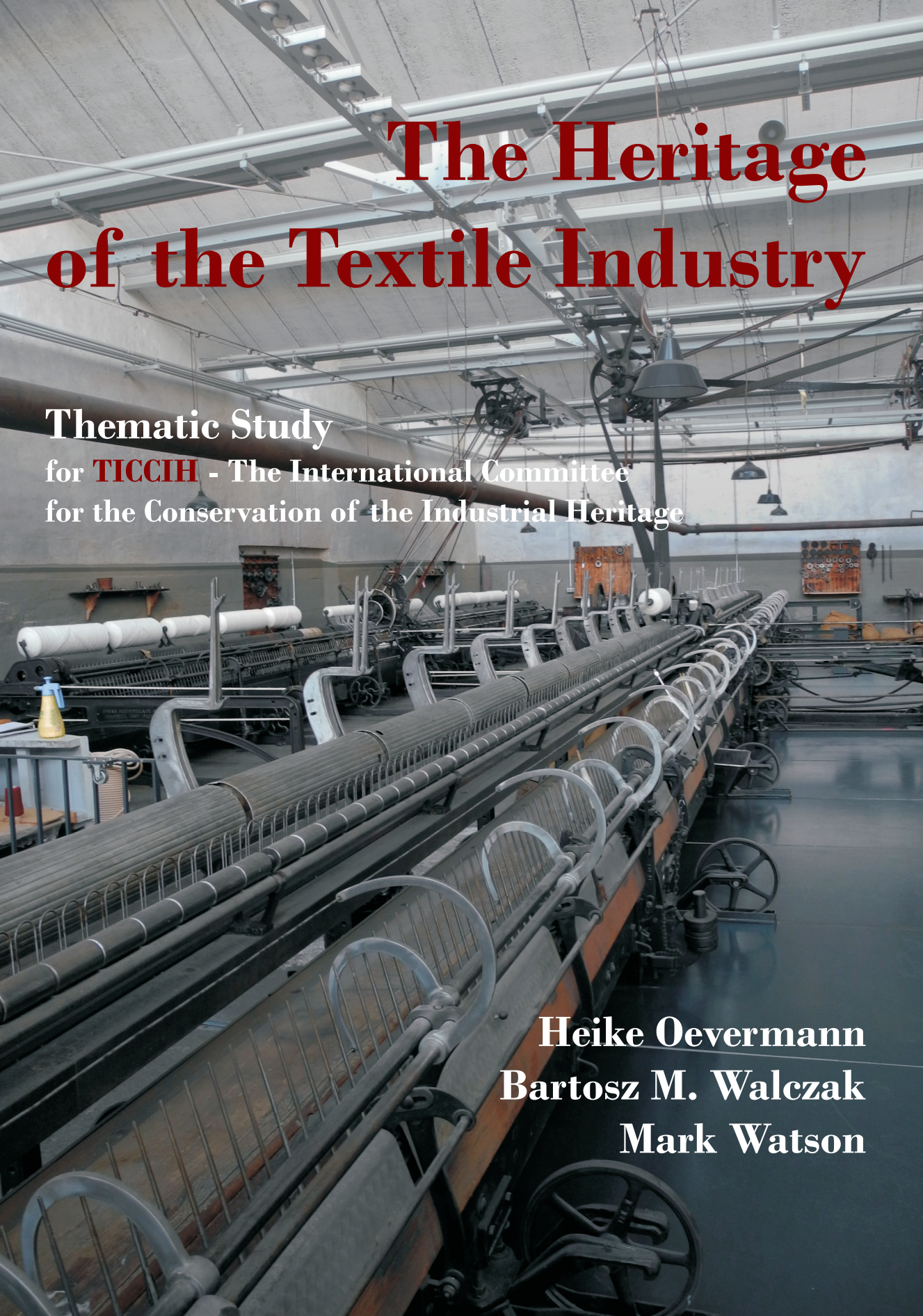

The Heritage of the Textile Industry

Thematic Study

for TICCIH - The International Committee for the Conservation of the Industrial Heritage

Heike Oevermann
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Mark Watson

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The International Committee
for the Conservation of the Industrial Heritage

The Lodz University of Technology

Lodz, 2022

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Proofreading: Mark Watson

Cover design: Bartosz M. Walczak

ISBN 978-83-66741-23-2

DOI: 10.34658/9788366741232

Lodz University of Technology Press

93-005 Łódź, 223 Wólczańska St.

Phone: 42-631-20-87, 42-631-29-52

E-mail: zamowienia@info.p.lodz.pl

www.wydawnictwo.p.lodz.pl

Lodz University of Technology Monographs, No 2386

First edition

Circulation 100 copies; 12 printing sheets

Printing and bookbinding: Quick-Druk, 90-562 Łódź, Łąkowa 11

Authors would like to thank the following institutions for their support:

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PREFACE

A word from the TICCIH President

It gives me great pleasure to be able to write this short Foreword in my capacity as TICCIH President. This study is the latest in a sequence of thematic studies which spring from our hugely valued close relationship with ICOMOS, with whom we have been in formal partnership since signing an agreement in London in 2000. The aim of these studies is to inform the evaluation of emerging UNESCO World Heritage nominations, but they have a much broader value and purpose, helping to raise awareness of the importance of industrial sites and landscapes at global, national, regional and local levels.

Following hard on the heels of water and petroleum, Textiles has proved to be a particularly rich and rewarding industry which is truly global in nature. The three principal authors have done an extraordinary job reaching out into areas hitherto not well represented within TICCIH and have networked extensively, making new contacts and discovering what were, to many of us, wonderful new places. To some extent, this has been assisted by the CoVid19-induced revolution in digital communications technologies, but the pandemic also created major problems, not least the postponement of meetings and conferences, all of which makes the completion of this study all-the-more impressive.

Ultimately, Oevermann, Walczak and Watson have managed to collate an enormous body of information which reflects many years of patient work and collaboration with others. In these days of increasing awareness of the impacts of Climate Change, it is especially good to see that this study looks forward as well as back, taking time to focus on examples of how some textile sites have achieved a second life through adaptation and re-use, often providing the focus for sustainable regeneration. So, congratulations and thanks are due to everyone who helped contribute to what has evolved into a hugely valuable thematic study.

Dr Miles Oglethorpe
TICCIH President

Message de la Présidente de l'ICOMOS

C'est un grand honneur pour moi d'écrire un avant-propos dans cette publication qui témoigne de la longue collaboration entre le TICCIH et l'ICOMOS, le Conseil International des Monuments et des Sites, pour encourager et aider à la connaissance, à la protection, à la conservation et à la mise en valeur du patrimoine industriel à travers le monde. Cette étude thématique de l'héritage de l'industrie textile offre un contexte aux évaluations et recommandations de l'ICOMOS dans le cadre de ses fonctions entant qu'organisation consultative du Comité du Patrimoine mondial pour la mise en œuvre de la Convention du Patrimoine mondial de l'UNESCO.

Le processus d'industrialisation dans le monde constitue une partie majeure de l'histoire de l'Humanité où les technologies, l'architecture, les savoir-faire côtoient la vie sociale et la mémoire des communautés. Cependant, dans le monde d'aujourd'hui, la conservation de ce patrimoine inestimable, souvent fragilisé, se heurte à d'innombrables obstacles aux niveaux sociaux, politique et environnemental. En 2011, l'ICOMOS et le TICCIH ont convenu de principes conjoints pour la conservation des sites, constructions, aires et paysages du patrimoine industriel, connus sous le nom de Principes de Dublin, signés lors du Congrès du TICCIH en 2000 et adoptés par la 17e Assemblée générale de l'ICOMOS le 28 novembre 2011. Dans son article 5 , et je cite « ... *une connaissance approfondie de l'histoire industrielle et socio-économique d'une ville, d'une région ou d'un pays ainsi que de leurs liens avec d'autres parties du monde est nécessaire pour comprendre l'intérêt patrimonial des constructions ou des sites industriels. Des études comparatives, typologiques ou régionales sur certains secteurs industriels ou certaines technologies sont utiles pour évaluer l'intérêt de constructions, de sites ou de paysages particuliers…* ».

L'ICOMOS reconnaît les nombreuses études que TICCIH a déjà produites à cette fin - sur les ponts, le charbon, les canaux, les villages ouvriers, l'eau et les industries pétrolières - et se félicite de l'ajout de l'industrie textile à cet ensemble.

Dans cette étude thématique, le TICCIH a rassemblé des études d'experts pour produire une étude représentative et complète de l'héritage de l'industrie textile. Cette étude illustre la grande variété des efforts déployés par les membres du TICCIH/ICOMOS pour cette fonction essentielle, qui est la nôtre, de contribuer au développement scientifique et à la conservation du patrimoine dans le monde. Les études ici présentés contribuent à une meilleure connaissance de l'histoire de l'industrie textile et des bâtiments associés, ainsi que leur contexte

urbain et social. L'inventaire présentée en fin de volume élargi les sources pour les chercheurs et gestionnaires. L'approche globale et interdisciplinaire, pratique et théorique, des études présentées enrichit l'interprétation (tangible et intangible) et permet d'identifier structures, sites, bâtiments et paysages survivants et leurs attributs qui fournissent des preuves tangibles des valeurs selon des considérations d'intégrité et d'authenticité.

En ma qualité de président de l'ICOMOS je félicite tous ceux qui ont collaboré pour l'excellence de cette étude thématique. Je la considère comme le résultat d'une collaboration enrichissante, inspirante pour tous et qui montre combien il est important d'aligner nos approches pour garantir un processus actif de continuité historique et de contribution culturelle. J'attends avec impatience de futures collaborations utiles !

Dr Teresa Patrício
Presidente de l'ICOMOS

A message from the ICOMOS President

It is a great honour for me to write a foreword for this publication, which is a testament to the long-standing collaboration between TICCIH and ICOMOS, the International Council on Monuments and Sites, in encouraging and assisting the development of knowledge, the protection, the conservation and the enhancement of industrial heritage throughout the world. This thematic study on the legacy of the textile industry provides a context for the assessments and recommendations ICOMOS makes in its role as advisory body to the World Heritage Committee for the implementation of the UNESCO World Heritage Convention.

The process of industrialisation throughout the world constitutes a major part of human history where technology, architecture and know-how go hand in hand with the life and memories of communities. However, in today's world, the conservation of this priceless and often fragile heritage faces countless obstacles at the social, political and environmental levels. In 2011, ICOMOS and TICCIH agreed on Joint Principles for the conservation of industrial heritage sites, buildings, areas and landscapes, known as the Dublin Principles, signed at the TICCIH Congress in 2000 and adopted by the 17th ICOMOS General Assembly on 28 November 2011. In their article 5, and I quote *"... a thorough knowledge of the industrial and socio-economic history of a city, region or country and of their links with other parts of the world is necessary to understand the heritage value*

of industrial buildings or sites. Comparative, typological or regional studies of particular industrial sectors or technologies are useful in assessing the interest of particular buildings, sites or landscapes...".

ICOMOS recognises the many studies that TICCIH has already produced for this purpose - on bridges, coal, canals, workers' villages, water and oil industries - and welcomes the addition of the textile industry to this set.

In this thematic study, TICCIH has brought together expert studies to produce a representative and comprehensive survey of the textile industry's legacy. This study illustrates the wide range of efforts made by TICCIH/ICOMOS members in our essential function of contributing to the scientific development and conservation of heritage around the world. The studies presented here contribute to a better understanding of the history of the textile industry and associated buildings, and their urban and social context. The inventory presented at the end of the volume expands the sources for researchers and managers. The comprehensive and interdisciplinary, practical and theoretical approach of the studies presented enriches the interpretation (tangible and intangible) and allows the identification of surviving structures, sites, buildings and landscapes and their attributes that provide tangible evidence of values according to considerations of integrity and authenticity.

As President of ICOMOS, I congratulate all those who have collaborated on the excellence of this thematic study. I see it as the result of a rewarding collaboration, inspiring for all and showing the importance of aligning our approaches to ensure an active process of historical continuity and cultural contribution. I look forward to future useful collaborations!

Dr Teresa Patrício
ICOMOS President

A word from a leading authority on the industrial heritage

Of the primordial technologies of human advancement the ability to spin plant or animal fibres and weave or knit them to create fabric is of ageless and elemental importance. This thematic review sets out in comprehensive detail the material evidence of textile manufacture with particular emphasis on the period of industrialisation in the last three hundred years, what in some circles is called the Industrial Revolution. The mechanisation of the spinning and weaving processes and the ability to apply water and later steam power to drive these new machines resulted in a step change in the quantity, quality and consistency of fabric production. Importantly, it gave rise to new and distinctive building types, new communities and new landscapes, all reflecting the unprecedented transformation of fabric manufacture from a cottage industry to the primary economic driver of industrialisation in many parts of Europe and North America and ultimately throughout the world.

Unlike the material evidence of other industries, like coal mining or steel making for example, the remnants of industrialised textile manufacture frequently afford opportunities for re-use in the form of large multi-storey mills. Today, without the machinery they once contained, they have grown to become a distinctive genre in their own right. These buildings have proved eminently suitable for adaptive re-use, most commonly for residential purposes. Today they are as distinctive a typology as when they were built, graduating progressively from liabilities, then to low-cost storage, warehousing for mail-order companies, or cheap office use, to become serious and modish assets, offering previously unimagined and stylish residential opportunities. Such has loft living become a desirable aspiration in crowded inner urban environments that new-build apartment blocks have come to mimic those mills that have been converted for residential use

This review is thus unique as not only does it define and identify textile technologies and their development across time and the building types unique to their industrial purposes but it recognises too their new-found re-use merits. These are not just intellectual abstractions but have become a new and palpable urban landscape configuration with its own community values, that live in the hearts of new populations as distinctive today as in their industrial heyday.

In this volume TICCIH has assembled expert opinions from people in countries across the world to produce this most comprehensive representation of the textile industries and the creative transformation of its buildings into something entirely new.

Sir Neil Cossons

1

Context

Plate I. Finlayson cotton mill and Tampella linen and engineering works in Tampere, Finland. This industrial canyon was on Finnish 20 Mark banknotes. Source: Mark Watson, 2010.

1.1 Thematic studies

This report forms part of a series of comparative thematic studies of the heritage of different industrial sectors organised by TICCIH in its role as the designated consultant to lCOMOS in matters related to the study and preservation of industrial heritage. In turn, ICOMOS advises UNESCO on properties nominated to be added to the World Heritage List, drawing on its advice from TICCIH.

These comparative studies summarise the worldwide history of the sector, identifying the periods, locations and authors of the most significant developments, thus providing a contextual framework to help identify the outstanding as well as the most representative attributes: plant, buildings, sites and landscapes. Thematic studies present a synthesis of the available knowledge of a specific theme at the time they are undertaken. The theoretical and practical considerations of any properties as possible World Heritage sites are examined in the light of the criteria for Outstanding Universal Value in UNESCO's Operational Guidelines for the Implementation of the World Heritage Convention.

The direct beneficiary of the report is UNESCO, to help it distinguish places eligible for inscription on the World Heritage List, but the criteria are applicable to other national or regional lists and inventories. No regional assessments of the heritage of this sector have been found, outside Europe, and this is certainly the first global comparative study assessing the significance of the historic sites and landscapes of the textile industry.

1.2 Objectives

This report will:

1. summarise the global development of the world textile sector, concentrating on the physical atributes associated with textile production and the territories most involved in its history;
2. indicate the types of structure, buildings, sites and landscapes which constitute the tangible remains of the industry with the potential to be conserved as heritage;
3. suggest, based on these surveys, what would be of special historical interest were examples to survive with an appropriate degree of integrity and authenticity;
4. provide comparative information to help identify the sites or landscapes which best represent these contributions.

1.3 Methodology

The methodology used for the thematic studies has three parts. The first is a brief global history of the textile industry and related buildings and their urban and social context. This outline identifies and highlights what is of particular historical significance, both internally for the development of that industry, and externally for human society in general. The second consists of criteria to help identify those surviving structures, sites, buildings or landscapes and their attributes which provide tangible evidence for the historic values previously identified, tempered by the usual considerations of integrity and authenticity. The third part is an inventory (a gazetteer) of sites identified during the research.

The process of preparing this study consisted of a desk-based examination of the literature, consultation with relevant experts in different territories who would give a representative geographical and professional spread, the incorporation of their comments and suggestions, and finally to achieve a consensus for the report.

The TICCIH/ICOMOS thematic studies do not recommend specific places, intending rather to help characterise those attributes of this class of cultural heritage which ought to be taken into consideration in an assessment of historic merit, not only but including UNESCO´s measure of Outstanding Universal Value.

1.4 Cooperation

This thematic review is the result of a wide interdisciplinary effort with a sizable group of colleagues, researchers and scholars. Eusebi Casanelles, past President of TICCIH, had a key role in initiating the project in the late 1990s. The preliminary comparative study ***The International Context for Textile Sites*** was compiled by members of the TICCIH Textile Special Interest Section. The text was discussed at meetings of the section in London, UK, in 2000, Barcelona, Spain, in 2001, in Euskirchen, Germany, in 2003 and Sedan, France, in 2007. The draft list was presented to the UK Association for Industrial Archaeology Conference in 2002, to the Society for Industrial Archaeology in Providence, USA, in 2004 and to TICCIH in Terni, Italy, in 2006. The study report, written by Mark Watson, was also available at the TICCIH website, and occasionally updated. This revision takes account of many changes that came to light as a result of geo-location of sites. The Inventory previously arranged the entries by and also according to materials and an urban/rural split, the sites are now arranged alphabetically by country. The draft arrangement had enabled easy comparison by researchers of sites internationally, but not the easy location of specific places.

The new arrangement, mainly by Bartosz Walczak, will we hope be user -friendly. An on-line version will be capable of further amendment.

Finally, in 2020, Dr Miles Oglethorpe, TICCIH president, encouraged the three authors of this study to bring this project to completion. In consequence, two on-line meetings were organised in 2020 and 2021 with participation of experts who had been already involved at the previous stage of the research, and a new group of specialists who joined the project at this stage and widened the knowledge of textile industry heritage to give a more global perspective. Without their contributions, the completion of this study would not be possible.

Fig. 1.1. TICCIH experts in action:Textile section meetings in Terrassa, 2001 (top left), Euskirchen, 2003 (middle left) and Sedan, 2007 (bottom); a TICCIH group discusses conversion of a wool mill in Roubaix, 2015 (top right). Sources: Bartosz M. Walczak and Mark Watson.

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We dedicate this report to
Jeppe Tønsberg, Robina McNeil and Michael Mende,
who did not live to see its completion but gave valuable insights.

2

Introduction

Plate II. Courtyard of the "White Factory" in Lodz. Geyer cotton mill was based on English model and built in the 1830s. Now the Central Textile Museum. Source: Bartosz M. Walczak, 2009.

2.1 Scope

More than 600 textile industry sites were identified in nearly 500 locations in 67 countries during the research conducted 1998-2021. Without doubt the list is far from complete. It is, however, an ample source of information for comparative analysis and further research. The gazetteer of all those places is an integral part of this publication.

The sites were selected to illustrate all stages of textile manufacturing history: preindustrial (domestic), protoindustrial (manufacture), industrial (factory). They exemplify all major branches of textile industry. Processing of all natural fibres is covered: cotton, wool (sheep, goat, alpaca, etc.), flax, jute, sisal, silk, while artificial fibres are represented mainly with factories producing viscose, nylon and polyester. What is more, the authors have made efforts to ensure that the selected examples illustrate all production processes: preparatory stages, spinning, weaving, and finishing A wide range of products: yarn, thread, fabric, lace, embroidery, carpet and hat production has also been investigated. Finally, some places related to the supply chains of raw materials as well as finished products were also taken into account.

Apart from technological aspects of textile production, architectural and structural criteria were also valued. Architectural style, building typology, building materials and structural solutions were also of great importance for the research team.

Attention has been paid to key figures: entrepreneurs, engineers, builders and architects, whose role was crucial for textile manufacturing development, never forgetting the most important component, which was and is the skills of the workforce.

2.2 Value of textile heritage

Values are both intrinsic and extrinsic. Intrinsic value is that which relates to the object concerned, and this report seeks to put them into context with their peers and in terms of concepts like truth- what are the attributes of an authentic textile mill? Cultural significance is said to be ‘embodied’ or contained in the fabric, setting, use, associations, and meanings of a place, and includes aesthetic, historic, scientific, social and spiritual values for past, present and future generations[1]. In order to preserve such values a ‘cautious approach’ of minimum intervention is

[1] *Burra Charter* (*vid.* Preamble, Articles 1, 3, Guidelines) (PDF). Australia ICOMOS. Viewed 22/09/2021.

often advocated, such as a preference for continued operation in its original use, with as little modification as possible. But the consensus of the contributors to the TICCIH working group is that the majority of textile sites will not survive in the function for which they were built, because the global textile industry has moved centres of production away from the places that were created for them.

That then leads to extrinsic, public or instrumental value: textile mills are the vehicles for delivering some of humanity's goals in respect of big issues like global warming, and immediate issues: what about jobs in new industries, provision of homes in a pleasant environment, and, yes, how can this land retain or enhance its financial value, sufficient to justify on-going maintenance?

New industries seeking light industrial space, such as the early electronics industry in Lowell, Mass. (USA), was drawn to the ready availability of large areas of cheap floor space in former cotton mills. Cotton mills in Lancashire, and Temple Mill in Leeds, are examples of places that attracted the mail-order industry in its early stages. In both these industries some of these businesses are moving on, but they gave economic purpose and employment to places as a result of available textile mills. So now the opportunity is there to give those mills a third lease of life that gives them renewed instrumental value to their communities.

Textile mills are amongst the industrial building types that have proved most capable of adapting to new uses (fig. 2.1.). They are designed to utilise good natural light (except for the most recent of them which exclude sunlight), have comfortable, or to modern standards very generous floor to ceiling heights, in robustly framed buildings with quite thick walls, that are able to cope with structural changes internally (such as new stairs and light wells) as well as externally, given sufficient engineering advice and guidance[2].

Adapting old industrial buildings can make a significant contribution towards meeting international targets for climate change reduction. Simply put, they already exist and their building materials contain embodied energy already invested in them: the stone has already been cut, the bricks and tiles fired, the iron smelted, and is already turned into cast or wrought iron elements. Timber seals in the carbon dioxide that was absorbed when trees grew, and the energy that went into sawing it. And these building materials have already been taken to its present location, so new transport costs do not arise that would be the case in constructing

[2] *Scottish Iron Structures | Historic Environment Scotland | HES* viewable free at Guide for Practitioners 5 - Scottish Iron Structures - (05-0 by Historic Environment Scotland – issuu.

a new building for any purpose. Using this environmental capital means less demolition waste taken to landfill sites and less energy needs to be devoted to bringing in new building materials.

Operational savings - by energy-efficient insulation and by use of renewable energy - take many years to take effect. Benefits can be lost if short design lives that are typical of new buildings, and short refit cycles, increase lifetime emissions, no matter how efficient when in use. The calculated benefits from that investment cannot account for future variation in energy prices. As energy will increasingly be derived from yet more 'green' sources than at present, the savings in carbon dioxide in operational use will be less in future than today.

Savings in embodied energy achieve immediate reductions in carbon dioxide when compared against a new building. An existing textile mill might perform surprisingly well against modern codes due to factors inherent in the structure. A solid brick-arched or concrete floor, or a 'slow-burning' timber floor (American mill construction employing heavy timbers), contains much embodied energy compared to a standard joisted timber floor. They perform well in sound tests, and perhaps with some adjustments are going to be relatively secure against fire. A series of publications giving exemplars of re-used industrial buildings exists in France[3]. Historic England has produced guidance and exemplar case studies from regions of northern England -Yorkshire and the North West- that are specific to textile mills[4].

Therefore the gazetteer in this report contains mill buildings that are adaptively re-used. They are to be celebrated because they have a continuing utility to people. Only those that are in the "time capsule" category might be those where the working group would hesitate to endorse radical change of use. For the rest the best use might be one still to come. Countries that have recently gone through, or are going through deindustrialisation can take heart from the examples given here. Many will have important mills that are under-utilised or where change is to be expected, and welcomed. Minimum intervention is not the guiding light.

A programme for active use, and often that means a wide variety of uses different to the original function, of textile mills in a textile landscape is a pre-requisite where world heritage nomination and ongoing management is under

[3] Gasnier, M, *Patrimoine industriel et technique*, Belfort, 2011.

[4] *Engines of Prosperity: new uses for old mills | Historic England* one of the reports here, along with more specific concerns like arson: *Research and Guidance on Re-Use of Mills | Historic England*.

consideration. That should be the norm, and the cause for concern arises where there is no use in prospect. That can happen where there is severe over supply of such buildings, due to rapid change in a localised industry. In that case “mean-time” temporary uses are expedient ways of getting local engagement with industrial heritage, and ensuring some maintenance for the best of these, intrinsically and extrinsically, until a long -term use can be secured. An example of this is the series of summer concerts in Kreenholm cotton mills in Narva, Estonia.

Fig. 2.1. Examples of successful adaptive re-use of textile mills: a school in the former Companyia cotton mill in Terrassa, Spain (left); mixed-use development in the former Wallaerts cotton mill in Lille, France (right). Sources: Bartosz M. Walczak and Mark Watson.

3

Historical and geographical development of textile industry

Plate III. Masson Mill, in the Derwent Valley Mills WHS, Derbyshire, UK. Built in 1783 by Sir Richard Arkwright, who aspired to be a country gentleman, and showed that in his architecture.
Source: Bartosz M. Walczak, 1999.

3.1 Before the Industrial Revolution

Textile is any flexible woven fabric or cloth. The word might be also used to describe raw material suitable to be made into cloth; fibre or yarn. While yarn is defined as a continuous twisted strand of natural (mainly wool, flax and cotton) or synthetic fibres, used in weaving, knitting, etc.[5]

Making textiles has been a cultural activity since time immemorial. The prime purpose of textiles was clothing, which is specifically human characteristic and most human societies wear some form of clothing. There is evidence that suggests that humans may have begun wearing clothing somewhere from 100,000 to 500,000 years ago. Anthropologists suggest that animal skins and plants were originally adapted as protection from weather conditions. There is another hypothesis, according to which the clothing was initially used for purposes such as magic, decoration, cult or prestige, and then later found to be practical as means of protection[6].

Textiles appeared in the Middle East during the late Stone Age. Primitive sewing needles have been found and are dated to around 40,000 years ago. Dyed flax fibres which have been found in a prehistoric cave in the Republic of Georgia are old some 36,000 years[7]. The earliest evidence of weaving date from 27,000 years ago and were found in Dolní Věstonice in the Czech Republic in the shape of impressions of textiles on little pieces of hard clay[8]. Some 25,000 years ago artistic representations of female deities depicted with clothing started appearing in Europe. In particular, the sculpture of Venus found in Lespugue (Haute-Garonne, France) is most likely the earliest representation of spun thread, according to Elizabeth Wayland Barber's research[9].

The first known textile of South America dates back to 8,000 BC. The piece woven out of vegetable fibres was discovered in Guitarrero Cave in Peru[10]. In the same period flax was already cultivated in the Near East. Linen cloth was made

[5] *Collins English Dictionary*, HarperCollins Publishers, 2014.
[6] http://www.historyofclothing.com/ (access: 04.08.2021).
[7] Harvard University. "Archaeologists Discover Oldest-known Fiber Materials Used By Early Humans". ScienceDaily, 11 September 2009.
[8] Soffer, O. et al., "Perishable Technologies and the Genesis of the Eastern Gravettian", *Anthropologie*, vol. 36, no. 1/2, 1998, pp. 43-68.
[9] Barber E.J.W., *Women's Work: The First 20,000 Years: Women, Cloth, and Society in Early Times*, W. W. Norton and Company, 1994, p. 44.
[10] Adovasio J.M., Lynch, T.F. "Preceramic Textiles and Cordage from Guitarrero Cave, Peru", *American Antiquity*, vol. 38, no.1, 1973 pp. 84–90.

in Egypt from the Neolithic period[11]. Ancient Egyptians used various spinning and weaving techniques, which most likely came from Asia. Cotton was used for clothing in India from ca. 5,000 BC, with the evidence based on excavated clay figurines representing men with long cloth wrapped over their waist[12]. Japanese developed textiles from bark fibres ca. 5,000 BC. The earliest proof of silk production in China dates from the same time, as is the archaeological evidence of the hemp use. However, textile use of *Cannabis sativa* in the West did not take place earlier than the Iron Age[13]. While jute was used for making textiles in the Indus valley civilization since the 3rd millennium BC[14].

Although sheep were domesticated some 11,000 to 9,000 years ago, archaeological evidence from Iran suggests that they were not bred for wool before ca. 6,000 BC[15]. Woolly sheep were introduced into the Near East and Europe some two millennia later. The oldest known European wool textile dates back to 1,500 BC, and was recorded in Denmark, where the Arden Woman was found in the Bredmose bog[16].

Trade in textiles rose along with tastes for luxury. In particular, Silk trade helped in the development of the great civilizations of China, Egypt, Mesopotamia, Persia, the Indian subcontinent and Rome. The famous Silk Road, like that for spices, formed links between Asia and Europe already in 2nd century BC, well in advance of other consumer goods such as sugar, tea and coffee.

In medieval times buildings dedicated for textile trade emerged throughout Europe. Great architecture of the period owes much to the commerce of textiles, from English monasteries (Fountains Abbey WHS) to Flemish cloth halls (such as Ypres). Cloth and linen halls were built in European trading towns from medieval times into the 18th century. Typically they were situated on the main marketplace. Particularly impressive cloth halls were built in the towns of

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[11] Jenkins D.T., *The Cambridge history of western textiles*, Cambridge-New York: Cambridge University Press, 2003, pp. 39-47.
[12] Kenoyer J.M., "Ornament Styles of the Indus Valley Tradition: Evidence from Recent Excavations at Harappa, Pakistan". *Paléorient.* vol. 17, no. 2, 1991, pp. 79–98.
[13] Barber E.J.W., *Prehistoric Textiles: The Development of Cloth in the Neolithic and Bronze Ages with Special Reference to the Aegean*. Princeton University Press, 1992, p. 18.
[14] Wright R.P. et al. "New evidence for jute (Corchorus capsularis L.) in the Indus civilization", *Archaeological and Anthropological Sciences*, vol. 4., no. 2, 2012, pp. 137-143.
[15] Ensminger M.E., Parker R.O., *Sheep and Goat Science*, Danville, Illinois: The Interstate Printers and Publishers, 1986.
[16] Glob P.V., *The Bog People: Iron-Age Man Preserved*. Ithaca, New York: Faber and Faber Limited, 1969, pp. 82-100.

Flanders. The trade in Flemish cloth and other textiles spread throughout northern and north-eastern Europe carried by the towns of the Hanseatic League[17]. A number of cloth halls survived and witness the early textile trade development in European towns, including: Braunschweig; Bruges; Cracow; Ghent; Halifax (the Piece Hall); Leuven; Liège; Rouen; Tournai; Verviers; Ypres; Zwickau. Similarly, in Spain buildings for silk trade emerged about the same time, with a spectacular example being the Silk Exchange in Valencia[18].

Conversely, the textile products of some nomadic communities are the principal cultural artefacts by which they can be represented, whether now in museum collections or still in living communities. Ancient textile trade traditions are cultivated in such places like the northern provinces in Afghanistan, where artisanal carpet manufacturing is still an important part of the local economy[19]. Likewise, Medina of Fez in Morocco remains a centre of traditional craftsmanship in silk weaving, of great interest since the fibres are made of an agave plant, not from the silkworm cocoons[20].

The textile business was and is a world-wide industry drawing on raw materials produced all over the world. It was to produce textiles that development occurred in otherwise non-productive places, such as the vast sheep farms in Australia and New Zealand. Production of sisal (in Mexico and St Helena), and of coir (Zanzibar), manila (Philippines), hemp and jute (Bangladesh) enabled parts of South and South East Asia to develop, or to be exploited. Most famously, the growing of cotton moved from India to the Southern United States, to be worked in large slave plantations, the conservation of evidence for which is a thorny issue. Since then cotton growing has moved back to Egypt and the former Soviet

[17] Coomans T., *Belfries, Cloth Halls, Hospitals, and Mendicant Churches: A New Urban Architecture in the Low Countries around 1300* [in] Gajewski A., Opačić Z. (eds.), *The Year 1300 and the Creation of a new European Architecture*, Turnhout: Brepols Publishers, 2008, pp. 185-202.

[18] Santisteban Cazorla M.P., Rodríguez Pasamontes J., Pastor Villa R. "La Lonja de la Seda en Valencia" [in] *Actas del Segundo Congreso Internacional de Buenas Prácticas en Patrimonio Mundial: Personas y comunidades*. Madrid: Universidad Complutense de Madrid, Servicio de Publicaciones, 2015, pp. 560-572.

[19] Spooner, B. "Afghan carpets: weavers and dealers", *Expedition: The magazine of the University of Pennsylvania*, vol. 15, no. 2, 1973, pp. 9-16.

[20] Stuck L., "Handweaving in the Everyday Life of Artisans, Merchants and Consumers in Fez, Morocco, in the 1980's" [in] *Textiles in Daily Life: Proceedings of the Third Biennial Symposium of the Textile Society of America, September 24–26, 1992*, Earleville, MD: Textile Society of America, 1993.

republics of central Asia, followed by manufacturing plants in those places, at the expense of the older spinning and weaving districts.

Prior to the industrial revolution, many textile products were made at home (either for personal use or as a part of putting-out system) or in small workshops. In putting-out, work is contracted by a central agent to subcontractors who complete the work in off-site facilities, either in their own homes or in workshops with multiple craftsmen. Therefore, apart from craftsmen's houses, a house of the putting-out entrepreneur emerged. It was usually a building with a large storage area for the raw material and finished products taken from the craftsmen. One of the most spectacular, best known and well-preserved of these is the so-called Rotes Haus (Red House) of the Scheibler family in Monschau, Rhineland (fig. 3.1.). It was used for washing and preparation steps in wool finishing and dying. This combination of putting out and centralisation of work allowed high flexibility and quality control. On one hand the system increased production, but on the other hand contributed to the pauperisation of weavers. It was a very important stage, necessary to accumulate the capital needed to establish the first manufactories and factories[21]. Such a form of production relations was not limited to Europe before the industrial revolution. To the contrary, the putting-out system is a relatively enduring feature of capitalist production, surviving or re-appearing in various times and places, like cloth production in Turkey or silk manufacturing in Japan[22].

