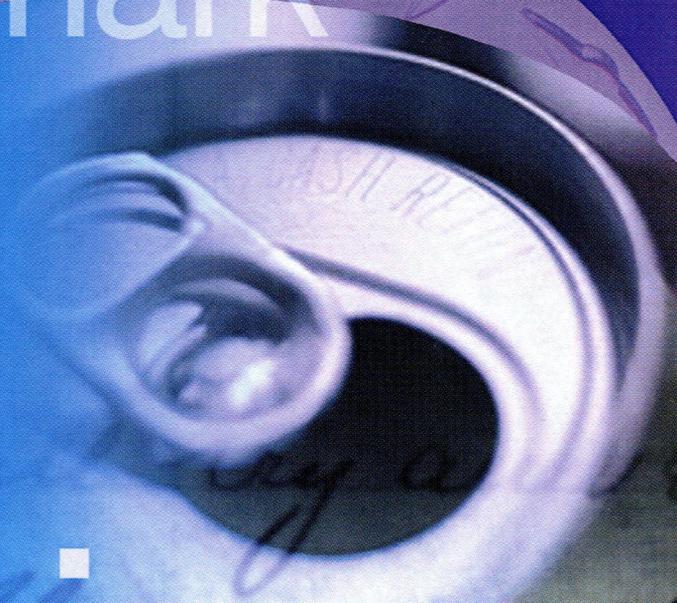
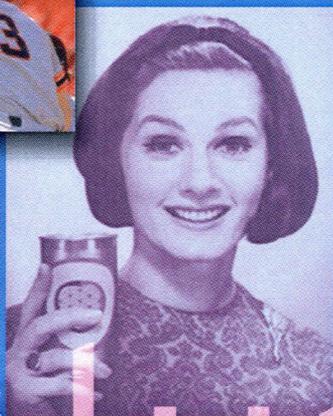


Commercialization of Aluminum  
Pittsburgh, Pennsylvania  
November 2, 2001

# Historic Chemical Landmark



# aluminum



AMERICAN CHEMICAL SOCIETY  
SCIENCE THAT MATTERS

# metal of the modern era

*When aluminum was first introduced to the public at the Paris Exposition of 1855, a writer for National Magazine remarked, "just now, in this new metal, so long concealed in every hill-side, and even in the very dust of our streets, science seems about to make over to the arts one of her occasional bestowments, by which both the knowledge and power of our race are, at an instant, so widely increased."*

## Celebrating chemistry

*The American Chemical Society designated the Commercialization of the Hall Aluminum Process a National Historic Chemical Landmark in Pittsburgh, Pennsylvania, on November 2, 2001.*



Aluminum often replaces steel in structures such as the Empire State Building.

## The aluminum revolution

Aluminum, the third most abundant element in the earth's crust—and its most plentiful metal—is made from bauxite, a reddish-brown rock discovered in Les Baux, France, in 1821. In 1886, chemists finally discovered an economical way to separate pure aluminum from aluminum oxide (alumina) and two years later, commercial aluminum began to revolutionize the world.

## The path to progress

More than 7,000 years ago, Persians made their strongest pottery out of clay containing aluminum oxide. But because aluminum has a high affinity for oxygen and never occurs in its metallic form in nature, it proved difficult to isolate. In 1825, the Danish chemist Hans Christian Oersted finally produced a sample—albeit very impure—using heat and a potassium-based mixture. Over the next 20 years, Friedrich Wöhler, a German chemist, improved this process by using metallic potassium.

