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The Joy of Chemistry- Personal Impressions (text and audio)

Frank D. Starkey
Illinois Wesleyan University

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Personal Impressions

by Professor Frank D. Starkey

Coming to this podium after last year's honoree, Harvey Beutner, is difficult indeed. My name is much too common for me to be able to speak for all the Franks of the world as he did for the Harvey's, and I cannot even include a cryptic comment about reserving the right to alter my bachelor status, for I am already married. In fact my wife Gunilla was instrumental in determining the title of this talk. I had settled on "The Joy of Chemistry—A Personal Cookbook", but she felt that it was just too corny so I had to change it.

As the Century Club Honoree, I want to immediately express my appreciation to those who made this honor possible—the students. For me, much of the joy of chemistry has been found in six years of teaching and advising students at Illinois Wesleyan. This year I am on sabbatical leave doing research at the University of Minnesota, and the enjoyment to be found in research is different from that in teaching. Because I am on sabbatical in Minneapolis another title for this talk flitted through my mind during the writing of the speech. I thought about calling it "A Tale of Two Cities, Bloomington and Minneapolis," however, part of that title has been used before so the "The Joy of Chemistry" it is.

Some of you may be wondering just what is chemistry and what is it that chemists do? I recall two years ago when Bedford Watkins gave a marvelous presentation when he was the Century Club Honoree. Bedford had composed music which was performed live the night of the Century Club dinner, so I thought about bringing over some test tubes, beakers, bunsen burners, and chemicals for a demonstration of chemistry right before your eyes and noses, but I have opted for a more literary description of science. The "New York Times Book Review" of April 9, 1978 contained an article by John Leonard which was based on *Spontaneous Apprentices*, a book which describes an experiment involving children and development of language. A rather far cry from the type of science that I do but the basis for an excellent article about science and scientists. Quoting Leonard—"But what makes *Spontaneous Apprentices* so agreeable is its portrait of scientists at work in the everyday, unencumbered by crash programs, doomsday deadlines, malice, greed, the specter of Alfred Nobel, the appetite of war for the technology of death, and so on. Hypotheses are hatched, experiments designed. It is a civilized activity, this science, even when—as is most often the case—it is boring. ... And it is rather dreamy, an innocent ambition to know and explain on the part of not-so-spontaneous apprentices." Leonard goes on to discuss the images of scientists found in much of contemporary literature, Frankenstein and Dr. Strangelove, and the common themes of "science is

madness" and "science is the death of the soul." Finally Leonard asks—"Why, though, are our writers so hard on the case of Science? Surely the desire for elegance, the sense of wonder, the experience of mystery and uses of inspiration belong as much to science as to art. And art requires just as much method as science: selection, inclusion, concentration." Early candidates for the title of this speech used the words wonder and mystery as well as joy, but I chose "The Joy of Chemistry" because I wanted to emphasize my own feelings about being a professor of science at a small college, and in large part those feelings have to do with joy.

Not only am I a scientist of the chemical variety but further I am an organic chemist, and organic chemistry has been described thusly: "Organic chemistry nowadays almost drives me mad. To me it appears like a primeval forest full of the most remarkable things, a dreadful endless jungle into which one does not dare enter for there seems to be no way out." This quote comes surprisingly not from one of my students but from a scientist considered one of the outstanding early chemists, Friedrich Wöhler, and it is dated 1835. The role of a professor of organic chemistry is to aid the student in developing the skills, techniques and strategies needed to realize that the jungle is really an oasis. Just how does a professor of organic chemistry accomplish this feat? I suggest by being just that—a true professor. One of the best instructors that I ever had, Mrs. Lyons who taught English at Washington High School in my hometown of Indianapolis, always insisted in reference to college instructors that the words teacher and professor were not synonymous. This is the same demanding, inspiring educator who made a distinction between the words pupil and student. For Mrs. Lyons a pupil merely occupied space in a classroom, but a student studied and learned. Mrs. Lyons stated that college professors taught but also had to be involved with some scholarly work. For her, scholarship was essential to being a professor. She probably was actually referring to university professors, but even at a small college it is crucial that we teachers have some opportunities for some scholarly activity, both to keep us current and alive in our teaching and to keep us involved in our academic discipline.

