The amazing life of Ellen Swallow Richards;

A look at one of the most respected women of science

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I want to have lunch with Ellen Henrietta Swallow Richards. You know how they ask that question about what famous person you'd like to meet? I want to know how she made the time to do all that she did. As Frank Aplan and I researched her life for a nomination to the National Mining Hall of Fame (she was inducted in 2014) and for a presentation at the first TMS Diversity Summit that same year, I became amazed at this Renaissance woman.

In addition to her accomplishments in ore chemistry and the minerals industry, she did so much more. She created the Women's Laboratory at the Massachusetts Institute of Technology (MIT) after she found funding for the equipment. She founded the American Association of University Women. She founded ecology or the art of right living, as she termed it. In his 1973 book, Robert Clarke recognized Ellen Swallow as "The woman who founded ecology." She founded home economics from her experiments within the schools of Boston, MA with food chemistry and nutrition, and used her home as a model for proper ventilation. But she also read novels, attended the theater, corresponded with friends and relatives and was part of the Boston social and business scene, with guests in her home weekly and students as boarders. And she traveled, which was no small feat in the late 1800s.

Ellen Swallow was born in 1842 near Dunstable, MA. She got a late start on her career, as she helped her parents with the family business, not graduating from Vassar with her B.A. until 1870 when she was 28 years old. Then she became an experiment at MIT as its first female student. Since she was an experiment, the school waived her tuition. It really was the only way she could afford to continue her education. In a later letter, she indicated that if she had known that the tuition waiver was because she was a woman, she would have declined the offer. MIT was founded in 1861, and she graduated with her B.S. in chemistry in 1873. With that degree she became the first U.S. woman chemist. She then became the first female faculty member at MIT and founded the school's Women's Laboratory to teach women so that they could become science teachers in the public school system or continue with their science educations. Several of the 14 books written in the last decade of her life speak for themselves: *Air, Water and Food*, 1900; *The Art of Right Living*, 1904; *Sanitation in Daily Life*, 1907; *The Cost of Living*, 1899; *The Cost of Food*, 1901; *The Cost of Shelter*, 1905 and *The Cost of Cleanness*, 1908. And, FYI, you can get reprints of most of these on Amazon.

In 1872, while an undergraduate at MIT, Swallow isolated 0.02 percent vanadium from a sample of an ore, a very difficult analysis at that time. Her work on vanadium was recognized by Vassar with a M.A. degree in chemistry in 1873. That thesis, according to the Vassar College archives, was titled "Notes on the estimation of vanadium in an iron ore from Cold Spring N.Y."

Also as an undergraduate, she studied a sample of samarskite and identified an insoluble residue later identified by others as two new rare

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Safety share: For some of us, October means it's time to prepare for cold weather. Here is Caterpillar's take on cold weather preparations.

- Be aware of current weather conditions — Stay informed of potentially hazardous weather — monitor weather forecasts.
- Dress appropriately — Wear layers of loose fitting clothing — stay dry with water resistant clothing — wear windproof material as an outer shell — wear clothing with proper ventilation — keep a spare set of clothes on hand.
- Protect head, feet and hands — Keep head covered whenever possible – when head protection is necessary, make sure it is equipped with an insulated liner – protect feet with insulated socks, wear two pairs if feasible – protect hands with insulated gloves.
- Exposure guidelines — Restrict exposure time if temperatures reach -17° C (0° F) – restrict exposure time if wind chills reach –30° C (-22° F)

Submitted by Caterpillar (http://safety.cat.com/toolbox)

Value share: "Most people are afraid of what will happen when they go outside the lines."

K. Melissa Kennedy, "The Innovation Revolution: Discover the Genius Hiding in Plain Sight"

President's Page: Remembering one of the trailblazers in mining

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earth elements: samarium and gadolinium. While she was writing her master's thesis for Vassar, she completed her thesis for her B.S. in chemistry at MIT also in 1873. It was titled "Notes on Some Sulpharsenites and Sulphantimonites from Colorado."

In 1877, she published "A New Method to Determine Nickel in Pyrrhotites and Mattes." This likely earned her recognition as a fellow of the American Association for the Advancement of Science. In 1879, she became the first female member of the American Institute of Mining Engineers (AIME) and was the only woman member throughout her lifetime. AIME had only been founded in 1871. With all of this, she became a recognized international expert mineralogist and was sought out for her thorough and expert analyses.

After graduation with her B.S., she married mining professor Robert Richards. Ellen was fluent in German and translated German mining and metallurgy publications for professor Richards as both an undergraduate and later as his wife. This was when most significant mining and mineral processing publications were published in German. In an era of great expansion in mining in the western United States, she organized housing, tours and engineering experiments for Richards' MIT mining field camp each summer and participated in the camps, including underground mining experiences and including one as her honeymoon. She taught his mining engineering classes while he recovered from typhoid pneumonia during a two-year period in the mid-1880s. SME's Mineral & Metallurgical Processing Division presents the Robert H. Richards award to recognize achievement in any form that unmistakably furthers the art of mineral beneficiation in any of its branches.

I'd like to focus a bit on what I think was one of Swallow Richards' major contributions to the mineral industry, all because of her attention to detail and thoroughness. No reference has the particular date when David H. Browne showed up at MIT with his ore sample from the Copper Cliff Mine in Sudbury, ON, Canada. However, it appears to be some time after Swallow Richards had developed her technique for determining nickel, so it would be in the early 1880s. At MIT, the copper ore sample that he brought in was given to Swallow Richards for analysis. Rather than simply analyzing the ore for copper content, she did a complete analysis, including using her technique for determining nickel. The other four assayers that Browne went to simply gave the value for copper. Ellen provided a complete analysis, including 5 percent nickel. Why is this significant? Copper Cliff became one of the first major nickel mines in Sudbury, kicking off the Sudbury nickel industry.

In the 1903 Report of the Bureau of Mines in Ontario, we read about the Sudbury nickel deposits and the development of mining in the district. "Though nickel and copper were discovered in the Sudbury district in 1856 by Murray at what is now the Creighton Mine, undoubtedly the most productive existing nickel mine, no importance was attached to this occurrence as long as the region was inaccessible except by canoes; and the history of mining in the district dates from the construction of the Canadian Pacific Railway in 1882, when the ore deposit, later called the Murray Mine, was disclosed. In 1883, the orebodies of what are now the Stobie and Copper Cliff mines were found. But, at first, they were taken up for their copper contents, and it was only three or four years later, after a thousand tons of the Copper Cliff ore had been sent away for treatment, that its value as an ore of nickel was established."

I think this is when Swallow Richards made her mark.

As I'm sure most of you know, the Sudbury nickel deposits continue to be a major source of nickel for not only Canada but also the United States and many other countries. Why was nickel so important? It had been used for a long time as coinage and the United Sates still uses nickel in our nickels today (though maybe not much longer). But at that time, the era of "nickel steel" was beginning — nickel steel being less corrosive and stronger than ordinary steel. We'd see more stainless steel production as the 1900s began. Copper Cliff North and Copper Cliff South are still on the map in Sudbury. And just a note that Browne would go on to write several papers on processing nickel ores and their uses.

In 1910, Swallow Richards received an honorary doctorate from Smith College. This was a bit of a jab at MIT, as they didn't want a female to receive their first Ph.D. in chemistry, though she had certainly done the work and received international acclaim. Ellen passed away a year later having suffered from increasingly poor health over the last 10 years of her life. But what a life. So should we have lunch with Ellen Swallow Richards? I think it would be a blast. ■