

The Last Ice Age: The trade in natural ice as an agent of modernization and economic integration in the nineteenth and early twentieth centuries

1. Relevance relative to the call for proposals

The Last Ice Age will be sustained by research conducted by an international, interdisciplinary team of world-leading global, maritime and environmental historians, a post-doctoral scholar and a group of MA and PhD students. This team will investigate the production, transport and consumption of natural ice trade, an extraordinary business that offers a lens through which under-researched facets of the maritime, urban, social, cultural and environmental histories of Northwest Europe and North America can be perceived. The collective endeavour of experienced scholars and early career researchers will yield a range of scholarly research outputs, including two monographs and at least six peer-reviewed journal articles, all of which will meet the highest academic standards (3* and 4* in the measures adopted by the UK's Research Excellence Framework), as well as impacting significantly on an array of non-academic audiences. In so doing, the project will meet the strategic objectives cited in the call for applications; that is, scholarly excellence, international collaboration, disciplinary development (in terms of subject matter and research expertise), innovative approaches and ground-breaking insights.

2. The research project

The overarching aim of the project is to enhance knowledge and understanding of the scale, character and significance of the natural ice business during the late nineteenth and early twentieth centuries. The overseas trade in ice will be analyzed in the wider contexts of transport history, technological and logistical developments, changes in consumer patterns and environmental factors during this era. It will thereby highlight the economic, social and cultural implications of what might be called a 'logistical and dietary revolution' by generating and disseminating illuminating insights into the process of technological innovations and economic integration that created modern urban culture and city living.

Background and state of knowledge

A great number of local history works have been written about the ice trade, both in the US and in Europe, together with a number of more general overviews. Academic books and articles have more seldom been published on this subject, with those that have appeared mainly limited to certain aspects of the trade and shipping of ice. From this scant literature, an outline of the development of the ice trade can be assembled:

Ever since Antiquity, ice and snow has been collected and used for cooling foods and drinks in the Mediterranean world, the Near East and beyond. In Western and Northern Europe, ice cellars are known to have been in use on royal and aristocratic estates from at least early modern times, while ordinary farmers collected ice for cooling. As a mass phenomenon, however, the trade and utilisation of natural ice was a function of modern industrial and urban society.

The transport overseas of ice emerged as a viable business in New England in the early nineteenth century, and was subsequently copied and adapted in Europe, with Norway becoming the dominant European supplier from the middle of the century. Occasionally, natural ice was shipped from Norway as far as the Mediterranean, and more exceptionally to Africa, Southeast Asia and South America. Nonetheless, the bulk of the export was destined for countries in Northern and Western Europe, notably Britain. To numerous small towns and coastal villages, especially in the Oslo fjord and Telemark region, the ice business played a major economic role for almost three generations, until the international trade in ice came to an almost complete halt during the Great War (1914-1918). It never really picked up again after the war, completely losing out to artificially produced ice and modern cooling and freezing techniques (although local natural ice was still used in Norway during the late 1960s).

Natural ice from New England had crossed the Atlantic to supply the British market in the early nineteenth century, but in the 1880s and 1890s the US occasionally constituted a market for Norwegian ice. This

highlights the dependence that had developed in urban areas on regular supplies of ice, the speculative character of the ice business, and the impact that climatic factors, and fluctuations in freights charged by ship owners (in a business that could not tolerate high transport costs), had on profit levels.

The modern trade in Norwegian natural ice started with harvesting an abundant natural resource, but as this resource was commodified, the ice business developed into a complex logistical and commercial operation, involving: an extensive infrastructure of ice dams, ice stores and transport facilities; complicated ownership structures; a huge fleet of ships employed temporarily or on a permanent basis in the ice trade; and great technical and commercial know-how.

In spite of some scattered information in the literature on railways and the industries that used natural ice for cooling, surprisingly little has been published on the role played by the trade in natural ice in the development of the fresh food and cold beverages industries, of overland transportation of fresh foods and of the market for modern cooling technology—activities that became important aspects of modern urban life. Furthermore, we know that the ice business was highly speculative, with supply, demand and prices depending heavily on seasonal changes in temperatures as well as micro-variations in climate from one year to the other. However, we know less about how ice merchants, ship owners, other links of the logistic chain, as well as the food industries and the consumers in a generally growing market adapted to great fluctuations both in supply and demand. These issues will be explored by the research team. See below for a brief and select bibliography. As part of the preparation work on this project, an extensive bibliography has been collected on an interactive website:

http://lokalhistoriewiki.no/index.php/Bibliografi:Naturiseksporten_i_norsk_sj%C3%B8fartshistorie and in Norseng 2014.

Approaches, hypotheses and choice of method

The proposed project is designed to build on the scant literature on the history of the ice trade to fill major gaps in our knowledge and understanding of the natural ice business, in conjunction with the development of modern cooling techniques, the history of shipping, general transport history, the development of the food and beverage industries, health and consumer history. In short, the project will examine major economic, technological and cultural developments that together shaped modern urban society in Scandinavia, Northwest Europe and North America.

