in chemistry, like those offered for many years to prospective "industrial chemists" by the International Correspondence

Schools of Scranton Pennsylvania (figure 6.6). In reality, these men functioned, like myself and Bob, as mere laboratory technicians, since the people who really ran the show were the chemical engineers in the office at the far end of the lab complex.

The first job we were assigned was to clean and organize the laboratory stock room – a task which we tackled with great gusto, only to be pulled aside after 20 minutes and told that we were working too fast. The job, we were informed, was intended to occupy us for the entire afternoon and, at the rate we were going, we would instead be finished in less than an hour. Since I loved to handle laboratory glassware and bottles of chemicals, this task was pleasant. The same, however, cannot be said of a later job we were assigned, which involved cleaning out a large storage room used by the engineers that was located elsewhere in the mill. This was filled with boxes of old technical reports, massive spools of old circular temperature-chart readouts held together with bailing wire, and 50- or 60-pound chunks of some dark-brown, evil-looking, material that smelled like creosote, and whose exact nature and origin were never explained to us.

Initially many of our assigned tasks were truly chemical, such as preparing standard solutions for titrations, and this led to my only laboratory accident when I suddenly got a mouth full of potassium permanganate solution that I was mouth pipetting. Luckily I was able to spit it out before swallowing any, but for more than a week my mouth felt like it had been cauterized inside and I could not taste anything. However, as time went on, we were assigned more and more to the task of paper testing in the humidity controlled room in the central section of the lab complex, especially if we worked on weekends when the senior chemists were not present. This involved cutting the sample sheets of paper to be tested into strips of a prescribed width using a paper cutter and then measuring, by means of various mechanical instruments, how much force was required to

either tear the strips or to punch holes in them. We would do hundreds of samples each work session and dutifully enter the readouts in tally sheets for the engineers to evaluate. This was, to say the least, not just tedious, but truly soul numbing – which no doubt accounts for why the senior chemists so often assigned it to us.

As with my earlier job at the Pradel Drug Store, the problem of job boredom began to play an increasing role in our actions. Indeed, I recall that one evening, when Bob and I were working alone, we became so bored that we prepared a large batch of nitrogen triiodide and spread it on the floor around the work space for one of the senior chemists (who, in all fairness, was prone to practical jokes himself). This was a typical piece of ill-conceived adolescent humor and, after returning home that evening, I spent a restless night worrying that our little prank might end up inducing a heart attack in the old guy when, the next morning, he suddenly found the floor around him exploding in loud pops of violet vapor.

The one task in the laboratory we were never allowed to perform was testing the pulp samples taken at periodic intervals from the beater room. A senior technician would drop a red, gallon-size, plastic bucket on a rope into one of the openings in the floor and draw up a sample. This was then taken to the pulp bench and a handful placed in a device that would squeeze it and measure how much water came out. This was necessary in order to approximate how much water would be released when the pulp slurry was fed into the paper machines. Too much water and one risked flooding the machine floor. After performing this test, the technician would pour both the handful of pulp used in the test and the unused portion still in the sample bucket down the sink.

By now it should be obvious that our lab did not deal in research and development but was primarily concerned with monitoring and maintaining the day to day operation of the mill. Nevertheless, while I

was there, one of the engineers took notice of how this test was performed and calculated that, over the years, we had dumped a substantial quantity of useable pulp slurry down the sink. As a result, the technician was ordered, from then on, to return the unused portion of the pulp sample to the beater room and to pour it back into the bulk slurry tank. Unfortunately the first time he did this, he accidentally dropped the bucket into the tank and it was fed out into the adjacent room, where it became jammed in one of the paper machines, thus requiring that operations be shut down for a day in order to fish it out. That, to the best of my knowledge, was both the beginning and the end of research and development at the Brokaw Paper Mill.

Physically the mill was a random labyrinth of buildings and towers of differing ages and functions and I don't think I ever figured out how it all fit together. I was taken on a tour when I was first hired and recall being shown the paper and rolling machines and having to go up a horrible contraption that consisted of tiny alternating footholds and handholds arranged on what was essentially a vertical conveyor belt. But what sticks out most in my memory was the visit to the bleach room. Here I met a poor, introverted technician with plastic, black-rim glasses held together with white adhesive tape. In addition to himself, the rather tiny, windowless room that was his domain contained a small table with a stand and a pair of burettes for titration, a few beakers and flasks, and several tanks of chlorine gas. In the center of its floor was an open manhole that looked directly down into the massive tank of bleach solution below and from which the technician would, from time to time, take a sample in order to determine its concentration. But what gave the entire scene its most memorable aspect was the fact that both the room and the light coming from the hole in the floor were a yellow red color. No doubt this was to inhibit the photochemical decomposition of the bleach solution, which is sensitive to blue and ultraviolet light, but it also

gave the impression that one had just entered Dante's Inferno, save that it reeked of chlorine gas rather than sulfur.

