INTERIOR OF A BREWERY

Lemp Brewing Company, St. Louis.
The Heritage Group has considerable information on the history of Refrigeration covering systems, equipment, installations and manufacturers. In addition, the Heritage Group Archive, compiled over some forty-five years, holds a large collection of textbooks, catalogues and technical papers on the subject.

However, UK information on Refrigeration in American Breweries is small, one reason being the difference in brewing techniques between the Great Britain and the United States. Traditionally, Great Britain used the top fermentation process in making beer. However, from the beginning of the 19th century, breweries in some countries began to adopt bottom fermentation, which requires lower temperatures both for brewing and storage. The standard was set by Germany with its lager, this type of beer being introduced into the United States around 1840. Without control of temperature, good quality lager could only be made in spring and autumn. This lager breweries became large users of natural ice. In the United States, some breweries each used as much as 30,000 tons of ice each year, being difficult to handle, and so became increasingly attracted to the developments in refrigeration.* This was particularly important in the Southern States where supplies of natural ice were cut off during the Civil War.

*It has been said that British breweries were less interested in refrigeration, because they used top fermentation, but by 1800 there existed many refrigerated warehouses for hops. Also, ice-making and cold stores were important growth areas.

BREWERY REFRIGERATION MANUFACTURERS

AMERICAN BREWERY LOCATIONS

GENERAL INFORMATION
Refrigeration in Brewing: 4, Ice Harvesting: 7, Boilers: 11, References: 44

BMR, Budleigh Salterton 2021.
2.3. INTRODUCTION OF REFRIGERATION IN BREWING

2.31. It may seem surprising to find a whole chapter, even if brief, devoted to brewing, as part of the evolution of refrigeration during this period from 1875 to 1914, but there are many reasons for it. In the first place, breweries were very large users of natural ice in many countries, since the middle of the 19th century. There were many drawbacks to this practice, and naturally the breweries were among the first to be interested in possibilities of using artificial cold. The relationship with the preceding chapter is quite close because mechanical refrigeration was first used in breweries to produce ice. Thus, although the breweries represented only a relatively restricted part of the professional life of a country, they absorbed a considerable proportion of the total installed refrigeration capacity, in many countries around 1900 to 1910. This amounted to 70% in Sweden, 60% in Germany and Austria, 50% in Holland, 40% in France and Denmark, and 30% in the United States. Many of the very first refrigerating machines constructed by the great pioneering firms were installed in breweries, around 1860-70, and, oddly enough, brewery refrigeration played a determining rôle in the rational and scientific development of the compression refrigeration system, as we shall see.

2.32. At the beginning of the 19th century, breweries in some countries began to adopt “bottom fermentation”, which requires relatively low temperatures for the fermentation of the wort (6 to 8°C) and for storage of the beer (0 to +4°C). The standard was set by Germany with its lager; this type of beer was introduced into the United States about 1840. (Great Britain for a long time remained faithful to its “top fermentation” beer.) Without means of controlling the temperature in bottom fermentation it was not possible to make good quality beer except in spring and autumn, in most regions. Thus breweries became large users of natural ice. In Europe, the use of natural ice first began to expand in Austria towards 1820, then in Germany, Switzerland and Alsace-Lorraine. About 1875 in the United States, brewing was the sector of the economy which used most natural ice, many breweries using 20 to 30 000 t/year. The encumbrance of the stock of ice, to get through the summer, was really extravagant. The brewery in Pilsen, the largest in continental Europe, which used natural ice up to 1884, was obliged to operate a system of ponds from which to collect ice in the winter. Thus one can understand why the brewers were only too pleased to welcome artificial refrigeration to free them from such constraint.

How was natural ice used at that time? Recollect that in 1819 Salmon and Warell were granted a British patent for cooling malt in a brewery by blowing cold air over the surface. But the real breakthrough came in 1856, when the French engineer Jean-Louis Baudelot (1797-1881) introduced the wort cooler which bears his name. This is made up of a vertical bank of tubes through which a cold fluid circulates, and over which the wort flows. Iced water could be used in the tubes, and cooling was very rapid. On leaving the “baudelot” the wort is taken to the fer-
REFRIGERATION IN BREWING

mentation vessels, in which at that time the temperature was kept at a correct level by “swimmers” containing natural ice (50 to 60 kg); these floated on the surface. They were much used in Germany and Austria.