Thematically, the proposed project will address the following issues:

- Natural ice as a commodity, and the logistics of the international, regional and local trade in ice;
- The role of the ice trade in the development of shipping and the role of shipping in the development of the ice trade;
- Natural ice in a logistical and dietary revolution: the use of natural ice for cooling in the production and distribution of fresh foods and cold drinks;
- Climate, natural resources, ownership and legal frameworks in the development of the ice trade

Geographically, the research will focus on:

- *Norway*, as the principal producer, exporter and shipper of natural ice in the European market;
- *Britain*, as the most important European importer and consumer of natural ice;
- *Germany*, which, for climatic reasons, had a very volatile ice market, that in turn had a strong influence on demand, production and price levels in the Northern and Western European ice trade. For comparative purposes, the ice markets in other Baltic and North Sea countries will also be examined;
- *North America*, where a large-scale trade in natural ice, based on key technological innovations, was pioneered in the early nineteenth century.

Analytically, the project will address the following research themes and questions:

The local and international ramifications of the trade in natural ice

- When and why did large-scale enterprise develop in the ice industry?
- How significant was the ice business for local communities in the main production and consumption areas, in terms of incomes for landowners, ship owners, etc., and employment for the coastal population, which often had to combine several seasonal occupations to make ends meet?
- To what extent was vertical integration with 'complementary' businesses (shipping, sawmills and export of timber and planks, breweries, restaurants, trade in fish, meat) a feature of the business of harvesting/producing natural ice?
- What part did wholesale purchasers of ice—slaughterhouses, fisheries, breweries, shops, restaurants—play in the growth of the ice business, in comparison with household consumers?
- How important were longstanding partnerships between exporters and foreign importers of ice?
- To what extent was multinational enterprise—foreign ice merchants/importers as exporters/owners or tenants of ice ponds, ice plants—an important factor in the ice trade?
- Did ice producers, ship owners, exporters/importers and retailers seek and derive intelligence from climatologists and meteorologists to inform their business decisions?

The ice trade in the history of shipping and vice versa

- How extensive were the Norwegian and international ice fleets, and what operational and organizational patterns characterized the ice trade?
- What was the relationship between primarily Norwegian exporters and ship owners and foreign importers?
- What knowledge was necessary to become a stakeholder in this trade, compared to other segments of international shipping, and how was this knowledge obtained?
- Was the ice trade a curse or blessing for ship owners, notably in respect of the transition from sail to steam?
- How profitable was the ice trade in comparison with other shipping routes?
- To what extent was international vertical integration—foreign ice merchants importing ice from Norway in their own ships—a feature of shipping ice?

Natural, economic and legal frameworks: climate, resources and the ice trade

- How did international shipping and the production and consumption of natural ice and artificial ice, respectively, react and adapt to short and long term changes in temperatures and demand for ice?
- To what degree did the manufacturers and users of natural ice take into account climate/weather unpredictability in making long term business decisions?
- Although the annual 'crops' fluctuated according to winter temperatures, natural ice was regarded as an inexhaustible resource. But to what extent can the production of, and trade in, natural ice be regarded as sustainable when possible alternative uses of land, the economic and ecological costs of constructing dams and other infrastructure for producing and transporting the ice, are taken into consideration?
- Why did manufacturers shift from low-cost natural ice-production to high-cost, energy-intensive artificial ice-production?
- Commons or private property—what kind of legal frameworks and conflicts developed around the harvesting of natural ice during the process of commodification of frozen water?
- By which mechanisms was the technology of the modern ice trade transferred from North America to Europe and Norway – to what extent did public authorities, ship owners, landowners or the food industries actively contribute to this process?

Evidence relating to these questions can be assembled from existing local history books, business histories and scholarly works. In addition to physical remains (industrial archaeology) and photographic evidence, much of the existing literature on the ice trade is based on public customs records and trade statistics

specifically concerning ice, consular reports, contemporary industrial journals and magazines for the ice business—and to a limited degree also private business archives. To get to grips with our research questions, the participants in the proposed project will have to dig both deeper and wider into these, as well as other kinds of sources, notably overland transport records, trade statistics for fresh fish, meat and dairy products, health statistics, newspaper reports and advertisements, land registers, and select business archives from all links in the logistical chain of the trades in fresh food and cold beverages.

3. The project plan, project management, organization and cooperation

With The Norwegian Maritime Museum/The Norwegian Museum of Cultural History as project owner, *The Last Ice Age* is conceived as a joint venture between the museum, the School of business at the University college of Southeast Norway (HSN), and the Maritime Historical Studies Centre (MHSC) at the University of Hull, UK. To cover US and German aspects, as well as climatic issues, professor Ingo Heidbrink at ODU in Norfolk VA, who is an Honorary Research Fellow of the MHSC in Hull, will also participate as one of the principal researchers and student supervisors.

At the practical and organizational levels, the proposed research investigation will entail the execution of four research strands:

- (1) Production (climatic aspects, access to natural resources, technology of production, organization, manpower);
- (2) Transport & marketing (the 'supply chain' comprising shipping, railways and the growing scale and scope of markets);
- (3) Consumption patterns (improving food supplies, health conditions and standards of living);
- (4) Ice and modernization (taste, fashion, aesthetics and the role of ice in cultural and technological developments).

