Education as the Organizing Principle Behind the Oral History Program at the Chemical Heritage Foundation

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The Oral History Program (OHP) at the Chemical Heritage Foundation (CHF) has been collecting and preserving oral histories of scientists for nearly thirty years. While much of the content of each oral history is technical, these oral histories reveal the relationships, stories, and human motivations that remain hidden within science. Science needs to be something the public can, and should, appreciate; yet, American students often lack an understanding of scientific careers. By targeting scientists as interviewees, the program offers a unique product which can easily be utilized in education: a document rich with scientific knowledge and with knowledge about science and scientists. For the CHF, the educational sphere is a large one, encompassing science education, public understanding of science, and academic research. Reaching all of our audiences requires constant repackaging and repurposing of the oral histories. Each educationally-geared use of oral history brings the OHP one step closer to making oral histories and science part of America's everyday vocabulary. With the program's focus on making the oral histories useful through education, these documents become interactive, personal, and engaging, allowing science to have a voice off the page. In this paper, we trace how a focus on education has provided new opportunities for educational outreach and internal organization. We also look at the continued efforts of the OHP to understand and reach diverse audiences.

The Oral History Program (OHP) at the Chemical Heritage Foundation (CHF) has been collecting and preserving oral histories for nearly thirty years. Since its inception, the CHF's OHP has been an anomaly in the oral history world in two ways: its interviewees and its strong and continuing focus on transcription. As part of an organization dedicated to the history of chemistry and the chemical sciences, the CHF's oral histories have focused on scientists, oftentimes those in the American

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chemical industry generally or in a specific discipline such as mass spectrometry, polymer science, or technical and information systems. Many of the oral history interviews concentrate on pioneers in these fields, "big names" of chemistry that may not be well-known outside of the sciences. The OHP at the CHF is a decidedly transcription-based program, and, historically, these oral histories have existed as bound copies—blue, hardcover books on the CHF's Othmer Library shelves. Additionally they have existed as research tools; they are not only edited for clarity, but careful attention is paid to full names of institutions, people, and places, and each oral history has a well-developed table of contents and an index. Much of the content of each oral history is technical and heavy with scientific phrases and jargon; a mention of a scientific paper, a book, or even a movie garners a footnote.[2] Many oral histories contain appendices, with figures, pictures of the interviewee, and/or scientific instruments. With a collection that boasts over 400 completed oral histories, it is a gem of the Chemical Heritage Foundation.[3] Seemingly, though, it has been underused, given the wealth of information within the pages: very few publications have been written based on oral histories conducted for the CHF.[4] What's more, the oral histories have been absent from student-oriented events begun recently at the CHF, as well as the CHF's podcast and blog. These research tools have only recently been viewed by the OHP staff and the CHF more broadly as a means to bring science to a wider audience. The Oral History Program's outlook on oral histories—and the program itself—had to change to bring this valuable resource into the educational sphere.

For the CHF, the educational sphere is a large one. When we refer to education within this paper, we focus on three types: science education, public understanding of science, and academic research. This three-pronged view of education provides the CHF with certain opportunities, but also with certain challenges. By targeting scientists as interviewees, the program can offer a unique product: a document rich with *scientific knowledge* and with *knowledge about science and scientists*. Each oral history can be used for many different purposes, including, as we have done traditionally, as a tool for academic researchers, but also

[2] Oral histories pre-2007/2008 contain a "Notes" section instead of footnotes.

[3] The collection continues to grow. The OHP conducted 26 interviews and completed 22 oral histories in 2010; thus far in 2011, the OHP has conducted nearly 20 interviews and has completed approximately 30 oral histories.

[4] For example: J. S. Gravenstein, Michael B. Jaffe, David A. Paulus, *Capnography: Clinical Aspects: Carbon Dioxide Over Time and Volume* (Cambridge: Cambridge University Press, 2004); Peter J. T. Morris, *The American Synthetic Rubber Research Program* (Philadelphia: University of Pennsylvania Press, 1989); Eric Roston, *The Carbon Age: How Life's Core Element Became Civilization's Greatest Threat* (New York: Walker Publishing Company, 2008); L. B. Slater, "Instruments and Rules: R. B. Woodward and the Tools of Twentieth-Century Organic Chemistry," S*tudies in History and Philosophy of Science Part A* 33 (2002): 1-32.

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as a way to increase scientific understanding among the general public and as a means to give science a human face and a human voice. Potentially, these oral histories can reach all of the CHF's diverse audiences. However, the groups that could be targeted by the OHP educational programming are quite different in age range and interest. What's more, these groups are often not attracted to the same types of programming—from scholarly papers to online exhibits, the OHP has had to determine whether there existed a catchall type of programming that could appeal to our audiences.

A new museum and commitment to public programming, along with a new website, sparked interest in bringing oral histories to new audiences. As Allesandro Portelli argues, oral history interviews are so much more than mere question and answer sessions, but "a work of relationships; in the first place, a relationship between the past and the present, an effort to establish, through memory and narrative and the written or audiovisual form of the historian's product."[5] The CHF oral history collection details and uncovers the relationships, stories, and human motivations that remain hidden within science. The OHP developed in its own right, beginning as a group that collected oral histories as a tool to strengthen ties with the chemical industry, and then transitioned to an organized program that created materials for academic researchers and, subsequently, to one that is also engaged in oral history as a means of sharing stories of the human side of science with a wider audience. But this transition was not without its problems. Our collection did not lend itself smoothly to the development of online exhibits, to publications, and to educational programming due to several factors. First, the collection of oral histories has traditionally undergone liberal editing of oral history transcripts into an almost memoir-like document. For example, interviewees were permitted to edit their documents after the interview to correct grammar, delete/add passages, etc., without any notation to the reader that such changes had been made. Thus, many oral histories appeared less like a conversation and more like a streamlined, edited document. Coupled with other factors such as a fast staff turnover and a lack of a collection plan or processing manual, the resulting collection was a miscellaneous assortment. To create cohesive projects from a seemingly unorganized collection required the OHP to focus initially on two things: what the collection contained—both in terms of projects *and* themes—and the potential audiences. The OHP's plan included crafting its oral history processing philosophy, making sense of digital records, digitizing audio and text, and "tagging" the oral histories themselves by grouping them thematically. Only when these tasks were achieved could the OHP move into successful program development.

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[5] Alessandro Portelli, "What Makes Oral History Different," in *Oral History, Oral Culture, and Italian Americans*, ed. Luisa del Giudice (New York: Palgrave MacMillan, 2009), 21.

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In this paper, we trace the new opportunities the Chemical Heritage Foundation's Oral History Program created through a focus on education, including the expansion of the collection beyond the library shelves and into classrooms with digital programming. We also look at the continued efforts of the OHP to understand and reach diverse audiences—high school and college students, teachers, researchers, and science-minded members of the public—and its evolving view of what oral histories as part of education means to the OHP at the CHF. Surveying the ways in which the OHP achieved its goals to insert oral history into educational and public programming highlights the difficulties that can arise in making such a move, but it also demonstrates the beneficial results of such endeavors.