Mrs. Lyons also kindled my latent interest in studying literature, but my fascination with chemistry prevailed, and I entered Wabash College in 1962 as a chemistry major, one of the "Sputnik Generation" science students. However my initial close encounter with college chemistry was not particularly enjoyable. I was one of two freshman in a sophomore chemistry class which was taught by the redoubtable Edward Haenisch. All of us knew about Professor Haenisch even before starting classes at Wabash. Under his

leadership as department head, the Wabash chemistry department had an outstanding record of producing students who later earned Ph.D's. He was a very large man with a fearsome demeanor, and making sure that he would not hear us, we called him Big Ed, in reference to both his size and his reputation as "the biggest man in small college chemistry." He had a unique teaching style. His personality absolutely dominated the classroom, and he managed to convince each student that he, Haenisch, was watching him all during the lecture. That first year I was assigned to a laboratory section which met the very first day of classes, one day before the first lecture for the class. I was enjoying an afternoon stroll around campus that first day when one of my friends asked me why I was not in the chemistry building listening to the prelaboratory lecture being given by Haenisch. I had forgotten my very first college chemistry class! I ran back to my room, grabbed my books and tried to inconspicuously enter the room where Haenisch was lecturing. Of course, he stopped, fixed me with a glare, and said something like—"Happy to see that you could make it, Mr. Starkey." I was mortified, and since I was wearing the green beanie that instantly identified me as a rookie the other students particularly relished my discomfiture. Professor Haenisch taught me more chemistry than any professor that I have had since; I learned in self-defense. I have not emulated his teachig methods, but in his own way he was an extremely good teacher. His best performances were called three meter stick lectures because of his habit of emphasizing important points by banging on the lecture table top with a meter stick. He would actually break the sticks and then magically produce new ones to replace them.

While Haenisch furthered my interest in chemistry the person who most influenced my decision to become a professor of chemistry was another Wabash chemistry professor, Quentin Petersen. With Haenisch, respect and fear led us to produce as students, but Petersen did not have to intimidate us. He let his tests do it for him. Those tests were real gems, each with a definite structure and many facets, each quite hard. He was a professor of organic chemistry, and he did more than teach, he actually professed belief in the intrinsic beauty of the discipline and the joy of being an organic chemist. He also did research and published papers with students. There are many Petersen stories for he is an interesting individual, a true original. Whenever I meet his former students and colleagues at conventions, we swap stories. Having taught at five different schools, Petersen has almost as many former colleagues as he does former students. He and I left Wabash for the East Coast the same year, Petersen for a position as department head at Simmons College in Boston and I for graduate school

at Brown in Providence. He beat me back to the Midwest as department head at Monmouth and now is the department head at Central Michigan University. One of my favorite Petersen stories and one which greatly influenced one aspect of my teaching style deals with his teaching our qualitative organic analysis course during the last semester of my senior year. He gave each student ten compounds to identify. After working many long, hard hours each week for an entire semester, the best student, who was to enter graduate school at Cal. Tech that coming fall, was able to identify six compounds. The rest of us, after similar periods of time in the laboratory, identified four or less of our ten compounds. Students' having such a low success rate is now, and perhaps even then, considered poor educational practice. We educators are told that students like to be rewarded (read that, "obtain high grades") when they work hard and put in the hours; however, Petersen never graded on effort, only on results. I believe that he was trying to prepare us for graduate and professional school where learning to deal with frustration is a way of life. By the way, I have been told that in other years some students did get eight or nine unknowns correct, so perhaps another point to this story is that 1966, the year of my graduation, was not one of Petersen's vintage years.

Let me relate one more story before I leave the Wabash years. At Wabash it was not at all uncommon for visiting lecturers from other schools to actually teach a class or two during their visit. One day in 1964 my organic class was visited by Professor Lloyd Ferguson, then professor of chemistry at Howard University in Washington, D.C. and now at California State University, Los Angeles. Ferguson was the first Black Ph.D. chemist that I had ever met, and I have followed his career since that time. From listening to his lecture and observing him during that brief visit I appreciate how well he deserves his many honors and awards, among them the Manufacturing Chemists Association National Teaching Award in 1974 and the American Chemical Society Award in Chemical Education in 1978. To quote one of his colleagues, "Lloyd Ferguson stands for all that is excellent in chemical education: a respect and love for students, his colleagues, his fellow man, and learning." I was quite fortunate to have met Professor Ferguson, and I regret that I have not met him in person since that day 14 years ago.