Strand 1 will mainly consist of two sub-projects:

Sub-project A will be led by professor Ingo Heidbrink at the ODU in Norfolk, Virginia (CV attached), and will focus on the role of climate and environmental factors in shaping human economic, social and cultural activity, with the ice trade and the use of natural ice for cooling as a case study. Heidbrink will write a monograph on this topic, focusing on the following issues: to what degree did the manufacturers and users of natural ice take the unpredictability of climate/weather conditions into account when making long term business decisions and contracts? Were they able to cooperate with climatologists/ meteorologists to make business decisions more reliable? And with special regard to the (for climatic reasons) extremely volatile German ice market, how can we explain the comparatively rapid transition there from natural ice to artificial ice production, in spite of the very high energy consumption involved in the artificial production, and the minimal costs of producing natural ice, especially in cold winters?

Such issues are not only of historical relevance, but illustrate a question that is of great importance for many of today's industries: whether climate and shifting weather conditions was/are simply considered as something you need(ed) to live with and react on spontaneously, or whether it was/is possible to use science (in casu climatology/meteorology) as a tool for making mid- to long-term business decisions or escape the problems of shifting weather or permanent climate changes (a modern parallel well known to Norwegian readers is the way ski resorts for some decades have increasingly invested in equipment for making artificial snow in order not to lose business in the frequent mild winters)—perhaps extremely cheap energy is a common factor here, in addition to technological innovations?

With his MA students, professor Heidbrink will also contribute to the work of the other strands. He will come to Norway for three stays during the project period to serve as a visiting scholar at the Norwegian

Maritime Museum and the University college of Southeast Norway, where he will co-supervise Norwegian MA students within his core project.

Sub-project B will focus on the way technology was transferred from the pioneers in New England and adapted to other topographic, demographic, economic and climatic circumstances. These issues lend themselves naturally to a comparative approach, focusing on a limited number of local cases in the US, Norway and Germany. The main bulk of the research in this core project will be carried out by a PhD student in the Norwegian Maritime Museum (cand.philol. Eyvind Bagle, CV attached), enrolled in a PhD programme in the HSN or elsewhere. The following may serve as a theoretical point of departure:

The natural ice business became integral to nineteenth-century globalization. Technological developments that kept foodstuffs fresh over time and distance facilitated the growth of new markets. There are several potential approaches to this historical phenomenon. According to the staple theory of economy development, raw material production in the peripheries becomes profitable with falling transportation costs to the core economy (i.e. Britain in the 1800s). Some regions and countries deprived of natural resources, nevertheless manage to tap into the opportunities offered by maritime connections to the global economy. Was the Anglo-Norwegian natural ice trade a corroboration of this pattern, and if so, how?

This is essentially a demand-driven growth perspective. Within it, there are potential case studies of technology/knowledge transfer and diffusion where historical actors on the supply side come to prominence. When and how did the American-developed system of natural ice production, storage and transportation venture into other economies? Within this strand of analysis, insights from business history, studies of technology transfer, as well as development theory perspectives, can offer useful frames for comparative approaches. An environmental perspective is also possible, as natural ice was a renewable resource, which came to be harvested in industrial processes. How did the transformation of frozen water into a commodity take place? Does this process have a fruitful relation to debates about the 'commodification of nature'?

Strand 2 will investigate the 'supply chain' that linked centres of ice production with markets that tended to grow in scale and scope in line with improvements in sea and land transportation. It will mainly be researched by a post-doctoral research fellow recruited for three years from medio 2018 and allocated to our Norwegian partner, the School of business, University college of Southeast Norway (HSN). Knowledge of commercial operations is important in any industry. For shipping in general it is important to have different sorts of knowledge, contacts and partners in different areas. Within the niche a company chooses to specialize in, this becomes even more important. The research questions in this core project will revolve around shipping and other business aspects of the ice trade.

- a) organizational patterns in the ice export and the ice trade
- b) the degree of knowledge, necessary to operate within the segment
- c) the ice trade and the transition from sail to steam

These issues can be approached by investigating the relationship between primarily Norwegian exporters and ship owners and foreign importers. The ice trade reached its apex around 1900, at a time when Nordic ship owners started overseas liner trades—complex operations where market knowledge and good relations was of paramount importance. To what extent did this also apply to ship owners within the ice trade segment? Was market knowledge and good contacts equally important there, or was the ice trade more like tramp shipping where shipbrokers acted as intermediaries between the owner of the ship and the owner of the cargo? And does the ice trade represent an early example of international vertical integration—to what extent and in what ways were foreign importers also involved directly in production and exports, to which degree did they obtain control of ice ponds, lakes and export facilities, and to what extent did they operate their own tonnage under Norwegian or their home nation's flag?

The ice trade was a segment where the competitive advantage for many ship owners mainly consisted of lower wages and second-rate technology in the shape of older sailing vessels. But how did the transition to

new ship technology influence the ice trade, and how did the trade affect the pace of this transition for the companies involved? To what extent did sail and steam compete in the same segments of the ice trade, and to what extent did they cater for different market segments in a trade partly based on long term contacts and contracts, partly however also on a vivid spot market for ice due to great fluctuations in demand? Strand 2 will culminate in a monograph.

