Louis C. W. Baker (1921–2003), A Personal Tribute from His Wife, Grateful Students, and Colleagues on the 10th Anniversary of His Death

George B. Kauffman* and Violet E. S. Baker

Department of Chemistry, California State University, Fresno, Fresno, CA 93740-8034, georgek@mail.fresnostate.edu; 3718 Huntington St., NW, Washington, DC 20015-1818; ViBaker@aol.com

Abstract: Louis C. W. Baker, Professor Emeritus of Chemistry at Georgetown University and a world-renowned inorganic chemist and educator, died on April 15, 2003, ten years ago, in Washington, DC. This article discusses the family background that molded and influenced him and his personal and professional life and work, with an emphasis on his research on heteropoly compounds, mentoring of students, and activities in scientific societies.

Introduction

Louis C. W. Baker (Figure 1), Professor Emeritus of Chemistry at Georgetown University and an internationally renowned inorganic chemist and educator, died on April 15, 2003 in Washington, DC from the complications of diabetes and renal failure at the age of 81. His last two years were spent either in bed or in a wheelchair, a particularly poignant sight to those of us who knew and loved him and remembered his formerly vigorous and enthusiastic self. He was survived by his wife of 39 years and former student, Violet (née Simmons**),** his sons William and his wife Ilyanna and their children, Samuel and Violet of Denver, Colorado, and Godfrey (Goff) and his wife April and their children, Alexander, Ava, and Samantha of Huntsville, Alabama (Figure 2). On May 2, 2003 on the Georgetown campus a celebration of his life was held in the Dahlgren Chapel, followed by a reception in the Riggs Library [1–4].

Family Background and Formative Experiences

Louis Coombs Weller Baker was born on November 24 (Thanksgiving Day), 1921 in New York City, the only child of unusually creative, imaginative, and resourceful parents (Figures 3 and 4). His father, F. Godfrey Baker, born in 1885 in Kingston, Ontario, Canada, was the youngest of the four children (of eight) who survived childhood. He attended Queen's University in his hometown, where his oldest brother—a student of 1906 Nobel physics laureate Joseph John (J. J.) Thomson (1856–1940)—was already a Professor of Physics. After an academic career enriched with summers of employment for the provincial government, surveying the northern provinces, commonly traveling alone by canoe into uncharted areas inhabited primarily by Indians and learning a high degree of self-sufficiency and survival skills, he became a mechanical engineer.

During the early years of the twentieth century Lou's father gradually gained a reputation for the design of automatic—and sometimes highly imaginative—machinery such as a device that produced, from raw starting materials and in one continuous process, 60,000 packaged and labeled "Mrs. Smith's Home-Baked Pies" per day (and another machine that similarly produced potato chips). Among his projects were: the huge stage elevators for the Radio City Music Hall; the massive elevators for bringing a plane every seventeen seconds to the flight decks of the aircraft carriers U.S.S. Yorktown and U.S.S. Enterprise; and most importantly, the pilot plant at Columbia University which was being designed and built simultaneously with the production plant at Oak Ridge for separating uranium isotopes by gaseous diffusion under the Manhattan Project. However, he always seemed able to find time and imagination for the delight and edification of his only child, with stories, drawings, poems, and toys of his own design, such as the "galloping tricycle horse" that he built for Lou's fourth Christmas and that was the basis of the only patent for which he ever applied in his own name. He learned early that, without deep-pocket financial backing, a patent affords little protection against a well-heeled infringer.

Lou's mother, Marion Georgina Weller, was born in 1886 in Liverpool, England, the youngest of thirteen children. Her paternal grandfather had narrowly escaped from Germany with his life after killing a nobleman in a political duel (One was expected only to wound, not kill, to satisfy honor), and he sought asylum in Liverpool. A graduate of the Universität Bonn and an accomplished mathematician (and freemason), he settled in England and was eventually given "The Freedom of the City of Liverpool" for his success in applying calculus to the computation of the volumes—and thus the cargo-carrying capacity—of ships with curved hulls, an accomplishment of considerable financial significance in one of the major shipping centers of the world. One of his sons, Louis, became a federal judge in the territory of Nevada before it became a state. He was instrumental in persuading the Shoshone Indians to settle on a reservation, and he remained there with them as the ultimate (and very sympathetic and respected) legal authority. His oldest son, George, however, though well educated, became an alcoholic, causing most of his children to leave home and find their own way as soon as they were able. Thus his youngest daughter Marion, Lou's mother, left for America at the age of sixteen, to visit her oldest brother Louis, a bachelor who lived on Long Island, New York; her uncle in Nevada; and a cousin who was a professor of music at Berkeley.

Marion was an amazing woman in many ways—extremely witty, articulate, daunted by nothing, capable, artistic, a good English country dancer, and very strong-willed and

* Series Editor contribution.

Figure 1. Louis Coombs Weller Baker (1921–2003).

Figure 2. Lou, William, Godfrey, and Vi Baker (left to right). This photo was taken at the reception in the Bishop's Garden of the Washington National Cathedral, following Will's graduation from St. Albans in May 1988. His younger brother Goff, who was a freshman there at the time, was already taller than Lou (He eventually stopped growing at 6' 7").

Figure 3. Lou Baker as a Young Boy.

Figure 4. Lou Baker in His First Car. As an adult Lou possessed an attachment to old automobiles.

independent. She was very well read. She loved the poetry of Scotland's national poet Robert Burns and could entertainingly recite many of his works from memory, including "Tam o'Shanter" in its entirety. Dickens was another of her favorites. She must have identified to some extent with the character of Mr. Pickwick's astute and resourceful cockney servant and companion Sam Weller, because she adopted the name Sam and was so known for the rest of her life. Her trip across the United States and back was a series of adventures, including crossing the Isthmus of Panama in part on foot, through parts of the Canal, which was then under construction, where she saw the effects of the deleterious endemic tropical diseases, particularly malaria and yellow fever. She took a number of temporary jobs, including that of governess in the Singer (Sewing Machine) family. She arrived in San Francisco on April 6, 1906, the day of the Great Earthquake, and was moved, under martial law and along with many others, to a city park where bodies were piled and covered with tarpaulins (She described seeing the militia shoot through the tarps at any sign of movement, presumed to be caused by ghouls robbing the bodies). After several days the survivors were evacuated across San Francisco Bay to Oakland.

Upon her return to her brother and New York, Marion enrolled in the nursing school of the New York Hospital (affiliated with the Cornell University School of Medicine), graduating as a registered nurse in 1914. A number of the new nurses as well as doctors from the hospital were volunteering with an American Red Cross unit to nurse for the Allies. A classmate from Gananoque, Ontario invited several of the new graduates to spend a week canoeing around the Thousand Islands. It was there that Lou's parents' romantic meeting took place, and Godfrey determined to wait for Sam. She served as a war nurse throughout the entire war, becoming a chief nurse at a large base hospital with hundreds of beds (the U. S. Army took over the medical service after the United States entered the war). She saw service at Verdun, the most horrible of all the battlefields. All of her brothers (except for overage Louis in New York) were killed by the Germans, while fighting for Britain, which made her a passionate pacifist. She returned, haggard but experienced, and more strong-willed than ever, five years later and ten years older. Godfrey was there to meet her, and they were married on Christmas Day, December 25, 1919.

Through the good offices of a American-trained nurse in her unit, Sam found a summer position as camp nurse at a major summer camp for girls on Lake Morey, a vacation destination in central Vermont where she might recuperate and regain her perspective. Godfrey, now referred to as "The Skipper," went with her and was hired as a counselor at the young boys' camp of the same chain. Within three years, they were head counselors, with Lou's father directing the boys (ages 7–11) in major building projects—among them a sizeable Viking ship, a large wooden castle that converted into a theater, a full-size Dutch windmill, and a "Spanish Galleon" boathouse, the stern of which hinged down and became a boat deck. Sam organized a major pageant each year—Robin Hood, The Pied Piper of Hamlin, *etc*.— with all the campers participating, hundreds of costumes, scenery, scripts, action, and rehearsals! And Lou, as a toddler, was part observer, part participant in all the activity and creativity, absorbing the love of and know-how for sailing and all the other sports and activities.

In 1927, when Lou was not yet six, his parents decided to start their own camp, for older (teen-aged) boys, with emphasis on sailing. With financial assistance from Sam's brother Louis, they found a property on the western shore of South Hero Island, with safe anchorage in a sheltered bay of Lake Champlain. They named it Dingley Dell, after the country estate where Mr. Pickwick of Dickens' "Pickwick Papers" found rest and restoration (Figure 5). They also acquired all of

Figure 5. Dingley Dell, May 11, 1991, Before It Was Opened for the Summer. View of the Back of the House from the Tennis Court, Showing the Judge's Bench and the Fanciful Elephant's Head Chimney, Which Backed the Living Room Fireplace.

the materials for building their sailboat. By then both of them were firmly convinced of the great personal benefit of taking time off from work for 2½ to 3 months every summer, despite any threat of severe professional disadvantage, a practice that Lou rued being unable to follow in his own adult life. They sometimes returned to New York at the end of the summer to find the Skipper's job filled by someone else, but such was his growing reputation that he seldom had to wait long to find work, even during the depression.

Meanwhile Sam had become involved in establishing the first Home Nursing Service in the slums of New York City. She was also taking care of Lou, whose health during childhood was surprisingly frail. In fact, he was home-schooled for two years before undertaking formal schooling.

The Aladdin and Vermont

Much of Lou's "education" (if not his schooling) came from those vigorous and developmental summers in Vermont. In 1928, together with Lou's parents, the first class of campers—apparently seven in all, but with a core of boys who had just "aged out" of the Aloha camp, where they had acquired from the Skipper formidable skills and habits that enabled them to be efficient beyond their years—built in a mere six weeks the 75-foot long, 21-ton wooden sailboat "Aladdin" from the Skipper's original design, with a 20-foot beam, 24 bunks, a large galley, and fo'castle, under the watchful and skeptical eyes of the local farmers who gathered on the shore every afternoon to watch the construction (Figures 6 and 7).

They were even able to rig a sail and make a single trip due west to Plattsburgh at the foot of the Adirondack Mountains in upstate New York and back before having to haul her up on the shore for the winter. The following summer they hung 280 square yards (five mainsails and three topsails) of rainbow-striped canvas sail (sewn on a treadle sewing machine and tie-dyed by Sam) and began their ten summers of adventures on Lake Champlain and up into the province of Québec in French Canada via adjacent waterways and Lac St. Pierre, learning sailing, navigation by the stars, seamanship, outdoor skills, organizational skills, purchasing, resourcefulness, and above all, responsibility and self-reliance. They fashioned home-made diving helmets (possibly for emergency rescue, but certainly for fun exploring for sunken ships); acquired social skills by visiting other camps around the lake; learned American history exploring the then-as-yet unreconstructed Forts Ticonderoga and "Blunder"; played "shipwrecked sailors," which required them to go overboard with whatever they thought they might need and could grab on a few minutes' notice, swim to a nearby island (carefully chosen in advance by the Bakers), and survive for several days by fishing (Figure 8), trapping or whatever, until they were "rescued" (survival skills), and learned to "cuss like a sailor" (seamanship, no doubt).