Another important development in the organisation of textile production was a centralised manufactory, where particular stages of production were carried out by specialised employees, cooperating with each other and subordinated to the uniform management. Launching such an enterprise required considerable capital, therefore the earliest companies include royal manufactories. France was one of the countries where centralised organisation was of particular importance for economic development. This was mainly due to Jean-Baptiste Colbert, minister under Louis XIV. Le Dijonval was the first French cloth manufactory, established in Sedan in 1646 by Nicolas Cadeau, a Parisian merchant (fig. 3.2.). This concept

[21] Cf.: Kisch H., *From Domestic Manufacture to Industrial Revolution: The Case of the Rhineland Textile Districts*, New York: Oxford University Press, 1989.
[22] Jirousek C., "The Gaziantep Cloth Trade: a Study of a Putting-Out System of Cloth Production in Southeastern Turkey" [in] *Approaching Textiles, Varying Viewpoints: Proceedings of the Seventh Biennial Symposium of the Textile Society of America, Santa Fe, New Mexico, 2000* , Earleville, MD: Textile Society of America, 2001, pp. 244-252. Nakabayashi M., "Flexibility and diversity: the putting-out system in the silk fabric industry of Kiryu, Japan" [in] Tetsuji Okazaki T. (ed.) *Production Organizations in Japanese Economic Development*, London: Routledge 2007, pp. 127-166.

was developed by Colbert into a general strategy for advancement in textile production. As a result several other royal manufactories were built in places such as Abbeville; Elbeuf; Louviers; Paris (Faubourg Saint Marcel); Villeneuvette[23].

Similar development of cloth production occurred in Spain, where royal manufactures were established in the 18th century under Ferdinand VI and Charles III of the Bourbon dynasty, including Brihuega; Ezcaray; Nuevo Baztán[24]. However, the most important manufactory associated with the Spanish Bourbon dynasty was not established on the Iberian Peninsula, but in the south of Italy, in the kingdom of Sicily, which had been under their rule since 1735. A royal silk manufactory San Leucio was organised in Caserta estate in 1789 (WHS). Another extremely interesting silk manufactory was built in Budapest in Hungary around 1785. This investment initiated by the emperor Joseph II included spectacular late-baroque silk-winding building on the oval plan[25]. New forms of industrial production organisation also appeared in Russia, where 14 manufactories were built in the early 18th century, with the beginning of Peter the Great's reforms. Already in 1722 in Yaroslavl, on the initiative of the local Russian-Dutch merchant company, a manufactory specializing in linen canvas production was established. The presence of a partner from the Netherlands has probably influenced the use of windmills to drive the equipment necessary for flax processing[26].

There were very few examples of centralised manufactories outside Europe. In India, for example, traditional textile production combined sophisticated techniques with relatively static organisational forms. There were, however, some attempts undertaken by European entrepreneurs, including James Anderson's silk projects on the Coromandel Coast in India and massive woollen and silk production in the viceroyalty of New Spain (Mexico)[27].

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[23] Gayot G., *Les cloths de Sedan*, Paris: École des hautes études en sciences sociales, 1998; Diffre S., Jaoul M., *Villeneuvette 1674-1954: la Manufacture royale de Villeneuvette en Languedoc,* Gignac: Bibliothèque 42, 1997.

[24] Clayburn La Force J., "Royal Textile Factories in Spain, 1700-1800", *The Journal of Economic History*, vol. 24, no. 3, 1964, pp.337-363.

[25] Markus T.A., *Buildings and Power*, London: Routledge, 1993, s.252-253.

[26] Gryaznov A.F., *Yaroslavskaya bol'shaya manufaktura*, Moscow: Sinodal'naya tipografiya, 1910.

[27] Berg M., "Passionate Projectors: Savants and silk on the Coromandel coast 1780–98", Journal of Colonialism and Colonial History, vol. 14, no. 3, 2013. Trujillo Bolio M., "La manufactura de hilados y tejidos en la historiografía mexicana, siglos XVIII y XIX. Obrajes, protoindustrias, empresariado y fábricas textiles", *Secuencia*, no. 97, 2017.

Fig. 3.1. Rotes Haus (Red House) of the Scheibler family in Monschau, Rhineland, Germany – a proto-industrial development based on the putting out system. Source: Bartosz M. Walczak, 2006.

Fig. 3.2. Le Dijonval cloth manufactory in Sedan, France – a centralised manufactory worked by hand. Source: Bartosz M. Walczak, 2007.

3.2 From the Industrial Revolution to Today

The textile industry was the lead sector in many countries' experience of the industrial revolution. Textiles were often the dominant industry in terms of employment, value of output and capital invested. Apart from modern production methods and technology, the textile industry was also the first to use new forms of power generation, finance, labour, and industrial organisation. They were combined in a textile mill on a scale that foreshadowed today's industrialised and urbanised society. This process is well-known, and extensively described[28]. The key facts should be, however, highlighted here to give readers a proper image of the textile industry development.

Simultaneously with the development of the organization of production (described in previous section), the gradual evolution of textile tools and machines took place. Until the early modern period the technological progress was slow. In Europe, the accumulation of trading capital, which took place at the end of the feudal period, contributed to the creation of the first manufactures and the acceleration of technical progress. The earliest attempts at mechanized spinning were undertaken with wool. They were, however, unsuccessful, since wool spinning proved more difficult to mechanize than cotton. All major improvements and inventions took place in relatively short period from the early 18th to early 19th century. Most of them were developed in Britain, and to some extent also in France.

The flying shuttle invented in 1733 by John Kay, contributed to an increase in fabric production and consequently in demand for yarn. Further improvements were made in a very short period of time: the spinning jenny was invented by James Hargreaves in 1764, and five years later Richard Arkwright patented the water frame, a spinning machine using a different technology. In 1779 Samuel Crompton presented a combination of the two previous machines - hence the name: mule. At the same time there was a further development of weaving machines, which led to a power loom, patented by Edmund Cartwright in 1785, and improved by William Horrocks in 1813. Concurrently, knitting and stocking machines were also being developed and upgraded. In France, Joseph Marie

[28] eg.: Henderson W.O., *Britain and Industrial Europe 1750-1870*, Leicester: Leicester University Press, 1972. Clarkson L.A. (ed.), *The Industrial Revolution: A Compendium*, Basingstoke: Macmillan, 1990.

Jacquard invented a punched card loom in 1801, while Barthélemy Thimonnier developed the first functional sewing machine in 1830[29].

The above lists illustrates a processes typical for the period of industrial revolution, which was initiated in Great Britain, where the political and economic changes that took place in the 17th century, along with technological progress at the beginning of the following century, triggered a profound transformation. Due to the complex and organic nature of the changes, it is difficult to indicate a breakthrough date - it is assumed that this took place between 1760 and 1780.

The oldest water powered textile factory in England is considered to be the one built as early as 1702 by Thomas Cotchett in Derby on the Derwent River. However, the establishment of this factory was an isolated phenomenon, ahead of the development of industry by several decades. Then, also in Derby, there was a silk throwing mill established by the Lombe brothers in 1717-1721, deploying Italian technology, was not only the first successful silk throwing mill in England, but most likely the first fully mechanised factory in the world. Mechanisation of production in the high-end of the industry, was not a real breakthrough. The 1740s brought cotton mills established with spinning machines (using the principle of two sets of rollers travelling at different speeds to enable fully mechanical spinning), patented by Lewis Paul and John Wyatt. The mills in Birmingham, Northampton and Leominster remained operational from 1741 until 1764. None of them was financially viable[30]. The first fully successful attempt was by Richard Arkwright, who set his cotton mill in Cromford on the Derwent River in 1772. This was followed by the establishment of further businesses in Belper, Milford and Darley Abbey, and with them the first factory and residential complexes[31]. The area thus became the cradle of the textile industry and the importance of this process in both economic and architectural terms is reflected in the WHS status of these complexes.

The British achievements were soon followed by entrepreneurs at the continental Europe and the USA. In particular, the mills on the Derwent River were source of inspiration for the first developments. As early as 1784 a factory was founded on the property of Johann Gottfried Brugelmann near Ratingen in

[29] A complete timeline of inventions related to textile manufacturing is available at: https://en.wikipedia.org/wiki/Timeline_of_clothing_and_textiles_technology (access: 05.08.2021).
[30] de Lacey Mann J., Wadsworth, A. P., *The cotton trade and industrial Lancashire, 1600-1780*. Manchester: Manchester University Press, 1965. pp. 433-448.
[31] *The Derwent Valley Mills and their Communities*, County Hall: The Derwent Valley Mills Partnership, 2001.

Germany. Its name – Cromford – referred to the first Richard Arkwright's mill (fig. 3.3.). Just a year later - in 1785 – the first mechanised cotton-spinning mill in France was built in Louviers, with the assistance of two English mechanics who had worked for Richard Arkwright. In the United States, Samuel Slater of Belper established a cotton spinning mill at Pawtucket in 1793 (fig. 3.4.). About the same time the first factories were built in Saxony, while the early 19th century brought further developments in other European countries[32]. By the 1830s textile mills were operational everywhere on the continent. On the other side of the Atlantic Ocean, dozens of spinning mills were built in Massachusetts by 1810, and a decade later Lowell was founded in the 1820s as a planned textile manufacturing town. The first modest-scale mills in Canada emerged about this time, while in Mexico, the first major textile enterprise was established in Puebla in 1835. The textile industry did not develop in Southern America before the 1860s. One of the earliest examples was Garmendia woolen mill, built in 1861 in Lucre, Peru, and equipped with Belgian machinery. Towards the 1870s Brazilian cotton industry was booming due to development of plantations as a consequence of the Civil War in the USA, as some reserchers suggest[33].

In Asia, the Ottoman Empire implemented industrial production methods in textile plants intended to be lead sectors for modernisation. In Istanbul, a fez factory was built in 1839. Concurrently, the first modern silk reeling factory in Ottoman Syria was established in 1840, while a modern cloth mill was established near Izmir in 1844. The latter was designed by William Fairbairn, as was the first cotton mill in India: the Bombay Spinning and Weaving Company of 1854. In the Far East textile industries developed in the late 19th century, with a spectacular example of technology transfer to set up Tomioka silk mill in Japan (WHS) as a merger of Eastern and Western traditions. In Africa, Egypt was the first country where buildings related to the industrialised textile industry emerged during the 19th century (see insight box 1).

[32] Walczak B.M., „Wpływ rozwiązań europejskich na budownictwo przemysł w Łodzi w świetle ostatnich badań", *Kwartalnik Architektury i Urbanistyki*, vol. LIV, no. 2, 2009, pp. 68-77.
[33] Giroletti D., "The Growth of the Brazilian Textile Industry and the Transfer of Technology", *Textile History*, vol. 26, no. 2, 1995, pp. 215-231,

Fig. 3.3. Johann Gottfried Brugelmann's mill near Ratingen, Germany – an early example of technological transfer (by smuggling). Source: Bartosz M. Walczak, 2003.

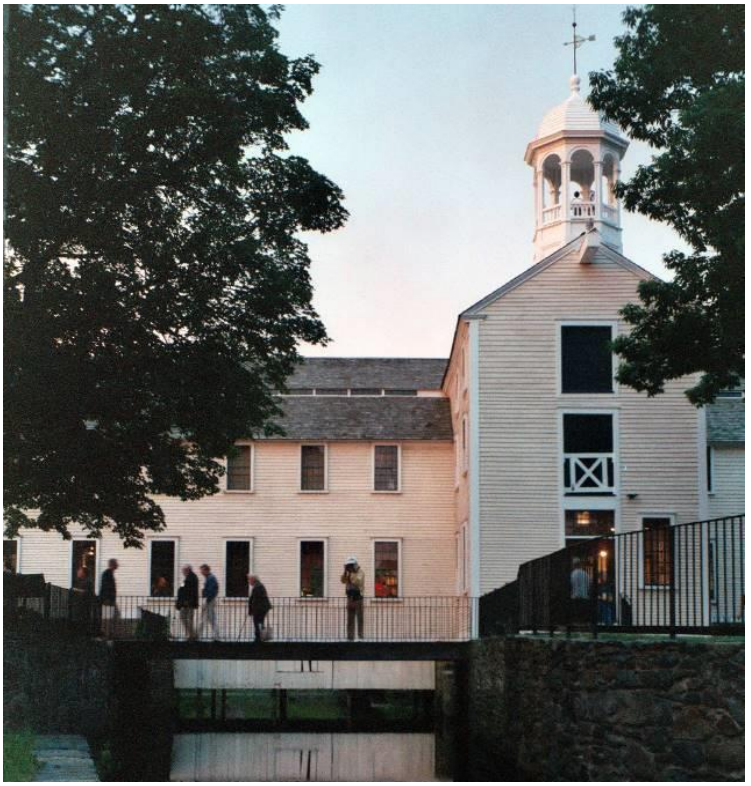


Fig. 3.4. Slater mill in Pawtucket, RI (USA) based on the Belper model, but with timber structure and cladding. Source: Mark Watson, 2004.

Insight box 1.

COTTON TRADE AND SUPPLY CHAIN

Warehouse complex, Port of Alexandria, Egypt

Qesm Mina Al Basal, Alexandria, Egypt [31°11'6.32"N 29°53'10.63"E]

Located by the Western Port, the giant warehouse complex extends on both al-Qabbārī and Mīnā al-Baṣal districts overlooking the former al-Maḥmudiyah Canal in Egypt's main port city of Alexandria. The warehouse complex comprises a chessboard-like spatial arrangement along both Canal banks. This developed since the 19th century. alongside the city's western-influenced orthogonal urban fabric Due to the Cotton Famine of the American Civil War in 1861-1865 the export of Egyptian cotton surged to become the main source for European mills. Corresponding to a cotton boom in Egypt, the warehouse complex represents international interchange that reinforced the prominence of Egypt's global exports[1]. This is evident in the detailed insurance map published by Charles E. Goad Company in 1898 (fig. 3.5.). The pioneer role of the warehouse complex was not limited to the storage of Egyptian commodities, but also those of the far East. The still-standing al-Qabbārī Terminus, a railway station within the warehouse complex, is significant as the first railway terminus in Egypt, Africa, and the Middle East. It was founded originally to facilitate and speed trade travel between Britain and its colonies in the far East and India. It comprises the physical structures of the terminus, the workshops, among others, albeit mainly neglected. Besides the warehouse and railway industry, the complex includes other buildings supporting textile industries. These are represented in *Le Marché au Coton*, cotton press factories, and a workers' settlement. *Le Marché au Coton* was built to host all spot sales and to arbitrate disputes around cotton and grain, as Egypt's main export commodities. Le Marché, as well as the pressing and storage establishments were founded and managed predominantly by non-Egyptian merchants, mainly of Greek origin. The warehouses, dating back to the second quarter of the 19th century has one to two-storey volumetric cubature with plastered facades and small windows. A press dates to the first quarter of the 20th century. It features corporate signage on 3-storey building blocks with visible columns, girders, and red bricks articulating the facades. The cotton press and storage buildings, dating from the 19th and early 20th centuries, are equipped with sprinklers, internal and external hoists, and machines mainly from Manchester. Operational time capsules are represented by two building blocks: the first for cotton press and the other for cotton blowing. Besides being the only witness in use for Egyptian cotton pressing, the operational process uses the same historical machines (fig. 3.6.).

Mirhan Damir

[1] Exported commodities did not only include cotton, but also sugarcane and grains, among others

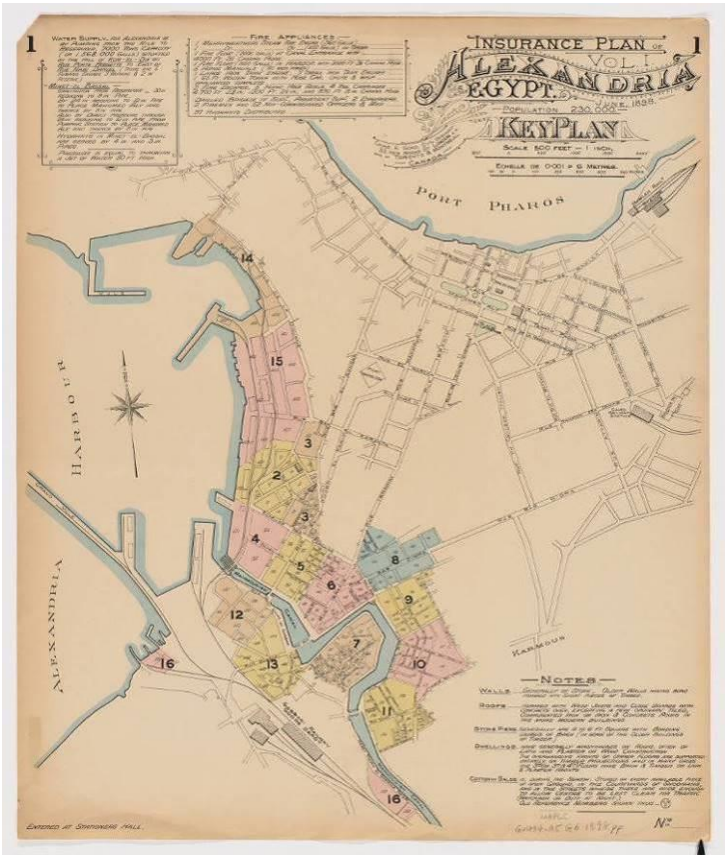


Fig. 3.5. Insurance map plan of Alexandria Egypt by Charles E. Goad, published in June 1898. Source: Harvard Map Collection, Harvard Library.

Fig. 3.6. Cotton carding machines inside the only cotton press in use in Alexandria, Egypt. Source: Mirhan Damir, 2019.

The late 19th century brought a new wave of developments, related to inventions in artificial fibres. Processes for making artificial silk were developed both in France and the United Kingdom. In 1890-1892, the first factory in France producing artificial silk established in Besançon. While in the UK the first commercial viscose rayon was produced by Courtaulds Fibres in Coventry in 1905. In the early 20th century similar factories were established in other European countries and also in the USA and Canada. In 1939, the first nylon plan in the world was opened by DuPont in Seaford, Delaware.

In the 20th century, the Soviet Union invested in the textile industry in Central Asia – already in the 1920s factories were built in Turkmenistan and Uzbekistan. In the same period, Iran also experienced investment in the textiles, and several factories were built with support of German capital, know-how and technology. After WWII, new textile industries emerged in post-colonial countries in Asia, where new borders meant for example many new jute mills in East Pakistan (now Bangladesh) in the 1950s to rival existing mills in India. The next decade brought new developments in African countries, often with help of foreign investment, as occurred in Cameroun, where French company DMC was involved, and in Tanzania, where Urafiki Textile Mill was a gift from China. In Europe, processes were strongly affected by new political and economic circumstances - in the West industry contracted as a result of globalisation, while in Eastern communist regimes some mammoth factories were built in the 1950s to 1970s to meet demand in the bloc, alongside significant output by many older factories.

3.3 Supply chains

3.3.1 Cotton

Cotton growing, and its transformation into cloth, originated independently around 2- 3,000 BCE in South Asia, East Africa and Central America. Techniques in processing the fluffy balls were most refined in India, from where production spread across Asia, and it moved from East to West Africa. Until 1750 CE it was mainly part of subsistence farming along with food, but surplus production organised in the household led to the development of trade routes, and allowed payment of taxes in China, of tributes in Africa and among Aztecs.

From 1750 cotton also was a monocultured cash crop. It went hand in hand with invention of new technologies and the amassing of capital in England and then other parts of Europe and North America. Historians of the cotton industry cannot adopt a neutral stance about dark aspects of that industry. The transit of

enslaved people, begun in 1510 in Spanish acquisitions for work on high-value seasonal crops like sugar, cocoa, coffee, tobacco and rice accelerated in the mid 18th century to bring cotton to European markets, to rival and supplant cloth imports from India. West African people with knowledge of cotton cultivation were advertised at a premium by their captors, and their treatment was deplorable. But related locations in West Africa and the West Indies were only temporarily focussed on the cotton industry. The most substantial remains at colonial plantations in the Caribbean relate to the sugar industry, not covered here.

The pioneering phase of the mechanised cotton industry, 1770-1800 in the United Kingdom, saw imports of slave-grown cotton from the West Indies and South America added to Indian and Asian cottons that still provided the bulk of world production. After 1800 southern United States plantations developed rapidly and came to supply half of the world market in the 1830s to 1861, and ¾ of cotton imports into the UK (fig. 3.7-8.). The bulk of those cotton imports came through Liverpool, the docks and warehouses (one of them containing the International Museum of Slavery) of which were a World Heritage Site from 2004 to 2021. "Liverpool Prices" were key to investment decisions worldwide, and that city was the obvious key link in a global supply chain. Bremen or Le Havre were other important cotton importing cities and feature on the World Heritage List, for Bremen town hall, a statue, and Le Havre as a city rebuilt after WWII, 1945-1964, but the attributes of each do not represent their historic roles as cotton ports.

There was almost no correlation during 19th century industrialisation between cotton growing districts and manufacturing districts. Where there was slavery European immigration was low and directed towards overseeing roles, so the economy stagnated in southern USA. Even in 1865 there were only nine cotton factories in Brazil, and Cuba in 1900 had none at all. Sven Beckert in "Empire of Cotton" concludes that "a society dominated by slavery was not conducive to cotton industrialisation"[34].

There was dualism in Manchester, city of liberal progress, its economy based on the backs of enslaved people yet strongly supportive of the abolition of slavery. Similarly, David Dale, buying cotton for his New Lanark and Catrine cotton mills in Scotland, saw no obstacle to his being the first chair in 1791 of the Glasgow Society for the Abolition of the Slave Trade. Soon the search was on to find alternative sources not dependent on slavery, before the looming collision of values between north and south in the USA that was resolved by war in 1861-65,

[34] Beckert S., *Empire of Cotton. A New History of Global Capitalism,* 2014, p. 171.

shaking businesses at that time of "cotton famine". Cotton as a cash crop became important again in Egypt (see insight box on Alexandria for gins and warehouses in that port) and India, where price volatility arguably leading to famines, which found markets in Japan, leading to industrialisation there that cut out British exports to the East.

The American Civil War had a dramatic effect on the historic environment in many countries. There was distress in cotton manufacturing districts, construction of cotton mills halted for the duration and took some time to recover, and cotton mills built before and after the war look different from each other. Conversely, woollen, worsted, velvet, linen and jute mills expanded in 1861-1866, to fill gaps left as cotton prices shot up. Entrepreneurs invested some of the profits made then, and into the 1870s, in new mills and social buildings that have their own indicators of that period, such as towers in the then fashionable Italianate style.

After the civil war some cotton manufacturing transferred from the north to the former Confederate states (which had only 1/6 of American spindles in 1850), but then moved on to Mexico and beyond. Cotton growing scaled back but did not end in the southern states, and this had the effect of preserving some "time capsule" plantation estate buildings, slave barracks and cotton gins, representative examples of what had been widespread. Many of the landmark buildings and heritage sites in southern US highlight the 'glory and glamour' of plantation owners and regrettably few represent a black-lives-perspective, but things are changing[35].

Today American cotton-growing is heavily state-subsidised, but cotton manufacturing is overwhelmingly concentrated in central Asia. Just one cotton spinning mill operates in the UK (Tower Mill, Dukinfield, Greater Manchester, built in 1885). Child labour and forced labour in cotton fields are again factors that keep most cotton cheap. These and environmental issues like abstraction of water from the Caspian Sea, pollution from fertilisers and stages in processing, might make other naturally-grown fabrics the preferred choice of consumers, despite their cost.

[35] African American Cultural Heritage Action Fund #TellTheFullStory; Confederate Monuments—Frequently Asked Questions; National Trust for Historic Preservation: https://savingplaces.org/ (access: 15.10.2021).

Fig. 3.7. Magnolia Plantation, Cotton Press-Gin, LA Route 119, Natchitoches, Louisiana (USA), a picture from Survey HABS LA-1193-A (Historic American Buildings Survey). Source: Library of Congress, https://www.loc.gov/item/la0278/.

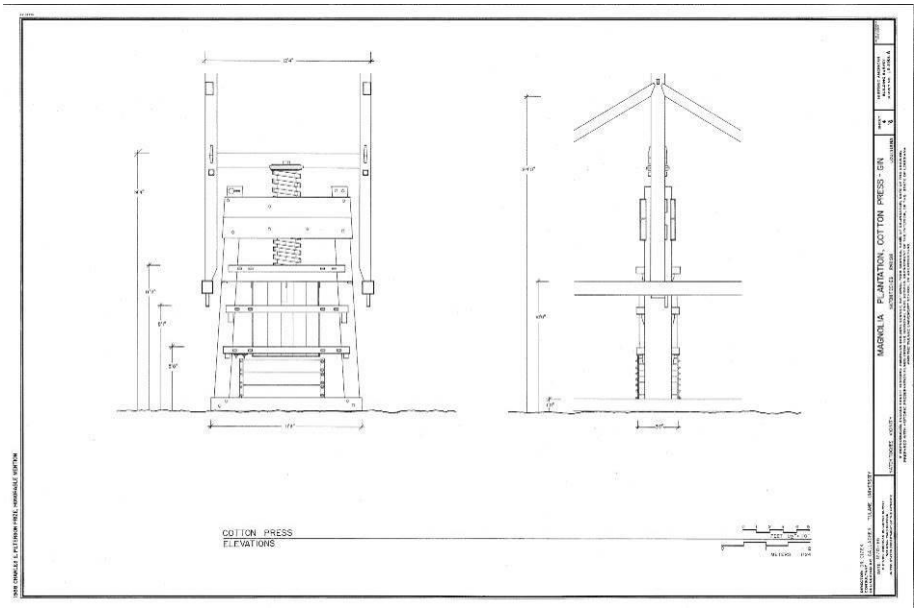


Fig. 3.8. Cotton screw press in Magnolia plantation, Natchitoches, Louisiana, (USA), a drawing from Survey HABS LA-1193-A (Historic American Buildings Survey). Source: Library of Congress, https://www.loc.gov/item/la0278/.

Fig. 3.9. Woolmers woolshed, Tasmania. Source: Michael Pearson.

Fig. 3.10. A wool store in Brisbane, Australia, Source: Michael Pearson.

Fig. 3.11. Wool supply chains - Estancia Rio Verde, Chile.
Source: Michael Pearson.

3.3.2 Wool[36]

Wool has a long history of being transported in its raw state, for example from medieval English monasteries to Brugge or Florence, or after scouring, more than as manufactured woollens. In the 19th century it was found that the best and softest wools could come from large sheep farms in Australia, New Zealand and southern South America, along with Alpaca, also from South America, and cashmere from central Asia, particularly China. Wool from British sheep might have gone into carpets, but not so much went into clothing after imports began from overseas.

There are many woolsheds scattered throughout rural Australia, some of them very large, most of them at real risk due to changing industry practices and amalgamations leaving many abandoned. A number are in public ownership as museums - Mungo Woolshed in Willandra Lakes National Park, Kinchega woolshed in Kinchega National Park, Old Errowanbang shed, in New South Wales; Yarralumla and Lanyon woolsheds in the ACT; Jondaryan shed in Queensland; Cordillo Downs in South Australia as well as many others (fig. 3.9-10). There also are woolscours such as at Blackall Queensland and some woollen mills for local needs, like army uniforms made in Federal Mill from 1915 in Geelong.

The shorn and scoured wool awaited shipment from woolstores in Australian port cities. Those in Geelong, Sydney and Brisbane are largest and most numerous, and many are conserved as mixed commercial and residential redevelopments. These multi-storey masonry buildings have extensive windows to allow wool bales to be opened and examined for quality by potential buyers – after the global sale of wool moved to the Australian woolstores. The National Wool Museum is housed in the 1872 wool store in Geelong.

Woolsheds in Patagonia, southern Chile and Argentina, were largely established by Scottish farmers, such as the Estancia Christina at El Calefate (Argentina), and Harberton (Chile), some with very elaborate clock towers to keep time (fig. 3.11.). The operating estancias only permit access by private contact.

Once wool had crossed oceans it was sold by weight. However wide variations in the weight of a fleece could result from the relative humidity of the place in which it was stored. For this reason, wool conditioning houses, where

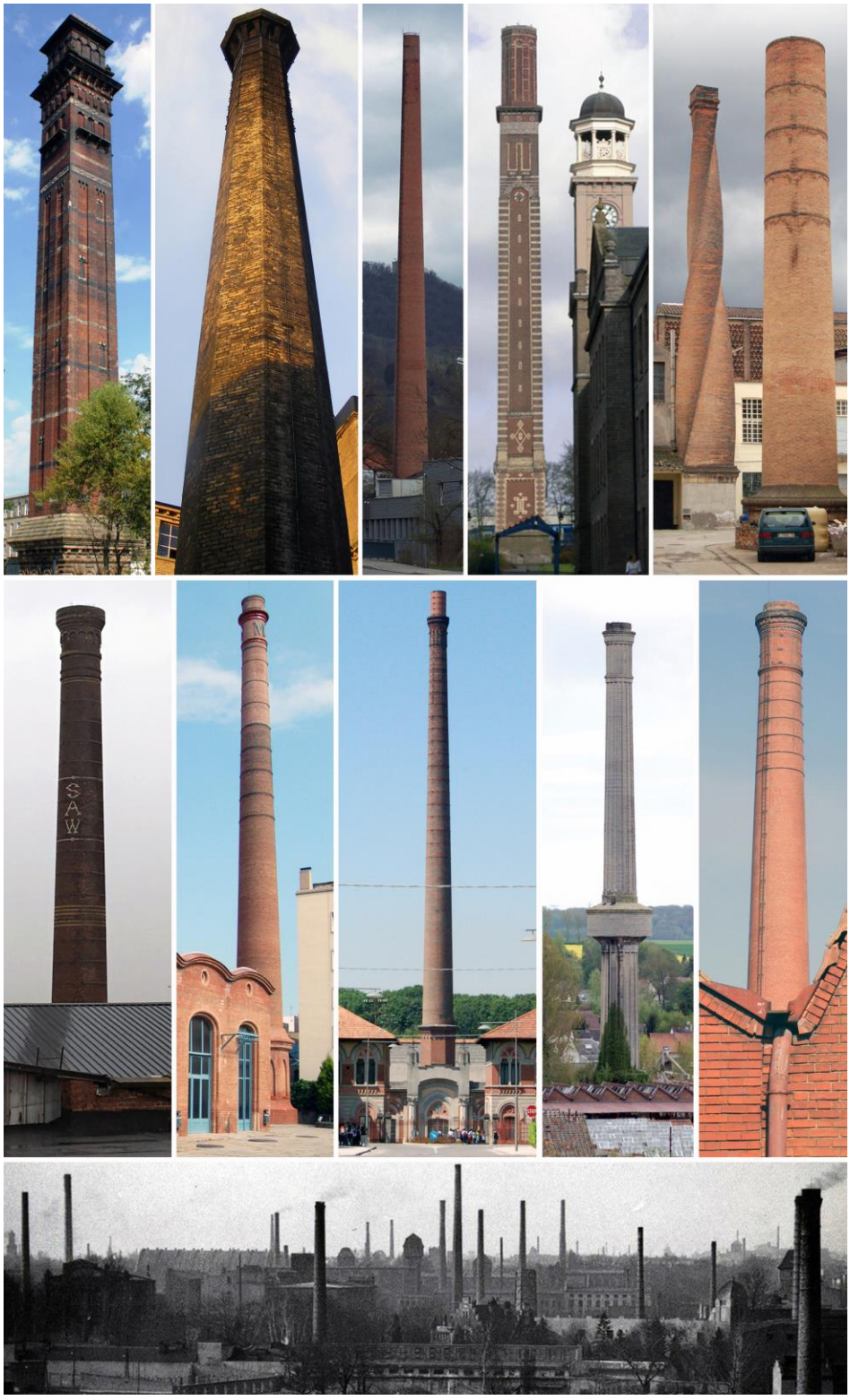
[36] Further reading: Freeman P., *The Woolshed: a Riverina anthology*, Oxford University Press, Melbourne, 1980; Pearson, M. & Lennon, J. *Pastoral Australia: fortunes, failures and hard yakka – a historical overview 1788-1967.* CSIRO Press, Melbourne, 2010.

humidity was regulated were set up and run cooperatively or municipally in the most important wool manufacturing areas. A covered yard is a distinguishing attribute of these to reduce climatic extremes. La Condition Publique in Roubaix is a particularly colourful example, built in 1902 and which became a cultural laboratory in 2004 (fig. 3.12.). There are others in Mazamet, southern France, a town known for fellmongered wool from dead sheep, and Bradford's Conditioning House in England was recently adapted to apartments.

Fig. 3.12. La Condition Publique in Roubaix, France - a wool conditioning house: façade detail (left); covered yard (right). Source: Mark Watson, 2015.

→

Fig. 3.13. Chimneys as major features of industrial landscape and attributes of textile mills: India Mill in Darwen, UK; Bradford, UK; Reutlingen, Germany; Cox's stack in Camperdown, UK; Colonia Sedo, Spain (top, left to right). SAW in Waarschoot, Belgium; Aymerich, Amat y Jover in Terrassa, Spain; Crespi d'Adda, Italy; Saint Ouen, France; DMC in Mulhouse, France (middle, left to right). Panoramic view of Lodz, Poland in the 1950s (bottom). Sources: Patrick Viaene; Bartosz M. Walczak; Mark Watson; MIASTOGRAF.


SAW

4
Building types

Plate IV. Lippett Mill, Rhode Island, USA. A woollen mill clad in wooden shingles and with a clerestory roof, attributes of early mills in USA. Source: Mark Watson, 2004.

4.1 Domestic workshops

Vernacular architecture around the world includes provision for textile working. There are large Gassho-style houses in Japan (fig. 4.1.) in which the roof space is given over to silkworm raising (a key element in the Shirikawa-go and Gokayama WHS). Similarly large houses, but for linen weaving, exist in a row as the "Twelve Apostles" at Chełmsko Śląskie, Poland.