1. Moving Towards Cohesion

The OHP at the CHF is almost older than the organization itself. Although founded in 1982, the first oral histories had already been conducted beginning in 1979. After the first handful of interviews, the organization began regularly collecting oral histories of chemists starting in 1983. Since then, interviews have been conducted every year with a wide variety of individuals, for example, Nobel laureates, leaders of the chemical industry, and renowned academics. From what our records tell us, what unifies these individuals is that they were all involved in some way in the chemical sciences. Some individuals were recorded because of the interest of a specific interviewer, some because of national prestige, some as the beginning of larger projects, and some based on the interests of outside parties.

Prior to 2007, interviewee selection was arbitrary, often without a larger historical research question. While the history of science and history itself became more inclusive, for example, with the development of social history over the past thirty years, the CHF oral history collection remained opportunistic, typified by a focus on the fame of the individual with little thought to diversity. In this way it differed from much oral history which tried to give a voice to those without one in the official historical record.[6] While the pre-2007 collection remains a rich resource for many aspects of the history of chemistry and its related sciences, the experiences of women and minorities remained largely ignored. In our over thirty years of conducting and processing oral histories, much has changed, but many of the challenges we face today as a growing twenty-first century oral history program stem from decisions made decades ago.

In a world before social media and the Internet, the oral history program at the CHF was library-based with a focus solely on transcription. However, no norms

[6] Donald A. Ritchie, *Doing Oral History: A Practical Guide* (New York: Oxford University Press, 2003), 23.

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were in place to govern the process of transcribing and editing transcripts, and so it allowed for heavy editing, by interviewers and interviewees alike, without proper notation or citation. From its inception, the CHF's commitment to transcribing and binding the oral history interviews relegated the audio recordings to supplementary research materials and not the primary oral history product. While the voice recordings were important, they were viewed not as treasures, but as tools to acquire the transcript. The recordings were simply part of the process with a book-like oral history volume as the ultimate goal. The purpose was to fill the CHF library with beautiful bound volumes with stories of the history of chemistry rather than to use the growing oral history collection for any larger historical research questions.

In addition, the oral histories, while always viewed as important to the mission of the CHF, were considered to be independent from the rest of our collecting. Unlike traditional archival items such as papers, photographs, instruments, and artifacts, no one foresaw using the oral histories as part of museum or travelling exhibits, or educational publications. While some oral history interviewees donated papers or artifacts in conjunction with their oral history, there are many interviewees of whom nothing further was asked. Often the OHP staff made no effort to take photos of the interviewees, let alone collect them; as a result, photographs related to oral history interviews are scant in our Collections department. Instead of viewing them as a research tool complementary to the rest of the CHF's work to preserve the history of chemistry, the oral histories were viewed as a separate entity. Without an early commitment to dual collecting or how these oral histories might be used, there was little reason to collect anything unless it was offered. Therefore, the oral histories were put aside from the rest of materials related to the history of chemistry.

The original purpose of the OHP seemed to be one of preserving the stories of scientists. While certainly an admirable goal that we continue today, it remains unclear what the plans of the CHF's OHP were for these oral histories beyond preservation. There was little written about them and few scholars employed them in widely disseminated historical and/or oral history publications, and the collection received little written promotion. Without the "publicity" of being used and cited, the collection, unique for its commitment to chemistry and its related sciences, has been largely unknown. Until recently, the oral histories have not been featured in the CHF's travelling exhibits, online exhibits, or museum exhibits.

Since 2007, however, many changes have been made within the OHP, including processing methodology and interviewee selection, with the goal of providing scholars, staff, and a broader educational audience the means to utilize a newly-streamlined collection. Although we remain a transcript-based oral history collection, one of the earliest changes instituted was an attempt to adhere to Best Practices methods set out by the Oral History Association (United States),

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particularly the commitment to the original recorded conversation.[7] A more difficult, and yet necessary, shift in the OHP's operation was attempting to reinsert women and minorities into the narrative of our oral histories.

To begin rectifying some areas in which the broader collection was deficient, in 2008 the OHP began efforts to fill these gaps in our collection. As a first step, the OHP initiated a project specifically geared towards interviewing women in chemistry. Of the hundreds of oral histories in the collection prior to the advent of this project there were merely a handful of oral histories conducted with female chemists. These interviewees were with distinguished women, including past presidents of the American Chemical Society and prominent award winners. Additionally, the few theme-based projects into which some of our oral histories fit, such as plastics and polymers or mass spectrometry, were largely devoid of female representation. Since the new Women in Chemistry project began, close to 20 new oral histories of female chemists have been conducted and are in various stages of processing. The collection of Women in Chemistry oral histories has more than doubled in size, from 10 to 30 completed oral histories, and this now more robust female perspective on the experience of being a chemist is better represented within the CHF collection. Also, the OHP has worked hard to address the larger issue of finding minority voices in the sciences, working closely with a visiting scholar on a project concerning African-American Women in Chemistry whose oral histories are now part of the CHF collection. We continue to build collaborations and projects that focus on minority scientists to ensure that these voices, and the history of chemistry they represent, are not silent within our collection. When new projects are undertaken, we are mindful of maintaining increased diversity in the interviewee pool. Chemistry has neither been all-male nor all-white in the United States for a very long time, and the CHF oral history collection is striving to demonstrate this reality. We realized that any efforts of the OHP to use the oral history collection for educational purposes had to include an increased commitment to diversity.

Interviewee selection continues to evolve as the OHP and the CHF look more generally to interview interesting chemists, and to pose focused research questions through oral history projects.[8] These focused oral histories will continue to expand the overall collection in new and diverse ways while assisting in research projects

[7] "Principles and Best Practices," Oral History Association, October 2009, http://www.oralhistory.org/do-oral-history/principles-and-practices/

[8] While interviewee selection is not a scientific process, the OHP has taken steps to standardize the ways in which interviewees are selected. Many interviewees are recommended by CHF employees, board members, or previous interviewees. In addition, the OHP created a matrix by which to "rank" potential interviewees by such categories as age, location, prizes received, relevance to existing OHP projects, collaboration with previous OHP interviewee(s), etc. OHP staff members also evaluate candidates based on their ability to provide insight into an area of chemistry our collection currently lacks (for example, catalysis).

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throughout the CHF. These new research questions allow for traditional oral histories of people—long interviews covering their life and work—as well as newer oral histories of a particular subject, rather than a person. One such example undertaken by the Environmental History Program within the CHF has been the Toxic Substances Control Act (TSCA) Oral History Project, which conducted short, in-depth oral histories with the men and women involved in writing the original TSCA legislation in 1976.[9] These fifteen short oral histories do not focus on the interviewee's life story, but instead their involvement with the TSCA legislation, creating a collection that becomes one collective oral history telling the story of TSCA. Other oral history projects are being planned in an attempt to answer specific research questions that expand both the oral history collection and the voices represented within the collection.

The program has come a long way in a short period of time. Yet staff still had no clear idea about the actual content of our hundreds of oral histories. Even though most completed oral history had their own abstract, table of contents, and index, the quality of the information varied: some of these oral history components focused on the bare basics of an interview, noting only the chronological breakdown of the interview and some names of colleagues. But what of the themes within these oral histories? How might we know if a dozen oral histories all speak to themes of science education, work/family balance, or entrepreneurship? How could we quantify the number of interviewees who all worked with the same advisor? We realized that we had to survey and critically examine all of our oral histories.