On another occasion I was taken by Chuck and some of the other engineers to see the mill's new Copeland fluidized bed reactor. This was designed to produce magnesium oxide and sulfur dioxide through air oxidation of the spent magnesium lignosulfonate liquor left after separating the pulp cellulose from its lignin matrix. The magnesium oxide produced was then reacted with both water and the expelled sulfur dioxide to regenerate the magnesium sulfite used in the initial deligninification process. The result was essentially a closed system that recirculated the chemicals used in the sulfite process rather than dumping them into the river and was thus a significant contribution to pollution abatement. It was a beautiful stainless-steel reaction chamber that was several stories in height. They had just finished a test-run and we were able to crawl inside by means of a small porthole near floor level and found the interior lined with white magnesium oxide and the floor covered in magnesium oxide pellets that were still slightly warm. However, the interior made me feel extremely claustrophobic and I could not help but imagine what would happen if someone trapped us inside by accidentally closing the porthole.

At least once, Bob and I were able to explore on our own. One Saturday we decided to do a marathon work session extending from 10:00 am to 5:00 pm. This meant that we would have to eat lunch in the lab and we had been told that there were some pop, soup and sandwich dispensers on one of the lower floors. Come noon, we went looking for them and finally ended up in what must of been the original building for the mill since it looked directly out onto the Wisconsin River and several incrusted, antique waste pipes that were languidly discharging a viscous black goo directly into the water while emitting little puffs of steam in the process. But the most

unnerving of our discoveries was a down stair case set into the floor that became submerged after a few steps in a pool of dark water, thus hinting at the existence of long forgotten nether regions. All of this, of course, was long before it became a Hollywood cliché to have the good guys confront the bad guys in a violent shootout set in the cavernous remains of some deserted factory, but when this movie trend finally materialized, we were well prepared to appreciate its inherent creepiness.

I am uncertain what motivated me to take this job in the first place, as I did not make that much money. A surviving weekly pay stub shows that, for the week in question, I had managed to clock only 12 hours for a grand total, at $2.42 per hour, of $23.94 after taxes. I think I was flattered to have been asked and was attracted by both its inherent flexibility and the fact that, unlike the case with the drug store, it was truly a job dealing with chemistry. My letter of appointment explicitly indicated that the job was only temporary and I think I had lost interest by the spring of 1968 and dropped out, though I also seem to recall that Bob continued on his own through the end of that summer, when we were both scheduled to transfer to Madison for our junior year of college.[3]

The Wisconsin paper mills were the inheritors of the once proud Wisconsin lumber industry. They rose to prominence in the early 20th century only after the large trees of the virgin forest, used to make lumber, were largely depleted and only the smaller secondary growth, suitable for pulping, remained. Like most American industries, in recent decades the paper industry has been subject to repeated buyouts and amalgamations by ever larger national and international corporations. When I worked there, the Brokaw Mill was actually owned by a firm known as Wausau Papers and in 1997 this company also became associated with the mill at Mosinee. In 2011 Wausau Papers sold the Brokaw Mill to Neenah Paper, and in March of that year the

new buyer decided to close the site after 112 years of continuous operation. At last report, the abandoned mill site had been sold to a developer. Even the innovative Marathon Chemical Corporation and the Rothschild-based vanillin plant are gone. After passing through several new owners, the company was acquired in 1990 by a Norwegian-based international corporation known as Borregaard LignoTech. Long before this, however, vanillin production from lignin waste had ceased in the United States, since it could no longer commercially compete with a newer synthetic procedure based on petrochemicals.

