CHEMICAL HERITAGE FOUNDATION

FOIL A. MILLER

The Bolton Society

Transcript of an interview
Conducted by

Arnold Thackray and John B. Sharkey

at

Pittsburgh, Pennsylvania, and Glenview, Illinois

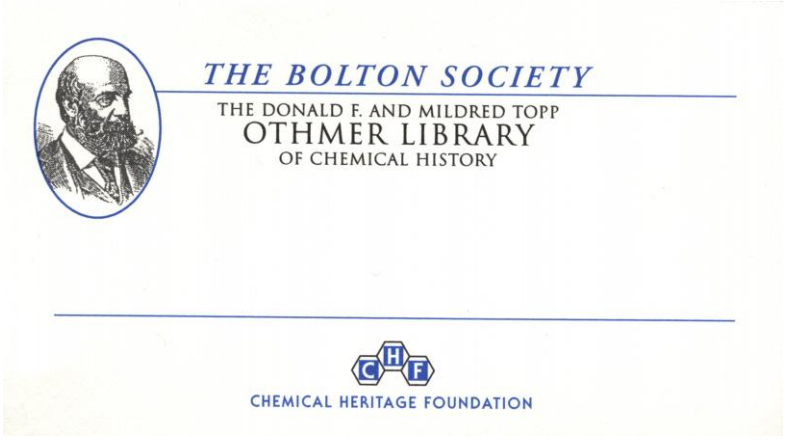
on

23 May 2001 and 28 June 2011

(With Subsequent Corrections and Additions)

ACKNOWLEDGMENT

This oral history is one in a series initiated by the Bolton Society, an Organization of Chemical Bibliophiles at the Chemical Heritage Foundation. The Bolton Society will, from time to time, record and publish the oral histories of collectors of works in chemistry and the molecular sciences including the various aspects of these disciplines: engineering, technology, history, biography, bibliography, philately, et cetera. The person or persons selected for such an oral history need not be a member of the society. The series documents the spirit and enthusiasm of the individual's collecting interests, rather than emphasize biographical details.



CHEMICAL HERITAGE FOUNDATION
Oral History Program
FINAL RELEASE FORM

This document contains my understanding and agreement with the Chemical Heritage Foundation with respect to my participation in the audio- and/or video-recorded interview conducted by Arnold Thackray on 23 May 2001 and by John B. Sharkey on 28 June 2011. I have read the transcript supplied by the Chemical Heritage Foundation.

1. The recordings, transcripts, photographs, research materials, and memorabilia (collectively called the "Work") will be maintained by the Chemical Heritage Foundation and made available in accordance with general policies for research and other scholarly purposes.

2. I hereby grant, assign, and transfer to the Chemical Heritage Foundation all right, title, and interest in the Work, including the literary rights and the copyright, except that I shall retain the right to copy, use, and publish the Work in part or in full until my death.

3. The manuscript may be read and the recording(s) heard/viewed by scholars approved by the Chemical Heritage Foundation subject to the restrictions listed below. Regardless of the restrictions placed on the transcript of the interview, the Chemical Heritage Foundation retains the rights to all materials generated about my oral history interview, including the title page, abstract, table of contents, chronology, index, et cetera (collectively called the "Front Matter and Index"), all of which will be made available on the Chemical Heritage Foundation's website. Should the Chemical Heritage Foundation wish to post to the internet the content of the oral history interview, that is, direct quotations, audio clips, video clips, or other material from the oral history recordings or the transcription of the recordings, the Chemical Heritage Foundation will be bound by the restrictions for use placed on the Work as detailed below.

4. I wish to place the conditions that I have checked below upon the use of this interview. I understand that the Chemical Heritage Foundation will enforce my wishes until the time of my death, when any restrictions will be removed.

Please check one:

a. ✓ **No restrictions for access.**
NOTE: Users citing this interview for purposes of publication are obliged under the terms of the Chemical Heritage Foundation Oral History Program to obtain permission from Chemical Heritage Foundation, Philadelphia, Pennsylvania.

b. _____ **Semi-restricted access.** (May view the Work. My permission required to quote, cite, or reproduce.)

c. _____ **Restricted access.** (My permission required to view the Work, quote, cite, or reproduce.)

This constitutes my entire and complete understanding.

(Signature) Foil A. Miller
Foil A. Miller

(Date) March 22, 2012

This oral history is designated **Free Access**.

***Please note*:** Users citing this interview for purposes of publication are obliged under the terms of the Chemical Heritage Foundation (CHF) Oral History Program to credit CHF using the format below:

> Foil A. Miller, interview by Arnold Thackray and James B. Sharkey at Pittsburgh, Pennsylvania, and Glenview, Illinois, 23 May 2001 and 28 June 2011 (Philadelphia: Chemical Heritage Foundation, Oral History Transcript # 0220).

Chemical Heritage Foundation
Oral History Program
315 Chestnut Street
Philadelphia, Pennsylvania 19106

The Chemical Heritage Foundation (CHF) serves the community of the chemical and molecular sciences, and the wider public, by treasuring the past, educating the present, and inspiring the future. CHF maintains a world-class collection of materials that document the history and heritage of the chemical and molecular sciences, technologies, and industries; encourages research in CHF collections; and carries out a program of outreach and interpretation in order to advance an understanding of the role of the chemical and molecular sciences, technologies, and industries in shaping society.

FOIL A. MILLER

1916 Born in Aurora, Illinois, on 18 January

Education

1937 B.S., Hamline University
1942 Ph.D., Chemistry, Johns Hopkins University

Professional Experience

University of Minnesota
1942-1944 National Research Council Postdoctoral Fellow in Chemistry

University of Illinois
1944-1948 Assistant Professor of Chemistry

Mellon Institute
1948-1958 Head, Spectroscopy Division
1958-1967 Senior Fellow, Independent Research
1967-1974 Adjunct Senior Fellow

University of Pittsburgh
1952-1964 Lecturer in Chemistry
1964-1967 Adjunct Professor of Chemistry
1967-1981 University Professor; Professor of Chemistry; Head, Spectroscopy Laboratory
1981-present Professor Emeritus

Philatelia Chimica et Physica
1997-2004 Editor

Honors

1957 Guggenheim Fellow
1964 Pittsburgh Spectroscopy Award
1965 Pittsburgh Award, American Chemical Society
1973 Hasler Award, Society for Applied Spectroscopy

ABSTRACT

Foil A. Miller begins the first interview, given about ten years before the second, by describing the origins of the Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy (Pittcon). Miller was involved early on with Pittcon and its two founding groups, the Spectroscopy Society of Pittsburgh and the Society of Analytical Chemists of Pittsburgh. In the 1950s, Pittsburgh had an active community of both academics and people from industry; this collaboration contributed to the success of Pittcon. Although the emphasis of the conference has evolved over time and reflects changes in the fields, it possesses a strong institutional history that allows for smooth transitions in leadership and administration. Miller outlines some of the changes in the field of instrumentation that he has observed during the course of his career and reflects on some of the key individuals in instrument entrepreneurship. Although Miller first came to Pittsburgh to work at the Mellon Institute, he later moved to the University of Pittsburgh where he taught in the chemistry department until his retirement at age sixty-five. After retirement, Miller indulged his love of travel and developed an interest in stamp collecting, particularly stamps relating to physics and chemistry.

Revisited ten years after the first interview, Miller reprises his description of the early Pittcon years. The newer interview has a slightly different—slightly more personal—focus, beginning with Miller's family background and continuing with a short précis of his growing up and selection of chemistry, especially spectroscopy, as a career.

Miller was born in Aurora, Illinois, but grew up in Pepin, Wisconsin, the only brother of five sisters. His class at school numbered seven. Though he had a very good English teacher, Mrs. Morris, he had no chemistry classes at all. His first exposure to chemistry, from *The Book of Knowledge*, bored him, but his high-school science teacher gave him a chemistry textbook, which he loved, and which thoroughly convinced him that he was destined for chemistry.

Miller entered Hamline University in St. Paul, Minnesota, as a chemistry major. The two chemistry teachers there were not good, but he persevered. He also had to work several jobs to supplement his scholarship. Miller then spent a year as a teaching assistant at the University of Nebraska, which had a good organic chemistry program. He wanted, however, to switch to physical chemistry, so he applied for and won the Chemical Foundation Fellowship at Johns Hopkins University. There he worked with Richard Lord, helping him build a Raman spectroscope and learning infrared (IR) spectroscopy. At about the time he finished his PhD he married Ruth Naomi Zeller. He taught a class in analyzing explosives. He found Joseph Mayer and Frederick Wiselogle excellent teachers after whom to model himself.

Next came two years as a National Research Council postdoc under Bryce Crawford at the University of Minnesota and then a position at the University of Illinois, where he taught physical chemistry, a job he loved. Technological advances in spectroscopy helped Harold Klug recruit Miller to the Mellon Institute. Miller had reservations about moving to Pittsburgh, but forgot them when he saw the new Baird double beam infrared instrument and the Cary visible/UV spectrometer, both with serial number one. He became Head of the Spectroscopy Division at Mellon and later Senior Fellow in Independent Research. He concurrently taught a course on spectroscopy at the University of Pittsburgh (Pitt). When Mellon Institute merged with Carnegie Institute of Technology in 1967 to form Carnegie-Mellon University, Miller transferred to Pitt and taught there until he retired at the age of sixty-five. He wrote a series of papers with William Fateley; he taught, for fifty-three years, a summer course at the

Massachusetts Institute of Technology; and with Dana Mayo and Robert Hanna, he wrote *Course Notes on the Interpretation of Infrared and Raman Spectra*. These notes were published after much revision and updating, but only after having been translated into Chinese for a course in China.

About the time of his retirement, Miller began collecting stamps concerning chemistry and physics. He is himself the subject of a cachet as a landmark scientist in analytical chemistry. He has been editor of *Philatelia Chimica et Physica* and, with Edgar Heilbronner, wrote *A Philatelic Ramble through Chemistry*. He has a number of different collections, including one of stamps on different metal foils. He has enthusiastic audiences for his talk, "Great Mistakes in Science," and he has written an article about mistakes on stamps.

Miller provides a number of general observations within the interview. He thinks that Raman spectroscopy is still going strong, but that infrared is leveling off. He believes that education should be difficult, and that not everyone needs a college degree; that education in grade schools is abysmal; and that teachers should learn their subjects, not theories of education. He laments the demise of the home chemistry set; he regrets the virtual techniques that permit students to avoid getting messy, techniques that prevent a real understanding of what students are doing. Miller says his most important award of the many he has received is his first, the Pittsburgh Award from the American Chemical Society. He enthusiastically discusses his many travels over the years, especially those with his sons. He has been to Africa, Nepal, Canada; and he has spent at least two nights in each of the fifty states and in fifty-two foreign countries.

Miller concludes his interview with his four necessities for a happy retirement: a year-round hobby (he still collects stamps and gives slide lectures about his travels); enough money to be able to indulge the hobbies; a companion (he and his wife had been married for sixty-five years before she died five years ago); and good health. As he told his doctor, Miller, now ninety-six, is "…shooting for a hundred."

INTERVIEWER

Arnold Thackray founded the Chemical Heritage Foundation and served the organization as president for 25 years. He is currently CHF's chancellor. Thackray received M.A. and Ph.D. degrees in history of science from Cambridge University. He has held appointments at Cambridge, Oxford University, and Harvard University, the Institute for Advanced Study, the Center for Advanced Study in the Behavioral Sciences, and the Hebrew University of Jerusalem.

In 1983 Thackray received the Dexter Award from the American Chemical Society for outstanding contributions to the history of chemistry. He served for more than a quarter century on the faculty of the University of Pennsylvania, where he was the founding chairman of the Department of History and Sociology of Science and is currently the Joseph Priestley Professor Emeritus.

John B. Sharkey is Professor Emeritus of Chemistry at Pace University in New York City. He received his BS (1964), MS (1968) and PhD (1970; under Seymour Lewin) degrees from New York University. At Pace he served as department chair, associate dean, and associate provost. He was elected a Fellow of Dyson College in 1985 and received the Keenan

Award for Teaching Excellence in 1988. He has been a member of the American Chemical Society (ACS) since 1969 and has served on the Committee on Nominations and Elections, the Society Committee on Education, the Board of Trustees for Member Insurance Plans, and the National Historic Chemical Landmarks Committee. He currently serves on the Board Standing Committee on Audits. At the Chemical Heritage Foundation, Sharkey is a charter member of the Heritage Council, representing the ACS, and the Bolton Society. Sharkey has been a long-time member of HIST, and is currently serving as the Division's Archivist. He also serves as Historian and Archivist for the ACS New York Section, and was Chair of the Section in 1987. Sharkey's research interests are in the history of chemistry. He was elected a Fellow of the American Chemical Society in 2011.

TABLE OF CONTENTS

INTERVIEWEE: **Foil A. Miller**

INTERVIEWER: **Arnold Thackray**

LOCATION: **Pittsburgh, Pennsylvania**

DATE: **23 May 2001**

THACKRAY: [Let us focus on] the origins of the Pittsburgh Conference [on Analytical Chemistry and Applied Spectroscopy (Pittcon) and its [early] years […]?

MILLER: Yes. [The start of the Conference] goes back to the fact that there were two active organizations [in Pittsburgh at that time, both of which] started in the '40s. The older [organization] is the Spectroscopy Society of Pittsburgh, which was an outgrowth of […] seminars that Mary [E.] Warga […] had organized. She was an emission spectroscopist [at the University of Pittsburgh (Pitt), and] performed a very valuable service during the War [World War II] by training […] atomic spectroscopists, who worked in the various mills around Pittsburgh. [Mary and the spectroscopists had] periodic meetings […]. Finally they organized—I think it was perhaps around 1946 […]—into the […Society, which held] annual meetings. The other group was the Society of Analytical Chemists of Pittsburgh [(SACP). They consisted of] analytical chemists [who had] started meeting in one another's [domiciles], because they felt that the local ACS [American Chemical Society] section didn't quite meet their needs. [The SACP was not] as social as […other groups. The SACP also] organized, and [held] annual meetings. In 1950, the two groups decided [that] they would combine their meetings and *that* was the [beginning] of the Pittsburgh Conferences.

THACKRAY: What […were] the employment [realities] that led to […] so many people [being] interested [in spectroscopy]?