2. Understanding the Collection

In order for the OHP to determine the content of the oral histories, it was necessary to undertake a focused project to "tag" the existing oral histories, which numbered 320 at that time. The project itself was simple, yet daunting: first, staff members needed to determine thematic tags as well as characteristics each tagged oral history would provide (Figure 1). Next, three OHP staff members each read a third of the completed oral history collection, noting characteristics such as an interviewee's educational and professional institutions, field, or advisor. Secondly, each history was tagged. For example, one oral history interview could be tagged with discussion topics such as education and lab safety, historical time periods such as the Space Race and World War II, and/or scientific fields, from the most general (chemistry) to the most specific (mass spectrometry). Staff members noted when interviews contained interesting or unique anecdotes that might have been missed otherwise: for

[9] The Toxic Substances Control Act (15 U.S.C. 2601–2692). "TSCA Oral History Project," Chemical Heritage Foundation, http://www.chemheritage.org/research/policy-center/projects/tsca-oral-history.aspx.

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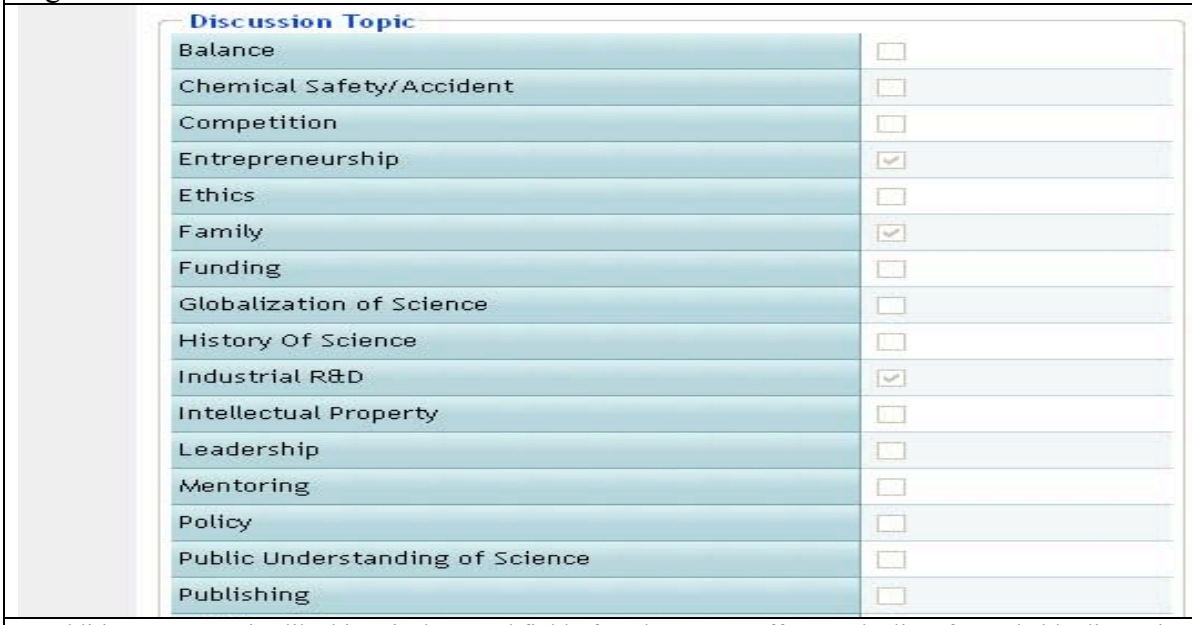
instance, the debate over who invented Silly Putty or an anecdote about a scientist whose secondary school teacher in Japan pre-World War II was really an FBI agent.[10] When complete, the body of oral histories was sortable and searchable by any of the thematic categories of our "tagged" database (Figure 2). Tagging the oral histories took three staff members approximately five months to complete, but the results were monumental for the program's potential as a research and programming collection. Staff learned that the thematic strengths of its collection included chemical industry, polymers, and World War II-era science, among other areas. Without this tagging project, attempts at useful insertion of oral histories into educational programming and outreach would not have been possible. The first such instances of successful use of oral histories in outreach include an online exhibit based on an "unintentional collection" of thematically similar oral histories and insertion of oral histories into the CHF publications and online materials.

Figure 1



In addition to categories like historical era and field of study, OHP staff created a list of searchable discussion topics.

[10] Earl L. Warrick, interview by James J. Bohning at Midland, Michigan, 16 January 1986 (Philadelphia: Chemical Heritage Foundation, Oral History Transcript #0045) and Rudolph Pariser, interview by Arthur Daemmrich and George G. Cremer at Chemical Heritage Foundation, Philadelphia, Pennsylvania, 28 October 2005 (Philadelphia: Chemical Heritage Foundation, Oral History Transcript #0320).

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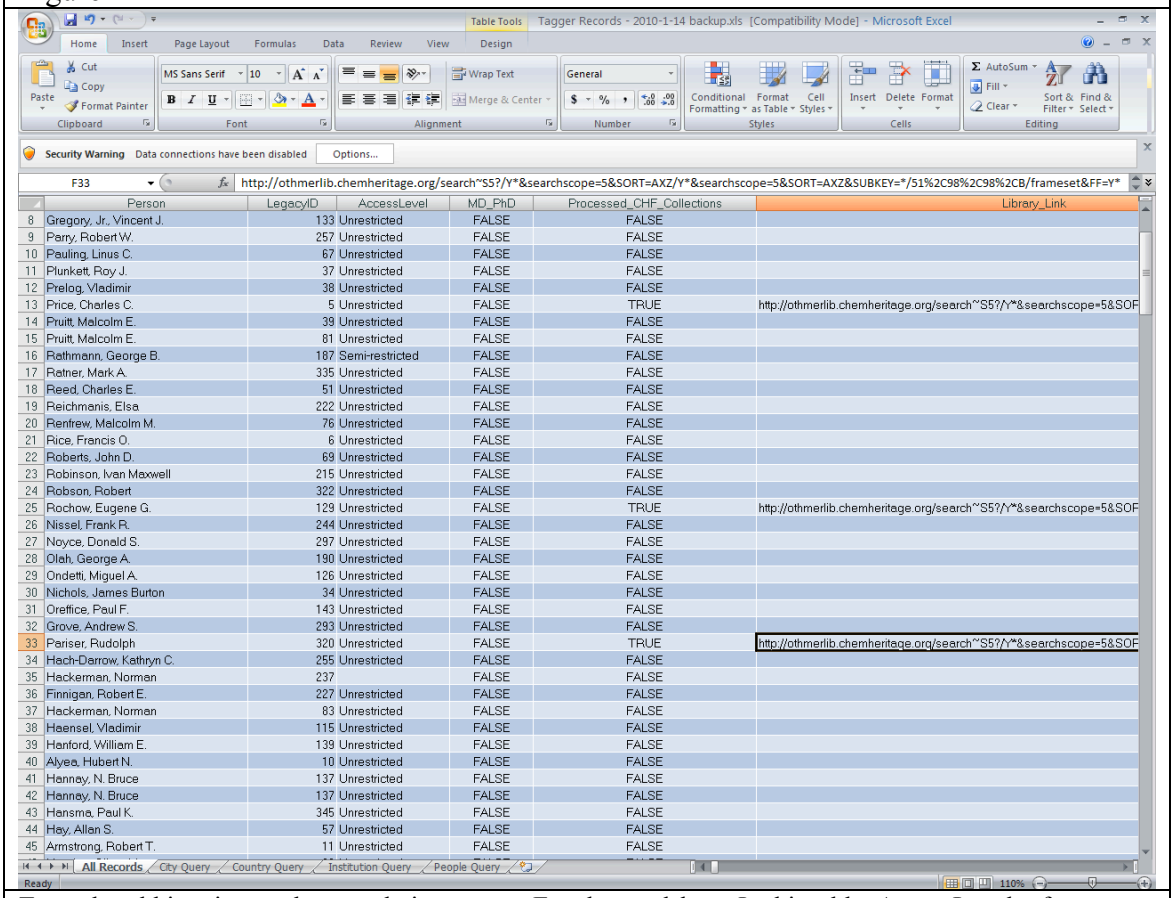
Figure 2