When breweries began to use artificial ice, they still used these “swimmers”. They also used floating coils of iced water. But it soon became general practice to cool the fermentation vessels by means of fixed immersed systems. Firstly, there were coils of iced water, then systems of tubes sandwiched between two plates. The “baudelot” was still used, with iced water or brine, and later (about 1890) with direct expansion of the refrigerant. (It was only much later that they dared to use direct expansion coils in the fermentation vessels).

It was only in about 1880 that the storage cellars were cooled, and then by ice tanks at the ceiling. In 1882 a German brewery, Aktienbräu at Dortmund, was the first to cool the cellar by brine coils. Much later they were emboldened to put direct expansion coils in the cellar.

2.33. From just before 1860, the large pioneering manufacturers of the period began to install their first refrigerating machines in breweries: in 1859, an ethyl ether compressor of F. Carré in the Velten brewery at Marseille; in 1860, a Harrison ether compressor in the Bendigo brewery near to Melbourne (perhaps there was a machine tested by Harrison in a brewery in 1857); in 1861, a Harrison-Siebe ether compressor in a London brewery; in 1868, a Tellier methyl ether compressor in the Merz brewery in New Orleans; in 1869, a Tellier machine in a Marseille brewery, in 1870, a Carré absorption machine in the Liebmann brewery in Brooklyn, New York.

As early as 1865, Charles Tellier * began to be interested in using refrigeration in brewing; he dealt very clearly with the topic in his book “Ammonia in industry”, written in 1866. In 1871, he wrote a leaflet on “Refrigeration applied to the production and storage of beer”, but French brewers largely ignored his work. On the contrary, the International Congress of Brewers, held in Vienna in 1873, was a resounding success and played a decisive rôle, not only in the development of the use of refrigeration in this industry, but also in a rational consideration of systems of production of cold in general. It was at this congress that Carl von Linde *, then a young professor in Munich, made a convincing story of the advantages of the system using compression of liquefiable gases. The machine using expansion of cold air was defended by Franz Windhausen *, at this congress.

It has already been said that in 1876 and 1877, Linde produced his two types of ammonia compressor. As early as 1877, this type of machine was installed in the Spatenbräu brewery in Munich (where it was used to cool the wort and the fermentation vessels), and in the Dreher brewery in Trieste (cooling also the storage cellars), and then, a little later in the Westminster brewery in London. The winter of 1883-1884 was especially mild in Germany, and the acute shortage of natural ice which resulted threw the brewers into the arms of Linde! In 1881, there were already 750 Linde machines in 445 breweries. The Carlsberg brewery in
Copenhagen installed Linde machines in 1879; their competitor Tuborg, also in Copenhagen, obtained their first machine in 1883 and in 1900 had an installed capacity of 750,000 kcal/h. The Pilsen brewery installed mechanical refrigeration in 1889, to cool wort. It still cooled the storage cellars by natural ice up to 1897, when all cooling was done mechanically. In 1907, they had an installed capacity of more than 3 M kcal/h, and also owned 300 refrigerated wagons. By 1891, most American breweries had changed from natural ice to artificial cooling. In 1904, the total breweries in America had 300 M kcal/h and 5 Mm³ of cooled cellars. By 1911, the figures were 420 M kcal/h and 7 Mm³ (the Anheurin Busch brewery, in Saint Louis, alone had 5.2 M kcal/h).

It has already been said that at this time, the English breweries were less interested in refrigeration, because they used top fermentation, but in 1900, there existed many refrigerated warehouses for hops (notably an establishment of 10,000 m² in Birmingham).

In 1903, Germany had 1,500 breweries with refrigerating plant (about 70% NH₃, 15% SO₂, 15% CO₂). At the same date, France had less than 100 breweries equipped with refrigeration. In 1915, 93% of the 1,350 breweries in the U.S.A. had refrigeration machinery.