Strand 3 will analyze the contribution made by natural ice in the improvement of food supplies, health conditions and standards of living in regions that imported the natural ice. It will address questions like: to what extent can the use of natural ice be seen to have enhanced production, distribution and consumption of fresh foods in urban society prior to large scale introduction of artificial ice and subsequently more modern cooling techniques? can logistical improvements in the food and beverages industries, caused by the use of natural ice combined with modern means of transportation, have paved the way for modern cooling technology by extending the demand for fresh food and cold drinks? what was the impact on local, regional, national and international economic integration of the use of natural ice in food logistics, extending the areas from which fresh foods could be imported to the towns, and enhancing the possibility for the farmers to sell their produce, the fishermen to sell their catch? to what extent can the trade in natural ice be seen as a catalyst of the dietary changes that took place from the second half of the nineteenth century, creating a new urban lifestyle and making the consumption of fresh foods more widespread and democratic?

Strand 4 will discuss the impact of natural ice on societal taste, fashion and aesthetics, and the role of this extraordinary commodity in driving cultural and technological developments. Among the issues to be explored are: did the ice trade entail a logistical and dietary revolution comparable to that driven by the introduction of salt? what were the hygienic implications of the ice trade, and did it have an impact on public health? in preserving foodstuffs and cooling drinks, did the import of ice into Britain have a measurable impact of the standard of living? with regard to the economic and technological interplay between the import of natural ice, local production of natural ice, and artificial ice in the importing areas, can differences in quality or great variations in temperatures/demand for ice have contributed to prolonging the production and use of natural ice?

Strands 3 and 4 will mainly be researched by two PhD students at the Maritime Historical Studies Centre at the University of Hull, recruited and supervised by Professor David J. Starkey (CV attached), and his colleague in Hull, Dr Martin Wilcox. These core activities in the overall project will run for three years, starting in October 2018 and ending in September 2021, focusing on Britain as the principal market for the European ice trade, but with a comparative perspective. The exact scope and design of these PhD projects will be decided after the students have been recruited, within the thematic perimeters suggested above.

The four research strands will be supplemented and supported by contributions from a number of collaborating researchers and students:

Professor Starkey and Dr Wilcox will throughout the project spend 10% of their work hours on research for the project, and they will both write two articles in the context of strands 3 and 4. During the project period they will also recruit and supervise local MA students and supervise visiting Norwegian MA students participating in the project in any of the four research strands.

The project manager and initiator, senior curator/professor Per Norseng (CV attached) will contribute articles within strands 1 and 2, one on the structures of ownership to ice ponds and lakes in the Oslo fjord area, the other on the development of ship and railway transport of fresh fish in and from Norway, as well as offering supervision of MA students in the University college of Southeast Norway. His colleague in the Norwegian Maritime Museum, Dr. Elisabeth S. Koren, who is a specialist on medical history and sailors, will contribute an article on manpower and work conditions in the Norwegian ice fleet for research strand 2. An ethnologist and independent researcher specializing in consumer history and the kitchen as a workplace, Dr. Inger Johanne Lyngø, has agreed to write an article on the introduction and social distribution of ice

boxes in private households in Norway in the 1850-1920 period as a contribution to research strands 3 and 4. Finally, professor Jan Thomas Kobberød at the School of business, University college of Southeast Norway, has agreed to contribute to strands 3 and 4 by examining government politics relating to the use of natural ice in the Norwegian food industries. The project will also be open for contributions from other colleagues.

The Norwegian Maritime Museum/The Norwegian Museum of Cultural History will supply administrative and management support, with Per Norseng as the project manager. He will be assisted by the museum's finance officers in budget matters. To assist in coordinating and cohering the different research strands, professors Heidbrink and Starkey will form with him an academic steering committee for the project.

In addition to local student seminars, together we plan one kick-off seminar (ultimo 2018) and two manuscript seminars/workshops (2019 and ultimo 2020/primo 2021) for the researchers and students engaged in the project and a limited number of invited expert commentators, alternating between Hull and Oslo and/or one of the campuses of the HSN. We also plan a concluding conference (ultimo 2021) to present and discuss the outcomes of the project with invited colleagues from different historical and other relevant academic disciplines before the publication of a concluding scientific anthology. Between the seminars the lead researchers will meet once or twice per year in Hull or Oslo, and keep close contact by video conferences and email.

4. Key perspectives and compliance with strategic documents

Compliance with strategic documents

This is not a traditional project on the history of shipping in the age of sail and steam, nor merely a project on the history of a long defunct extractive industry. With a much broader approach we want to explore not only the interconnection between the natural ice business and shipping, but also some issues which are currently at the top of the agenda for economic, urban, international and maritime history. It is our ambition to open new ways of looking at developments which continue to influence life today such as settlement patterns, diet, public health, climate changes and international shipping links.