North Central Heating

The Post Office and the Brokaw Paper Mill hardly exhaust my list of temporary, minimum wage jobs. During the Xmas break of 1966/1967, for example, I was employed for a week as a receptionist for North Central Heating. This local Wausau business was located just off of 6th street in a turn-of-the-century building and was owned and operated by the father of one of my high-school friends by the name of James Wicke (figure 6.7), though, for some reason, we always called him Wicke rather than Jim. The Wickes lived in a ranch-style house on Pied Piper Lane on the southeast side of town near the airport. Though Wicke had an older married sister, by the time I knew him he was the only child still living at home with parents who were considerably older than my own, and he had assumed something of the aura of a privileged only child. His bedroom, for example, occupied the entire second floor of the house and was filled with his collection of jazz and big-band records and his collection of books on military history and political caricature. His domain also extended to most of the basement, which housed his mineral collection, a lab bench complete with a commercially produced kit for chemically testing minerals (which I dearly coveted), and an old upright piano on

Figure 6.7. James Wicke as he appeared in 1965.

which he would pound out, on request, his version of Scott Joplin's famous "Maple Leaf Rag."

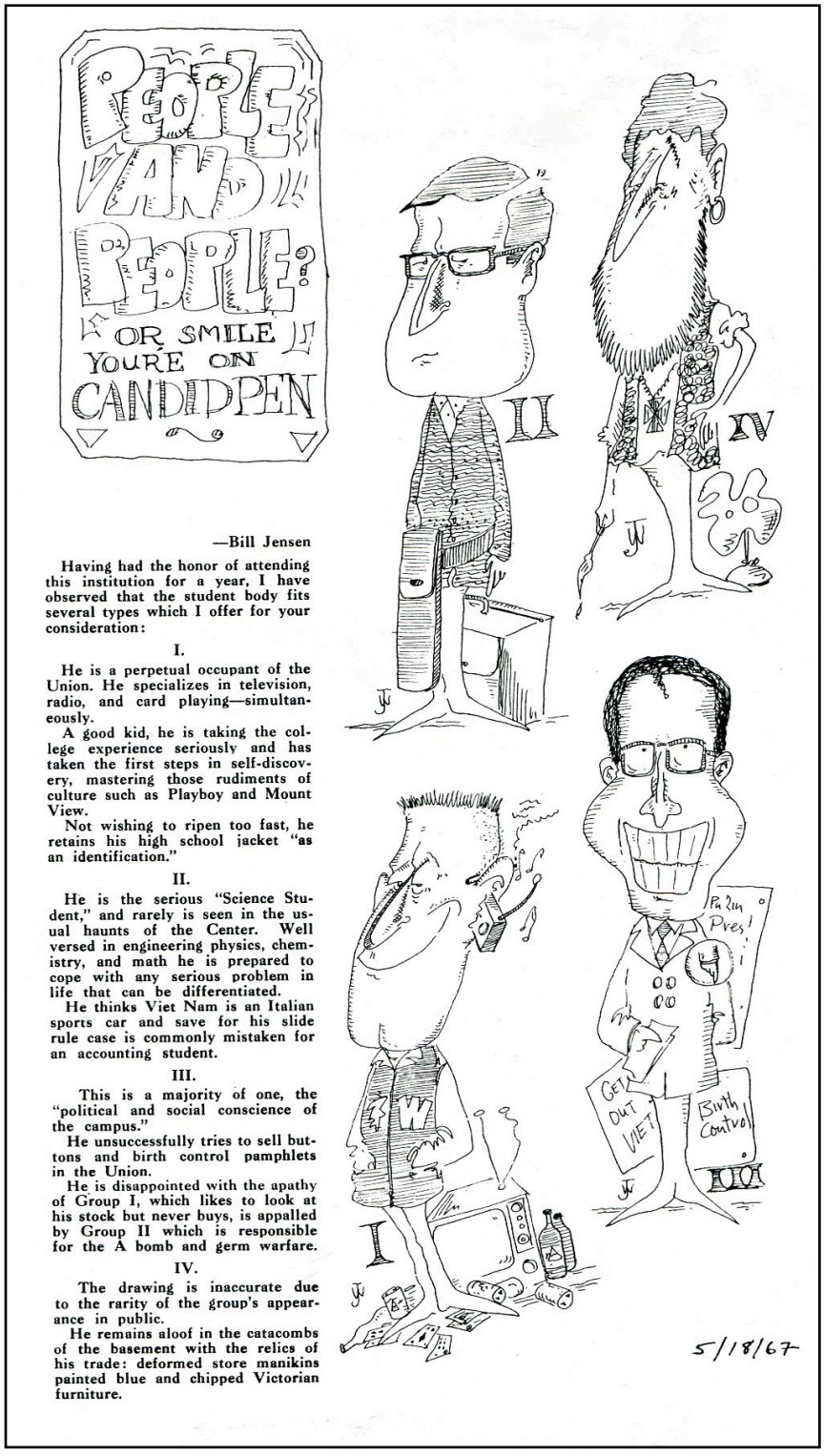
After high school, Wicke continued on with me at the Marathon County Extension Center and we would later be roommates during my first year at the main campus in Madison. Either during his last year of high school or his first year of college, his parents gave him a vintage, 1950s, two-tone, blue and white, Pontiac convertible with large tail fins and white-wall tires in which we would take weekend day trips to either Green Bay or Madison in order to visit used books stores, since by our first year of college we had both begun to seriously collect books. During this year he also wrote an occasional opinion/ review column for the college newspaper which I illustrated with cartoons and caricatures (figures 6.8) and for which we were both given journalism awards.