2.34. A first conclusion may be drawn from these two chapters on ice and brewing; very broadly speaking it would be correct to say that the two driving forces for the development of artificial refrigeration, on a world scale around 1875 were: firstly the manufacture of ice in the southern United States, and secondly, brewing in Germany and the northern United States. With the transport of meat by sea, which will now be dealt with, we find the third “big event” of the beginning of this history of refrigeration.
ICE HARVESTING
Figure 20. Edmund Jungenfeld, architect: New Brew House (Brew House proper), Cross Section, detail of Additions to Anheuser-Busch Brewing Association, St. Louis, 1879. Source: The Western Brewer. IV, 12, December 1879, unpaged foldout supplement.
Figure 32. Wilhelm Grieser, architect: Model Brewery (Brewery L’Esperance), 1886. Source: The Western Brewer, XI, 9, September 1886, unpagged supplement.

Figure 33. Grieser & Maritz, architects: Texas Brewing Co., Ft. Worth, TX, 1890. Source: The Western Brewer, XV, 10, October 1890, p. 2258.
BREWERIES

Figure 9. Edmund Jungenfeld, architect: Additions to Anheuser-Busch Brewing Association, St. Louis, 1879. Source: The Western Brewer, IV, 12, December 1879, unpaginated foldout supplement.
Hauck Brewery boiler room, Cincinnati, sketch of 1890.
MECHANICAL REFRIGERATION

BY THE

PROCESSES AND APPARATUS

OF

THE DE LA VERGNE

Refrigerating Machine Co.

MANUFACTURERS OF

REFRIGERATING AND ICE MACHINES

AND OF

ANHYDROUS AMMONIA.

OFFICE AND WORKS:

Foot of East 133th Street (Port Morris),

NEW YORK.

John C. De La Vergne, President.

Louis E. De La Vergne, Vice-President.

C. H. Cone, Secretary.

FRANKLIN INSTITUTE:

LIBRARY,

PHILADELPHIA.
DE LA VERGNE REFRIGERATING CO.
PLATE S.—110-ton Machine, with Condensers on floor above.
## LIST OF CUSTOMERS

