FIVE WOMEN WHO WORKED WITH ALFRED WERNER

Dean F. Martin and Barbara B. Martin, Department of Chemistry,
University of South Florida, Tampa, FL 33620; dfmartin@usf.edu

Laboratory Experiences for Women in the Nineteenth Century

Women chemists faced a significant battle for recognition in the late nineteenth and early twentieth centuries. We are reminded that it was a 40-year battle before women chemists were allowed to join the Chemical Society (a forerunner of the Royal Society of Chemistry) in England (1).

On the positive side, there were several male chemists who fought for women's rights. The earliest was Augustus Harcourt, father of eight daughters and two sons. He was one of the founders of Somerville, Oxford's non-denominational women's college. He also forced university authorities to permit mixed classes. At the time women chemistry students had to find professors who were willing to give duplicate lectures owing to the existence of sex-segregated classes. Harcourt refused to give duplicate lectures, and he managed to force the issue (1).

Other British men who supported women's rights in science were Sir William Ramsay of University College London, William Tilden (1), and Cambridge biochemist F. Gowland Hopkins, whose research alumnae called themselves "Hoppy's Ladies" (2). In addition, we may recall Ernest Rutherford (radiochemistry) as well as William H. Bragg and William L. Bragg (crystallography), as being in a group of special supporters of women scientists (3). Rutherford at Manchester (a red brick university) was concerned that women would not be overwhelmed by the assigned project. Hopkins, even at the peak of his career, having received the Nobel Prize and able to have his pick of applicants, had laboratories where half were women, which alone would have provided a comfortable atmosphere.

The overt discrimination at the time in Great Britain, the United States and elsewhere was remarkable, as can be seen from just a few examples. During a meeting of the American Chemical Society in Boston in 1880, a dinner was held which included the performance of anti-female songs and poems. No women were invited, and when several members brought their wives, the women were turned away. The sole female member of the ACS at the time, Rachel L. Bodley, after hearing of the incident, resigned her membership. The next woman member was not elected until eleven years later (3). At least one Englishman who was required to lecture to mixed audiences would characteristically address the mixed audience as "Gentlemen." The first women members of the Chemical Society in Britain were only admitted in 1920, and this because the issue was forced by the Sex Disqualification (Removal) Act passed by Parliament in 1919 (1).

What attracted women to the British scientists noted above? At least three factors (3): the women themselves had strong educational backgrounds and self-images; they went into research areas (biochemistry, radiochem-

istry, and crystallography) that were new, exciting, and relatively open; and they worked with strong mentors who provided a welcoming atmosphere.

Has women's status in science really improved enough when Dr. Marie Curie is still consistently referred to as "Madame Curie" (4)?

Contrasting Situations at Zürich

We, however, focus on a place and a field where women were more welcome in the laboratory. We have a particular interest in Switzerland because of a grandfather (of DFM), Fernand Rausis who came to the United States from there as a 13-year-old orphan. And we have a long-time interest in the field of the chemistry of coordination compounds (5).

In contrast with England, women were allowed to study at the University of Zürich from 1840 (6-8). The first woman to do graduate work in chemistry at Zürich was Lydia Sesemann from Wiborg, Finland, who earned a D.Phil. in 1874 for the dissertation "Dibenzylacetic Acid and a New Synthesis of Homotoluic Acid" under the direction of Viktor Merz and Wilhelm Weith. In 1887, Rachel Lloyd, also working with Merz, completed her Ph.D. work—the first American woman to do so—with a thesis written, curiously, in English, not German as would have been expected (9).

Eugster begins a pertinent and particularly interesting section of his history of chemistry at Zürich by noting (6):

> Starting in 1900, many women completed their doctorates in Werner's group. For example, Edith Humphrey from London (1901); "Anna Dorn ... studied the conductivity of many carboxylic acids (1905); Dora Stern from Göttingen who worked on nitrophenanthrenquinones; Cornelia Geissler ... (1907); Chana Weizmann from Pinsk...".

Table 1 lists five women who definitely were Werner advisees. We chose to look at the backgrounds of these women who certainly were doctoral advisees of Werner and for whom adequate information is available.