MILLER: The heavy metal industry. The steel mills, the aluminum company […], and then, to a lesser extent, […] companies like Gulf Oil and Koppers Corporation. There was a big demand for analytical spectroscopy. For example, [if] an order of steel [is] placed by […] an automobile company, they will specify a certain composition for the steel—so much manganese, so much vanadium, and so on. This mixture is kept molten in an open-hearth furnace, […which is sampled. Perhaps, the mixers] will add […] a little more manganese ore to bring that amount up, but […] a number of quantitative analyses [are needed]. When [the analyses were] done by "wet" chemistry, it was a slow process, [which] cost [the mills] real money to keep [a] furnace full of molten steel [until the mixers] got the composition right. So that's when [the mills] started using spectroscopy.

THACKRAY: […How was that] driven […]? Large, well-established, older corporations aren't necessarily innovative in technique.

MILLER: I don't know how that happened in the steel industry. In the aluminum industry, […] H. V. Churchill […] was keenly aware of the need for […] rapid analyses. He was instrumental in having the so-called "direct readers" developed. Now, he didn't do it himself [in his research lab. It] was done by people like [Maurice F.] Hassler on the West Coast. In the steel industry, I don't know who […] was behind it, but I know that by the time I got here in '48, [direct readers were] a widely used practice.

You might be interested in knowing how […the companies managed this]. Evacuated glass tubes, about […] four to six inches long […], were [used. A tube was] held in a pair of tongs out over the molten bath, and then [its tip was] lowered to the surface. The glass melted and a sample of the […] melt was sucked up into the tube and […] solidified […. That tube was thrown] it in a […] bucket of water, [so that] the glass would crack off, [leaving] a metal rod. [The rod] was […] sent by pneumatic tube to the spectrograph. […] A man […] would saw the [rod] in two [to give] a fresh, clean cut. Then he would mount it in a spark holder. [In a dark room were the] spectrograph […] <**T: 05 min**> and […a man] who would change the film and take the exposures. […These exposures were developed—there were] a series of exposures […], usually by some kind of a [step]-sector arrangement. […The exposures were then taken to a third man who developed the photograph, and then the photograph went through the] densitometer.

[Now], densitometering was not a very satisfactory process, so in time they developed direct readers […. In direct readers], the receivers were [photon-capture devices that were mounted] at the slits where the [light from] each [element they were interested in] would come out of the spectrograph. That way, [a measurement] could [be taken] very quickly, […an analysis made], and then […] the composition of the mix [was doctored up. This process] cut the holding time down dramatically […]. Although it cost […] money to put in this [new equipment and to hire new people, the companies] saved money many times over […].

THACKRAY: [Let us go back to] the Pittsburgh Conference.

MILLER: All right […. The Pittsburgh Conference. The SACP and the Spectroscopy Society of Pittsburgh] decided to combine their meeting in 1950 and somebody—[Jack Anderson of Koppers]—had the brilliant idea of having an instrument exhibit [… in the future]. That was a stroke of […] good fortune because the instrument exhibit has been an important component ever since. […Because it had] been traditional for one of these groups to meet around the end of February, that's when they had the first meeting. It's been traditional to hold the meeting in the [late-February]/early-March [period] ever since then. [That] was a very unfortunate choice.

They should have picked a time when the weather was better. At that stage, they could have done [that].

To change [it now] would be almost impossible because convention centers have lined up their dates so far in advance that you can scarcely move a big meeting like Pittcon. We would interfere with the ACS fall meeting, [the FACSS (Federation of Analytical Chemistry and Spectroscopy Societies)], the Eastern Analytic Symposium, and so on. But that [first] meeting was held in Pittsburgh, and [for several years the meeting] stayed in Pittsburgh—it pleased [everyone] that the [initial] attendance was so good, as I recall, […] something like eight hundred. So they decided to have it the next year, and […] the next year, and so on.

THACKRAY: [Were you] actively engaged [with the first conference]?

MILLER: I was at the first one, yes. I don't remember whether I had a role in it. Anyway, I […] got into the [program] committee [very quickly], but I'm not sure which year that was. [I moved to Pittsburgh] in the summer of '48 and went to a couple of the society meetings. I'm sure I went to the spectroscopy one in '49 […]. I went to the SACP one in '49, and then I was certainly at the [combined meeting in 1950. That meeting] was held on the seventeenth floor of […the William Penn Hotel].

There are a couple of interesting stories […] about [the early Pittcon conferences]. The elevator was, let's say, 16 feet high and [someone] had a [crate] that was 17 feet long. How did [he get the crate onto] the elevator? [Well, he leaned it on its side. But] there was another [crate] that was too long to do that, [so] it was put on top of the elevator car. I talked [to] somebody who rode up with it. He was on top to see that it didn't fall off! [laughter] Wouldn't that be something?

Then, on one occasion, PerkinElmer [Inc.] didn't get a crate back after the Conference so they called the hotel. […] No crate [had been left at the hotel]. Several years later, [PerkinElmer] got a call from the hotel saying [that a crate] had [been] found […] in the basement of an elevator shaft when [the elevator was being] overhauled. […The crate belonged to PerkinElmer. It] had the company name on the side. *That* was [the missing crate]. How it got down there? Nobody knows. [No one] who *should* know knows. Why it wasn't smashed, I have no idea. [It's just] amazing to think [what] could be down […] there. **<T: 10 min>**

THACKRAY: […] Fisher Scientific [International, Inc.] was [in Pittsburgh. Were other companies] in Pittsburgh […as well]?

MILLER: […] Yes, there was Burrell Scientific [Incorporated]. […There] may have been some others. Fisher was a big supporter of the Conference. [At] the first meeting, [Fisher] had [about] three booths, [whereas] most companies […only had one].

THACKRAY: Was Chester [G.] Fisher visible in local scientific circles?

MILLER: Yes, but before that. I never saw him, [but], to my knowledge […], he was very active [through the War; he] would go to ACS meetings and so on. [But that] tapered off—maybe [he] had died—I'm not sure—by the time I got here [in 1948].

THACKRAY: [Fisher had] three sons […]. Were they visible?

MILLER: Not very. I knew Jim [James Fisher] slightly, [but he and his brothers] really didn't take part in the scientific side of things […].

THACKRAY: In […this] era, [the late 1940s], infrared was very […] important. What else [was very popular during this era]?

MILLER: The [conference] program was [split into] in two parts. One was atomic emission spectroscopy, and the other […], wet chemistry. Infrared was a small sideline. [Now that's] changed almost completely. Those two subjects [are now] a very small part of the Conference. As you go through the years, you'll find [that] the emphasis has changed. [When] gas chromatography came [in, it] was a [popular topic, followed by] other kinds of chromatography. Then, clinical chemistry, and now, various aspects of biochemistry or molecular biology [… are popular. Conference subjects mirror] what general research interests are, as far [as] they impinge on analytical chemistry.

THACKRAY: […Currently, there's] a very sophisticated, […] volunteer structure that carries memory forward […] in various ways. […] Was the development of that structure a matter of fierce […competition between members]?

MILLER: No. It started very early but there was never any doubt that it was a good idea as far as I'm aware [of]. There [were] two aspects of it. First of all, every chairman was to write a lengthy report on the activities of his committee, with such things as timelines, addresses of people you [had to] be in touch with, things that went well, things that didn't go well, and [things that] should be thought about [in] the future. Each committee [also] had a chairman-elect. The chairman was to keep [the chairman-elect] thoroughly informed of what was going on and what was being done—send him copies of all correspondence, for example—so that [the chairman-elect] would be well prepared to take over the following year. Between these two

[people], a big body of knowledge was accumulated—[…] experience—which was then passed down from one year to the [next, which was] very important.

THACKRAY: […The Pittsburgh Conference is a very extraordinary entity. It's extraordinary] that the chemistry and instrumentation community in Pittsburgh has been able to sustain it. […] That community must have changed a great deal over the years. [Can you tell me how the] community [has] changed?

MILLER: We went through a period when a number of large laboratories disappeared. The Westinghouse Research Laboratory, which [had] twenty-two hundred to twenty-four hundred people in it, [has always been] active in Pittcon. Gulf Oil disappeared. The Koppers Corporation Lab disappeared. U.S. Steel [Corporation] was cut way back. This meant that the number **<T: 15 min>** of potential committee people, the pool, was reduced […]. Now, this [loss was] partly made up by new companies and the growth of some other ones. Pittsburgh Plate Glass (PPG) […has] grown a great deal. The Bayer [Corporation] Labs are relatively new so that brought in a new pool of people. […] This has become a serious problem. Another thing is that the [Pittcon] jobs are taking a lot of time now, especially […for the chairmen]. So people are more reluctant to take [these jobs].

Then there's another thing. The companies in town used to take great pride in having their people involved in [the conferences], and they would, rather freely, give them time to do it, and often [give] secretarial help and that sort of thing. Now, with the current economy and the "sharp eye" on the bottom line, that's more difficult. Lots of people have to take personal vacation [days] to go to Pittcon, even if they're an officer. […] This has been a serious concern. Another thing is that the people who started the conference are pretty much thinning out right now. There are only a few of us [left] who were there the first year. […Thus], we have to keep getting a new pool of [young] people. That's pretty obvious. Fortunately, I think [we've] done quite well with that. We've had some very good additions in the last ten years or so. So I'd say we're holding our own. It's a steady state, but it's a matter of considerable concern [as well].

I'll mention one other thing in passing. Pittsburgh is one of the few cities in the country where Pittcon could have [been] started. It had a big pool of people interested in the subject and working in the field. It had [the SACP] and [the Spectroscopy Society, which] had a track record of holding their own meetings. The conditions were right [in Pittsburgh]. I suspect there aren't very many other cities in the country [that] could have met those requirements.

THACKRAY: [The devotion and hard work of people like you is reflected in the structure of Pittcon…].

MILLER: Right. […Pittcon has taken the effort to] make a provision for keeping on the "old-timers" in some way or another. If I wanted, I could still be very active on the program

committee. I just [feel that I am] not with it very much anymore and […] somebody else, who would be better at it, should have a chance.

THACKRAY: What […] role [does the] program committee [play]? [Does it act, simply, as] a "traffic manager," or is it more […]?

MILLER: No, it's more than that. When [Pittcon] started, [the committee] used to [find the] invited speakers and [organize the] invited symposia. [The ideas] originated [in] the program committee, [but the program] got to be too large to do that. So now [the committee invites] suggestions from attendees, as well as committee members, for invited speakers, and, particularly, for symposium topics. [The committee will invite] people to submit a […] proposed symposium with a list of potential speakers and the subjects they would deal [with]. The program committee takes […] all of these suggestions that come in and […] winnows them down to a manageable number. So, in that sense, I guess you'd say it's [like] a traffic-control system. The other thing [the committee does] is […arrange] all the contributed papers in sessions. That's a huge job. Then there's a meeting [at] which we decide what days of the week each of these [sessions are] going to take place. You have to look and see that you don't get two gas chromatography sections the same half-day and things like that. It's quite a complicated business. The program committee chairman has a big job.

THACKRAY: […] Is there a formal or informal structure of succession <**T: 20 min**> […]?

MILLER: There's nothing formal […]. The person who's going to be the [Pittcon president] for a given year appoints [his/her] committee chairmen […]. That's done at least two years in advance. For example, if I were to be [president] next year, I would have appointed the person who was going to be program chairman, and that person will be assistant program chairman this year. [The chairman gets] a year of training. But there's no guarantee that [from that] you'll go [on] to be treasurer […], be in charge of housing, or anything else. That is [at] random. Each president-elect [picks his own chairmen. We also work] three years in advance—this year, next year, and the following year […].

THACKRAY: If you […] look […] back before the Pittsburgh Conference […], into the '30s, […what big] changes [do you see] in analytical instrumentation […]?

MILLER: A big change [was in] the application of electronics […]. The next [biggest change] would be [in] the application of computers.

THACKRAY: [When did computers begin to have an impact]?

MILLER: Maybe [in] 1980. By 1985, [computers were] really big, but I think the [more] important [change] was the switch to electronics.

THACKRAY: Both of those things are, at least initially […], enablers of something that already exists. Within the different categories […] of analytical instrumentation […], if you were to […] characterize […] by [decade] as to [what was popular], how would that go?

MILLER: I'd say in the late '40s and '50s, it would have been the advent of infrared. Maybe [even] mass spec [mass spectrometry] at that time, then chromatography. Didn't that come in about '62 or so […]?

THACKRAY: Somewhere around there, because […] I know [that] when I was coming into the field it was very [popular].

MILLER: Very [popular], but, of course, the various forms of that came in over a period of ten [to] twelve years. [First it was] paper […] and gas chromatography, [then high-pressure] liquid, and so on […].

THACKRAY: What has dwindled?

MILLER: […] Wet chemistry is […] the main one. Emission spectroscopy [also] took a […] nose-dive, but it's coming back. [Well], a little bit. […] For example, the advent of ICP [inductively-coupled plasma] has revitalized [emission spec. Yes], wet chemistry [was] probably the main sufferer. Mass spec is not as important as it used to be. Well, wait a minute. I take that back. Let me change that to microwave. At one time it was thought [that] microwave might be pretty useful [for analytical purposes], but it hasn't turned out […] that way. NMR [nuclear magnetic resonance] has never caught on [big time] at Pittcon and [that's] been a little disappointing to some of us. They have their own meeting, [which is scheduled] pretty close to Pittcon's [dates], I believe.

THACKRAY: There's been a huge increase, especially in the very recent past, in the […] life **<T: 25 min>**sciences territories. […Has Pittcon addressed] those territories […]?

MILLER: [Pittcon is] trying hard. [It's] making a big push, now, to do that, because it's thought that this is a very promising area […]—a new area for analytical methods.

THACKRAY: […What's] the [obvious] competition [for] that?

MILLER: […] There are some [electro]-biology type meetings […]. I've sat in on a big discussion in one of the program committee meetings about what to do about this […]. Pittcon exhibits at various other meetings, trying to publicize [its] program. [Pittcon exhibitors] went to one [conference] and [found out that the people there were] totally unaware of Pittcon and what it's all about. […As an important feature in] next year's program, for example, there'll be several invited, [half-day] symposia on […] topics of [this] sort.

THACKRAY: What, apart from sheer growth in size, […do] you notice about change in Pittcon? [laughter]

MILLER: […] What I know is all tied to size. […] You can't hear everything you want to hear. You can't see everything you want to see. […] If you walk around the exhibits, spending one minute per exhibit, you can't see more than about three-quarters of [the show] in the [full] time the exhibits [are] open. It's just […] impossible. […Therefore] it's harder to browse […]. What else? […Yes], because of size, we [are limited to holding the conference in] fewer cities […].