There was, however, one serious defect in Wicke's character and that was his fascination with extremist political movements. In high school he became an outspoken advocate of Barry Goldwater's bid for

Figure 6.8 An example of an illustration I did for one of Wicke's newspaper columns dealing with an exposé of George Lincoln Rockwell and the American Nazi Party.

President of the United States and even managed to get a group of us arrested for staging an unauthorized Friday-night parade through downtown Wausau in support of his candidate. He also became an avid collector of Ku Klux Klan literature, and I remember his excitement when it was announced that George Lincoln Rockwell, the founder of the American Nazi Party, had been assassinated in a Virginia parking lot.

In college Wicke did a complete 180 degree flip (figure 6.9) and by the time I moved to Madison he had became both an avid Marxist and a Black Studies major. That's right, your eyes have not deceived you. He actually decided to major in Black Studies! As you may well imagine, I have since wondered whether this extreme about-face was some kind of bizarre penance for past political sins. He also proceeded to decorate our room with African art and large posters of such political radicals as Malcolm X and Che Guevara. Indeed, I can recall returning from campus one day to find him in a



—Bill Jensen

Having had the honor of attending this institution for a year, I have observed that the student body fits several types which I offer for your consideration:

I.

He is a perpetual occupant of the Union. He specializes in television, radio, and card playing—simultaneously.

A good kid, he is taking the college experience seriously and has taken the first steps in self-discovery, mastering those rudiments of culture such as Playboy and Mount View.

Not wishing to ripen too fast, he retains his high school jacket "as an identification."

II.

He is the serious "Science Student," and rarely is seen in the usual haunts of the Center. Well versed in engineering physics, chemistry, and math he is prepared to cope with any serious problem in life that can be differentiated.

He thinks Viet Nam is an Italian sports car and save for his slide rule case is commonly mistaken for an accounting student.

III.

This is a majority of one, the "political and social conscience of the campus."

He unsuccessfully tries to sell buttons and birth control pamphlets in the Union.

He is disappointed with the apathy of Group I, which likes to look at his stock but never buys, is appalled by Group II which is responsible for the A bomb and germ warfare.

IV.

The drawing is inaccurate due to the rarity of the group's appearance in public.

He remains aloof in the catacombs of the basement with the relics of his trade: deformed store manikins painted blue and chipped Victorian furniture.

Figure 6.9. A cartoon satire which I did for the college newspaper my freshman year (1967). Wicke is caricatured as Type III. Apparently he forgave me, since we later became roommates after my move to Madison.

dither. While I was gone, two Mormon missionaries had shown up to inquire about my lack of church attendance. Based on their conservative haircuts, their dark suits, white shirts, ties, and wing-tip shoes, as well as their obvious disapproval of his decor, Wicke had become convinced that they were actually FBI agents come to spy on him.

By the end of the year we had parted company for good, in large part because of my refusal to respect his extremist views and because, from the standpoint of his newly acquired political "religion", this refusal to become part of the "solution" automatically meant that I was part of the problem. In retrospect I regret this development since, whatever else he may have been, Wicke was always an interesting and stimulating companion, with a wicked sense of humor and a broad range of historical and cultural interests. When I last heard of him, more than 30 years ago, he was living in Chicago and spending his weekends on street corners passing out political pamphlets for the Communist Party.

But to return to Wausau, Wisconsin, during the winter of 1966/1967. It seems that the elder Wicke's secretary had quit her job at the heating company shortly before Xmas and he felt that it would be impossible to find a permanent replacement until sometime after New Years. As a family friend and college student on holiday break, I was asked if I would be willing to temporarily take her place. My primary duty was to take phone messages and to deal with the nonexistent walk-in customers when Mr. Wicke was out of the store on sales and service calls. This was hardly demanding work and most of my time was actually spent reading H. P. Lovecraft horror stories. Desperate to better utilize his short-term employee, and knowing of my work illustrating his son's column in the college newspaper, Mr. Wicke eventually set me the task of designing several cartoon-based ads for his business. I believe that several of these were actually printed in the

city newspaper, though I find, for some reason, that I do not have copies in my files.