They learned, largely by misadventure, to carry full operational and repair supplies, and then to double that, which made them invaluable for assisting other boats in distress —a not infrequent occurrence. Promotion in the crew was strictly by merit, even for Lou, and the recognition of his merited advancement from cabin boy eventually to first mate was a source of considerable satisfaction to him. On land they played tennis, lacrosse, table tennis, badminton, and similar sports, and under Sam's direction, learned folk dancing and English country dancing. The farmer across the road was the fiddler, sometimes joined by various of his children, all of whom played musical instruments, and every Friday evening saw the Assembly Hall filled with squares composed of campers as well as locals, who were always welcome.

The happy and formative experiences of those wonder years connected Lou closely to Vermont and to its people, the resourceful and unpretentious but fiercely independent apple-growers and dairymen who had lived on the island for many years, descendants of Ethan Allen's Green Mountain Boys, with whom he shared ownership of part of the islands given to him in gratitude for his service to the independent nation of Vermont during the Revolutionary War. Lou appreciated their honesty and straight-forwardness and understood the irritation some shop-keepers displayed when a customer publicly counted his change before pocketing it, recognizing in the gesture a lack of trust in his honesty. He found the pace, the integrity, the competence, and the generosity and willingness to offer help deeply restorative of his outlook on life and his creativity. A story that Lou liked to tell concerned a New York City lawyer who, having just driven up for a visit, realized that he had forgotten to bring a flashlight. He went into the small general store asking to see flashlights. He selected one and asked the price. Forgetting where he was, when the storeowner said "Two dollars", he snapped back, "Why, I can buy that in Manhattan for half that price." The proprietor calmly retrieved the flashlight, restored it to its former position in the showcase, and said, "Well, do."

There is one other blessing that summers in Vermont conferred on Lou, which would not have been unique to Vermont but which he appreciated vastly nevertheless. Because Lou was the most accessible of men the rest of the year —his office door was always open to anyone seeking his help, his office and home phones were never turned off, no matter what the hour— he refused to have a phone in Vermont and really loved not being reachable (although in fact he had made arrangements for possible cases of emergency).

Education and Overlapping Professional Experience

Horace Mann School and Horace Mann High School, which Lou attended from 1933 to 1939, was an independent college preparatory private boys' school, founded in 1887, in New York City that was justifiably proud of the quality of its classical curriculum and the qualifications of its faculty (The *Wall Street Journal* ranked it as the fourth best high school in the United States, and *Forbes* magazine ranked it as the second best preparatory school in the country in 2010). Lou's parents

Figure 6. Model of the Aladdin.

Figure 7. The Baker Family on the Aladdin. Lou's Mother; Lou's Father, Seated, Holding a Ship's Lantern; a Camper; Lou; the Ship's Cook; and Two More Campers, Seated on the Gunwales (left to route), 1933 or 1934.

Figure 8. The Catch of an Early Morning Fishing Trip (45 yellow perch and one bass) Taken by Lou on August 11, 1978. Lou, Will (who was then in St. Albans Lower School), Michael Dougherty (a classmate of Goff's), and Goff (left to right). Michael and Goff had just finished at Beauvoir, the coed elementary school of the Cathedral schools.

applied for admission for him because they were not satisfied with the education that he was receiving in public school.

Lou started in the lower school, which was (and remains) well known for its progressive approach to education (in the sense of the permissive education advocated by John Dewey and his followers). There was nothing "progressive" about the atmosphere in the classroom at the Horace Mann High School. Students were expected to remain in their seats at all times unless addressed by a faculty member and to use "Sir" (or if appropriate, "Ma'am") when addressing faculty and staff. That and the coat-and-tie dress code represented a major culture shock for Lou, who was used to being able to get up and walk around any time that he felt like it (Figure 9).

However, regardless of the rigor of the program, there were all kinds of activities in which to indulge outside of classes. Lou developed a flair for dramatics, wrote stories for the school magazine (frequently centered on his experiences in Vermont), excelled at tennis (Figure 10) and the breaststroke (repeatedly winning that event in school competitions so that the team pressed him to stay on). He also learned many other administrative, leadership, salesmanship, political, accounting, and design skills through his supervision of the school's professionally equipped print shop, which printed most of the school's publications and notices intended for distribution to parents and/or students and also accepted small private orders to help defray the costs of supplies and of running and maintaining the presses. The management skills that he learned on the Aladdin helped him keep the student staff working cooperatively and on schedule.

Lou was academically well prepared upon his arrival at Columbia University, which he attended from 1939 to 1943 and where he first intended to major in biology. A significant factor in changing his mind may have been the fun that he had with chemistry experiments (not all of which were in the course schedule). In his naiveté, he also decided to become a university professor so that he could continue to have his summers off to go to Vermont (He attended the University of Vermont at Burlington during the summer of 1940). He earned his A.B. degree in chemistry from Columbia in 1943.

However, during a one-week break in the summer of 1942 (during the war years, the former long stays in Vermont were replaced by 16-hour working days in New York City), Lou's father, with his assistant and with Lou, developed an idea for an internal combustion engine of maximum brake thermal efficiency, intended to double either the range or the payload of large propeller-driven bombers. Called the B-3, for the names of the three designers, it was funded at high priority, and a government contract was awarded through Research Corporation with the stipulation that the work and building of the engine would be conducted at Research Corporation's Bound Brook, New Jersey plant, supervised by the three co-designers. Lou's father put in two days per week there (while working the other five 16-hour days on the isotope-separation pilot plant mentioned previously); Lou put in two days/week (during his senior year at Columbia, and then for two more years while a graduate student and Assistant Instructor at the University of Pennsylvania); and the assistant worked full-time on the engine. After numerous unavoidable delays caused by problems in casting the unconventional cylinder block, the engine was built, but before it could be tested, general orders halted all war research projects except those that could reach fighting units within six months. The engine was never tested and was eventually sold as scrap.

In 1943 Lou began graduate studies at the University of Pennsylvania in Philadelphia, the prestigious Ivy League university founded by Benjamin Franklin in 1779 (some sources state that Franklin sold the idea of his "Academy" to Philadelphians in 1749 and was named its President then), which was the fourth oldest institution of higher education in the United States and the first American university with both undergraduate and graduate studies as well as the first nondenominational institution of higher learning in the country.

During the years 1943 to 1945, while continuing to spend two days per week on the B-3 engine, Lou was a full-time graduate student as well as an Assistant Instructor in Chemistry at the University of Pennsylvania's Towne School of Engineering and Applied Science (now the School of

Figure 9. Lou Baker's High School Portrait.

Figure 10. Lou Baker and Tennis Racket, at the Chemistry Department Party for the Passing of the Chairmanship from Lou to Joseph E. Earley, Georgetown University, June 1984. The racket was given to Lou by his research group, with the explanation that now that he was no longer chairman, he should have time to brush up on his tennis game. The entire department was there, including Professor Robert de Levie (b. 1933) (at left).

Engineering and Applied Sciences, teaching undergraduate recitation sections and supervising labs for "honors" chemistry majors (GBK graduated as an "honors" major), but also teaching special courses for students from the active Army and Navy who qualified for advanced education. To be permitted to continue in the program, those students had to receive high grades on every weekly exam and lab write-up/quiz, with the threat of being returned to active duty if they did not.

After termination of the B-3 contract, Lou continued in that position but as Head Instructor from 1945–1949, which included being "straw boss" (a junior assistant in charge of supervising and expediting the work of a small group of workers) for the several General Chemistry courses, organizing and scheduling lab sections, indoctrinating other graduate student-teaching assistants in how to run their recitations, often preparing hour exams for the approval of faculty members, *etc*. He also simultaneously held two other appointments. In a large program run by the Department of Public Education of the Commonwealth of Pennsylvania to address the needs of the large numbers of qualified returning war veterans who could not be accommodated at the overcrowded regular institutions, he was an Instructor in Chemistry in Martin College and Rittenhouse College of the Pennsylvania Area College Centers. Along with 39 other instructors drawn from regular university faculty members in the area and working at night in spaces in large local high schools, he taught lecture, recitation, and laboratory sections in general chemistry and in qualitative analysis. The program shrank with the decreasing need, and when it finally closed in 1948, Lou was one of the six remaining Instructors.

Lou's third concurrent position was as Instructor in Chemistry in the University of Pennsylvania's College Collateral Course program, which was taught evenings and weekends, primarily to older, non-traditional students who were much less academically qualified and frequently had other life-complications not common to traditional students. These groups were more challenging to teach, but also more appreciative of help given, in general. His total teaching load during this period ran between 20 and 25 contact hours, not optimal for the rapid completion of his dissertation research, but necessitated by the unexpected death of his father, leaving him with financial responsibilities. In 1948, he also briefly tried his hand at the manufacture and marketing of DDT (dichlorodiphenyltrichloroethane) in northern Vermont, under the brand name "Baker's Best" (Vermont farmers of a certain age still remember it as "the best". Lou remembered it as an object lesson in how much more the peripherals—bottles, labels, salary of his one salesman partner—cost than did the product that he was marketing!).

Other activities engaged in while Lou was a graduate student included gaining a rudimentary knowledge of structural x-ray crystallography by working in the laboratory of Arthur Lindo Patterson (1902–1966), the world-renowned New Zealand-born British-Canadian-American crystallographer, for a day or two per month for ten or twelve months during the period 1948–1950. This work had a direct bearing on the interpretation of his dissertation research problem and led to his arranging to spend a postdoctoral year at Oxford University in the laboratory of chemical crystallographer Herbert Marcus (H. M., "Tiny") Powell (1906–1991), an arrangement that did not come to fruition.

Lou's mentor, Thomas Potter McCutcheon, Jr. [5], allowed him to gain experience directing research by letting him supervise as many first-year graduate students as he could entice to work for him during their required one-semester of research in a field other than their own. Six students chose to do their research with Lou, which resulted in three full papers in the *Journal of the American Chemical Society*, in addition to three articles based on his own dissertation. According to the late Joseph Schmuckler (d. 2011), Professor Emeritus of Chemistry at Philadelphia's Temple University, Lou was spending so much time on his teaching that it appeared that he was never going to get his degree (Figures 11 and 12).