Whilst spinning as a domestic activity leaves little archaeological trace, the larger room required by looms can be traced in building types, and by pits and loom-weights. Linen and cotton required a relatively humid atmosphere, and would best be woven on earthen ground floors or in basements (examples in Preston, Blackburn and Barnsley, England, Angus, Kinross and Fife in Eastern Scotland, and Bretagne, France, often with separate external steps).

Preliminary warping, beaming and starching, and subsequently tentering, would take place on upper floors, sometimes elsewhere than in the domestic property, being hung to dry in warp lofts or outdoors Silk weaving shops would similarly occupy top floors, whether in La Croix- Rousse in Lyon, France (a WHS) or in Paradise Street, Macclesfield, England, before giving way to power loom sheds.

Woollen loom shops would also be found on upper floors, to capitalise on natural light, received through mullioned windows in the Yorkshire Pennines, UK (fig. 4.2.). Detached weaving shops, each containing a treadle loom, are characteristic of the Harris tweed industry established in crofts, still a living textile landscape, combined with small-scale agriculture, in the Western Isles of Scotland, UK. On the other hand some woollen factories could be on a large scale such as those in Sedan, France, most notably le Dijonval, even when most processes were by hand.

Tenter frames had also formed part of the proto-industrial woollen landscape, as at Rahmenberg (Drying Frames' Hill), Monschau, Germany. Also in Monschau the Rotes Haus was the centre of a putting-out system: there were parallel systems in most parts of Europe. Perforated teasel houses in Gloucestershire, UK, and timber *Trockentürme* in Switzerland illustrate specific building types for the finishing of woollen cloth that illustrate regional responses to a common functional requirement. For fulling (or waulking) cloth, urine was essential, and monuments even to its collection exist at for example the *Secktürmchen (*Urine Tower) at Bad Münstereifel, Germany.

Fig. 4.1. Shirakawa-go WHS silk coccoon houses, Japan.
Source: Victoria Murray.

Fig. 4.2. Handloom shops in Golcar, Yorkshire, UK. Source: Mark Watson.

Hosiery knitting workshops might also be found in detached, non-domestic, workshops in the East Midlands of England, where windows are large, and Hawick, Scotland, where windows are small: each the local responses to available building materials. Bowls of water were used to magnify the light required by each framework knitter.

Carpet weaving in India and across central Asia would generally take place under sheltered awnings in courtyards, children still having the most nimble fingers.

4.2 Industrial buildings

4.2.1 Textile mill design

The textile factory was the first new type of building created by the Industrial Revolution. The first textile factories were built in the period before that of efficient steam engines. They depended on water power, based on the water wheels and the experience of water mills, hence in English, the word 'mill' is used to refer to a textile factory as well as specifically to spinning mills, fulling mills and so on. Therefore, multi-storey factory buildings, designed on an elongated rectangular plan of relatively small dimensions, should be perceived as a result of adaptation of the initial model - the mill.

All textile factories erected in the 18th and 19th centuries duplicated the spatial solutions of the first factories; however, their scale was changing. Along with the increase in the efficiency of the steam engine, the availability of new building materials and other technological improvements opened up new possibilities. The factories became larger and larger as the dimensions of the machines increased. The dimensions of the machines grew because the factories were supplied with energy sufficient to make them move. In other words, the continuous improvement of the steam engine and production machinery made the textile factories one of the largest buildings erected at that time. Cotton factories in particular were distinguished by the scale, form and organization of production. The optimal arrangement of the machines and the interconnection of individual production departments determined their shapes and sizes. Thus, in this context, the factory can be viewed as "packaging" for machines.

Such a pragmatic approach also determined the evolution of another major building type – a single-storey shed. Older plants, especially those built at the turn of the 18th and 19th century, developed solely on the basis of multi-storey buildings, as the single-storey halls did not appear until the 1830s. However, in

the last decades of this century, the trend has clearly intensified, indicating a move away from multi-storey buildings towards single-storey halls. The trend can be observed in France, where more often than in other countries there were factories developed only on the basis of one-storey halls. An exception is Russia, where the construction of single-storey buildings was avoided, perhaps to retain warmth. The functional division is also clear - usually the spinning mills took the shape of a multi-storey building and the weaving mills of single-storey halls. This resulted, among other things, from the fact that mechanical looms caused much greater vibrations, which caused problems of a structural nature when placing them on the ceilings of multi-storey buildings.

A successful mill design required a good understanding of production methods, including technological processes, machine layout, power transmission and the latest structural solutions. The latter were of crucial importance for factory builders. Already in the late 18th century, they made attempts to use iron and cast iron in order to increase the load-bearing capacity of the ceilings, but above all to minimise the effects of fire. The importance of this issue can be seen in the fact that the search for solutions in this area was faster than the adaptation of the steam machine to the textile industry. Furthermore these experiments and experiences also influenced the construction for other building types. Often the factories were designed by engineers and millwrights without the participation of an architect. For example, this is how the vast majority of factories in Lodz (Łódź), Poland and Dundee, UK was designed and built[37].

The issue of economic calculation was also particularly important. This can be confirmed by the very strict requirements for cost optimisation, which was analysed in detail by the authors of manuals for textile factory designers, published at the end of the 19th century in England: *The Science of Modern Cotton Spinning* by Evan Leigh or *Recent Cotton Mill Construction and Engineering* by Joseph Smith[38]. These studies emphasized the importance of design in terms of optimal arrangement of machines and equipment and proper connection of individual branches of the plant. As it was written, properly selected machines, properly located in the designed building have an impact on productivity, drive energy consumption, and even the number of workers employed. Joseph Nasmith also pointed out in his book that the basis for good design of the factory is

[37] cf. Watson M., *Jute and flax mills in Dundee*, Tayport: Hutton, 1990. Walczak B.M., *British experience in the conversion and rehabilitation of textile mills and the lessons for comparable work in Lodz, Poland* (PhD thesis), Glasgow: University of Strathclyde, 2002.
[38] Leigh E., *The Science of Modern Cotton Spinning*, Manchester: Palmer & Howe, 1873; Nasmith J., *Recent Cotton Mill Construction and Engineering*, London: Heywood, 1894.

primarily about the profile and volume of production. By performing a number of calculations, it was possible to determine the type, quantity and even size of machines, which allowed design of a production building in a rational way.

The above analysis shows that the functional and technological conditions had a key impact on the physical shape of industrial buildings. Architectural forms were determined by: technological requirements, machinery used, functional flexibility, economics, product, methods of transporting raw materials and products within the buildings and their surroundings, concepts of building construction, construction materials used, and installation layout. Thus, it can be considered that textile factories were among the first buildings to herald the 20th-century concepts of architectural design (functionalism, linking forms and structures, reduction of decoration, rationalism, experiments with new construction materials)[39].

4.2.2 The multi-storey mill

Multi-storey buildings appeared before the birth of industry, still at the stage of centralised manufacture. Italian 17th century silk throwing mills were tall because their machinery rose through several floors, and this type was the precursor to all other forms of textile factory. It is not surprising then, that Lombes Mill in Derby, built in the early 18th century on the Italian model, was not only the first mechanised textile factory in Britain, but also represented almost all the features typical for multi-storey mill, with spacious production rooms organised by the rows of pillars.

Early cotton mills (such as Richard Arkwright's in Cromford, 1772) were also multi-storey, of between 3 and 7 storeys, the stages in the process going from floor to floor, partly driven from waterwheels. Here the organisation, or exploitation, of labour was perfected. It took, however, almost a century until the cotton mill finally developed into its mature Lancashire type, such as Houldsworth's Mill in Reddish, Greater Manchester[40].

The ground floors of the early wool mills in France and Italy had shallow two-directional vaults springing from stone piers, as at Lanificio Zignone, Biella,

[39] The key role of factories in the development of frame construction is highlighted by Giedion (Giedion S., *Space, time and architecture*, Cambridge: Harvard University Press, 1959, pp. 179-209, chapter "From the iron column to the steel frame").
[40] See: Williams M., Farnie D.A., *Cotton Mills in Greater Manchester*, Preston: Carnegie Publishing, 1992; Gurr D., Hunt J. *The Cotton Mills of Oldham*, Oldham: Olldham Education and Leisure Services, 1998.

Como, and at Prato, Tuscany, Italy. Upper floors are of timber, kept dry and separate from wet process like fulling.

Fireproof mills had a similar arrangement. The first cast-iron frame was built in 1797 at Ditherington Mill, Shrewsbury, UK, from which all metal framed buildings are descended. The skyscraper then owes its origin to textile mill construction, and also to practical devices such as the lift that also evolved in textile mills and warehouses. Karl Friedrich Schinkel studied the type while investigating British building technology[41]. It seems to have been in Prussia (e.g. the Royal flax mill in Mysłakowice, now in Poland, 1844) that iron frames first carried multiple arches on a grid or iron beams and joists. This was later matched by patented systems by different Lancashire architects who sought to achieve wider spans that suited the action of the spinning mule. Until then the majority of mule spinning mills (wool and cotton) had timber floors while a flax, jute or worsted mill was more likely to suit fireproof construction.

A European variant of the type – cast iron columns and brick vaults in place of iron beams – occurred ca 1860 in France (Le Blan, Lille), Italy and Spain (Barcelona). Perhaps this was due to inability to cast large beams, or to the persistence of the Italian tradition of ground floor vaults. Timber construction generally persisted to this date in Poland and Russia. For example, in Lodz (Poland) only the leading cotton-manufacturing companies invested in cast-iron frame structures – the most spectacular examples can be seen at the Scheibler and Poznański mills (fig. 4.3-4.). Recent investigation of the latter revealed, that structure nodes were designed to adjust the position of individual elements during assembly.

Slow-burning timber construction was the American preference, given plenty of timber to suit the requirements of insurance policies. This limited possible widths of American mills, but not their length. The Waltham system meant greater mechanisation and less skill, necessary given relative labour shortage in the USA.

The mill shape and dimension were closely related to technology housed and adopted structural solutions. Broadly speaking – cotton mills were bigger and had wider plans that those manufacturing wool. Closer investigation reveals that mills relying on spinning frames (e.g. water frame, throstle, ring frame) might have a relatively narrow plan. While mule spinning mills (in the cotton and woollen industries) were initially similar, but with characteristic proportions counted in mule lengths when they were laid end to end. From c.1860, a variant with mules

[41] See the section on the international interchange

running transversely saw a much deeper form of mill, some of them almost square in plan, others rectangular, depending on the number of spindles per mule (more spindles in squarer Bolton than in elongated Oldham mills, UK). Sometimes, when doubled, and linked together, an extraordinary length would be displayed as a unified piece of architecture, e.g. Poznański, Lodz, and Houldsworth, Reddish. There is an interesting example of the Scheibler factory in Lodz, which was of double type, but housing both spinning (in a wide-plan mill) and weaving (in a narrow-plan mill) - fig. 4.5.

In the case of flax, jute and worsted spinning mills, preparatory carding and combing processes could take place in separate buildings arranged around courtyards (Coffin Mill/Logie Works, Dundee, and Le Blan Mills, Lille) and later in single-storey outshots (as at Camperdown Works, Dundee, and Salt's Mill, Bradford). There was therefore scope for neo-classical proportions, such as at La Foudre in Rouen, France, and perhaps renaissance-style water towers, seen in Bradford and Dundee, UK, and as open dust flues in Lille.

The roof form was largely dictated by the width of the building:

a) Steep pitch with tiers of extra attic accommodation (e.g. early mills in Switzerland, Saxony in Germany, USA and Gloucestershire UK), (1800-1860)
b) Shallow pitches without roof lights (favoured in USA, Russia, Sweden, Poland and Catalan colonies, Spain 1835-1900)
c) Shallow pitches with roof lights (wrought-iron as in train sheds, circa 1845-65), e.g. Salt's Mill, UK.
d) Curved lamellar roofs: the capriata roof in Italy.
e) Shallow pitches with monitor lights (e.g. Ravensberger Spinnerei in Bielefeld, Germany)
f) Steep pitches with cast iron mansard: Dundee, UK (1850-85). Mansards are also known at various periods in France and Sweden, with timber structures.
g) Saw-toothed: in woollen mills and as UK cotton mills got deeper for mules, sometimes top-lit like a weaving shed. (1850- 1900)
h) Flat water reservoir (favoured in Lancashire UK 1890-1907 and in France and Germany).
i) Broad and high steel spans in some of the Ghent cotton mills, Belgium.

Fig. 4.3. Scheibler spinning mill at Księży Młyn in Lodz, Poland – an example of "fire-proof" structure with a cast-iron skeleton. Multiple small arches were needed to span spinning mules, here aligned across the breadth of the mill. Source: Eliasz Stumann, Ansichten der Baumwoll-Manufactur von Carl Scheibler, Central Museum of Textiles in Lodz.

Fig. 4.4. Poznański spinning mill in Lodz, Poland – structural solutions: cast-iron skeleton with shallow jack-arches (left); structural nod allowing adjustments of elements (right). Source: Bartosz M. Walczak, 2009.

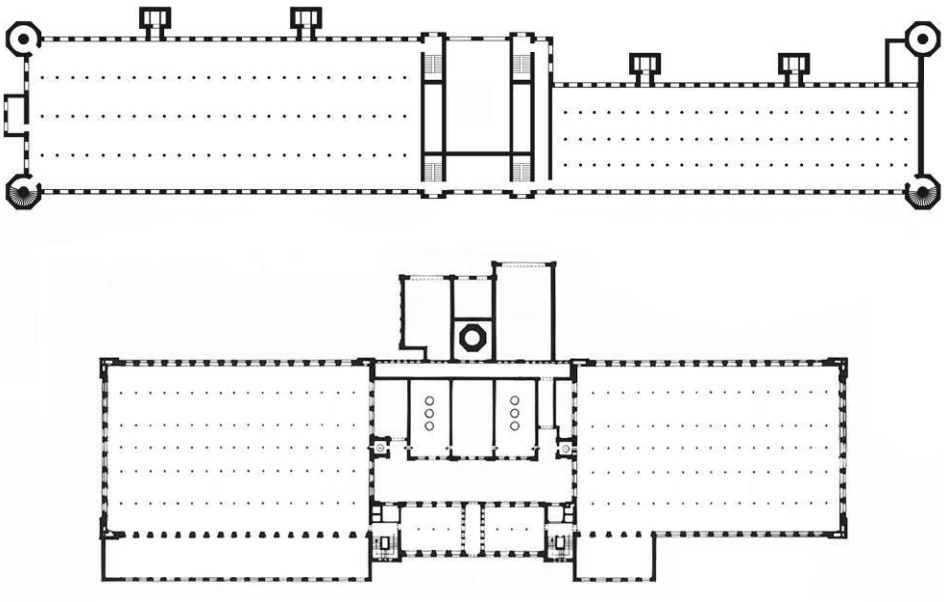


Fig. 4.5. Doubled cotton mills: Scheibler at Księży Młyn in Lodz, Poland (top) and Houldsworth in Reddish, UK (bottom). Source: Bartosz M. Walczak, 2009.

Fig. 4.6. P.S. Stott-designed mill in Borås, Sweden – an international plan with a regional roof type. Source: Bartosz M. Walczak, 2005.

Fig. 4.7. Iron and steel shed of the Carmichaël jute factory in Ailly-sur-Somme, France. Source: Mark Watson, 2014.

Fig. 4.8. Sheds in the middle of a textile industry district, Girangaon in Mumbai, India. Source: Neera Adarkar, 2020.

National and regional characteristics come to the fore more in the form of the roof and of the tower than in the basic plan, layout and proportions, which often conform to an international type dictated by machines. Therefore the textile museum at Borås, Sweden (fig. 4.6.), has a later East European shallow pitch zinc roof over a P.S. Stott-designed mill that otherwise would have sported multiple pitches if it were in Lancashire. The 17 cotton mills built to P.S. Stott designs in West Münsterland and nearby parts of the Netherlands gave a similar nod towards local style with helmeted water towers.

4.2.3 The single-storey building

This is particularly clear in relation to the second type of building - a one-storey hall - commonly known as the *shed*, which begins to appear in the 1820s. These buildings were most often covered roofs of a characteristic shape, resembling a saw blade, with partially glazed rooflights, enabling the introduction of uniform upper lighting of the production rooms. Unlike a multi-storey building, it was not a form produced by the textile industry - halls of this type in production plants came to be associated with many branches of industry.

The weaving shed is often considered the prototype of the typical modern factory with everything arranged for ease of supervision on one level. Weaving could be in multi-storey factories, found in the USA and UK up to 1870, on the European continent even later, when the speed of looms increased. Spinning might also be sometimes performed in a single storey shed- more so in jute (from 1865), worsted and wool than cotton. The choice of single storey shed layout can also be influenced by available land holdings, power sources etc., but regional and national variations can be detected (fig. 4.7-8.).

The sheds developed in Britain from the late 1820s. Roofs were usually saw-toothed and north-lit but there were variants:

a) South-lit in the Southern hemisphere, (e.g. Brazil, where large spans were favoured)
b) Domed vaults (Deanston and Leeds, UK, Issenheim, France): fireproof but expensive and relatively dark.
c) Catalan brick vaulting in single-storey factories. Mills in Catalan colonies however were of two or three storeys due to topography and water power: weaving at ground level, spinning above.
d) Flat roofs on vaults with monitor lights (Kolkata, India, and in Italy) helped reduce heat and direct light.

e) Some larger forms of shed had scope for overhead passes for supervision (e.g. woollen tweed mills in Roxburghshire, UK) and in lace mills (e.g. Nottinghamshire, UK).
f) Longer spans could be achieved by directing power systems from below rather than above (as at Salts WHS, Bradford, and in Dundee, UK).
g) Some sheds are two-storey, one carrying out subsidiary functions, set into a slope, e.g. jute and linen factories in Dunfermline, Fife, and Angus, UK, and Picardie, France.
h) The *Tonnendach* type in central and northern Europe has a broad span in a shallow curve, with raised transverse roof lights. Sequin-Brunner of Rüti, Switzerland, patented such a system in 1885. They were more flexible regarding layout and could sustain heavy snowfalls.
i) Formed in small section timber, without raised roof lights: the curved "Belfast Roof" favoured in Ireland (as at Barbour Threads in Hilden, Northern Ireland, UK and at Portlaw, Eire).
j) Wrought iron or steel lattice trusses were favoured in France from around 1870 and especially in the 20th century.

4.4 Structural solutions

Structural solutions evolved, although the general principle of the internal skeleton, based on a column grid, has remained unchanged from the beginning. Transformations concerned new materials to increase load capacity, span and fire resistance. Fire safety issues have particularly affected cotton factories and to a lesser extent other textile industries. For this reason, constructional innovations were pionnered in textile mills at the turns of the 18th and 19th centuries - cast iron, and a hundred years later, reinforced concrete. The first iron-framed factory in the world was Ditherington mill in Shrewsbury, England, built in 1797, followed by Belper North spinning mill in 1804, among those discussed here.

The iron frame tended to be more effective and more common in flax spinning mills. Fires were equally a risk in cotton mills but the column spacings did not suit the mules used in cotton mills. An early iron framed mill of 1818, McConnell Kennedy and Co in Ancoats, Manchester had to be rearranged by William Fairbairn to have fewer columns, but that required ingenuity. Eaton Hodgkinson worked out a formula for parablic shapes of I beam which made the cast iron beam more reliable, so that they continued to be used into the 1890s and even in 1914 in cone case. Wrought iron was only used in exceptional cases, and

steel started to be used in the 1880s, first in small joists imported from Belgium, and then for main beams.

The increase in the power of steam engines, as well as the development of longer spinning and weaving machines resulted in a significant increase in the dimensions of factory buildings, which, together with the search for ways to reduce the fire hazard, influenced the application of modern structural solutions.

Alternative structural solutions to the UK "fireproof" floor were "slow-burning" floors in North America. The timber would be arranged in layers against the grain of the wood so that a fire would char the outside of the timbers but not burn through their structural cores before there was time to extinguish the fire. Joists would be minimised or sealed over. Insurance companies made this type of construction universal in American textile mills, and also in Canada (fig. 4.9.).

Towards the end of the 19th century, the textile mill led the way in European reinforced concrete just as did the motor car factory in America, slightly later. It was first tried in a large building in 1895 by François Hennebique at the Charles V Spinning mill, Tourcoing, France (demolished)[42]. There are relatively few reinforced concrete mills in Britain, but more on the continent, e.g. Brede, Denmark, (Hennebique) and Bendix, Dulmen, Germany (Koenen system), both 1908, and they became standard in 1920s in the Netherlands, in Moravia (Brno), in Italy and elsewhere (fig. 4.10.).

4.5 Power technology

4.5.1 Power systems

Hand/foot: even large factories were initially hand-powered for most or all processes (e.g. le Dijonval, Sedan, France). Hand processes continue to this day in some industries, such as in lace (e.g. Koniaków, Poland) and central Asian carpets (e.g. norther provinces in Afghanistan). Sometimes the work was/is put out domestically, and sometimes organised in factories.

Animal: used in small-scale enterprises, e.g. horse power in small dye works in Hungary (e.g. in Papa) and Slovenia.

Waterwheels were mainly used from the 1770s-1850s, initially of timber, then with increasing quantities of iron. Width was more important than diameter

[42] Ramette J.-M., *Roubaix-Tourcoing et les villes lainières d'Europe: découverte d'und'un patrimoine industriel,* Villeneuve d'Ascqd'Ascq: Presses Universitaire Septentrion, 2005.

for regularity of power. There are well-preserved examples (e.g. Quarry Bank Mill, Styal, UK). Use of wheels persists at smaller locations (fig. 4.11.).

Turbines[43] developed in France (by Benoît Fourneyron and Philippe de Girard in the 1820s) and USA (by James B Francis at Lowell from the 1840s) - fig. 4.12. These were the prime power source in factories at Catalonia (e.g. Colonia Vidal) and Brazil (e.g. Salto).

Steam power allowed creation of the first great industrial cities, notably Manchester (the oldest extant being Murray's Mill, 1798) and was important in the development of other textile cities such as Leeds, Dundee, Lille, Ghent, Lodz, Fall River, New Bedford, Puebla, Mumbai and Kolkata. Engine houses might be detached, or at the end of a building, or in the centre of a double mill. Once rope races came to be used, c. 1870-1890, an Oldham-type of cotton mill evolved where the engine projected asymmetrically from the mill, the rope race providing a fire barrier between blowing and spinning departments. A water tower with ornamental roof would be placed at that point (fig. 4.13.).

Electricity raised by steam or water turbine was used for lighting from the 1880s, firstly in USA. The first in Nordic countries was at Plevna weaving shed, Finlayson Mill, Tampere, Finland, 1882, Edison system, and for power in the early 20th century: early examples in UK and Germany date from 1906/7.

There are also examples of using other sources of motion power, like **windmills** (e.g. Yaroslavl in Russia) or **petroleum-based fuels**, such as a kerosene engine in Juiz de Fora in Brazil.

4.5.2 Power transmission

Power transmission from whichever source tended at first to be directed horizontally along the ground floor and then upwards to groups of machines in the same way that groups of stones were driven in corn mills. Over time the horizontal (or lying) line shaft evolved from timber to wrought iron: square bar and then round. The main transmission would be vertical from bronze bearings close to the power source. Bevel gearing was progressively replaced by ropes, or leather or canvas belting, which required more space, so engine houses would project from the mill. America led the way in the switch from gearing to pulleys driven by belts in the 1820s. They were less noisy and more easily repaired. Electric motors at first drove groups of machines, and later individual machines.

[43] http://www.history.tampere.fi/rapids/index2.htm (access 07.08.2021)

Fig 4.9. American "slow burning" construction - layers of timber plank floors on large wooden beams - had enough flexibility to allow weaving in multi-storey mills. The weave room in Boott Mills, Lowell, Mass. (USA), demonstrates looms with Northrop automatic loading of weft into shuttles, an American innovation. Source: Mark Watson, 2004.

Fig. 4.10. An early reinforced-concrete mill, bult in 1908 in Brede, Denmark. Source: Bartosz M. Walczak, 2005.

Fig. 4.11. Waterwheels of the Malcolmson mill (designed by William Fairbairn) in Portlaw, Ireland. Source: Robert Vogel collection.

Fig. 4.12. The first ever Francis turbine, at the sluice gate that directed waterpower to cotton mills in Lowell, Mass. (USA). Source: Mark Watson, 2004.

4.6 Other attributes

Sprinkler systems were first operated manually, based on the British inventions in the 1810s. Later, sprinklers were first automated in the USA by Henry S. Parmalee and Frederick Grinnell. The latter proved to be more successful, was patented in 1881 and then became widespread in Europe in the 1880s. The sprinklers are known in France as *grinnells*. Mather and Platt of Manchester had distribution rights in the eastern hemisphere from 1883. This resulted in a renewed architectural focus on the water tower (fig. 4.14.). In cotton mills the tower would be placed at the location of the rope race from the engine that also served to separate the hazardous blowing rooms from the spinning flats. In Lancashire, the use of automatic sprinklers led to the appearance of mills with flat roofs, behind parapets, which allowed rainwater to be collected for use in the sprinkler system[44].

Ventilation systems were of particular importance for cotton mills. Cotton dust (or "fluff") hung in the air and was breathed in by the workers, causing a lung disease called byssinosis, known also as "brown lung disease" or "Monday fever". What is more, cotton dust is highly combustible, and causes an explosion hazard. Thus, its removal from production room was of great importance already in the early stage of textile industry development. Initially dust was simply swept by children, which was dangerous labour, as they had to get under the operating machines. There was, therefore, a growing need for an adequate ventilation of production rooms. Ventilation towers as well as hand-driven wooden fans were known already in the 18th century. If water power was available, which was primarily the case in spinning mills, it was also used to its full advantage to power fans. Steam engine-driven mechanical ventilation made its breakthrough during the late 19th century[45]. As wool processing was less hazardous, it was in cotton mills where such systems were adopted. Dust towers are characteristic architectural features added to older spinning mills - eg, Nashua, NH (USA), and Ghent, Belgium - whilst new spinning mills would incorporate them into the multi-storey mill.

[44] Phelps A. et al., *The Textile Mills of Lancashire: The Legacy*, Lancaster: Oxford Archaeology Ltd, 2017. p.64.
[45] Olsson D., *History of Ventilation Technology*, Gothenburg: Swegon Air Academy, 2016, p.9.

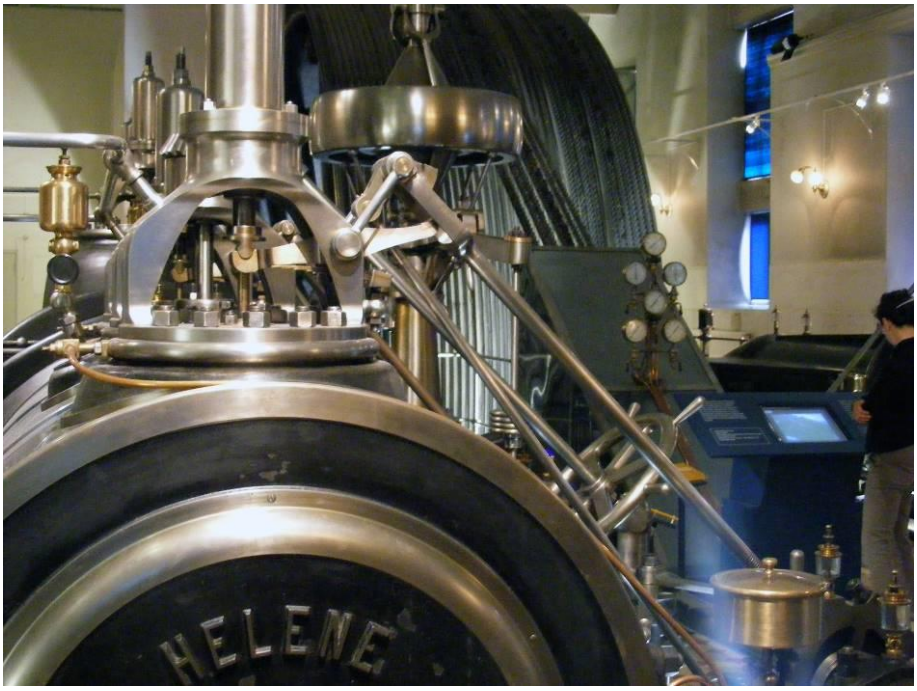


Fig 4.13. A Sulzer steam engine at the Finlayson mill in Tampere, Finland. Source: Mark Watson, 2010.

Fig 4.14. Water towers are for sprinklers, but they were also often for corporate image or time-keeping: New Egerton Mills in Dhariwal, India (left); Regent Mill in Oldham, UK (centre); Haney cotton mill in Rokytnice, Czech Republic. Source: Aishwarya Tipnis and Mark Watson.

Fig 4.15. Simple Classical architecture of a mill in Hørsholm, Denmark (top left); Italianate architecture of the Salts mill at Saltaire, UK (top right); Gothic Revival adopted at Crespi d'Adda, Italy (bottom left); German-French Renaissance style of a cotton mill in Smržovka, Czech Republic (bottom right). Source: Bartosz M. Walczak and Mark Watson.

4.7 Architectural treatment

Externally, mills are characterised by regular repetition of windows to suit the operations and operatives within. Window size progressively increased throughout the 19th and early 20th centuries, until virtually forming a glazed curtain wall: something more often achieved on continental Europe than in the UK.

Although the above considerations indicate that architectural design was of secondary importance in relation to the functional and technological conditions, it was an expression of the aspirations of industrialists, as well as a reflection of current trends and fashions in architecture.

The earliest industrial buildings, erected at the end of the 18th century, usually received a simplified classicist design. The best examples of this period come from the UK, including Masson Mill in Cromford, as well as factories in Styal and New Lanark. The strong Palladian tradition of the local architecture was manifested in the use of Venetian windows. On the other hand, in the case of buildings dating back to the beginning of the 19th century, the links with classicism can be found in proportions rather than in the façade design, which was usually kept to a minimum at that time, for example: Hard near Winterthur in Switzerland, Hørsholm in Denmark, Verviers in Belgium (fig. 4.15.). Classical motifs were present in industrial architecture until the end of the first half of the 19th century, as confirmed by the first spinning mills in Żyrardów and Scheibler in Lodz. On the other hand, among the industrial buildings in the analysed complexes of rational, cubic buildings, completely devoid of the decoration that was erected at that time in Manchester and its vicinity.

Progress in terms of construction and technological solutions could go hand in hand with historicist architectural forms. One of the most glaring examples of such dualism of innovation and conservatism is the Temple Mill at Marshall's Mills built in the 1840s in Leeds, UK. Its front elevation is inspired by the newly publicised ancient Egyptian temple of Horus in Edfu. Behind the façades is a one-storey production hall with innovative cast-iron construction, supporting brick groin vaults with conical skylights. The flat roof was covered with grass, on which sheep grazed over the spinning of flax and thread.[46] These contast with the rather severe earlier spinning C. D & E mills next door, 1817-1830.

[46] J. Musgrove (ed.), *Sir Banister Fletcher's A History of Architecture*, Butterworths, London 1989, p.1107; cf.: Giedion S., *Space, time and architecture*, Harvard University

Historicism was a characteristic feature of the architecture of the 19th century, and especially its second part. This was also reflected in industrial buildings. Around the middle of the 19th century, the "Italian style" was particularly popular in Great Britain, which influenced the architectural forms of the factories in Reddish, Saltaire and Sion Mills (fig. 4.15.). At the same time, in Germany, industrial buildings were eagerly designed in English Gothic Revival style - as was done in Bielefeld and Hannover.

In the last decades of the 19th century, buildings with simple architectural divisions prevailed. The sparing decoration referred to eclecticism, without any clear stylistic features. Most often the water towers were crowned with the most careful design. It was still popular to refer to medieval architecture. Extremely interesting, rich eclectic decoration with a predominance of Gothic Revival motifs was obtained by the buildings of the factory in Crespi d'Adda in Italy (fig. 4.15.). In Central Europe influences from various directions were blended and affected architectural and structural solutions, resulting in a unique appearance of some mills – for example a cotton mill in Smržovka (Czech Republic) was built in 1895-1896 to a design by a local contractor, based on the Lancashire layout (derived probably form a Sidney Stott's blueprint), floored with Monier vaults and plastered in a confusing German-French Renaissance style (fig. 4.15.). It must be admitted, however, that in this period relatively few richly decorated buildings with were built. One exceptional case is Tittel & Krüger (later VEB Buntgarnwerke) in Leipzig with a décor following Roman and Baroque motives combined with a rich horizontal structure of brick and white plastered elements. Among others, one should mention Poznański's spinning mill in Lodz, the Val-des-Bois factory in France, the Proviantbach factory in Augsburg and the warehouse of Delmenhorst in Germany. The latter is an excellent example of the use of architecture in shaping the company's image - a monumental inscription with the company's name was placed on the front elevation, and the tower was decorated with a bas-relief of a merino, whose fleece was the basic raw material for the factory.

Water towers were also extensively used for strengthening corporate image. They were carrying a variety of roof forms (French-style pavilion, or even Byzantine) and the name of the mill. Flemish cotton mill roofs in Ghent could be particularly tall and ornamented, like the local Hotels de Ville. German roofs from Rheine to Lodz more often followed an ogee curved helmeted type (*Glockenturm*),

Press, Cambridge 1959, pp. 209-216, (chapter "The schism between architecture and technology").

like a pickelhaub. The towers were generally located 2/3 of the way along the mill in the 1880s-1890s, while the corner was the favoured location by 1905. In urban terms, the water towers played the dominant role, becoming what spires and town hall towers were for medieval centres.

Most of the production facilities were characterized by façades with facing brickwork. Initially, this was mainly due to rational, economic reasons. Later on, it became a manifestation of fashion, which can be proved by numerous patterns of brick details published at the end of the 19th century[47]. Bricks in two contrasting colours were willingly used (among others in Augsburg in Germany), brick and plastered elements were also combined, of which the Val-des-Bois factory is a particularly interesting example. It should be emphasized that the quality of façade materials varies greatly from country to country, and even from industrial centres - clinker, veneer, as well as plain bricks were used.

The facades of buildings erected at the turn of the 19th and 20th century reflected new trends in architecture. It was marked by Art Nouveau, post-Secession (Wilhelmian) Neo-Baroque, but most of all modernist tendencies were visible. Among the complexes in which the most interesting buildings from that period were built, one should mention Augsburg in Germany (*Glaspalast*), Brede in Denmark, Tanvald in the Czech Republic, as well as Żyrardów in Poland and La Casaremona in Barcelona.