In this way, and with its international team of researchers, the project aligns with central elements of the strategic plan (2017-2021) of the University college of Southeast Norway, whose academic staff are encouraged to publish more of their research findings beyond Norway in collaboration with high-profile international scholars, and to participate in international academic networks and meetings. The college also aspires to enable its students to engage in research at an early stage in their postgraduate programmes.

Concurrently, *The Last Ice Age* not only complies with the ambition of the Norwegian Maritime Museum/The Norwegian Museum of Cultural History (Norsk Folkemuseum) to strengthen its research productivity, but also with Norwegian government policies designed to make museums more relevant to the challenges of the present and develop their research interests in collaboration with colleagues in universities and university colleges (most recently expressed in a parliamentary report on the humanities in research and education ("*Humaniorameldingen*" or *Meld. St. 25 (2016–2017) Humaniora i Norge*)).

Relevance and benefit to society

In addition to the benefits described immediately above, we hope that the climate issues that will be highlighted especially in research strand 1, when disseminated to a general audience, will contribute to a higher awareness of the extent and consequences of the on-going climate changes. It is our experience, from a very successful recent temporary exhibition in our museum on plastic waste in the ocean, that museum exhibitions on such matters may make an imprint on people and the media, and stir an interest in them (see also the application form and ch. 5 below on dissemination)

Environmental impact

We do not envisage any negative impacts on the environment of the project or, nor of the use of its results. On the contrary, we hope that the climate issues that will be highlighted in research strand 1, when disseminated to a general audience, will contribute to a higher awareness of the extent and consequences of the on-going climate changes. It is our experience, from a very successful recent temporary exhibition in our museum on plastic waste in the ocean, that museum exhibitions on such matters may make an imprint on people and the media, and stir an interest in them.

Ethical perspectives

While preparing the application, the checklist issued by the Norwegian national committees for research has been consulted. No ethical issues mentioned there, or any others we can conceive of, seem to be relevant to our project.

Gender issues (Recruitment of women, gender balance and gender perspectives)

Maritime history is traditionally a male-dominated line of research. This is, unfortunately, so far also reflected in the composition of our research group in spite of efforts to achieve a better gender balance. Two female researchers at post doc-level have, however, been recruited to contribute articles to the project, and with female students outnumbering males in the history departments and adjacent lines of study these days, and our broad interdisciplinary approach, we believe that our project will help us to recruit more women to research in maritime history as well.

5. Dissemination and communication of results

In addition to what is stated in the application form, the following is to be said about the planned itinerant physical exhibition: If the application for the research grant is successful, the Norwegian Maritime Museum will start planning this exhibition in 2021 as part of the research project, with the ambition to produce it in 2022, financed as part of our programme for temporary exhibitions, show it in our own venue for about a year before it is put on tour to the University of Hull and other museums in Norway and abroad. It is our hope that it can end up as a permanent exhibition in a Norwegian Museum in one of the ice export harbours.

Select bibliography

Contemporary Works

Anonymous: *Die Schädlichkeit des Natureises*. In: *Zentralblatt der Bauverwaltung*. Heft 15, Jahrgang 1892, pp 159-160

Crawhall, T.C., Lentaigne, B., 'A brief account of the historical development of mechanical refrigeration', Science Museum exhibition pamphlet (London, 1934).

Critchell, T.J., Raymond, J., *A History of the Frozen Meat Trade* (London, Constable & Company Ltd, 1912).

Eis- und Kälteindustrie Monatsschrift für Natureis-Industrie, Eisfabrikation, Kühlmaschinenbau, Kälteverwendung.

Wittenberg: Ziensen, 1899-1919 (journal)

The Frozen and Chilled Meat Trade: a practical treatise by a specialist in the meat trade (London, Gresham, 1929).

Gervais, Maxime. 1914. «La glace naturelle de Norvège et son importation en France». *Science & Vie mensuel* No 17

Griffiths, E., Heron, C., *The Handling and Transport of Fish*, Department of Scientific and Industrial Research, Food Investigation Board, Special Report no. 25 (London, HMSO, 1925).

Ice and Cold Storage Traders Directory: Handbook for 1900, (London, Ice and Cold Storage Publishing Co., 1900).

Kiær, A.N., 'Historical Sketch of the Development of Scandinavian Shipping', *Journal of Political Economy*, 1 (1893), pp. 329-364.

Marshall, A.B., *The Book of Ices* (London, Robert Hayes, 1895).

Masters, T., *The Ice Book* (London, Simpkin, Marshall, & Co., 1844).

The Pocket Book of Refrigeration and Ice-Making, ed. Wallis-Taylor, A.J. (London, Technical Press, 1934). Stevens White,

R., *On the Stowage of ships and their Cargoes* (London, Longmans Green, Reader and Dyer, 4th ed., 1867).

Ståhl, Peter. *Die Isolierung und Ventilation als wichtigste Faktoren für Natureis-Kühlanlagen*. Nürnberg: Hof-Buchdruckerei G.P.J. Bieling-Dietz, 1904.