	Person	LegacyID	AccessLevel	MD_PhD	Processed_CHF_Collections	Library_Link
8	Gregory, Jr., Vincent J.	133	Unrestricted	FALSE	FALSE	
9	Perry, Robert W.	257	Unrestricted	FALSE	FALSE	
10	Pauling, Linus C.	67	Unrestricted	FALSE	FALSE	
11	Plunkett, Roy J.	37	Unrestricted	FALSE	FALSE	
12	Prelog, Vladimir	38	Unrestricted	FALSE	FALSE	
13	Price, Charles C.	5	Unrestricted	FALSE	TRUE	http://othmerlib.chemheritage.org/search~S5?/Y*&searchscope=5&SOF
14	Pruitt, Malcolm E.	39	Unrestricted	FALSE	FALSE	
15	Pruitt, Malcolm E.	81	Unrestricted	FALSE	FALSE	
16	Rathmann, George B.	187	Semi-restricted	FALSE	FALSE	
17	Ratner, Mark A.	335	Unrestricted	FALSE	FALSE	
18	Reed, Charles E.	51	Unrestricted	FALSE	FALSE	
19	Reichmanis, Elsa	222	Unrestricted	FALSE	FALSE	
20	Renfrew, Malcolm M.	76	Unrestricted	FALSE	FALSE	
21	Rice, Francis O.	6	Unrestricted	FALSE	FALSE	
22	Roberts, John D.	69	Unrestricted	FALSE	FALSE	
23	Robinson, Ivan Maxwell	215	Unrestricted	FALSE	FALSE	
24	Robson, Robert	322	Unrestricted	FALSE	FALSE	
25	Rochow, Eugene G.	129	Unrestricted	FALSE	TRUE	http://othmerlib.chemheritage.org/search~S5?/Y*&searchscope=5&SOF
26	Nissel, Frank R.	244	Unrestricted	FALSE	FALSE	
27	Noyce, Donald S.	297	Unrestricted	FALSE	FALSE	
28	Olah, George A.	190	Unrestricted	FALSE	FALSE	
29	Ondetti, Miguel A.	126	Unrestricted	FALSE	FALSE	
30	Nichols, James Burton	34	Unrestricted	FALSE	FALSE	
31	Oreffice, Paul F.	143	Unrestricted	FALSE	FALSE	
32	Grove, Andrew S.	293	Unrestricted	FALSE	FALSE	
33	Pariser, Rudolph	320	Unrestricted	FALSE	TRUE	http://othmerlib.chemheritage.org/search~S5?/Y*&searchscope=5&SOF
34	Hach-Darrow, Kathryn C.	255	Unrestricted	FALSE	FALSE	
35	Hackerman, Norman	237		FALSE	FALSE	
36	Finnigan, Robert E.	227	Unrestricted	FALSE	FALSE	
37	Hackerman, Norman	83	Unrestricted	FALSE	FALSE	
38	Haensel, Vladimir	115	Unrestricted	FALSE	FALSE	
39	Hanford, William E.	139	Unrestricted	FALSE	FALSE	
40	Alyea, Hubert N.	10	Unrestricted	FALSE	FALSE	
41	Hanney, N. Bruce	137	Unrestricted	FALSE	FALSE	
42	Hanney, N. Bruce	137	Unrestricted	FALSE	FALSE	
43	Hansma, Paul K.	345	Unrestricted	FALSE	FALSE	
44	Hay, Allan S.	57	Unrestricted	FALSE	FALSE	
45	Armstrong, Robert T.	11	Unrestricted	FALSE	FALSE	

Tagged oral histories can be sorted via a master Excel spreadsheet. In this table, AccessLevel refers to whether an oral history is unrestricted (users may read, quote, and cite an oral history without needing interviewee permission), semi-restricted (users may read an oral history, but need interviewee permission before citing/quoting), or restricted (users need interviewee permission before reading oral history); MD_PhD refers to interviewees who may have both an M.D. and a PhD degree; Processed_CHF_Collections refers to whether or not the interviewee also has papers or other materials in the CHF Collections.

With a new body of tagged oral histories and a better understanding of a decades-old oral history collection, OHP staff could finally move towards bringing these oral histories to life in programming. The audience for these new projects, however, was unknown. Previously, the oral history program had directed its oral histories towards its own interviewees and academic researchers as the audience. Programming and projects based on the oral histories could reach a broader range of people and expand that audience in previously unconsidered ways. But who was the

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OHP trying to reach? Initially, the OHP looked to a group targeted by the CHF as early as 2005: students and teachers.

3. Education Focuses the Collection

As the OHP staff became more knowledgeable about everything that the collection contained, it became apparent that defining an overarching goal would be necessary to make the collection a useful and coherent research tool. The OHP saw numerous ways in which the collection could play a vital role in the CHF's commitment to public understanding of science and education. Students and teachers were an obvious audience for the OHP because of the collection's important contribution to understanding the world of science. As the CHF as a whole turned its eye to its public, it became clear that U.S. science education was, and still is, at a critical juncture. For years, American high school students have lagged behind those in other developed nations in scientific knowledge, despite the fact that the U.S. has long been considered a world leader in scientific research. Most recently, U.S. students tested below the international average for 21 countries in math and science.[11] Early in 2011, U.S. Congressman Bart Gordon, Chair of the House Committee on Science and Technology, noted the following: "Unless the United States maintains its edge in innovation, which is founded on a well-trained creative workforce, the best jobs may soon be found overseas. If current trends continue, along with a lack of action, today's children may grow up with a lower standard of living than their parents."[12] Clearly, leaders in government understand the need for an educated and interested scientific workforce. However, reversing this trend of declining interest and ability in science by American students is a problem with multiple causes and solutions.[13]

One way to address this issue is to bring scientific life into the classroom: what it means to conduct scientific research as told by the scientists themselves, its successes and its failures in the real world. With our reorganized tagged collection, the CHF's OHP is now in a strong position to shed light on the processes of science: what a scientist does, the types of skills necessary for a career in science, and the

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[11] For statistics, please see Trends in International Mathetmatics and Science Study (TIMSS). Reports from 1999, 2003, and 2007 are available at http://nces.ed.gov/timss/, and OECD Programme for International Student Assessment (PISA) at http://www.pisa.oecd.org/pages/0,2987,en_32252351_32235731_1_1_1_1_1,00.html

[12] Bart Gordon, "U.S. Competitiveness: The Education Imperative," *Issues in Science and Technology Online* 23 (2007).

