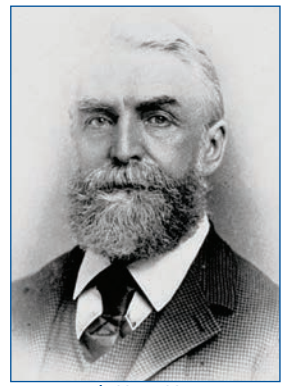
Inventing the Ammonia Refrigeration Compressor

Excerpt from *Adventures in Heat and Cold,* "Selling Lemonade to the Yankees and Inventing Ammonia Refrigeration with the Help of My Wife"

Many historical sources say that the ammonia refrigeration compressor was invented by David Boyle. We can argue for and against that claim, but Boyle is legitimately a refrigeration pioneer whose career is much more interesting when you consider his arduous journey to success—with the help of his wife!

David Boyle began that journey in Johnstone, Renfrewshire, ten miles west of Glasgow, Scotland, where he was born in 1837. His father was a grocer and liquor dealer who enjoyed tinkering with mechanics, and even building a cork-cutting machine. David Boyle was said to enjoy playing around machine shops and cotton factories and enjoyed reading *The Glasgow Mechanics' Magazine*. His budding technical interests were thwarted by his father who insisted that he go into the grocery business, which he did, ultimately rising to foreman of a wholesale grocer. He emigrated to Mobile, Alabama, desiring to start a grocery business. The American Civil War ruined his progress and, by the end of the war, he only had 250 dollars to his name. By that time, he was living in Demopolis, Alabama, and had recently married Margaretta (Margaret) Henry, who was from Ireland. Northern soldiers were stationed in Demopolis, and Boyle seized the moment by selling iced lemonade to them.[1] Boyle later recalled the event:

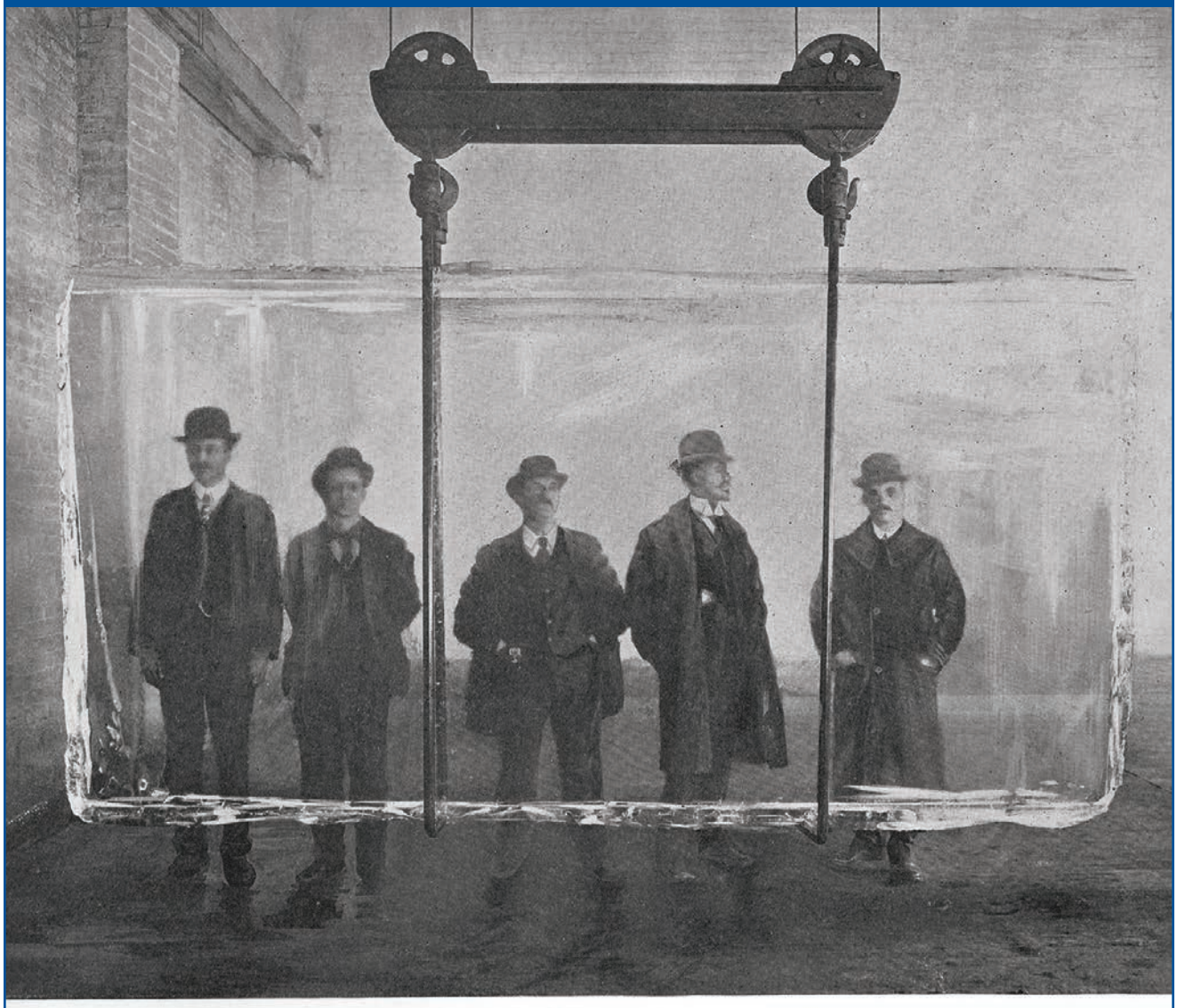


David Boyle | 1837 – 1891

"I was keeping store and making and selling ice cream and lemonade. A brigade of Federal troops were stationed there and were a bonanza to me. I had a shipment of ice from New Orleans.... The weather was hot and it did not take long to get rid of it. I used it to cool lemonade and sold it at a good profit to the Yankee soldiers. The unreliability of transportation, the high cost, and the absolute need of ice at Demopolis set me to thinking and determined me to attempt the making of a machine to supply the wants of Demopolis. Just think of it! The wants of Demopolis! And that was my idea."[2]

Boyle's lemonade business was so successful that he made eight thousand dollars in four months. During the War, he had heard of an ice-making machine operating in Augusta, Georgia, so he went to see it in 1865, but decided it would be too expensive to pursue, so he spent the next four years trying to find out what other machines might be available. Nothing was found until 1869, when he heard of an ice machine in New Orleans. After investigating it, he sold his store

An example of plate ice. Ice made by the plate method was known for its transparency. (From *Ice and Refrigeration,* June, 1905, ad section p. 73)



PICTURE OF ICE CAKE MADE BY OUR SYSTEM

and property and purchased a machine that was being made under the VanderWeyde patents.[3] The machine proved to be a failure. A disappointed Boyle moved his family to San Francisco in the summer of 1869, where he began to study anything possibly related to refrigeration machines at the library of the Mechanics' Institute. During his stay in California, he purchased a machine from London, had to sue for return of his money when the machine never arrived, and finally decided the only solution was to design and build a system of his own design.[4]

He built two experimental machines and applied for a U.S. patent, receiving U.S. Patent #128448 in 1872.[5] His patent describes an ice-making system, where the ice was frozen in horizontal sheets or plates, unlike other ice-making proposals, where the ice was frozen in cans. This method was adopted by some manufacturers later because ice made this way had superior transparency, lending more visual appeal than ice made by freezing in cans.

By 1872, Boyle had almost run out of money so he moved again, this time to New Orleans, where he thought he could sell his improvements in ice making. Although he had a patent, his system was still experimental and only partly constructed. He moved again, this time to Jefferson, Texas, where he completed the

ice-making system.[6] Boyle erected the machine in the nearby town of Marshall, using up his remaining funds. Soon after starting the equipment, numerous splits and leaks developed, preventing continued operation. Total failure and no more money apparently stretched Boyle to his mental limits. As he tells the story:

"My brother and I sat down on the wood pile to cool off. We were worn out with worry and disappointment and the machine was a wreck. All was gone and I was at the end of my tether. I had success within reach but lacked the means to secure it. My wife joined us and after listening to any complaints, made a most astounding statement. She could furnish me with money—money that she (cramped financially as we were) had managed to lay by for darker days. The amount was not large, but it was enough to start me on the path to success."[7]