Choosing a Profession—The Influence of Teachers

All the people that I have mentioned: Mrs. Lyons, Professors Haenisch, Petersen, and Ferguson taught me more than specifics about their disciplines. They taught me about education itself, so it was natural for me to seek to emulate them and become an

educator. I decided to become a professor at a small college and picked my graduate school with that goal in mind. I was not interested in the very large research schools like Wisconsin, Illinois and Berkeley, and they were not too likely to be interested in me, so I decided on a medium size department at a smaller but still distinguished university which also focused on quality undergraduate education. My choice was between Northwestern and Brown, and I chose Brown because of its East Coast location and because of the advice of Petersen (himself a Northwestern Ph.D.).

My years at Brown were invigorating and exciting. I was a graduate student during the late Sixties, a time of ferment and needed change in higher education and in the country in general. So many things were happening that at times it was difficult to concentrate on chemistry. My thesis adviser, Professor Harold Nace, was understanding of my various commitments and allowed me freedom to continue my outside activities at the same time that I continued my classes and research. In this regard Brown was perfect for a graduate student like me. I could, for example, work with the graduate deans to develop recruiting, admission, and retention programs for students who were considered underprepared for graduate studies at an Ivy League school like Brown. For me one of the joys of chemistry was observing four students that I had recruited for the chemistry department progress toward completion of their programs.

In terms of helping me further define my vision of chemical education, those years at Brown were invaluable. I have been fortunate enough to know four of the fifteen winners since 1963 of the American Chemical Society Award in Chemical Education, the afore mentioned Lloyd Ferguson, Ed Haenisch at Wabash, Lee Clapp at Brown, and Robert Brasted at Minnesota. The undergraduate students at Brown routinely selected Lee Clapp as one of the best instructors on campus, and he received standing ovations at the end of each semester from his organic classes. But most remarkable, and the thing that most impressed and influenced me, was his skill with students one-on-one or in small groups. During the day, except for those times that he explicitly set aside for research with his graduate students, his office was never empty. He was patient, understanding, and quite effective. He always taught one of the sections of organic chemistry, and his students learned organic chemistry. His openness with and concern for students never became a crutch because his singular aptitude for motivating students caused them to come up to his standards. His students wanted to learn the material, and he wanted to help them do so.

Developing a Student-Centered Teaching Philosophy

Exposure to many excellent teachers during my undergraduate and graduate years helped me formulate my own teaching philosophy. First and foremost, my teaching is student centered. Just as I do not believe in only teaching to the talented tenth and forgetting the rest, I also do not believe in pitching the presentation to the middle and neglecting the best. Reaching and motivating each and every student is important to me, and my lecture style incorporates attempts to actively involve each student in the educational process. As former students can testify, I expect students to have read the material to be covered before the class meeting, and I call upon students in class for answers to questions. Some students have called this procedure "instant reply." Such faculty-student interaction only starts in the lecture room. The laboratory is a good place for a professor to listen to students and to observe how well they can apply some of the things they learned from the textbooks and the lectures. I like lecturing and laboratory instruction, but for me the most enjoyable part of teaching is the one-to-one contact of professor and student so I particularly relish answering students' questions in my office. I am not sure what increment of a student's knowledge of chemistry is gained in these sessions *vis-a-vis* that amount gained in lectures, laboratory, and out-of-classroom study. It may be small for most students, but others benefit greatly. Face-to-face contact allows me to determine on which points a particular student is weak and also to determine whether the class as a whole is comprehending crucial ideas and theories presented in lecture. Chemistry is not a collection of dry facts to be memorized, but a body of concepts, models, and theories which must be understood and mastered. My major goal has always been to motivate each student to reach his or her potential or in fact to strive to exceed the limits that have been placed on them by that socalled potential. Knowing each student well and knowing how he or she is progressing is crucial to my ability to motivate them and to involve them in their own education. So while I am like Petersen in not grading on effort alone, I am like Clapp in trying to encourage effort that leads to the desired results. It may be true that I expect quite a bit from students in my courses, but I hope and I believe that the results are worth the effort. By results I mean not merely a grade in my course, but preparation for other educational challenges and for challenges outside the classroom.