Lou received his M.S. degree in inorganic chemistry in 1947 and on June 14, 1950 his Ph.D., degree upon the defense of his doctoral dissertation, "Heteropoly Salts Containing Cobalt and Tungsten in the Anion" (Figures 13–15), supervised by McCutcheon [6], who had worked with Alfred Werner at the Universität Zürich and who was the lecturer in GBK's General Chemistry course in 1948 (Lou was GBK's laboratory instructor). Lou subsequently remained at Penn, accepting a six-month appointment as an Associate in Chemistry of the Johnson Foundation for Medical Physics with Thomas Foxen Anderson (1911–1991), a biophysical chemist and geneticist who developed techniques for using electron microscopes. His work there was an early development of Anderson's important "critical-point drying method" for electron micrograph

Figure 11. Lou Baker in His Lab, Harrison Laboratory, University of Pennsylvania, Late 1940s. On the bench is one of his polyhedral molecular models. The two columns were packed with what were then newly developed synthetic ion-exchange resins, which he utilized for the preparation of heteropoly acids in a high state of purity. He probably became acquainted with the resins while working at the Research Corporation facility in Bound Brook, New Jersey.

Date October 25, 1950

1. Name (Print) BAKER, (Last Name) LOUIS (First Name) COOMBS WELLER (Middle Name)
2. Permanent (Home) Address "Dingley Dell", (Street and No.) South Hero, (City) Vt. (State) Telephone No. none
3. Philadelphia or Temporary Address 4818 Regent St., (Street and No.) Phila. 43 Telephone No. SA-7-6263
4. Date of birth Nov. 24, 1921 5. Sex male 6. Are you a citizen of the U. S.? yes
7. Height 6' 3¼" 8. Weight 185 lbs. 9. Condition of health excellent
10. Physical impairments none (Hard of hearing, etc.)
11. What is your father's occupation? mechanical engineer
12. Marital Status: (underline) Single, engaged, married, divorced, widowed.
13. Military Status (Veteran, etc.) none
14. Dependents Marion G. Baker – mother (Give names and relationships: e.g., Mary Jones, wife)
15. List educational institutions attended:

School or College	Location City	Location State	Attended From	Attended To	Degree or Diploma	Major Subject
Horace Mann Schl. for Boys	N.Y. City	N.Y.	'33	'39	yes	—
Columbia College of Columbia Univ.	N.Y. City	N.Y.	'39	'43	A.B.	Chemistry
Univ. of Vermont	Burlington	Vt.	Summer Session 1940			—
University of Pennsylvania	Phila.	Pa.	1943	1950	M.S. (1947) Ph.D. (1950)	Chemistry Inorganic Chemistry

Figure 12. Lou Baker's Graduation Application to the University of Pennsylvania, October 25, 1950.

Mr. Baker is fully qualified for the position of Asst. Prof. of Chemistry. His success as a Teacher in this Department has been outstanding, over more than five years.

He has excellent character, and pleasing personality, initiative, originality, and the qualities essential for leadership.

He has completed and published research work of high grade, displaying ingenuity and creative imagination. He is well prepared to perform and direct original investigations.

Signed Thomas P McCutcheon Date June 27, 1950
Official Position Professor of Chemistry
Institution or Firm Univ. of Penna.

Figure 13. Thomas P. McCutcheon's Recommendation of Lou Baker, June 27, 1950.

specimens. While working on the properties of liquid carbon dioxide solutions, which showed potentialities as a solvent, he independently determined a fairly complete phase diagram for the liquid system CO_2-H_2O-C_2H_5OH at high pressures, resulting in another paper [7]. Before he could take up his postdoctoral opportunity at Oxford however, in 1951 he was offered and accepted a position as Assistant Professor of Chemistry by Boston University.

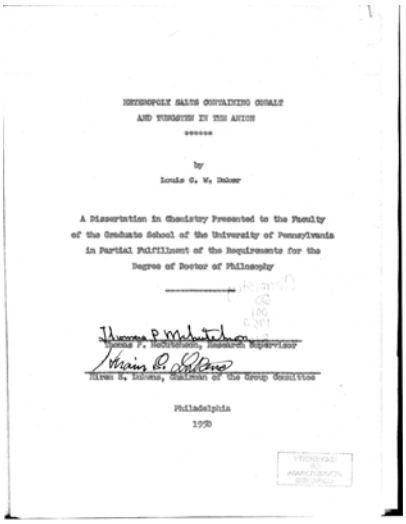
Teaching and Department-Building at Boston University

At Boston University Lou was charged with reorganizing the teaching of general chemistry, especially building a strong course for science majors, and establishing inorganic chemistry for both undergraduate and graduate work (Figure 16). Under his guidance, the intensive science major/premed freshman course grew from 175 to 400 students in six years, and the median student was in the 75th percentile for comparable courses, according to the calibrated American Chemical Society examination for each of the two years that Boston University administered those exams. As part of their preparation to become professional chemists, all graduate students were expected to spend at least a year as a teaching assistant, and general chemistry teaching assistants were charged with a real measure of responsibility for the performance of their students. Their performance as TAs became part of their own departmental evaluations. In a helpful and supportive atmosphere they were given to understand that original research was a necessary but not sufficient part of their professional responsibilities for faculty and graduate students alike.

Under the gentle but inspired leadership of their chairman, J. Philip Mason, who held this post from 1952 to 1961, every faculty member was made aware of what was expected, but in a cooperative, friendly, and supportive atmosphere, despite the very heavy teaching loads of two to three courses per semester per faculty member. With a total of only eight tenure-track faculty members, the department was producing among the largest numbers nationally of accredited chemistry majors per year, as well as a steady stream of Ph.D.s. Lou was a vigorous supporter of what he believed should be the academic mission of science faculty— what he called "doing the whole job"— as opposed to the too common view that emphasis on research publication is what makes a department good.

While at BU, Lou expanded the offerings in inorganic chemistry, adding a senior course in inorganic, a senior laboratory preparations course, and eventually graduate courses. Aiming to build a strong research team for the application of modern methods to the chemistry of heteropoly and isopoly electrolytes, but also continuing his interest in coordination complexes, he sought outside support and obtained sponsorship from the Atomic Energy Commission, Research Corporation, U.S. Public Health Service, Monsanto Chemical Company, National Science Foundation, and Climax Molybdenum Company. His research group included half a dozen graduate students, including Violet E. Simmons, several international postdoctoral fellows, and a Japanese professor on sabbatical leave.

With the addition of a second Assistant Professor of Chemistry in Inorganic Chemistry in 1958, an Inorganic Division was created, and Lou was promoted to Associate Professor. However, in the ensuing year or so, the relationship



HETEROPOLY SALTS CONTAINING COBALT
AND TUNGSTEN IN THE ANION
******

by
Louis C. W. Baker

A Dissertation in Chemistry Presented to the Faculty
of the Graduate School of the University of Pennsylvania
in Partial Fulfillment of the Requirements for the
Degree of Doctor of Philosophy

Thomas P. Nightingale, Research Supervisor

Miriam B. Williams, Chairman of the Group Committee

Philadelphia
1950

Figure 14. Lou Baker's Doctoral Dissertation, Title Page, 1950.

Figure 15. Lou Baker and His Mother after His Ph.D. Graduation, 1950. This photograph was taken by the Pan Sundial in the University of Pennsylvania's Morris Arboretum, an interdisciplinary center that integrates art, science and the humanities amidst thousands of rare and lovely woody plants. These include many of Philadelphia's oldest, rarest, and largest trees which are set in a romantic, 92-acre, Victorian landscape garden of winding paths, streams, flowers, and special garden areas.

Figure 16. Lou Baker of Boston University demonstrates chemistry to high school students, 1958.

between the department and the university administration changed, and the chairman resigned, changing the prospects for the future of the department (Figure 17).

Department-Building and Teaching at Georgetown

In 1962 Lou moved to Georgetown, the nation's pre-eminent Catholic university, in Washington, DC to serve as reform chairman of the Chemistry Department, where he led part of a university-wide effort to upgrade the science departments (Figure 18). With the university's new Science Building already well under construction by the time that he arrived, he redesigned the research laboratory space allocated to chemistry in the new Science Building to maximize flexibility of assignment and supervised the allocation of space and equipping of the new laboratories, offices, and service spaces. During these first two whirlwind years, in addition to teaching the large general chemistry course, and starting his new research group focused on innovative research on heteropoly electrolyte chemistry, a previously neglected field, he undertook the complete rebuilding of the department's faculty and also negotiated a contract with the Food and Drug Administration that charged Georgetown with teaching modern instrumental methods of analysis to large numbers of FDA scientists from around the country. The three-month course, which ran three or four times a year for several years, boosted the growing Department of Chemistry by providing additional faculty positions, new graduate fellowships, and major instrumentation as well as retraining a large fraction of the FDA's chemists.

It was also during these two years that he and Violet, who was away in Oxford University at the time as a North Atlantic Treaty Organization (NATO) postdoctoral fellow in the laboratory of Robert Joseph Paton (R. J. P.) Williams (b. 1926), decided to marry. Their wedding was celebrated on the afternoon of June 28, 1964 in a lovely outdoor ceremony on the lawn of the Merion Tribute House in suburban Philadelphia with a string quartet of musician friends enriching the beauty of the day (Figure 19). The plan was for a four-week "honeymoon" at Dingley Dell (then very much in need of restoration itself). However, perhaps as a harbinger of what life for the new couple was going to be like, it soon became evident that Lou had not yet cleared his desk of those problems that could not wait. Therefore instead of heading north to Vermont, it was back for a week in Washington and Georgetown's Department of Chemistry, in a new sort of partnership that endured for 39 years (Figure 20).

Lou was avidly committed to the best interests of all his students, both undergraduate and graduate. He was tireless in his efforts to stimulate and develop their intellectual curiosity and honesty, to guide them in understanding how research is carried out and why it is essential to learning chemistry—to intellectual life itself–-and to create opportunities in which they could flourish on their own. His personality was clearly evidenced by the extraordinary time, effort, and energy that he devoted to removing obstacles to their learning (and occasionally to leaven that learning, as when, in the middle of a lecture on kinetic theory, he ducked behind the lecture table, started up a phonograph and emerged with a skimmer (straw hat) and cane to perform a soft shoe dance to the tune of "Maaaaah le cules, Maaaaah le cules, EV'rything EV'rywhere IiiiiiN the world Is MAde up of daaan-cing Maaaah le cules!). He tried to further those educational ends by painstakingly building a cohesive and dedicated faculty at Georgetown who shared his ideals.

Lou acquired an international reputation, was invited as a guest at universities, research institutions, international

Figure 17. Lou Baker bids farewell to Boston University June 1962. At left is Ronald M. Milburn, Assistant Professor of Inorganic Chemistry, and on the right is Lucius Peck, the Keeper of the Chemistry Stockroom.