Table 1. Some women who worked for Alfred Werner (6)

Dissertation Year	Person	Origin
1901	Edith Humphrey	London
1905	Anna Dorn	Naundorf (near Dresden)
1911	Sophie Matissen	Poltawa, Russia (now Poltava, Ukraine)
1912	Chana Weizmann	Pinsk, Russia (now Belarus)
1919	Jeanne Schwyzer	New York City

The problem of identifying collaboration and who was the advisee was more difficult here than in the United States. In the latter, for example, in the *Journal of the American Chemical Society*, a paper involving a two-person authorship would have a footnote stating that the publication was submitted in partial fulfillment of the requirements for the degree of doctor of philosophy. In contrast, many of Alfred Werner's publications seemed to be single-author publications, in that his was the only name at the beginning. But in the experimental section, identified by the heading "*Experimenteller Teil*," can be found the name(s) of the doctoral advisee(s) who did the actual research. To us, it seems like a remarkable approach, but clearly it was satisfactory for the time. The only problem is identifying the collaborators from a reference list of publications, but this is treated superbly by Kauffman (10) in his list of Werner's papers.

Alfred Werner (1866-1919)

George Kauffman illustrated Alfred Werner's versatility by considering his contributions to organic as well as inorganic chemistry (11, 12). As Kauffman noted, Werner was trained essentially as an organic chemist at the Zürich Eidgenössisches Polytechnikum and was hired to teach organic chemistry at the Universität Zürich. In point of fact, Kauffman reminded readers that "of Werner's first 30 publications (1890-1896) organic papers outnumber the inorganic ones by a ratio of two to one" (12). Moreover his interest in organic chemistry persisted. Roughly 25% (or 45) of his 174 publications are concerned with organic subjects, including "oximes; hydroxamic and hydroximic acids; azo, azoxy; hydrazo, and nitro compounds; and dye stuffs" (12). His later years, i.e., after 1902, were significantly concerned with inorganic chemistry. We note that a summary of Werner's contributions observed that none of his work led to patents (6).

Werner, the son of a factory foreman of modest means, was born in Mulhouse, Alsace, on December 12, 1866, some four years before the Franco-Prussian War. As a consequence it may be said that he was born as a Frenchman, raised as a German,

and became a Swiss (after marrying a Swiss citizen, Emma Wilhelmine Giesker) in 1894 (10). He showed an early fascination for chemistry and earned money doing "menial tasks" for locals that allowed him to create a laboratory in his father's barn and to engage in research projects. When he was 18, he provided a report to the head of the *Chemie-schule* at (then German) Mülhausen and asked innocently how long it would take to become a professor. Fortunately Emilio Noelting wrote a tactful, if guarded reply that provided encouragement to Werner. In 1886, he moved to Zürich to study chemistry at the Federal Polytechnic School. Three influential faculty members were eminent chemists: Georg Lunge, Arthur Hantzsch, and Frederic Treadwell (6, 10). Werner was awarded a doctorate at Universität Zürich (13). This was based on research on the structure and stereochemistry of organic nitrogen compounds, supervised by Hantzsch.

In 1891, Werner was faced with a need to present a habilitation dissertation, the success of which would allow him to accept students. But he was faced with a shortage of time, and chose to review the status of the bewildering amount of information about what we now recognize were coordination compounds. The result, "Beiträge zur Theorie der Affinität und Valenz" ("Contributions to the Theory of Affinity and Valence") appeared in 1891. It was published in the *Vierteljahrschrift der Züricher naturforschenden Gesellschaft,* which was a publication of limited circulation, so his new ideas were not rapidly appreciated (14).

Werner's considerations of coordination chemistry would seem to follow a classic pattern of "perspiration, incubation, inspiration." In an incident described by a former advisee, Paul Pfeiffer wrote (15)

> According to his own statement the inspiration came to him like a flash. One morning at two o'clock, he woke with a start; the long-sought solution of this problem had lodged in his brain. He arose from his bed and by five o'clock in the afternoon, the essential points of the coordination theory were achieved. Werner was then twenty-six years old.

In 1892 (at age 26) he wrote a major statement of an outline of the concepts of coordination chemistry (16).

Werner was assigned teaching of Section A of organic chemistry (for chemists). His knowledge of chemistry was encyclopedic, his lectures were well organized, he lectured with conviction, and he was charismatic. In time the lecture theater (130 seats) was packed with 200-250 students who occupied aisles, window sills, even packed around the lecture bench. Within five years he was a full professor (10).

Although hired as an organic chemist, his enthusiasm for coordination chemistry led him to shift his emphasis to inorganic chemistry. He pursued the field with avidity, and in 1913 was the 14th recipient of the Nobel Prize in chemistry, the first Swiss (6, 10). Subsequently he was ill, though not so obviously to others, plagued by strong headaches lasting several days (6, 10). From 1915 nearly until his death in 1919, his lecture duties were periodically taken up by colleagues. His resignation of his position became official October 15, 1919; he died November 15, 1919, "released by death" (10). His concepts of coordination chemistry are given in several places (5, 10, 15, 17).