THACKRAY: Has [the] size [of] the conference affected the core group who run it?

MILLER: No, I don't think so. It's my feeling that we've just about leveled off on [the] size. I don't think we're [going to] have [much more] significant growth. This year it dropped back [to] twenty-five thousand, which I think is the reflection of the poor economy. Interestingly enough, the exhibitors […] didn't feel badly about that, because apparently the people that [attended] were the people that had the authority to place orders[…]. The ones that didn't come were lower-level [employees].

THACKRAY: […] If we go back to infrared and Raman spectroscopy, how are those fields themselves faring with these changes?

MILLER: Let's take Raman first, [because it's] easier. I think it's booming. A while ago we were talking about changes in technology. [Of course], the advent of the laser [had] an enormous […] impact on Raman spectroscopy. There were [also] other things, like array detectors, that are important. So, [Raman is] doing very well. […] I would say [infrared is] treading water […]. There haven't been any really big changes since the advent of Fourier-

transform techniques. The next big [change] that I foresee is a tunable infrared laser, so you get rid of […] the spectrometer and have lots of power. That would be another giant step forward, but when it will arrive, I don't know […] <**T: 30 min**>.

THACKRAY: […When] you think about individual instrument entrepreneurs and inventive geniuses in those fields, Arnold [O.] Beckman is [a] name [that comes to mind]. What other names [do] you […also think of]?

MILLER: Howard Cary, Howard Malmstadt, and Jim [James] Waters. Although he wasn't an instrumental man, […] A. J. P. Martin certainly got two very important fields going.

THACKRAY: Two?

MILLER: Well, two kinds of chromatography: [paper and gas].

[END OF AUDIO, FILE 1.1]

THACKRAY: […We haven't touched] on your […] move to Pittsburgh, [to] the University, and how and why that came about.

MILLER: [I] came [to Pittsburgh from the University of Illinois, in 1948, to work at Mellon Institute because of Mellon's excellent facilities and a fine job offer. I moved from Mellon to the University of Pittsburgh rather unexpectedly. That move came about because I was offered the job of dean of science and mathematics at the University of Kentucky—it was a definite offer. [Kentucky wanted me to arrange for them to receive] some letters of reference [for] their file, just *pro forma*. […] So I did […]. I asked people at Mellon Institute to write for me, but then I [realized that] they [didn't] know anything about my teaching […].

I had been teaching a course at Pitt for many years, so I went to Ed [W. Edward] Wallace, who was the chairman of the Pitt chem[istry] department, [and] asked if he'd write such a letter. Just like that, he said, "[…] If you're talking about going out of town, can we [Pitt] talk with you?" […There was] an informal agreement [among] the [chemical laboratories in Pittsburgh] that they wouldn't rob one another, but [since] I was talking about going out of town, [Ed] felt that [the agreement didn't apply. Within] two days, [Ed] and the dean [whipped] up an offer that was better than the Kentucky offer, and I didn't have to move either [our] home or my lab. Mellon was very good [to me. Mellon] let me […] keep my group going […in a] lab there while I was building a new [lab] at Pitt […].

That's how] it happened. […] This was about two years after the merger between [Carnegie Institute of Technology] Tech and Mellon [Institute. In hindsight], it was a good […move], because [the combined chemistry department] was way over-staffed. There wouldn't have been enough [graduate] students to go around, so I benefited from cutting loose [at] that […] time. But I can't overemphasize how *good* Mellon was to me. They gave me space there for about a year, and […] a little budget, so that I could get services like glass-blowing, drafting, and that kind of thing done. It was very nice. [It] was a very happy arrangement. I [moved] to Pitt at a very good time. [Pitt was] getting a new building and […was] on [a rapid upward] incline […].

THACKRAY: […] Did you have a regular teaching [schedule at Pitt]?

MILLER: […] I told […Pitt] that [I wanted] to be a regular professor. In fact, when [I] applied for a grant, […] somebody at the granting agency said, "Do you plan to set up your own [institute] or department?" I said, "No, I want to work within the framework of the chemistry department." My feeling was to let somebody else do the administrative work, [so that I could] just stay with researching and teaching. I love to teach […].

THACKRAY: […] You came […upon your] formal retirement […date from the University and became] emeritus. Did you continue [to teach at Pitt]?

MILLER: I didn't teach [much, except for a] short, one-month course […]. It cost me about sixty thousand dollars to retire when I did. I retired at [the age of] sixty-five. The next year they put in an early retirement incentive program, which [enabled one to] get […half their salary]—I've forgotten the [specific] arrangements now, but it would have come to sixty thousand dollars. I had such a good time the year I retired that I don't regret it. I went to Nigeria [and] I […] had a trek in Nepal. My sons took me on a canoe trip up in northern Minnesota and Ontario […].

THACKRAY: Did you [continue your laboratory work after retirement]?

MILLER: I didn't keep a lab. I kept an office up until about two years ago. The department was very good [about] that. […Whenever the department got] a new chairman, I'd go to him and say, "You can have this [office] any time you need it […]. I would like about two weeks notice, so [that] I can clear out […." The chairman] finally called me **<T: 05 min>**, but I feel very fortunate. I've been treated very well. But I didn't do any teaching […nor] any lab work [after retirement].

THACKRAY: When you look at your own contributions to the field, what words would you use to describe [your contributions]?

MILLER: […] The research will be forgotten […. My most important contribution]—I think this is true of most graduate research—[…was] training students. I have been fortunate in having some very nice students […]—good ones […]. That's the main part. [Some] of my […] papers [will survive since I've] had [many] reprints [from them], but nothing [that's earthshaking] at all.

THACKRAY: [What are most of] your students [currently doing? Have they] gone into industry or academia?

MILLER: [Most have gone into] industry. A few [are] in academia, but not too many. One went to Brooklyn Poly [Polytechnic University] and then the University of Alabama. […] I had several [go to] what used to be the Bureau of Mines, [now the] Pittsburgh Energy [Technology] Center, and one to the Mobil Corporation. One went to what used to be National Lead—NL Industries now—one to Alcoa [Incorporated], and a couple of them [have] died. It's amazing. A couple [have] retired. [I am] very pleased to have had all of them.

THACKRAY: […] People in the field [admire you] as a critiquer of instrumentation, [someone] with suggestions and thoughts about [its] improvement and use, [as well as a] very reliable information source […]. Would you […] describe [yourself] in those ways?

MILLER: […] Only modestly. I'm not really an instrument man. I used instruments, [but that] was the science that I was most interested in. […] Beckman [Instruments Inc.] has a letter in [their] files [in which] I complain about [a] gear train [in one of] their instruments. After all those years of building gears, couldn't they do a better job? [laughter] One time, early on, I made a detailed comparison between […] the [PerkinElmer], Beckman, and Baird [Instruments, Inc., infrared instruments. It] really was straight from the shoulder. [It] didn't pull any punches.

[But] I don't think [that] I'm regarded as an instrument person at all. I'm just lucky that we had […] two [brand] new instruments at Mellon [Institute in 1948: a Baird double-beam infrared spectrophotometer and Howard Cary's first visible/UV instrument. Both were serial # 1. Mellon became] almost a pilgrimage place for people that wanted to see the instruments before they bought one […]. So we had lots and lots of visitors come through [to look at them].

THACKRAY: […] Where does stamp collecting [fit into all of this]?

MILLER: [Collecting didn't] come into […play until about] a year before I retired. It's been a hobby [of mine] since then. [It] keeps me off the streets! [laughter] I have a number of hobbies, but [collecting is] getting more [and more] important. I love to travel, but I can't travel much anymore. My eyesight isn't very good, among other things.

THACKRAY: […] The book that you co-published is a very extensive and ambitious formulation and, certainly, in a class by itself.[1] Where did the idea […] and the energy [for this book come from]?

MILLER: My […co-author, Edgar Heilbronner, lives] in Switzerland, [so] the Swiss Chemical Society came to him and asked [if he'd] be interested in writing a book of this sort. He had written another rather similar type of book on symmetry in chemistry. [It had] nice illustrations [and was] intended to be a lighter treatment **<T: 10 min>**. He said he'd be interested in [writing the book], but he didn't want to do it by himself. If he could get somebody to join him, then he would consider it. So he wrote [to] me. I knew him briefly from [my] sabbatical year [in Zurich from 1957 to 1958], but I […] was [not] a stamp collector [back] then. […Since the publishing of our book], we have written […] a couple of joint papers on stamp collecting and chemistry. [Anyway], he wrote and said, "Would you care to join me?" I wrote back […], "Yes, providing it's in English. I can't write in German." He said, "Of course it [will] be in English." So that's the way we got started and it was just a lot of fun. [Because it was fun], I got the energy to do it. All of the stamps pictured in [the book], except one […], belong to one or the other of us. […] We read each other's material and criticized it, both positively and negatively. [Neither of us had e-mail], so we each have a […] stack of correspondence that's thicker than the book.

THACKRAY: How long did […it] take [to complete the book]?

MILLER: Two and a half years. We started, essentially, from scratch. We divided up the subjects. Edgar wrote on some, [while] I wrote on the […others]. When you read the […] chapters you can sense very quickly which person wrote it. We have different styles. He was a wonderful person to work with. [He had a] great sense of humor and a lot of knowledge.

THACKRAY: Did you travel [back] and […forth] to [Switzerland]?

[1] Edgar Heilbronner and Foil A. Miller, *A Philatelic Ramble Through Chemistry* (New York: Wiley-VCH, 1998).

MILLER: Just once. Near the [completion of the book], I went over there for a week, met the editor, and […] worked with Edgar settling a lot of little, last-minute details, [but] that's the only time we talked [in person].

THACKRAY: What [kind of feedback have you gotten from] the book […]?

MILLER: [I've read] a number of reviews, which […], on the whole, [have been] pretty good. [We've] been pleased by that. I would say my main disappointment is the price [of the book]. I know it has to be expensive, but [that's] a shame.

THACKRAY: […] How well [has the book] sold?

MILLER: I don't [know]. There were one thousand copies published. If you look in [your copy], you'll see, on one of the first few pages, a block that has a number in it. I've seen numbers up around seven or eight hundred. [However], there may be […many] under that that haven't been sold, so I really don't know. I've [only gotten] one royalty check and that was quite a while ago.

THACKRAY: It was enlightened of the publishers to [want to create such a book], because it's obviously not the sort of book that the publisher [can make a lot of] money [from].

MILLER: […Yes], I think this was the editor's [initiative]. His name […is Dr. Volkan Kisakürek], and he has a Ph.D. in organic chemistry from one of the Swiss schools. I agree with you. I think it was nice [of him] to take on […that project. Recently, I read the] play that [Roald] Hoffman and [Carl] Djerassi wrote [which] was also published by the Swiss Chemical Society.[2] So [the Society enjoys publishing] these [types] of [works].

THACKRAY: [That play was] very […interesting. Are] you still actively collecting?

MILLER: Yes. […] I'm [also] editor of […*Philatelia Chimica et Physica*, a quarterly devoted to the hobby.[3] Each] year I write an article with [Russell Harvey] from England on stamps […relating] to chemistry and physics. [I'm still] collecting.

---

[2] Carl Djerassi and Roald Hoffman, *Oxygen* (New York: Wiley-VCH, 2001).
[3] See, for example, Foil A. Miller, ed., *Philatelia Chimica et Physica* 23(2) (Spring 2001).

THACKRAY: […] Do you have any criteria [for collecting] beyond [that the stamps have to focus on] chemistry and physics […]?

MILLER: No. In fact, [my criteria are] pretty loose. I'll take mathematicians […], certainly, [some] biochemists, [and] medical people. You often get [a wide variety, because] you have to buy a set to get a single stamp. […For example], a set [will be created which displays Nobel prizewinners including] biochemists, [M.D.s, or people] of that sort. So, [I have] very loose [criteria].

THACKRAY: How long have you been […collecting]?

MILLER: I started [around] 1980.

THACKRAY: […] You also have a collection of <**T: 15 min**> foil [stamps]?

MILLER: [Yes, stamps printed on metal foil]. […] It's a sub-set. I have another sub-set on [Alexander G.] Bell and the telephone; another […] on research universities; and another […] on minerals. [These are] not complete by any means, but I've got quite a few stamps.

THACKRAY: […] How is your collection organized […]?

MILLER: By country. […] It's a working collection, Arnold, [which] I […keep] in plain, old, Mellon Institute three-ring binders rather than buying albums, because [albums are too] specialized. You can [quickly] put more money [into purchasing] albums than you do in [purchasing] your stamps. I want to keep that to a minimum. […] I say it's a working collection, because I'm always pulling stamps out, using them in a paper, and then I [putting them] back. I've just written a paper on Nobel Prizes.[4] This is the [Nobel Foundation's] centennial year […], so I have a lot of interesting [pieces] about family relatives, how people heard about […their] Nobel Prize, and what they did with the money. […] Things like that that are not widely known.

[4] Foil A. Miller, "Nobel Prize in Science through Their First Century," *Philatelia Chimica et Physica* 23(4) (Summer 2001): 164-86; and Foil A. Miller, "A Century of Nobel Prizes In Science," *Chemical Heritage* 19(4) (Winter 2001): 10-11, 44-45.

THACKRAY: […] Are you publishing [that paper] in the magazine […]? What is the circulation of [*Philatelia Chimica et Physica*]?

MILLER: […Yes, we do publish those articles, and our circulation is about two hundred fifty]. We have about two hundred paying members, then we send [issues] to some libraries—[the] Library of Congress, for example. […] Two-thirds of the members are in the U.S.

THACKRAY: […We (the Chemical Heritage Foundation) could] give […] publicity to *Philatelia Chimica et Physica* [existence] if you would like.

MILLER: [That would be very nice].

THACKRAY: [If you look in the most recent issue of *Chemical Heritage*, you'll see that the ACS history division has a piece saying that they exist. We would like to do the same for you].

MILLER: That would be very nice. [Thank you…].

[END OF AUDIO, FILE 1.2]

[END OF INTERVIEW]

INTERVIEWEE: **Foil A. Miller**

INTERVIEWER: **John B. Sharkey**

LOCATION: **Glenview, Illinois**

DATE: **28 June 2011**

SHARKEY: Okay. This is John Sharkey speaking with Dr. Foil Miller at his home in Glenview, Illinois. I know that you were born on January 18th, 1916, in Aurora, Illinois. Can you tell me a little bit about your parents?