4.8 Modern textile heritage since 1920 worldwide

The doctrine of functionality over form went hand in hand with industrial architecture since its beginning. We have seen that 19th century textile mills were always designed according to functional needs, but might have had neo-historicist decoration applied to them, most notably the flagships. Architects and engineers who introduced a modernist philosophy took inspiration from humble undecorated industrial forms such as grain silos and what JM Richards describes as the "functional tradition in early industrial buildings" to non-industrial architecture typologies, and brought them to perfection[48]. Modernist architectural language extended also to industrial architecture typology. Some architects went beyond

[47] e.g: Chabat P., *La brique et la terre cuite*, Paris: Morels & Cie, 1881; Liebold B., *Ziegelrohbau. Taschenbuch für Bauhandwerker*, Holzminden: C.C. Müller, 1891.
[48] Richards, J. M. (James Maude) 1907-; De Mare, Eric 1910- The functional tradition in early industrial buildings (1958) and Banham, Reyner, A concrete Atlantis. U.S. industrial building and European modern architecture, 1900-1925 (1986).)

and searched for a new form for industrial architecture; a design that was functional and representative at the same time.

As a result, textile complexes became flagships of German modernist architecture, such as the Verseidag complex in Krefeld, Germany, by Mies van der Rohe (1930s) and Egon Eiermann (1950s). The eleven-bay shed (for dying), the four-storey, so-called HE building and the one-storey entrance volume form a balanced composition and define the entrance situation of the complex. So the HE building is a plain white cube with large, clearly structured window ribbons constructed of steel. All facade details support this rhythm, even the rainwater pipes and a small base in dark red. Mies realised a similar composite building in multi-storey (similar to the HE-building) and shed construction (similar to the dyeing plant) in 1937–1938, where film printing was carried out. Even more spectacular is the construction of Egon Eiermann which were used for storage and office functions. This entire section of the Verseidag complex follows the idea of a freestanding figure on ground, in this case a high-rise building of nine-storeys and a long, rectangular, three-storey low-rise building; both connected through the corridor, which is formed as a form of glass ashlar block– and situated in a private park. A well-structured facade of huge steel-framed windows and further notable features include the elevated canopy with six, slim columns reaching out from the entrance door, presenting optimistic and welcoming atmosphere (fig. 4.16.).[49]

The office of the industrial architect Philipp Jakob Manz provides further example of modernist architecture, such as the Niehues & Dütting spinning and weaving complex in Nordhorn, Germany, later NINO Vertriebs Gmbh and now converted into a business centre. Built in the late 1920s the five-storey construction shows a sober architecture and clearly structured facade with huge windows and one designed corner tower that composes the volume and mirrors the fascination for the North American skyscrapers.[50]

Another important factor was ideology – this was particularly important for Soviet Russia, which in the 1920s strongly supported new architectural forms as visual symbols of a break with the tsarist past. A number of new textile factories were built with façades clearly representing features typical of constructivism. One of the most interesting examples was Red Talka factory in Ivanovo, where a new spinning department with 120,000 spindles was built in 1927-1929. The

[49] Oevermann H.,, *Urban Textile Mills: Conservation and Conversion*. Berlin: Bebra, 2021, pp. 134-140.
[50] Renz K.,, *Philipp Jakob Manz (1861-1936) Industriearchitekt und Unternehmer*, Stuttgart: Universität Stuttgart, 2003, pp. 83-85.

modernist reinforced-concrete building was designed by Moscow architects I. Nikolaev and B. V. Gladkov. Nikolaev. It housed a new production line which had been earlier demonstrated at the World Exhibition in Paris in 1925. Prominent foreign architects were also invited to design in Russia, including Erich Mendelsohn, who envisioned an extension to the "Red Banner" textile factory in St Petersburg (fig. 4.17.), then Leningrad (see also 6.1). What is more, some new textile mills were built in the Soviet republics in the Central Asia, e.g. Ashgabat cotton mill named after S.A. Niyazov, built in 1927 to the design of Vsievolod Keldysh.

New production methods required new spatial and functional solutions. However, the majority of innovations in textile industries took place in the 19th century. The most significant changes in the 20th century included artificial fibres – nylon in particular (the first factory was built in Delaware in the USA in 1939), and open-end spinning (with spindle-less machines), developed in Czechoslovakia in the 1960s. Therefore, the impulse for new architectural forms was due to new building materials and technologies, as well as logistics and transportation.

Few new textile mills were built in the UK after World War One, but the British Bemberg Factory in Doncaster was pure Germanic modernism, rectilinear forms in white concrete, translated by Wallis, Gilbert & Partners from the company designs of Ferdinand Flakowski. Making artificial silk or rayon, it switched to nylon under ICI fibres and was demolished in 2000. Nylon production by Courtaulds and ICI was concentrated in Pontypool, Wales, in a British Nylon Spinners factory that opened in 1948. It has a vertical spinning tower, by Sir Percy Thomas, off-setting the horizontality of the rest of the factory.

In France, postwar reconstruction brought an important contribution from Le Corbusier, who designed a hosiery factory in Saint-Dié-des-Vosges. The *Usine Claude et Duval* is the only industrial building built to a design from the "Pope of Modernism". The factory, completed in 1948-1951 (contemporarily with the *Unité d'habitation* in Marseille), is also the first building designed using the concept of Modulor[51]. It has been inscribed into the World Heritage of UNESCO with sixteen other works of Le Corbusier.

[51] "Saint-Dié: le Modulor de Le Corbusier pour ouvrir la «ville nouvelle»", *Vosges Matin*, 02.05.2015.

Fig 4.16. Verseidag complex in Krefeld, Germany, by Mies van der Rohe (1930s). Source: Heike Oevermann, 2021.

Fig 4.17. "Red Banner" textile factory in Leningrad, Soviet Union (now: St Petersburg, Russia), by Erich Mendelsohn. Source: Katriina Etholen.

Fig 4.18. Post-war modernism in the Communist bloc: "Dalmatinka" yarn and thread factory in Sinj, Croatia, by Lavoslav Horvat (1946): aerial view (top); main yard with a water tower (centre); an interior of the shed (bottom). Source: Archive of the Museum of the Cetina Region and Antonio Nevešćanin.

Insight box 2.

MODERNISM IN SOCIALIST YUGOSLAVIA

Yarn and thread factory "Dalmatinka"

Sinj, Croatia [43°42'12.4"N 16°38'58.1"E]

The design process for industrial complex of Dalmatinka, yarn and thread production factory, started in 1946. Author of the project was Lavoslav Horvat, accomplished Croatian architect. From the very beginning, building the factory complex was the project which was to be realized in multiple phases, but upgrades and additions to the complex lasted for another 30 years, enough to carry Horvat out to retirement. However, it is important to note that although the complex was built in phases, this did not involve compromising quality of composition and added objects. Throughout the whole process, Horvat was the main author of all the phases of the project. The factory was opened, and the production started in 1953. Not only was Dalmatinka factory complex was the biggest textile factory in Yugoslavia, but it was a pioneer in many other aspects as well. Horvat not only designed the factory complex, but paid attention to the architectural design of all individual elements, including special consideration of "public" and outside spaces where workers could spend breaks, eat lunch etc. Greenery was particularly important, and factory hired gardener which was taking care of all the horticulture once a week. The factory was also equipped with a large kitchen, working 24/7. The factory also had infirmary, which was even then opened to the public, and is the only part of the complex which still functions nowadays. Furthermore, Horvat placed the office building right at the entrance to the factory complex, designed in classicistic manner, for which he was known, with a façade covered with local stone. Floors in production halls and factory were paved in a combination of wood and stone. Shed roofs, covering large-span production halls, provided plenty of indirect natural light in the space, resulting in maximum rationality and cleanliness of concept and construction. Production hall glass facades were orientated to the patio, in centre of which was a large water tower, designed in sculptural way as a dominant of the complex. Dalmatinka factory complex, due to all its aspects is one of the jewels, not only of industrial architecture typology, but of modernist architecture in general (fig. 4.18.).

Antonio Nevešćanin

Production halls (see 5.2.4) became the most common for textile production after the Second World War. These one-storey constructions could have enormous width and length because of artificial light and ventilation systems. The machinery, as the light and ventilation, is powered by electricity. The main

advantage is – next to cheap construction cost – that the machinery, delivery and storage can be totally organised due to the necessities of production. The specific interplay between building and production which have shaped textile complexes for centuries have been lost. That also means that these production halls can host every kind of production and are not textile-specific.

However, even some of these production halls show a front façade with architectural elements as the example of UCO-Maïsstraat in Ghent, Belgium shows. Build in 1948, with extensions in the 1990s and 2000s, the construction extends from 190 m width to 280m length with a front facade along Maïsstraat of approximately 170 m. The prefabricated and prestressed concrete construction – a standardized skeleton with 100 primary and 600 secondary on-site prefabricated I-beams according to the Blaton–Magnel system – hosted all functions except for warehousing. The engineer Gustave Magnel developed this innovative construction technique at that time in Ghent, which was realised together with the Blaton-Aubert company, whereas the traditional brick facade along Maïsstraat was designed by Jean Hebbelynck. The main building facade is of red brick with a plinth of stone (blue-hardstone) and the main entrance is emphasized with an *avant corps* of greater height and an opening that is three bays wide framed by two columns of blue-hardstone corresponding to neo-classical architectural décor. In Leinefelde, DDR, roof systems for production halls were renewed with a three-dimensional slim steel beam structure (Stabfaltwerk Typ Berlin), covering around 200 to 400 m., creating a sober functional building[52]

The latter example shows that it was in the Communist bloc that new textile factories were mainly built in Europe, as part of an intense industrialisation programme. As a result, industrial areas covered a much larger area and constitute a much higher percentage of urbanised areas than in Western European countries, which is illustrated by the comparison for selected cities: London 4.7%; Paris 5.2%; Prague 13.4%; Warsaw 15.1%; Sofia 27.1%; Cracow 28%; Moscow 31.6%[53]. This industrialisation was based chiefly on the heavy and machine industry. Textiles were also booming and a number of new establishments were built in Central and Eastern Europe. They represented either socialist realistic architecture (in the 1950s) or late modernism (in the 1960s and 1970s). Many of them were exceptionally large, such as for example Europe's largest knitting plant

[52] Oevermann H.,, *Urban Textile Mills: Conservation and Conversion*. Berlin: Bebra, 2021, pp. 164-169.
[53] Tosics, I., *Urban Regeneration in Eastern and Western Europe: Current Issues and Challenges*. International seminar – Urban regeneration in Europe, Université Paris-Est-Créteil, Paryż 2013.

built in Ogre in Latvia. They were often designed in line with a state paternalistic approach, which can be illustrated by the "Dalmatinka" thread mill in Croatia (see insight box 2.) and TatraSvit (Bata) sock factory and company town in Slovakia.

Another interesting example is a woollen factory "Runotex" in Kalisz, Poland (fig. 6.7.). A new production hall was built in 1961 to a design by Jerzy Główczewski, Stanisław Sikorski and Wojciech Zabłocki, who were responsible for its sculptural façades. Initially, their vision was a sequence of inclined rectangular blocks following the roof geometry. Spaces between the blocks were to be filled with a significantly recessed glazing. The actual building varied from the concept design, but it retained the stark contrast between the white façade plaster and the triangular, dark, recessed wall surfaces of the ground floor. However, the structural solution of a 30-m span is at least of similar importance and the quality of shell rooftop resembles that of the aforementioned factory hall in Lodz, designed by Wacław Zalewski, a structural engineer who later migrated to Venezuela and the USA, where he was a professor at the MIT Department of Architecture. For the purpose of the "Runotex" production hall, Zalewski adopted a thin-walled reinforced-concrete shell structure, which was a complete novelty when designed in the 1950s[54]. A similar solution was adopted in the extension to the Marzotto factory in Valdagno, Italy, designed by Carlo Mollino in the early 1960s[55].

A further interesting development after the 1920s is the technology and design transfer of textile production from Europe to countries such as Iran. Industrial textile production played an important role in Iran's economy in the first Pahlavi era 1925–1941, and in Isfahan, Shiraz, Yazd, and also in Mashhad a modern textile industry developed (see insight box 3).

Other countries used technology transfer as a matter of foreign relations, such as China, – within the Cold War – which built several textile factories in Africa in the 1960s. Friendship Textile Factory in Tanzania, is such an example; it was built in 1966 and is still operating until today[56].

Apart from post-colonial developments, globalisation processes also instigated further investments. Substantial factory complexes were built in

[54] *Wacław Zalewski: Shaping Structures*, Wolk Gallery, MIT School of Architecture and Planning, 2006.
[55] Desideri, P et al. (eds.) *La concezione strutturale*, Turin: Allemandi & C., 2013, pp.75-87.
[56] Credits to Li Fan.

countries which were rapidly becoming leading textile producers, like Bangladesh.

Insight box 3.

A PIONEERING EXAMPLE OF MODERN INDUSTRY IN IRAN

Mashhad Textile Factory

Mashhad, Iran [36°16'04.6"N 59°36'40.7"E]

The Mashhad Textile Factory is a pioneering example of modern industry in eastern Iran, which had a constructive role in the Mashhad economy in the first Pahlavi era. The factory was financed and owned by the Persian government. The design process started in 1927 under the supervision of the German Max Otto Schünemann, who supposedly brought to Iran sketches by famous German architects, such as Walter Gropius, Hans G. Meyer, and Martin Hoffmann, as inspiration for the design of the factory buildings.

Local Iranian architects were involved in the design process and construction of the Mashhad Textile Factory in order to match the sketches to Iran's climatic conditions and to harmonise the architectural drawings with local materials. The first section was built in 1934 and the factory started partial production until its completion and formal opening in 1937. Architectural elements such as the flat roof of the central hall, the gable roof of the production halls, and unadorned walls lacking conventional ornamentation, resemble the Bauhaus style. Some architectural details, such as stair-shaped form, the entrance, limited ornamentation, and monochrome colour resemble the architecture of Peter Behrens. The architectural style of the Mashhad Textile Factory quickly became a source of inspiration for the city. Therefore, some elements of the building, such as the detailing of the cladding roof and simple triangle in frieze of the front facade, have been mimicked in other buildings in Mashhad.

The textile factory stopped production in 1943, when all the foreign engineers had left the country due to the invasion of the Allied forces. After WWII, the factory reopened with the help of British engineers and had a positive impact on the economy of Mashhad.

Mohammadjavad Mahdavinejad

5
Mills and urban development

Plate V. Camperdown Linen, Hemp & Jute Works, Dundee, UK. The spinning mill, now apartments, was built in 1858-68 with gothic cast-iron roofs. The 93-metre campanile chimney was built in 1865. Source: Mark Watson, 2015.

5.1 Textile landscape

In the 18th century, mechanisation of production in the textile industry was ahead of the development of a steam machine applications other than pumping water from mines, the problem of providing the necessary driving force for emerging factories arose. The solution was the well-known and widely used water-power technology since the medieval times. The requirements of eighteenth-century factories were far superior to those of earlier factories, such as mills. The appropriate capacity could be provided mainly by rivers with a relatively large drop, which meant that at that time, upland areas were preferred for the location of production, where there were convenient conditions for obtaining a source of machine power. Many times they were relatively uninhabited places, located far away from human settlements. This forced factory owners to build workers' apartments near them. In this way the earliest factory and residential complexes began to be built. And the basic factor determining their development was the need to create favourable living conditions for people necessary for the efficient functioning of the enterprise.

Regardless of the emergence of isolated textile production centres (fig. 5.1.), the last decades of the 18th century saw the start of dynamic growth in the textile industry in the North-West of England - in the counties of Lancashire and Yorkshire. This is due to a number of factors, including the availability of raw materials (sheep farming, which is common in the upland landscape, characteristic of this area of the country, as well as the seaports that allow cotton to be brought in from the colonies), coal and iron ore deposits, and a favourable climate (high air humidity to facilitate yarn production). The region's textile tradition, which has been linked to the production of wool and flax products since the Middle Ages, was also important. The result was the creation of the world's largest textile district around Manchester, which fascinated newcomers from Europe, on the eve of the industrial revolution, including Karl Friedrich Schinkel, whose drawing of Manchester witnessed to the birth of the first industrial city of the world[57]. In just a few dozen years, the urbanisation of a vast area took place, which was described two hundred years later as follows:

> *The square stone tower at the entrance to the Rossendale Valley rewards those who climb its winding staircase with a comprehensive view of a landscape created almost totally by the cotton industry and the myriad*

[57] Bindman D., Riemann G. (eds.), *Karl Friedrich Schinkel "The English journey: journal of a visit to France and Britain in 1826"*, New Haven: Yale University Press, 1993.

developments the industry set in train. Extending almost as far as the eye can see is one of the world's most densely-populated districts, where town is joined to town, village to village, and where all, with hardly a break, are linked to the tall buildings of Manchester in the middle distance[58].

5.2 Urban industrial typology of textile complexes

Textile mills have been part of the city since the late 18th century. Steam engines, bulk transportation infrastructures, and workers allowed the expanding industry to relocate from its initial riverside locations and to settle in cities. Textile cities arose, as well as urban industrial districts and landscapes (fig. 3.13.).

In England—the motherland of industrialization—the use of machines and steam to power machinery triggered an enormous push for rationalization during the 1770s to 1790s, which was subsequently repeated on the continent somewhat later (usually beginning in the 1790s). The textile industry has often promoted the settlement of other industries: Mechanical engineering companies that grew up with the production of textile industry machines, such as in Winterthur, Switzerland, and the chemical industry, which has close links to the textile industry through printing works, dye works, and synthetic fibre textiles, such as in Wuppertal and Krefeld. But also training and research spaces were established. The local exchange of knowledge and innovations as well as close entrepreneurial ties within a city brought economic advantages.[59]

Chronologically, the early urban textile mills, as found in Manchester in the 1790s (fig. 5.2.). They consist of rectangular, multi-storey building volumes determined by machine sizes, transmission systems, and urban plots. They were increasingly built as iron skeleton structures with brick facades and were, in continental Europe, often described as the English style. The complexes usually featured steam rather than water as the driving technology, which, depending on the location, had become established from about 1800–1840 in England and later on the continent.

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[58] Aspin C., "Cotton's legacy" [in] Rose M.B., (ed.) *The Lancashire Cotton Industry. A History Since 1700*, Preston: Lancashire County Books, 1996, p. 325.
[59] Föhl A., Hamm M., *Die Industriegeschichte des Textiles. Technik, Architektur, Wirtschaft*. Düsseldorf: VDI-Verl., 1988; Rose M.E., Falconer K., Holder J., *Ancoats. Cradle of industrialisation*. Swindon: English Heritage, 2011; Miller I. at al. (eds.), *A & G Murray and the cotton mills of Ancoats*. Lancaster: Oxford Archaeology North, 2007.Musgrove J. (ed.), *Sir Banister Fletcher's A History of Architecture*, London: Butterworths, 1989.

Fig 5.1. Stanley mills in Perthshire, UK – an example of a rural cotton mill founded in the 18th century (1787). Source: Crown copyright Historic Environment Scotland.

Fig 5.2. Urban cotton mills (of McConnell Kennedy & Co, and Murray's) in Ancoats, Manchester, UK. Source: Bartosz M. Walczak, 2013.

Fig 5.3. Verseidag works in Krefeld, Germany – a 20th-century complex with an axial arrangement and chimneys as representations in the urban context. Source: Heike Oeverman, 2021.

Fig 5.4. Templetons carpet factory in Glasgow, UK - a good example of a "flagship": an industrial complex that was designed to impress within a townscape, even during the night. Source: Bartosz M. Walczak, 1999.

Textile industry complexes, which often grew at one location, via extensions, to form a very large complex with a large surface area, known as integrated mills. They were mostly built between about 1850 (England), 1870 (continental Europe) and the 1930s. This group was significantly influenced by two innovations: a new building form – the shed[60] – and the implementation of power loom weaving machines (established around the 1820s in England[61] and after the 1840s on the continent). Consequently, multiple buildings were differentiated: Warehouses, preparation, spinning mill, weaving mill, finishing, and steam engine house with chimney (from the 20th century also electric generator houses), office, and often residential functions. Workers' housing was mostly realized as independent groups of buildings but often spatially connected. The entrepreneur's residence differed significantly from the production and storage buildings. Here, multi-storey buildings as well as single-storey sheds form the mill. Frequently, additive arrangements and sheds in the inner part of the complex were structurally formative.

In the mid- and late 19th century the Victorian style—on the continent the so-called historicism— became more dominant in mill design and led to representative facades, especially where the mill displayed itself towards its urban setting. On the continent, these mills are often called palace type, whereas in England it is often referred to the Lancashire cotton mill style[62] around this time. In addition, the compositions of some later complexes show axial arrangements, for example at the Verseidag works in Krefeld, or certain entrance gestures and facades or chimneys as representations in the urban context (fig. 5.3.). Some complexes were designed as factory towns, such as Saltaire in England. At the beginning of the 20th century, factories and mills were addressed by the modern architecture movement, for example the so-called Neues Bauen, with new materials: reinforced concrete, glass, and steel, as well as curtain wall construction. Nevertheless, certain architectural elements were used to achieve a

[60] Weaving sheds started to be built in the UK after 1820, examples surviving from the 1830s . Types of shed are illustrated by the engineer William Fairbairn in his *Mills and Millwork* as a convenient way to show machine layouts; an early example on the continent was built in 1859 in Switzerland by Séquin and Knobel.

[61] Pevsner mentioned the following numbers for England: 1813 = 2,000 power looms, 1829 = 45,000 power looms, 1835 = 96, 679 power looms and 1850 = about 250,000 (see p. 276).

[62] Holden R.N., *Stott & Sons: architects of the Lancashire cotton mill*, Lancaster: Carnegie, 1998; Lassotta A. (ed.), *Cotton mills for the continent. Sidney Stott und der englische Spinnereibau in Münsterland und Twente = Sidney Stott en de Engelse spinnerijen in Munsterland en Twente*. Westfälisches Textilmuseum; Museum Jannink; Textilmuseum Rheine; Ausstellung. Essen: Klartext, 2005.

sublime or monumental appearance. Here, electricity often became the primary power system.

Functional aspects dominated the construction and complex organization of mills built mainly after the Second World War. In the textile branch, the huge single-storey production hall without sheds or windows became common, with technical installations providing light and ventilation. These mills were predominantly located in industrial parks.

The changes, translocations, and regional declines of the textile sector in much of the world has meant that converting and repurposing these historic industrial complexes has become a new opportunity and important task. The mills include familiar elements of urban design and architectural representations, but also enrich the variety of spatial structures. Not at least in this context we have to take into account the urban spatial structures of these mills as heritage to be potentially listed and reused.

Focussing the urban spatial structures of the mills and their integration into the urban surrounding we can differentiate four types of historic urban textile mill[63]:

5.2.1 Urban block

Multi-storey complexes such as Murray's Mill in Manchester, Geyer's Mill in Lodz, or the Mottau & Leendertz Mill in Krefeld illustrate how industrial production volumes were integrated into urban spatial patterns. These patterns generally consisted of a grid structure that was typical of late 18th and 19th century urban extensions. The complexes were arranged along street layouts, thereby continuing the block perimeter design although differing in scale. The separation of production spaces and boiler functions from engine houses located in the courtyards improved fire safety. Multi-storey industrial brick buildings are appreciated for their solid construction and their flexibility for reuse.

5.2.2 Flagship

The flagship composition describes a mill complex that was designed to impress within a townscape or landscape. In such cases, form might override functional needs (fig. 5.4.). Salts Mill, constructed from 1851 to 1853, provides a clear example, including its overall design, symmetry, impressive volume, and strong architectural representation. Of interest is the readable differentiation of

[63] Oevermann H., *Urban Textile Mills: Conservation and Conversion*, Berlin: Bebra, 2021.

production into separate units, such as spinning, weaving, dyeing, or finishing. Furthermore, historic structures might relate to improvements in social provision such as workers' canteens or bathrooms. Even if complexes are conserved and converted, parts of these historic urban spatial structures often suffer from neglect, demolition, or inappropriate re-densification.

5.2.3 Additive structures

To highlight additive structures as a distinct type might be viewed critically, since almost all of these complexes show some additions due to changing business needs, reorganisation, or increased production; consequently, these complexes typically lack monumental architecture or main representative elements. They expanded incrementally over time and were continuously changed, adapted, and rebuilt in accordance with functional needs and improvements. Hence, their historical development typically included reuse or partial demolition. Examples are manifold, such as the Schleife-Areal in Winterthur. A more difficult task is to understand and research their built history in detail, as the many changes and temporal layers might no longer be differentiable. Conversion might maintain this continuity by updating spaces of work.

5.2.4 Production hall

The term "production hall" is well suited to distinguish this type of building from shed structures. Once individual electric motors were introduced, any type of product could be manufactured within a hall, and so this building type is not specific to the textile sector. UCO-Maïsstraat in Ghent, mainly constructed in 1948, is one such huge, flat structure. There is little experience of reusing or converting such buildings for other purposes, and their vast volumes do not easily allow the introduction of new functions that require additional daylight, such as housing or offices.

5.3. The impact of textile industry on social relations

The industrial revolution changed the nature of work and society. The dynamic development of the British textile industry required not only new technologies, but also new methods of management and work organisation. These issues became the subject of in-depth analysis by Andrew Ure, a Scottish chemist and later an expert of government commissions in London in the mid-1830s. His book is an extensive, comprehensive description of the new phenomenon, then called the 'factory system'. In addition to these aspects, an extensive chapter is

devoted to working conditions and the possibilities of their improvement[64]. Thus, it shows the emerging awareness that industry is not only a source of economic growth. The industrialisation of cities has become one of the most important factors which made previously unknown phenomena and social problems emerge during this period. This stage of uncontrolled development of industry was characterised primarily by intensive exploitation of unskilled workers and progressive pauperisation of craftsmen who stayed with traditional production methods. The global relationships of power and trade, including the slavery system, raises issues of dark history and of intensive exploitation[65].

The lack of response from industrialists and the lack of interest on the part of the state caused the radicalization of social groups (e.g. movements of Luddites and Chartists), which resulted in outbreaks of social unrest. The situation was aggravated by very poor housing conditions in rapidly urbanizing industrial districts, which was manifested, among other things, by waves of cholera epidemics. At the same time, in the 1840s, the first economic crisis took place, caused by overproduction of the leading industry – the textile industry. This led to workers' protests. In this respect, Disraeli's bold statement, that *Manchester is as great a human exploit as Athens*[66] could be perceived only as a "Tory interpretation" of the harsh reality.

Almost a century later George Orwell wrote his famous book *The road to Wigan Pier*, which begins with the following passage:

> *The first sound in the mornings was the clumping of the mill-girls' clogs down the cobbled street. Earlier than that, I suppose, there were factory whistles which I was never awake to hear*[67].

Although it was written in Northern England in the 1930s, this scene could illustrate the realm of a typical mill community anywhere in the world from early 19th century until present times: a high proportion of the workforce would be female, or child, so the need for factory legislation, and for education, arose at textile sites at a time when such consideration did not exist for adult males. Sometimes the gender imbalance would be temporary and met by specially built lodging house barracks for young unmarried women - e.g. the "Yankee girls" of

[64] Ure A., *The Philosophy of Manufactures*, London: Charles Knight, 1835.
[65] Beckert, S., *Empire of Cotton, A new history of global capitalism*. London: Penguin Books Ltd., 2015.
[66] Disraeli, B. *Coningsby or the New Generation*, London: Henry Colburn, 1844.
[67] Orwell, G. *The road to Wigan Pier*, London: Left Book Club/ Victor Gollancz Ltd, 1937.

Lowell, Mass. (USA) and Nordwolle in Delmenhorst, Germany. Social consequences of there being higher wage earners amongst women than men could be deep-seated, as in Bradford and Dundee, UK, driving men to seek work abroad or in engineering (although this was not the case in other countries). The engineering industry would evolve as the textile industry matured and would seek out new markets, either to export the latest machinery and so create competition with home markets or to diversify into new products. Where men retained a role in production (as did mule spinners in the UK) they might accumulate sufficient funds to develop new economic models: the Co-operative movement and the first limited liability companies both came from the Lancashire cotton districts of Rochdale and Oldham, and were copied world-wide. The significance of textile history can then be very wide-ranging and aspects may claim universal value.

The middle of the 19th century therefore became a breakthrough not only in economic terms, but also in terms of solving cumulative social problems. On the wave of revolutionary events there was, among others, an increase in interest in building factory housing estates on the part of industrialists, which will be discussed in more detail in the following section.

5.4 Textile company towns 1750–1900: models for society, or social control?[68]

The company towns were an inseparable element of the 19th-century European landscape. By the beginning of the 20th century, hundreds of factory settlements were established on the continent. The company towns emerged as a result of rapid social and economic transformations caused by the industrial revolution. With progressing industrialisation many traditional urban centres evolved into extensive, agglomerations. Dismay at the overwhelming of the former spatial order was already expressed in the 1840s, best illustrated by the famous *Contrasts* by A.W. Pugin[69].

Opposition to those spontaneous changes was undoubtedly one of the motives for establishing company towns by industrialists with philanthropic views. The spatial order of such complexes can be seen as a counterweight to chaotically developing cities. Their spatial arrangement was an attempt to reconcile tradition and modernity. On the one hand, the return to traditional spatial

[68] This section is largerly based on: Walczak, B.M., "For Housing or for Managing? Textile Company Towns in Europe", *TICCIH Bulletin*, no. 86, 2019.
[69] Pugin A.W., "*Contrasts" with an introduction by H. R. Hitchcock*, Leicester: Leicester University Press, 1969.

relations known from farming estates was visible: the place of living = the place of work. On the other hand, there was an open plan, zoning and linearity of systems, announcing the projects of Arturo Soria y Mata and Tony Garnier. Especially the latter concept met the needs of the industrial era, while bearing the seeds of modern methods of urban design, developed after the Great War by the leaders of the modernist movement, and in particular by Le Corbusier. That is why factory and residential complexes testify not only to the significant period of economic history, but also to the development of social thought, being one of the most important steps leading to the emergence of pioneering architectural and urban concepts at the turn of the 19th and 20th centuries.

The progressive spatial solutions contrasted with conservative attitudes in social relations. In the 19th century there were rapid changes in a class-divided society. The industrialists tried to strengthen their social prestige not only by alliance with aristocratic families, but also by playing the role of feudal lords. Estates and country residences were acquired. Noble titles were sought after. This process can be also traced in company towns, where industrialists ruled themselves not only a factory but also an adjacent housing. What is more, everything necessary for the lives of workers and their families was provided or at least controlled by the factory owner. Both, working and resting time were supervised. The novelty was the changed rhythm of life, determined by the shift work system, measured by clocks placed in visible places - usually on factory towers. Workers became cogwheels of a big machine. Thus, the company towns became spatial exemplifications of the total integration of production, work, society and - in many cases – religion (e.g. Val de Bois, France)[70].

During early stages of textile industry development in the 18th century, workers' housing emerged on a larger scale only in Great Britain. The most spectacular achievement was New Lanark in Scotland (WHS), the tenement housing built in 1785-1799, before it formed the utopian vision of its manager and co-owner, from 1800-1825, Robert Owen (fig. 5.5.)[71]. In continental Europe, settlements near textile factories were built relatively early in Belgium (e.g.:

[70] Gremillion J.B., *The Catholic movement of employers and managers*, Rome: Editrice Pontificia Università Gregoriana, 1961.
[71] Donnachie I.L., Hewitt G., *Historic New Lanark*, Edinburgh: Edinburgh University Press, 1993. *Nomination of New Lanark for inclusion in the World Heritage List*, Edinburgh: Historic Scotland, 2000.

Grandes Rames, Verviers) and also in Scandinavia. Relatively early development of company towns occurred also in the New England, USA.

The expansion of paternalistic settlements in the textile industry reached its peak between 1850 and 1890, when most of the sites developed. Saltaire (UK), established 1851, is considered to be one of the best of them, and among the last built for textiles in the UK[72] for quality of urban layout, architecture and functional program. Another noteworthy complex is Crespi d'Adda (Italy), existing since 1878[73]. Both sites have been inscribed on the World Heritage List, which clearly underlines their universal values. In the second half of the 19th century, some North American company towns surpassed European complexes. On the Merrimack River in New Hampshire (Manchester) and Massachusetts (Lawrence, Nashua, Lowell), the world's largest textile factories were surrounded by vast workers' housing schemes, and barracks for young women (fig. 5.7.)[74].

Workers' housing was provided by the textile companies well into 20th century. This tendency was strengthened by the housing losses caused by the world wars and later with the communist state paternalism in Central and Eastern Europe (e.g. Orsha in Belarus, and Zambrów in Poland)[75]. On the other continents the concept of company town also prevailed until recently, which might be linked with the post-war and later post-colonial development. Among complexes established in this period, of interest would be the Urafiki Textile Mill complex in Dar Es Salaam, Tanzania, as well as company towns in Burewala, Pakistan and Kaliganj in Bangladesh.

Company towns appeared in all significant districts of the textile industry in Europe. The dominant position was kept by Northern England, where the concentration of textiles is unmatched anywhere else in the world. The second area - much more extensive - is a wide strip stretching from northern France, through the Belgian-Franco-German border, Switzerland, southern Germany and Austria (fig. 5.6.). Another area covers the areas at the junction of Saxony, the Czech Republic and Silesia. A large concentration of company towns was also in Catalonia on the Iberian Peninsula (see insight box 4.).

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[72] Styles J., *Titus Salt and Saltaire. Industry and Virtue*, Saltaire: Salts Estates Ltd, 1994.
[73] Cortesi L., *Crespi d'Adda Villaggio ideale del lavoro*, Bergamo: Grafica & Arte, 1995.
[74] Harven T.K., Langenbach R., *Amoskeag. Life and work in an American factory-city in New England*, London: Methuen & Co., 1979.
[75] Zawistowski A., *Kombinat: Dzieje Zambrowskich Zakładów Przemysłu Bawełnianego – wielkiej inwestycji planu sześcioletniego*, Warszawa – Białystok: Instytut Pamięci Narodowej, 2009.

Fig 5.5. New Lanark, Scotland, UK. Mills and tenement housing built 1785-1799. Institute and school added by Robert Owen in 1816-1818. Source: Crown copyright Historic Environment Scotland.