[13] Discussion of causes and solutions of decreasing interest and aptitude of American students in science can be found in Todd Morton, "Fixing U.S. Stem Education is Possible, But Will Take Money," *Ars Technica*, March 2010, http://arstechnica.com/science/news/2010/03/fixing-us-stem-education-is-possible-but-will-take-money.ars; Organisation for Economic Co-Operation and Development Global Science Forum, "Evolution of Student Interest in Science and Technology Studies Policy Report," May 2006.

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types of work environments in which it is conducted. For example, one of our interviewees, Catherine H. Middlecamp, director of the Chemistry Learning Center at the University of Wisconsin, Madison, describes in her oral history both U.S. science education and science's image problem:

> I'm going to go on record, happily, to say that I think our profession, our discipline, has shot itself in the foot. What I mean by that is by pursuing this rigor in the absence of humanity, if you like, we have educated generation after generation of students who don't like chemistry—let me say that more strongly, who hate chemistry—never want to take it again and think they're stupid. What has this done to our citizenry? Nothing that I can think is very good for the chemical profession. What is my evidence? My evidence is [social occasions], and as I said, it runs about eight to one: "What do you do?" "I teach chemistry." Enter into the transcript: she frowns, she made a face. That's the response I get, usually eight times out of nine.[14]

Chemistry in particular, and science more generally, has an easily discernable image problem where the public and students perceive science as intimidating, obscure, and boring. The CHF's oral histories give scientists a voice and demonstrate that they do interesting, exciting work.

Through our analysis of our collection and its valuable oral histories, the OHP realized that it could become active in the attempts to rejuvenate scientific education and public understanding of science. Previous generations of American students easily grasped the excitement and the demand for science through events like the American space program; exciting current events could be paralleled for today's students through careful repackaging and repurposing of our collections into student- and teacher-friendly formats. For example, many of the CHF's oral history interviewees grew up in a generation when scientific education was marked by the launch of Sputnik in 1957 and the ensuing American educational reforms. However, twenty-first century students and researchers do not have a Sputnik moment to galvanize popular interest in science, technology, and innovation. Rodger Bybee argued in a 1997 paper presented at the National Academies of Science Symposium, "Reflecting on Sputnik: Linking the Past, Present, and Future of Educational Reform," that Sputnik "symbolized a threat to American security, to our superiority in science and technology, and to our progress and political freedom. In short, the United States perceived itself as scientifically, technologically, militarily, and economically weak." This prompted educational reforms that would encourage an

[14] Catherine Hurt Middlecamp, interview by Hilary Domush at University of Wisconsin, Madison, 10 and 11 December 2008 (Philadelphia: Chemical Heritage Foundation, Oral History Transcript #683), 62.

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interest in scientific careers.[15] Within the CHF's oral history collection, Sputnik is remembered as a transitional moment in the lives of many future scientists.

Oral history interviewee William H. Davidow, a former Intel vice president, recalled,

> When I was deciding where to go to graduate school, they shot up Sputnik—I remember sitting in class in 1957 and the professor came in and announced that Russia had launched Sputnik. […] And so, I was trying to make up my mind whether I'd be a businessman or a scientist. I decided that I owed it to my country to be a scientist and that if I was going to become a scientist I ought to go to the world's best place for training, and that boiled down to either Caltech [California Institute of Technology] or MIT [Massachusetts Institute of Technology] or Stanford [University].[16]

Finishing his undergraduate degree at the time of Sputnik's launch, Davidow remembers the moment as memorable. While he did not benefit from the Sputnik-era educational reforms and programs, he was motivated to pursue a career in science, which in turn helped maintain American technological interests. Davidow's noting of Sputnik and the pressures he felt to pursue science instead of business appears early in his oral history, at the time when the CHF interviewers usually ask how the interviewee first became interested in science. Instead of relating a story from his youth or early education, Davidow instead recalled this pivotal moment from 1957.

Unlike Davidow, many of the interviewees who refer to Sputnik reference not the impact of its launch, but rather the educational reforms undertaken by the U.S. government, leading scientists, and educational institutions. The reforms encouraged a return to educational basics with the aim of making students at all levels interested in math and science, and providing them with the necessary educational background in the hope that many would pursue scientific careers. For Sally Chapman, Chemistry Professor at Barnard College since 1975, the effects of the educational reforms proved to be the most important factor. Like Davidow, Chapman discusses Sputnik early in her oral history conversation, again during the time when interviewers ask what led to an interest in science.

> I characterize myself as a child of the Sputnik generation. You know Sputnik went up…what was it, 1957. I think I was eleven years old.

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[15] Rodger W. Bybee, "Reflecting on Sputnik: Linking the Past, Present, and Future of Educational Reform" (paper presented at the National Academies of Science Symposium, Washington, DC, October 4, 1997); see http://www.nationalacademies.org/sputnik/index.htm.

[16] William H. Davidow, interview by David C. Brock at Palo Alto, California, 8 May 2007 (Chemical Heritage Foundation, Oral History Transcript #362), 1.

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> This country—at least as I understood it at the time and I think this is correct—was utterly horrified. There was a huge, huge effort to think about education in science and so on. When I got into high school there were all sorts of very exciting innovative programs in high school science. […] Absolutely dynamite. It was. I mean, I remember being in the gymnasium with these giant slinkies with looking at wave motion and with these ripple tanks. I think it was much more experimental then…of course, I didn't have the previous curriculum, but the degree to which the teachers were excited by it. We actually at our school had…it was a little school but we had two different high school chemistry courses. One was, sort of, the honors and the CHEM Study, Chemistry was the honors section. My understanding just from talking to people, it was night and day. One was memorizing valances and memorizing things. The other was sort of very, very…I remember the first lab was sitting and looking at a flame and writing things down and trying to observe and trying to think about all the things that were going on and so on. So, those were very exciting. Then there was this…as I said there was this whole, sort of, *Zeitgeist* of your country needs you. Science is important and they'll go into it. So, there was this being pushed into science that in a lot of ways I was always resistant to being pushed into anything. It was an exciting time to study science.[17]

Sputnik led to Davidow's patriotic desire to study science and Chapman's interesting and engaging educational experiences with science. However, American students in the twenty-first century do not have anything like Sputnik to motivate them nor any similar mass educational reforms. Teachers and reformers must find other means to motivate students who do not always initially see the practicality or intrigue of science. In his paper, Bybee claimed that an unintended outcome of the Sputnik-era educational reforms was creating a generation of students and citizens who believed in the power of innovation, science, and technology. This attitude regarding science is in stark contrast to today, where the majority of American students see science as none of these things and do not score well on standardized testing.[18] The oral histories of scientists in the CHF collection in their own way have the ability to inspire students, not in the same way as Sputnik or government-led educational

[17] Sally Chapman, interview by Hilary Domush at Barnard College, New York, New York, 5 and 6 January 2009 (Chemical Heritage Foundation, Oral History Transcript #633), 2.
[18] Stephanie Banchero, "Students Score Poorly on Science Test," *Washington Post*, January 26 2011, http://online.wsj.com/article/SB10001424052748704698004576103940087329966.html; Brent Staples, "Why American College Students Hate Science," *New York Times*, May 25 2006, http://www.nytimes.com/2006/05/25/opinion/25thu4.html.