Figure 18. Lou Baker dishes out foaming Christmas brew after sampling it to assure himself of its potency, Georgetown University, Probably December 18, 1964.

Figure 19. Lou and Vi Baker's Wedding, June 28, 1964. The cleric to Lou's right was the Dean of Georgetown's College of Arts and Sciences, Father Joseph Sellinger, S.J. To Vi's left are her sister and brother-in-law and the first two of their three children. All of the others are wedding guests.

Figure 20. Violet and Lou Baker at an Open House (in Their Home) for Alums of the Horace Mann and Barnard Schools (which became affiliated some time after Lou had graduated), April 24, 1982.

conferences, and professional meetings around the world, and served as a consultant to numerous major chemical companies. He was asked to present lecture series to coordination chemistry and polyanion research laboratories in the U.S.S.R., Romania, Spain, and Poland in addition to seminars in many other countries such as the United Kingdom, France, Sweden, Germany, and Hong Kong.

When Lou resigned the chairmanship in 1984 (having refused reelection as Chairman), he was awarded the President's Medal for Distinguished Service to the university and continued his membership in the University Faculty Senate, where he had spent more than two decades, the Main Campus Planning Committee (1988–1992), and many other committees. He had spent more than a quarter-century each on the Executive Committees of the College of Arts and Sciences, of the Graduate School, and of the School of Nursing. He retired in 1994 but remained active in research.

From his first contact with Georgetown, he made plain (to faculty applicants, among others) his vision of a well-run department, which included prominently that every faculty member would be expected to teach undergraduates as well as graduate students, in addition to doing research. It was his firm conviction that students need and deserve to be taught by faculty who are actively engaged in cutting-edge research. Brought in as a "reform chairman," he set an example and made it clear that the first reform would be to end the two-layer faculty structure: research faculty (the stars who could expect higher pay, the best lab space, the biggest departmental budget allocations, the lightest teaching loads with no undergraduate courses, *etc.*) and teaching faculty (who were not expected to publish much but carried most of the teaching load).

Lou viewed his chairmanship as presiding over a "guided democracy." And interestingly, the democracy established was very pervasive. Department meetings were often quite long (painfully so?) and sometimes quite heated, but decisions—policies, tenure decisions, curriculum changes, departmental choices for instrument grant applications, degree requirements, qualification of students (*i.e.*, permission to continue)—were made by vote. One faculty member later confided that rumor had it that "Lou was descended from some especially long-sitting Quakers," but that "the value of those gatherings, and of many other tactics that Lou developed, in generating a humane and collegial atmosphere in the Department, has become quite clear in retrospect."

Faculty members often cooperated with one another, helped each others' students on their research and in many other ways, and felt invested in the outcomes. Each faculty member was expected to make meaningful efforts to obtain outside support but was not punished for not succeeding. For quite some years, Lou was proud to boast that every faculty member in the department had obtained external funding. One faculty member, who had maintained a federal research grant for something like five years, was told that their evaluation panel felt the topic had become "old-fashioned" and that while they would look favorably on an application from him in a different area, they were terminating his current grant. He came to Lou to tell him why he believed that the research still held great promise and that he wanted to continue it. Lou assured him that the department would stand by him and assist him, though not at grant-support levels. He then carried on, and not long after, was able to overturn conclusively a long-accepted mechanism for the biochemical process that he had been

studying and to prove that it proceeded by a totally different mechanism. Yet another faculty member expressed appreciation for the freedom that he had enjoyed in being able to take his research interests in a totally different intellectual direction, which had evolved along with the science course that he had developed for non-science students.

Memberships, Honors, and Awards

Lou was extremely active in the many professional societies to which he belonged. For example, the American Chemical Society Division of Inorganic Chemistry was part of the Physical-Inorganic Division until 1957, when it was granted provisional status as a separate division, with Lou as the first Program Chairman (1957–1958) [8]. Lou was concerned that the new Division might be established with something less than the highest standards so for two years, while still at BU, as Chairman of the Committee on Papers, he oversaw the reviewing of all manuscripts submitted to the new division, both those for presentation at national meetings and those for publication in the *Journal of the American Chemical Society* (1957–1959). His duties turned out to be very heavy, for the number of papers received was much greater than had been anticipated, and within a few years the idea of screening papers had to be abandoned. Lou, being a perfectionist, had read and edited every manuscript! He also served as Chairman of the National Academy of Sciences' Committee on Recommendations to the U.S. Army for Basic Scientific Research (1974–1978).

In 1960 Lou received a Guggenheim Fellowship, on the basis of an application seeking cross-fertilization of ideas and methods with some of the European laboratories pursuing research on heteropoly and isopoly anions. During the spring of 1961 he spent time visiting and presenting lectures at the laboratories of several international colleagues: Ingvar Lindqvist (1921–1991) at Uppsala University in Sweden; Pierre Souchay in Paris, and Viktor Ivanovich Spitsyn (1902–1988) at the Institute of Physical Chemistry of the Academy of Sciences of the U.S.S.R. in Moscow. No publications resulted directly from the visits, but he felt that the discussions were profitable.

Lou's future wife, Violet E. Simmons (b. November 18, 1932), on June 27, 1962 at the Seventh International Conference on Coordination Chemistry in Stockholm presented a paper, co-authored with Lou and based on the results of her doctoral research, presenting new data showing how the unusual coordination geometries sometimes afforded transition metal atoms in polyanions new testing areas for ligand field theory, which in turn contributed to the interpretation of their spectra and magnetic properties [9]. GBK still vividly recalls how he, Lou, Violet, and other conference participants walked the streets of Stockholm late at night after public transportation had ceased. Lou was waxing enthusiastic about the results that he and Violet had obtained. It was this typical enthusiasm that made him such a successful publicist for the field of heteropoly electrolyte chemistry.

In 1962, the year that he came to Washington, Lou was inducted as a member of that city's Cosmos Club, which had been founded in 1878 for "the advancement of its members in science, literature, and art." Its members have included many recipients of the Nobel Prize, Pulitzer Prize, and the Presidential Medal of Freedom. He also served the Chemical Society of Washington in various positions, the American Chemical Society in innumerable national and local committees, the National Science Foundation and National Academy of Sciences on review boards, and many college and university accreditation committees. He was active in the Gordon Research Conferences and was the Plenary Lecturer on heteropoly electrolytes at the 15th International Conference on Coordination Chemistry (ICCC) in Moscow (1973). In that year the U.S.S.R. Academy of Sciences awarded him its Lev Aleksandrovich Chugaev Medal (which GBK also received in 1976), and Lou joined the International Governing Committee for the ICCC, a committee on which he served for many years.

Lou was Vice President (1972–1973) and President (1973–1974) of the Georgetown Chapter of the Society of the Sigma Xi. He served as a scientific member (1974–1978) of the visiting committee to evaluate and advise on the improvement of Ferdowsi University, the state university named after the ninth-century Persian epic poet and scholar, in Mashad, Iran (Figure 21). He presented invited lectures at the Symposium on Heteropoly Electrolytes at Shimoda, Japan (1985) (Figure 22), Heteropoly Symposium at the Congress of Chemical Societies of the Pacific Rim at Honolulu, Hawaii (1989), the Symposium on Polyoxometallates: From Platonic Solids to Antiretroviral Activity, Bielefeld (1992), and the Romanian Academy of Sciences Chemical Institute, Cluj (1992). In 1982 Georgetown University awarded him its Vicennial Gold Medal (for twenty years of full-time service) and in 1988 an honorary degree (D. Hum. Lett., *honoris causa*) (Figure 23).

Personality, Family, and Cultural Interests

Lou was a man of unusually wide interests as well as lovable eccentricities and idiosyncrasies. He loved intellectual discourse and was extremely well versed in history, politics, government, geography, art, music, world culture, creative construction, and repair. He relished passionate political debates on national, international, and district- or campus-related topics. His interest in and knowledge of history in general and American and modern European history in particular were especially keen and deep. Extemporaneous history lectures were a regular feature at the family dinner table, often enlivened by his fondness for a good laugh.

During his early years Lou enjoyed English and Scottish country dancing, and he often performed as a Morris dancer. He was also fond of sailing, tennis, and piano. His knowledge of Gilbert and Sullivan and their operettas was encyclopedic; he knew all the tunes and most of the lyrics to most of the songs and even the most abstruse references—literary, historical, mythological, and political of Gilbert and Sullivan's time.

Lou possessed an attachment to old automobiles, the older and the more commodious the better (Figure 24). His two 1964 convertibles, the four-door Lincoln convertible with two "suicide doors" and his wife Vi's Morris Minor (into which he miraculously folded his 6 foot 4 inch frame) were fixtures on the Georgetown campus for several decades (If for any reason a rear door should become unlatched while the car was in motion, the draft could yank the door fully open leaving a rear-seat passenger at great risk of hitting the road). The tales of Lou's cars' numerous amazing breakdowns—and even more amazing, his *ad hoc* repairs—were legendary.

The Baker home at 3718 Huntington St., NW in Washington, DC was a focal point for departmental events. Dinner seemed to start at midnight, a time when most of us are

Figure 21. Lou Baker with Mohammad Reza Shah Pahlavi (1919–1980), Mashad, Iran. Upon being approached about its possible interest in becoming a sister university to Ferdowsi University, Georgetown agreed to send a visiting committee for a two-week site visit to Iran in June of 1975. Lou was asked to serve as the committee member for the sciences. Their visit coincided with the visit of the Shah to open Ferdowsi's brand new Computer Center. The group on the left is the Georgetown visiting committee, with Lou (eighth from the left) nearly totally obscured by a member of the Ferdowsi delegation.

Figure 22. Violet and Lou Baker in Victoria Park at the top of the island of Hong Kong, where they had stopped en route to the Symposium on Heteropoly Electrolytes, in Shimoda, Japan, 1985.


THE PRESIDENT AND DIRECTORS OF GEORGETOWN COLLEGE, TO ALL WHO SHALL VIEW THESE PRESENTS: GREETINGS AND PEACE IN THE LORD

LOUIS C. W. BAKER
Doctor of Humane Letters, honoris causa

Figure 23. Lou Baker's Honorary Degree, Doctor of Humane Letters, Georgetown University, April 23, 1988.