Without a doubt, Alfred Werner was a remarkable person. He was gifted with a formidable memory that was an asset in dealing with a large number of students, involving 200 dissertations in a period of about 25 years (though some were assisted by colleagues after 1915, when his health difficulties became more debilitating).

He had an extraordinary ability for three-dimensional visualization that was essential to his full understanding of the features of coordination theory. He had a remarkable work ethic, usually being the first in the laboratory and the last to leave (10). He and his assistants worked six days a week. He would also be present in his institute on Sundays, unless he went hunting with colleagues. This was surely not lost on his associates, or students, who called him "Der Alte" ("The Boss"). A saying (translated) noted, "Der Alte walks through the lab... All songs quickly fade away to be replaced by great fervor."

Earlier in his life, however, he enjoyed sports and had remarkable physical strength. He engaged in mountaineering and hiking. Also, he enjoyed ice skating, bicycling, and rowing, as well as bowling and billiards. He had a range of interests. For a time he took up chess and was a member of the Chess Society of Zürich. A biography noted "he also collected stamps and had a valuable collection" (6).

No doubt Werner could appear formidable in part by size, serious mien, and by dedication. There was, however, another side. Yuji Shibata, a graduate of the University of Tokyo, was working at Leipzig some time around 1910 when he wrote to Werner, asking for a place in his laboratory. Werner responded in his own hand, "I should like to inform you that I would be happy to have you work with me. At present there is so much of interest to investigate here that a topic will certainly be found that will give you special pleasure" (18). May we

note that Werner said "with me" rather than "for me"? Shibata also noted that "Werner always spoke slowly with a smile on his lips" (18).

Alfred Werner greatly appreciated food and wine and overindulged in them. Over time he gained weight, much more than he should have, undoubtedly. He also gained a fondness for alcohol and in time became addicted, thought this was not initially evident. Finally he succumbed to arteriosclerosis.

His loss was tragic in many respects, not the least of which is the amount of material that did not appear in the open literature. Several dissertations appeared after his death, the last in 1929, and these probably involved more up-to-date "spectroscopic and chiroptic measurements" (6).

Five Women Who Worked with Werner

Though Werner could appear formidable by virtue of his size and his incredible mental prowess, he also evidently could be charming, and his lectures certainly revealed a person who was charismatic and, perhaps, engaging. In any event some 20 non-Swiss women chose to do dissertations in his research group. Werner may have made the initial approach easier. Whereas most doctoral faculty required a face-to-face introduction, Werner is said to have permitted a third-party introduction.

In addition Werner had a compassion or a concern for success. Each student *Doktorand*, male or female, was assigned a guaranteed successful problem, owing to a pre-trial by a Werner assistant. Faculty members over the years have approached the problem assignment in different and interesting ways: perhaps a truly challenging favorite problem of high interest, followed by a less demanding one that would lead to a dissertation. The "give-'em-a-used-problem" approach had a couple of flaws: The dissertations were described as "pretty routine and unimaginative" (19). And lacking the opportunities to fail and respond to the challenges "very few of Werner's students made significant contributions to chemistry" (19).

The number of women who were part of the Werner research group probably was not large at any one time, but the point of interest is that they were there and had come from some distance (like the men) to work with him. For example a group of 16 in about 1911 included Sophie Matissen, Hedwig Kuh, and Chana Weizmann (20).

We found material for five women of interest, Drs. Edith Humphrey. Anna Dorn, Sophie Matissen, Jeanne Elizabeth Schwyzer, and Chana Weizmann.

Edith Humphrey

Presumably the first British woman to obtain a doctorate in chemistry (1), Edith Ellen Humphrey was a remarkable woman as well as a remarkable chemist (21). She was Alfred Werner's first woman doctoral candidate (*Doktorandin*) and his first assistant (22).

Her background was middle class in Kentish Town, London, where she was born September 11, 1875, the youngest of seven surviving children of Louisa Frost Humphrey, a teacher, and John Humphrey, a clerk at the London Metropolitan Board of Works. He strongly supported educational progress of his daughters and his sons.

Ms. Humphrey benefitted from a good education (19). She attended the Camden School for Girls, then North London Collegiate School (1891-1893), which was one of the first UK girls' schools to have a science component of the educational curriculum. A scholarship (£60 annually) allowed her to attend Bedford College, London, where her studies included chemistry and physics (1893-1897).