MILLER: My father, [Fred Allen Miller] was Canadian. He lost his mother, [Mary Adelia (Clark) Miller], when he was about ten or fifteen, and was raised by his father, [William Enoch Miller]. They were in rather poor economic circumstances. I know for two winters he worked in what they called the Shanty, which was […] a logging camp. One of them was up on the Wanapitei River; [the other was at Canoe Lake in Algonquin Park]. I don't recall the location of the other one. But, anyway, his job: he was fourth cook, which meant, essentially, peeling potatoes, but pretty tough for a young boy to be sent up there in the woods for the wintertime.

SHARKEY: Yeah.

MILLER: Then he started to work at a local general store and he expanded his ambitions and moved across Lake Ontario to Rochester, [New York], worked there, and then he moved to Dayton, [Ohio]. […] He was very footloose. I remember [he told me] that he was at a party some young people were having in Dayton, and a girl visited from Minneapolis, [Minnesota]. She had a book of pictures of the city of Minneapolis. He thought, "Well, that looks like a nice place. I think I'll go there." So he just moved there and took a job. Then he went from there to a small city in Minnesota called Winona, where he was the [salesman] for fabrics […] for a department store. That's where he met my mother [Bertha Milliren].

Now, my mother came from Pennsylvania Dutch ancestry. Her […] grandparents, [Samuel Milliren and Esther (Smith) Milliren], had [migrated] from central Pennsylvania to Pepin, Wisconsin, a little village on the Mississippi River. That was a pretty interesting experience—this was 1858. The family and several other families from the same village—it was Summerville in Jefferson County, Pennsylvania—had decided to go. So they appointed three young men to go out and make land claims, and they did. They went to the land office in Hudson, Wisconsin, and made their claims.

Well, during the winter, the family got rid of everything it didn't want to take, and they put their goods on a raft, and floated them down Redbank Creek to the Allegheny River, and then down the Allegheny to Pittsburgh, [Pennsylvania]. There were several children. They left one daughter back there, because she had been married, but everybody else came. In Pittsburgh, they got on the new boat that had just been built called the "Canada." It was the maiden voyage of the Canada, and it was going to St. Paul, [Minnesota], from Pittsburgh down the Ohio River to the Mississippi and then up the Mississippi.

Then it was interesting. I know they had some fowl with them, geese or chickens or something, and [my grandmother] gave birth to a baby on route. I've always been astounded. This family set off knowing that she was pregnant and that she [would give] birth on route…

SHARKEY: Wow.

MILLER: …to my uncle Milt, [Milton Samuel Milliren], whom I knew very well (he lived in the same village with us). Anyway, they got off the boat on the banks of the Mississippi, and ultimately claimed their land and built a house and lived there. I've never asked my grandfather where they stayed when they arrived. I've often wished I had. I just don't know where they lived for the months it took to build the house.

Also, they took to [farming] on what is now regarded as very poor soil. It was an old sandbar on the Mississippi River, and <**T: 05 min**> had they gone back in one of the valleys, the soil would be rich, and fine, and no rocks. Here it was sandy and dried up quickly and didn't have much nutrients. My father asked my grandfather why they settled there, and he said it was because of water. There were no pumps, no hand pumps in those days. There was a spring on the property, and that made it attractive to them.

SHARKEY: Now this was in Pepin, Wisconsin.

MILLER: This was in Pepin, yeah.

SHARKEY: Pepin, and were your sisters…you had five sisters [Ruth, Carol, Betty, Mildred, and Helen]?

MILLER: I had five sisters.

SHARKEY: Were they born in Pepin, Wisconsin?

MILLER: Yes, all of them.

SHARKEY: Wow.

MILLER: Well, one was [born] in a hospital. There was only one born in a hospital…

SHARKEY: Is that right?

MILLER: and that was in Winona.

SHARKEY: And it's amazing you said a little earlier today that, all but one are still alive, and…

MILLER: That's right, yeah.

SHARKEY: …in their eighties and nineties, wow. That's good bloodlines there.

MILLER: Yeah. One had diabetes, and that's what [ended her life]. Anyway, my mother remembers Indians coming to the door trying to trade a squash for a loaf of fresh bread. She was raised in Pepin. She went to business school, and wound up ultimately working in Winona. She was the chief secretary of J.R. Watkins of the Watkins Company, […] quite a well-known company there. She met my father in Winona, and they got married. So that's the family background.

[…] His work was as a traveling salesman selling sheet metal [ware]—[…] tubs and pails and boilers and setter cans and things like that, primarily used by the dairy industry. He traveled initially by railroad, and that's why they moved to Aurora, where I was born, because it was a railroad junction. Then my mother's mother died in Pepin, and left her father and a sickly sister. So my family moved back to Pepin to take care of them. They had a large house there…

SHARKEY: I see.

MILLER: Dad said he could travel out of Pepin all right, because the Burlington [railroad line] ran through there. After some years, […] he drove [a car] instead of taking the train, and, of course, it didn't make any difference at that stage.

SHARKEY: Now, in your high school, there were only seven students in your graduating class?

MILLER: Seven in the graduating class. [Initially], there were more than that, but the numbers [tapered] off. They stayed to work the family farm. That was the…this was in the [Great] Depression, […because] I graduated in 1933. That hit people pretty hard, so the numbers in the class just kept dwindling, and there were only seven [by graduation]. I think I'm the last one living […].

SHARKEY: Were there any teachers that had an influence on you at…in your…

MILLER: Yes.

SHARKEY: …high school.

MILLER: Yes, I was very fortunate [in having a superb] teacher of grammar and English. She, [Mrs. Morris], taught to us with the notes that she had from her college course. She was a disciplinarian, and drilled us. I could parse sentences to a "fare-thee-well." I've always been so grateful for having had her. I wanted to write her a thank you letter, but, unfortunately, she died in childbirth just a few years after I graduated. I never did that, to my great regret.

SHARKEY: What attracted you to chemistry?

MILLER: Accident. We didn't have any chemistry in our high school at all, but we had general science. The general science [teacher] came in [my] homeroom one day [and] came to me with a book. He said, "Here, Foil. Would you like to have this?" It was a high school [chemistry text] that some publishing house had sent him. He wasn't teaching it, so he gave it to me.

Now, I should back up. […] We had in our home an encyclopedia called *The Book of Knowledge*,[5] twenty volumes, [which I liked to read]. I think I got through volume nineteen. There would be a section on literature […] <**T: 10 min**> and then on mathematics, and then geography and science, and so on. I got [to] the chemistry part, and I thought it was so dull, that H_2O [and CO_2 stuff…]. But several years later, when the teacher gave me that book, I looked through it and I thought it was fascinating […]. So I decided to be a chemist [without ever having done any chemistry].

SHARKEY: Wow.

MILLER: And I have always thought I was cut out to be a chemist, because not only was that a handicap, but the chemistry staff where I went to college was very poor, and in spite of that, I still went on to graduate school.

SHARKEY: And that was at Hamline University.

MILLER: That was at Hamline, yeah.

SHARKEY: Hamline. I had never heard of that. I had to look it up, and it's a very highly rated university. It's tops in the…

MILLER: It's [Minnesota's first college…].

SHARKEY: Yeah.

MILLER: Yes.

SHARKEY: So you were very fortunate to go there, especially during the Depression.

MILLER: I certainly was. They made a real effort to help people stay in school. I got [several jobs] there. […] I opened and closed the [school] buildings. I opened in the morning and closed them up at night and swept the steps and that sort of thing. College was a great

[5] *The Book of Knowledge*, 20 vols. (Grolier, Inc., 1910).

experience for me. It was like opening whole new worlds. Here I came, a [green] country boy from a small school, and I was exposed to things that I'd never been exposed to before. It was a great experience.

SHARKEY: And you had some…you had some chemistry there, as well…

MILLER: I had…I was a chemistry major…

SHARKEY: Chemistry major.

MILLER: Uh-huh.

SHARKEY: Okay. Any particular teachers you remember there? Or…?

MILLER: I remember them for being so poor.

SHARKEY: Is that right.

MILLER: And I realized at the time that they were poor, but in spite of that I stayed with it.

SHARKEY: Then you moved on to…

MILLER: Well, let me give you an example of why they were poor. There were just two chemistry teachers. The lower one was a lady who taught me physical chemistry, but she'd never had calculus. I had had calculus, so I knew more about the subject than she did. I could understand more on…

SHARKEY: Yeah.

MILLER: …derivations and that sort of thing.

SHARKEY: Right. Then, I think you went to [the University of] Nebraska for a while, and then went…

MILLER: I went…yes…

SHARKEY: …to Johns Hopkins [University].

MILLER: Yes. That was interesting. I applied for a teaching assistant at, oh, about eight different colleges. In those days, they sent out the letters of acceptance around, let's say, April 1. I don't remember exactly, but there was a fixed date. So you would have them all in your hand at once. Well, Nebraska jumped the gun. They sent me it much earlier, about six weeks earlier with an offer and with a statement that, "Would I please respond right away."

So, I took it to my favorite physics professor [Kent H. Bracewell], and I asked him what to do. He said, "Foil, these are tough times." He said, "A bird in the hand is worth two in the bush. If [you] turn it down, [you] may not get another offer." So, he would…he suggested I take it. So I did. Well, I didn't tell the other schools, because I wanted to see what would happen.

SHARKEY: Sure.

MILLER: It turned out I got four or five other offers, too. But anyway, I went to Nebraska. And I'm very glad I did because they were good in organic chemistry. I got an excellent background in that. I was never afraid to synthesize things from my experience there, which gave me a nice niche in my field of spectroscopy because we made things other people wouldn't touch, and studied them. [Most] of these molecules [were] very interesting.

I spent a year there. Oh, incidentally, in that year—I've forgotten what I was paid now—but I paid roundtrip train fare for two trips, down in fall and back at Christmas, and back in spring. I paid my room and board. I bought a suit <**T: 15 min**>, and I had fifty dollars left over. I think I got six hundred dollars for the year.

But after a year, I decided that I wanted to go into physical chemistry, and they were not very good. I had a friend, [Carl Vestling], who was graduating from Hopkins, and was vacating a fellowship, [the Chemical Foundation Fellowship]. So, I thought I'll apply for that fellowship and see if I [could] get it, and I did.

SHARKEY: Right.

MILLER: It paid a thousand dollars a year, which was big money. What I didn't know was that I had to pay tuition out of it. So I didn't wind up as far ahead as I thought.

SHARKEY: And you became Professor Richard [C.] Lord's first graduate student.

MILLER: Yes.

SHARKEY: How did…was he new at the school?

MILLER: He was new. He had just come back from being a postdoc in Copenhagen, [Denmark]. He arrived in the fall, and during that year was when [I] selected [my] research director.

SHARKEY: Now his work was…he did a lot of work during the war, and was concerned with some…the early efforts on guided missiles…

MILLER: Yes.

SHARKEY: …as well as military applications of infrared radiation. Were you involved in that at all?

MILLER: No, not at all. Let me think what happened. I got my degree in '42. I stayed on [at Hopkins] and helped teach a course in analyzing explosives […]. Aberdeen Proving Ground, [Maryland], was near Baltimore, [Maryland], and a lot of people [who] were working [there came] and took this course. Then I went to Minnesota for two years, and then to Illinois. So [that is where] I was […] during the war.

SHARKEY: Oh, okay.

MILLER: I did some work on the Rubber Reserve Project when I was at Illinois. I [also] taught some [young Naval officers]…I've forgotten what the acronym was, but they were naval people that were going to go into technical work. I taught them physical chemistry.

SHARKEY: Okay. So at Hopkins, is that where you got introduced to infrared and Raman spectroscopy?

MILLER: Yeah, right, right.

SHARKEY: Okay.

MILLER: […] It was primarily Raman when I started. Infrared was very uncommon. Dick Lord built a Raman instrument. I helped him […] and I was the one that did all the [alignment and testing of it]. I also had the problem of making deuteral pyrroles, that is, pyrroles with deuterium in it in various ways—deuterium on the nitrogen, deuterium just on the carbons, deuterium in all positions—and getting their Raman spectra. [Near the end of my project—I think it was the spring of 1941—American] Cyanamid had built an [infrared] instrument at their labs. Dick […visited] them. He took my samples with him, and they ran [their infrared spectra]. That was my first exposure to infrared.

SHARKEY: Oh, okay.

MILLER: So I didn't actually do the experimental work on the infrared. But I had these spectra…

SHARKEY: So in the early 1940s, there were no commercial IR [infrared] or Raman instruments.

MILLER: [Adam Hilger Company in England] made a little […], almost useless [infrared spectrometer], but it had started twenty years or so earlier. That was the only thing on the market. There was nothing else. Every installation was homemade. There were perhaps a dozen or fifteen [infrared instruments] around the world, mostly built by physicists and mostly used for higher resolution spectra of small gaseous molecules like ammonia, and CO_2 […].

SHARKEY: Were there any instruments, of the early IR and Raman instruments, that you considered to be landmark instruments?

MILLER: Oh, yes. […] The first models of both the Beckman [Instruments, Inc.] and the Perkin-Elmer [Corporation infrared] instruments are such.

SHARKEY: Okay. How important to your career and intellectual approach towards chemistry were your professors in college and graduate school?

MILLER: Not so much in college, but certainly <**T: 20 min**> in graduate school. Yeah. I had some very good teachers. Took a course from Joe [Joseph E.] Mayer. Does that ring a bell?

SHARKEY: No.

MILLER: His wife was Maria Goeppert Mayer who got the Nobel Prize…

SHARKEY: Oh, yeah, sure.

MILLER: …in Physics [1963].

SHARKEY: Yeah.

MILLER: He was a very capable chap. Oh, yeah, they had a big influence. [A chemistry professor at Johns Hopkins named] Fred [Frederick Y.] Wiselogle had a big influence in setting a teaching example. My teaching style was modeled very much after the one he used.

SHARKEY: It seems when I was reading over your background, you were very fortunate to, number one, meet Professor Lord, who you remained friendly with for many years. And number two, that you were just getting into a field—infrared and Raman—that was just starting…

MILLER: Exactly, I was extremely fortunate in my timing.

SHARKEY: …that's just your timing was just perfect.

MILLER: Yeah, it certainly was. I have often said I had a wonderful career, which would be very hard to equal, I think.