Trier, P.: Deutschlands Import und Export von Eis 1889 bis 1903. In: *Eis- und Kälte-Industrie*. 1904, Band 5, pp 121 – 124

Uddrag af Indberetninger fra de forenede Rigers Konsuler angaaende Handelen med Is m.M. Kristiania 1895 (Excerpts from Norwegian Consular Reports regarding the icetrade)

Secondary Sources:

- Acovitsióti-Hamaeau, Ada: «La glace dans la vie quotidienne ou les nuances du confort: exemples de l'Europe et de la Méditerranée». *Journées d'Etudes du Pôle Universitaire Européen de Montpellier, Perpignan, novembre 1997*. Perpignan 1997
- Acovitsióti-Hamaeau, Ada: «Pratiques, prescriptions et mises en garde concernant la fourniture de la glace en France aux époques modern et contemporaine». Antonio Guerci: *Il cibo culturale. Dal cibo alla cultura, dalla cultura al cibo. Cultural food. From food to culture. From culture to food*. U.sted: 199 pp 409-419
- Ait, Christiane. *Natureis: Ein vergessener Rohstoff*. Berlin: Verein d. Freunde d. Domäne Dahlem, 1992.
- Altenkirch, Gunter. *Herstellung und Lagerung von Natureis in der vergangenen Bauernkultur anlässlich der Eröffnung der 23. Ausstellung im Museum für Dörfliche Alltagskultur in Gersheim-Rubenheim*. Gersheim-Rubenheim, [Erfweilerstr. 3]: G. Altenkirch, 2007.
- Anderson, O.E., *Refrigeration in America* (New Jersey, Princeton University Press, 1951).
- Anonymous: "Einsatz von Natureis in der Brauerei". *Brauindustrie*. 95, 2010 no. 12: 14-15.
- Anonymous. "Supplementary Material on Frederick Tudor Ice Project". *Bulletin of the Business Historical Society*. 9, 1935 no. 1: 1-6.
- Beamon, S.P., Roaf, S., *The Ice-houses of Britain* (London, Routledge, 1990).
- Bean, S.S., 'Gold Mine', *American Heritage* (July/August 1991), pp. 71-76.
- Behringer, Wolfgang. *Löwenbräu: Von den Anfängen des Münchner Brauwesens bis zur Gegenwart..* München: Süddeutscher Verlag, 1991.
- Blain, B. B.: «Melting Markets: The Rise and Decline of the Anglo-Norwegian Ice Trade, 1850-1920». Working Papers of the Global Economic History Network (GEHN) No. 20/06
- Cooper, A.J., *The World Below Zero: A History of refrigeration in the UK* (Buckingham, ACR Today and Battlepress, 1997).
- Crowhurst, B., *A History of the British Ice Cream Industry* (London, Westerham, Food Press, 2000).
- Cummings, Richard O. *The American Ice Harvest*. Berkeley 1949
- David, R., 'The Demise of the Anglo-Norwegian Ice Trade', *Business History*, 37 (1995), pp. 52-69.
- Dickason, David G.: «The Nineteenth-Century Indo-American Ice Trade. An Hyperborean Epic». *Modern Asian Studies* 25/1 (1991)
- Diarmuid O Drisceoil, Donal O Drisceoil: *The Murphy's Story: The History of Lady's Well Brewery, Cork* 1998
- Ellis, M., *Ice and Icehouses through the Ages, With a Gazetteer for Hampshire* (Southampton, Southampton University
- Foster, J.B.. Foster: *Ecology Against Capitalism* (2001)
- Gardåsen, T.K., 'Isblokkar viktig eksportvare. Isbruk i grenlandsfjordane 1835-1962' ['Ice blocks: a crucial export commodity. Ice-mining in Grelansfjords, 1835-1962'],
- Gillet, E., *A History of Grimsby* (London, Oxford University Press, 1970)
- Gjølborg, Ole: «The Substitution of Sail for Steam in Norwegian Ocean Shipping, 1866-1914. A Study in the Economics of Diffusion». *The Scandinavian Economic History Review* XXVIII/2 (1980)
- Grandi, Alberto. 2008. «From Global to Local: Technological Development and Evolution of the Ice Market». *World History Bulletin* Fall 2008 vol XXIV No 2: 19-21
- Green, Brigid Grafton *Milk for the Millions: The Express Dairy in the Borough of Barnet*. Barnet Libraries, Arts & Museums, 1983
- Grytten, Ola Honningdal: "Krise eller glemt storhetstid? Transformasjonen fra seil til damp I norsk skipsfart 1880 – 1910 i internasjonalt perspektiv" [Crisis or Golden Age? The Transformation from sail to steam in Norwegian shipping 1880-1910 in international perspective]. SIS-notat nr. 24/1991. Bergen 1991
- Guillaume, Pierre. *Histoire sociale du lait*. Paris : Éd. Christian, DL 2003
- Gøthesen, G., *Med Is og Plank i Nordsjøfart [Ice and Timber in Norwegian North Sea shipping]* (Oslo, Grøndahl og Søn Forlag A.S. 1986.
- Hanson, Simon G. "Argentine Meat and the British Market". *American Journal of Agricultural Economics*, 1939, vol. 21, issue 2, pages 538-540
- Harley, C. Knick: "Shipping and Staple Economies in the Periphery", in Harlaftis G., Tenold S., Vadaliso J.M. (eds.) *The World's Key Industry. History and Economics of International Shipping*. London 2012
- Hawke, G. R. *Railways and Economic Growth in England and Wales 1840-1870*. Oxford: Clarendon Press, 1970
- Hengsbach, Arne: *Natureiswerke im Umland Berlins*. In: *Jahrbuch für brandenburgische Landesgeschichte*. Jahrgang 1970, Seiten 88-99
- Hughes, Thomas P.: *Networks of Power. Electrification in Western Society 1880-1930* (1983)
- Hård, M., *Machines are Frozen Spirit: The Scientification of Refrigeration and Brewing in the 19th Century - a Weberian Interpretation* (Boulder, Colorado, Westview Press, 1976).
- Johnston, M.M., *Ice and Cold Storage - a Dublin History* (Dublin, Autozero, 1988)
- Jones, J., *American icemen: an illustrative history of the United States natural ice industry in 1925* (Humble, Tex., Jobeco Books, 1984).
- Kinross, F., *Coffee and Ices: The Story of Carlo Gatti in London* (Sudbury, Felicity Kinross, 1991).
- Klovland, J.T., 'Business Cycles, Commodity Prices and Shipping Freight Rates: Some Evidence from the Pre-WW1 Period', See: <http://www.econ.ku.dk/kgp/doc/Workshopfrms/jantoreklovland.pdf>
- Kohnert, Fritz. *Eisernte in Ostpreussen*. Stuttgart: Kohlhammer, 1936.
- Kurlansky, Mark: *Salt. A world History*. London 2003
- Lange, Even and Helge W. Nordvik. 1995. «Economic History». William H. Hubbard et al. (eds.): *Making a Historical Culture. Historiography in Norway*. Oslo – Copenhagen – Stockholm – Boston
- Lange, Even and Lewis R. Fischer. 2011. "Introduction: New Directions in Norwegian Maritime History". Lewis R. Fischer og Even Lange (red.). *New Directions in Norwegian Maritime History. Research in Maritime History* 46. St.