Subsequently she applied to Zürich and was allowed to matriculate for the chemistry Ph.D. at the university (October 1898). Here, she joined a growing number of Werner's students working in the inadequate cellar space known as the "catacombs" (10, 22).

Finances were an issue for her. She had been awarded a grant (£60 per annum for three years) by the Technical Education Board of the London County Council. But Zürich was expensive, and the grant was inadequate (21). Fortunately, Alfred Werner appointed her his assistant at a salary. And she was able to engage in what was very significant, but somewhat controversial, research.

Her dissertation was accepted in 1901: Über die Bindungsstelle der Metalle in ihren Verbindungen und über Dinitritodiäthylendiaminkobaltisalze. She had described a group of compounds that, had their significance been appreciated at the time, would have provided crucial support for the correctness of Werner's coordination theory. Success in this respect was achieved much later.

A controversy centered around the assumption that a particular compound she prepared could undergo spontaneous resolution, much like tartaric acid crystals studied by Pasteur. Did she have sufficiently large crystals

to show the existence of the enantiomorphic forms? The failure to appreciate the phenomenon may be ascribed to a personal problem between Werner and an expert mineralogist (22). Subsequently (a century later) one study was critical of the quality of her sample (23).

Humphrey returned to England and was employed by Arthur Sanderson & Sons, a firm that made fabrics and wallpaper. She served as research chemist in their factory in Chiswick until her retirement (21). She was interviewed about her experiences in Zürich on the occasion of her 100th birthday (24). The title of the interview "Going to Meet Mendeleev," is curious; the short article said that she was a student of Mendeleev in Zürich. Who was confused—the interviewer or Humphrey? She died at the age of 102.

Anna Dorn Ernst

Frau Dr. Anna Elisabeth Ernst (née Dorn) was born on October 9, 1880, near Kötzschenbroda, which probably was then a depot on the Dresden-Leipzig railroad. She was educated in Naundorf (Seminarzg. Höh Töchterschule) (25).

Anna Dorn entered Zürich in the winter term of 1899, where she worked as Vorlesungsassistentin (unpaid assistant) to Werner (25). This was at a time when he was working as an organic chemist and before the completion of his transition to inorganic chemistry. Accordingly she produced a dissertation (1905) on dibasic organic acids. It was entitled "Beiträge zur Kenntnis der Beziehungen zwischen Affinitäts-Konstante und Konstitution bei zweibasischen organischen Säuren" (25). Her work was evidently not published by Werner (10).

In 1907 she married Alfred Ernst (1875-1968), who had been a graduate student in botany. His dissertation was entitled, "Über Pseudo-Hermaphroditismus und andere Missbildungen der Ongonien bei *Nitella syncarpa*." (26). He was in botany at ETH 1901-1926, presented a habilitation lecture, and held the rank of Ordinarius, serving as Rector 1928-29 (26). The Ernsts divorced in 1926. His second marriage was to Dr. Marthe Schwarzenbach who had also earned her doctorate at Zürich (Matr. Nr. 28263).

Subsequently Dr. Anna Ernst relocated to Kressbronn am Bodensee and devoted many years to collecting material for a biography of her beloved former teacher (10). She was impressive for the nature of her post-graduate life. In the preference and acknowledgment section of his book, George Kauffman described her as "This indomitable octogenarian endowed with the enthusiasm and energy usually reserved for persons one-fourth her age." And he noted, "Despite illnesses and accidents, she never failed to respond to my numerous pleas for information and advice" (10).

Sophie Matissen

Dr. Sophie Matissen was born in Poltawa, then part of Russia (now Poltava, Ukraine) November 25, 1887. She left Konstantinograd, Russia, in 1906 to attend Universität Zürich (27). She was part of the Werner research group, and was acknowledged in a paper dealing with the resolution of an asymmetric cobalt compound (10). Based on her dissertation, she was granted a Ph.D. in May 1912. A paper submitted in 1917 appeared in 1918 in the first issue of *Helvetica Chimica Acta* (28). No additional information was obtained concerning her post-doctoral life.

Jeanne Elizabeth Schwyzer

Dr. Schwyzer was a Swiss woman who was born March 2, 1894, in New York City. The daughter of a physician, Fritz Schwyzer, she died October 24, 1957 (29, 30). Her childhood was spent in New York, where she studied at the Charlton School and Bryn Mawr College. Then she moved with her parents to Switzerland in 1911. At Universität Zürich she took the Eidgenössische Maturität and started a study of medicine (6). Presumably she would have been in Section B of organic chemistry, for medical students, teaching candidates, and food chemists. Perhaps she heard about the lectures in Section A as taught by Werner. In any event she transferred to chemistry and worked under Werner (6, 29).