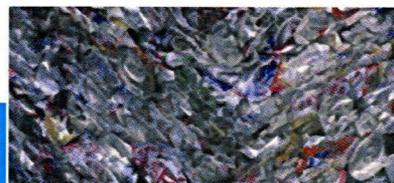
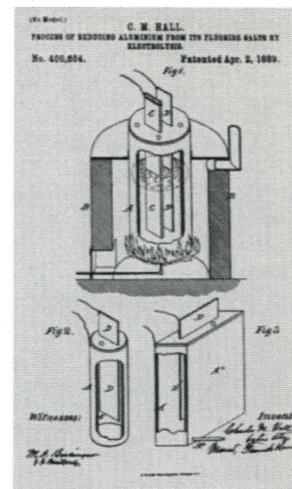
Since 1972, an estimated 660-plus billion beverage cans have been recycled—placed end-to-end, they could stretch to the moon nearly 300 times.

## The Paris debut

Henri Sainte-Claire Deville of France substituted potassium with less expensive sodium in 1854 and created enough aluminum for display at the Paris Exposition of 1855. Billed as "silver from clay," aluminum bars were shown alongside France's crown jewels. At that time, pure aluminum was valued at \$115 per pound—more expensive than gold. Napoleon III proudly displayed aluminum cutlery at his state banquets and even had an aluminum and gold baby rattle made for his son.

## Young scientists

In 1886, Charles Martin Hall of the United States and Paul L.T. Héroult of France—both age 22—independently discovered the way to produce aluminum economically. Hall, under the initial direction of his Oberlin College professor, Frank Fanning Jewett, developed a method for "reducing" alumina to pure aluminum by electrolysis. In the electrolytic cell, alumina is dissolved in molten cryolite. A strong electric current passes through the solution and removes the oxygen, leaving deposits of nearly pure aluminum, which are siphoned off and cast into pigs. This method is still used today.



## Commercialization: aluminum to the forefront

A group of six industrialists led by Alfred E. Hunt provided the financial-backing that enabled Hall to found the Pittsburgh Reduction Company in 1888. Before the year was out, Hall and his first employee, Arthur Vining Davis, had produced the first commercial aluminum.

As Hall improved his process, the price of aluminum ingots dropped from \$4.86 per pound in 1888 to 78 cents in 1893. Because manufacturers were reluctant to use an unfamiliar metal, the company developed prototype products such as the first cast aluminum tea kettle.

## The first name in aluminum

In 1907, the company was renamed the Aluminum Company of America (Alcoa). Business grew as manufacturers grasped the benefits of this light, lustrous, non-rusting metal. In the mid-1930s, industrial designer Henry Dreyfuss predicted that “aluminum will play a large and significant part” in the “greatest period of redesign the world has known.” By the late 1930s, a pound of aluminum cost just 20 cents and its uses numbered more than 2,000.

## At the front

Aluminum was at the forefront of the development of our industrial society and also played a strategic role in World War II. Demand doubled as the material spawned a new generation of aircraft and automobiles. Today, the United States is the world’s greatest producer and consumer of aluminum—metal of the modern era.

## A multi-use metal

### • Aluminum as art

In contact with air, aluminum becomes covered with a transparent layer of aluminum oxide that does not tarnish or rust. “Eros,” the aluminum statue by Sir Alfred Gilbert erected in Piccadilly Circus in 1893, stands unaffected by the elements. Austrian architect Otto Wagner was among the first to use aluminum to accent modern buildings such as Die Zeit (1903).



### • The property of conductivity

More than 90 percent of the power lines in the United States are made of aluminum. In 1884, a 100-ounce cast aluminum pyramid was placed atop the Washington monument as a lightning conductor. Also an excellent conductor of heat, the metal is used in automobile radiators, cooling coils and heat fins.

### • Metal on the move

Transportation is the largest sector of the aluminum market, as composites replace heavier metals in fuel-efficient cars and trucks. The Wright Brothers made the engine block of their 1903 flyer out of aluminum. Union Pacific Railroad launched the first all-aluminum, high-speed train in 1934.

### • Structural engineering

Aluminum often replaces steel in structures such as the Empire State Building. Pure aluminum is weaker than steel, but aluminum combined with other elements can provide equal strength while weighing 35 to 80 percent less.