SHARKEY: You…

MILLER: And coming back to Dick Lord, he was a very good mentor. We were warm, personal friends up until he died. I continued contact with his wife, [Wilhelmina (Van Dyke) Lord], and she died just a few months ago.

SHARKEY: Oh, wow, great. Wow. You then moved on to University of Minnesota as a National Research Council postdoctoral fellow with Bryce [L.] Crawford, [Jr.]. Did you continue your work in spectroscopy there?

MILLER: Oh, yes. Bryce was building an infrared instrument, and he had a Raman instrument. He had a spectrograph that had been acquired by his predecessor, George [C.] Glockler. It was a three-prism Steinheil spectrograph; just marvelous mechanical thing and lots of flexibility. You could change the telescope. You could change the number of prisms you used, and so on. But he was…he had a student, [Ronald J. Gledhill], who was building an infrared instrument. I worked with him a great deal.

Then I did a theoretical [study of] the vibrations of benzine with Bryce, a normal coordinate treatment. That was my first exposure to normal coordinates, and about my last. I was very glad to have a sampling of it, but I decided it was a losing proposition. There were many, many papers published on the subject, but that was the only one by me.[6]

SHARKEY: Oh, okay. Minnesota was known for mass spectrometry. It was Alfred [O.C.] Nier…

MILLER: Alfred Nier, yeah.

SHARKEY: Did you have any contact with his research group, or…?

MILLER: I knew Al, but I didn't have any real working contact with him. In fact, he was away most of the time at, I believe, Oak Ridge [National Laboratory] setting up the big mass spec facility. Was it K12 or…? Anyway, there was a huge collection of […] mass spectrometers. [They were called] calutrons—from California. The way I got to know him [there], if I remember rightly, […] was through the faculty club. I used to have lunch at the

[6] F.A. Miller and B.L. Crawford, Jr., "The Non-Planar Vibrations of Benzene," *Journal of Chemical Physics* 14 (1946): 282-92.

faculty club. Bryce Crawford was very good about taking me over and introducing me […]. So that was really my only contact with Al.

SHARKEY: Now did he build his own instruments as well, or were there…?

MILLER: Oh, yes. Yeah.

SHARKEY: He wasn't just using a commercial…

MILLER: There were no commercial instruments.

SHARKEY: No commercial mass spectrometers…

MILLER: No, not at all.

SHARKEY: Amazing. Well, I assume by this time you had decided to spend your professional career as a spectroscopist.

MILLER: Yes, definitely.

SHARKEY: Okay.

MILLER: I never thought of not doing it, until pretty late in my career. I thought at that stage that maybe I ought to change. I had a sabbatical, which I spent at the University of Arizona looking into solar energy, and seeing what the <**T: 25 min**> prospects were. I didn't [change fields]; I stayed in spectroscopy. I decided solar energy was awaiting some breakthrough discovery which would probably come unexpectedly, not by somebody working on that problem, but by somebody else. It would be an accident in effect, and [perhaps serendipitous]. I didn't want to do that.

Spectroscopy…on several occasions I had thought the field was getting ripe, and every time some new thing would turn up which would revitalize it. Initially, it was the introduction of chopped optical systems to avoid drift, thermal drift, of the room and surroundings. Then there was sample handling methods, the KBr pressed disk method and the frozen…idea of

freezing samples in a very dilute argon matrix, for example, [and] several more sampling problems like that. Then in came the Fourier transform, which…

SHARKEY: Right.

MILLER: …just revolutionized the whole field. In Raman spectroscopy, the advent of lasers and then the very fast array detectors […]. Well, before that, photoelectric detection replaced photographic detection. So […] periodically there were these revolutionary changes and they just kept me in the field.

SHARKEY: Right. Those early instruments were single beam instruments.

MILLER: Exactly.

SHARKEY: How did they…who came up with the idea, was it Perkin-Elmer for…

MILLER: Perkin-Elmer's…

SHARKEY: …the double-beam?

MILLER: …model 21 was the first successful double-beam instrument.

SHARKEY: Okay.

MILLER: No, that's not true. Baird [Associates, Inc.] built the first one. That was based on the instrument that Norman Wright and his colleagues built at Dow Chemical [Company]. We had serial number one of the Baird at Mellon [Institute]. It was marvelous. I couldn't get over how lucky I was that we could get a spectrum that was all plotted out […]; it was a tremendous step forward. Perkin-Elmer came out with their [model] 21 a few years later. That became a very successful instrument.

SHARKEY: Mm-mm. I remember using the Infracord…

MILLER: That's right.

SHARKEY: …where you had to change the paper halfway through, and change the grating, and its…

MILLER: Yeah.

SHARKEY: But it […gave beautiful spectra].

Were you married by this time to Naomi [Ruth Naomi (Zeller) Miller]?

MILLER: Yes. We got married […] just after I had finished my research, but before I was handed the degree. We got married in the fall of '41. Actually, I never attended a graduation ceremony where they award PhD degrees until many, many years later. My degree was handed to me through the grill of the registrar's office…

SHARKEY: Sure, yeah.

MILLER: …because I missed the spring graduation, finished up in the fall. Had my final oral in October […].

SHARKEY: I'm going to stop this for a minute, if I can figure out…

[END OF AUDIO, FILE 2.1]

MILLER: Now that's working right.

SHARKEY: Well, it seems to be working okay, because it's receiving the signal.

MILLER: Okay.

SHARKEY: I know we have power, so…. So now, 1944, you move on to the University of Illinois as assistant professor of chemistry.

MILLER: Right.

SHARKEY: Was this your first experience with teaching?

MILLER: Except for being a TA [teaching assistant]. I was…I did a little bit of that, and then I said I'd help teach that course on explosives…

SHARKEY: Right, okay. Now what courses were you responsible for at Illinois?

MILLER: It was essentially physical chemistry that the juniors take, first year…

SHARKEY: Oh, sure.

MILLER: …physical chemistry.

SHARKEY: Wow, okay. What book did you use, just out of curiosity?

MILLER: […] We used the book authored by [Worth H.] Rodebush who was the head of physical chemistry at Illinois.[7]

SHARKEY: Okay, all right. How did you like teaching?

MILLER: I love it. I miss that. When I retired, I missed it because I'm enough of a ham to enjoy it. What I didn't miss was […] two things: making up exams and writing research proposals. We put our [old] examinations at Pitt [University of Pittsburgh] in the library, so that all students would have access to them […].

SHARKEY: Yes.

---

[7] Worth Huff Rodebush and Esther Kittredge Rodebush, *An Introductory Course in Physical Chemistry*, 2nd ed. (New York: D. Van Nostrand company, Inc., 1938).

MILLER: …and that meant that I had to make new questions all the time. I don't like questions where all they do is just substitute a different number in an equation. I wanted questions that made them think a little bit. And that got very hard toward the end.

SHARKEY: Sure, oh, yeah. But you were, by this time, ready to make a career in academe.

MILLER: Oh, yes. Yeah.

SHARKEY: Did you start a research program there at Illinois?

MILLER: I started at Illinois. There had been a name…a man named [Arthur M.] Buswell. Buswell and Rodebush did […] early work on the near infrared. They had some equipment, mostly for near infrared, so I was starting to go through that and organize it. […] The Perkin-Elmer commercial [infrared] instrument became available. Speed [Carl S.] Marvel and Roger Adams were consulting for companies like DuPont [E.I. DuPont de Nemours and Company]. They saw these instruments […] there and what they could do, so they got an early model. They gave it to me, and asked me to run a service laboratory. We hired a lady that had some experience […]. Her husband [James L. Johnson] had come to Illinois to do graduate work […]. Her name was Agatha [R. Johnson].[8] She had done group frequency work there. She [was] a godsend. She brought a wealth of knowledge and know-how. So she would run spectra for the organic chemists […] and would […] interpret it. I would look over her shoulder and that's the way I got into [infrared group frequencies].

SHARKEY: Do you remember what those instruments were? Were they…

MILLER: Which models?

SHARKEY: …early Perkin-Elmer, you said?

MILLER: The Perkin-Elmer 12B. Their first one was 12A. Then…what was the difference? I think we started with a 12A, and then they added a drive mechanism that made it 12B […].

[8] She worked for American Cyanamid in Connecticut before her time at the University of Illinois and subsequently for the Upjohn Company in Kalamazoo.

Then they introduced Max [D.] Liston's breaker amplifier, which chopped the radiation and the detector was tuned to that…

[…] So that was a tremendous step forward. Then we got a strip chart recorder. Boy, was that a big advance.

SHARKEY: Oh, sure.

MILLER: There were [several kinds of strip chart recorders. I remember the] Leeds & Northrup and there was […] a Speed-a-Max—that was […] a Brown instrument. [It] was such <**T: 05 min**> a tremendous advantage to get a [printed record].

SHARKEY: Oh, sure. Did you receive support and assistance from the senior faculty at Illinois? You were just starting off….

MILLER: […] Not very much. In fact, they […] almost [derailed] me. There was a big drive […] all through the university to improve the teaching. […] I don't remember now how they were going to do it. Some of the senior chemistry faculty wanted me to take this on for the chem department. In that case, I would have been marked as an instructor/teacher rather than a researcher, and I'm sure I wouldn't have done very well in […] advancement. [The program was abandoned and I never] heard anymore about it, thank goodness.

SHARKEY: We're still debating that today. What…do you have any thoughts about education today? How students are being taught in college, especially?

MILLER: I've been away for thirty years, John, and I really don't. I have strong feelings about […] grade school teaching. I think it's a disaster. I think that what we need are better teachers, teachers who have majors in subjects rather than majors in education. I remember I had a grad student one time [John Nakovich, Jr.], who had been an education major. […] He was drafted and […] was in Vietnam for a number of years, and then came back and decided to go to graduate school in chemistry. He told me the only thing he learned in the education courses was that you should erase the blackboard up and down rather than horizontally so the chalk dust would go in the tray at the bottom.

SHARKEY: That's pretty good. So in 1948, you moved [to] the Mellon Institute for Industrial Research [in Pittsburgh, Pennsylvania], as head of the spectroscopy division. How did that come about?

MILLER: Well, another example of 'it's who you know and not what you know.' There was an x-ray crystallographer at Minnesota named Harold [P.] Klug, whom we knew [both] socially [and professionally]. I knew him at the university [and we often had lunch together…]. They were [members] of the [University] dance club, and we were also […].

[Klug] left and went to Mellon Institute to set up a department of chemical physics after the war. There were [many] new instruments becoming available. The [researchers] at Mellon wanted to have some available, […] but they didn't want to bother learning how to use them. So they decided to set up a department of chemical physics, which would have x-ray crystallography, spectroscopy, and electron [microscopy]. He was hired to be head of it […].

Harold Klug was looking [for a spectroscopist] and he remembered me and wrote and asked me if I'd be interested. Well, I really wasn't [because] Pittsburgh had a terrible reputation in those days, but I said I would come for an interview. I was really impressed. I was impressed because my predecessor, Alfred Marston, had acquired two important instruments: the first Baird double-beam infrared [instrument] and the first Cary visible UV [ultraviolet] recording instrument, serial number one in both cases. Our place was just a mecca for people that wanted to see these before they bought one. A steady stream of people coming through…

SHARKEY: Right.

MILLER: …to look at them.

SHARKEY: Wow.

MILLER: Well, Mellon was a nice place, a wonderful building, and I was really taken with it. My wife had taken our…Bruce [A. Miller] was a little baby then <**T: 10 min**>. She had gone to Baltimore to visit her folks while I was interviewing in Pittsburgh. I was concerned whether she would like it, and the Mellon people said, "Well, we'd be glad to pay her way […] here so she could look it over." She came up while I was still there, and looked it over, and they showed her around town a little bit, and we decided to [move there].

Now there's an interesting prelog to that. […] On my way to Baltimore, one of the early trips, I was riding the B&O [Baltimore and Ohio Railway], which went through Pittsburgh. We pulled in and stopped at the station, and I was right underneath one of the inclines, funiculars. I'd never seen one before, so I sat and watched. I quickly figured out how it worked. I said to myself, and I remember this very distinctly, "Foil, you'd never catch me living in a place where they have to use something like that to get around." Ten years later, there I was…

SHARKEY: I…was that the old Pittsburgh and Lake Erie station…

MILLER: Exactly.

SHARKEY: …right on the river?

MILLER: It was.

SHARKEY: I visited there a few years ago, because I'm a rail fan, and I love old railroad stations.

MILLER: Bruce thought you were.

SHARKEY: Yeah. What a magnificent station…

MILLER: Oh, yeah.

SHARKEY: That is…even today. It's a restaurant.

MILLER: Yeah.

SHARKEY: We took the funicular up to…

MILLER: That's the incline […], the Duquesne Incline.

SHARKEY: Yes. The Mellon…that was not a university at the time. It was strictly a research…

MILLER: No.

SHARKEY: …doing research…

MILLER: It was a research…

SHARKEY: …they were doing research for the neighboring industry, is that…?

MILLER: It was set up to show companies the value of research. It's the third oldest industrial research operation in the U.S. It was preceded by the GE [General Electric] labs, and I don't remember what the other one was. Interesting background: there was a man in Kansas who wrote a book saying that […] research would really be of value to industry, but [that] industry was reluctant to do it because they didn't know anything about it.

SHARKEY: Right.

MILLER: He therefore proposed that there be a department set up in the university where they would have people come from industry, work for say at least a year on some project of theirs. They [would] introduce students to this [practical] work. The findings would be the property of the company. The company would find this very worthwhile, and then would be willing to set up their own research laboratories. Andrew [W.] Mellon […] was trying to learn, I think it was French, and he had a person come in to teach him. This person somehow had that book. Don't ask me how. He loaned it to Andrew Mellon, and Andrew read it. He thought that it was a great idea. He convinced his brother [Richard B. Mellon] to […join him in setting] up Mellon Institute as a department of the University of Pittsburgh and it ran that way. It was wildly successful. In fact, it became too big and too much for a university. So they set it up as a separate organization.

SHARKEY: I didn't know that.

MILLER: And then, ultimately, gave it its own building.

SHARKEY: What was it like to live in Pittsburgh at that time with the serious air pollution? In October of 1948 there was the infamous Donora smog.

MILLER: Yeah. That was the only smog we saw. We moved there in July of '48. I remember […] the Donora smog very well, but we never saw any after that because they had put in regulations right after the war to burn treated coal. Then it turned out that natural gas was brought to the city, and almost everybody converted to that.