Fig 5.6. Example of workers housing in Continental Europe – La Cité Heureuse in Tourcoing, France, typical cul de sac courtyard housing, which often was back-to-back (a type found also in Leeds and Bradford in UK). Recently rehabilitated. Source Mark Watson 2015.

Fig 5.7. Examples of company towns within a North American city – Lawrence, Mass. (USA): Pemberton Mills (top); boarding house (bottom left); mechanic houses (bottom right). Source: Mark Watson.

Fig 5.8. Jacquard Garden in Schio. Source: Bartosz M. Walczak, 2007.

Insight box 4.

A CATALAN COMPANY TOWN

Colònia Sedó D'Esparreguera[1]

Calle Continuas, Esparreguera, Spain [41°32'53.0"N 1°52'18.0"E]

The Colonia Sedó of Esparreguera, near Barcelona, is, by itself, the summary of the history of the textile industry in Spain. It is also the most enlightening example of what an industrial colony is. It was, moreover, the largest Spanish textile factory in the twentieth century. Despite the destructions, it is still sufficiently evocative. It has preserved all the buildings built in the last two decades of the nineteenth century, with the big factory which is now an industrial polygon and the workers' village where some rows of houses are to be rebuilt identically soon. A museum, satellite of the Museum of Science and Technology of Catalonia (MNACTEC) recalls the major stages of its history and allows a social and technical approach to the subject.

This exceptional building is both the largest Catalan industrial colony (it was able to accommodate around 1500 inhabitants) and the largest textile factory in Spain, with 3000 workers at the end of the nineteenth century. In 1900, it had nearly 50,000 spindles for its spinning mill and 1200 looms for the weaving section, which no other textile factory in Spain could bring together on its own. For this it had the energy of the river Llobregat, where it comes out of the mountain and received almost all its tributaries. The plant was built around the hydraulic infrastructure, unique in Europe and well preserved, with in particular a graceful aqueduct that carries water from the Caïrat dam, 4km upstream. It became the emblem and symbol of the factory. The water fed a 1400 hp turbine, still in place and inside which one can walk. In addition to the dam, built in 1878, a hydroelectric power station, built in 1903, captures all the energy of the river. The testimonials are still in place and give rise to walks and excursions.

Today, civil society is concerned about the future of the site. The municipality, helped by an association created for the defense of the Colonia Sedó, aims to recover the space and want to restore all its dignity to the former industrial site (fig. 5.9.).

Gracia Dorel-Ferré

[1] Dorel-Ferré, Gracia, *La Colonia Sedó d'Esparreguera, la llarga història d'una colónia industrial emblemática*. Edicions Centre d'Estudis del Baix Llobregat, 2021.

There were also isolated districts towards the North and East, such as: Lodz and Żyrardów (Poland); Narva (Estonia); Yaroslavl (Russia). Beyond Europe,

company towns developed in Latin America, including: Metepec (Mexico)[76]; Blumenau and Rio Grande (Brazil); Bellavista Tomé (Chile).

Considering that the majority of textile industry company towns were established before 1890, it is not surprising that urban planning concepts from the turn of the 19th and 20th centuries had relatively little influence on their shape. Perhaps that is why none of the discussed settlements was composed in such a picturesque way as Bournville or New Earswick (both UK) or Margarethenhöhe (Germany) founded around 1900. However, it can be noted that the textile settlement layouts, as well as the connection with greenery, constituted an important step towards the idea of garden cities (cf. next section on Gardens). In this respect, Gmindersdorf established by Gminder brothers in Reutlingen, Germany, may be of particular interest[77]. Construction of the estate began in 1903, i.e. just a year after the founding of the Gartenstadtbewegung, modeled on the English Garden City Association. The housing was designed by a renowned architect Theodor Fischer. His students included Bruno Taut, Hugo Häring, Ernst May, Erich Mendelsohn and Jacobus Johannes Pieter Oud, the next generation of architects and urban planners whose revolutionary concepts from the period of modernism in the 1920s and 1930s were largely a reaction to the malfunctioning of an industrial city.

Company towns are found all over the world, yet there was significant level of individuality and specificity of particular solutions at the regional scale. Cultural differences were apparently stronger than the universalism of 19th-century capitalism. The complexes share a common socio-economic concept, but not spatial arrangement and architectural forms. At the same time, however, the influence of two countries is obvious: Great Britain and Germany. This reflects their position in the European economy of that time. British solutions are primarily associated with production technology and are dominant especially in the first half of the 19th century. While the end of the century is the period of Germany's economic hegemony, with the impact on the architectural forms of buildings (*Ziegelrohbau*) as well as the organisation of production and business management. In the first half of the 20th century America led the way, with Taylorism/ Fordism in the motor industry.

[76] de la Luz Vergara Berdejo S.A., Alejo García Ó., Morales Moreno H., *Patrimonio Industrial de Puebla Siglos XIX y XX*, Puebla: Gobierno del Estado de Puebla, 2021.
[77] Schwager B., *Arbeiter-Siedlung Gmindersdorf*, Reutlingen: Heimatmuseum der Stadt Reutlingen, 2003.

Industrialists, wishing to display their progressiveness, deployed those complexes to build a positive image of their enterprises through quality of architecture. The company towns in which philanthropy was combined with paternalism were characterized not only by a higher standard of living, but also by a more careful architectural design of buildings. A typical way of manifesting charity was through impressive architectural forms to buildings such as hospitals, schools and community centres, an excellent example of which is the main square in Saltaire surrounded by representative buildings of this kind. The industrialist's patronage had a similar impact on the quality of architecture. An unparalleled example of this attitude was the support of Antoni Gaudí's work by Eusebi Güell, which resulted in the famous crypt (chapel) in Colònia Güell, which is inscribed in the World Heritage List along with other Gaudi's masterpieces[78].

The life of a group of people in a relatively small area causes both positive and negative social phenomena. They were microcosms with strong sense of belonging among residents. Spatial order and social harmony remained in many company towns until the 1970s, when the global crisis shook the traditional branches of European industry. The collapse of the factory meant not only the loss of the economic basis of existence for the residents – in fact it was the end of the local community, the collapse of bonds connecting people, sometimes for generations. After the demolition of the factory in Catrine, West Scotland, the inhabitants of the village decided to commemorate it with a modest monument. The demolition of the building not only created a gap in the urban fabric, but radically demonstrated the inevitability of the economic process. These towns had to diversify or die.

5.5 Gardens

Woodland walks above New Lanark were a significant aspect of Owen's environmental ideas. Public parks might be provided by paternalist mill owners for the general enhancement of a town, such as Lister Park, Bradford, and Baxter Park, Dundee. They were not especially close to the owners' Manningham and Dens Mills respectively so were important facilities for the entire city as well as underpinning a textile landscape shaped by a single industry.

More closely identifiable as parts of textile landscapes is the treatment of parks along the power canals at Lowell, Mass. (USA). The immediate settings of Ravensberger Spinnerei and of Nordwolle, Delmenhorst (Germany) are much

[78] Padró i Margó J., *Colonia Güell Industria, arquitectura* i *societat,* Barcelona: Angle Editorial, 2002.

enhanced by small parks. Parks also played their part in the paternalist colonies of Catalonia and Italy, such as that opposite Lanificio Rossi in Schio, containing a grotto and a theatre (fig. 5.8.).

Where the climate was particularly oppressive to European sensibilities gardens have a still more significant role. They are places of respite in the grounds of jute mills in Kolkota and of woollen and cotton mills in Brazil and Mexico (see insight box 5.), where their creation would have been all the more of a challenge. They sought to show the benefits brought by industry so as to retain a happy workforce and management.

Insight box 5.

UTOPIAN IDEALS

La Constancia Mexicana, First mechanized textile mill in Latin America

De Obreros Independientes Col, Luz Obrera, Puebla, Mexico [19°05'36.4"N 98°14'00.4"W]

In 1835 Estevan de Antuñano and Gumersindo Saviñón, inaugurated the first mechanised cotton mill in Latin America: La Constancia Mexicana. This factory, 9km from the centre of the present city of Puebla, is an illustration of the introduction of modern European concepts about to the development of industrial capitalism. The mill was built in lands belonging to the old farm (Hacienda) of Santo Domingo, just where a branch of the Atoyac river forms a small waterfall. These waters were well arranged for the hacienda's corn mills and for partial irrigation of farmland. The hacienda had since the late XVI century important hydraulic infrastructure not only for irrigation but a former aqueduct system to transport drinking water. The property is composed of two main construction periods: the first is owed to Antuñano and Saviñón, the promoters and subsequently mill owners; (1835-1906). Antuñano traveled through England, especially Manchester in the 1820s to contact machinery sellers, and most of this British machinery arrived via New Orleans to Mexico, when Britain still prohibited machinery exports. A formal garden in the courtyard indicates paternalist or utopian ideals. The second phase is owed to the businessman Francisco Martínez Conde, who endowed it with new machinery and, necessarily, new company housing. (1906-1930). The late period (1930-1991) was managed by the worker's union until 1991. Now the mill is partially adaptively re-used. *Company town. International interchange* (fig. 5.10.).

Humberto Morales Moreno

Fig 5.9. An example of a Catalan textile company town - Colònia Sedó D'Esparreguera, Spain, seen from the Ter River.
Source: Bartosz M. Walczak, 2007.

Fig 5.10. Main square at Constancia Mexicana, Mexico.
Source: Humberto Morales Moreno.

6
International interchange

Plate VI. Catalan vaulting and line shafting in MNACTEC museum, former Vapor Americh, Amat y Jover wool mill in Terrassa, Catalonia, Spain. Source: Bartosz M. Walczak, 2007.

6.1 Agents of change: architects, builders, and engineers

What nowadays is called know-how and technology transfer happened through employing foreign specialists. Therefore, experienced, skilled master spinners and weavers played important roles in spreading knowledge in textile production. The luxurious products addressed to social elite – royal courts, aristocracy, and wealthy burghers, but also the church were primarily subject to this process. In particular, Italians were responsible for transmitting methods related to silk manufacturing. Flemish masters specialising in tapestry were also invited to many countries. This might be illustrated with the case of La Real Fábrica de Tapices (The Royal Tapestry Factory) in Madrid, which was founded in 1721 and then managed by the Vandergoten Stuyck family of Flemish origin[79].

Later, with industrialisation process, engineers, builders and architects also became important agents of change in the textile industry. Since the very beginning of Industrial Revolution, such experienced professionals were employed to build and set up new factories. In particular, expatriate British engineers played important role in this process, especially during the earlier stages of industrial revolution[80]. For example, the first mechanised spinning mill in France was built in Louviers in 1785, with the assistance of two English mechanics who had worked for Sir Richard Arkwright[81]. However, the UK authorities, recognising the role and importance of the technical upheaval that took place in the country, introduced an embargo on technology and machinery exports. Strict regulations even limited the possibility for engineers to go abroad to prevent knowledge being made available to competitors from other countries. The few who managed to go abroad were sought-after and valued employees and often partners in the then emerging companies[82]. Despite these limitations, one of the most important producers of textile machines outside the UK became the English engineer, William Cockerill, who settled in Verviers in Belgium. The Cockerills did not limit themselves to machine-building, but also established their own textile factories (including those in Gubin on the Oder River). Another

[79] Vidal Galache B., Vidal Galache F., „Livinio Stuyck Vandergoten, un flamenco contra Bonaparte", *Cuadernos de Historia Moderna. Anejos*, vol. IX, 2010, pp. 17-46.
[80] Henderson W.O., *Britain and Industrial Europe 1750-1870*, Leicester University Press, Leicester 1972, p. 106-113.
[81] Belhoste J.-F., "Les grandes étapes de la mécanisation de l'industrie lainière à Louviers" [in] Becchia A. (ed.), *La draperie en Normandie du XIII^e siècle au XX^e siècle*, Rouen: Publications de l'Université de Rouen, 2000, pp. 325-356.
[82] Sigsworth E.M., "Fosters of Queensbury and Geyer of Lodz, 1848-1862", *Yorkshire Bulletin of Economical and Social Research*, no. 2, 1951, p. 67-82.

interesting example is the case of the Thorntons, a family of engineers and entrepreneurs from Lancashire, who were involved in development of the Austrian textile industry in the early 19th century: John Thornton established a cotton spinning mill in Pottendorf. His brother, Jonathan Thornton, was the owner of the Ebenfurther cotton spinning mill, while another brother, Joseph Thornton, founded a spinning mill in Münchendorf[83]. It is interesting that the other family of Thorntons from Yorkshire made a similar career in Russia some three decades later, and their most spectacular achievement was establishing their own cloth mill in St Petersburg in 1841. This practice was not limited to British engineers – for example the flax mill in Żyrardów, Poland, was established in 1832-1833 with help from Philippe de Girard, the renowned French inventor of the water turbine and machines for wet flax spinning. Only later was it managed by Scots, who sought to demonstrate that the owners were not Austrian in WWI in order to obtain war reparations.

Apart from engineers and builders directly involved in establishing new mills, there were also prominent figures, who influenced the process by their publications. The most spectacular example would be renowned Prussian architect Karl Friedrich Schinkel, who in 1826 made a tour of France, England, Scotland and Wales. In fact, he was sent by the Prussian King on a mission to investigate factories, bridges, warehouses and museums that were under construction at the time. He kept a notebook in which he recorded the new buildings he saw during this journey, such as Stanley Mill in Gloucestershire[84]. The drawings and explanatory notes helped him to deploy new technologies in the buildings he designed on his return to Prussia, including the museum in Berlin, and even most importantly, the Building Academy (*Bauakademie*), an extremely rational edifice, well-ahead of its times, where several generations of German builders were educated. The impact of his knowledge might be also traced in the structural solutions adopted at some German factories of the period.

Many British architects made their names with industrial buildings. They were perceived as the best experts in the mill design, and therefore sought after by entrepreneurs in each region of the world where the textile industry was at initial stages of development and therefore there was no local architect capable to deliver

[83] Offenthaler, E. *Thornton, Johann (John) Edler von (1771–1847), Mechaniker und Unternehmer* [in] *Österreichisches Biographisches Lexikon 1815-1950*, vol. 14, issue 65, Vienna 2014, p. 311.

[84] Bindman D., Riemann G. (eds.), *Karl Friedrich Schinkel "The English journey: journal of a visit to France and Britain in 1826"*, New Haven: Yale University Press, 1993.

a design of a building allowing successful competition in textile trade. Therefore, numerous mills were built with help of experienced builders and architects from Britain. The oldest preserved Manchester-style cotton mill in Catalonia - La Cotonera in Igualada – was possibly erected by British technicians in 1841-1842. The Dobri Zhelyazkov's four-storey woollen spinning and weaving mill in Sliven, Bulgaria, was built according to English planning in 1842. The same could be said about Ludwig Geyer factory in Lodz, Poland (fig. 6.1.). The latter case is interesting, since the plans in the state archive adopt (the British) imperial measurement system, though without any information on the architect's name[85]. This practice continued in the following decades, in other countries, on other continents. In Brazil, an Englishman Arthur Sterry designed a cotton mill in Itu, one of the earliest textile factories in São Paulo region. Most likely, one of the most spectacular Brazilian mills in in Paracambi, was designed by a British architect in 1870 – perhaps from Lancashire, judging the mill body and its architectural treatment.

The international activity of architects was supported by the transfer of technology - English, German, French and Belgian technology was used throughout Europe. Soon architects and builders of other nationalities were active internationally. One of the most spectacular examples is the main factory of the Lanificio Rossi in Schio, Italy, which was redesigned by a Belgian architect Auguste Vivroux, who gained a reputation working earlier for industrialists in Verviers. French architect and master builder Louis Marins Amirat was active in Brazil. Among other French architects the Edmond et Paul Sée studio from Lille gained an outstanding position. Similarly Julius Jung moved from Stuttgart in Germany to Lodz in Poland, where he worked for the Poznański factory during 1884-1900.

Often foreign investors appointed designers from their home country, with whom they had already established corporate links or whom they perceived more experienced and trustworthy. This approach might be illustrated with a hosiery factory in Bregenz, Austria, which was built in 1892 as a branch of the Benger Brothers company from Stuttgart to a design of Wittman & Stahl – an architectural practice from the same city. Similarly, a factory in Litvínov (then Austrian-Hungarian monarchy, nowadays Czech Republic) was established by the Marbach & Riecken company from Chemnitz, while their architects (August Händel and

[85] Walczak B.M., „Wpływ rozwiązań europejskich na budownictwo przemysł w Łodzi w świetle ostatnich badań", *Kwartalnik Architektury i Urbanistyki*, vol. LIV, no. 2, 2009, p. 68-77.

Theodor Franz Franke) were from Leipzig. Karl Scheibler, when he built an exceptionally large mill at Księży Młyn in Lodz, Poland, most likely commissioned its plans from Otto Intze, a professor at the Aachen Polytechnic, who also designed a factory for Scheibler's uncle.

Eventually, a group of architects specialising in industrial buildings emerged, and the following names should be mentioned in the respect of textile mill design:

- **William Fairbairn** (1789-1874), a Manchester civil engineer, structural engineer and shipbuilder. Designed a number of textile mills worldwide, including: Manchester in England (1818-1820 and later); Portlaw in Ireland (1825); St Petersburg in Russia (1835)[86]; Sion Mills in Ireland (1835-1839); Carlisle in England (1836); Kartepe in Turkey (1843); Rouen in France (1846); Ivangorod in Russia (1850); Saltaire in England (1851); Mumbai in India (1854) – fig. 6.2. W. Fairbairn authored one of the first books on factory construction and technology, published in two volumes in 1863-1871[87], which had a great impact on mill structural design of the period[88].
- **Stott**, a family of English architects, based in Oldham including: Abraham H. Stott (1822-1904), his brother and rival Joseph Stott (1837-1894), Abraham's son Philip Sydney Stott (1858-1937), George Stott (son of Joseph, 1876–1936), who specialised in designing cotton mills. They were responsible for many Lancashire mills of the late 19th and early 20th centuries. Victorian mills, many of them in the 1880s, had 2:5 proportion, separating the mill by an asymmetrical rope race, engine house, dust flue and water tower. Fireproof floors had multiple brick arches between iron beams and later steel beams Edwardian mills, many built around 1905-7 had these placed at the end of a building with the ideal of forming a double mill, and windows were larger, with greater use of flat concerte floors), which became a model for similar establishments elsewhere. The most renowned internationally was P.S. Stott, son of A.H. Stott who had a practice separate from Stott & Sons and who designed several mills in European countries: in Chemnitz (1896-1903) – fig. 6.3.; Rheine in Germany (1896); Borås in

[86] Allegedly, the initial project was commissioned from William Fairbairn. However, without waiting for the final project, one of the co-owners A. Wilson together with arch. N. Y. Anisimov developed the actual building with some adjustments made by Fairbairn.
[87] Fairbairn, W. *Treatise on Mills and Millwork*, Longmans, Green and Company. London 1863-1871.
[88] Byrom R., *William Fairbairn: the Experimental Engineer. A Study in Mid-19th-century Engineering*, Railway and Canal Society, Market Drayton 2017.

Sweden (1898) –fig. 4.6.; Enschede in the Netherlands (1900). Most likely some industrial buildings in Lodz (Poland) were also designed by P.S. Stott. George Stott designed mills in Ramleh (Egypt) and Brazil, continuing the firm of Joseph Stott who had built mills in Glasgow[89]. The design of the building went along with orders in detail for machinery, mainly supplied by Platt Brothers of Oldham, Lancashire in the case of medium counts of yarn on the Oldham model.

- **Carl Arnold Séquin-Bronner** (1845-1899), a Swiss architect, responsible for more than 250 factories. Together with Hilarius Knobel, he formed the Séquin & Knobel office around 1895. The firm was active in Switzerland, Germany, Austrian-Hungarian monarchy, but had also commissions from other countries. Among Séquin-Bronner's works there are also textile factories, for example in Chrastava (1885); Zürich (1894); Hejnice (1894-1895) – fig. 6.4.; Varnsdorf (1895, façades by Lazar Kraus). Séquin & Knobel patented a top-lit single-storey hall structure which was deployed in the weaving shed of the Scheibler factory in Lodz (1899). After that architect's death the firm Séquin & Knobel continued to design industrial buildings, e.g. Slaný-Kvíček 1903; Hrádek nad Nisou (1906-1908); Nova Paka (1907); Triesen (1911). Séquin-Bronner was the agent of the technological transfer in Central Europe. He was spreading Platt spinning mules together with Lancashire mill typology. He also co-operated with Sulzer – a renowned machine-making company from Rüti[90].
- **Philipp Jakob Manz** (1861-1936), a German, Stuttgart-based architect, specialising in industrial architecture. As a young architect, Manz took a tour of Great Britain (and probably also of the USA) to learn on the current advancements in industrial design and building. His work gave essential impulse for the development of Modernist architecture. Manz was active in Germany and Austrian-Hungarian monarchy, where he was responsible for several dozen of textile factories, including highly acclaimed "Glaspalast" in Augsburg (1909-1910) – fig. 6.5. – and "Stromeyersdorf" in Konstanz (1905-1912). Some of his works are nowadays in Czech Republic (in Tanvald) and Poland (in Bielawa, Nowa Ruda, and Kudowa-Jeleniów)[91].

[89] Holden R.N., *Stott & Sons: architects of the Lancashire cotton mill*, Carnegie, Lancaster 1998. And Gurr G and Hunt J, *The Cotton Mills of Oldham*, Oldham, 1985; 3rd edition 1998.
[90] Hanak M., Beran L. C. *A. Séquin-Bronner, the common denominator*, presentation during the TICCIH Textile Section Workshop, Berlin 2020.
[91] Renz K., *Philipp Jakob Manz (1861-1936) Industriearchitekt und Unternehmer*, University of Stuttgart, Stuttgart 2003.

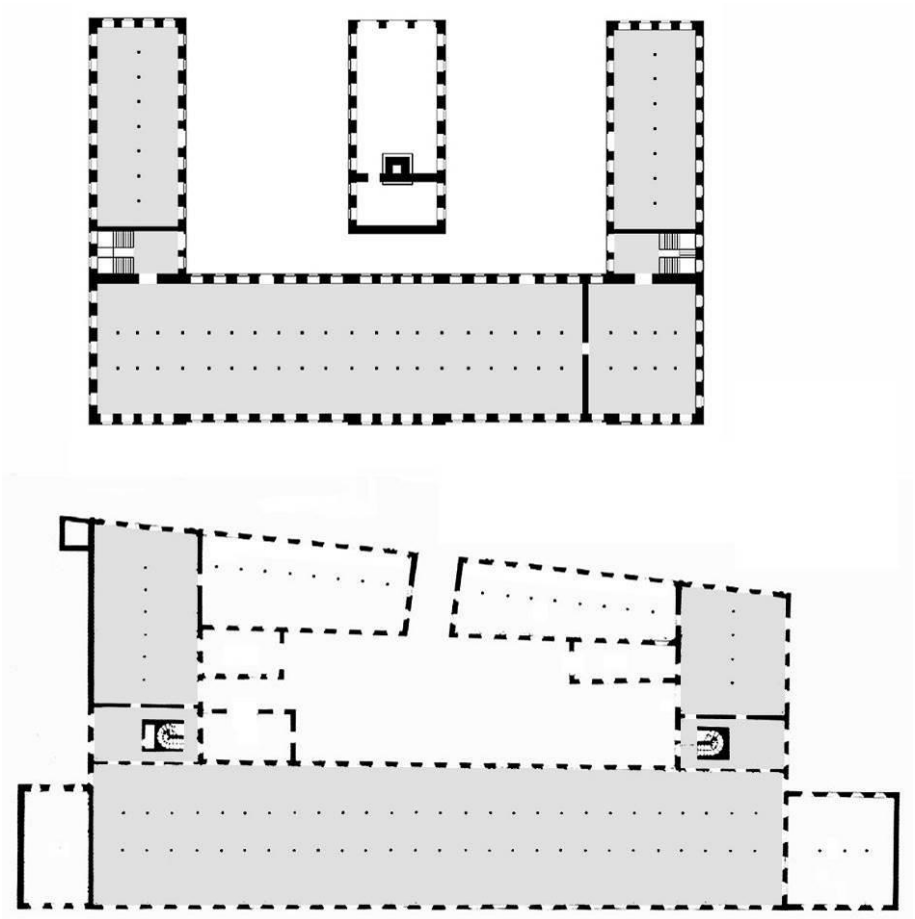

Fig 6.1. The impact of British expertise of mill design in the early 19th century: Geyer cotton mill in Lodz, Poland (top) and Brunswick mill in Manchester, UK (bottom). Source: Bartosz M. Walczak, 2009.

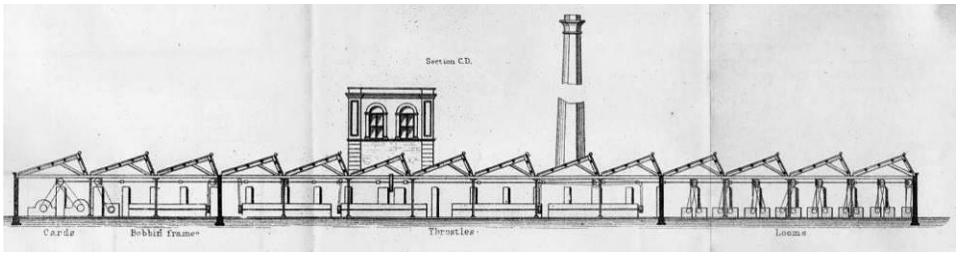

Fig 6.2. Oriental Spinning and Weaving Co in Mumbai, India – an example of a textile factory designed by William Fairbairn. Source: Fairbairn W., Treatise on Mills and Millwork. Part II, plate 15.

Fig 6.3. A cotton mill in Flöha (Chemnitz), Germany – an example of a textile factory designed by Philip Sydney Stott. Source: Bartosz M. Walczak, 2008.

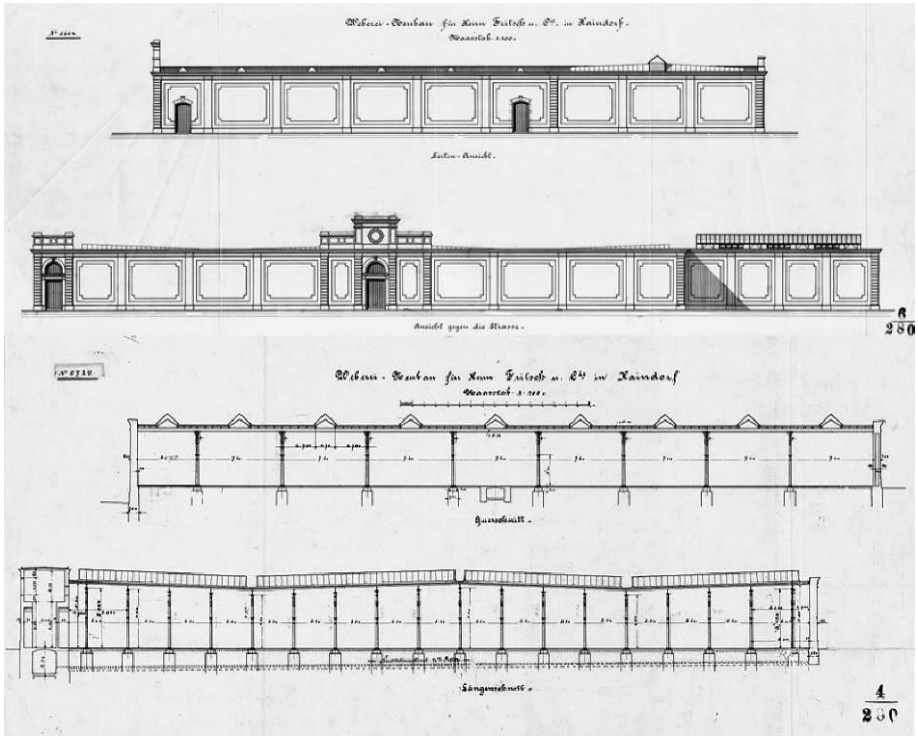

Fig 6.4. A weaving mill in Hejnice, Czech Republic – an example of a textile factory designed by Carl Arnold Séquin-Bronner with a roof structure later protected with an international patent.
Source: ETH Zürich, gta Archiv, fonds no. 116: Séquin & Knobel, box no. 0164.

Fig 6.5. So-called Glaspalast in the SWA complex in Augsburg, Germany – an example of a textile factory designed by Philipp Jakob Manz. Source: Bartosz M. Walczak, 2008.

Fig 6.6. Reinforced-concrete structures of mills in Velke Hamry, Czech Republic (left) and Mulhouse, France (right) – both designed and built by Eduard Ast & Co from Vienna. Source: Mark Watson and company advertisement from 1902.

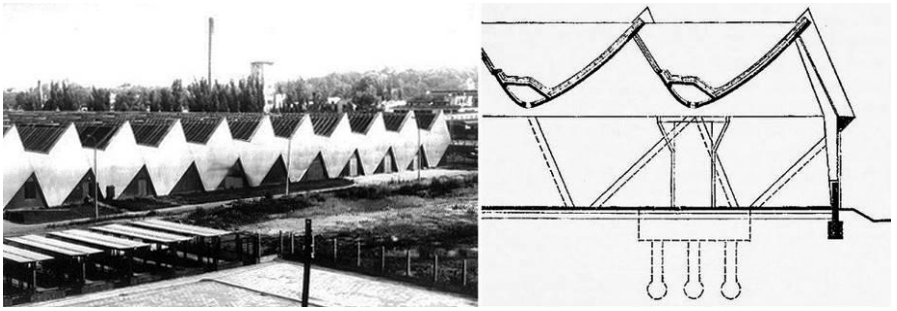

Fig 6.7. Shell structure of the Runotex factory in Kalisz, Poland by Wacław Zalewski. Source: Archive in Kalisz and W. Zalewski internet archive.

- **Bruno Bauer** (1880-1938), an Austrian architect, based in Vienna. In 1907 he obtained a doctoral degree. He mainly focused on architectural design of industrial buildings and achieved a good reputation internationally. Bauer was responsible for some spectacular textile factory buildings, mainly in the Austrian-Hungarian Monarchy: in Litvinov (1907-1910 and 1930-1933); Teesdorf (1908-1910); St Pölten (1912); Tanvald (1913-1914); Brno (1915 and 1926-1930). Bauer's works represent rational design and advanced structural solutions.
- **Gerrit A. Beltman** (1843-1915). Gerrit Beltman founded his office in 1871 and quickly made a name for himself as an architect of factory buildings and industrialists' villas. Beltman designed several mills in Twente, a major textile production centre in the Netherlands. His architectural style resembles Stott's mill design and is seen as archetypical for textile factories in the region. Among Beltman's works there are: Spinnerij Oosterveld in Enschede (1911); Spinnerij Roombeek in Enschede (1912); and Stoomspinnerij Twenthe in Almelo (1916). The first building - "Wilhelmina" - of a large industrial complex "De Tricot" in Winterswijk, was designed by Gerrit Beltman. Further extensions were designed by Arend Beltman, Gerrit's son[92].

With the development of reinforced-concrete structural design, a new wave of engineers emerged. In the early 20th century, Austrian firms were particularly active on an international scale in the Central Europe. For example Pittel & Brausewetter provided structural solutions for mills in Bratislava (now Slovakia) and Żyrardów (Poland), while Eduard Ast & Co. designed mills in Mulhouse, Velke Hamry and Bielsko-Biała (then on the Austrian-German border, nowadays in Poland) – fig. 6.6.

Towards the late 19th century, Germany was gaining the prime position in the industrial development. The same occurred with international position of German architects, who more often were appointed to provide plans for textile factories abroad. For example, in 1905-1907 a large woollen factory complex was built in Juan Lacaze, Uruguay, to a design by Peter Behrens. The same architect (along with Walter Gropius) inspired initial concepts for a textile factory in Isfahan, Iran, during the 1920s. In the same period, another Iranian textile factory in Mashhad was designed and built by Hochtief, a German structural and civil engineering

[92] Stenvert R., "Gerrit Beltman – Textielgebouwen in Nederland en Duitsland" [in] Lassotta A. (ed.), *Cotton mills for the continent. Sidney Stott und der englische Spinnereibau in Münsterland und Twente = Sidney Stott en de Engelse spinnerijen in Munsterland en Twente*. Westfälisches Textilmuseum; Museum Jannink; Textilmuseum Rheine; Ausstellung. Essen: Klartext, 2005. pp. 111-115.

company. While in 1926 Erich Mendelsohn prepared a design for a major extension of the "Red Banner" textile factory in St. Petersburg, Soviet Russia (fig. 4.17.). Subsequently, the factory got a reputation as a masterpiece of modernist industrial architecture and an exemplary socialist enterprise. More and more, however, local architects were involved in industrial design, including such big names as Pier Luigi Nervi, who was responsible for an extension of one of the factories owned by Lanificio Calamai in Prato, Italy.

In the post-war realm of the Soviet bloc in the Eastern Europe, the ultimate expertise was provided by Russian engineers and architects. For instance, In the 1950s two large textile factories in Fasty and Zambrów in Poland were built to the designs from „Giprolegprom" office in Moscow. This does not mean there was no skilled architects there. On contrary, Lavoslav Horvat, a prominent Croatian architect, was responsible for a number of industrial premises in the post-war Yugoslavia, including a yarn and thread factory "Dalmatinka" in Sinj (fig. 4.18.). While "Runotex" in Kalisz, Poland, designed by J. Główczewski, W. Zabłocki and S. Sikorski is an excellent example of a late-modernist industrial architecture with advanced structural solutions. The latter was well-published internationally (fig. 6.7.)[93].

6.2 International entrepreneurship

Some of the above-mentioned engineers not only were involved in setting up industrial production for local businessmen, but also managed to set up their own factories. These include the Welshman Evan Evans in Siebenhöfen, Saxony, and the Scots: William Gibson in Jonsered, Sweden and James Finlayson in Tampere, Finland. Among the British entrepreneurs, there were also Richard Cosens and William Chamberlain who established the first textile factory in Russia, as early as 1753. It was located in Krasnoye Selo, and cotton and silk fabrics were printed there. In fact, Britons were active almost everywhere textile industry development was in question. For example, Roger Tatham built a spinning and weaving factory in Hungary in 1887, while other British entrepreneurs established mills in São Luís and Paracambi in Brazil, often in partnerships with local people.