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reform, but through putting a human face on science. The oral histories provide details about the hidden side of science that do not appear in the published record or students' textbooks, giving voice to scientists who usually remain nameless and mysterious, allowing them and their complicated research to appear interesting and approachable instead of formidable. Anecdotes from the oral history collection make science personal and conversational, while also imparting a lasting impression about the critical importance and far-reaching effects of science.[19]

We re-conceptualized our collection and developed content to address the many problems with the public image of science, including the perception that science is boring or impossible to understand. Notably, many scientists have difficulty communicating their work to the average layperson. This has allowed us an opportunity to insert our collection into conversations about science education. When the OHP turned its focus to education, students, the public, and academic researchers, our oral history collection coalesced into a useful one. Our first attempts at programming were built from the thematic groups within the collection, discovered through tagging, which emerged as topics easily packaged for education.

4. Demonstrating Purpose

To serve the new focus on education, the OHP now had a collection that could easily be mined for information by various audiences. In creating successful educational programming, the OHP could achieve multiple results: it could publicize the collection, make science dynamic and interesting to students and the general public, and demonstrate the utility of the collection to potential researchers and teachers. It was important as well to adopt strategies used by public historians when designing educational programs. Oral history and public history are often considered together with good reason. Both fields pursue increased access to the past, the act of "giving people back their own history."[20] Additionally, both fields aim for a more participatory history. The CHF's OHP needed to take into account public history and best practices in both fields in its educational programming.

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[19] Seeing scientists as people with interesting lives and careers has improved certain groups' perceptions of science as a career. See, for example, Zahava Scherz and Miri Oren, "How to Change Students' Images of Science and Technology," *Science Education* 90 (2006): 965–985. Other studies also found that realistic, issue-oriented science activities can improve students' beliefs about the relevance of science. See: Marcelle A. Siegel and Michael A. Ramney, "Developing the Changes in Attitude About the Relevance of Science (CARS) Questionnaire and Asssessing Two High School Science Classes," *Journal of Research in Science Teaching* 40 (2003): 757-775. Fermilab also documents their program, "Who's the Scientist?" designed to help improve the image of scientists with middle school students, at http://ed.fnal.gov/projects/scientists/index.html.

[20] Jill Liddington, "What is Public History? Publics and Their Pasts, Meanings and Practices," *Oral History* 30 (2002): 88.

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First attempts at educational uses included inserting oral histories into extant CHF programming. Since the CHF already had an outreach arm in place, the Roy Eddleman Institute, a few outlets were available that had proven reach to students, teachers, CHF donors/board members, and the elusive science-minded public. The CHF has both a magazine, *Chemical Heritage,* published three times a year, and a biweekly podcast, *Distillations.* These communications have received numerous awards and have utilized various CHF resources, including its archives, collections, rare books, and in-house scholars. Before we instituted changes to our program in 2008, inclusion of oral histories was difficult, requiring extensive reading and full text searching. With the tagged oral histories, staff could make suggestions for articles, provide feature articles on interviewees of interest, or enrich articles with quotes and behind-the-scenes looks into labs and the industry. Finding this information was for the first time relatively simple.

Together with the OHP's efforts to make its collection useful, the CHF also focused on developing a wider audience through the Internet. With its increased focus on multimedia, the Internet became the primary educational outlet for the oral history collection, which included medias in the form of audio, video, and images. After months of planning, meeting, and deliberation, a new CHF website launched in the summer of 2010, with a focus on ensuring that the CHF's mission was clearly represented. The website brought our oral history collection to life in several ways. The first was by utilizing "Web 2.0" technology: interactive features like Facebook, Twitter, and YouTube, which allowed the CHF to publicize events and the work of CHF staffers and fellows. The second was a reconfiguration of the site to allow for easy access to programs, events, and new projects. With the entire reworked website, greater flexibility meant that the OHP could create a new type of project, an online exhibit.

By intensively analyzing the large group of polymer-related oral histories, a previously unrecognized thematic collection emerged: scientists who participated in the World War II U.S. Synthetic Rubber Program. This topic was attractive because of the World War II connection. World War II is a popular topic with a story arc that allows for easy storytelling. From January 2010 until January 2011, staff worked at parsing the "story" that these dozen interviewees told, how to tell it in an in interesting way, and how to utilize the CHF's archives, photographs, and collections to enrich the main story. Collaborative efforts across the CHF were also important. Following the direction of the editing processes used by the CHF's magazine, the text was edited by several CHF staff members from various departments to ensure readability and clarity. But the OHP staff also paid attention to how an audience of students, teachers, and science-minded public might approach the site. Consequently, the OHP built an online-exhibit that could be customized with features like sidebars, stories that could not fit into the main narrative but might be interesting to some. Photographs and letters, found with the help of our Collections and Library staff,

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could be viewed in large sizes. A glossary, bibliography, and timeline provided context and background for the more research-minded viewers (Figures 3 through 5). Overall, *Rubber Matters*: *Solving the World War II Rubber Problem* was a success both inside the CHF and out.[21] Feedback within CHF has been positive, and the pages were some of the most viewed within the OHP's departmental section of the website in the months following the launch, continuing to garner page-views and interest.[22] With this successful experience, the OHP plans to launch a new online exhibit every 12 to 15 months, with 2012's topic the more challenging chemical field of mass spectrometry.

Figure 3

The landing page for *Rubber Matters*.

[21] Please see http://www.chemheritage.org/research/policy-center/oral-history-program/projects/rubber-matters/index.aspx. *Rubber Matters* utilized twelve extant OHP collection interviewees, mostly from the Polymers Project. To supplement these interviews, two interviews from the University of Akron ACS Rubber Division Oral History Collection (a partner of CHF's OHP) were utilized. Most of the exhibit text came from the narratives told by these interviewees, with other sources supplementing that information.

[22] http://www.chemheritage.org/research/policy-center/index.aspx. See further discussion of the exact numbers of page hits on page 24.

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Figure 4

Features such as audio clips (top) and archival material (bottom left) enriched the online exhibit.