SHARKEY: Oh, okay.

MILLER: Also steam locomotives were replaced by diesels, and on the river diesel engines became used, so that all these things came together. They set up controls for the smoke and so the city improved dramatically. I never saw it in the old, dirty days <**T: 15 min**>. It really used to be fierce. If a man was going to an affair in the evening, he'd take a white shirt to work, and he'd change into that just before going to the affair because the one he was wearing would be dirty.

SHARKEY: Now was the steel industry in full production at that time?

MILLER: Yeah, when I was there.

SHARKEY: Was that contributing to the pollution?

MILLER: Well, it certainly did before these rules went into effect. There was no doubt about that.

SHARKEY: Yeah. That must have been a big change from Illinois and academe for you to be at the Mellon.

MILLER: Yes. But you know I just took it…never thought anything about it. It was different. But we had a lot of independence at Mellon. […] The arrangement was that we would work half time for other people in the Institute on an hourly charge basis, and then half time on our own work. The young people were doing graduate work. They were graduate students at Pitt, but I was directing their research. I also, after a few years, started teaching one course at Pitt—I taught every year. So it wasn't as big a change as it might seem.

SHARKEY: Do you remember the instrumentation that was available there at Mellon? It must have been…

MILLER: Oh, yeah, I've…

SHARKEY: …state of the art.

MILLER: …already described the Baird number one and the Cary number one. Then we didn't have any trouble getting equipment. When better ones came out, we got the series. We had the Beckman IR4, and the Beckman IR7, and the Beckman IR11, which was the far infrared. Later, Bill [William G.] Fateley succeeded me after I moved to Pitt, and he got one of the first Fourier transform [infrared] instruments. We got a Cary Raman instrument when they came out. So it was pretty good that way.

SHARKEY: Wow. In 1952 you wrote a forty-one-page paper on infrared spectra of inorganic ions with C. [Charles] H. Wilkins. That must have been a monumental undertaking.[9]

MILLER: It was.

SHARKEY: And especially inorganic. You know, a lot of people think IR [equals] organic.

MILLER: That's one reason it was so popular. […] Thousands of copies of that [reprint] were made and given out. Chuck Wilkins was one of the young people. He wasn't working for a degree. It was just a job for him, but he ran zillions of samples. For example, we went through the stockroom at Mellon and went […] through the stockroom at Pitt and got little samples from all…

SHARKEY: Just ran everything, huh.

MILLER: Yeah.

SHARKEY: Wow.

MILLER: Because we didn't know what we were going to find. It turned out that the [carbonate] ion is like a molecule, that phosphate ion is a tetrahedral molecule.

[9] F.A. Miller and C.H. Wilkins, "Infrared Spectra and Characteristic Frequencies of Inorganic Ions," *Analytical Chemistry* 24(8) (1952): 1253-94.

SHARKEY: I was going to ask how you joined the University of Pittsburgh, but Mellon…I can see how that happened now, because you were working with Mellon and they were already associated with Pitt.

MILLER: And Mellon had close ties with Pitt. We also went over and ate lunches at the faculty club. That was the closest good place to eat. So I got to know a lot of the faculty over there just on a social basis.

SHARKEY: Then you gradually became…well, assistant professor and then full professor at Pitt or…?

MILLER: Well, I was really an adjunct. In 1950 they had a man on the faculty, [Prof. Robinson], who was to teach quantum mechanics. He committed suicide. So they […] didn't have anybody, and they came over to the head of Mellon Institute, [Edward R. Weidlein], and asked if they could ask me to do it. He said, "Sure." So they did and I did it. I wasn't paid anything, as I remember, to fill in. Then, after that was done, they got somebody <**T: 20 min**> to do it.

But they asked me if I'd teach a spectroscopy course, and that was really quite an undertaking, because we had a laboratory with it. This was an evening course, because I could get away then. So, that went on for a good many years.

SHARKEY: You were professor of chemistry…well, from '67 to '81, you were professor of chemistry and head of the spectroscopy laboratory. Was that unusual in those days to be both a professor and head of a laboratory?

MILLER: Well, head of the laboratory was just a sales pitch to help sell me on the job. I was made what they called a University Professor, which meant I could get students from any department, and I did have one or two from physics. They were actually students who wanted to major in physics, but wanted to do molecular spectroscopy.

SHARKEY: I think it was around this time that you wrote a series of papers with W.G.…

MILLER: Fateley…

SHARKEY: Fateley, using the far infrared.[10] What information—I'm not that familiar with the far infrared—what information did that give you?

MILLER: Far infrared are low frequencies—[…] anything below two hundred wave numbers. There are some special kinds of vibrations that have these low frequencies. A simple one is a torsion around a single bond. They're interesting because they measure the height of the potential barrier for that twist. Ring molecules have puckering vibrations where the ring goes like this. Those have low frequencies. […] Then of course, if you have a molecule with heavy atoms like a bromine, […] or covalently bonded uranium, or any heavy metal [such as] mercury, there will be low frequency vibrations. The far infrared gives you access to [them].

SHARKEY: Now was that a different instrument or the same…

MILLER: Yes.

SHARKEY: …instrument…?

MILLER: It was a different instrument, because you had to use a different detector. If you were using a grating, that had to be a courser grating, and then the detector was what was called a Golay detector, not a thermal couple. The energy […] in these low frequencies is very low.

SHARKEY: Yeah, right.

MILLER: So we built our first far infrared instrument, had to build [it]. Later we had a commercial one.

---

[10] W.G. Fateley and F.A. Miller, "Torsional Frequencies in the Far Infrared-I. Molecules with a Single Methyl Rotor," *Spectrochimica Acta* 17 (1961): 857-68; W.G. Fateley and F.A. Miller, "Torsional Frequencies in the Far Infrared-II. Molecules with Two or Three Methyl Rotors," *Spectrochimica Acta* 18 (1962): 977-93; F.A. Miller and D. Bassi, "Infrared Spectrum of Methyl Azide-d_3," *Spectrochimica Acta* 19 (1963): 565-74; F.A. Miller and W.G. Fateley, "The Infrared Spectrum of Carbon Suboxide," *Spectrochimica Acta* 20 (1964): 253-266; W.G. Fateley, R.K. Harris, F.A. Miller, and R.E. Witkowski, "Torsional Frequencies in the Far Infrared-IV. Torsions Around the C-C Single Bond in Conjugated Molecules," *Spectrochimica Acta* 21 (1965): 231-44; F.A. Miller, D.H. Lemmon, and R.E. Witkowski, "Observation of the Lowest Bending Frequencies of Carbon Suboxide, Dicyanoacetylene, Diacetylene, and Dimethylacetylene," *Spectrochimica Acta* 21 (1965): 1709-16; F.A. Miller, W.G. Fateley, and R.E. Witkowski, "Torsional Frequencies in the Far Infrared-V. Torsions Around the C-C Single Bond in Some Benzaldehydes, Furfural, and Related Compounds," *Spectrochimica Acta* 23A (1967): 891-908; and W.G. Fateley, F.E. Kiviat, and F.A. Miller, "Torsional Frequencies in the Far Infrared-VI. Ethyl Chloride, Ethyl-1,1-d_2 Chloride, Ethyl-2,2,2-d_3 Chloride, and Ethyl-d_5 Chloride," *Spectrochimica Acta* 26A (1970): 315-22.

SHARKEY: Well, it's apparent that you love teaching, and you're back in teaching at Pitt, directing research and you're an active researcher. Do you have an overall philosophy of education?

MILLER: No, I don't think so, except that I thought it shouldn't be too easy. I think that not everybody should go to university or college. I think that there are some…we have lots of needs for good technical people like electricians, and plumbers, and roofers, carpenters, and so on. They don't need to spend the money and time to get a college education. For the people there, I thought it ought to be a rigorous experience.

SHARKEY: What is the—moving on to today—what is the current status of infrared and Raman spectroscopy?

MILLER: Raman, again, I'm not really with it. [I have been retired for thirty years].

SHARKEY: Sure.

MILLER: …but I do read a journal. Raman is flourishing […]…it's amazing to me. In fact, before I retired, it became as easy to get a Raman spectrum as an infrared, which just floored me [because that was] beyond my wildest expectations. Raman has continued to go very well. Infrared, I think, has leveled off. I can foresee a change that might make a tremendous difference in infrared and that is if we got tunable lasers so you could get rid <**T: 25 min**> of the dispersing element—prism, or grating, or interference plates. Just tune the grating and have lots of power. That would really be a big boost for infrared.

But I think at present there aren't many exciting things coming in. That's not quite totally true. There are array detectors now, so you can get the spectrum of an area of say a crystalline sample. But let's say a mineral, a rock, that you get, which has a number of different substances, you can get the spectrum of the whole array. So that's of interest to some people.

SHARKEY: Well, the Fourier transform was certainly a major…

MILLER: Oh, a major change.

SHARKEY: Wow.

MILLER: Oh, I tell you, I couldn't believe it. Just couldn't believe it.

SHARKEY: I remember…

MILLER: Interesting thing is that, essentially, [it is] going back to the single-beam instrument again. You could pair the sample…

SHARKEY: Exactly…

MILLER: …with different spectra.

SHARKEY: Yeah. Yeah. It's gone] full cycle from the single to the double, and now back to the single beam instrument. You remained as an adjunct senior fellow with Mellon even after it joined with the Carnegie Institute of Technology to form the Carnegie Mellon University. I believe that was 1967. How did these two institutions come together?

MILLER: Well, the Mellons had backed Mellon Institute and they wanted to get that off their shoulders. So, what do you do with an operation like that? Well, one obviously attractive idea is to fold it into a university. The logical thing would have been to put it in with Pitt, but the Mellons and the president of Pitt at the time, a man named [Edward H.] Litchfield, were on the outs. So they wouldn't do that. So the other leading university [in Pittsburgh] was Carnegie Tech. So they decided to merge the two and make Carnegie Mellon University.

SHARKEY: To what extent was the chemistry department at Pitt involved in research at the Mellon Institute and local industries, for example?

MILLER: Not much. They were pretty independent. […] They didn't have much influence of what [each other] did.

SHARKEY: Okay. Now, I didn't know about your long-term involvement with the MIT [Massachusetts Institute of Technology]-Bowdoin College summer courses in infrared spectroscopy. How did that start?

MILLER: In the late '40s, the instrument firms got concerned that there weren't going to be enough people [who] knew how to use their instruments. They could see their market being limited by that fact. So both Perkin-Elmer and Baird independently came to Dick Lord and asked him if he'd run a short summer course to train people in infrared—how to get spectra and what to do with [them]. He agreed to start such a course, […] and he asked me if I'd help him […].

I remember going […] to Boston, [Massachusetts], two or three weeks before the course started and [putting things together]. We had had correspondence, but we actually got down to the nitty-gritty then. So the first year, it was just one week, if I remember rightly. It was a roaring success, so the second year we gave the same week twice. We just duplicated it. Then there was so much material that we decided to make it two weeks on two different aspects. The first week would be on <**T: 30 min**> how to run the instruments, how they operated, how to prepare samples, and all the experimental aspects. The second week would be interpretation of the spectra. So that was a big success, and just went from there.

SHARKEY: Yeah. That continued for how many years?

MILLER: I stayed with it for fifty-three years. It's still running, although it's limping at this stage. They've given up the second week.

SHARKEY: Well, there's a website…I, just out of curiosity, looked up on Alibris[.com], your book, which you used in that course, *Course Notes on the Interpretation of Infrared and Raman Spectra*.[11]

MILLER: Yeah.

SHARKEY: You know, collector's editions are selling for two hundred and eighty-eight dollars.

MILLER: What?

SHARKEY: Yes. Currently, right now, on the web, Alibris.

[11] Dana W. Mayo, Foil A. Miller, and Robert W. Hannah, *Course Notes on the Interpretation of Infrared and Raman Spectra* (New York: Wiley Interscience, 2004).

MILLER: I don't think they're selling.

SHARKEY: Well, that's what they're for sale for.

MILLER: Oh, gosh.

SHARKEY: So that's a real collector's item.

MILLER: There's an interesting story about that. We didn't write this [book] until [near the end of my participation]. I resisted writing anything for a long time, because I said, "If we write it, we're going to be reluctant to change," and we'd want to keep modifying it. The course had changed remarkably over the years. But there was an invitation from China to give the course there, and they insisted on having a written text. It turned out they translated it in Chinese.

SHARKEY: Oh, sure.

MILLER: So we were forced to write it down at that stage. [We then gave the notes to the students, refining them each year. Finally] we put it in book form, three of us—Dana [W.] Mayo, and Bob [Robert W.] Hanna, and I.

SHARKEY: And I know from…

MILLER: And there's another interesting thing. This was about the time new methods of printing were coming in, electronic setting up, and so on. So the book came out and it had some terrible misprints, where we had some figures of arrows that might be boxes, and they got the experiments all fouled up, too. It had to do with [electronic typesetting], I think. So the publisher, who is Wiley [Interscience]…oh, we were really irked, because we checked against what we sent in, and what we sent in was correct. So they said they wanted to give out a little correction with each copy, a little pamphlet…

SHARKEY: Handout, sure.

MILLER: I said, "That is ridiculous. We spent hours transferring the information." I said, "If you're going to do that, I want a statement at the beginning saying that this was the fault of the

publisher or printer. The materials received by the authors was perfectly correct." So they […] printed the thing over again and did it right.

SHARKEY: Oh, wow. That was good.

MILLER: But it never sold very many copies.

SHARKEY: You still have a copy?

MILLER: I have a copy, yeah. I have a copy of each version. I [can] show you the corrected [versus] the erroneous one.

SHARKEY: I would like to see that. Now for many years, you were part of the ACS [American Chemical Society] Speakers Bureau. I'm sure you don't remember this, but I heard your talk, and it's probably the first time I met you, in Jersey City, New Jersey.

MILLER: Oh, did you. I didn't…

SHARKEY: Was it at St. Peter's or…it was probably a meeting of the Hudson-Bergen Section of the ACS, New York Section. You gave your wonderful talk "Great Mistakes in Science." How did that…how did you come up with that concept of…? How did you do the research for that talk?

MILLER: Well, […] all my career, I've tended to collect interesting stories […]. I was invited to give a talk at […] what is now Clarion University […], which is just north of Pittsburgh. It's part of the Pennsylvania state system. I was to be on, I think, some kind of an awards ceremony […] where there would be wives present. So my usual technical talk wouldn't have been appropriate. I got to wondering what I could talk about, and I hit on that idea <**T: 35 min**>. I've just been gathering stories [ever since…].