Germans, like their British counterparts, were among the most internationally active entrepreneurs. Some of them were responsible for some of the most spectacular achievements in the textile trade. The key example could be Ludwig Knoop, native from Bremen in Germany, who started his career in Russia as a

[93] eg.: Desideri, P et al. (eds.) *La concezione strutturale*, Allemandi & C., Turin 2013.

representative of British producers of textile machines. After several years, he managed to establish his own enterprise in Kreenholm (now Estonia), which eventually became one of the largest cotton manufacturers in the world. Knoop also was a partner in other textile companies, such as Vysokovsk spinning and weaving factory established in 1864. The Scheiblers were another important family closely linked with textile manufacturing. They rooted in Moschau on the German-Belgian border, where they had a prosperous business based on the putting-out system. Members of the family managed to develop successful enterprises in other countries – in Eupen, Belgium, in Lodz, Poland and in Milan, Italy. The swiss entrepreneurial family Rieter, Winterthur, started with spinning, built their own machinery and grew towards an international company, that today is again specialized in textile machinery. There was also a well-established tradition of German investment in the South American countries. In Brazil, the Rheingantzs and the Herings were active in textiles, and the Companhia Hering was one of the largest manufacturers of cotton goods. While the golden age of the "Bellavista Tomé" an important woollen factory in Chile corresponded to the period when it was owned by the Werners. Later, Germans played important role in textile industry in countries such as Iran, where Max Otto Schünemann, a politician and businessman, functioned as a catalyst for many projects in the 1920s and 1930s.

French entrepreneurs also played an important role in the international textile trade. As early as 1824, Louis Benoît Boussu established a woollen mill in Biella in Italian Piedmont. Several French enterprises were established in Russia (and Russian partition of Poland) to avoid import taxes. Those included worsted mills in Lodz (owned by Allart, Russeau, Desurmont and other factory masters from the Lille-Roubaix-Tourcoing region). Similarly, mills in Częstochowa were owned by „Motte, Meillassoux, Caulliez et Delacutre" from Lille and the "Societe Textille La Czenstochovienne" based in Roubaix. A company "Lasalle-i Dumas & Martin" established silk spinning mill in Hungary, while the "C. J. Bonnet et Cie" expanded their activities to Italy and Poland. French businessmen were also involved in the international enterprises, such as the "Sociedad Industrial Franco-Belga" that operated a textile factory in Colombia, or the "Compañía Industrial de Atlixco", French and Spanish co-owners, which managed a large cotton mill in Mexico. More recently, the famous French Textile Group (DMC) from Mulhouse were involved in the development of Cotonnière Industrielle du Cameroun (CICAM).

However, during the Industrial Revolution, numerous entrepreneurial individuals of other nationalities were also seeking opportunities abroad. The Swiss citizens Glinz and Ganzenbach established a curtain and lace company in St. Petersburg, Russia, already in 1834. Another entrepreneurial family from Switzerland, the Vonwillers were present in Milan, Haslach an der Mühl and Žamberk, when all these places were within the Austrian-Hungarian monarchy, and now are in three different countries (Italy, Austria and Czech Republic). Similarly, the Simonetta family operated in Milan (Italy) and Helfenberg (Austria). Another example could be the Richters, a Czech family of textile manufacturers, who were active not only in their native region – in Raspenava and Varnsdorf, but also were successfully developing their mills in Lodz, Poland. While the Catalan entrepreneurs Francesc and Antoni Dalmau Soler established a cotton spinning and weaving factory in Ecuador. Finally, in the 1920s Jewish factory masters from Lodz in Poland, inspired with the ideas of Zionism, built in Tel Aviv a modest mill, proudly named Lodzija, to commemorate their home town.

Finally, the late 19th century also brought a new phenomenon – the emergence of multinational companies. In particular, one of the world's first companies of this type should be mentioned here – namely J.&P. Coats from the UK. The firm originated in Paisley in Scotland, where two family businesses of the Clarks and the Coats amalgamated to establish a large thread manufacturing enterprise. Both families had already owned branches in the USA: at Newark, NJ (1864, Clark) and Pawtucket, RI (1868, Coats). Subsequently, they developed a strategy based on acquisitions of existing thread mills in various countries: St Petersburg in, Russia; Borgonya and Fabra i Coats in Catalonia, Spain; Lodz in Poland; Budapest in Hungary, Lucca in Italy.

7

Textile industry sites as world heritage

Plate VII. DMC (Dollfus-Mieg et Cie) in Mulhouse, France – a vast industrial complex (ca. 40 ha) developed gradually from the 1810s towards the 1930s. Source: Bartosz M. Walczak, 2008.

7.1 UNESCO evaluation criteria relevant to the textile industry

The aim of this analysis has been to provide a framework to guide governments and the World Heritage Committee. The TICCIH and ICOMOS thematic studies only present examples that may help guide States Parties in their selection of sites for inclusion in the World Heritage List. Only a few of the sites mentioned will on detailed examination prove to be of universal value, sufficiently authentic or adequately protected. Not all will be priority for nomination by the relevant state party. The majority are here to give context to the few that are or may become world heritage sites.

7.1.1 Definition of a textile site

A textile site is a place which is or was indelibly associated with the manufacture of or trade in textiles and in which the cultural imprint of that activity is physically evident. It may be of outstanding universal value from the point of view of history or technology, either intrinsically or as an exceptional example representative of this category of cultural property. It may be a single monument or an integral component of a complex cultural landscape. It may demonstrate a connection with similar sites in other countries through the transfer of technology, of goods and of migrants ("Movement of Peoples, Developing Technologies and Utilisation of Natural Resources"). The TICCIH Textile Section acknowledges the need for further study to bring in more non-European sites and landscapes.

The terms *pioneer, flagship, giant, international interchange* and *time capsule* are more fully explained through the examples given at the end of the list. They are intended to be applicable to other forms of industry besides textile. The TICCIH Textile Section agreed that approaches to universal significance that related to human perceptions of a place were more useful than categorisation simply by each branch of the industry.

Internationally significant sites might also be categorised as belonging to one of three monument types according to the scale and unity of the site:

(i) Individual significant mills and their contents that stand alone. These will be the most difficult to have accepted by non-specialists. They may be sub-classified as *pioneer, flagship, giant, time capsule* or with others elsewhere a representative of *international interchange.* No single textile building has yet been inscribed on this basis as it is more useful to consider the possibility of designating a landscape. However, a parallel example in the paper industry is the Verla Board Mill WHS in Finland, a time capsule within a small

landscape, and also the medieval cloth hall in Valencia, Spain: built for trading in oil, a single building in an urban context.

(ii) Large textile complexes and adjoining workers' settlement and facilities, that may or may not be considered "model". The inscribed World Heritage Sites at Crespi d'Adda and San Leucio, Italy, Saltaire and New Lanark in the United Kingdom fall into this category. The criterion for these is *urbanism*, although mills within them may also, but not necessarily, be considered *pioneer, flagship, giant* or *time capsule.*

(iii) Integrated textile landscapes comprising more than one enterprise, some with associated processing activities, transport and power infrastructure, housing and worker settlement institutions. Other industries (agriculture, machine-making, soap-works etc.) may exist but are mostly subordinate to or supportive of the principal textile industry. The inscribed World Heritage Sites of the Derwent Valley Mills in the United Kingdom, and Shirakawa-go and Gokayama, Japan, fall into this category. One or more of the mills within them may also be considered *pioneer, flagship, giant* or *time capsule.* These cultural landscapes are divided according to whether they are broadly speaking urban or rural, and by the principal raw material: cotton; wool, linen (flax jute hemp and other vegetable fibres) and silk. A relict landscape has changed its function. A living landscape is still partly or fully devoted to textile production.

To be deemed of Outstanding Universal Value, a property must also meet the conditions of integrity and authenticity and must have an adequate protection and management system to ensure its safeguarding.

On **authenticity,** guidance is given in the Nara Document on Authenticity (Nara, Japan, 1994). Essentially it allows each culture to define its own level of authenticity. However international fora such as the TICCIH Textile section will have to define authenticity on the basis of what it considers authentic. The World Heritage Committee stresses that reconstruction is only acceptable if it is carried out on the basis of complete and detailed documentation on the original and to no extent on conjecture. Therefore excluded from this list are collections that have been created for museum purposes rather than to meet the social and economic needs of the societies they portray. The relocated woollen mills at Upper Canada Village, Ontario, Canada and at the Welsh Folk Museum, St Fagan's, Wales, UK, the collection of fulling mills at Astra, Sibiu, Romania, the replica weaving shed at Bocholt, Germany, are each very valuable for the meticulous research that went into their documentation and rebuilding. But they lack the authenticity that can only be given by preservation *in situ*.

There are also museums that contain working machinery brought from elsewhere. Thus the principal textile museums in the Netherlands, at Tilberg, in Norway, at Solingstadt, in America at the Museum of American Textile History (a machine shop in Lowell) and in the UK at for example Bradford Industrial Museum (Moorside Mills) and Dundee Industrial Heritage (Verdant Works), contain valuable and in some respects unique collections that inform studies of textile history (fig. 7.1.). In themselves the buildings they occupy are interesting but not internationally remarkable. Some may however qualify as focal points for the interpretation of textile landscapes that are of outstanding value: so Lowell National Park as a whole is identified as a universally significant landscape.

Yet there are some museums that occupy buildings that could themselves be described as internationally significant: Leeds Industrial Museum in Armley Mills (UK), for example, is the second or third extant oldest iron-framed building in the world, and the oldest fireproof mill to contain cylindrical cast-iron columns. Its significance to the textile comparative list lies in that fact, rather than in its collection brought from elsewhere.

Where a textile landscape is presented as of international significance it needs to have adequate safeguards as a landscape rather than a series of individual monuments. So in Britain the "conservation area" is the designation used to convey the cultural significance of landscapes and townscapes at Holbeck and Bank, Leeds; Nottingham Lace Market; Ancoats, Manchester; Blackness, Dundee; Saltaire and Little Germany, Bradford; New Lanark and Deanston, Scotland; Cromford, Milford, Belper and Darley Abbey, Derbyshire. Wider landscapes still are presented through tourist mill trails. In America, National Park designation was utilised to safeguard and promote Lowell and other large-scale landscapes are denoted as National Heritage Areas. More limited area might be National Landmark areas, like Harrisville, NH. In Norkopping. Sweden the Riksantikvariebetet similarly declared a landmark area around the Motala Strom.

Integrity addresses whether anything important been left out- workers' housing, canals, railways as well as the mills? Is the property so big that it includes unrelated heritage or too many modern intrusions? Is there a strategy to remedy defects, such as incentives for re-use, that might be included in a management plan? UNESCO Guidelines require that[94]:

[94] UNESCO Operational Guidelines as revised in 2019: UNESCO World Heritage Centre, *The Operational Guidelines for the Implementation of the World Heritage Convention* (https://whc.unesco.org/en/guidelines/).

Fig 7.1. Industrial museums in textile factories - Bradford Industrial Museum in Moorside Mills (left) and Dundee Industrial Heritage in Verdant Works (right). Source: Bartosz M. Walczak and Mark Watson.

Fig 7.2. International Fashion Center in Shanghai, China - conservation of textile mills and their landscapes depends on promotion of active re-use as a major protection mechanism. Source: Li Fan, 2021.

"All properties nominated for inscription on the World Heritage List shall satisfy the conditions of integrity Integrity is a measure of the wholeness and intactness of the natural and/or cultural heritage and its attributes. Examining the conditions of integrity therefore requires assessing the extent to which the property:

a) includes all elements necessary to express its Outstanding Universal Value;

b) is of adequate size to ensure the complete representation of the features and processes which convey the property's significance;

c) suffers from adverse effects of development and/or neglect. This should be presented in a statement of integrity.

For properties nominated under criteria (i) to (vi), the physical fabric of the property and/or its significant features should be in good condition, and the impact of deterioration processes controlled. A significant proportion of the elements necessary to convey the totality of the value conveyed by the property should be included. Relationships and dynamic functions present in cultural landscapes, historic towns or other living properties essential to their distinctive character should also be maintained."

Where a textile landscape is presented as of international significance it needs to have adequate safeguards as a landscape rather than a series of individual monuments. So in Britain the "conservation area" is the designation used to convey the cultural significance of landscapes and townscapes at Holbeck and Bank, Leeds; Nottingham Lace Market; Ancoats, Manchester; Blackness, Dundee; Saltaire and Little Germany, Bradford; New Lanark and Deanston, Scotland; Cromford, Milford, Belper and Darley Abbey, Derbyshire. Still wider landscapes are presented through tourist mill trails. In America, National Park designation was utilised to safeguard and promote Lowell and other large-scale landscapes and heritage corridors are denoted as National Heritage Areas. More limited areas might be National Landmark areas, like Harrisville, NH. In Norkopping, Sweden the Riksantikvariebetet similarly declared a landmark area around the Motala Strom.

7.2. Protection Mechanisms

On prospects for preservation, it is important that the list should not be dominated by "sites at risk". It has to be recognised that no textile mill in Western Europe or North America can be considered secure if it is still in its original use. The fact that the textile sector is at the leading edge for industrialisation around

the world, including countries where wages are very much lower, means that what textile industry does survive in areas that saw industrialisation in previous centuries can only do so on a limited, but high-value, scale. The future for Crespi d'Adda, the first textile site to be inscribed on the World Heritage List, is under consideration following closure of the mill.

Insight box 6.

ADAPTIVE RE-USE

Wanrenchang / International Fashion Center, Shanghai, China

Shanghai No.17 Cotton Mill, Yangshupu Road 2866, [31°16'21.36"N 121°33'15.18"E]

Originally a Japanese-owned cotton factory built in 1935 to designs by a Japanese architect. At its peak, it used to have more than 10,000 employees, and was known as Wanrenchang, literally meaning the factory of 10,000 people. In 1999, the site was listed as a cultural monument by the Shanghai Municipal Government. The site is located along the Huangpu River, one of Shanghai's industrial bases. In 2007 a large number of Shanghai Textile Group employees retired, which made it easier to restructure and relocate the factory to Jiangsu Province.

As one of the strategies to develop Shanghai as an international metropolis, the site was identified as an international fashion center enjoying preferential policies from Yangpu District Government and financial support from the national, municipal and district governments. After production was moved in 2007, regeneration was started in 2009 to transform it to a creative park, which opened in 2011. Parts were demolished as they were regarded as not valuable to keep. The rest of the 16 buildings were carefully renovated in an area of 12 hectares. A large open space has been increased through a terrace along the waterway and a central avenue for pedestrian and new buildings have been added, making this a good example of adaptive re-use of a versatile textile mill. *Giant* (fig. 7.2.).

Li Fan

Conservation of textile mills and their landscapes therefore depends on promotion of active re-use (see insight box 6.). Lowell, Mass. (USA) has survived thanks to its second-generation role in the micro-electronics industry. Much of the Oldham (UK) landscape is based on mills now serving as large mail-order warehouses. In Dundee (UK) twenty mills are now converted to flats. The impressive landscapes of Norrkoping (Sweden), Tampere (Finland) and Lille

(France) depend on imaginative mixed-use developments. Such is the robust quality of the textile mill that conversion can be celebrated as reinforcing rather than detracting from authenticity, but some rules need to be applied:

- Documentation, inside and out, of the buildings before conversion to gain an understanding of its significance.
- Application of conservation controls to ensure that elements essential to the character of the textile mill survive: chimneys, identifiable power houses, structural systems (so a preference against "façadism") and landscape features: mill ponds, lades, canals etc.

PIONEERS (ii, iv): into this category should be put those that had no real precedent, where innovations were first tried out and to which other textile sites acknowledge their origin.

FLAGSHIPS (i, ii, or iv): these are architectural one-offs or trend-setters. They either: (i) "*represent a masterpiece of human creative genius*": (Claims of outstanding status as works of art will only accepted sparingly, or not at all. One approach may be to sites that produced outstanding designs) or (ii) *exhibit an important interchange of human values, over a span of time or within a cultural area of the world, on developments in architecture or technology, monumental arts, town-planning or landscape design*; or are (iv) *an outstanding example of a traditional human settlement or land-use which is representative of a culture (or cultures), especially when it has become vulnerable under the impact of irreversible change*

GIANTS (iv) Scale is not itself an indication of quality as a measure of universal value. But as one aspect of the significance of a textile site, and which impressed contemporary visitors, is scale, this is a relevant criterion. Measurement can best be by the size of the workforce, and thereby local economic importance. Other measures can yield very variable results: numbers of spindles increase in accordance with the fine count of the yarn: a Bolton cotton mill can contain many more spindles than an Oldham mill of the same dimensions, which would have more again than a woollen or jute mill.

INTERNATIONAL INTERCHANGE sites "*exhibit an important interchange of human values, over a span of time or within a cultural area of the world, on developments in architecture or technology, monumental arts, town-planning or landscape design*" [UNESCO criterion (ii)] This criterion reflects universal significance in the form of that interchange. It could either be the source of the technological transfer or the destination, or it could indicate a two-way transmission. In either case the significance is heightened if it led onto greater

things, such as Toyota in Japan, or one of the early multinational corporations. Another aspect that could be considered is the production of raw material in one country for processing in another, but they are covered below under textile landscapes.

TIME CAPSULES ("La Belle au Bois Dormante"). These contain rooms full of *in situ* machinery, and are not re-creations: Taking as a model the inscribed WHS of Verla Groundwood and Paper Board Mill, Finland, they may: bear a unique or at least exceptional testimony to a cultural tradition or to a civilisation which is living or which has disappeared; (criterion iii) or be an outstanding example of a type of building or architectural or technological ensemble or landscape which illustrates (a) significant stage(s) in human history (criterion iv) - fig. 7.3.

URBANISM: (ii, vi) Outstanding examples of paternalist or utopian town planning could qualify under criterion (ii) in respect of influence on town planning. Only exceptional sites can be considered to fall into UNESCO criterion (vi) as directly or tangibly associated with events or living traditions, with ideas, or with beliefs, with artistic and literary works of outstanding universal significance.

TEXTILE LANDSCAPES (iv, v): Groups of mills, factories, textile machine works, industries ancillary to textiles and its workforce, workers' and owners' housing, parks, related institutions, water power and transport systems, agricultural landscapes where the raw material is produced and is processed. They may be divided into relict (defunct but with much physical evidence remaining) and living textile landscapes where textiles are still an important aspect of daily life. In Britain the Harris tweed industry of the Western Isles, and the hosiery industry in Hawick may serve as living examples, and in central Asia the manufacture of handmade carpets continues to be a main source of income.

Much here depends on management strategies that safeguard the landscape. According to the potential variously presented by forms of national legislation and local initiatives, some of these landscapes may have to be reduced in scale to more well-defined but conservable areas (see insight box 7).

Fig 7.3. Queen St. Mill in Burnley, UK - an example of a time capsule. Source: Mark Watson, 2016.

Fig 7.4. Living heritage - an opportunity for conservation at one of the last working cotton mills in Girangaon mill district in Mumbai. Source: Neera Adarkar, 2020.

Insight box 7.

CONSERVATION OF A MILL DISTRICT IN MUMBAI

Girangaon ('village of the mills'), Mumbai

The areas of Tardeo, Byculla, Mazgaon, Reay Road, Lalbaug, Parel, Naigaum, Sewri, Worli and Prabhadevi in Mumbai

Girangaon ('village of the mills') is a working-class district of the textile industry located in the heart of the island city of Mumbai. It evolved in the late nineteenth century with nearly 80 mills which spanned an average footprint of 2 ha each, employing two thirds of the city's labour. These mills gave the city's skyline its tall brick chimneys, and imposing masonry architecture.

Employing 250,000 workers, the mills were the hub around which community consciousness took shape through a network of diverse spaces. Interspersed between the mills emerged unique, communal, tenement housing - the chawls, mini neighbourhoods by themselves. These evolved into integrated sites of political struggles, social networks and progressive, cosmopolitan cultural expressions.

In 1991, as state policies allowed closure of textile mills leading to gentrification, the industrial metropolis transformed into a service metropolis, changing its identity. The trade union which fought for mill labour issues, now pushed their focus to address urban issues through the 'Save neighbourhood movement'.

Heritage Conservation groups legally fought for conserving mill structures. The delayed court verdict led to the demolition of almost all the mills, to be replaced with modern day offices. At present around four mills exist that can tell the stories of the mill neighbourhood if restored. The state government has proposed to create a textile museum and a musical fountain in one of these dilapidated mills. It is unclear if the museum will tell the history of Mumbai's textile industry and its labour (fig. 7.4.).

Neera Adarkar

8

Inventory of textile industry sites

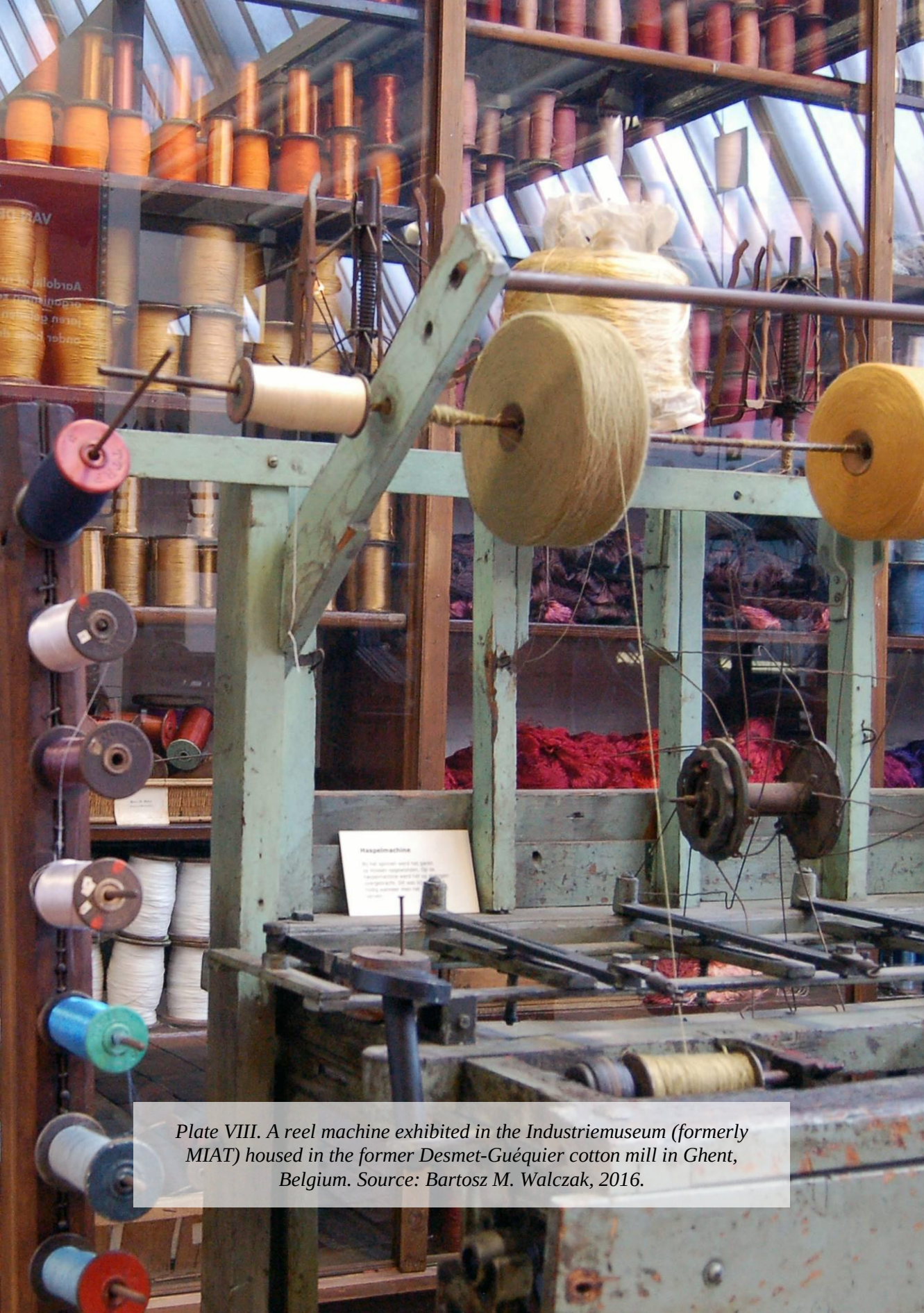

Plate VIII. A reel machine exhibited in the Industriemuseum (formerly MIAT) housed in the former Desmet-Guéquier cotton mill in Ghent, Belgium. Source: Bartosz M. Walczak, 2016.

8.1 Introduction

This list is one of a series of industry-by-industry lists offered to ICOMOS for use in providing guidance to the World Heritage Committee as to sites that could be considered of international significance. This is not a sum of proposals from individual countries, neither does it make any formal nominations for World Heritage Site inscription: States Parties do that. A thematic study presents examples, and omission here does not rule out future consideration. The study attempts to arrive at a consensus of expert opinion on what might make sites, monuments and landscapes significant. This follows the Global Strategy for a representative, balanced and credible world heritage list. Industrial sites are among the types of international monuments that are at present considered to be under-represented on the World Heritage List. They offer the opportunity to engage countries that are under-represented under the thematic headings Movement of Peoples, Developing Technologies and Utilisation of Natural Resources.

While the bulk of mills of the industrial revolution period are inevitably found in Europe and North America, they depended upon a supply network that was world-wide. As the lead sector for industrialisation in many countries, textile sites have importance for bringing modernity to many countries around the world, and the majority of textile products are now made in Asia. Study of textile production in Africa and Asia helps the understanding of domestic production and of industrialisation elsewhere.

8.2 Gazetteer[95]

Afghanistan

Jowzjan. Aqcha, [36°54'05.8"N 66°11'01.2"E], traditional carpet manufacturing centre.

Herat. Shindand, [33°18'27.2"N 62°08'12.9"E] and Adraskan, [3°38'36.9"N 62°16'02.0"E], traditional cartpet manufacturing centre.

Balkh. Mazar-e Sharif, [36°42'38.5"N 67°06'37.6"E], woollen trade centre.

Golbahar. Golbahar Textile Company, [35°08'08.1"N 69°18'06.2"E], a cotton factory.

[95] A complete version of the gazetteer, with extended descriptions of the sites, is available at the TICCIH website.

Argentina

Buenos Aires, Fábrica Argentina de Alpargatas, [34°38'22.6"S 58°22'09.7"W], jute textile footwear, established in partnership with Douglas Fraser of Arbroath, Scotland. *International interchange.*

Australia

Blackall Woolscour (Queensland), [24°23'41.4"S 145°29'15.1"E], wool scouring facility.

Brisbane (Queensland). Twelve woolstores were built at the Teneriffe riverside area between 1909 and the 1950s, such as the Australian Estates Company Ltd, 1927 and Goldsborough Mort & Co Ltd, 1933. They have been redeveloped as commercial and residential buildings in what is now a vibrant riverside community.

Geelong (Victoria), Woolstores Conservation Area and National Wool Museum, [38°08'42.8"S 144°21'41.6"E], wool stores dating from 1872 and related harbour infrastructure.

Gostwyck Station, Uralla, (New South Wales). Deeargee woolshed, built in 1872 by Alexander Mitchell, a 50 ft diameter octagon with a 75 ft extension for 24 blade shearers. The name stands for the original wool brand, 'DRG', for 'Dangar, Gostwyck'.

Lobethal (South Australia), Onkaparinga mill, [34°54'28.3"S 138°52'21.3"E], started producing blankets in 1872, and the buildings are conserved as a museum and small business park since closure in 1993.

Tasmania. Woolmers woolshed, [41°37'32.8"S 147°08'52.5"E], built in 1819, the oldest surviving woolshed in Australia.

Austria[96]

Bad Vöslau (Niederösterreich), Vöslauer Kammgarnfabrik, [47°58'07.0"N 16°13'14.0"E], a worsted factory.

Bludenz (Vorarlberg), Textilwerke Getzner, Mutter & Cie, [47° 9′ 4″ N 9° 49′ 23″ E], a woollen weaving mill. Spinnerei Klarenbrunn, [47°08'46.3"N 9°49'27.7"E], a woollen spinning mill.

Bregenz (Vorarlberg), Textilwerke Benger, [47°30'10.2"N 9°44'01.6"E], a hosiery factory.

Bürs (Vorarlberg), Textilfabrik Lünersee, [47°09'06.1"N 9°48'34.2"E], a wool spinning and weaving factory.

[96] With contribution by Theresa Hahn.

Dornbirn (Vorarlberg), Textilfabrik Hämmerle, [47°24'20.0"N 9°45'27.6"E], a cotton factory complex; Weberei Fussenegger, [47°23'20.8"N 9°43'26.3"E / 47°23'10.4"N 9°42'50.9"E], a cotton factory complex; Spinnerei Juchen, [47°24'15.5"N 9°44'48.6"E], a flax /cotton spinning mill.

Ebensee (Oberösterreich), Spinnerei und Weberei Ebensee, [47°47'58.9"N 13°46'01.3"E], a cotton spinning and weaving factory.

Ebreichsdorf (Niederösterreich), Textilfabrik Regner und Rücker, [47°57'46.3"N 16°23'58.3"E]; Kattunfabrik (Thorntonhaus), [47°57'47.2"N 16°23'58.8"E], a cloth/calico manufactory.

Frastanz (Vorarlberg), Textilfabrik Ganahl, [47°13'09.5"N 9°37'46.9"E], a cotton spinning and weaving mill.

Gmunden (Oberösterreich), Theresienthaler Spinnerei und Weberei, [47°56'11.4"N 13°47'53.2"E], a wool and cotton mill.

Golling an der Erlauf/Neuda (Niederösterreich), Jute-Spinnerei und -Weberei (HITIAG), [48°12'20.9"N 15°11'05.5"E], a jute factory and paternalistic complex.

Gramatneusiedl (Niederösterreich), k.k. priv. Marienthaler Baumwollgespinst und Wollwaren Landesfabrik [48°01'19.9"N 16°29'42.4"E], cotton factory and workers housing (Arbeitersiedlung Marienthal).

Groß-Siegharts (Niederösterreich), Lebende Textilmuseum, [48°47'30.4"N 15°24'11.9"E], an old ribbon weaving mill.

Hainburg an der Donau (Niederösterreich), Tuchfabrik Hainburg, [48°08'57.8"N 16°56'39.3"E], a cloth manufactory.

Haslach an der Mühl (Oberösterreich), Textilfabrik Vonwiller, [48°34'32.3"N 14°02'12.8"E], a linen and cotton weaving mill.

Helfenberg (Oberösterreich), Textilfabrik Helfenberg, [48°32'30.5"N 14°08'28.8"E], a cotton weaving factory.

Hoheneich (Niederösterreich), Textilfabrik Backhausen, [48°46'25.1"N 15°00'51.7"E], an upholstery factory.

Kennelbach (Vorarlberg), Textilwerke Jenny & Schindler, [47°28'39.2"N 9°45'49.4"E], a cotton factory complex.

Klagenfurt am Wörthersee (Kärnten), k.k. Feintuchfabrik Thys, [46°37'44.0"N 14°17'52.1"E], a fine cloth manufactory.

Linz (Linz), Linzer Wollzeugfabrik [48°18'40.1"N 14°17'44.0"E], a manufactory of heavy woollens; Baumwollspinnerei Rädler [48°14'51.0"N 14°18'09.7"E], a cotton-spinning mill; Textil Linz AG, [48°15'08.7"N 14°19'25.1"E], a cotton factory.

Möllersdorf/Traiskirchen (Niederösterreich), Kammgarnfabrik Möllersdorf, [48°01'44.5"N 16°18'29.3"E], a worsted spinning and weaving factory with workers housing.

Neudau (Steiermark), Garnfabrik Borckenstein, [47°10'20.2"N 16°06'09.9"E], a yarn (a multitude of synthetic and natural fibers) spinning mill.

Nüziders (Vorarlberg), Textilfabrik Lorünser, [47°10'31.0"N 9°48'03.6"E], a woollen factory.

Pottendorf (Niederösterreich), Baumwollspinnfabrik Pottendorf, [47°54'24.6"N 16°23'38.5"E], a cotton factory and company town.

Pottenstein (Niederösterreich), Tuchfabrik Pottenstein, [47°57'52.7"N 16°05'23.0"E], a cotton / worsted factory.

Rudersdorf (Burgenland), Textilfabrik Sattler, [47°02'48.4"N 16°07'30.1"E], a factory for rubbered textiles.

Kleedorf / Schrems (Niederösterreich), Anderlfabrik, [48°46'43.7"N 15°02'36.0"E], A cotton and half-woollens mill.

Schwadorf (Niederösterreich), Schwadorfer Spinnerei, [48°04'12.6"N 16°34'55.0"E], a cotton-spinning mill.

Schwertberg (Oberösterreich), Schloss Poneggen [48°16'20.3"N 14°33'51.7"E], a small castle transformed into a hosiery manufactory.

St. Pölten (Niederösterreich), Glanzstoff St. Pölten, [48°12'59.0"N 15°38'15.0"E], a rayon factory; Fabrikanlage Harlander Coats [48°09'42.2"N 15°38'17.6"E - 48°10'10.8"N 15°38'18.8"E], a thread factory and paternalistic complex, founded 1849, linked to J. & P. Coats from 1894-1940 and 1945-1991.

Teesdorf (Niederösterreich), Baumwollspinnerei Teesdorf, [47°57'02.4"N 16°17'14.7"E], a cotton-spinning mill.

Ternitz (Niederösterreich), Rohrbacher Spinnerei [47°43'21.1"N 16°03'47.9"E], a cotton spinning (and later weaving) factory.

Weigelsdorf (Niederösterreich), Baumwollspinnfabrik Fischapark, [47°56'14.3"N 16°23'17.8"E], a flax and later cotton spinning mill.

Weitra (Niederösterreich), k.k. privilegierten Modewarenfabrik Hackl & Söhne, [48°42'26.4"N 14°53'39.4"E], a factory for embroidery, tapestry, and upholstery goods.

Wels (Oberösterreich), Hutfabrik Blum, [48°09'44.2"N 14°01'57.9"E], a hat factory.

Azerbaijan

Baku, Azerbaijan Museum of Carpets, [40°21'37.1"N 49°50'06.1"E] - demonstrations of traditional carpet weaving techniques inscribed by UNESCO on the list of the Intangible Cultural Heritage of Humanity in 2010.