She received her Ph.D. in 1919 in recognition of a dissertation concerned with 2,4-pentanedionato- (*N*,*N*′-diethylenediamine)cobalt(III) salts (29). Clearly, she must have been the beneficiary of an advisor other than Werner who was suffering from the effects of arteriosclerosis during part of this time (6, 10). We suspect that Paul Pfeiffer, a former Werner student who took over some of his lectures during his illness, was helpful to her. Schwyzer also had her dissertation published in part (10, 31).

In 1920, she married Professor Robert Eder (1885-1944) who at one time was the director of the Pharmazeutisches Institut of ETH (6).

Schwyzer did not pursue a career in chemistry, but perhaps her interests in women's issues had a longer-lasting impact. She served as president of the Swiss Corporation of University Women (1935-1938). She was the co-founder (1935) then president of the FDP (Freisinnig-Demokratische Partei or Free Democratic Party) Frauen der Stadt Zürich (1939-1949), an association concerned with the voting rights of women in Zürich (30). Women achieved the right to vote in Zürich in 1970. Women voted for the first time in national elections March 16, 1971, following an earlier favorable vote by Swiss men in a referendum concerning the right of women to vote (32).

During World War II, she presided over a defense group of the Women's Auxiliary Service, then after the war, she was president of the women's arm of the Swiss intelligence organization, Schweizerisch Aufklärungsdienst (1947-1950). In addition she directed the Third Congress on Women's Interests in Switzerland (Zürich, 1946) (30).

In addition, she was a member of the Board of Directors of the Alliance of Swiss Women's Associations (BSF in German, 1949-1957), president of the committee on international collaboration (1951-1957), and BSF representative on the National Swiss Commission for UNESCO (1949-1954). She served as president of the International Council of Women from 1947 to 1957 (30).

We may easily say that though she did not continue in the field of her training, her post-doctoral contributions were remarkable and probably had a greater impact than had she chosen to pursue a career as a bench chemist or as a faculty member.

Chana Weizmann

Chana Weizmann was born September 14, 1885, in Motol (near Pinsk) in czarist Russia in the so-called "Pale of Settlement" where Jewish families lived. She was named Anushka, one of 15 children of Rachel Chemerinsky Weizmann and Ozer Weizmann (Figure 1). Her father was a lumber merchant, who earned a living by floating logs down the Vistula to Danzig. An older brother, Chaim, would later become a biochemist, a pioneering noted biotechnologist, a significant Zionist, and the first president of the State of Israel (33).

Figure 1*. Weizmann family picture in Motol, 1904. Anushka (also known as Chana or Anna) is standing second from left. Chaim Weizmann is standing third from right (34).*

Chaim went west in 1892, owing to the lack of educational opportunities available to Jews in the "Pale." He earned a Ph.D. degree (*summa cum laude*) in chemistry at the University of Fribourg (Switzerland) in 1899, and accepted teaching posts first at the University of Geneva (1901-1903), then at Manchester (England) (33). While a lecturer at Manchester, Chaim Weizmann discovered how to use bacterial fermentation to produce useful chemicals, a foundational event in biotechnology. He used the bacterium *Clostridium acetobutylicum* (also known as "the Weizmann organism") to produce acetone. This compound was used as a solvent in producing cordite explosive propellants at a critical time for the Royal Navy during World War I. This important achievement was one of the developments that led the British to commit to establishing a homeland for Jews at some future time, as set forth in the Balfour Declaration (33).

We presume that Chaim's experience with opportunities in Switzerland led three of his sisters to study at Zürich. Kauffman tells us that "until World War I, about two-thirds of the women [at Zürich] were medical students, and most of them were Russian" (10). That was true of the Weizmann women. Chana was the first to enroll, in 1906, in chemistry. Mascha and Minna Weizmann followed, in 1907 and 1908 respectively, in medicine. Mascha earned her medical degree there in 1911 (33, 35).

We have found no specific information as to why Chana chose to work with Werner, but assuming she had an interest in chemistry and would have encountered his lecturing, he may have been an obvious choice. She is pictured with the Werner research group including Paul Karrer, Hedwig Kuh, and Sophie Matissen in 1911 (10) the year that she submitted her dissertation "Über den wechselnden Affinitätswert mehrfacher Bindungen."

Interestingly enough her dissertation did not lead to a publication in a refereed journal, according to the list of Werner's publications (10). On the other hand her dissertation of 42 pages was published by a German publisher (Druckerei Gebr. Leemann, 1912), and for a time was available from Amazon.com (January 12, 2009).