Teaching and Advising Students—A Professor's Crucial Roles

All professors love talking about their students and many profes-

sors think that they had a crucial role in the affairs of the successful and played no part whatsoever in the outcome of the failures. I confess that I will talk only about the successes. I will mention some by name and others will remain anonymous. One group of students will always have a special place in my thoughts: the nine chemistry majors in the class of 1975, for they are my class—they started Illinois Wesleyan as I did in 1971. Of that class, one took a job as a bachelor degree chemist, one entered medical school, one dental school, two started on chemistry Ph.D. programs, one became a high school teacher and then later became a caramel corn entrepreneur in New Orleans, one undertook a master's program in business administration, and two started graduate programs in science fields related to chemistry. There are many stories to be told about that group, but let me relate just one. Kathy Hayes who is now in her third year at Princeton as an organic chemistry Ph.D. candidate took a sophomore analytical chemistry laboratory course that Dorothy Banfill and I taught. Part of the course was an independent project for which students could analyze for anything that we were equipped to handle. There have been projects such as calcium in water and protein in various cereals. Kathy chose to analyze for Vitamin E in different commercial products. During the January Short Term course she obtained some tentative values but, perfectionist that she is, Kathy wanted better results. She convinced me to serve as her adviser for an independent research project to develop a better analytical procedure for Vitamin E. Fortunately, Kathy did not need much advice because I know very little about Vitamin E. She modified a known procedure and collected data which culminated in her presenting a paper before the Collegiate Section of the Illinois State Academy of Sciences. Kathy is still working hard and still getting results: last summer she was the co-author with her thesis adviser of two papers in the prestigious "Journal of The American Chemical Society." Working with Kathy was a real experience, but let me now relate another experience that has ostensibly little to do with chemistry but much to do with joy. For the University's bicentennial celebration of 1976 I developed and taught a January Short Term course titled "Benjamin Franklin, an American Scientist." That course for non-science majors certainly ranks as one of my favorite courses. I wanted to mention those students with whom I shared that experience, but to insert a list of 30 names into this speech would be too cumbersome. So I will borrow a phrase from Harvey's address of last year. We of the Ben Franklin class: *we know who we are.*

I have known several IWU science graduates who also knew who they were, but who were not sure about how they might stack up

against the other students at the famous graduate or professional schools that they were entering. One in particular, who shall remain nameless, wrote me after a couple of weeks of graduate school expressing some concern about the impressive credentials and accomplishments of his fellow students. He also exhibited some culture shock in dealing with them on a personal level. To him they all seemed brilliant and not at all shy about letting everybody know it. I reminded him of his accomplishments and pointed out that his graduate school obviously considered him among the most qualified students in his class, since I was sure that they did not normally give fellowships to students that they planned to flunk out. My next letter from this student came at the end of his first semester when he informed me that he had received all A's in his courses. That was the same level of performance that he had maintained throughout high school and college.

This year while I am on sabbatical leave I have received several letters from students telling me of their acceptance into graduate school, medical school, dental school, and medical technology school and thanking me for letters of recommendation written and advice given. Such letters are particularly gratifying because for me part of professoring is advising, and the role of adviser in higher education is sometimes forgotten in the emphasis on teaching and research. I enjoy advising, again because I thrive on the one-to-one student/teacher contact. Advising should be just that. I think that advisers should help the student reach the proper decision for that particular student, not tell the student what to do.