Sabirabad (Petropavlovskoye, Petropavlovka), Samedov Cotton Plant, [39°59'45.3"N 48°28'09.0"E], a cotton factory.

Bangladesh

There is a great number of plantations for jute growing and packing. Almost 80% of the world's jute was grown in Bangladesh but the mills were almost all over the border in Kolkata. So factories developed after the 1947 partition and 1972 independence. There are also many clothing factories of recent date:

Chittagong, several jute manufacturing complexes, e.g.: Amin Jute Mills [22°23'02.6"N 91°49'35.3"E]; Chittagong Jute Manufacturing Company [22°23'26.2"N 91°52'37.1"E]; Gul Ahmed Jute Mills [22°31'31.2"N 91°42'11.4"E]; Hafiz Jute Mills [22°28'29.6"N 91°43'37.2"E].

Dhaka, a number of large jute mills, such as: Karim Jute Mills (with a mosque) [23°43'15.6"N 90°29'53.5"E]; Latif Bawani Jute Mills [23°43'20.1"N 90°29'50.3"E]; Nawab Abdul Malek Jute Mills [23°42'12.8"N 90°31'16.9"E].

Kaliganj, Muslin Cotton Mills, [23°55'14.1"N 90°33'41.9"E], a large cotton factory.

Khulna, a number of large mills, such as: Crescent Jute Mills [22°52'05.9"N 89°32'50.7"E]; Daulatpur Jute Mills [22°51'31.4"N 89°33'03.0"E]; Khalishpur Jute Mills [22°51'48.7"N 89°32'29.0"E]; Peoples Jute Mills [22°52'06.0"N 89°32'36.0"E]; Platinum Jubilee Jute Mills [22°51'38.8"N 89°32'57.8"E]; Star Jute Mills [22°52'06.4"N 89°33'10.9"E].

Narayanganj, Adamjee Jute Mill, [23°40'40.2"N 90°31'46.1"E], large jute factory known also as the Dundee of the East.

Rajshahi, Rajshahi Jute Mills, [24°22'02.0"N 88°40'43.4"E], a jute factory with a paternalistic complex.

Belarus

Baranovichi, Baranavickaje vytvorčaje bavaŭnianaje abjadnannie (Baranovichi Cotton Production Association) [53°08'50.3"N 26°02'42.7"E], a cotton spinning and weaving combine.

Brest, Brest Stocking Factory, [52°05'58.5"N 23°43'41.3"E], a hosiery factory.

Minsk, Kamvol (originally named after the 50th anniversary of the Communist party of Belarus), [53°51'34.5"N 27°34'08.7"E], a worsted factory.

Orsha, Lnokombinat, [54°29'22.8"N 30°23'45.6"E], a large flax mill with state-paternalistic complex.

Vitebsk, Dvina, [55°10'24.8"N 30°08'56.0"E], a linen factory (now carpet factory); Vitebskii Kombinat Shelkovyh Tkanei, [55°10'22.8"N 30°09'09.2"E], a silk weaving factory; KIM [55°10'26.4"N 30°10'15.6"E], a hosiery and knitwear factory; Znamja Industrializacii [55°12'25.5"N 30°13'07.9"E], a large garment factory with state-paternalistic complex.

Belgium

Eupen, a major woollen industry centre, with the Kammgarnwerke AG, [50°37′16″N 6°1′55″E], a worsted factory; and Tuchfabrik Peters, [50°37'11.2"N 6°03'11.6"E], a cloth mill.

Ghent, the first cotton mills were adapted from monasteries followed by the oldest purpose-built fireproof steam mill. De Gandt-Vanderschueren built in 1839, now flats.

Cotton Harbour, Nieuwe Vaart [51°04'10.6"N 3°43'15.5"E], a group of cotton warehouses and spinning mills (Parmentier -van Hoegaerden, Texas, Florida, Galveston, Louisiana, Pipijn, UCO)). All the mills of this textile "cluster" were re-used by Vynckier, later ABB, 1937- 2017 for production of bakelite and electronic components. An ambitious masterplan is a first step for a sustainable reconversion by Ghent promotor 'Revive' to offices). and clean production areas. Rabot hemp spinning mill is now apartments and Carel Brothers engine works is already in mixed uses as Noord Dok; *Historic Urban landscape*.

Desmet-Guéquier, a smaller cotton spinning mill now Industriemuseum (formerly MIAT), [51°03'35.2"N 3°43'45.5"E

Oudenaarde, Textielfabriek Gevaert, [50°50'56.4"N 3°36'22.1"E], a big cotton mill, 1888/1897/1905, now lofts and a mall, with workers' housing.

Kortrijk, TEXTURE - Nationaal Vlasmuseum (National Flax Museum), [50°49'49.2"N 3°15'20.7"E], a museum of the flax region and linen culture on the Lys River, adapted from a flax warehouse.

Ronse, Textielfabriek Cambier-Ronette, [50°44'57.8"N 3°36'05.1"E] a wool mill, now part of the Must - Museum of Textiles.

Verviers, important woollen production centre: Iwan Simonis "au chat" mill [50°35'51.3"N 5°52'38.2"E], the first mechanised wool-spinning mill in the continental Europe; Les Grandes Rames [50°35'46.6"N 5°52'18.5"E], the earliest continental multi-storey workers' housing, from 1806; other wool

mills include Maison Closset [50°35'36.8"N 5°51'07.2"E] and Dethier-Bettonville [50°35'44.5"N 5°51'02.9"E]. The solventing process continues in the historic part of Solvent Belge S.A., bought by the city and the Walloon Region, steam technology installations and technical equipment is conserved.

Brazil

Blumenau (Santa Catarina), Companhia Hering, [26°55'31.7"S 49°04'55.4"W], a large cotton factory complex and company town.

Caxias (Maranhão), Companhia da União Têxtil Caxiense, [4°51'46.0"S 43°21'50.7"W], a cotton-weaving factory.

Gouveia (Minas Gerais), Fábrica de Fiação e Tecidos São Roberto, [18°27'47.3"S 43°43'27.2"W], a spinning and weaving factory and a paternalistic complex.

Itu (São Paulo), Edifício da Fábrica de Tecidos São Luís, [23°15'39.6"S 47°18'09.2"W], the first steam-powered cotton mill in the São Paulo province.

Juiz de Fora (Minas Gerais), Companhia Têxtil Bernardo Mascarenhas, [21°45'41.0"S 43°20'41.7"W], a cotton weaving factory.

Paracambi (Rio de Janeiro), Companhia Têxtil Brasil Industrial, [22°35'59.8"S 43°42'22.0"W], a cotton factory symmetrical with two towers, built in 1871; in the vicinity there were other cotton factories: Cia. Tecelagem Santa Luisa and Fabrica Maria Cândida, [22°35'46.3"S 43°42'45.6"W].

Rio Grande (Rio Grande do Sul), Fábrica de Tecidos Rheingantz, [32°02'41.7"S 52°06'22.9"W], a woollen factory with paternalistic complex.

Rio Largo (Alagoas), Companhia Alagoana de Fiação e Tissues (CAFT), [9°29'29.0"S 35°50'49.5"W; 9°29'18.8"S 35°51'07.4"W], a cotton spinning and weaving company, formed by Fábrica Cachoeira, Fábrica Progresso and a paternalistic complex.

Salto (Sao Paulo), Fábrica têxtil "Brasital", [23°12'25.1"S 47°17'47.9"W], a paternalist company town based on two earlier cotton mills - José Galvão and Barros Júnior.

São Luís (Maranhão), Fábrica de Tecidos do Rio Anil, [2°32'44.6"S 44°14'16.8"W], a cotton spinning and weaving factory; Fábrica Santa Amélia, [2°31'58.4"S 44°17'57.7"W], a woollen factory.

São Paulo (São Paulo), Fábrica de Tecidos Labor, [23°33'13.8"S 46°37'03.2"W], a wool and cotton factory.

Bulgaria[97]

Gabrovo, is known as Bulgarian Manchester due to a large number of textile factories, including: Uspeh, [42°52'00.8"N 25°19'06.2"E]; Hadzhi Stoychevi Bros, [42°51'09.2"N 25°19'27.1"E]; Hristo Raykov factory, [42°50'08.9"N 25°18'16.3"E]. There is the Interactive Museum of Industry (IMI) in a house of a Grabovo industrialist [42°52'16.0"N 25°19'10.4"E]. Ethno Village Etar, [42°48'12.5"N 25°20'56.7"E], an open-air museum with a fulling mill, a ribbon weaving shop, a dyehouse and a shop for spinning and weaving goats' hair.

Sliven, Dobri Zhelyazkov factory (the National Museum of Textile), [42°41'19.6"N 26°19'04.0"E], the first woollen mill on the Balkan peninsula; several other woollen factories on the Asenovska River, including Georgi Stefanov and sons [42°41'18.8"N 26°17'08.0"E], and Iliya Kalov [42°41'23.9"N 26°16'35.7"E].

Cameroun

Douala-Bassa. Cotonnière Industrielle du Cameroun (CICAM), [4°02'48.5"N 9°44'48.2"E], a large cotton combine.

Canada

Textile manufacturing was mainly located in Québec and Ontario. The first complete factory system for woollen cloth manufacture started in 1826 in Lower Canada. and a small cotton mill operated from 1844, also in Lower Canada. Most of the cotton mills combined together in 1905 as Dominion Cotton Mills, Ltd. -11 mills in Halifax and Windsor, Nova Scotia; Moncton, New Brunswick; Kingston and Branford, Ontario; Montreal, Magog, and Caoticook, Quebec; Montmorency Cotton Mills Co, Merchants Cotton Co and the Colonial Bleaching and Printing Co, in Montreal, specialised in denim for workwear. The Kingston and Merchants mills are among those adaptively re-used, with slow-burning floors along American insurance lines, and the business continues at some other plants.

Cambridge (Ontario), Galt Woollen Factory, [43°21'26.3"N 80°18'55.6"W], the oldest surviving textile mill in the area.

Cornwall (Ontario), a number of mills built along the Saint Lawrence River, including Dundas, Canada, Stormont and Glengarry mills [45°00'58.9"N 74°42'43.1"W], cotton and viscose rayon factories.

Drummondville (Québec), Celanese Canada, [45°52'14.5"N 72°29'06.1"W], an acetate yarn factory.

[97] With contribution by Mirela Svetoslavova.

Montréal (Québec), Belding Paul & Co, a silk-manufacturing enterprise established in 1876, the first of this kind in Canada. Preserved and re-used as a residential complex [45°29'05.2"N 73°33'51.8"W].

St. Catharine (Ontario), Merritton district developed on the Welland Canal as an industrial centre; there are cotton factories, such as Lybster Mill, [43°08'14.5"N 79°12'51.3"W] and Old Merritton Mill, [43°08'08.0"N 79°12'54.2"W].

Toronto (Ontario), Toronto Carpet Factory, heavily buttressed [43°38'22.0"N 79°25'29.8"W].

Chile[98]

Patagonia: many sheep and cattle ranches in Patagonia were major wool producers, for example: Estancia Rio Verde, [52°36'10.0"S 71°30'20.3"W], woolshed, located on Seno Skyring between Punta Arenas and Puerto Natales in the Chilean Magallanes region, a substantial late 19th century settlement for the estancia workers sits adjacent to the woolshed with a clock tower; and Estancia Pecket Harbour woolshed, near Punta Arenas.

Tomé, Bellavista Oveja Tomé, [36°38'01.7"S 72°57'21.7"W] a large woollen factory and a paternalistic complex. *Company town*

China[99]

Changzhou, Daming Cotton Mill, [31°44'22.14"N 120°01'49.59"E], a large factory and paternalistic complex.

Guangzhou, Guangzhou No.2 Cotton Mill [23°07'14.71"N 113°21'00.34"E], a large industrial complex.

Nantong, Dasheng Cotton Mill, [32°03'59.68"N 120°48'10.72"E], a cotton mill within Tangzha industrial complex, now museum.

Shanghai, A number of mills established in the end of 19th century by foreign companies, including: Shanghai No.17 Cotton Mill, [31°16'21.36"N 121°33'15.18"E] and Shanghai Huafeng No.1 Cotton Mill [31°18'38.03"N 121°32'35.61"E]: cotton and wool were processed here.

Tianjin, Tianjin No. 3 Cotton Mill was merged from Baocheng Cotton Mill and Yuda Cotton Mill [39°05'24.82"N 117°14'29.00"E] into a large factory with workers' housing.

[98] With contribution by Eusebi Casanelles and Mónica Ferrari.
[99] Contributed by Li Fan.

Qingdao, Zhongyuan Textile Factory (Qingdao No.6 National Textile Factory), [36°10'04.20"N 120°22'37.69"E], a large factory complex with workers' housing.

Xi'an, Dahua Textile Mill, [34°17'10.68"N 108°58'10.21"E], a large cotton mill.

Zhengzhou, Zhengzhou Textile Industrial Heritage Museum, [34°45'42.1"N 113°36'40.3"E], former cotton factory.

Colombia[100]

Medellín, Compañía Colombiana de Tejidos (Coltejer), a large entreprise at multiple locations, including: Itagüí weaving shed [6°10'20.0"N 75°36'04.1"W] and Centro Coltejer [6°15'00.1"N 75°33'59.2"W], initially a cotton factory, which later processed various fibres.

Samacá, la Fábrica de Textiles Samacá, [5°28'42.7"N 73°31'10.8"W], a cotton-weaving factory.

San José de Suaita, Fabrica de tejidos de san José de Suaita, [6°09'40.8"N 73°26'58.9"W], a cotton factory with well preserved machinery.

Croatia[101]

Duga Resa, Josef Jerusalem, [45°27'05.7"N 15°29'58.8"E], a cotton spinning and weaving factory, and a company town.

Sinj, Dalmatinka, [43°42'12.4"N 16°38'58.1"E], a cotton yarn and thread mill started in 1946. Architect Lavoslav Horvat, now disused.

Varaždin, Varteks, [46°17'40.7"N 16°20'33.3"E], a woollen spinning and weaving factory; Varaždinska Industrija Svile (VIS) [46°18'22.7"N 16°20'59.0"E] a silk factory.

Czech Republic[102]

Brno, Sdružené továrny vlněného zboží [49°11'36.1"N 16°37'11.6"E], dye works; Offermann, Quittner, Schoeller & spol. [49°12'42.32"N 16°35'54.28"E], a cloth factory; E. E. Essler [49°13'40.99"N 16°38'57.68"E] a wool spinning mill.

Broumov-Olivětín-Meziměstí-Police, František Novotný factory complex [50°34'56.1"N 16°20'13.7"E], a cotton spinning and weaving factory and paternalistic complex; Benedikt Schroll complexes in Olivětín [50°36'05.9"N 16°19'57.5"E], and in Meziměstí [50°37'25.4"N 16°15'00.2"E] - cotton spinning and weaving mills with paternalistic

[100] With contribution by Eusebi Casanelles and Mónica Ferrari.
[101] With contribution by Antonio Nevešćanin.
[102] With contributions by Lukáš Beran, Lenka Popelová and Tomáš Šenberger.

settlements; Vilém Pelly complex in Police nad Metují [50°31'59.2"N 16°14'02.1"E], a cotton spinning mill. After 1945 these factories merged into the national enterprise VEBA.

Červený Kostelec, Tovární Mrakodrap, [50°28'37.6"N 16°05'52.6"E], so called "skyscraper" textile mill.

Dětřichov, Carl August Preibisch factory complex, [50°53'36.7"N 15°02'21.2"E], a good example of a rural paternalistic settlement.

Dvůr Králové nad Labem, Josef Sochor factory complex and Juta combine [50°25'28.0"N 15°48'42.9"E], large industrial zone with workers' housing and owners' villas.

Hejnice, Fritsch a spol. factory [50°52'37.63"N, 15°11'23.11"E], a woollen weaving shed; Karl Bienert und Söhne complex in Bily Potok [50°52'27.0"N 15°13'04.0"E], a cotton-spinning mill (now Jizera Mountains Technical Museum).

Horní Branná, Plátenický dům (Cloth House), [50°36'51.3"N 15°34'00.9"E], the 1st Czech "factory" for linen cloth.

Krásná Lípa, Stefan Schindler company, [50°55'01.9"N 14°29'36.7"E], a hosiery factory.

Litvínov. E. G. Pick & spol., [50°35'37.05"N, 13°36'52.75"E], a cotton spinning and weaving mill; Marbach & Riecken in Šumná [50°36'22.29"N 13°35' 38.69"E], a cotton spinning and weaving factory.

Nachod, Josef Bartoň a synové, [49°56'20.57"N 17°54'39.76"E], a cotton spinning factory complex, later merged with other factories under the Tepna Náchod name.

Nova Paka, Gottlieb Schnabel, [50°29'03.46"N, 15°31'36.49"E], a cotton spinning mill.

Opava, Johann Kudlicha a synové, [49°56'20.57"N 17°54'39.76"E], a weaving factory.

Pelhřimov, J. F. Kouřimský, [49°25'38.8"N 15°13'35.4"E], a factory for knitted goods.

Písek. Jitex knitted goods factory, 1958-62, multi-storey and hall structures [49°18'17.23"N 14°08'03.77"E].

Raspenava, Josef Anton and Gustav Richter, [50°53'26.4"N 15°08'54.0"E], a worsted wool spinning mill.

Slaný-Kvíček, Honoré de Liser, [50°13'24.14"N 14°04'41.65"E], a cotton spinning mill.

Rokytnice nad Jizerou, Franz Haney, [50°43'42.82"N 15°27'14.47"E], a mechanical cotton weaving factory.

Semily–Podmoklice, Franz Schmitt, [50°36'44.7"N 15°19'15.6"E], a cotton spinning and weaving factory with a workers' colony.

Smržovka, Přádelna Johann Priebsche dědicové – Klášter [50°44'17.14"N 015°16'23.93"E], a cotton spinning mill.

Sokolov, J. Krumbholz / N. Hellmann [50°11'04.26"N 12°38'24.68"E], a cotton spinning mill.

Strakonice, FEZKO, [49°15'26.19"N 13°54'08.82"E], a fez hat factory.

Šumperk, Klapperothova Manufaktura, [49°58'17.0"N 16°58'28.3"E], the first corduroy manufactory in the Habsburg monarchy.

Svatava. Ignaz Schmieger [50°11'43.22"N 012°37'13.57"E], a worsted spinning mill and associated residential complex.

Tanvald, Tanwalder Baumwollspinnerei, [50°44'13.20"N 015°18'36.34"E], a cotton spinning mill complex.

Trutnov, Johan Faltis factory, [50°33'50.9"N 15°54'26.8"E], a linen cloth mill.

Varnsdorf, Bratři Perutzové [50°54'28.01"N 14°38'12.12"E], cotton spinning mill; Bratři Richterové [50°54'48.89"N 14°36'37.45"E], a cotton weaving mill; Julius Kunert a synové [50°54'40.25"N 14°37'52.67"E], a cloth factory.

Velké Hamry, Johann Liebig & co. [50°42'51.27"N 15°19'08.13"E], a spinning mill.

Žamberk, Vonwiller a spol. [50°05'44.89' N 16°27'28.70"E], a cotton mill.

Železný Brod. Johann Liebieg. [50°38'26.3"N 15°14'58.2"E], a factory with an extensive workers' housing estate.

Denmark

Aarhus, Den Gamle By, [56°09'32.1"N 10°11'30.1"E], an open-air museum with a water-powered wool spinning mill and a steam-worked weaving mill.

Brede / Lyngy-Bogen, Brede Klædefabrik, [55°47'39.2"N 12°29'59.5"E], a woollen factory with paternalist settlement. Now a museum and stores for the National Museum. *Company Town*

Herning, Textilforum, [56°08'10.3"N 8°57'51.4"E], a textile museum in a hosiery factory.

Hørsholm, Usserød militære Klædefabrik, [55°53'45.9"N 12°29'34.9"E], a cloth mill.

Odense, Brandts Klædefabrik, [55°23'44.0"N 10°22'48.3"E], a large factory complex.

Valby, De Danske Bomuldsspinderier, [55°39'53.5"N 12°30'36.0"E], a cotton mill.

Equador[103]

Antonio Ante, Fàbrica Textil Ibamburra, [0°19'18.7"N 78°12'44.8"W], a cotton spinning and weaving factory with a company town.

Egypt[104]

Al-maḥallah al-kobrā, Misr Spinning and Weaving Company, [30°57'38.67"N 31°10'22.81"E], a cotton factory complex and company town with a radial urban form. *Urbanism*

Alexandria, complex of warehouses and cotton press factories for the export of cotton to mills around the world, [31°11'6.32"N 29°53'10.63"E]. *International interchange*

Cairo, Dar Al-Kiswa Al-Sharifa, [30°3'7.17"N 31°15'30.42"E], a drape weaving manufactory, the first textile factory established in Egypt, provider of the Kaaba drape to Mecca.

Estonia

Narva, Kreenholm, [59°21'39.4"N 28°11'41.6"E], largest cotton factory complex in Europe and company town with a hospital, all founded by Russian entrepreneur Ludvig Knoop. Powered by waterfalls to either side of Crow's Island, which contains two courtyard-plan 1850s mills and is on the Russian border. A power canal also drove the Ioala spinning mill and Georg weaving mill, parts rebuilt in reinforced concrete after WWII. The mills closed in 2008 and host operatic concerts each summer. *Urbanism/ Giant.*

Sindi, Sindi Kalevivabrik, [58°24'28.0"N 24°39'20.5"E], a woollen mill and a paternalistic settlement.

Tallin. Baltic Cotton Spinning and Knitting Factory, [59°27'04.3"N 24°42'17.7"E], a large industrial complex; Marat, [59°25'46.5"N 24°46'24.4"E], a knitwear factory; Rauaniit [59°26'33.7"N 24°44'31.8"E], a knitwear factory.

Vaernla Küla (Hiiumaa), Vaemla Wool Factory, [58°49'54.2"N 22°49'37.2"E], a woollen mill with old machinery.

Kabala, Kabala wool mill, [58°55'55.6"N 24°38'44.2"E], a small mill with old machinery.

Ethiopia

Bahir Dar, Bahir Dar Textile, [11°35'46.1"N 37°24'22.6"E], a cotton factory.

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[103] With contribution by Eusebi Casanelles and Mónica Ferrari.
[104] Contributed by Mirhan Damir.

Finland

Forssa, Axel Wilhelm Wahren's factory, later Finlayson-Forssa, [60°48'54.0"N 23°37'15.8"E], a cotton factory with a company town, now Forssa National Urban Park.

Hämeenkoski, Hankalan Pellavanloukku, [61°00'40.0"N 25°10'08.5"E] a flax scutching mill.

Helsinki, Seurasaari, [60°10'56.1"N 24°53'00.8"E], an open-air museum with domestic wool weaving in Kurssi farmstead.

Hyvinkää, Hyvinkään Villatehdas, [60°37'58.1"N 24°51'58.3"E], a large woollen mill.

Killinkoski, P.G. Holm, [62°24'13.1"N 23°53'28.9"E], a ribbon factory.

Pori, [61°29'31.6"N 21°48'03.2"E], a large cotton mill (1898/ 1935), now the campus of 4 unversities and a shopping mall.

Tampere. Finlayson [61°30'02.8"N 23°45'32.4"E], first cotton mill in Finland, established by James Finlayson from Scotland in 1828, sold to Rauch and Nottbeck in 1836, who retained the Finlayson name, staying as the biggest cotton factory in the Nordic countries until it closed in 1996. An exemplary model of adaptive re-use, the complex also contains seven museums. A mill built in 1837 has the first iron columns in Finland, carrying timber floors. Plevna weaving shed 1877 had the first electric light in Nordic countries from 1882 and 1200 looms, Siperia and Kongo spinning and weaving mills by C Sequin-Brunner, 1899 with a 1650 HP Sulzer horizontal steam engine which is operated by Werstas Labour Museum., and the director's house now a restaurant. Tampella is a flax spinning and engineering complex relied on the same waterfall for hydro power, now the main city museum, Vapriikki. Lapinniemi flax mill is converted to flats and Klingendahl, a large woollen mill in multiple uses. A block of workers housing is presented in the Amuri museum. *International Interchange.*

France

Abbeville, La Manufacture des Rames, [50°06'36.4"N 1°49'19.8"E], a tapestry manufactory.

Amiens. Cosserat, [49°54'29.0"N 2°16'35.8"E], a velvet factory.

Bussières, Braud factory, [45°50'11.4"N 4°16'05.8"E], now silk weaving museum.

Besançon, Société anonyme pour la fabrication de la soie de Chardonnet, [47°13'44.1"N 6°02'29.3"E], the first factory in France producing artificial silk.

Calais, Boulart, [50°57'00.1"N 1°51'31.7"E], a weaving and lace-making factory.

Caudry, Théophile and Jean-Baptiste Carpentier lace factory, [50°07'31.5"N 3°24'41.1"E], now Museum of Lace and Embroidery; Carpentier & Preux, [50°07'48.3"N 3°24'30.2"E], a factory for curtains and other decorative textiles.

Chazelles sur Lyon, Jules Blanchard, [45°38'17.6"N 4°23'41.4"E], a hat factory (now museum).

Chirols, Ecomusée du moulinage de Chirols, [44°41'18.6"N 4°16'56.5"E], a large water-powered silk factory, now museum of the Ardèche silk region.

Cholet, Blanchisserie de la Rivier Sauvageau, [47°04'06.1"N 0°53'52.5"W], bleachworks.

Elbeuf, Bellest Clarenson et Lebret, [49°17'21.4"N 1°00'02.6"E], a woollen factory.

Fourmies, Prouvost-Masurel, [50°01'01.7"N 4°02'34.4"E], a single-storey wool-spinning mill, now Écomusée de l'Avesnois.

Givet («Les Quatre Cheminées»), La Soie Artificielle, [50°09'13.2"N 4°49'27.4"E], an artificial silk factory and workers housing.

Husseren-Wesserling, Manufacture Royale du Textile, [47°53'08.4"N 6°59'53.2"E], a large factory complex, now museum "Parc de Wesserling".

Issenheim, Filature Edouard Gast, [47°54'06.4"N 7°15'20.4"E], a cotton mill with vaulted roofs.

Jujurieux, C J Bonnet et Cie, [46°02'33.0"N 5°24'30.3"E], a silk factory and paternalistic complex.

La Terrasse-sur-Dorlay, Richard Chambovet, [45°27'27.1"N 4°34'58.9"E], a lace and ribbon factory.

Langogne, Filature de Calquieres, [44°43'31.5"N 3°51'20.4"E], a woollen mill operated and interpreted by Musée Vivant de la Laine.

Lille-Moulins. Le Blan, [50°37'07.9"N 3°04'15.8"E], flax mill complex. La Filature was a pioneering conversion by Reichen et Robert architects. While the rest of the mill operated into the 1990s before being adapted to the Faculty of Law at the Uinversity of Lille. Some floors are supported on transverse brick arches.; Wallaert [50°37'10.6"N 3°04'06.7"E], cotton mills adapated to new uses, as "Tertiares".

Lille-Canteleu. LeBlan-Lafont [50°37'58.4"N 3°01'13.2"E], two big cotton mills converted to mixed uses as Eurotechnologies.

Lyon, La Maison des Canuts, [45°46'37.9"N 4°50'02.2"E], a domestic silk weaving shop in the La Croix Rousse district (WHS).

Marcols les Eaux, Le Moulinage de la Neuve, [44°48'53.8"N 4°24'04.5"E], a silk mill.

Mazamet, [43°29'54.2"N 2°22'17.4"E], a wool conditioning house and mills connected with fell-mongered wool.

Monplaisant, Filature de Belvès, [44°47'04.5"N 1°00'40.8"E], a woollen mill, now the Centre d'interprétation de la laine.

Mulhouse, DMC - Dollfus-Mieg et Compagnie, [47°45'06.5"N 7°19'02.0"E], a large cotton factory complex and company housing but the oldest of the steam-powered mills was recently demolished.

Notre-Dame-de-Bondeville, Corderie Vallois, [49°29'42.3"N 1°02'53.4"E], a thread mill.

Paris. Les Gobelins [48°50'05.5"N 2°21'10.4"E], a royal tapestry manufacture; Rue St Denis [48°52'10.4"N 2°21'09.3"E], tailoring district.

Nièvre Valley (Picardy), Saint Freres, Flixecourt [50°01'05.2"N 2°04'58.5"E], Saint Ouen [50°02'26.4"N 2°07'06.4"E], L'Etoile [50°00'56.9"N 2°02'29.6"E], jute factory complexes and extensive workers' housing schemes. *Company Towns*

Roubaix, an important woollen production centre, with a number of factories, including: Motte-Bossut "Le Monstre", [50°41'22.4"N 3°10'40.1"E], cotton and wool mill, now Centre des Archives du Monde du Travail, Israël Jean-Baptiste Craye, [50°40'58.6"N 3°11'45.9"E], former upholstery factory, now an industrial museum – La Manufacture.

Rouen, La Foudre, [49°25'43.1"N 1°03'55.0"E], a neo-classical fireproof flax mill by William Fairbairn, 1845. *Flagship*

Saint-Dié-des-Vosges, Usine Claude et Duval, [48°17′26″N 6°57′02″E], a multi-storey modernist building of a hosiery factory designed by Le Corbusier in 1948 (WHS).

Saint Pierreville, Ardelaine, [44°48'50.9"N 4°29'06.5"E], a woollen mill and the centre of the regional wool tradition.

Sedan, Le Dijonval Ancienne Manufacture Royale, [49°42'22.1"N 4°56'20.1"E], a broadcloth manufactory established in 1646.

Tourcoing, an important woollen production town similar to Roubaix, with several mill complexes, e.g.: Vanoutryve, [50°42'05.6"N 3°09'31.6"E] a tapestry factory; Provost, [50°43'01.4"N 3°09'21.9"E], a worsted factory; Desurmont [50°42'57.2"N 3°08'45.4"E]; notable also for an early Hennebique reinforced-concrete structure (Filature Six) [50°43'24.2"N 3°09'58.6"E], demolished in the 1980s.

Tours, Le Manach, [47°24'06.8"N 0°41'25.9"E], a silk weaving factory.

Villeneuvette, Manufacture Royale, [43°36'37.1"N 3°24'04.3"E], woollen manufactory and a company town from the XVIIth century.

Warmériville/Val-des-Bois. Léon Harmel [49°21'05.8"N 4°12'56.1"E], a cotton factory, extensive worker's housing and social facilities, based on Catholic social ideas, opposed to paternalism.

Germany[105]

Augsburg (Bayern), Schülesche Kattunfabrik, [48°21'32"N, 10°54'24"E], the first calico factory on the European mainland; Augsburger Kammgarnspinnerei (AKS), [48°21'49"N, 10°54'49"E], a worsted spinning factory with a housing estate; Mech. Baumwollspinnerei und Weberei Augsburg (SWA), [48°21'48"N, 10°55'36"E], a cotton manufacturing combine (4 locations) with an extensive workers' housing programme.

Bamberg (Bayern), Baumwollindustrie Erlangen-Bamberg (Erba), [49°54'06.6"N 10°52'10.7"E], a large cotton factory complex.

Bayreuth (Bayern), Mechanische Flachsspinnerei, [49°57'37"N, 11°38'17"E], the first Bavarian flax spinning mill. Neue Spinnerei Bayreuth (NSB, Neue Baumwollen-Spinnerei Bayreuth), [49°57'8"N, 11°34'15"E], a cotton factory with paternalistic facilities.

Bielefeld (Nordrhein-Westfalen), a major textile production centre (cotton, flax, underwear). Among the most spectacular complexes, there are: Ravensberger Spinnerei, [52°01'22.7"N 8°32'34.9"E], a flax spinning mill; Wäschefabrik Baumhöfener & Heise, [52°01'38.4"N 8°31'58.2"E], a lingerie factory.

Bocholt (Nordrhein-Westfalen), Spinnerei Herding, [51°50'02.4"N 6°37'28.0"E], a cotton spinning mill designed by Sequin and Knobel in 1907, now part of the textile museum (TextilWerk).

Bramsche (Niedersachsen), Bramscher Tuchmacherei, [52°24'17.5"N 7°58'40.3"E], a cloth mill, now museum.

Chemnitz (Sachsen), major textile production centre, with a number of factories, e.g.: Bernhard'sche Spinnerei, [50°46'18"N, 12°54'49"E], the first factory building in Saxony; Spinnmühle Hößler, [50°47'30"N, 13°0'59"E], an early spinning mill; Chemnitzer Aktienspinnerei, [50°50'22"N, 12°55'39"E], a large cotton spinning mill; Weberei Cammann & Co, [50°51'27"N, 12°55'46"E], a large upholstery factory.

Crimmitschau (Sachsen), Many cloth mills, spinning mills, workers' quarters and manufacturers' villas; worldwide trade connections for the import of raw

[105] With contribution by Detlef Stender, Theresa Hahn, Heike Oevermann, and Kerstin Renz.

materials as well as the export of finished goods; in 1903/04 one of the most important labor struggles of the German Empire took place in Crimmitschau; Carl Spengler GmbH, [50°48'43"N, 12°23'14"E], a woollen factory; Tuchfabrik Gebr. Pfau, [50°49'44"N, 12°23'17"E], a cloth factory complex, now museum.

Delmenhorst (Niedersachsen), Nordwolle/BWK, [53°03'17.8"N 8°38'22.4"E] Germany's largest wool scouring works and biggest wool combers in Europe, with model industrial village, contains museum and some innovative houses adapted from a north-lit shed.

Euskirchen (Nordrhein-Westfalen), Tuchfabrik Müller, [50°38'57.8"N 6°49'23.3"E], a cloth mill with complete equipment preserved. *Time capsule*

Flöha (Sachsen), Flöha-Plaue and Flöha-Tal were traditional centres of the European textile industry for wool, flax and cotton; Baumwollspinnerei Clauß, [50°51'4"N, 13°4'14"E], a cotton spinning and weaving factory complex developed from the late 18th to early 20th c.

Glauchau (Sachsen), known as a town of cloth makers and linen weavers; Textilwerke Palla, [50°49'33"N, 12°32'44"E], a large mechanical weaving mill for silk and woolen fabrics.