She was able to do research and publish in a new area of chemistry (36) in collaboration with G. L. Stadnikov at Khimiya Tverdogo Topliva (Leningrad).

In 1933, she went to the British Mandate in Palestine, where Chaim Weizmann had created a scientific research center in Rehovot, then a "small agricultural community in the British mandate" (37). The Daniel Sieff Research Institute was founded with the assistance of friends, Israel and Rebecca Sieff, and named after their son, Daniel. The Institute was formally dedicated in 1934 with an initial scientific staff of ten, including Anna Weizmann. The Institute housed the private library of Fritz Haber, but it also focused on research related to the country's economy, i.e. "citrus, dairy, silk and tobacco as well as synthesis of chemical products of medical value" (37).

Many of the publications by Dr. Anna Weizmann seem to reflect some of these areas of interest but certainly not all of them (38-42). Upon Chaim Weizmann's death in 1952, Anna Weizmann (Figure 2) took over his laboratory and supervised it until she died in 1965.

***Figure 2**. Dr. Anna Weizman in 1950*

Summary

One might surely wish for more information for all of Werner's women advisees, but it probably safe to say, based on other studies, that few became professors, and at best would become supporting instructors (19). All five that we have considered led productive lives, and one may hope that the same was true of others, though given that the opportunities at the time were limited for what were, clearly to us, highly qualified individuals.

Acknowledgments

We thank Prof. Dr. Jay Siegel, Institute of Organic Chemistry, Universität Zürich and 2010 Martin Lecturer at the University of South Florida, who provided the helpful issue of *Chimia*; Stephanie Pofahl and Enaam Alnaggar, undergraduate research advisees, who provided useful information chiefly from matriculation documents; and Prof. Dr. Roman Manetsch, Northeastern University, who provided useful historical and background information concerning Switzerland.

References and Notes

1. M. Rayner-Canham and G. Rayner-Canham, "Fight for Rights," *Chemistry World*, March **2009,** 56-60.
2. M. Rayner-Canham and G. Rayner-Canham, "Hoppy's Ladies," *Chem. Brit.,* **1999**, *35*(1), 47-49.
3. M. F. Rayner-Canham and G. W. Rayner-Canham, *A Devotion to Their Science: Pioneer Women of Radioactivity,* McGill-Queens University Press, Montreal, and Chemical Heritage Foundation, Philadelphia, 1999.
4. Google Ngram Viewer, http://books.google.com/ngrams/. Ngrams were generated for the time period 1900-2008 for the terms "Marie Curie" and "Madame Curie" on Sept. 13, 2017. Before the mid 1950s the former appeared in print more frequently than the latter, but even at the end of the period the latter appears in print nearly ¼ as frequently as the former.
5. D. F. Martin and B. B. Martin, *Coordination Compounds*, McGraw-Hill, New York, 1964.
6. C. H. Eugster, "150 Years of Chemistry at the University of Zürich," *Chimia*, **2008**, *62*(3), 75-102.
7. For additional background as cited in Ref. 6: E. Gagliardi and H. Nabholz, *Die Universität Zürich 1833-1933 und ihre Vorläufer*, Zürich, 1938. F. Tiburtius, *Erinnerungen einer Achtzigjährigen*, Schwetschke & Sohn, Berlin, 1923.