Figure 24. Lou Baker on the Georgetown University Campus in the Morris Minor, Probably in the Late 1980s. The car was repainted in the summer of 1991.

asleep, but for the Bakers this hour was still early. Their home was also a place for faculty interviews with discussions around the dinner table as well as the site of grueling grading sessions for "Baker Chem" that evolved into social events as they began in late afternoon and sometimes extended into the dawn hours [3]. Parties sometimes evolved into impromptu Gilbert and Sullivan performances. Guests chose parts and read the spoken lines from his numerous copies of libretti and collected works; then the phonograph (sometimes accompanied by a brave partier) provided the musical parts from one of Lou's many recordings. At one party, in honor of a visiting foreign scientist, Lou produced a score for a hilarious production of Little Red Riding Hood, with numerous faculty, postdocs, and grad students participating: Michael T. Pope as Little Red Riding Hood (in hooded red cape and yellow mop head for a wig); Lou as the wolf, with a moth-eaten raccoon coat draped over his shoulders and a marvelous wolf's head built on a wire-hanger frame, with fearsome cardboard teeth and a long dangling tongue of red toweling; and several graduate students garbed in toga-like shower curtains with floral crowns as spirits of the springtime.

Research

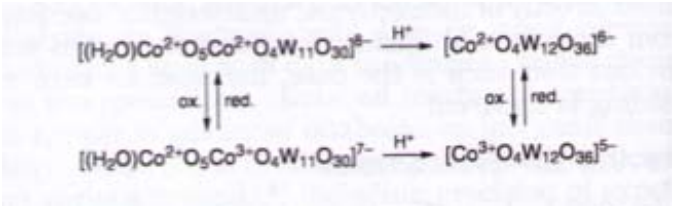
Although heteropoly electrolytes had been recognized during the latter half of the nineteenth century, by the middle of the twentieth century most chemists considered them to be too large and complicated to be amenable to investigation by the experimental methods available at the time. According to Michael Thor Pope, a British-born chemist who spent two years as a postdoctoral fellow with Lou at Boston University and later joined Lou when he moved to Georgetown and remained there, in 1950 these compounds were studied by only two investigators—Lou and Professor Pierre Souchay of the Université de Paris-VI-Pierre-et-Marie Curie and the École national supérieure de chimie, whose previous and subsequent research has stood the test of time and laid the groundwork for the development of what has become a major area of inorganic chemistry with applications in many scientific disciplines from medicine to nanotechnology [2]. Pope himself went on to become a leading contributor to the field.

Lou was the author or coauthor of more than one hundred research articles on inorganic chemistry, exchange interactions, coordination theory, reaction mechanisms, isotope exchanges, multinuclear nuclear magnetic resonance, electron transfer, magnetochemistry, and other topics. His primary interest, however, was in the preparation, characterization, and exploitation of the unique characteristics of heteropoly electrolytes with transition metal heteroatoms, which provided a handle for the application of probing methods such as spectra, magnetic study, ligand field interpretation, redox potentials, lability, *etc*.—in general, application of the methods of coordination chemistry—and they in turn provide a feedback of interpretation into coordination chemistry. This approach had not actually been used before in the polyanion field. It was his continuing conscious endeavor to use the heteropoly compounds as a test area for theory, capitalizing on their unique characteristics.

At the time that Lou began his work in 1943, the universally accepted formulation for a typical heteropoly ion based on a transition metal central atom was, following the Miolati-Rosenheim representation, $Na_3H_6[Cr^{3+}(MoO_4)_6].8H_2O$, for example. The structure was accepted as consisting of six

separate MoO_4^{2-} (or WO_4^{2-}) tetrahedral ligands coordinated (each via one oxygen) to the octahedral central atom. By analogy, 9-heteropolies were formulated as $[Ni^{4+}(Mo_2O_7)_3(MoO_4)_3]^{8-}$ (The existence of a few 12-heteropolies with transition metal central atoms, in the older literature, had been discredited).

Lou's dissertation work [6, 10] led to the first 12-heteropolies with a transition metal central atom—four interrelated, interconvertible tungstocobaltate complexes, which are now formulated:



These were the first examples of complexes containing a d^6 ion (Co^{3+}) in a tetrahedral site, permitting correlation of its spectrum and magnetic susceptibility with ligand field calculations for the new coordination [9, 11, 12]. In a cooperative project with Prof. K. Eriks at Boston University, an x-ray crystallographic structure determination of the heteropoly complex, $[Co^{3+}W_{12}O_{40}]^{5-}$, was carried out, the first in which all forty oxygen atoms were directly located [13–15].

This showed the great variation of W-O distances in given WO_6 octahedra caused by heavy inward unbalanced polarization of the exterior unshared O atoms toward the W^{6+} octahedra, the distortions of the WO_6 octahedra, and the resulting unusual condition of forces in the interior of the complex. The principles that Lou deduced from this structure led to his explanation of the relative strengths of heteropoly acids, shapes of certain polyanions (such as the bent shape of paramolybdate, $[Mo_7O_{24}]^{6-}$, *vs.* the flat shape of $[CrO_6Mo_6O_{18}H_6]^{3-}$), and the very low tendency of many heteropoly anions to hydrogen-bond to water, the factor which accounts for their observed hydrodynamic radii being the same as their crystallographic radii [16–18]. The structure determination, taken together with the regular tetrahedron in the $Co^{2+}O_4$ isomorph, also provided the first unambiguous demonstration of a Jahn-Teller distortion caused by removal of degeneracy in the e_g electron level in tetrahedral coordination (the $Co^{2+}O_4$) group.

Together with Michael T. Pope, a postdoctoral fellow at the time, Lou demonstrated that "Riecke's Law," which related ionic weights and diffusion coefficients, is totally invalid. This was important because polyanion chemists were using this presumed "law" to determine ionic weights in solution. Baker and Pope showed that $[SiO_4W_{12}O_{36}]^{4-}$ and $[SiO_4Mo_{12}]^{4-}$ have identical diffusion coefficients, despite widely different ionic weights.

One of the most accurate crystal structure determinations made up to that time, in terms of lowness of R (R=3.3%), was performed on $Na_3[Cr^{3+}O_6Mo_6O_{18}H_6].8H_2O$. This proved that the constitutional hydrogen atoms are on the oxygen atoms surrounding the chromium atom [19]. Later work found several new types of constitutional hydrogen atoms in heteropoly complexes [20, 21]. The presence of surface-active catalysts during certain preparative procedures was shown to yield very different products than are obtained in their absence [6]. A novel behavior was discovered for several heteropoly solids; they were found to shrink, reversibly and continuously, upon being heated. An explanation was postulated [20, 22].

Baker and Bezas demonstrated that two H atoms (H_2^{2+}) can function as a central atom in heteropoly complexes, occupying a tetrahedral site between four oxygen atoms [20, 23]. Copaux had proposed the existence of such a unit (actually (H_2O_6), but with no experimental evidence, purely on the basis of the since-discredited Miolati-Rosenheim theory [24]. Pope and Varga [25] had also found such a tetrahedral group at the center of the isopoly metatungstate ion, $[H_2O_4W_{12}O_{36}]^{6-}$.

Some other earlier contributions made by Lou and members of his group include: the first demonstration that 6-heteropoly molybdates of Ni^{2+}, Co^{3+}, Cr^{3+}, Al^{3+}, Fe^{3+}, Rh^{+3}, and Ga^{3+} are monomeric in solution and in crystals [22, 26, 27]; development of the technique of cryoscopy in fused $Na_2SO_4.10H_2O$ into a major technique not only for ascertaining degrees of polymerization but also for ensuring and checking the purity of reactants in solution and for determining thermodynamic stability constants [27–30]; first extensive kinetic studies of isotope exchange reactions of heteropoly complexes and deduction of the detailed exchange mechanisms, yielding the detailed mechanism of hydrolytic degradation of many heteropoly complexes, and also several novel results; first example of a Cr(III) complex that exchanges its Cr rapidly with $[Cr(H_2O)_6]^{3+}$; demonstration and rationalization of the great inertness of polytungstates as contrasted with isostructural polymolybdates; first case of a proven exchange of intact MO_n polyhedral units (*e.g.*, CrO_6) with unbroken M-O bonds (*e.g.*, unbroken Cr-O bonds); quantitative explanation of the three different exchange rates for the three structural types of oxygen present in these complexes [16, 27, 31, 32]; and first heteropoly complex containing two different elements (Co and Si) as heteroatoms [9], the first member of a new structural category of heteropoly complexes they established—the diheteroatom 11-polytungstates (or 11 polymolybdates), with a Keggin-like structure except that only one of the twelve tungsten atoms (or molybdenum atoms) is replaced by any of a wide variety of octahedrally coordinated metal atoms. The other heteroatom (metal or non-metal or H_2^{2+}) goes in the usual tetrahedral cavity [20]. Subsequently, a large number of new complexes were reported by Lou's ex-postdoctoral fellow, Timothy J. R. Weakley of the University of Dundee in Scotland. Weakley also prepared analogous 17-tungsto derivatives.

Lou and his group discovered that all kinds of conventional ligands can be attached to the one unshared coordination position on the octahedral metallic heteroatom (replacing the water molecule which was actually there in the parent complex). These complexes are of an entirely new type: hybrid between heteropoly and conventional complexes [21]. They also prepared "heteropoly blues" [33] of the 11-tungstodiheteroatom class.

All of the further work of Lou's groups, post-1970, as well as the earlier and later work of other groups such as those of Souchay [34] and Pope [35], was reviewed and discussed in the context of the current understanding of heteropoly electrolytes in a major review article containing more than 1200 references written by Lou and his last doctoral student, Diana Carbonneau Glick [36]. It was his last major contribution to the field (Figures 25 and 26).

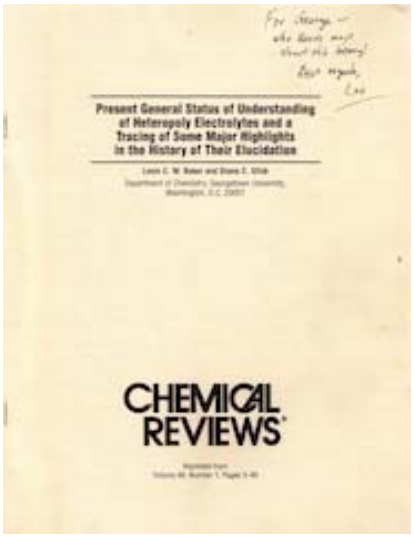


Figure 25. Lou Baker's Last Major Contribution to Heteropoly Compounds, an Extensive Review of the Field (With Diana C. Glick), Autographed Title Page [36].

Figure 26. Diana C. Glick and Lou Baker.

Figure 27. Michael T. Pope.

Michael T. Pope's Reminiscences (written in 2003) (Figure 27)

I first met Louis Baker some 45 years ago, when I arrived from England with my new wife and a new PhD into the oppressive heat and humidity of a New England summer. I was to spend two years doing chemistry as a postdoctoral with Lou at Boston University, but my cultural indoctrination began within hours of our arrival at his summer place in Vermont. I learned that, although Boston considered itself to be the hub, the only true center of civilization was… Philadelphia. There was also something very special about Packard convertibles, of which there were three I recall, in various states of repair/decay. One of these was alleged to be safe on the highway, and it lasted through Lou's first years at Georgetown.

