



From the Board – Impact of our Communities

The story of aluminum's commercial use is recent compared to other metals like steel and bronze. The pair of articles in this newsletter talk about its earliest beginnings, and the importance of our communities to develop uses with global impact. If you look deep enough, I'll bet you'll find people in your community, maybe even your family, who have made a significant impact in something. Check it out!

Paul Louis Toussaint Héroult – The Imaginative Engineer [1]

Like Charles Martin Hall of Ohio, Paul Louis Toussaint Héroult of France was obsessed at an early age with becoming an inventor. In 1886 both men independently invented the modern electrolysis process of aluminum production. It has never been entirely clear who was the first to produce pure aluminum.

Héroult's father, Patrice, a tannery owner near Paris, died in 1883, one year after Paul had entered the Paris School of Mines. Paul began to use the tannery's steam generator for another purpose. He connected it to a small dynamo to run experiments on electrochemical production of aluminum. Inheritance from his father's estate created the opportunity to also purchase a larger dynamo in early 1886 [2].

So, at the age of twenty Héroult was focused on using dynamos and electric-arc heat to liberate aluminum from oxygen. His early experiments indicate that he started out using so much energy it created conditions by which aluminum re-oxidized as quickly as it was produced. He had been trying to prevent formation of a frozen crust on the surface of the cryolite so that his electric furnace could regularly be "fed" with small doses of alumina. [3]

His patent application was submitted a few months before Hall's. It was based on a solid concept. But his experiments involved co-reduction of small amounts of copper oxide along with aluminum oxide in order to "trap" the aluminum [1]. He was producing what was commonly known as aluminum bronze. It appears that Hall was the first to produce pure aluminum by electrolysis on February 23, 1886 in a woodshed on the back of his family home.

When Héroult began collaborating with Martin Kiliani [2], a German metallurgist, at his first smelter in Neuhausen, Switzerland, they figured out how to feed a crusted cell. They were then able to reduce the energy input enough to produce pure aluminum without relying upon copper. Commercial production began at Neuhausen in August 1888, a few months before the Pittsburgh Reduction Company began metal production in Pittsburgh, PA.

Neuhausen's main focus was on low cost production of aluminum bronze, a material in demand. In 1888 there were no common applications for pure aluminum. Co-reduction of aluminum with copper wasn't a problem.

Early cell designs by Héroult and Kiliani in France included pots that were rotated with fixed anode positions and stationary pots in which the anode was rotated.

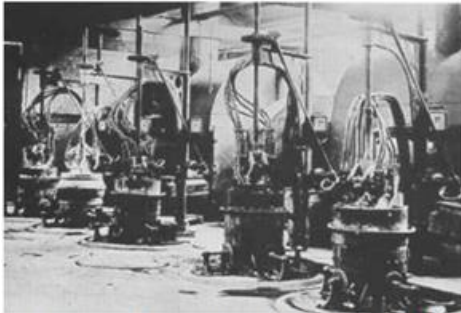


1890 : Froges 4 kA

Photo of 1890 electrolysis shop in Froges, France, Héroult's second smelter, with pots that rotated



Rotation was thought to help to stir alumina in the cryolitic bath. Stirring soon proved to be unnecessary. The story goes that one weekend the rotation equipment failed but the pots continued to make metal just as well.



1890 : «Marmites » de 5 à 6 kA

Photo of early Héroult pots in Froges, France

Héroult's experiments with aluminum and his work with the development of electric furnaces led to international success in steel production. His electric-arc furnaces for steel became widely used around the world.



1905 – Héroult electric-arc furnace [4]

Héroult's approach was that of an engineer, whereas Hall had taken the approach of a scientist. Héroult's development of electric furnace technology enabled the discovery of inexpensive and practical ways to fulfill his original ambition for aluminum production as well as for aluminum bronze and steel.

The author, Stephen Lindsay, is a graduate of Clarkson College of Technology who began his 40-year career with Alcoa at Massena Operations in 1979 as a Process Engineer.

[1] Acknowledgements to: Maurice Laparra and the Institut pour l'histoire de l'aluminium, and Revue Cahiers. <https://www.cairn.info/revue-cahiers-d-histoire-de-l-aluminium-2012-1-page-84.htm>

[2] Acknowledgement to: <https://corrosion-doctors.org/Biographies/HeroultBio.htm>

[3] P. Stobart, *Centenary of the Hall & Héroult Processes 1886-1986*, International Primary Aluminium Institute, London, 1986, p. 32

[4] Acknowledgement to Duetsches Werkzeugmuseum in Remscheid, Germany: <https://www.youtube.com/watch?v=V8VvluddUGc>

The First Aluminum Bridge

Seventy-five years ago, in the autumn of 1946, a world's first occurred in Massena, NY. A 100 foot span of Alcoa aluminum was placed on a new railroad bridge over the Grasse River. This was a post-war demonstration using a "battle tested" material, aluminum, as plate girders, to support heavy loads.

Aluminum had only been used once on a bridge, prior to this time. In 1933 Alcoa, Massena Operations had formed aluminum channels used for new decking of the Smithfield Street Bridge in Pittsburgh, PA. The replacement of iron by aluminum reduced the dead weight by 750 tons. The change enabled the traffic carrying capacity of the bridge to quadruple.

For the next thirteen years there wasn't another example of aluminum bridge construction anywhere in the world. The focus for use the lightweight metal had soon shifted to military applications including aircraft. It



wasn't until after WWII that the output of the aluminum industry diversified into a wide variety of new applications, including construction materials.



MTRR Girder Bridge over Grasse River [1]

Use of aluminum in other bridges followed. Unlike steel bridges, aluminum offered advantages of being lighter, highly resistant to corrosion, and low in on-going maintenance costs. However, its use as a building material never truly became commonplace. The construction costs for bridges of steel or reinforced concrete remained lower.

Nonetheless there are now hundreds of examples of aluminum bridges around the world and the very first span, which is still in operation, can be found in Massena, NY.

The author, Stephen Lindsay, is a former resident of Massena. His north country heritage goes back five generations to when his ancestors emigrated from Germany to northern New York in the early 1800's.

[1] Photo credit:Nathan Holth, April, 2018
<https://historicbridges.org/bridges/browser/?bridgebrowser=newyork/massenarrgirder/#photos/videos>

To read the full article: The First Aluminum Bridges and Alcoa-Massena Operations go to the NAPHA link at:

<http://www.naphausa.org/newsletters/>



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