8. J. R. Huber, "A Brief History of the Institute of Physical Chemistry at the University of Zürich," *Chimia*, **2008**, *62*(3), 103-110.
9. American Chemical Society National Historic Chemical Landmarks. Rachel Lloyd, Ph.D., Pioneering Woman in Chemistry. https://www.acs.org/content/acs/en/education/whatischemistry/landmarks/rachel-holloway-lloyd.html (accessed Sept. 13, 2017).
10. G. B. Kauffman, *Alfred Werner, Founder of Coordination Chemistry*, Springer-Verlag, New York, 1966.
11. G. B. Kauffman, Ed., *Werner Centennial*, Advances in Chemistry Series, Vol. 62, American Chemical Society, Washington, DC, 1967. Based on a symposium sponsored by the Division of Inorganic Chemistry and the Division of the History of Chemistry at the 152nd Meeting of the American Chemical Society, New York, Sep., 1966.
12. G. B. Kauffman, "Some Lesser Known Aspects of the Work and Thought of Alfred Werner," in Ref. 11, Ch. 4, pp 41-69.
13. The Polytechnic did not yet confer doctoral degrees, so the degree was formally granted by the *Zürcher Hochschule*, later named the *Universität Zürich* (Ref. 10, p 19).
14. S. Soloveichik and H. Krakauer, "Alfred Werner," in Ref. 11, Ch. 2, pp 3-7.
15. P. Pfeiffer, "Alfred Werner," *J. Chem. Educ.*, **1928**, *5*, 1090-1098.
16. A. Werner, "Beitrag zur Konstitution anorganischer Verbindungen," *Z. anorg. Chem.*, **1893**, *3*, 267-330.
17. J. C. Bailar Jr., "The Early Development of the Coordination Theory," in J. C. Bailar Jr., Ed., *The Chemistry of the Coordination Compounds*, Reinhold, New York, 1956, pp 100-118.
18. Y. Shibata, "Some Personal Recollections of Alfred Werner," in Ref. 11, Ch. 1, pp 1-2.
19. W. H. Brock, *The Chemical Tree: A History of Chemistry*, W. H. Norton & Co., New York, 2000. G. B. Kauffman was credited for the observation, a but a specific reference was not cited: cf. Ref. 10, Ch. 15.
20. Pictured in Kauffman, Ref. 10, Plate 9, p 71.
21. M. F. Rayner-Canham and G. W. Rayner-Canham, "Pioneering Women Chemists of Bedford College." http://www.rsc.org/education/eic/issues/2006May/Pioneering-Women.asp (accessed Sept. 13, 2017).
22. I. Bernal and G. B. Kaufmann, "The Spontaneous Resolution of *cis*-Bis(ethylenediamine)dinitrocobalt(III) Salts: Alfred Werner's Overlooked Opportunity," *J. Chem. Educ.*, **1987**, *64*, 604-610.
23. K.-H. Ernst, F. R. W. P. Wild, O. Blacque and H. Berke, "Alfred Werner's Coordination Chemistry: New Insights from Old Samples," *Angew. Chem. Int. Ed. Engl*., **2011**, *50*, 10780-10787.
24. R. Brandon, "Going to Meet Mendeleev," *New Scientist,* **1975**, *67* (Sept. 11), 593.
25. Universität Zürich Matrikeledition, Dorn (oo Ernst) Anna (Elisabeth), http://www.matrikel.uzh.ch/active/static/25638.htm (accessed Sept. 13, 2017).
26. Universität Zürich Matrikeledition, Ernst Alfred, http://www.matrikel.uzh.ch/active/static/5541.htm (accessed Sept. 13, 2017).
27. Universität Zürich Matrikeledition, Matissen Frl. Sophie, http://www.matrikel.uzh.ch/active/static/26928.htm (accessed Sept. 14, 2017).
28. A. Werner, and S. Matissen, "Zur Konstitution der inneren Metallkomplexsalze," *Helv. Chim. Acta*, **1918**, *1*, 78–84.
29. Universität Zürich Matrikeledition, Schwyzer (oo Eder) Frl. Jeanne Elizabeth, http://www.matrikel.uzh.ch/active/static/27742.htm (accessed Sept. 14, 2017).
30. R. Ludi, "Eder [-Schwyzer], Jeanne," (2005) in *Historisches Lexikon der Schweiz* online, http://www.hls-dhs-dss.ch/textes/d/D9292.php (accessed Sept. 14, 2017).
31. A. Werner, J. E. Schwyzer and W. Karrer, "Ueber einige optisch-aktive Kobaltsalze mit β-Diketonresten im Komplex," *Helv. Chim. Acta*, **1921**, *4*, 113-129. This was evidently Werner's last publication in a refereed journal.
32. FDP Frauen der Stadt Zürich, "Zeit für Neuzeit: Frei(sinnig)er denken und handeln!," downloaded from http://www.fdp-zhstadt.ch/pdf/1114177659.pdf (accessed July 25, 2014). Archived at the Internet Archive, https://web.archive.org/web/20050525091454/http://www.fdp-zhstadt.ch/pdf/1114177659.pdf (accessed Sept. 15, 2017).
33. N. Rose, *Chaim Weizmann: the Making of a Zionist Leader*, Viking, New York, 1986.
34. JewishGen KehilaLinks, Weizmann Family from Motol, http://kehilalinks.jewishgen.org/motol/weizmann_family_from_motol.htm (accessed Sept. 14, 2017).
35. Universität Zürich Matrikeledition, Weizmann Chana (= Anna) http://www.matrikel.uzh.ch/active/static/28202.htm (accessed Sept. 15, 2017). Records for sisters Mascha and Minna are also available online via http://www.matrikel.uzh.ch/active/static/623.htm
36. G. Stadnikow and A. Weizmann, "Ein Beitrag zur Kenntnis der Umwandlung der Fettsäuren im Laufe der geologischen Zeitperioden," *Brennstoff-Chemie*, **1929**, *10*, 61-63. The same authors published paper III with the same title, which translates to "A Contribution to the Knowledge of the Transformations of Fatty Acids in the Course of Geologic Periods" in the same journal, **1929**, *10*, 401-403.]
37. M. Levy and G. Martin, "Chemistry at the Weizmann Institute: A Concise History," Downloaded from http://www.weizmann.ac/il/chem/history.shtml (accessed July 28, 2014). Archived at the Internet Archive, https://web.

