HALL-HEROULT CENTENNIAL: First Century of Aluminum Process Technology 1886-1986

Edited by:
Warren S. Peterson
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Hall-Héroult Centennial

First Century of
Aluminum Process Technology
1886 - 1986

The anniversary volume sponsored by the Light Metals Committee of The Metallurgical Society and presented at the 115th TMS Annual Meeting held in New Orleans, Louisiana, March 2-6, 1986.

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Preface

One hundred years ago, two young men, oceans apart, independently devised a new method of making aluminum. This discovery in 1886 by Charles M. Hall in the United States and Paul T. Héroult in France gave the world the shiny light metal at costs that made it competitive in the market place.

The Light Metals Committee of The Metallurgical Society is proud to celebrate the anniversary of this important event by publishing Volume I of *Light Metals 1986* as a Centennial Edition.

This special edition has two parts: a pictorial section and a series of invited papers. The objective is to highlight with pictures and text the important developments in the past one hundred years in the process metallurgy of aluminum. This includes the electrolytic method of making aluminum, emission and waste control measures in plant operations, manufacture of carbon electrodes, methods of processing bauxite and alumina, technology for melting and casting process ingots and processes for reclamation and recycling.

**Pictorial Review**
This collection shows “how it was” and “how it is now”, during the years in which the infant aluminum industry grew into a giant. Many companies from all over the world opened their archives to provide a large collection of photos from which to make selections. The Russians were invited, but, regrettably, did not respond.

Wherever possible, photographs were chosen which show people at work. This is fitting because this Centennial Edition is a tribute, not only to Hall and Héroult, but to all the men and women who have made contributions to the Aluminum Industry.

In addition to material from industry, we have drawn heavily upon the literature for drawings and photographs to provide a visual record of the changing nature and scale of the numerous processes involved in making aluminum and aluminum process ingots.

**Invited Papers**
An important part of this Hall-Héroult Centennial volume is a series of papers by experts in their fields. A pair of human interest reports tell us about the personal lives of Charles Hall and Paul Héroult at the time of their discovery. These reports are followed by papers describing developments in technology, equipment, and practice in the various areas of aluminum process metallurgy during the past one hundred years.

**Ronald E. Miller,**
Chairman
Light Metals Committee
Acknowledgements

Pictorial Review
This Pictorial Review is the result of efforts of many individuals and companies. Without their willingness to open their files and send photos, this Review could not have been assembled.

We are indebted to the following companies: Air Industrie, Alcan, Alcoa, Almeq, Alusuisse, Aluminum Association, Arco Metals, ASV, British Alcan, Consolidated Aluminum Company (Conalco), Commonwealth Aluminum Company (Comalco), Elkem, Granges Aluminum, Hazelett, Hunter Engineering, Intalco, Japan Aluminum Federation, Kaiser Aluminum and Chemical Corporation (KACC), KBI (Cabot Corporation), Loma Machine, Mitsui Aluminum, National Southwire Aluminum, Norsk Viftefabrikk (Flakt), Pechiney, Properzi International, Pyrotek, Reynolds Metals Company, Showa Aluminum K.K., Sumitomo Aluminum, Union Carbide (Linde Division), VAW, Wagstaff Engineering.

I will not list, but hereby, thank all contributors. A special acknowledgement is due to: Kjell Nielson (consultant); W.O. Stauffer (consultant); J. Peter McGeer, G.G. Robertson (Alcan); Vergi Sapp, Ronald E. Miller, Gordon Bell (Alcoa); Ulrich Mannweiler (Alusuisse); Andreas Anderson (ASV); David Williams, H. McDonald (Conalco); Gunnar Sem (Elkem); T. Pritchard, H.E. Miller, W. Kramer, B.J. Foster, R. Zabreznik (KACC); F.R. Mollard (KBI); A. Nussbaum (Loma Machine); N. Bjune (Mosal); E. Keul (Norsk Viftefabrikk); Prof. N. Craig (Oberlin College); Christian Bickert (Pechiney); A. Roy (Pyrotek); C.M. McMinn, S. Levy, J. Creel (Reynolds Metals); T. Matshushima (Showa); K. Yamada (Sumitomo); G. Winkhaus (VAW); W. Wagstaff (Wagstaff Engineering).

Also, special appreciation and thanks to Elizabeth Luzar, Gayle Geddes and the TMS staff, and particularly to my wife.

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Invited Papers
A special thanks is extended to Dr. Subodh K. Das of Arco Metals for soliciting the invited papers, and to each invited author who contributed to this volume: P. Atkins, D. Belitskus, C. Bickert, N. Craig, R. Friederich, W. Haupin, J. P. McGeer, N. Oberg, W. Peterson, N. Richards, B. Welch.

W.S. Peterson
R.E. Miller
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## Abbreviations
Abbreviations used in the captions to the photos and figures include:

- CWBP: center work prebake pot
- DC: direct chill
- EM: electromagnetic
- HDC: horizontal direct chill
- HSS: horizontal stud Soderberg
- kA: kilo amperes
- MW: mega watts
- PBA: prebake anode
- SWPB: side work prebake pot
- VSS: vertical stud Soderberg

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1. Charles Martin Hall.  
Born December 6, 1863 in Thompson, Ohio and later moved with his family to Oberlin, Ohio. Graduated from Oberlin in 1885. Worked in family woodshed on aluminum experiment. Died December 27, 1914 at the age of 51.

2. Original Hall patent.  
Alcoa.


6. The Héroult Tannery, Gieutre, France, where Héroult discovered the electrolytic process for producing aluminum. Alcoa.
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Reduction Technology

9. The 1890 site of the first European aluminum smelter near the "Rhinefall", Switzerland. Alusuisse.


13. Interior of the Pittsburgh Reduction Company's Smallman Street Plant showing aluminum reduction pot circa 1888. Alcoa.

15. Pot with six cylindrical anodes corresponding to the first type of pot installed by Héroult at the La Paz Plant in 1893. Pechiney.

16. Héroult pot with four electrodes; his first attempt to lower the current density in 1892-93. Pechiney.
17. Alcan's first smelter and cable plant at Shawinigan located on hilltop above powerhouses. Electricity was conducted uphill on bundles of aluminum rods erected 1901. Alcan.

18. The Pittsburgh Reduction Company's smelter rises brick by brick, leading to the first aluminum production in Canada, October, 1901. Alcan.
19. The original Hall pot as installed in 1901 with its small pre-baked anodes up to 64 in number at Shawinigan, Alcan.

20. Hall pots at Shawinigan Plant during the early 1900s. Alcan.


22. Alcoa Tennessee Smelting Works pictured here February 4, 1952, originally installed in 1914. Last line of so-called Hall type pots closed down after 38 years. Except for size, same type of cell had been used since production began in 1888. Alcoa.
23, 24. Prebake pots at Hoyanger, Norway circa 1917. ASV.

25. 16kA PBA pot circa 1920 in Neuhausen, Switzerland. Alusuisse.