John's: 1-5

- Lawrence, Lee E.: "The Wisconsin Ice Trade". *The Wisconsin Magazine of History* 48.4 (1965)
- Lütgert, Stephan A.: *Eiskeller, Eiswerke und Kühllhäuser in Schleswig-Holstein und Hamburg*. Husum 2000
- Martin, P.G.: "Ice houses and the commercial trade in Brighton". *Sussex Industrial History* 14 (1984/1985)
- McNeill, J.R. *Something New Under the Sun: An Environmental History of the Twentieth-Century World*. N.Y. (2001)
- Mielke, Heinz-Peter. *Die Eisernte*. Greiffrath: Museumsverein Dorenburg, 1990
- Miller, H., *Halls of Dartford 1789-1985* (London, Hutchinson Benham, 1985)
- Nelson, Richard R. and Sidney G. Winter. *An Evolutionary Theory of Economic Change*. Harvard University Press, 1982
- Le Musée de la glace: «Espace Recherche – Bibliographie indicative sur la glace». <http://museedelaglace.free.fr/biblio.html>
- Mokyr, Joel: *The Lever of Riches. Technological Creativity and Economic Progress* (1992)
- Nordvik, Helge W.: «Norwegian Maritime historical Research during the past twenty years». *Sjøfartshistorisk årbok* 1990. Bergen 1991: 241-278
- Norseng, Per G.: «Naturiseksporten i norsk sjøfartshistorie». Elisabeth S. Koren and Frode Kvalø (eds.). *Hundre år over og under vann. Kapittel om maritim historie og arkeologi i anledning Norsk Maritimt Museums hundreårsjubileum*. Oslo 2014 [The export of natural ice in the history of Norwegian shipping and maritime historiography, with comprehensive bibliography and suggestions for further research]
- Norseng, Per G.: «Kystsammfunn i endring». Olav Rovde (ed.): *Telemarks historie vol 3*. Bergen 2014 (b)
- Nygaard, Knut M.: *Fra seilskip i trampfart til dampskip i linjefart. Fred. Olsens rederivirksomhet i forandringens tegn 1886-1904*. Sjøfartshistorisk årbok 2003. Bergen 2005
- Oddy, Derek J, and Alain Drouard. *The food industries of Europe in the nineteenth and twentieth centuries*. Burlington. Ashgate 2013.
- Olsen, M, 'Issjau i Kragerø-distriktet' ['Ice collection in the Kragerø district'], *Budstikker gjennom loka lokalhistorien [Messages through local history]*, Årsskrift 1981 (Kragerø, Kragerø og Skatøy historielag, 1981), pp. 14-35.
- Ouren, Tore. 1981. «The Norwegian Ice Trade». D.V. Proctor (ed.). *Ice Carrying Trade at Sea. The proceedings of a symposium held at the National Maritime Museum on 8 September 1979. Maritime Monographs and Reports* 49: 31-42
- Ouren, Tore: "Tusen skipninger av is fra Risør". *Geografi i Bergen* 120: 157-167 (1989)
- Ouren, Tore. 1990. "Is-skipingen over Bergen tollsted 1822-1913". *Geografi i Bergen* 37: 33-44 (1990)
- Ouren, Tore: «The impact of air temperature on old Norwegian ice exporting». *Norsk Geografisk Tidsskrift* 45: 25-33
- Perren, Richard: *The meat trade in Britain, 1840-1914*. London. Routledge and Kegan Paul, 1978.
- Perren, Richard: *Taste, trade and technology. The development of the international meat industry since 1840*. Ashgate 2006
- Petersen, K., *The Saga of Norwegian Shipping: an outline of the history, growth and development of a modern merchant marine* (Oslo, Dreyers Forlag, 1955).
- Pohlmann, W.: 75 Jahre Eisfabrik Hermann E. Mudrack, Berlin-Reinickendorf-Ost, 4 Generationen in der Eisindustrie. In: *Kälte-Industrie*. 1931, Seiten 54 - 56.