The Xmas holidays were not exactly a boom period for selling furnaces and air conditioners. The main reason for staying open was to deal with the service calls. Having your furnace quit in the midst of a freezing Wisconsin winter was no laughing matter and Mr. Wicke felt obligated to insure that this did not happen to any of his loyal customers. Indeed, I remember one of these service calls in great detail. It came in about 5:30 pm, just before closing time, from a farm in the wilds of Stettin to the west of Wausau. Since Mr. Wicke knew that it would be dark by the time he arrived at the farm house and he was uncertain whether the county roads had been properly plowed, he asked me to accompany him, no doubt as extra muscle power should he have the misfortune to become stuck in a snow drift.

As it turned out, the snow plows had done their job and I soon found myself as a passenger, not in a drafty Volkswagen, but in a well heated luxury Cadillac cautiously moving down narrow county roads. For much of the trip the only thing visible in the beams of the headlights were the enormous piles of snow left by the plows on either side of the road. These were often taller than the car itself and, on the few occasions when we could see over them, only endless flat fields of snow were visible stretching to the horizon, which was itself marked only by the distant lights of an occasional farm. It was a bitterly cold, cloudless January night and the humidity was so low that the stars and moon shone with unusual brilliance and the only audible sound was the crisp crunch of the car's tires on the thin layer of compacted snow left by the plows.

When we finally arrived at the farm house, around 6:30 pm, the family, bundled in their winter coats, was just finishing supper. I remember the palpable sense of gratitude when we appeared out of the darkness of the night to rescue them and the surprise of the teenage

daughter, who recognized me from high school, though we had not personally known one another. Of course, I knew nothing about repairing furnaces, so I was quickly relegated to the job of holding the flash light and passing tools to Mr. Wicke. After about 20 minutes of tinkering, he got the furnace working again and, mission accomplished, we once more disappeared into the blackness of the January night. Though most would dismiss this episode as mundane in the extreme and hardly worth recording, it was, for some reason, strangely surreal and I am still surprised at the intensity with which I am able to recall its tiniest details after more than 40 years. Perhaps it is mute testimony to the ability of a cold January night to hyper-stimulate the human senses.

A surviving pay stub indicates that my week-long adventure working for North Central Heating earned me a total of $22.50 after taxes.

The Wausau Sign Company

My final part-time job occurred in the summer of 1969, between my junior and senior year at Madison, when I worked for the Wausau Sign Company, which had moved from its original location on North 2nd Avenue to newer accommodations on South 14th Avenue, about five blocks from our house. My father (figure 6.10) had been half owner of the original business, but had sold out his interest several years earlier in order to form his own company under the name of "Jensigns" – a disastrous decision which soon ended in a descent into debt and alcoholism. However, that summer he was in one of his increasingly brief periods of sobriety and had gone to work for his former partner, Mac Madison. Indeed, since he was the only trained sign painter working for the company, he was paid the highest wage. Mac, as usual, handled the financial accounts and the glassblowing