**January 1, 1890.**

**The De La Vergne Refrigerating Machine Co.,**

**Foot of East 138th Street, NEW YORK CITY.**

### BREWERIES.

<table>
<thead>
<tr>
<th>Name</th>
<th>Address</th>
<th>Number of Machines</th>
<th>Total Refrigeration</th>
<th>Year of Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jacob Ruppert</td>
<td>New York</td>
<td>One 110-ton, 110 tons</td>
<td>1884</td>
<td></td>
</tr>
<tr>
<td>Jacob Ruppert—Second Order</td>
<td>New York</td>
<td>Two 110 &quot;</td>
<td>220 &quot;</td>
<td>1885</td>
</tr>
<tr>
<td>George Ehret</td>
<td>New York</td>
<td>One 110 &quot;</td>
<td>110 &quot;</td>
<td>1885</td>
</tr>
<tr>
<td>George Ehret—Second Order</td>
<td>New York</td>
<td>Two 110 &quot;</td>
<td>220 &quot;</td>
<td>1885</td>
</tr>
<tr>
<td>William J. Lemp</td>
<td>St. Louis, Mo.</td>
<td>Two 110 &quot;</td>
<td>220 &quot;</td>
<td>1888</td>
</tr>
<tr>
<td>William J. Lemp—Second Order</td>
<td>St. Louis, Mo.</td>
<td>One 110 &quot;</td>
<td>110 &quot;</td>
<td>1889</td>
</tr>
<tr>
<td>Bernheimer &amp; Schmid</td>
<td>New York</td>
<td>One 220 &quot;</td>
<td>220 &quot;</td>
<td>1888</td>
</tr>
<tr>
<td>†Anheuser-Busch Brewing Ass’n</td>
<td>St. Louis, Mo.</td>
<td>One 110 &quot;</td>
<td>110 &quot;</td>
<td>1886</td>
</tr>
<tr>
<td><strong>Anheuser-Busch Brewing Ass’n</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Second Order</td>
<td>Kansas City, Mo.</td>
<td>One 12 &quot;</td>
<td>12 &quot;</td>
<td>1886</td>
</tr>
<tr>
<td>†Anheuser-Busch Brewing Ass’n</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Third Order</td>
<td>St. Louis, Mo.</td>
<td>One 110 &quot;</td>
<td>110 &quot;</td>
<td>1889</td>
</tr>
<tr>
<td>Anheuser-Busch Brewing Ass’n</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fourth Order</td>
<td>Dallas, Texas</td>
<td>One 4 &quot;</td>
<td>4 &quot;</td>
<td>1885</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(For Fifth and Sixth orders from Anheuser-Busch Brewing Association, see Artificial Ice Plants.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Budweiser Brewing Co., Lim’d</td>
<td>Brooklyn, N. Y.</td>
<td>One 110 &quot;</td>
<td>110 &quot;</td>
<td>1886</td>
</tr>
<tr>
<td>*L. Schlather Brewing Co.</td>
<td>Cleveland, Ohio.</td>
<td>One 110 &quot;</td>
<td>110 &quot;</td>
<td>1888</td>
</tr>
<tr>
<td>Hinckel Brewing Co.</td>
<td>Albany, N. Y.</td>
<td>One 100 &quot;</td>
<td>100 &quot;</td>
<td>1885</td>
</tr>
<tr>
<td>Joseph Schlitz Brewing Co.—First</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Order</td>
<td>Memphis, Tenn.</td>
<td>One 4 &quot;</td>
<td>4 &quot;</td>
<td>1886</td>
</tr>
<tr>
<td>Joseph Schlitz Brewing Co.—Sec-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ond Order</td>
<td>Milwaukee, Wis.</td>
<td>One 100 &quot;</td>
<td>100 &quot;</td>
<td>1890</td>
</tr>
<tr>
<td>Eberhardt &amp; Ober Brewing Co.</td>
<td>Pittsburgh, Pa.</td>
<td>One 100 &quot;</td>
<td>100 &quot;</td>
<td>1890</td>
</tr>
<tr>
<td>†Hyde Park Brewery Co.</td>
<td>St. Louis, Mo.</td>
<td>One 75 &quot;</td>
<td>75 &quot;</td>
<td>1886</td>
</tr>
<tr>
<td>†Pabst Brewing Co.</td>
<td>Milwaukee, Wis.</td>
<td>One 75 &quot;</td>
<td>75 &quot;</td>
<td>1886</td>
</tr>
<tr>
<td>*John Wieland Brewing Co.</td>
<td>San Francisco, Cal.</td>
<td>One 75 &quot;</td>
<td>75 &quot;</td>
<td>1889</td>
</tr>
<tr>
<td>Falk, Jung &amp; Borchert Brewing Co.</td>
<td>Milwaukee, Wis.</td>
<td>One 75 &quot;</td>
<td>75 &quot;</td>
<td>1889</td>
</tr>
<tr>
<td>Ballantine &amp; Co.</td>
<td>Newark, N. J.</td>
<td>One 110 &quot;</td>
<td>110 &quot;</td>
<td>1886</td>
</tr>
<tr>
<td>Ballantine &amp; Co.—Second Order</td>
<td>Newark, N. J.</td>
<td>One 100 &quot;</td>
<td>100 &quot;</td>
<td>1890</td>
</tr>
<tr>
<td>Ballantine &amp; Co.—Third Order</td>
<td>Newark, N. J.</td>
<td>Two 100 &quot;</td>
<td>200 &quot;</td>
<td>1890</td>
</tr>
<tr>
<td>†Bergner &amp; Engel Brewing Co.</td>
<td>Philadelphia, Pa.</td>
<td>One 50 &quot;</td>
<td>50 &quot;</td>
<td>1883</td>
</tr>
<tr>
<td>†Bergner &amp; Engel Brewing Co.—</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Second Order</td>
<td>Philadelphia, Pa.</td>
<td>One 50 &quot;</td>
<td>50 &quot;</td>
<td>1885</td>
</tr>
<tr>
<td>†Bergner &amp; Engel Brewing Co.—</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Third Order</td>
<td>Philadelphia, Pa.</td>
<td>One 110 &quot;</td>
<td>110 &quot;</td>
<td>1888</td>
</tr>
<tr>
<td>†Bartholomay Brewing Co.</td>
<td>Rochester, N. Y.</td>
<td>One 50 &quot;</td>
<td>50 &quot;</td>
<td>1886</td>
</tr>
<tr>
<td>Bartholomay Brewing Co.—Second</td>
<td>Rochester, N. Y.</td>
<td>Two 50 &quot;</td>
<td>100 &quot;</td>
<td>1887</td>
</tr>
</tbody>
</table>
FRICK COMPANY, ENGINEERS.