- Reinink, A.W. og J.G. Vermeulen. 1981. *Ijskelders. Koeltechnieken van weleer*. Nieuwkoop
- Rogan, Bjarne. 1996. «La récolte de la glace naturelle à Norvège. De neiges en glaces. Actes de la première rencontre internationale sur le commerce et l'artisanat de la glace, Brignoles 1994. Suppléments no 5 au cahier de l'ASER. Brignoles: 19-28
- Rohrbeck, Wilhelm: *Die Bedeutung der deutschen Eisindustrie*. In: *Die Kälteindustrie*. Heft 7, Jahrgang 1928, Seiten 81 – 83
- Rosenberg, Nathan L. E., Jr. Birdzell: *How the West Grew Rich* (1987)
- Sainsbury, Peter: *The Transition from tradition to technology. A history of the dairy industry in Devon*. Tiverton 1991
- Schrumpf, Ellen: *Byen ved elva. Porsgrunn 1840-1920. Porsgrunns historie* [History of Porsgrunn] bd. II. Porsgrunn 2006
- Seaburg, Carl and Stanley Paterson. 2003. *The Ice King. Frederic Tudor and His Circle*. Boston
- Schmid, Christian: "Als der Davosersee noch eine Goldgrube war: vom Natureis zur Kühltruhe". *Davoser Revue*. 10-18 (2002)
- Sigworth, E.M., 'Science and the Brewing Industry, 1850-1900', *Economic History Review*, 17 (1965), pp. 536-550.
- Smith, Philip Chadwick Foster. *Crystal Blocks of Yankee Coldness: The Development of the Massachusetts Ice Trade from Frederick Tudor to Wenham Lake, 1806-1886*. 1961.
- Smith, J. N.: "The Iceman Cometh: Frederick Tudor's Ice Capade-Exporting Ice from the Ponds of Massachusetts to the Caribbean". *World Trade*. 19, no. 8: 62-62 (2006)
- Solhaug, Trygve. *De norske fiskeriers historie 1815-1880* bd 2. Bergen-Oslo-Tromsø 1976
- Sudhalter, David. *When Ice Was King: The Story of Frederick Tudor*. Gloucester : the Magazine of the New England Coast 2, no. 3: 42-44. Gloucester, Mass: [publisher not identified], n.d.
- Syvtersen, Carsten Martin and Hans-Jørgen Wallin Weihe. 2012. «The rise and fall of the Anglo-Norwegian natural ice trade (1850-1914)». *Beta* 1/2012: 80-92
- Thevenot, R., *A History of Refrigeration throughout the world* (Paris, International Institute of Refrigeration, 1979)
- Tønnessen, Johan Nicolay og Nils A. Ytreberg. 1951. *Fra klipperen til motorskipet. Den norske sjøfarts historie fra de ældste tider til vore dage*. II Bind 3dje Del. Oslo
- Tønnessen, Joh. N.: *Fra trelast og skipsfart til industri 1807-1920* bd.2. Porsgrunn 1957
- Urbanization in History*, ed. Van der Woude, A., Hayami, A., De Vries, J. Oxford, Oxford University Press 1990
- Vaage, J.: 'En utdødd virksomhet: Isskjæring og iseksport' ['A bygone industry: Ice cutting']. *Byminner* 1979
- Weihe, Hans-Jørgen Wallin og Carsten Syvtersen. *Den norske iseksporten. The Frozen Water Trade*. Stavanger 2012
- Whetman, E.H., 'The London Milk Trade, 1860-1900', *The Economic History Review*, 17 (1964), pp. 369-380.
- Weightman, Gavin. *The Frozen Water Trade. How Ice from New England Kept the World Cool*. London 2002
- Worm-Müller, Jacob S.: «Fra klipperen til motorskipet. Verdenskrigen». *Den norske sjøfarts historie fra de ældste tider til vore dage*. II Bind 1ste Del. Oslo 1935: 235-705
- Worm-Müller, Jacob S.: *Fra klipperen til motorskipet. Den norske sjøfarts historie fra de ældste tider til vore dage*. II Bind 2den Del. Oslo 1950