SHARKEY: Wow, that's wonderful.

MILLER: I really wish I had published it and probably never will now. It's so big now that to do it, and to check all the facts, and to get the citations would be a tremendous job.

SHARKEY: Yeah. Wow.

MILLER: I've given it hundred-fifty times, I think, and so I got my money's worth out of it.

SHARKEY: Absolutely, amazing. Well, I'm going to take a little break here […].

[END OF AUDIO, FILE 2.2]

SHARKEY: Foil, I know Arnold Thackray interviewed you in quite some detail about the Pittsburgh Conference. But…so I don't want to repeat anything on that, but one thing that I think is worth mentioning is that you told Arnold that the Pittsburgh Conference probably could not have started in any other town but Pittsburgh. I was wondering if you could elaborate on that?

MILLER: Well, there were two societies there, which had independently run their own conferences. So there was that massive background available. There was a good-sized pool of people who were interested in the field—spectroscopists and analytical chemists. Then the industries in town gave us good support in the early years. I think that combination probably could not have been matched anywhere else because of the concentration of the heavy metals industry, the aluminum industry, the Gulf Oil Company, Westinghouse [Electric Corporation]. There was a big pool of talent ranging over many, many subjects.

SHARKEY: What were those two societies?

MILLER: There was the Spectroscopy Society of Pittsburgh, and the Society of Analytical Chemists of Pittsburgh.

SHARKEY: Okay. It must have been very exciting to be there at the first organizing meeting in 1950. Did you ever dream the conference would turn into what it is today?

MILLER: Heavens no, none of us had that idea. We were all surprised.

SHARKEY: As you look back on the conference, what were some of the landmark instruments that were introduced over the years?

MILLER: Well, all the infrared instruments that came out were shown there. I'm not sure it was the first showing. That's true of the NMR [nuclear magnetic resonance] from Varian, [Inc.]. I've forgotten the number of the first…what the name of it, but that was shown there. Again, I think it might not have been the first showing, but it was an early showing. Gas chromatography was a big introduction. People realized right away how useful it was.

SHARKEY: Probably HPLC [high-performance liquid chromatography].

MILLER: It…definitely HPLC. I can't think offhand of any others.

SHARKEY: There's a lot of analytical instrumentation that's now moving into things like the genomics, and the molecular medicine, and other applications…

MILLER: Yeah, clinical medicine…

SHARKEY: …and clinical medicine. What role do you see infrared and Raman spectroscopy playing in the future?

MILLER: I don't think infrared will be so very valuable in that field, because it's a water-based chemistry. You take the water away from tissue, and you've destroyed a lot of things. Infrared doesn't do very well when there's a lot of water around. Raman is just the opposite. Water doesn't bother Raman. So people are doing things like imaging tissues now and taking depth profile on tissues. I think Raman will be important. I think it will exceed infrared in that.

SHARKEY: Does that have anything to do with magnetic resonance imaging?

MILLER: No.

SHARKEY: Nothing at all.

MILLER: Totally separate. Yeah. Magnetic resonance imaging, you're looking for the concentrations of a certain kind of nucleus, a proton, or a carbon 13, or N14, or whatever. With

Raman, you're looking for a given kind of bond, or molecule, or ion, some small vibrational unit.

SHARKEY: As an instructor of instrumental analysis myself for many years, I'm interested in your observations of how the teaching of <**T: 05 min**> analytical chemistry has changed over the years.

MILLER: I'm not a very good one to respond to that, because I never taught analytical chemistry or instrumentation. In fact, I'm rather surprised people come to me to ask me questions about instrumentation. But, certainly, there's a huge difference from when I was a student. We did titrations and we did gravimetric analyses.

SHARKEY: Yes.

MILLER: I must say they were fun. You really were using your hands and you could see the results […]. I'm afraid now, to many students, the instruments are just black boxes and they don't really know what goes on inside of them.

SHARKEY: Exactly.

MILLER: We were in a much happier position, I think. So that's one difference. I very much deplore the idea of a paper laboratory, or virtual laboratory. I think students should go through the experience of doing things with their own hand, dropping a beaker, breaking it, having to start over again. All these things have a lot of relevance, and I think have a lot to do with capturing students' enthusiasm.

Incidentally, one other thing, which is an aside, is the disappearance of the home lab, chemistry laboratory. That started so many people on…

SHARKEY: Yes.

MILLER: …careers in chemistry.

SHARKEY: Absolutely.

MILLER: Now they're watered down, and not very popular anymore.

SHARKEY: I know in my own school, in the general chem lab, the titrations are done now with computers, and…I mean you have a burette, but the computer is counting the drops and you press a button, and you get the titration curve. You press another button, you get the first derivative, and the second derivative. The problem is that very often they don't work. The students are totally unprepared for taking titration data and making a plot. So it's…I have very, very mixed feelings, myself, about the trend.

This past semester in instrumental analysis, we were doing FTIR [Fourier transform infrared spectroscopy], and…of some compounds. You compared the spectra to your library, and it tells you what the compound is. So you don't have to know anything about what the peaks are. You just compare it to the reference library and it's, "Oh, this compound is so forth." So…

MILLER: Oh.

SHARKEY: I don't know. Getting back to the Pittsburgh Conference, I was particularly interested in the philatelic cachets, as a fellow philatelist, and I know you were involved for many years with that.

MILLER: Yes.

SHARKEY: Did all of that start with Ed [Edwin S.] Hodge?

MILLER: Ed Hodge originated that. He and Bob [Robert E.] Witkowski designed the first one, I think. It was such a success, it's just kept going ever since.

SHARKEY: I think that was 1976.

MILLER: I don't remember.

SHARKEY: Now where did you get to know Ed and Bob?

MILLER: Mellon Institute. I hired Ed, actually. He was our emission spectroscopist.

SHARKEY: Oh, I see.

MILLER: So, we've been good friends for many, many years.

SHARKEY: Yes, I know.

MILLER: And Bob, also, worked with us. He worked in the infrared laboratory while he was a graduate student. He got his degree in geology, actually.

SHARKEY: And they were both stamp collectors, I know.

MILLER: Yes.

SHARKEY: You must have been very proud when one of the philatelic cachets was issued in your name, as one of the…

MILLER: Oh, I was flabbergasted…

SHARKEY: …landmark scientists in analytical chemistry.

MILLER: I was just flabbergasted […].

SHARKEY: Oh, I think you're underestimating your contributions. How did they…so what was your role in the cachet program?

MILLER: Well, sometimes I was chairman of the philatelic committee, but [it] rotated around <**T: 10 min**>. There were only a few of us [who] were stamp collectors that were the logical people to do it. […] I was on the program committee for years and years and years. Finally, I decided that that wasn't appropriate any longer. I had retired and was not as [informed] as I should have been. I thought somebody else, younger […], should [take my place on] the program committee. So then I went over and spent full-time—and by that I mean during the week—I was full-time at the philatelic booth.

SHARKEY: Right. How were the subjects chosen for those cachets?

MILLER: Pretty casually. […] Several of us would turn in lists of possibilities and we would talk about them. Usually at the wrap-up or kickoff meeting, we would have a little sub-meeting and settle it there.

SHARKEY: Well, I'm […] glad to see that the program is still in existence.

MILLER: It's still going, but there's really only one person continuing it now, and that's Roy Backer. He collects stamps, but only modestly. It's one of many of his hobbies. But he's asked year after year […] to be the chairman of [the Philatelic Committee]. I helped him for a long time [until] I moved here[…]. He tells me who he's thinking of having, and I sometimes proofread material he […] writes.

SHARKEY: Do you have a complete set of those cachets?

MILLER: Yes.

SHARKEY: Some of those…

MILLER: I had two, and I gave one to the Pittcon office. So I think I have only one now, but I have most of two. The early cachets are hard to find now…

SHARKEY: The early ones, yes.

MILLER: …which is not surprising. There's no organized market for them. You don't have a single place to go and look.

SHARKEY: Moving on to another topic, to the Chemistry [and Physics] on Stamps Study Unit, [in] which we both have been very active for many years, I believe that study unit, as part of the American Topical Association, started with Richard Gratton.

MILLER: Gratton.

SHARKEY: How did you become involved with the unit?

MILLER: Somehow Ed Hodge learned about it. I learned from him, so that's the way. I don't know how Ed made the contact. I suppose Gratton contacted some people. I just don't know. Bob [Robert E.] Witkowski was also a member, so Ed, and Bob, and I, all working in the same Institute, […] used to get together at lunch and talk about things like that.

SHARKEY: Do you remember the first article you wrote for *Philatelia Chimica [et Physica]*?[12]

MILLER: Might have been on naming the elements. I'm not sure.

SHARKEY: No. It was a two-part series on spectroscopy in stamps.

MILLER: Okay […]. That's right.

SHARKEY: I just read it last week, prior to coming here. And it was a wonderful two-part…

MILLER: It's out of date now…

SHARKEY: …article. Well, you have to get it up to date. I was amazed and I'm always amazed at the interesting bits of information that you include in your articles. Where do you get this information?

MILLER: I just collect them over the years from my general reading. You know, things like *Physics Today* and *Chemical and Engineering News* will have interesting articles and I clip them out or photocopy them.

[12] Foil A. Miller, "Spectroscopy on Stamps. I. The Techniques. II. The Electromagnetic Spectrum and Its Interaction with Matter," *Philatelia Chimica* 3(2) (1981): 33-42.

SHARKEY: I know one of your major projects has been the publication with Edgar Heilbronner of *A Philatelic Ramble through Chemistry*,"[13] that was in1998. How did that book come about?

MILLER: Edgar was approached by the editor [M. Volkan Kisakürek] of *Helvetica Chemica Acta* to write a book of that sort. Edgar [and Jack D. Dunitz] had written one on symmetry <**T: 15 min**>, […] which was kind of a light-hearted approach to the subject.[14] I think the editor liked that, so he asked Heilbronner if he would write a book on stamps. Heilbronner said, "Well, yes, but not unless [I can] get somebody to help […]." So he wrote me and asked, and I said, "Yes, I'll do it, if it's in English, but not if it's in German, because I don't know German." He said, "Of course it'll be in English."

Then, initially, I misunderstood the nature of it, and I wrote my initial section and he wrote back and said, "I think we're writing […] two different books here." So I got back on the rails at that stage and we went on from there. It was a very happy collaboration. He was a great person. He had very good knowledge of English, including colloquial English, and good sense of humor.

SHARKEY: As I recall, you couldn't get a publisher in the United States. You had to…

MILLER: We never tried.

SHARKEY: Oh, you never tried.

MILLER: No, because the Swiss people had approached him, and so we did that [commitment…].

SHARKEY: Okay. Well, it […] is a beautiful book.

MILLER: I thought they did a marvelous job in reproducing it.

SHARKEY: Oh, it was wonderful, wonderful. […] Any plans to update it?

---

[13] Heilbronner and Miller, *A Philatelic Ramble through Chemistry*.
[14] Edgar Heilbronner and Jack D. Dunitz, *Reflections on Symmetry: in Chemistry—and Elsewhere* (New York: VCH, 1993)

MILLER: No. No. [Heilbronner's] gone now.

SHARKEY: Oh, he is.

MILLER: Uh-huh.

SHARKEY: I didn't know that.

MILLER: And I would be reluctant to take on a project that would be pretty large.

SHARKEY: […] I was not aware that you had an exhibit called "Foil on Stamps on Foil."

MILLER: Uh-huh.

SHARKEY: How did you put that exhibit together? These are all stamps, postage stamps, on foil.

MILLER: On metal foil.

SHARKEY: On metal foil.

MILLER: Right. How did I happen to do that? Well, there was an exhibit somewhere—and I can't recall where—I was looking for titles and I had accumulated a few such stamps, so I just got the idea of doing that. I'm still keeping it up to date as much as I can, but it's getting tough to find some of them. There have been stamps on copper foil that I don't have. There's one on bronze foil, presumably. Those are the two metals I don't have and one or two more on aluminum […].

SHARKEY: One of your major contributions to our journal [*Philatelia Chimica et Physica]* is the annual review of new science stamps.

MILLER: Oh.

SHARKEY: Where do you get your information on new stamps?

MILLER: I look through *Linn's* [*Stamp News*] and *Scott Stamp Monthly*. *Linn's* combined the two recently, so I don't take the weekly *Linn's* anymore, just the monthly-updated new issues. I wasn't getting much information out of the *Linn's* anyway. So that's where I get it. I get a great deal of help from a lady in Vancouver named Gwen Prout. She's very good about sending me information through the year […].

SHARKEY: Oh. Now how do you purchase new stamps?

MILLER: I get most of them through Bombay Philatelic.

SHARKEY: Bombay?

MILLER: Yeah, do you know them?

SHARKEY: Yes, I do. They used to be down…

MILLER: Used to be in Florida.

SHARKEY: Near Nassau Street, where I still work.

MILLER: Oh, really.

SHARKEY: Yeah, New York City.

MILLER: I didn't know that. Then they went to Florida, and now they're in Wake Forest, [North Carolina], or someplace in Carolina.

SHARKEY: I didn't know they were still in existence. Okay.

MILLER: […] The reason I go with them is [that] they have a good Web program. They illustrate all the stamps in a way that it's easy to get at. […Their lists come] out every two weeks. So I take, say, the June 1 to 15 [one]. That has all the countries [listed] alphabetically, and I look for the title of a [pertinent] stamp. Now I depend <**T: 20 min**> on the title, so I can sometimes miss some, and then you can view [the stamp], and […] buy it if you [wish].

SHARKEY: I see.

MILLER: Then [the stamps] are also listed by country, so if I learn elsewhere that there's a stamp from Guinea […], I can go to Guinea and look down that [list to] see if they have it. Now, they don't carry everything. There are a lot of small countries that put out issues whose validity is questionable. They're not listed in *Scott*. Bombay doesn't seem to carry many of them. Unfortunately, there are a lot of them that have things of interest to [me…]. The other place I get new stamps is from Herrick [Stamp Company].

SHARKEY: How do you spell that?

MILLER: H-E-R-R-I-C-K. It's a big outfit. But they're…

SHARKEY: Are they in Britain?

MILLER: […] No, [in] New York [State].

SHARKEY: New York.