Three years after the Popes had returned to England Lou reappeared in our lives with the news that he was going to be Chair of the Chemistry Department at Georgetown and wouldn't it be a good idea if I were to join him for a couple of years to prepare for an academic career in England. He knew that I was becoming dissatisfied by my position in Industry. Well, here I am forty years later.

It cannot be denied that Lou Baker was influential and skillfully persuasive, a man of strongly held convictions. He devoted his life to university chemistry education, from first-year undergraduates to junior (and not so junior) faculty. Indeed, when an occasion presented itself, he was famously not reluctant to publicly instruct Deans, Vice-Presidents, and Presidents. When he and I arrived on campus in 1962 Georgetown was beginning a push to strengthen science. The Reiss Building had just been completed, and the University President had established the Office of Science Advisor, the first and, as it turned out, only occupant of which was a newly appointed senior chemistry professor. Lou himself was given considerable freedom in the early days, and he tackled the reorganization and development of Chemistry with enthusiasm. He completely redesigned the 6th floor of Reiss to accommodate research labs, while the teaching labs remained in White-Gravenor. He negotiated a contract with the Food and Drug Administration, which had Georgetown teaching modern instrumental methods of analysis to large numbers of FDA scientists from around the country. The FDA program, which ran for several years, provided us with new faculty positions, new graduate fellowships, and major instrumentation—it was an enormous boost to a growing department. During the '60s the department expanded roughly to its present size with Lou constantly urging high standards of research and teaching. It was a source of great pride for him to be able to say for some years that every faculty member in chemistry had external research funding. He taught the Introductory General Chemistry course more or less continuously during his 22 years as Chairman—a course that became known as "Baker Chem" to generations of students. He was a pioneer in his own field of research—the world of heteropoly electrolytes. Although examples of this class of compounds had been recognized during the latter half of the 19th century, by the middle of the 20th century, when Lou was working on his Ph.D. at the University of Pennsylvania, these molecules were considered by most chemists to be too large and too complicated to be susceptible to investigation by the experimental methods available at that time. Indeed many contemporary publications reported erroneous results or drew fanciful conclusions regarding the composition and structures of these compounds. In 1950 there were only two investigators, Lou Baker in the U.S. and Pierre Souchay in France, whose previous and subsequent research has stood the test of time, and which has laid the groundwork for the development of what has come to be a major area of inorganic chemistry with applications in many scientific disciplines, from medicine to nanotechnology.

There is no doubt that Louis Baker with his friendship, enthusiasm, and unswerving commitment to excellence will be remembered by all of us who came in touch with him [37].

Richard D. Bates, Jr.'s Reminiscences (written in 2003) (Figure 28)

I am here to speak about a person I considered a colleague, a teacher, a mentor, and a friend…
A man who put the Chemistry Department at Georgetown on the map, who put the sciences on the map
A man who always considered the interests of the student
A man who was responsible for building the Chemistry Department at Georgetown to carry out Father Bunn's vision, doing it with the help of many former colleagues many of whom are here today
A man of strong opinions who stood tall in pressing to do what he believed to be the right thing
A man with a continuous commitment to excellence
A man who helped teach the University the right way to do things
A man with a strong commitment to Vi and his family
A man who loved Vermont, sailing, and time with his boys, and I think actually enjoyed having no phone so that a call had to be to a neighbor's house so that they could run down the road to fetch him
A strong man, a physical man, an athletic man, though his abilities as a tennis player did not necessarily lead him to know how to hold the bat in a faculty-student softball game—and you couldn't tell him otherwise
A man who took time out for cultural activities, and who enjoyed attending my son's high school musical theater performances and appreciated his CD
A faculty leader and early member of the Senate, who was not afraid to challenge the Administration
A man of the memo of near infinite length— no detail left unaccounted for
A man who loved teaching, guiding students and doing General Chemistry—and doing it his way
A man whose reputation for Baker Chem seemed to extend round the world, even to whispers overhead in supermarkets in New Jersey
A man whose house on Huntington Street became a focal point for departmental events, with dinners that seemed to begin at midnight (that was early for the Bakers) - from faculty interviews with discussions around the dinner table, to grading sessions for General Chem that became social events as they began in late afternoon and seemed to extend until dawn
A man who appreciated my sense of humor, at least some of the time
A man whose commitment to the Department led to the development under his leadership of the FDA program to train their scientists on modern chemical instruments, leading to Georgetown getting those instruments and funds to support faculty and graduate students to train the FDA scientists
A man whose foresight led to the development of the Continuing Ed program for students with bachelor's degrees to return to pick up pre-med requirements, which served for decades as a major source of funding for graduate students—a crucial need for Chemistry Departments
A man who brought a sense of fear to the eyes of the faculty member assigned by John Quinn or John Pierce to use the Reiss 103 lecture hall in the hour following Baker Chem where Lou's demonstrations, particularly the chlorine display near the end of the semester would empty the lecture hall and render it uninhabitable for some period of time
A man who was caught in his own game at least once when one demonstration that led to a mini-explosion timed to go off some minutes after the mixture was set down on filter paper caught him by surprise as he lost track of it and leaned over near it—and BANG!...he was speechless for minutes
A man for whom the trip back from Vermont to begin the first faculty meeting of the Fall semester was an adventure for all of us, with regular status reports phoned in, detailing where he was, when he might arrive, and when the meeting might actually begin
A man who took to new fangled things slowly, still preferring to record student grades on index cards and adding the scores up to get the grades by hand—even after calculators became wide spread, he'd always double check the calculators by hand
A man who…well, he had this thing for cars—no car of today could be as good as the one made yesterday; the juxtaposition of images of him cruising in his Lincoln convertible or scrunched into Vi's Morris Minor lives in the memory of any who knew him; he could fix them himself, though the saga of trying to keep them running involves numerous welding shops, trips to used parts dealers, and travels to Connecticut; even I had the privilege of serving as the horn in the Lincoln when here on my interview visit and being shown about the neighborhood, he advised me to lean out the window and beep if needed as the horn did not work; believe me he needed the horn, for stop signs were things to take note of, not necessarily to heed
I was less generous in my willingness to act as the assistant fuel pump in the Minor when the gasoline for the trip home had to be poured into a funnel connected to a tube than ran out the passenger side window and into the engine compartment.
I loved this man, relished his advice, enjoyed his idiosyncrasies; it pained me greatly to see him deteriorate in recent years and months; I shall miss him very, very much [37].

Bassam Z. Shakhashiri's [38] Reminiscences (Figure 29)

The following is excerpted from an American Chemical Society video available to the public [39]:
(Narrator) Bassam Shakhashiri was a child in Beirut in the 1950s, when a colorful piece of clothing launched his career in chemistry.
(Bassam) When I was growing up in my native Lebanon, my mother knitted a sweater for me, a yellow sweater. I liked that sweater a lot, but I wondered: why is it yellow? What does it mean to have a yellow-colored sweater? I wondered if the color yellow clashed with the color of one of my favorite pairs of pants. I was asking all kinds of questions about color, I was fascinated by color. Why is the sky blue? Why is it that when I looked at the surface of the Mediterranean Sea when the wind was blowing, I saw what we call white caps? And I wondered if the color of the white caps is related in any way to the color of the stuff that floats up in the sky. I was full of questions. I wondered why the cedars of Lebanon retained their color in the winter, while other trees lost their leaves, yet stayed alive and came back in the spring. I wondered about color all the time.
(Narrator) Young Bassam was spellbound by curiosity about color, light and vision. His parents and teachers encouraged that curiosity. They guided him toward answers to many of his questions. Shakhashiri's fascination with color never faded. It's the reason he chose to study chemistry in college.

Figure 28. Richard D. Bates, Jr.

Figure 29. Bassam Z. Shakhashiri (left) and Lou Baker (right) at George's Award for Undergraduate Research at an Undergraduate Institution Symposium, 219th National Meeting, American Chemical Society, San Francisco, California, March 28-April 2, 2000.

(Bassam) I learned that color changes happen because of chemical transformations, and I wanted to learn more about that, and so I became a chemistry major. When I went to college, I majored in chemistry because I wanted to learn more, not only about color changes, but about other chemical reactions, and so this is why I went into chemistry, and I found that experience to be very satisfying and very rewarding.
(Narrator) After Shakhashiri's first year of college at the American University of Beirut, his father, an eminent public health researcher, took a sabbatical at Harvard University. So in 1957, the whole family, Bassam, his mother, father, and two younger sisters, left Lebanon. Shakhashiri continued his studies in the United States, at Boston University, where he encountered a chemistry professor who had a profound impact on him. That semester, Lou Baker taught an advanced inorganic chemistry course to a class of one. Namely, then-college senior Bassam Shakhashiri.
(Bassam) I learned a lot from Lou Baker about color changes, I learned about ligand-field theory, I learned about electronic transitions that are useful in explaining the colors of different substances as they undergo transformations. Lou Baker had a tremendous impact on me. He influenced my attitude toward learning, and he was really giving me a tutorial, in the best sense of the word. I have since tried to emulate some of the ideas and some of the approaches that I learned from Lou Baker in my own practice as a professor, as a teacher, not only in large classroom settings, but especially when dealing with students one-on-one.

George B. Kauffman's Reminiscences (Figure 30)

Like many chemists of my generation, my introduction to the "central science" began with a chemistry set, which I received on my seventh birthday [40]. Because at the age of seventeen I matriculated at the University of Pennsylvania in February rather than in September of 1948, I could not enroll as a Bachelor of Science (B.S.) candidate but instead had to enroll as a Bachelor of Arts (B.A.) candidate. Although this situation was purely fortuitous, I realize in retrospect that it was a lucky choice, for I was exposed to a wider curriculum of liberal arts subjects not usually taken by most chemistry majors. I feel that this not only enriched my enjoyment of life but also made me a better teacher [41].

I was also extremely lucky in having Lou as my teaching assistant in general chemistry. After allowing me to carry out some preliminary experiments on crystal growing with copper(II) sulfate pentahydrate, Lou introduced me to coordination chemistry by allowing other freshmen and me to work in his private laboratory. I was impressed with his limitless patience with our inexperience, ignorance, and clumsiness.

The first complex compound that I prepared, which I labeled "compound α, May 7, 1948," was the versatile intermediate, carbonatotetraamminecobalt(III) nitrate hemihydrate, $[CoCO_3(NH_3)_4]NO_3.1/2H_2O$ (Figure 31), and I still keep the bottle on the shelf by my desk as a souvenir (Figure 32). Lou thus weaned me (but not completely) from adolescent pyrotechnics to coordination chemistry. I also tried my hand at his chosen specialty—heteropoly compounds [43, 44].