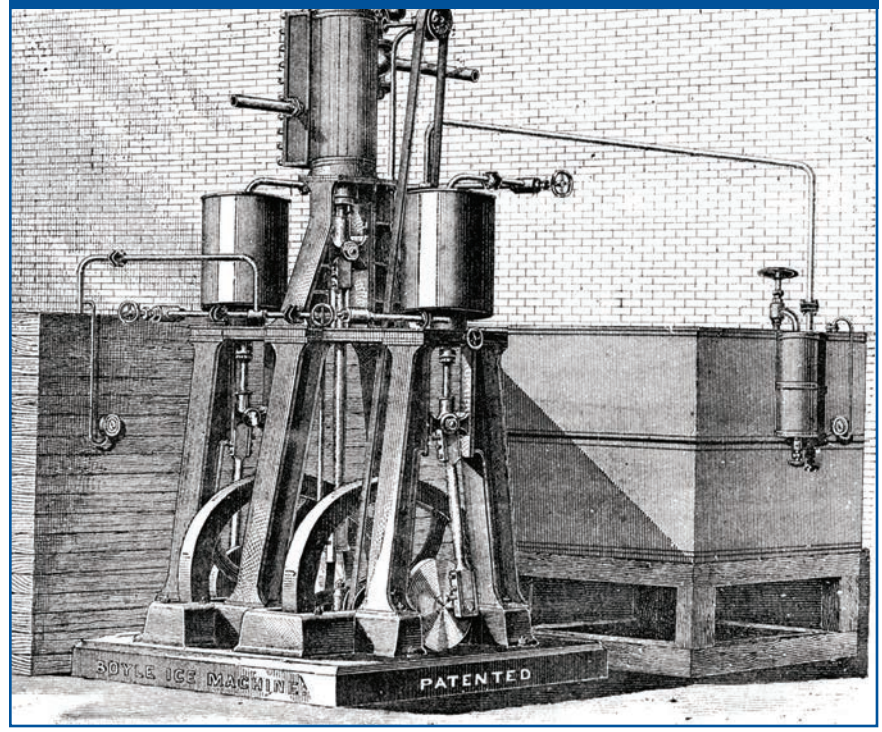
That path was not easy. As Boyle explains:

"…every joint of the machine had to be taken apart and remade. From sunrise to sunset seven days in the week he worked with the energy of desperation but it was October before the machine turned out its first batch of ice. It proved a perfect success at last but the ice season was over, he was taken sick and was deep in debt. After a winter of poverty and hardships to himself and family the machine was started up in spring of 1874, and it produced its full quantity of the finest transparent ice."[8]

Historical marker for site of David Boyle's ice plant near Jefferson, Texas. (From Jeffersonian, Fall–Winter, 2014–2015, p. 10)

Hearing of Boyle's ice manufacturing, some parties sought out Boyle to purchase an interest in his patent. Boyle secured backing in Quincy, Illinois, and moved there in the summer of 1874. He built two ice machines and sold them in Texas. Shortly thereafter, he established the Boyle Ice Machine Company and approached Crane Brothers Company of Chicago, manufacturers of fittings, valves, and piping, to contract their facilities to build his ice machines. Around 1877, Boyle Ice Machine Company expanded into refrigeration and began selling to breweries.[9] More than 75 refrigeration and ice machines had been sold by 1885.[10] Considering that commercial refrigeration and ice making was in its infancy in the period

Boyle Ice Machine, ca. 1877. (From 1880 catalog: The Boyle Ice Machine and Refrigerating Apparatus, Boyle Ice Machine Co.)

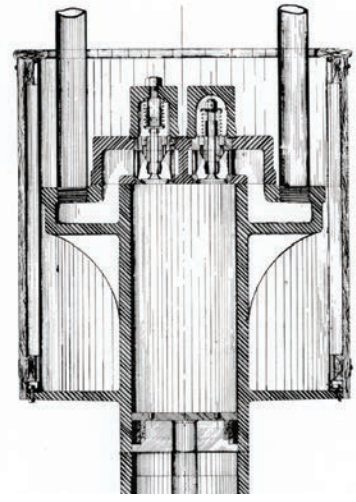


between 1873 and 1885, selling more than 75 machines proved the persistence and final success of David Boyle.