archive.org/web/20131030200509/http://www.weizmann.ac.il/chem/history.shtml (accessed Sept. 15, 2017).

38. E. Bergman and A. Weizmann, "Dipole Moment of Ethyl Benzoate," *J. Am. Chem. Soc.*, **1935**, *57*, 1755.
39. H. Pines, A. Weizmann, and V. N. Ipatieff, "Hydrogen Transfer. II. Reaction of Diisopropyltoluene and Isopropyl Cyclohexyltoluene with Methyl-cyclohexene," *J. Am. Chem. Soc.*, **1948**, *70*, 3859- 3862.
40. A. Weizmann, "Isolation of Colchicine from Colchicum Hierosolymitanum," *Bull. Res. Council Israel*, **1952**, *2*, 21-26.
41. Y. Mazur, A. Weizmann and F. Sondheimer, "Steroids and Triterpenoids of Citrus Fruit. III. The Structure of Citrostadienol, a Natural 4α-Methylsterol," *J. Am. Chem. Soc.*, **1958**, *80*, 6293-6296.
42. Y. Mazur, A. Weizmann and F. Sondheimer, "The Carbon Skeleton of the α-Sitosterols," *Bull. Res. Council Israel*, **1958**, *7A*, 82-83.

About the Authors

Barbara and Dean Martin have collaborated for 45 years in the Department of Chemistry at the University of South Florida (USF) where Dean is an emeritus professor and Barbara has held a courtesy appointment as an assistant professor. They met at Grinnell College where they earned B.A. degrees, and they earned graduate degrees at Penn State (Dean, Ph.D.; Barbara, M.S.). Their collaboration in applied coordination chemistry has involved studying the Florida Red tide organism, nuisance aquatic vegetation, and management of nuisance chemical species. They have collaborated on two books and about sixty publications. They were co-recipients of The Florida Medal of the Florida Academy of Sciences (1994). The Martins served as editors of Florida Scientist (1984-2010). Dean Martin taught a course "Historical Perspectives of Chemistry" for about ten years prior to his retirement in 2006. The Martins became interested in Alfred Werner as a result of their graduate research and first book, *Coordination Compounds* (1964).

2017 HIST Award to Jeffrey I. Seeman

The History of Chemistry Division (HIST) of the American Chemical Society (ACS) is pleased to announce that Dr. Jeffrey I. Seeman of the University of Richmond is the winner of the 2017 HIST Award for Outstanding Lifetime Achievement in the History of Chemistry. This international award has been granted since 1956 under sequential sponsorships by the Dexter Chemical Company, the Edelstein Foundation, the Chemical Heritage Foundation, and the History of Chemistry Division. A symposium honoring the work of Dr. Seeman will take place on March 20, 2018, at the ACS Spring meeting in New Orleans.

Seeman was born on May 25, 1946 in Jersey City, NJ. He graduated from the Stevens Institute of Technology in nearby Hoboken in 1967 with a degree in Chemistry with high honors. He earned a Ph.D. in Organic Chemistry in 1971 from the University of California at Berkeley. After an NIH Staff Fellowship at the National Institutes of Health in Bethesda, MD, he joined the Philip Morris Research Center in 1973 in Richmond, Virginia, and worked for them until 1999. For the past 10 years, he has been at the University of Richmond.

Among the highlights of Seeman's work in history of chemistry are his proposing and editing a series of autobiographies of eminent chemists issued as *Profiles, Pathways and Dreams* from 1990-1997; his service on the Heritage Council and Board of Directors of the Chemical Heritage Foundation; chair of the Division of the History of Chemistry of the American Chemical Society (HIST); and impresario of HIST's Citation for Chemical Breakthrough (CCB) Award program. More information on Seeman and the award can be found at http://www.scs.illinois.edu/~mainzv/HIST/awards/hist_award.php .