Lou exerted a profound influence on another aspect of my career — my writing ability. For some unfathomable reason, I had convinced myself that I was unable to write, and in my freshman English composition class I suffered from a chronic case of "writer's block." Three days after I had prepared compound α in Lou's lab, I wrote a composition describing the experiment. Because Lou had ruined the first run when his jury-rigged electric fan intended to accelerate evaporation of the mother liquor came crashing down onto the 3-liter evaporating dish, I referred to him under a pseudonym to protect his reputation. The composition received an "A," my case of writer's block was cured, and henceforth I wrote about scientific subjects—with great success. I now realize that I was merely applying the well-known maxim of writing on subjects with which I was familiar, but Lou served as the catalyst for my transformation from hesitant amateur to prolific author.

In gratitude, I dedicated the first of my 16 books, *Alfred Werner, Founder of Coordination Chemistry* [42] (Figure 33) to Lou:

> To Dr. Louis C. W. Baker,
>
> Who as a young and patient instructor of chemistry of freshman chemistry at the University of Pennsylvania, once took the time and effort to initiate the author into the amazing mysteries of the octahedron and so demonstrated to him that the carbon atom had no monopoly on stereochemistry.
>
> Lou Baker received his doctorate under Prof. Thomas P. McCutcheon, who had worked with Werner in Zürich. Thus the author is pleased to claim a direct, even if highly tenous, academic link with the Master (Figure 34).

I try to repay my debt to Lou by customarily giving several of my freshman chemistry students special research projects in the belief that early discovery and encouragement of talent is one of a teacher's most important functions. I lost contact with

Figure 30. George B. Kauffman (left) and Louis C. W. Baker (right) at George's Award for Undergraduate Research at an Undergraduate Institution Symposium, 219th National Meeting, American Chemical Society, San Francisco, California, March 28-April 2, 2000.

Figure 31. George B. Kauffman's Laboratory Notebook, Describing the Preparation of His First Coordination Compound, April-May 1948.

Figure 32. George B. Kauffman's Coordination Compounds, 1948. Compound α is on the far right.

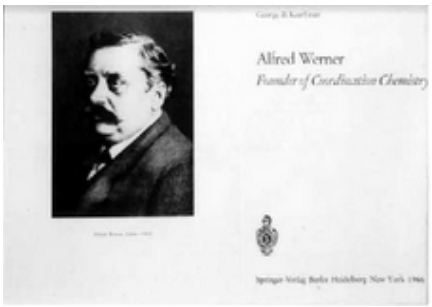
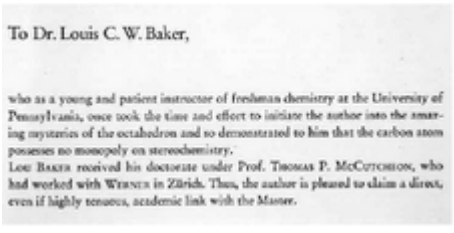


Figure 33. George B. Kauffman's First Book (1966), Title Page [42].


To Dr. Louis C. W. Baker,

who as a young and patient instructor of freshman chemistry at the University of Pennsylvania, once took the time and effort to initiate the author into the amazing mysteries of the octahedron and so demonstrated to him that the carbon atom possesses no monopoly on stereochemistry.
Lou Baker received his doctorate under Prof. Thomas P. McCutcheon, who had worked with Werner in Zürich. Thus, the author is pleased to claim a direct, even if highly tenuous, academic link with the Master.

Figure 34. George B. Kauffman's First Book (1966), Dedication to Lou Baker [42].

Lou after I graduated from Penn, and it was not until June 1962 that I saw him again, in Stockholm at the 7th International Conference on Coordination Chemistry, where we both presented papers. The years hadn't changed him. His same youthful enthusiasm and awkward scurrying to and fro to put the finishing touches on his molecular models poignantly reminded me how exciting he had made chemistry for me during my undergraduate years. Even today I still vividly remember Lou's boyish delight in performing his awesome lecture demonstrations, a practice that I have tried to emulate.

April is National Poetry Month, and I conclude my reminiscences with a poem.

A Tribute to My Mentor and Longtime Friend, Louis Coombs Weller Baker (November 24, 1921–April 15, 2003), on the Tenth Anniversary of His Death

By George B. Kauffman

Compound α: Ode to a Complex Salt $[CoCO_3NH_3)_4]NO_3.1/2H_2O$

"There and Back Again", Bilbo Baggins' original title for the Hobbit — J. R. R. Tolkien, *The Fellowship of the Ring*

I

It sits in a small, squat bottle on my office shelf,
A dull, brick-red, free-flowing powder,
Carefully labeled in a meticulous adolescent hand,
"Compound α, May 10, 1948."
First member of a growing collection of colorful substances,
Created with an endless parade of student protégés,
Now mature scientists scattered God knows where,
Today faceless names long since departed…
A partial payment of my debt to Lou.

II

The heavy metal fire door clanged shut behind us,
As Lou and I entered that part of the Harrison lab where freshmen never go.
In his apparatus-clogged office, bereft of human artifacts,
Save a solitary rose in a water-filled flask,
Through which the sunlight, the same glinting off his thick, rimless specs,
Cast a spectrum on the white pages of our prep book,
With growing excitement, we began our joint work.
He, the graduate assistant, towering over me, physically and intellectually,
And I, the admiring spellbound novice, obeying his commands and gesticulations;
Together we made the salt now gracing my shelf…
No wonder I dedicated my first book to him!

I used my work with Lou to write my first composition,
Breaking my defeatist conviction that I couldn't write prose;
Like Cyrano, I spoke in my own voice for the very first time.
Before, I had others write my English compositions;
I even copied one from a book (*Mea culpa!*).
It only earned a "B": Imagine that!
And now, years later, I turn to that first experiment again
To try my hand at poetry.

III

That salt was the color of dried blood,
Reason enough for me to make it.
I knew nothing of its properties, uses, or reactions,
Its crucial role in the coordination theory
Erected single-handedly by Alfred Werner,
My future scientific hero, whose story I would someday tell,
After a year's ferreting out the tale from his *Nachlass*,
In Zürich, that quaint medieval town on the banks of the Limmat.

That sheltered Jewish boy from Philly
Never dreamed where that salt would lead him,
Surprising his most unrealistic fantasies,
Honored and lionized on three continents,
Presenting a seminar in the shadow of Berkley's campanile,
Quizzed by a Nobel laureate;
Chairing a session in Moscow, while glancing out the window
At the gilded onion domes of Ivan the Terrible and Boris Godounov;
Lecturing in lush, rain-soaked Nikko,
Near the temple of the three monkeys
(See no evil, hear no evil, speak no evil);
All this swirled like a genie
From that little magic bottle.

IV

Trapped within each molecule of carmine crystals,
Hidden to the eye, ear, nose, and tongue,
Invisibly sleep four molecules of ammonia,
Slumbering harmlessly for six and a half decades,
Yet capable of expanding to liters of caustic, toxic gas
Upon the liberating touch of heat or chemicals.
The quintessence of stability…
I wish that I could be so stable!

And yet would I really want to trade my life today,
To be seventeen once more, awkward and uncertain,
Dreading the future, assuming the worst?
The salt still stands upon my shelf, unchanged by time,
Exactly the same in weight and color and form
As when I poured it into its container through a paper funnel,
Careful not to lose a grain of my precious prize;
Give 'Em Hell Harry was president then,
And a watergate was just an irrigation device.

Acknowledgments. We gratefully acknowledge the assistance of Bassam Z. Shakhashiri (bassam@chem.wisc.edu); Michael T. Pope (popem@georgetown.edu), Richard D. Bates, Jr. (bates@georgetown.edu), Joseph E. Earley (earleyj@georgetown.edu), and Gwen Owens, Head of the Blommer Science Library (owens@georgetown.edu), all of Georgetown University; the late Joseph Schmuckler of Temple University; and Mark Frazier Lloyd, Director of University Archives and Records Center (lloyd@pobox.upenn.edu), Judith Currano, Head of the Chemistry Library (currano@pobox.upenn.edu), and President Amy Gutmann (president@upenn.edu), all of the University of Pennsylvania; and Jean-Pierre and Madeleine Adloff of the Université de Strasbourg (jp.adloff@noos.fr).