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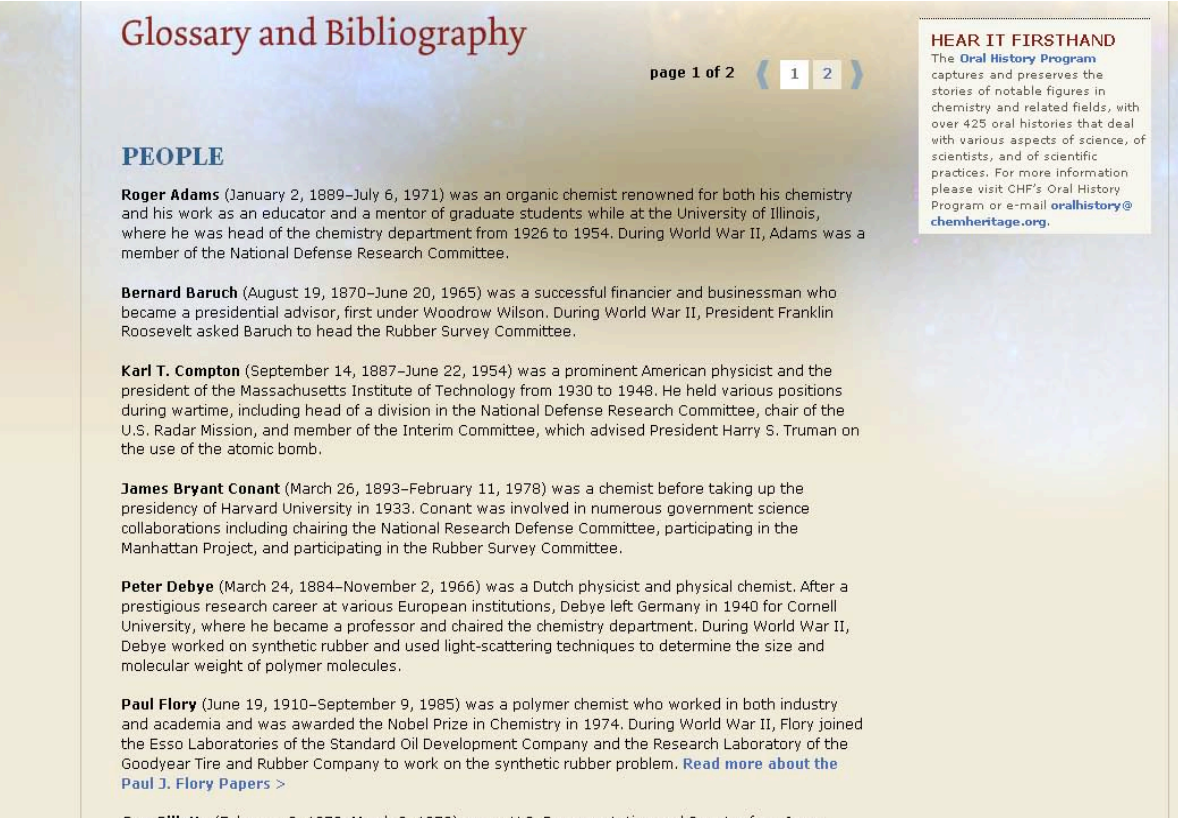
Figure 5



The glossary included categories for people, institutions, political terms, and technical terms.

But oral histories, with their focus on the human perspective and presence in history, also could make an impact. One specific OHP collection, Women in Chemistry, has brought oral history increased visibility with undergraduates and professors. The Career Pathways oral history project, a specific subset of Women in Chemistry oral histories, focuses on successful women chemists of the last generation and explores the success of women entering the chemical sciences workforce after Title IX, the 1972 American legislation that ensured public funding for equal treatment of women and men in initiatives as diverse as sports and science.[23] In the oral histories, interviewee success is defined variously for different

[23] Title IX, Education Amendments of 1972 (Title 20 U.S.C. Sections 1681-1688); http://www.chemheritage.org/research/policy-center/oral-history-program/projects/career-pathways-for-women-in-chemistry.aspx

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women, but all discuss the myriad ways in which women persevered in workplaces in which they were often the sole woman.

The interviews are used for more than just discovering trends of successful women chemists' careers. Starting in 2010, these oral histories have been the basis for several events that have provided a forum for undergraduate and graduate students to learn from these experiences. For example, panels at conferences now attempt to have at least one woman from industry or a national laboratory, two research locations of which students often have scant knowledge (Figure 6). The conferences provide both advice and networking for individuals who have historically been marginalized in their fields, many of whom have left scientific careers during critical transition points. Although approximately 50 percent of chemistry bachelor's degrees in the United States were earned by women as of 2002, the percentage of women earning PhDs hovered near 34 percent for the same period.[24] Women opt-out of chemistry and the sciences for a variety of reasons, including having limited resources to combat the negative atmosphere of academic chemistry departments. The Women in Chemistry oral histories and the Career Pathways events they inspired are intended to act as a bridge to help women in chemistry in the Philadelphia area overcome hurdles, allowing them to reach the next step on their chemistry path.

Figure 6

Students listen to panelists at the April 2011 Career Pathways Conference. Photograph by Conrad Erb.

[24] National Science Board, Science and Engineering Indicators 2010 (Arlington, Virginia: National Science Foundation, NSB 10-01), tables 2-12 and 2-28.

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The OHP's broadening of the reach of its oral histories was educational in more than one sense: first, inclusion of oral histories into the CHF publications and website materials educated the public on the presence of an oral history program, an underused and underrepresented resource at the CHF. Additionally, the CHF staff, while aware of the oral history collection, became educated about the many ways in which these oral histories could contribute to a wide variety of CHF projects. A broader audience has now learned of the story of the U.S. Synthetic Rubber Program, as well as the challenges and successes of women chemists in the post-Title IX era. While the past three years have seen numerous successful efforts by the OHP to educate the public regarding the existence of our collection and the rich stories about the history of science, inserting oral histories into an educational setting was a difficult process.

5. Challenges of Audience

Considering the educational possibilities of the CHF oral history collection has been daunting. We have needed to identify specific audiences for particular oral history projects, then package and repurpose the oral histories for those projects, such as the online exhibit *Rubber Matters* or the series Career Pathways for Women in Chemistry. While many of our current educational efforts bring us into contact with students, researchers, and the public through internet-based means, there is an ongoing challenge of who constitutes this online audience and whether that audience perceives our educational efforts as useful. Thus, our biggest challenge remains one of audience: identifying them, reaching them, and understanding their diverse needs.

In many ways the OHP tries to be all things to everyone. We desire a diverse audience: academic researchers, teachers, students and the public. One of the reasons we continue to conduct long, thorough oral histories that cover a complete biography is to provide ample resources for academic researchers who ask a wide variety of research questions. While the OHP staff have their own research questions, we want other researchers to be able to use the CHF oral history collection for research and educational projects that we could not have foreseen when the interview was conducted. In this way, we want the oral history collection to be a resource for a wide variety of uses. While the complete oral history transcripts and research files appeal to scholarly researchers, they do not necessarily serve teachers and students. They are available if requested, but the OHP has decided that repackaging the oral histories into projects, presentations, and online exhibits is a more productive way of interacting with teachers and students. The OHP works diligently to repurpose and repackage oral histories into online projects, short video segments, and other means of easily digestible information to attract both students and teachers.