MILLER: New York State. They have big ads, full-page ads in *Linn's*. It's a big outfit. But their program is not as easy to use as Bombay's. They do have some things Bombay doesn't have, however. The big problem is going back two or more years and getting [older] stuff. Herrick's keeps it until it's sold out, and then they don't have any more.

SHARKEY: I see.

MILLER: So it's a problem for me if I want to get something, say, in 1987. […] I really don't know where I'd go right now.

What do you do, John?

SHARKEY: Well, I try to order some stamps, the Marie Curie stamps this year from Spain, the new…celebrating her hundredth anniversary of the Nobel. I went onto their website, and it's all in Spanish. So it was impossible for me to order any stamps. Our friend, Miguel Fortea, sent me some.

MILLER: Oh, good.

SHARKEY: Because he lives in Spain, but…

MILLER: Yeah, that's Barcelona.

SHARKEY: It's very difficult to deal directly with the post office, especially for those countries where they're not speaking English.

MILLER: Yeah, right. Well, they're so scattered. There are so many of them, it doesn't work very well. That's why I [use] a dealer [like] Bombay [who] gathers them together. [It] is a big help, even though you pay a little premium.

SHARKEY: Yeah. How do you organize your collection of…?

MILLER: By country.

SHARKEY: By country.

MILLER: That's because it's what I call a working collection. I'm, all the time, removing stamps, using them for an article, and then putting them back. If I file them by subject, I would…well, some of them fit more than one subject, for one thing. So I find the best thing is to do is by country. But I don't have any order within the country, they are not chronological […]. I just put them in [in] the order in which I get them […]. I save money [by using] three ring notebooks and quadrille paper.

SHARKEY: I'd like to see that later…

MILLER: Yeah, I'll show you. It's not a handsome collection, but it's usable.

SHARKEY: How about covers? Do you still collect covers?

MILLER: I have a lot of covers. Yeah. I don't know why, because they're in a shoe box. I have to get them down, and go through them. You know, you can't display them like you can display a stamp. Incidentally, I have some sub-collections on other things. You mentioned metal foil. I have one on the sizes and shapes of stamps, which I find quite interesting, from the little tiny ones up to the biggest one from Mongolia.

[The shapes of stamps start with triangles, which can be equilateral, isosceles, or scalene. Four-sided stamps can be a square resting on either a side or a corner; a rectangle, either horizontal or vertical; diamond shaped; rhomboid; or trapezoid (a truncated triangle)…]. <**T: 25 min**> Then you go to five sides, six sides, and […] eights.

Then I go to rounds and semi-rounds, and ovals and semi-ovals. […There are some stamps with unusual patterns or proportions]. Gibraltar has one with the outline of the rock—terrible […] to tear those [apart…]. Then there are what I call free-form […]. By that, I mean, just stamped […] into any form [wanted…]. They started way back in the '60s or '70s. Remember the banana stamps?

SHARKEY: Yes.

MILLER: And then there were a whole series of anvils and watches and stars, and…

SHARKEY: I think you wrote an article on these…

MILLER: Yeah, I did.

SHARKEY: …different size stamps.[15]

[15] Foil A. Miller, "The Sizes and Shapes of Postage Stamps," *Philatelia Chimica et Physica* 27(2) (Spring 2002): 86-106. A shorter version can be found in *Topical Time* 53(5) (September/October 2002): 37-47 and 53(6) (November/December 2002): 6 (Errata).

MILLER: But that's quite a lot of fun. Then, I have another collection of beer on stamps. This strikes me as humorous because I don't like beer. I don't drink it. But there are quite a few stamps on that.

SHARKEY: Where do you think the hobby of philately is going today?

MILLER: I think it's going to level off at far less popularity than it used to have. I think the young people now don't like that kind of activity. They go for video games and that sort of thing, iPods, and so on. So, there will always be some [collectors], but I don't know whether one [is] going to get his money out of a collection. I don't go into it with that expectation. I regard it as a hobby and a pastime.

SHARKEY: Right. One of my favorite articles that you've written has been on mistakes in stamps.[16] That must have involved a lot of work to, first of all, find the mistakes. There can't be too many mistakes.

MILLER: Yeah. Some of the mistakes I stumbled on myself, not too many. Others I heard about from one place or another. I think every stamp collector is pleased when he can find a mistake.

SHARKEY: Oh, absolutely.

MILLER: Put pie [on] somebody else's face.

SHARKEY: You've received many honors and awards over the years, most recent being chosen as the 2009 Distinguished Topical Philatelist by the American Topical Association. Is there one honor that stands out above all the others that you have received?

MILLER: Oh, let me say first of all, that last one you mentioned was a total surprise. I was really flabbergasted. I have to thank my friends […] for doing that. I had no idea this was in the wind. Now, is there one I…I suppose maybe that would be at the top of the heap. That or the Pittsburgh Award of the ACS. I guess that one's high because it was my first award.

[16] Edgar Heilbroner, C.S. Kettler, Foil A. Miller, and Svi Rappaport, "Chomical Errors on Chemical Stamps," *Philatelia Chimica et Physica* 12(2) (Summer 1990): 33-64.

SHARKEY: Yeah, wow.

MILLER: That was done back in the days when they did them right. You wore tuxedos at the event, and it was a high class affair.

SHARKEY: We're almost finished […].

MILLER: Oh, that's…

SHARKEY: How are you holding up? Okay.

MILLER: I'm fine. […] I'm enjoying this.

SHARKEY: You were introduced as the unit secretary treasurer of the stamp group in 1981 as follows, and I quote, "He has just returned from a mountain-climbing trip to Nepal, not a mean feat at age sixty-five." Wow, that's some trip for a sixty-five-year-old.

MILLER: I'm glad I went then <**T: 30 min**>, because I wouldn't have been able to do it much later. I had a brother-in-law [H.R. Fishback] who turned sixty-five […], and retired the same year. He loved the mountains, so he proposed we do this. That's the way I got into it.

SHARKEY: Now, sixty-five today is a pretty young age to retire at. Do you have any regrets about retiring so young?

MILLER: No. I had a wonderful time. In fact, it cost me about sixty thousand dollars to retire then, for the following reason: if I had waited a year, the university put in a retirement program…

SHARKEY: Incentive?

MILLER: …incentive program, which would have given me an extra sixty thousand. I don't have any regrets, because I had such a good time. […] I did three major things. My sons

organized a canoe trip up in the Canadian boundary waters. I went to Nigeria, served as an outside examiner there—the only time I've been in West Africa. What was the third one? Oh, the Himalayan trip. So they were major events.

SHARKEY: Wow, and you couldn't have done them unless you were retired.

MILLER: Unless I retired, that's right. So that's […] why I say I don't have any regrets.

SHARKEY: Now, you've mentioned several times about, over the years, your love of travel. Why has traveling been such an important part of your life?

MILLER: I don't know, but I started it quite early. My father used to take me with him on his business trips. He had as a territory, southern Wisconsin, southern Minnesota, and northern Illinois. He'd be gone one to three weeks. So in the summertime, he would take me with him for, say, a week. I guess, maybe, that's where I got started.

He was very good to travel with. We'd pass a cheese factory, and he'd say, "Let's stop here and see how they do things," or some other kind of factory that…we did things that were fun. So I always enjoyed it very much, and I still do. […]Not many things I enjoy more than getting in a car in the morning and setting off on a long trip. [One thing I regret is I don't think I'll get abroad anymore].

I've been very lucky, incidentally, in that my sons go with me, just great, particularly, my younger son [Craig Miller] who is retired. He and I have very similar tastes on travel, and we've gone at least once a year for many, many years. We've taken twenty or twenty-five major trips together. Bruce, too…Bruce is still working, so he can't get away as much. But the last trip…well, this last weekend, they took me up to Milwaukee, [Wisconsin]. The last lengthy trip we had was when he drove me down the Skyline Drive [in Shenandoah National Park] a few years ago.

SHARKEY: Oh, yeah.

MILLER: And that was a lot of fun.

SHARKEY: So what have been some of your memorable…most memorable trips?

MILLER: Well, I'm asked that a lot, and I'll give you two answers. One applies to wildlife, and that would certainly be going to East Africa. I've made two trips, one to Kenya, and one to Tanzania and Zanzibar. I've also seen a lot of it in the Republic of South Africa. But the Kenya trip in particular was rewarding, because it was a camping trip. It was really great.

Then as far as human things [are concerned], my trip to Egypt would be tops, I think. Now, these are colored a lot by the guides you have and the weather and things like that. It was a very well-organized trip. It was three weeks. It was led by a lady who was a professional archeologist, and was very well organized. We started in Cairo and went to the Cairo Museum [of Egyptian Antiquities]. Then we went down to see the earliest part of Egyptian history, the area around the pyramids and Memphis and so on.

Then we came back to Cairo, and went to the museum, and studied the exhibits on Middle Egypt. Then we went down to Luxor, Valley of the Kings, and <**T: 35 min**> [Valley of the] Queens. Then we took a boat trip down to Aswan and went down to Abu Simbel. Then we came back to Cairo and looked at the sections on Copts and Muslims. Then did that part of Cairo, and a big mosque and Coptic churches and so on. So it was a very logical sequence done in a long enough period of time so you could do it justice.

SHARKEY: Yeah. So it seems to be the history…

MILLER: The history part…

SHARKEY: The history…

MILLER: I wanted to see the origin of Western civilization. I went to Greece after that. I enjoyed it, but it wasn't as good as the Egypt trip. And then I have been to many countries in Europe. I've been to, I think, fifty-two countries, spent at least a night in them. I don't count stopping in an airport to refuel or change planes.

SHARKEY: Right, right.

MILLER: I've also been to all fifty states, spent at least two nights. You know what's the hardest one to get, Rhode Island.

SHARKEY: I was going to say Alaska.

MILLER: Because it's so small. I drove up to Boston and to Maine for almost fifty years. I often went through Rhode Island, but you know you're through it just like that.

SHARKEY: That's right.

MILLER: Finally, my wife and I spent a couple [of] days […] at Newport, [Rhode Island...]."

SHARKEY: Right, okay. You mentioned that you're still presenting travel log slide shows of your trips. You've made almost four hundred presentations. That's absolutely amazing.

MILLER: Right, that's something I do.

SHARKEY: That's a lot of work.

MILLER: People don't realize how much work it is to prepare one of those. But, well, it's fun though, because it gives me [a reason] to look [at these slides] that I probably wouldn't do if I didn't have that motivation.

SHARKEY: Right. I know you're a member of the Bolton Society of the Chemical Heritage Foundation.

MILLER: Unfortunately, a pretty inactive member.

SHARKEY: Are you a book collector as well?

MILLER: Not really. No.

SHARKEY: So, it's through your stamps, I guess.

MILLER: It's through the stamps I did that. Yeah.

SHARKEY: How did you become associated with the Chemical Heritage Foundation? I know you spoke there once, because I […] heard your talk.

MILLER: Yes, I did. How did I? I don't [know]. I […] subscribed [to their] magazine back in the early days. It just kept going [from that].

SHARKEY: Something that I should have asked earlier, because it's come up: what advice do you have about balancing one's career versus your own personal interests?

MILLER: It's awfully nice to combine them.

SHARKEY: Yes, it is. It is.

MILLER: I think you ought to spend some time on your own personal interests. I think if you don't do that, you become too narrow an individual.

SHARKEY: Yes. Well, many people have thrown their entire lives into science, and the personal side has suffered.

MILLER: Yes.

SHARKEY: Many, many examples…

MILLER: That's right. I've seen it in some people…led to divorce in one case I can think of. It's a shame to ruin [lives] like that.

SHARKEY: You've been retired now for thirty years…

MILLER: Yeah, isn't it amazing.

SHARKEY: I've just retired this month.

MILLER: […] I offer you my very best wishes, John.

SHARKEY: Thank you.

MILLER: If your retirement is one-tenth as good as mind, you'll be very happy.

SHARKEY: Well, you mentioned four things that make for a happy retirement. I wonder if you can remember what you told me?

MILLER: Sure. Sure, I remember. You don't want me to [repeat] it, do you?

SHARKEY: No, but maybe you can share it for our listeners, because…

MILLER: [First], good health is important. [Second, you should have] at least one hobby that can keep you happily occupied, and this should be something you can do year around, not just playing golf or gardening, which you're shut out of for [part] of the [year. Third], enough money so that you can indulge yourself a little bit; you're not always worrying, can I do this <**T: 40 min**>? Can I buy that? [Fourth], it's awfully nice to have a companion.

SHARKEY: Right. I agree. Well, I think I have all four of those, so I look forward to…

MILLER: Oh, you're real fortunate…

SHARKEY: …a very happy retirement.

MILLER: Yeah. This fall would have been my seventieth wedding anniversary. My wife will have been gone five years then. So, I count myself fortunate that I had sixty-five years with her.

SHARKEY: Well, my last question, Foil, you're now ninety-five: what are your plans for the future?

MILLER: Well, I told my doctor I'm shooting for a hundred.

SHARKEY: Good for you.

MILLER: My plans are to try to stay reasonably healthy and active. I think my main risk is my eyesight. My vision is not good. I had expected to spend a lot of time reading after I retired. I find I can read about half an hour and then I'd like to do something else. I've had to give up birding, because I can't identify small birds anymore and that was a hobby that I enjoyed very much.

So, let's just say I plan to hang in there, do the best I can. I am trying to get things organized so that […] when I go, it'll be as easy as possible for my sons. One of my serious concerns is what to do with the stamp collection. Do you have any thoughts on that?

SHARKEY: My wife keeps reminding me, what are all those binders and what am I going to do with them? So, no, I don't have a solution for that. That's…

MILLER: I would like to get rid of it myself rather than leaving it to my sons, because they don't really know how to…they're not stamp collectors. Yet they urge me to hang onto it. They say, "Dad, you're still using it. It's a nice pastime. Keep it as long as you can." I think they're right on that.

SHARKEY: Yeah. You're still active. You're still…

MILLER: Still active.

SHARKEY: Writing for the journals, that's a very good point. Well…

MILLER: This has been a lot of fun, John.

SHARKEY: Thank you very much, Foil.

[…] It's a great honor, and I'm so glad I got out here to have this interview with you.

MILLER: It's very kind of you to spend the time and effort to make it. I can't believe that the information will be of any interest to anybody, but it's been fun for me, anyway.

SHARKEY: And it's been fun for me. Thank you very much.

[END OF AUDIO, FILE 2.3]

[END OF INTERVIEW]

INDEX