### • Packaging products

More than 20 percent of the aluminum manufactured goes into packaging. About 100 billion aluminum beverage cans are produced annually in the United States and half of each can is made from recycled aluminum—the most reused packaging material.

### • Reduce, reuse, recycle

The first all-aluminum beverage can appeared in 1963 and the first recycling effort began in 1968. In 2000, the recycling rate for aluminum cans was more than 60 percent, compared with only 15.4 percent in 1974.

Charles Martin Hall would have been proud that the process he discovered—and its commercialization—would also create valuable recycled materials.

## Charles Martin Hall: aluminum’s ‘boy wonder’

At age 12, Charles Martin Hall began experimenting with minerals, turning a small woodshed behind his home into a makeshift laboratory. He first studied chemistry using an 1840s textbook from the shelves of his minister father’s study. By age 16, he was a freshman at Oberlin College. His chemistry professor, Frank Fanning Jewett, showed students a small bit of aluminum and said the person who discovered an economical way to produce the metal would become rich. Hall leapt at the challenge.

Hall was born in Thompson, Ohio in 1863. He graduated from college in 1885 and went back to his woodshed to work on the purification of aluminum. On February 23, 1886, Hall produced his first small bits of aluminum using molten cryolite, aluminum oxide and homemade batteries.

Hall founded the Pittsburgh Reduction Company, and in 1888, began production of pure aluminum on a commercial scale. In 1907, the company became the Aluminum Corporation of America (Alcoa). He spent the next 25 years perfecting his process and developing the aluminum industry.

In 1911, Hall was awarded the Perkin Medal for his accomplishments. He died in Daytona Beach, Florida in 1914.



The American Chemical Society designated the production of aluminum by electrochemistry in Oberlin, Ohio, a National Historic Chemical Landmark on September 17, 1997. The plaque commemorating the event reads:

*On February 23, 1886, in his woodshed laboratory at the family home on East College Street, Charles Martin Hall succeeded in producing aluminum metal by passing an electric current through a solution of aluminum oxide in molten cryolite. Aluminum was a semiprecious metal before Hall's discovery of this economical method to release it from its ore. His invention, which made this light, lustrous, and nonrusting metal readily available, was the basis of the aluminum industry in North America.*

The American Chemical Society designated the commercialization of the Hall aluminum process in Pittsburgh, Pennsylvania, a National Historic Chemical Landmark on November 2, 2001. The plaque commemorating the event reads:

*In 1886 Charles Martin Hall invented an economical electrochemical process to release aluminum from its ore. Until then, this light, lustrous and non-rusting metal was rare and costly. A group of Pittsburgh investors, headed by metallurgist Alfred E. Hunt, agreed to support the commercialization of Hall's process and founded the Pittsburgh Reduction Company. In 1888 Hall, assisted by Arthur Vining Davis, began to produce aluminum in the company's pilot plant on Smallman Street. In 1907 the company became the Aluminum Company of America (Alcoa). Aluminum has since become part of everyday life with many uses—from teakettles in the early days, to aircraft, power lines, building materials, food packaging, and artwork.*

## About the National Historic Chemical Landmarks Program

The American Chemical Society, the world's largest scientific society with more than 163,000 members, has designated landmarks in the history of chemistry for more than a decade. The process begins at the local level. Members identify milestones in their cities or regions, document their importance, and nominate them for landmark designation. An international committee of chemists, chemical engineers, museum curators, and historians evaluates each nomination. For more information, please call the Office of Communications at 202-872-6274 or 800-227-5558, e-mail us at [nhclp@acs.org](mailto:nhclp@acs.org), or visit our Web site: [chemistry.org/landmarks](http://chemistry.org/landmarks).

A non-profit organization, the American Chemical Society publishes scientific journals and databases, convenes major research conferences, and provides educational, science policy and career programs in chemistry. Its main offices are in Washington, DC, and Columbus, Ohio.

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