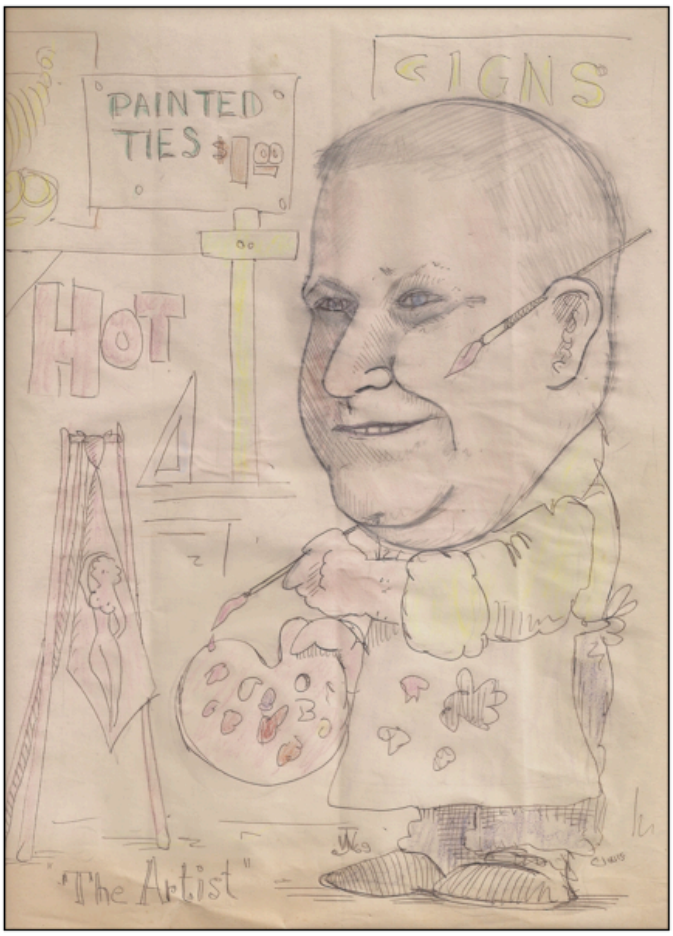


Figure 6.10. A caricature of my father, William Wickman Jensen (1927-1974), which I did around the time that I worked with him at the Wausau Sign Company. Unhappily the paper I used has not only darkened with time but has apparently sustained some water damage.

required for the increasingly rare demand for neon signs, and Joe Cole did most of the routine construction and mechanical work.

In previous years I had used my cartooning skills to help my father design and paint temporary window signs in tempera, mostly for seasonal specials sponsored by various car dealers in town, and he somehow got it into his head that I was a competent sign painter. He was obviously quite proud that I was working with him and that I was

finally doing something he could understand and appreciate. As a result, he insisted that Mac pay me a wage substantially above the minimum required by law.

This, however, proved to be a huge mistake. Though I excelled at cartoons, doodles, and quick sketches, I lacked the patience and skills to do precision layout work. I had known this since 8th grade when I had taken a course in mechanical drawing. If ever there was an anal retentive subject, this was it. The entire semester was spent drawing two-dimensional "orthographic" projections of various arrangements of wooden blocks and metal machine parts. Every aspect of the process had to be done by the book, from how we fastened the paper to our drafting boards and positioned our arms, to always rotating our No. 4 pencils when drawing lines so they would wear evenly on all sides. But try as I might, there was always something unfinished and frayed about my final product and, to my great disappointment, I received a B in the course rather than my anticipated A.

A second piece of evidence appeared the next year when I took "art" for the last time in 9th grade. The instructor was named Crawford and I remember that he was partial to plaid suit jackets and bow ties, and that he wore his hair in a military-style buzz cut – a somewhat unusual choice for someone in the arts. Though my drawings and designs of buildings and other inanimate objects were creative enough to earn me an A for the year, Crawford was not equally enthusiastic about my drawings of people and complained to me that everything I drew looked like a cartoon. I took the hint and never took another art course. That summer Crawford happened to walk by our house while I was sitting on the front porch and we had a brief, but interesting, conversation during which he informed me that he had resigned his teaching position at John Muir Junior High School in order to take a job as curator of a small art gallery somewhere in

the wilds of Texas, where, I assume, his buzz-cut proved to be less of an anomaly.

The first hint that I was in over my head at the sign company came when I was assigned the job of laying out the pattern for a sign to painted on the side of a panel truck. This was done using a pencil, yard stick, and T-square on an enormous 4 x 8 foot sheet of brown paper. Once the letters were penciled in, their outlines were traced using a small tool with a toothed wheel that left punctures in the paper every few millimeters. The resulting "stencil" was then taped to the side of the truck and liberally doused with chalk powder using a powder puff in order to create a temporary guide for my father to follow when he did the actual painting. Somehow I managed to mismeasure things with the result that my letters, due to an increasing lack of space, became thiner and thiner and more and more closely spaced as one read from left to right.

Nor was my second assignment a great success. This involved using a small hand-held electric jig saw to cut out 20 large cursive letters that my father had laid out on sheets of inch-thick plywood. My control of the saw was less than perfect and the resulting hesitations and unaccountable meanderings in and out of the lines meant that I had to spend hours afterwards with a file and sandpaper in order to achieve the desired smooth curves.

My employment was finally terminated by an accident. I was asked to fetch something from a storage bin that had been mounted near the ceiling directly above a large cylindrical steel tank. I foolishly placed a metal ladder against the curve of the tank and started up, only to have the ladder suddenly slip sideways. I came crashing to the cement floor and hit the back of my head rather violently against the side of the tank in the process. I recall my father being very upset but, as things turned out, I was only temporarily stunned and soon recovered. In any case, the tank seems to have finally knocked some sense into

me and I quit the next day, vowing to never again take another temporary job unless forced by truly dire economic circumstances.