On Sabbatical Leave—The Research Function of Scholarship

Teaching and advising: I have always put those first, and will probably always do so; however, I have also always remembered Mrs. Lyons from Washington High School in Indianapolis. In order to be a professor one must be actively involved in scholarship. For me that means research, in the laboratory making compounds and running reactions. While I have kept my hand in during my six years at IWU by directing numerous student independent study projects and working with students during one summer, I have known that I could and should be more productive and also provide more opportunities for undergraduates to participate in ongoing research. Therefore, I am spending my sabbatical in the chemistry department of the University of Minnesota as a visiting research associate. This is strictly a research appointment with no teaching. I am rediscovering another aspect of the joy of chemistry, the pleasure and challenge of research. When I am asked what is chemistry, I often answer that chemistry is what chemists do. Well,

I spent quite some time thinking about how to describe my research at Minnesota. One part of the project is the synthesis and solvolysis of derivatives of 8-*anti*-hydroxy-3-*endo*-*aza*-3-phenyltricyclo [3.2.1.$0^{2,4}$] octane. To quote from Abraham Maslow's *The Psychology of Science:* "Science is too often presented as a kind of functionally autonomous enterprise that cannot really make sense to the outsider. ....laymen might wonder why people should dedicate their lives to such unexciting ends. Such descriptions....or, for that matter, any talk of science rather than of scientists tends to leave out all the fun, the passion, the excitement, the triumph, the disappointment, the emotional and the conative, not to mention the 'esthetic', the 'religious', or the 'philosophical' turmoil of the scientist's life." The title of my project may be long and technical, but what I actually do is plan reactions, run them, analyze the results, and usually try another reaction because the previous one did not work. There are plenty of frustrations in being a research chemist but many rewards also. When reactions work I celebrate, my laboratory mates celebrate, everybody celebrates. And if the whole project works out, I will take Walt Cygan, a 1977 IWU chemistry graduate now a graduate student at Minnesota, out to dinner. That is a promise. My sabbatical is exactly what I hoped it would be, immersion into chemistry. I attend seminars, and I spend a lot of time in the laboratory, getting my lab coat dirty and coming home smelling like an organic chemist.

I have given considerable thought to the importance of sabbaticals to professors at small colleges, and since I am presently on leave the consideration is even more immediate. Our new revised sabbatical policy opens with the following strong declaration— "The University's interest is best served by providing opportunities for all members of its faculty to continue to grow as inspiring and effective teachers and to continue to grow as scholars." Sabbatical leaves are one way to provide such opportunities. For some a sabbatical is an opportunity to complete a piece of scholarly work, for others an opportunity to continue ongoing work, and for still others an opportunity to re-enter an intense research environment and become sufficiently energized to maintain an active research program here. I place myself in the latter group. At the University of Minnesota I am heavily involved in research, and while I do not plan to become strictly a researcher, research is fascinating, and I plan to continue working here with students. In the university housing complex where we are living, there is a professor on sabbatical leave from his position in biology at a small college. He is primarily interested in research and is thinking about taking a research position at an institute associated with a large university and not returning to his faculty position. Our professional and

professorial philosophies are different. He likes research with little or no teaching, and I like teaching with opportunity for some research. That is why I choose to be at a small college. This afternoon (April 28) I gave another talk on campus. I described my work at Minnesota to a meeting of the American Chemical Society Student Affiliates, and I also outlined an idea that I have for a research project here. I hope this coming academic year to have students working in the laboratory with me on projects that I have conceived during this sabbatical. This ongoing research will add for me a new dimension to the joy of chemistry at IWU. "Unencumbered by crash programs, doomsday deadlines, malice, greed, the specter of Alfred Nobel, the appetite of war for the technology of death, and so on," and imbued "with the desire for elegance, the sense of wonder, the experience of mystery and the uses of inspiration," we will make compounds and run reactions.

I have talked about many different things tonight in these personal impressions, teaching, advising, and research. I have discussed my past, my present, and my plans for the future. In doing so I hope that I have shared with you some of the joys of chemistry.

NOTES

[1] "Science, Virtuous Villain" by John Leonard, *The New York Times Book Review,* April 9, 1978, p 3

[2] *Organic Chemistry, 3rd edition,* by Robert Morrison and Robert Boyd, p 3

[3] *Chemical & Engineering News,* August 29, 1977, p 48

[4] *The Psychology of Science* by Abraham Maslow, Harper and Row, 1966, p 148