David Boyle passed away at the young age of 54 in 1891. Perhaps he was just worn out. His wife Margaret lived until 1929, dying at age 85 in Chicago.[11] The trade journal *Ice and Refrigeration* wrote: "Personally David Boyle was a man of sterling integrity, quick, sensitive and eager to succeed. His every thought was toward the advancement of the world's knowledge of the science of artificial ice making and refrigeration."[12]

Often we know only the specific accomplishment of an industry pioneer. But what is required to get there? Persistence and intelligence surely are needed, and David Boyle certainly displayed those qualities. But his story also shows that a great loyalty and love not only helped, but ultimately cemented success. There was not much money, but through it all, as Boyle moved all over the United States devoting "every thought" to his dream and placing a great strain on his family, his wife stayed with him. Through it all, and especially in the end, she was responsible for the difference between failure and success. There is a common saying that behind every successful man is a woman. This was certainly true for David Boyle.

Cross-section of David Boyle's compressor design. This design, using poppet-type suction and discharge valves above the piston, became known as the "Boyle Pattern," which was copied by later manufacturers. (From 1895 catalog: Ice Making and Refrigerating Machinery, Pennsylvania Iron Works Co., p. 20)



Notes

1. "David Boyle, Esq.," *The Western Brewer* (October 15, 1885): 1731.

2. "A reminiscence" in "Annual meeting of the southern ice exchange," *Ice and Refrigeration* 10 (March, 1896): 158.

3. David Boyle, Esq., 1885. The VanderWeyde machine was probably the machine being manufactured by Daniel Holden who had purchased rights to Peter VanderWeyde's U.S. patents. These machines were vapor-compression systems, using a petroleum-based refrigerant known as *Chimogene*.

4. "The late David Boyle," *Ice and Refrigeration* 1 (July 1891): 24. Boyle found a catalog from Siebe & Company of London that listed a vapor-compression refrigeration machine using ammonia built under William Harrison's patents, which he ordered, paid for, and never received. He had to hire a London attorney to recover his money. The entire process took more than a year, during which time he continued his research on refrigeration and ice making.

5. This patent is for a complete ice-making system using vapor compression and a plate ice-making method. Boyle used reversed-cycle (hot-gas) defrost to detach the ice plates after freezing. No specific refrigerant is specified.

6. It is possible that Boyle moved to Jefferson because there were attempts to establish an ice manufacturing plant in 1870. Apparently, nothing is known about it beyond the fact that it was incorporated and had secured rights to manufacture ice. It is possible Boyle heard of this while in New Orleans and decided to capitalize on the opportunity. See S. Torrans, "Jefferson Gets Dependable Lighting and Year Round Ice," *Jeffersonian* (Fall-Winter, 2014–2015): 10.

7. "A Reminiscence," 1896; David Boyle mentions his brother. Nothing has turned up regarding his brother's involvement or even why he either moved to or perhaps was already in Texas.

8. The late David Boyle, 1891.

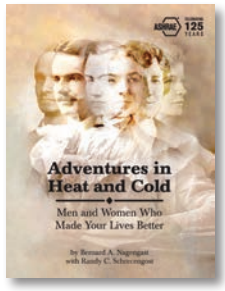
9. The Boy, "Twenty years of refrigeration," *Ice and Refrigeration* 9 (December 1895): 397. "The Boy" is a pen name for Victor Becker, early U.S. refrigeration pioneer, who started his career working for Richard Crane as a very young man. Because he was so young, he was known in the Crane engineering offices and shops as "the boy."

10. According to an advertisement for Boyle Ice Machine Company in *The Western Brewer* (January 15, 1883): 5. This ad lists Boyle installations up to that date.

11. Margaret H. Boyle. *Illinois Deaths and Stillbirths Index 1916–1947*. (From www.ancestry.com)

12. The late David Boyle, 1891. ■

About the Authors



Adventures in Heat and Cold: Men and Women Who Made Your Lives Better was written by Bernard A. Nagengast, Life Member ASHRAE, with Randy C. Schrecengost, P.E., Member ASHRAE, in conjunction with ASHRAE's 125th Anniversary. The book is available from the ASHRAE Bookstore.