The Demise of My Home Laboratory

I continued to use and expand my home laboratory throughout my first two years of college at the local Extension Center, but after my transfer to the Madison campus in the fall of 1968, I began to spend less and less time working there. After entering graduate school in 1970 I had continuous access to a professional chemical laboratory at the university and hence little reason for maintaining a private one at my mother's house. Nevertheless it was kept intact for several more years, though largely unused. My father would die in 1974 from a combination of lung cancer and cirrhosis of the liver, brought on by a lifetime of smoking and drinking, and my mother's elderly landlady would pass away in 1976, at which point her daughter, who had inherited the house, asked my mother to move as she wanted to give it to her unemployed son and his girlfriend. And so my hard-won accumulation of chemicals and apparatus, after proper disposal of any items considered to be either corrosive or otherwise dangerous, was finally placed in storage, where it has remained even to the present day.

A final set of snapshots taken in 1971 (figures 6.11-6.12), when I was student teaching in the Twin Cities, show that my home laboratory had reached a considerable level of sophistication before its final demise. Yet I cannot resist harping on how much has changed since these photographs were taken. Today, should the police discover such a laboratory in someone's basement, that person would almost certainly end up in prison, since the assumption would automatically be that they were engaged in either illegally making drugs or bombs. This irrational fear of chemicals, which now permeates every aspect of our society, is glaring testimony to the utter and total failure of the last 50 years of chemical education at both the high-school and college level.

Figure 6.11. Photo of one wall of my basement laboratory taken around 1971 when I was student teaching high-school chemistry in the Twin Cities.

If someone commits a crime using a pipe bomb or a Molotov cocktail, no one attempts to make possession of pipes or gasoline illegal, as they know that these items have many other practical and necessary everyday uses, yet our legislators are so chemically ignorant that they are willing to make possession of the most mundane chemical used in making a drug or explosive illegal, even though these same chemicals may also have literally hundreds of other practical and important uses.

Nor is this policing of chemicals restricted to private individuals as it now permeates our universities and high schools as well. My favorite example involves the requirement at Cincinnati that we monitor the location and quantity of every bottle of nitrate salts in our many laboratories. Many of these correspond to ridiculously small quantities of rare and very expensive compounds that no bomb maker in his

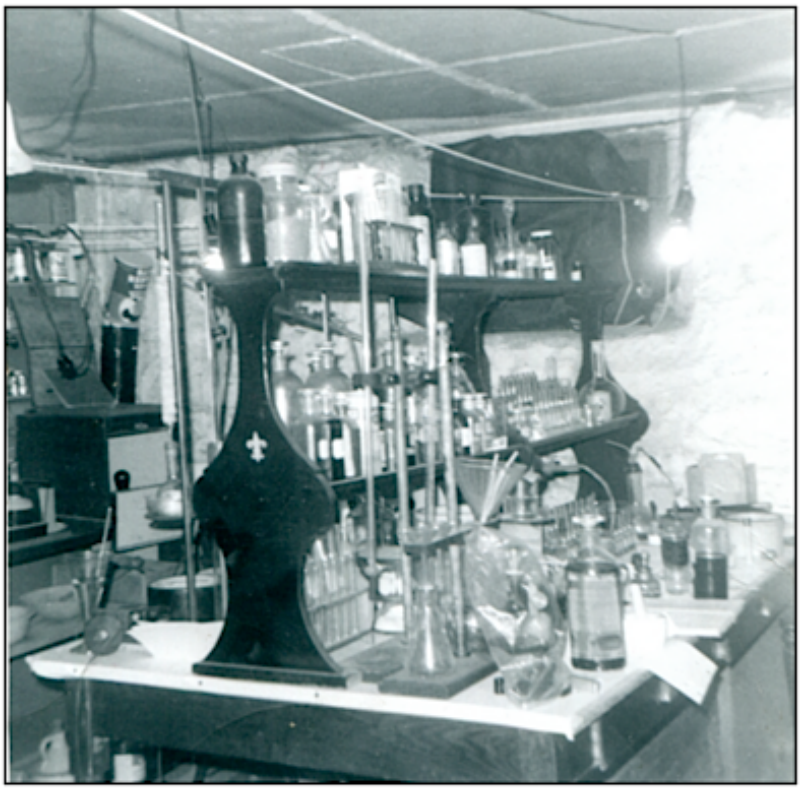


Figure 6.12. A second photo of my basement laboratory taken around 1971, when I was student teaching high-school chemistry in the Twin Cities, showing the central double-sided lab table.