The challenges of varying audiences present themselves most clearly in two examples of the OHP educational outreach: *Rubber Matters* and Women in

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Chemistry Career Pathways. An example of OHP repackaging and repurposing not only the lengthy oral history transcripts, but also archives and images from the CHF Collections, can be found in the online exhibit. *Rubber Matters* tells a concise story without making use of any interviewees' complete biography. A teacher or student never need read one of the entire transcripts if they do not wish to do so. Instead, *Rubber Matters* was designed to be interesting and educational on its own by utilizing the information and the quotations from the relevant oral histories. After the online launch of *Rubber Matters* in January 2011, we received limited but positive feedback from sources outside the CHF. The OHP staff did not place any kind of feedback mechanism within *Rubber Matters*' pages; therefore feedback was entirely voluntary and not explicitly encouraged. External feedback came mainly from those involved in the rubber or polymer industry or from others in the history field. These individuals praised the elucidation of a "hidden" historical subject and gave suggestions for other sources and possible interviewees the OHP could pursue.[25] We did not have the opportunity to interact with or know our audience. Conversely, the Career Pathways events are in-person events held at the CHF. While one could always hope for more feedback from an audience, it is possible to observe whether or not they are engaged with the topics during these types of personal interactions.

There remains an ongoing question as to an Internet audience's identity. Through the CHF's use of Google Analytics, we can ascertain specific quantitative information, such as the number of users and the length of time spent on particular pages.[26] However, identifying other qualitative information about the online audience is difficult to obtain unless an online visitor contacts a member of the OHP staff directly. Practitioners in the field of museums and oral history also encounter this problem of identifying and engaging the online visitor compared to the traditional "in-person" visitor. Minda Borun, of the Franklin Institute in Philadelphia, Pennsylvania, concisely framed the problem: "There are differences between exhibit and online program evaluation. With exhibits, the audience is known, goals are defined, visiting hours are limited, and outcomes are to some extent measurable. With the Web, the audience is unknown […] the goals are very broad and multipurpose, the site is always open, and the outcomes are difficult to measure."[27]

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[25] Within the CHF, feedback applauded the spotlight on oral histories, which many CHF staffers were unfamiliar with, the interdepartmental approach of the project, and the use of audio and visual features the new website provided. One CHF board member approached the OHP staff with the little-known fact that he worked on the Synthetic Rubber Project as an undergraduate.

[26] This information demonstrated interest in the websites and its contents: the *Rubber Matters* pages garnered 4,088 web hits in the first three months of its launch out of 10,491 overall hits of the OHP's section of the website. What's more, users spent between one and three minutes of time on each of these pages. The average time spent on pages of the site during that time frame was between 1:19 and 3:37 minutes.

[27] Minda Borun, "Evaluating Museum Exhibits and Online Programs" (presentation at Web Designs for Interactive Learning Conference, Ithaca, New York, June 15-18 2005).

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What's more, the aimed-for audience of web programming may be different from the actual audience. How might the CHF's OHP determine the audience's background and ascertain whether the intended audience is reached? Initial ideas centered on placing a survey on the OHP website or the online exhibit itself so a visitor might provide information about himself or herself and his or her interest in oral history and chemistry, among other topics. However, a web survey comes with its own set of concerns. Often, the rate of completion of such surveys is low and the population completing the survey is self-selected.[28] Thus, *Rubber Matter*'s audience remains unknown. However, with a growing number of Web-based exhibits and programming in oral history, science, and museums, case studies have shown that the key to online audience identification is in developing a relationship with that audience through online interaction.[29] While identifying and building a relationship with an online audience will be a difficult process, the OHP will look to new media as well as successful examples of audience-building online projects to ensure that not only is an audience identified, but cultivated.

We continuously strive to make our oral history collection appealing to academic researchers. Through the CHF we are able to offer travel grants to researchers. As scholarly researchers often come to the CHF to conduct their research, what begins as an online relationship can in time deepen. However, interaction with students and teachers remains limited.

Conclusion

As the CHF's OHP grows, so too do the challenges and opportunities presented by educational outreach and programming. A decision to focus on education provided purpose to this large and unique collection. Thus far, integration of oral histories into the CHF's podcast, magazine, and blog has greatly expanded the OHP's audience. A successful online exhibit launch has allowed the OHP to take advantage of Web 2.0 media. Future projects include more online exhibits and a greater presence in local schools through an Oral History Museum Lab program. This unifies the curatorial and public programming goals of the CHF's museum and Collections with OHP's

[28] For information on the challenges associated with targeting and surveying an online audience, see Johanna M. Russ, "Comparing Evaluation Methodologies for a Digital Exhibition: The End of Tobacco Road: Scenes From Liggett & Myers Tobacco Company's Final Days in Durham, North Carolina" (MA thesis, University of North Carolina at Chapel Hill, 2008); James B. Harold and Paul B. Dusenbery, "Bringing Mars Home: The MarsQuest Online Project," Museums and the Web 2004, n.d., http://www.archimuse.com/mw2004/papers/harold/harold.html.

[29] For two specific examples and plans, please see: Lynda Kelly and Pauline Fitzgerald, "Cooperation, Collaboration, Challenge: How to Work with the Changing Nature of Educational Audiences in Museums," in *Professional Learning and Development in Schools and Higher Education* 7 (2011): 77-88; Barbara Loren, "Audience-Based Measures of Success: Evaluating Museum Learning," in *Manual of Museum Learning*, ed. Barry Lord (Walnut Creek, CA: AltaMira Press, 2007), 221-251.

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interest in bringing primary source documents to high school students. These projects resulted from the OHP's commitment to maintaining a transparent and consistent oral history process, the need for younger generations to learn about oral histories as a resource, and to develop a positive outlook regarding science and scientific careers. With the CHF's overall commitment to increased use of social media and interactive Web technology, possibilities for the integration of oral histories into educational programming are greater. As well, the collection continues to grow: projects like Women in Chemistry, Mass Spectrometry, and Chemical Industry add oral histories yearly. With the program's focus on making the oral histories useful beyond the library shelves through education, these documents are no longer resigned to a fate of gathering dust.

The projects of the OHP have demonstrated various ways in which the oral history collection can be utilized by the CHF's diverse audiences. Focusing our efforts on education allowed the OHP to contribute to the current debates concerning science education in America and provided the OHP with a broader public history perspective that advocates for education through primary-source history. The presence of oral histories in education, especially in the subject of history, is clearly important. Oral histories can provide personal perspective, meaning and insight into impersonal or complex historical events. For many students, they can spark a conversation about what counts as historical narrative, and who makes the decisions regarding history? How do actors of/witnesses to history tell their stories? In the history of science, the need for oral histories is even greater as fewer oral history programs dedicated to telling the stories of science exist. Moreover, the importance of science in education, and American students' lack of understanding about scientific careers, creates a powerful need for such stories. Science needs to be something the public can comprehend. Although poorly understood, the processes of research and funding have consequences for the general public's lives, from the drugs they take to regulations for food. Reaching all of our audiences requires repackaging and repurposing, and using oral histories in different ways for varied audiences. Reaching large audiences is difficult, and evaluation methods are still developing. But each educationally-geared use of oral history brings the OHP at the CHF one step closer to making oral histories and science part of our everyday vocabulary.

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