“ECLIPSE” REFRIGERATING MACHINES

FOR USE IN COLD STORAGE DEPOTS, PACKING HOUSES, BREWERIES, ICE FACTORIES, ETC.

RANGING FROM 1 TO 300 TONS CAPACITY. FULLY WARRANTED.

WE FURNISH PURE ANHYDROUS AMMONIA FOR USE IN OUR MACHINES.

ADDRESS ALL COMMUNICATIONS TO FRICK COMPANY, ENGINEERS,
WAYNESBORO, FRANKLIN COUNTY, PENNA., U. S. A.

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FRICK COMPANY

OUR COMPLETE BRINE PLANT WITH PIPES IN ROOMS.

FRICK COMPANY
ENGINEERS, WINNSBORO
FRANKLIN COUNTY, PA.
Complete Brine Plant
Brine System.

OUR COMPLETE DIRECT EXPANSION PLANT WITH PIPE COILS IN POSITION.
D. L. HOLDEN & BROS.

MANUFACTURERS OF

ICE MACHINES,

ALSO

REFRIGERATING MACHINES,

FOR

Breweries, Distilleries, Packeries, Fruit Houses, Steamships, &c.

PENN IRON WORKS,

BEACH AND PALMER STREETS,

P. O. Box, 1808,

PHILADELPHIA, PA., U. S. A.

D. L. HOLDEN, E. C. HOLDEN, C. M. HOLDEN.

PHILADELPHIA:
Lehman & Bolton, Printers.
1878.
Fig. 1. is a perspective view of the Machine as used in breweries, a
1882: Three 50 TR Boyle "Ice" Machines, Anheuser-Busch Brewery, St. Louis.

After 1884, however, Edmund Jungefeld was no longer present to guide Anheuser-Busch's expansion, or to give form to any other clients' facilities. His business that year was booming, and in May 1884, he was lauded as 'a gentleman largely known in the trade, for the many monuments of his art and skill scattered over the country'. By October, his Empire Refrigerating Co. had merged successfully with the Boyle Ice Machine Co., and the new firm, Consolidated Ice Machine Co. claimed 33 clients and 'a larger cash capital than any other manufacturer of similar machinery employs ...' Also in October, however, Jungefeld took ill and on 20 December, at the still-young age of 44, he was dead. The sense of loss felt by many was apparent in the obituary for him in the January 1885 issue of The Western Brewer, along with some insight into...
PLATE VII.

REFRIGERATION
REFRIGERATION
BALTIMORE
BOSTON
BOSTON
DELAWARE
NASHVILLE

THE WILLIAM GERST BREWING CO.

BREWERS AND BOTTLERS OF
NASHVILLE LAGER BEERS

BOTTLED BRANDS: PILSNER, EXPORT, AND EXTRA PALE BOHEMIAN.

DRAUGHT AND BOTTLLED BEER SHIPPED TO ALL POINTS.
NEW YORK STATE

AMBER ALE & PORTER

ALBANY BREWING COMPANY

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AMBER XXXX PALE ALES,
BURTON INDIA PALE ALES & PORTER.
ST LOUIS
ST LOUIS

GENERAL VIEW OF BREWERY PLANT.

MALT HOUSE & ELEVATOR.
REFERENCES AND FURTHER READING

Abridged Listing.

Catalogues:
1878  Ice Machines also Refrigerating Machines, D.L. Holden Bros., Philadelphia.
1890  Eclipse Refrigerating Machines, Frick Company, Waynesboro.

1900  One Hundred Years of Brewing, H. S. Rich & Company, Chicago.
1904  Compend of Mechanical Refrigeration, J. E. Seibel, Nickerson & Collins, Chicago.

Books in Images of America Series, Arcadia Publishing:
2004  Brewing in New Hampshire.
2005  Straub Brewery.
2005  Brewing in Cleveland.
2006  Nashville Brewing.
2010  Cincinnati’s Brewing History.
2011  Brewing in Baltimore.
2012  Brewing in Greater Pittsburgh.
2012  Brewing in Seattle.
2014  Brewing in Milwaukee.
2015  Brewing in Delaware.

See also the CIBSE Heritage Group Website, E-Books Large, Refrigeration in American Breweries 1860-1920, Brian Roberts (in 3 Parts, 19 Sections with extensive list of References).