right mind would ever use to make explosives. Thus, for example, a mere 10 grams of rubidium nitrate costs nearly $200. As the recent Boston Marathon bombing illustrates, no terrorist is going to break into a university to steal trivial amounts of rare chemicals when they can go to any gun or fireworks store and legally purchase all the ready-made explosives they may need. This policing even goes so far as to dictate what chemicals can be placed next to one another on a shelf. Thus it is illegal to store a bottle of acid next to a bottle of base. Apparently some chemical ignoramus read that when acids and bases mix they produce heat and therefore falsely assumed that, should the adjacent bottles break, the resulting mixture would burst into flame.

Yet when one reads further in the regulations, they are told that the first step in dealing with an acid spill is to neutralize it with base.

I apologize for ending this memoir on such a negative note, but I cannot disguise my distress at what has happened to the public image of a science that I have loved and practiced since boyhood nor at the likely prospect that future generations of children and teenagers will never have the same opportunity to personally experience its many wonders first hand.

References and Notes

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in Wausau, but the 1910 City Directory indicates that he was clerking in a drug store at 412 3rd Street. This may have been the Palace Drug Store belonging to Gustave Naffz. Early entries in various directories of pharmacists spelled Pradel as Praedel, suggesting that the original German spelling was actually Prädel.

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8. For the influence of Parascandola, see W. B. Jensen, "Survival of the Best Fit: A Brief History of Drug-Receptor Interactions," W. B. Jensen website.

Chapter 4

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2. B. L. Hawk, *Organic Chemistry for the Home Lab,* Science Service: Washington, DC, 1956.
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4. See, for example, E. W. Schoeffel, "Sewage Treatment," US Patent 3060118, 1962 and numerous others, often filed jointly with Zimmerman.
5. See, for example, E. W. Schoeffel, "Manufacture of Vanillin," CA Patent 508600, 1954, and E. W. Schoeffel, "Purification of Vanillin," US Patent 3049566, 1962.

Chapter 5

1. Technically the laboratories are located in the suburb of Maplewood, just north of St. Paul.

2. C. H. Sorum, *Introduction to Semimicro Qualitative Analysis*, 3rd ed., Prentice-Hall: Englewood Cliffs, NJ, 1960.
3. C. E. Dull, H. C. Metcalfe, J. E. Williams, *Modern Chemistry*, Holt, Rinehart, Winston: New York, NY, 1958.
4. On examining Agre's report I discovered that he ranked students not only according to grade, but also, in the case of student's having the same grade, randomly. Thus seven students received 100% on the final retake of the ACS exam, but rather than all seven being ranked as 1, they were instead randomly ranked as 1 through 7. I have recalculated his rankings to eliminate this egregious error.
5. After writing this, it occurred to me to check the internet to see if I could determine what eventually happened to the few boys whose names I remembered. Not surprisingly, my prediction concerning Manning Butterworth proved correct and he did indeed go into the field of aerospace science. He has published numerous papers in such places as *The Astrophysical Journal*, *The International Journal of Geometric Methods in Modern Physics*, *The Journal of Astrophysics and Astronom*y, etc. He currently lives up the road from me in Dayton, Ohio, where I presume he is connected in some way with research for the U.S. Air Force. Alas, Merle Vanneputte did not become a chemist. He is listed as a private computer consultant living in San Diego. My roommate, Dana Kamerud, became a Senior Research Scientist in the Operating Sciences Department of General Motors in Detroit, where he specialized in policy analysis, and now (presumably retired) resides in Wayzata, Minnesota. Norman Henderson was more difficult to find as his name is quite common. However, based on his current photograph, I believe he is the Norman Henderson who is presently listed as Director of the Prairie Adaptation Research Collaborative (PARC) at the University of Regina in Canada and who is a well known expert on the ecology of prairie lands, though the dates and details of his university training given in his online vita do not seem to coincide with those expected of someone who would have graduated from an American high school in 1966.

Chapter 6

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2. See the webpage "Zimpro History." Zimpro was originally owned by Sterling Drugs and is now owned by Siemens.
3. My brother also worked at the Wausau Post Office the summer after graduation from high school and as a lab technician at the Brokow Mill the summer between his freshman and sophomore year in college. To the best of his recollection, both Raymond Fraedrich and Bob Vorwalske also worked there that summer as well.

Name Index