References and Notes

1. Gilman, V. Obituaries. Louis C. W. Baker. *Chem. Eng. News* **June 16, 2003**, *81*(24), 42.
2. Pope, M. T. Memorial for Lou Baker. May 2, 2003. *Hoya Chimica: Georgetown Chemistry News* **Fall, 2003**, *18*, 3.
3. Bates, Jr., R. D. Memorial for Lou Baker. *Hoya Chimica: Georgetown Chemistry News* **Fall, 2003**, *18*, 4.
4. Louis C. W. Baker; GU Professor, Researcher. *Washington Post*, May 2, 2003.
5. McCutcheon's father, Thomas Potter McCutcheon, was a graduate of the University of Pennsylvania and president of the neckwear manufacturers, T. P. McCutcheon & Bro. Inc. While applauding in the grandstand at the Cornell-Pennsylvania football game on Thanksgiving Day, November 29, 1907, in Philadelphia, at age 57, the father was stricken with apoplexy and died almost immediately, at the side of his son, Thomas P. McCutcheon, Jr., who was then Instructor in Chemistry at the University of Pennsylvania.
6. Baker, L. C. W.; McCutcheon, T. P. Heteropoly Salts Containing Cobalt and Hexavalent Tungsten in the Anion. *J. Am. Chem. Soc.* **1956**, *78*(18), 4503–4510. http://pubs.acs.org/doi/pdf/10.1021/ac60106a038 (accessed April 2013).
7. Baker, L. C. W.; Anderson, T. F. Some Phase Relationships in the Three-component Liquid System CO_2-H_2O-C_2H_5OH at High Pressures. *J. Am. Chem. Soc.* **May 1957**, *79*(9), 2071–2074. http://pubs.acs.org/doi/abs/10.1021/ja01566a013 (accessed April 2013).
8. Bailar, Jr., J. C. History of the Division of Inorganic Chemistry, American Chemical Society. *J. Chem. Educ.* **July 1989**, *66*(7), 537–545. http://pubs.acs.org/doi/pdf/10.1021/ed066p537 (accessed April 2013).
9. Simmons, V. E.; Baker, L. C. W. Magnetic properties, spectra, chemistry, and structures of five different heteropoly 12-tungstocobaltate anions, containing respectively $Co(II)O_4$ tetrahedra, $Co(III)O_4$ tetrahedra, $Co(II)O_6$ octahedra, and various pairs of these groups. *Proc. Seventh International Conference on Coordination Chemistry, Stockholm and Uppsala, Sweden, June 25–29, 1962, Abstracts*, 4D6, pp 195–197.
10. Baker, L. C. W.; McCutcheon, T. P. Redox Determination of Tervalent and Total Cobalt in Presence of Excess Tungstate. *Anal. Chem.* **1955**, *27*, 1625–1626. http://pubs.acs.org/doi/pdf/10.1021/ac60106a038 (accessed April 2013).
11. Simmons, V.E. Heteropoly Tungstocobaltoates and Tungstocobaltiates Based on CoO_4 Tetrahedra: Magnetic Properties, Spectra, Chemistry, and Structures, Doctoral Dissertation, Boston University, 1963; *Diss. Abstr. Int.* **1963**, *24*, 1391.
12. Baker, L. C. W.; Simmons, V. E. Heteropoly Tungstocobaltate Anions Containing Respectively Co(II) and Co(III) in CoO_4 Tetrahedra. 1. 12-Tungstocobaltoate and 12-Tungstocobaltiate. *J. Am. Chem. Soc.* **September 1959**, *81*(17), 4744–4745. http://pubs.acs.org/doi/abs/10.1021/ja01526a073 (accessed April 2013).
13. Yannoni, N. F. On the Crystallography of a Higher Boride of Aluminum; The Crystal Structure of Hexagonal Potassium 12-Tungstocobaltiate; An Absorption Correction for the Buerger Precession Camera, Doctoral Dissertation. Boston University, 1961.
14. Yannoni, N. F.; Simmons, V. E.; Eriks, K.; Baker, L. C. W. B. Papers presented before the Division of Inorganic Chemistry, 136th National Meeting, American Chemical Society, Atlantic City, NJ, September, 1959.
15. Eriks, K.; Yannoni, N. F.; Agarwala, U. C.; Simmons, V. E.; Baker, L. C. W. Abstracts of supplementary papers presented before the Fifth International Congress of the International Union of Crystallography, University of Cambridge, England, August, 1960, Crystal structures of two heteropoly salts: potassium 12-tungstocobaltiate $K_5[CoW_{12}O_{40}].20H_2O$ and sodium 6-

tungstonickelate $Na_4[NiW_6O_{24}H_6].14H_2O$. *Acta Cryst.*, **1960**, *13*, 1139.

16. Baker, L. C. W. Advances in the Chemistry of Heteropoly Electrolytes and Their Pertinence for Coordination Chemistry. In *Advances in the Chemistry of the Coordination Compounds: Proceedings of the Sixth International Conference on Coordination Chemistry*, Kirschner, S., Ed.; Macmillan Company: New York, NY, 1961, pp 604–612.
17. Pope, M. T.; Baker, L. C. W. The Hydrodynamic Volume of the Heteropoly Hexamolybdocobaltate(III) Anion from Viscosity Measurements. *J. Phys. Chem.* **December 1959**, *63*(12), 2083–2084. http://pubs.acs.org/doi/abs/10.1021/j150582a039 (accessed April 2013).
18. Baker, L. C. W.; Pope, M. T. The Identical Diffusion Coefficients of Isostructural Heteropoly Anions. The Complete Independence of D from Ionic Weight. *J. Am. Chem. Soc.* **August 1960**, *82*(16), 4176–4179. http://pubs.acs.org/doi/abs/10.1021/ja01501a014 (accessed April 2013).
19. Perloff, A. The Crystal Structure of Sodium Hexamolybdochromate(III), $Na_3[CrMo_6O_{24}H_6].8H_2O$, Doctoral Dissertation, Georgetown University, 1960.
20. Baker, L. C. W.; Simmons, V. S.; Eriks, K.; Pope, M. T.; Rollins, O. W.; Fang, J. H.; Koh, L. L. A New General Structural Category of Heteropolyelectrolytes. Unusual Magnetic and Thermal Contraction Phenomena. *J. Am. Chem. Soc.* **May 1966**, *88*(10), 2329. http://pubs.acs.org/doi/abs/10.1021/ja00962a052 (accessed April 2013).
21. Baker, L. C. W.; Figgis, J. S. New fundamental type of inorganic complex: hybrid between heteropoly and conventional complexes. Possibilities for geometrical isomerisms in 11-, 12-, and 18-heteropoly derivatives. *J. Am. Chem. Soc.* **June 1970**, 92, 3794–3797. http://pubs.acs.org/doi/abs/10.1021/ja00715a047 (accessed April 2013).
22. Rollins, O. W. Elucidation of Heteropoly Molybdogallates and Tungstogallates, a Crystallizable 6-Isopoly Paratungstate, and New Paramolybdate, Doctoral Dissertation, Georgetown University, 1965.
23. Bezas, C. Doctoral Dissertation, Georgetown University, 1971.
24. Rosenheim, A. In *Handbuch der anorganischen Chemie*, Abegg, R., Auerbach, F., Eds.; Hirzel Verlag: Leipzig, Germany, 1921; Vol. IV, Part 1, ii, pp 977–1064.
25. Pope, M. T.; Varga, Jr., G. M. Proton magnetic resonance of aqueous metatungstate ion: evidence for two central hydrogen atoms. *Chem. Comm.* **1966**, 653–654. http://pubs.rsc.org/en/Content/ArticleLanding/1966/C1/C19660000653 (accessed April 2013).
26. Tsigdinos, G. A.; Pope, M. T.; Baker, L. C. W., Papers presented before the Division of Inorganic Chemistry, 135th National Meeting American Chemical Society, Boston, MA, April, 1959.
27. Tsigdinos, G. Heteropoly Molybdate Anions of Certain Fifth Group and Transition Elements: Partial Elucidation of Structures and Chemical Properties, Doctoral Dissertation, Boston University, 1961.
28. Baker, L. C. W.; Weakley, T. J. R. The stabilities of the 9-molybdomanganate(IV) and 9- molybdonickelate(IV) ions. *J. Inorg. Nucl. Chem.* **1966**, *28*, 447–454. http://www.sciencedirect.com/science/article/pii/002219026680324X (accessed April 2013).
29. Figgis, J. S. Heteropoly Tungstate Anions Containing Both Si and Co, Some Fundamentally New Types of Complexes, Doctoral Dissertation, Georgetown University, 1970.
30. Rollins, O. W.; Baker, L. C. W. Potassium Calcium Paramolybdate and Cryscopy of Paramolybdates. *Inorg. Chem.* **February 1969**, *8*(2), 397–399. http://pubs.acs.org/doi/pdf/10.1021/ic50072a046 (accessed April 2013).
31. Lee, K. H. Isotope Exchanges Involving Various Isomorphous 6-Molybdo and 6-Tungsto Heteropoly Anions: Exchange of Intact CrO_6 Units, Doctoral Dissertation, Georgetown University, 1970.
32. Ter Haar, E. Preliminary Investigation of Oxygen-18 Exchange Between 6-Molybdochromate(III) Ion and Water, Master's Thesis, Georgetown University, 1968.
33. Müller, A.; Meyer, J.; Krickenmeyer, E.; Diemann, E. Molybdenum Blue: A 200 Year Old Mystery Unveiled. *Angew. Chem. Int. Ed. Engl.* **June 17**, **1996**, *35*(11), 1206–1208.
34. Souchay, P. Contribution à l'étude des hétéropolyacides tungstiques; Thèses présentées à la Faculté des sciences de l'Université de Paris pour obtenir le grade de docteur des sciences physiques; Masson et Cie.: Paris, 1945; Polyanions et polycations; Gauthier-Villars: Paris, 1967; Souchay, P. Ions minéraux condensées; Masson et Cie.: Paris, 1969; Souchay, P.; Lefebvre, J. Équilibres et réactivité des complexes en solution; Masson et Cie.: Paris, 1969.
35. Pope, M. T. *Heteropoly and Isopoly Oxometalates*; Springer-Verlag: Berlin, Heidelberg, New York, Tokyo, 1983.
36. Baker, L. C. W.; Glick, D. C. Present General Status of Understanding of Heteropoly Electrolytes and a Tracing of Some Major Highlights in the History of Their Elucidation. *Chem. Rev.* **1998**, *98*, 3–49. http://pubs.acs.org/doi/pdf/10.1021/cr960392l (accessed April 2013).
37. The Chemistry Department Remembers Dr. Baker. *Hoya Chimica. Georgetown Chemistry News*, Fall 2003, Number 18, p 3. http://chemistry.georgetown.edu/downloads/hc%20v18%20fall%2003.pdf (accessed April 2013).
38. Bassam Z. Shakhashiri, first holder of the William T. Evjue Distinguished Chair for the Wisconsin Idea at the University of Wisconsin, Madison, was born in 1939 in Anfe, El-Kouri, Lebanon to Dr. Zekin A. Bakhashiri, a pioneer in public health at the American University of Beirut and Adma N. Bakhashiri. The family emigrated to the United States in 1957, when Bassam was 17 years old and had spent one year at the American University. He received his B.A. in 1960 from Boston University and earned his M.S. (1964) and Ph.D. (1968) degrees from the University of Maryland. A recipient of numerous awards and renowned for his effective leadership in promoting excellence in science education at all levels, and cited as the "dean of lecture demonstrators in America," he served as President of the American Chemical Society in 2012. http://scifun.org (accessed April 2013).
39. Spellbound: How Kids Become Scientists (Ep. 3 featuring Bassam Shakhashiri) on Vimeo http://vimeo.com/25093295 (accessed April 2013).
40. Kauffman, G. B. My First Chemistry Set. *Today's Chemist* **December 1989**, *2*(6), 14–15.
41. Kauffman, G. B. Scientific Research: Process and Product; Acceptance Address for the 2000 American Chemical Society Award for Research at an Undergraduate Institution sponsored by Research Corporation. *Chem. Educator* **2000**, *5*(4), 277–292; DOI 10.1333/s000897000415a.
42. Kauffman, G. B. *Alfred Werner: Founder of Coordination Chemistry*, Foreword by John C. Bailar, Jr.; Springer-Verlag: Berlin-Heidelberg-New York, 1966.
43. Kauffman, G. B.; Vartanian, P. F. Isopoly and Heteropoly Compounds—A General Chemistry Laboratory Experiment. *J. Chem. Educ.* **March 1970**, *47*(3), 212–217.
44. Kauffman, G. B.; Fuller, R.; Felser, J.; Flynn, Jr., C. M.; Pope, M. T. 13-Vanadomanganate(IV) and Nickelate(IV). *Inorg. Syn.* **1974**, *15*, 103–110 (checked by L. C. W. Baker).