Kaufbeuren (Bayern), Mechanische Baumwollspinnerei und Weberei Kaufbeuren/ Spinnerei und Weberei Momm, [47°53'11.3"N 10°37'11.8"E], cotton spinning and weaving factory.

Kaiserslautern (Rhein-Pfalz), The Kammgarnspinnerei Kaiserslautern AG (KGSK), [49° 26' 50.654" N 7° 45' 22.745" E], a large worsted spinning factory complex.

Kempten (Bayern), Mechanische Baumwollspinnerei und -weberei Kempten, [47°43'5"N, 10°19'25"E], a cotton spinning and weaving factory.

Kolbermoor (Bayern), Spinnerei, [47°50'57"N, 12°3'35"E], paternalistic factory complex.

Krefeld (Nordrhein-Westfalen), Vereinigte Seidenwebereien AG, HE-Bau, Färberei [51°20'38.4"N 6°32'51.1"E], a velvet and silk print and finishing factory by Mies van der Rohe.

Kuchen bei Göppingen (Baden-Württemberg), Süddeutsche Baumwolle-Industrie AG, [48°38'47.2"N 9°47'30.0"E], a cotton factory with company town.

Kulmbach (Bayern), Kulmbacher Spinnerei, [50°06'33.0"N 11°27'06.5"E], paternalistic factory complex at various sites with workers' housing.

Leipzig (Sachsen), VEB Buntgarnwerke (former Tittel & Krüger), [51°19'39.2"N 12°20'28.1"E], a monumental cotton factory; Leipziger Baumwollspinnerei, [51°19'40.7"N 12°19'11.3"E], a cotton spinning mills with workers' houisng.

Monschau (Nordrhein-Westfalen), Rotes Haus Scheibler, [50°33'17.6"N 6°14'26.5"E], a major wool production centre based on a putting-out model. The Scheiblers established very large cotton mills in Lodz (Poland) and were also active in Belgium and Italy.

Mössingen (Baden-Württemberg), Pausa Druckerei, [48°24'27.504"N 9°3'13.831"E], textile printing works in a column-free weaving shed of the 1950s.

Nieder-Wiesa (Sachsen), Baumwollspinnerei Tannenhauer/Historische Schauweberei Braunsdorf, [50°52'30"N 13°1'36"E], initially a cotton spinning mill, later later dyeing works and felt factory, finally production of upholstery and decorative fabrics and plush.

Oberbruch (Nordrhein-Westfalen), Vereinigte Glanzstoff-Fabriken (VGF), [51°03'31.2"N 6°08'32.6"E], the major rayon factory of the company with multiple locations.

Penig (Sachsen), Industriekolonie Amerika, [50°55'51"N 12°44'3"E], initially cotton, and later wool and worsted factory with a paternalistic complex.

Plauen (Sachsen), from the mid-16th century cotton weaving developed in the region, and in the 19th century Plauen became the centre of the German lace and embroidery industry. Kattunmanufaktur/Weisbachsches Haus, [50°29'30"N, 12°8'3"E], the first calico printing works in Saxony.

Radevormwald (Nordrhein-Westfalen), Johann Wülfing & Sohn, wool manufacturing company in multiple locations: Dahlerau, [51°13'21.3"N 7°18'59.4"E]; Dahlhausen [51°12'52.2"N 7°18'29.8"E]; Vogelsmühle [51°13'20.6"N 7°18'22.0"E], with paternalistic housing in each of them; an industrial museum at Dahlerau with a horizontal steam engine.

Ratingen (Nordrhein-Westfalen), Cromford Spinnmühle, [51°18'22.6"N 6°51'10.8"E], the first cotton spinning mill in continental Europe modelled on the Arkwright mills in the UK.

Reutlingen, (Baden-Württemberg), Urlich Gminder factory complex [48°29'47.2"N 9°11'21.0"E], and Gmindersdorf industrial village [48°30'01.2"N 9°11'38.1"E].

Rheine (Nordrhein-Westfalen), Spinnereien und Weberei Kümpers, a company with multiple locations: a factory complex with a spinning mill by P.S. Stott [52°17'33.5"N 7°26'17.4"E], a factory complex with workers' housing [52°15'52.5"N 7°27'53.0"E].

Salach/Göppingen (Baden-Württemberg), Kammgarnspinnerei Schachenmayr, [48°41'15"N, 9°44'29"E], a cotton and worsted spinning mill with a workers' housing estate, taken over by J&P Coats.

Tannenberg/Siebenhöfen (Sachsen), Höffersche Spinnmühle [50°36'56.5"N 12°55'49.1"E], a spinning mill built 1812 by Evan Evans.

Wendlingen (Baden-Württemberg), Heinrich Otto Söhne, [48°39'50.18"N 9°21'53.395"E], a cotton yarn factory; [48°40'34.097"N 9°22'23.621"E], a large spinning and weaving factory. Both complexes designed by Tafel & Manz.

Wuppertal-Öhde (Nordrhein-Westfalen), J.P. Bemberg, [51°15'47.7"N 7°14'11.2"E], initially factory for production of "Turkish red" yarn, later artificial silk.

Zittau/Hirschfelde (Sachsen), Flachsspinnerei Hirschfelde, [50°57'14"N, 14°53'32"E], a flax spinning mill (later coverted into artificial silk production).

Ghana

Akosombo, Akosombo Textiles Ltd., [6°16'7.60"N 0° 4'1.82"E], a large factory with worker's housing established in 1967, ongoing operation.

Greece

Edessa, Edessa was called the "Manchester of the Balkans" due to its several textile factories, such as Tsitsis and SEFEKO (Sefertjis and Kokkinos). The Cannavourgio factory, [40°48'06.8"N 22°03'18.1"E], a fully equipped water-powered hemp spinning mill in spectacular location complete with all its German and UK-made machinery. *Time Capsule*. A water park has been developed to interpret the network of mlils.

Naoussa, Kyrtsi- Tourpali cotton mill (1875), restored after fire in 1946, now used for cultural and educational purposes; Lanara and Kyrtsis, [40°37'37.7"N 22°03'45.3"E], a woollen factory built 1922 with post war mechanical equipment and water turbine (1983) preserved.

Soufli, a major silk-production centre from the late 19th to the mid-20th century. The Silk Museum [41°11'40.2"N 26°18'01.8"E] has a two-storey "cocoon house" and owner's mansion.

Thessaloniki, YFANET, [40°37'00.4"N 22°57'54.2"E], a large woollen factory.

Grenada

Grenada was a big source of cotton in the 18th and early 19th centuries. Belmont estate, [12°10'29.5"N 61°37'36.8"W] run by French, Scots and Indian people has a presentation about its history, including that of enslaved people.

Hungary

Textile manufactories in Hungary were established in the early 18th century. The main industrial development took place in the 1920s in Budapest.

Budapest. Major textile production centre, with several companies, some of which had international significance: Valero selyemgyár, [47°30'35.7"N 19°03'00.5"E], a silk manufactory; Selyemgombolyító, [47°32'43.8"N 19°02'42.6"E], a silk mill; Goldberger Textilgyár, [47°32'07.9"N 19°02'36.0"E], a textile factory, now the Museum of the History of the Textile and Textile Clothing Industry; Goldberger Textilművek Kelenföldi Gyára (Kelenföldi Textilgyár, KELTEX), [47°27'48.5"N 19°03'09.6"E]; Magyar Textilfestőgyár Rt. [47°33'26.8"N 19°02'46.7"E], a large textile finishing factory; Magyar Pamutipar Rt. [47°33'57.7"N 19°05'31.8"E], a spinning and weaving factory with impressive workers housing; Angol-Magyar Cérnagyár Rt. (later the Coats Group), [47°35'07.3"N 19°04'55.6"E], a thread factory; Hazai Pamutszövőgyár, [47°34'33.7"N 19°05'30.4"E], a cotton weaving, dyeing, bleaching and finishing factory; Pamuttextil Fonógyár, [47°28'41.8"N 19°01'36.1"E], an impressive multi-storey mill; Filatorigáti Textilművek, [47°32'58.6"N 19°02'45.2"E], later part of the Budapesti Harisnyagyár – a hosiery and knitwear factory; Kispesti Textilgyár (Kistext), [47°27'11.6"N 19°09'41.4"E], a vast factory complex with paternalistic facilities.

Győr. Major industrial centre in north-western Hungary, including several textile factories, established primarily in the early 20th century. Taussig Sámuel és Fiai Mechanikai Len- és Kenderszövő, Kikészítő és Impregnáló Gyár, [47°41'11.2"N 17°39'18.8"E], a large industrial complex (mechanical flax and hemp weaving, finishing and impregnation factory) and owners villa; Heller & Asconas Rt. Harisnya- és Kesztyűgyár, [47°41'05.9"N 17°39'55.7"E], a largest glove factory in Central Europe; Magyar Selyemfonógyárak Győri Gyártelepe, [47°40'33.0"N 17°36'55.0"E], a silk spinning mill; Richards Richard posztó-szövetgyár, [47°40'50.2"N 17°38'40.2"E], a cloth factory.

Papa, Ferenc Kluge's blue dyeing works (now Kékfestő Múzeum), [47°19'41.9"N 17°28'11.0"E], one of the earliest textile enterprises in Hungary, powered with the horse treadmill.

Tolna, Tolnai Selyemgyár (Tolnatext), [46°25'22.9"N 18°47'35.5"E], a large silk factory.

India[106]

Several textile related sites in India exist as living cultural sites of tribal/handloom weaver communities. Examples: Varanasi silk weaver's colonies; Odisha's Kotpad; Ikat weavers; Maharashtra's saree weaver's vernacular houses.

As for industrial cotton textile production, this industry was affected by the partition of the country in 1947. India got 409 out of the 423 textile mills of undivided India while 22 percent of the land under cotton cultivation went with Pakistan. For many years after independence, Indian mills had to import cotton from Pakistan and from other countries.

Ahmedabad (Gujarat), referred to as the "Manchester of India", due to the city's spectacular rise as one of the world's prime cotton manufacturing centres. Shahpur mill and Calico Mills (1888), Calico Museum of Textiles.

Kerala (Alleppey Coir): First Coir Factory (1859), town with many coir factories incl.William Goodacre &Sons, Aspinwall &Co. GI status to Alleppey Coir. International Coir Museum.

Kolkata (Calcutta), India: Tithagur, Samugger, Howrah, Ludlow, Hastings, Fort William (fig. 8.1.) and Champdany Mills, Victoria and Angus Works and others, integrated single-storey fireproof mills with clerestorey rooflights, mostly built from the 1880s to the 1920s. Jetties on river Hooghly, gardens around offices and expatriate management bungalows, initially used by Dundee management. Some working jute presses, spinning and weaving mills such as Hooghly Mill still use Scottish machinery driven by line shafts. The first mill was established in 1855. *Textile landscape - urban jute: International interchange*

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[106] With contributions by Priyanka Panjwani; https://edition.cnn.com/style/article/silk-weavers-varanasi-banarasi-sari-intl-hnk/index.html (access: 25.10.2021); https://artsandculture.google.com/exhibit/the-world-of-kotpad-weavers/OwICvIKDpPimLQ (access: 25.10.2021); https://www.sahapedia.org/the-sambalpuri-ikat-of-odisha-history-symbolism-and-contemporary-trends (access: 25.10.2021); https://timesofindia.indiatimes.com/city/ahmedabad/calico-chimney-would-hold-citys-heritage-high/articleshow/5861316.cms (access: 25.10.2021); Kumaraswamy Pillai M., *Alleppey Coir - The Geographical Indication*, Coir Board, Kannur; https://www.bennykuriakose.com/post/2017/10/18/coir-museum-exhibition-2017 (access: 25.10.2021).

Mumbai, India. Massive urban growth here was in part due to expansion of the cotton industry in the 1880s, that had begun in 1854 with the establishement of the Bombay Spinning and Weaving Company at Tardeo by Cowaszee Nanabhoy Davar and his associates. The mill was designed by Sir William Fairbairn. This mill began production on 7 February 1856 under the supervision of British engineers and skilled cotton operatives. The peak number of mills in 1915 was 83, most of them owned by Indian entreprenurs. 60 redundant mills became ripe for development in the harbour area, and some of the High rise developments in Mumbai are at the sites of cotton mills. INTACH and INTBAU India studied adaptive reuse projects at, for example, India United Mills No 1. Phoenix mill became a retail and entertainment centre, and there was hope that a proportion of each of the others would become public open space. The Charles Correa urban planning report in 1996 identified 58 textile mills covering 240 hectares in Girangaon (the island that was the original heart of Mumbai) and had until recently employed 250,000 workers. 170 robust structures capable of being e-used in industrial regeneration in 2005 and while the courts issued a "hope and expectation" that they would be surveyed, 75% of them were demolished in 2006 on 32 private mill lands. Five cotton mills still operate. *Textile landscape - urban cotton*

Maharashtra has about 122 cotton textile mills and thus is the largest cotton producing state of India.

Iran[107]

Isfahan, Risbaf Textile factory, [32°38'19.9"N 51°40'00.7"E], a large factory based on German design.

Mashhad, Mashhad textile factory, [36°16'04.6"N 59°36'40.7"E], a large spinning a knitting factory complex, known as an exemplar of an Iranian and Europe/German shared heritage. The main product was textile, leather and treated wool (and fur for Persian carpet). All the spinning machinery was ordered from "Platt Brothers" (Oldham UK), and all the knitting machinery and accessories were from the German company "Union Matex".

Shiraz, Shiraz textile factory, [29°37'41.7"N 52°33'31.5"E], the factory site has been converted into the "Taropod Museum".

Yazd, Yazd Eghbal textile factory, [31°53'27.5"N 54°21'15.5"E], a large-scale textile mill.

[107] Contributed by Mohammadjavad Mahdavinejad.

Ireland

Portlaw, Malcolmson Brothers, [52°17'15.0"N 7°19'13.1"W], a water-powered cotton mill, designed by William Fairbairn, a paternalistic factory village rebuilt on a trivium plan of 3 radial streets.

Prosperous (An Chorrchoill), a philanthropic cotton-spinning settlement [53°17'17.7"N 6°45'12.9"W].

Israel

Tel Aviv, Lodzija Textile Factory, [32°03'54.0"N 34°46'42.6"E], one of the first large industrial facilities in Tel Aviv. The factory was established by Jews from Lodz in Poland, hence the factory's name.

Italy

Abbadia Lariana, Setificio Monti, [45°54'00.8"N 9°19'55.9"E], a silk mill with preserved machinery, now a museum.

Biella, a wool-manufacturing centre since medieval times. A rich industrial landscape in a mountainous locationwith multi-storey mills, chimneys, water infrastructure, workers' housing, e.g.: Lanificio Alfredo Pria, [45°34'28.0"N 8°03'08.6"E] a mill established by an French entrepreneur Luigi Benedetto Boussu, later acquired by the Pria family; Lanificio Trombetta, [45°34'19.2"N 8°03'20.9"E], a well-preserved woollen mill; Lanificio Maurizio Sella, [45°34'17.4"N 8°03'32.4"E]; Fabbrica della Ruota, (the former Lanificio Zignone) situated in Pray [45°39'46.9"N 8°11'59.5"E], well-preserved, now the seat of the Biella Ecomuseum, responsible for "La Strada della Lana" - a wool route, connecting all the industrial sites from Biella to Borgosesia.

Busto Arsizio, Cotonificio Bustese, [45°36'52.4"N 8°50'49.0"E], a cotton factory, now the museum of textiles and industrial tradition; several other mills, e.g.: Cotonificio Ercole Bossi, Tessitura Airoldi & Pozzi. The birthplace of Cristoforo Benigno Crespi of Crespi d'Adda.

Caraglio, Filatoio Rosso di Caraglio, [44°25'30.3"N 7°25'39.8"E], one of the first silk mills in Europe (and the oldest preserved silk manufacturing complex), now the Piedmontese Silk Factory Museum.

Collegno, Cotonificio N. Leumann, [45°04'19.3"N 7°33'39.5"E], a cotton factory and paternalistic complex.

Crespi d'Adda, [45°35'47.3"N 9°32'07.5"E], a woollen mill and paternalist model village (WHS). The Mill is closed. Hydro electric power station operates.

Fagnano Olona, Cotonificio Candiani, [45°40'06.1"N 8°53'06.5"E], a well-preserved cotton industrial complex.

Gallarate, the city experienced rapid industrial growth in the early 20th century, when a number of cotton factories were built, such as Manifattura Borgomaneri, [45°39'42.4"N 8°47'27.2"E]; tessitura Carlo Bassetti, [45°39'25.0"N 8°47'13.1"E]; cotonificio Maino [45°39'56.1"N 8°47'32.2"E].

Garlate, Abegg Silk Civic Museum, [45°48'24.8"N 9°24'14.8"E], a museum in the 18th-century silk mill and a mulberry grove.

Ghiffa, Giovanni Panizza & Co, [45°57'42.8"N 8°37'19.0"E], the largest felt hat factory in Italy.

Legnano, known as "Piccola Manchester d'Italia". A number of prominent textile factories situated mainly on the Olona River: Cotonificio Cantoni, [45°35'54.7"N 8°55'12.7"E], relics incorporated into a new shopping mall; Castellanza [45°36'39.3"N 8°54'09.7"E], a cotton factory complex with a mammoth multi-storey spinning mill; Cotonificio Bernocchi, [45°36'04.9"N 8°54'47.9"E]; Manifattura di Legnano, [45°35'38.5"N 8°54'53.5"E], a large cotton-spinning shed with owners' villa and workers' housing in the vicinity.

Lomazzo, Cotonificio Somaini, [45°41'49.0"N 9°02'02.9"E], a large cotton factory complex.

Lucca, Cucirini Cantoni Coats, [43°51'32.6"N 10°31'16.3"E], an industrial complex with paternalistic settlement.

Mesenzana, Filanda Decauville, [45°57'27.0"N 8°45'41.4"E], a multi-storey spinning mill.

Perosa Argentina, Il setificio Gütermann, [44°57'08.8"N 7°11'38.0"E], a large silk factory and a comprehensive paternalistic settlement.

Piancogno, Cotonificio Olcese, [45°55'57.8"N 10°14'34.1"E], a large cotton mill, still in use.

Pordenone, Cotonificio di Torre, [45°58'02.4"N 12°41'05.0"E].

Prato, an important woollen production centre with 134 mills (in 1918), many of them being spectacular structures: Il Fabbricone (originally Kössler-Mayer) and adjacent Lanificio Mazzini [43°53'30.1"N 11°05'51.4"E]; Lanificio Calamai, with multiple locations: [43°53'19.7"N 11°06'05.4"E] and [43°53'00.7"N 11°04'58.1"E], the latter was extended to the design of Pier Luigi Nervi; Cimatoria Campolmi [43°52'38.3"N 11°05'55.8"E].

Pratovecchio Stia (Arezzo), Lanificio Stia, [43°48'06.5"N 11°42'28.0"E], a woollen mill converted into a museum.

San Leucio, Belvedere di San Leucio, [41°06'02.1"N 14°19'01.5"E], the royal silk factory and the associated settlement built in 1789 as a part of the royal estate in Caserta (WHS).

Schio, Lanificio Rossi, [45°42'53.6"N 11°21'12.1"E], a woollen factory complex with paternalistic company town.

Solbiate Olona, Cotonificio Ponti, [45°39'11.2"N 8°53'23.5"E], the first mechanical spinning of cotton in Lombardy.

Valdagno, Marzotto, [45°39'03.9"N 11°18'00.8"E], woollen mills and company town - probably the biggest model town created by a single textile company.

Varano Borghi, Tessitura Borghi, [45°46'09.2"N 8°42'18.2"E], a large industrial complex with a spectacular multi-storey building in the Liberty style.

Verbania Pallanza, Rhodiatoce, [45°55'57.0"N 8°33'14.2"E], a cellulose acetylate (rayon) factory in a former cotton mill, later nylon factory.

Japan

Tomioka, Tomioka silk mill, [36°15'21.0"N 138°53'18.1"E], the oldest silk reeling factory in Japan, housing for foreign specialists, WHS.

Gunma, a rural silk region with several sites of interest, e.g.: cold storages for silkworm eggs in Tochikubo Wind Cave and Arafune-fuketsu, [36°14'47.4"N 138°38'08.2"E]; silk reeling houses in rural villages like Akaiwa [36°34'33.5"N 138°37'40.2"E] and Kiryu [36°25'10.5"N 139°20'41.5"E].

Nagoya, Toyota cotton mill, [35°11'00.3"N 136°52'36.0"E], a spinning and weaving factory where Sakichi Toyoda developed several looms and associated machines cotton production, now Toyota Commemorative Museum of Design and Innovation (TCMDI).

Shirakawa-go [36°15'28.9"N 136°54'22.5"E] and **Gokayama** [36°25'33.8"N 136°56'08.4"E], vernacular houses with huge thatched roof attics for sericulture, WHS.

Kenya

Kisumu, Kisumu Cotton Mill (KICOMI), [0°05'20.1"S 34°45'30.5"E], a large factory near the harbour.

Kyrgyzstan

Osh, Oshskiy shelkovyy kombinat, [40°30'46.8"N 72°49'08.0"E], a large silk factory - the oldest textile eterprise in Kyrgyzstan.

Latvia

Ogre, Ogres Knitwear, [56°49'14.9"N 24°34'08.6"E], a giant knitted goods combine

Liepaja, Lauma Fabrics, [56°32'05.1"N 21°01'20.5"E], a factory for lace, elastic knitted fabric and ribbons. The 8th largest shed in the world!

Lichtenstein

Triesen (Liechtenstein), Jenny, Spoerry & Co., [47°6'27"N 9°31'33"E], a cotton weaving mill successively extended with flat-roofed buildings by von Séquin & Knobel to form a large ensemble with villa, garden and workers' dwellings, converted to commercial, social and University of Liechtenstein use.

Vaduz (Liechtenstein), Jenny, Spoerry & Co., [47°8'58"N 9°31'0"E], a cotton spinning mill supplying the weaving mill in Triesen, converted by University of Liechtenstein.

Luxembourg

Esch-sur-Sûre, Martin Schoetter-Greisch, [49°54'26.2"N 5°55'52.4"E], a fulling mill, with machinery remained in situ, now museum (Musée de la Draperie).

Mexico

Metepec, Fábrica de hilados, tejidos y estampados de algodón, [18°56'24.9"N 98°28'19.6"W], a large cotton factory and a company town.

Puebla, La Constancia Mexicana, [19°05'36.4"N 98°14'00.4"W], an impressive water-powered cotton mill complex, now several cultural institutions and museums. Founded in 1835, closed in 1991, this was the first mechanised cotton mill in Latin America. *Company Town, International interchange*

Yucatan, a major region for sisal manufacturing with about 1,170 working haciendas in the early 20th century, e.g.: Hacienda Temozon, [20°41'16.8"N 89°39'09.4"W]; Hacienda Sotuta de Peon, [20°44'30.8"N 89°34'38.4"W], the only live henequen museum, with presentation of the whole process.

Moldavia

Tighina (Bendery), silk factory, [46°47'20"N 29°29'15"E]; cotton factory [46°47'22.3"N 29°28'59.6"E].

Tiraspol, Odema, [46°50'06.0"N 29°37'03.4"E], a garment factory complex.

Morocco

Fez, Medina of Fez, a centre of traditional craftmenship in silk (made of a Moroccan agave plant!) weaving and tanning, e.g.: Chouara tannery

[34°03'58.0"N 4°58'15.4"W]; Sidi Moussa tannery [34°03'51.6"N 4°58'33.6"W].

Netherlands

Almelo / Nijverdal, Stoomspinnerij Twenthe, [52°21'25.0"N 6°39'31.1"E], a large Gerrit Beltman mill with a spectacular water tower; Koninklijke Ten Cate (KTC) with multiple loactions in Nijverdal [52°22'04.7"N 6°27'57.7"E], and Almelo [52°21'38.4"N 6°39'16.5"E].

Eindhoven, a major textile production centre with numerous factory complexes in the area of Dommelstraat and Paradijslaan, where the front façade of N.V. Linnenfabriek Briel en Verster [51°26'29.5"N 5°29'01.4"E] is the only remaining relic.

Enschede, the most important centre of cotton production in the Netherlands, with several factories, e.g.: Van Heek & Co, [52°13'23.5"N 6°53'51.1"E], a complex of monumental mills; Spinnerij Oosterveld, [52°13'23.1"N 6°52'22.4"E], a large spinning mill designed by Gerrit Beltman; Rozendaal, [52°13'58.4"N 6°53'43.8"E], a factory converted into a museum; Jannik, [52°12'49.6"N 6°53'09.7"E], a Sidney Stott spinning mill.

Geldrop, a major woollen and linen industry centre in the Netherlands; Wollenstoffenfabriek v/h A. van den Heuvel & Zoon, [51°25'19.3"N 5°33'50.0"E], a woollen cloth factory, now the seat of the Weverijmuseum Geldrop

Goirle, a centre of linen industry, with several factory complexes, including HaVeP (B.V. Textielfabrieken H. van Puijenbroek), [51°30'59.6"N 5°03'55.8"E], a large shed with a uniquely well preserved steam engine house.

Helmond, Koninklijke Nederlandse Textielfabrieken J. A. Raymakers & Co. BV, [51°28'53.6"N 5°39'05.0"E], an impressive weaving factory complex.

Horst, a lace and embroidery production centre, illustrated by the Museum de Kantfabriek [51°27'04.0"N 6°02'56.5"E].

Tilburg, a woolen cloth industry centre, where several industrial monuments still bear witness to a rich industrial past: Woolenstoffenfabriek C. Mommers & Co, [51°34'15.3"N 5°04'46.4"E], now the Textiel Museum; AaBe [51°33'05.1"N 5°06'08.1"E], a large woollen fabrics and blanket factory converted into a shopping mall.

Vriezenveen, Jansen & Tilanus, [52°24'15.9"N 6°36'05.9"E], a cotton-weaving factory complex with paternalistic facilities.

Winterswijk, J. Willink en Paschen (later: De Batavier), [51°58'10.8"N 6°43'33.8"E], a good example of mid-20th century industrial architecture; De

Tricot, [51°58'29.5"N 6°43'07.6"E], a knitting factory with mills designed by Gerrit and Arend Beltmans.

New Zealand

Coldstream (Timaru District), Coldstream Homestead, [44°08'44.0"S 171°31'19.5"E], a large estate specialising in sheep breeding and wool shearing.

Manawatu, a flax milling region, (using native New Zealand flax which is quite different to European flax) with its history interpreted in the Foxton Flax Stripper Museum, [40°28'25.3"S 175°16'51.4"E].

Otago, a region famous for the high-quality wool with a number of sheep breeding estates, wool and knitwear producers, such as: Bruce Woollen Mill, [46°07'24.5"S 169°57'16.1"E]; Milton Woollen Mill, [46°07'17.4"S 169°57'21.5"E].

Riverton, Templeton Flax Mill, [46°20'22.0"S 168°03'20.7"E], a rural flax mill, now a small working museum.

Te Waimate (Waimate), Te Waimate Station, [44°45'25.2"S 171°02'15.5"E], a woolshed is one of the most attractive and historically important of any in New Zealand.

Nigeria

Kaduna, Kaduna Textile Ltd., [10°28'41.53"N 7°24'51.59"E], the first textile mill in Nigeria established in 1957 in co-operation with British textile company David Whitehead & Sons; other mills: Arewa Textiles, [10°28'30.56"N 7°24'52.05"E]; United Nigerian Textiles Ltd., [10°27'16.75"N 7°24'34.62"E].

Northern Macedonia

Štip, the main textile production centre in the country: Makedonka (Pamuchna Industrija Makedonka), [41°46'11.5"N 22°10'45.4"E], a cotton industry combine; Astibo, [41°44'46.5"N 22°11'06.8"E], a garments factory. Both complexes included workers housing and facilities typical for the state-paternalistic approach of the Communist times.

Tetovo, Teteks (Todor Cipovski Merdzhan), [41°59'49.5"N 20°58'17.4"E], a large woollen factory.

Veles, Noncha Kamishova, [41°41'19.6"N 21°44'57.6"E], a silk factory.

Norway

Mandal, Sjølingstad Uldvarefabrik, [58°04'08.1"N 7°23'20.9"E], a woollen factory with a rural paternalistic community, now living museum.

Salhus, Salhus Tricotagefabrik, [60°30'27.7"N 5°16'17.3"E], a knitwear factory and workers' housing, now the Textile Industry Museum.

Ytre Arna, Arne Fabrikker, [60°27'37.6"N 5°26'07.5"E], comprises two complexes: a cotton factory (Bomullsvarefabrikken) and a woollen factory (Ullvarefabrikken), both complexes are reused, including a museum warehouse and archive.

Pakistan

Burewala, Burewala Textile Mills, [30°9'13"N 72°41'19"E], a large cotton factory with company town (BTM Colony).

Karachi, a major textile production centre, with more than 60 cotton mills, including Dawood Cotton Mills, [24°50'36.3"N 67°13'02.2"E].

Peru[108]

Lucre, Fàbrica de Hilados y Tejidos de Lana, [13°38'20.8"S 71°44'26.2"W], a woollen spinning and weaving factory, preserved intact.

Marangani, Fàbrica de Tejidos Marangani, [14°19'39.6"S 71°11'43.4"W], a single-storey woollen mill with a company village, still operational.

Poland

Andrychów, Pierwsza Galicyjska Tkalnia Mechaniczna (later Andropol), [49°51'20.0"N 19°19'56.1"E], a cotton spinning and weaving factory based on the shed principle, a spectacular example of industrial architecture in the socialist-realist style.

Bielsko-Biała (Bielitz-Biala), a major wool production centre, with related mechanical engineering (e.g.: Gustav Josephy's Erben); a number of factories: Büttners cloth mill, [49°49'12.0"N 19°02'41.0"E], now the Museum of Technology and Textile Industry; Schlesinger-Rabinowitz dye works, [49°49'32.7"N 19°03'00.5"E]; Karl Hess factory, [49°49'32.3"N 19°03'08.8"E]; Karl Wolf cloth mill, [49°49'03.2"N 19°02'45.5"E], a reinforced-concrete building by Ed. Ast & Comp; Vöslau worsted mill, [49°50'09.3"N 19°03'16.2"E]; Fryderyk Tislovitz cloth mill, [49°49'18.5"N 19°03'03.7"E], re-used by local administration as a register office.

[108] With contribution by Eusebi Casanelles and Mónica Ferrari.

Biłgoraj, Zakłady Dziewiarskie MEWA, [50°31'24.5"N 22°42'00.4"E], a knitted-goods factory in late-modernist style.

Chełmsko Śląskie (Schömberg), a major cloth production centre since the 16th c. with well-established cottage industry (both woollen and linen); two groups of weavers cottages: Seven Brothers (Siedmiu Braci, Sieben Brüder) for Bavarian damask weavers; Twelve Apostles (Dwunastu Apostołów, Apostelhäuser) for Czech linen weavers [50°39'57.6"N 16°04'20.9"E].

Choroszcz, Moes, [53°08'59.1"N 22°58'42.9"E], a woollen factory with a complete paternalistic village; in 1929, converted into a psychiatric hospital, which still exists.

Częstochowa, there are several textile industry sites in the city, e.g.: Societe Textille "La Czenstochovienne", [50°47'39.8"N 19°08'19.9"E], a jute (later also cotton) factory – large industrial complex with a small workers' housing estate in vicinity, operational under the brand of POLONTEX; Stradom, [50°47'52.7"N 19°06'45.6"E], a linen, hemp and jute factory, later also polypropylene fibres, operational. Some Scottish machinery; Towarzystwo Gnaszyńskiej Jutowej Manufaktury (later Wigolen), [50°47'43.6"N 19°02'48.9"E], a linen, jute (and later polypropylene fibres) factory with Scottish machinery; Peltzer i Synowie, [50°47'53.0"N 19°07'07.3"E], a woollen factory under Franco-Belgian management, with workers housing; Motte, Meillassoux, Caulliez et Delacutr" (later „Union Textille"), [50°47'59.7"N 19°07'26.6"E] a worsted factory was established by the Lille-based company, a vast complex with managers' villas and workers' housing, high-quality architecture with two landmarks: a chimney and a water tower, the famous French actress Juliette Binoche is a descendant of one of the factory directors.

Fasty, Białostockie Zakłady Przemysłu Bawełnianego FASTY, [53°09'28.2"N 23°04'54.1"E], a large cotton combine of the socialist era, designed by „Giprolegprom" office in Moscow.

Gorzów Wielkopolski (Landsberg an der Warthe), Jutespinnerei und Weberei, Plan- und Sackfabrik Max Bahr A.-G., [52°43'15.7"N 15°13'27.9"E], was the largest jute factory in Germany, an extensive paternalistic workers housing complex. After 1945, nationalised and converted to silk manufacturing (Gorzowskie Zakłady Przemysłu Jedwabniczego Silwana).

Kalisz, there are several sites representing textile industry development from the early 19th c. to the late 20th c.: Repphan, [51°45'56.7"N 18°05'38.9"E], a cloth manufactory; Fabryka Wyrobów Runowych "Runotex", [51°45'60.0"N

18°04'39.1"E], a knitted goods and plush factory is an excellent example of a late-modernist industrial architecture with an advanced structural solutions.

Kowary, Fabryka Dywanów „Kowary" (initially Vereinigte Smyrna Teppich Fabriken), [50°48'02.1"N 15°49'48.7"E], a post-war modernist carpet factory complex with a carpet-like mosaic on the façade.

Kudowa-Jeleniów, Dierig, [50°25'35.9"N 16°14'48.9"E], a cotton weaving shed by Phillip Jakob Manz, workers' housing built nearby.

Lodz, a major textile-production centre in Central Europe, which developed since the 1820s. This archetypal mill city could be considered a textile landscape as a whole. There were ca. 400 mills mainly in cotton and woollen industries in the early 20th c., many of them still well-preserved, e.g.:

Cotton: Ludwig Geyer (White Factory), [51°44'42.3"N 19°27'42.3"E], a steam-powered mill to English plans with Cockerill machinery, now the Textile Museum (Centralne Muzeum Włókiennictwa); Grohmann established his firm in 1844 and Scheibler in 1854, both companies amalgamated in 1921 (Zjednoczone Zakłady Włókiennicze K. Scheiblera i L. Grohmana), a vast complex with significant examples of industrial architecture: Grohmann weaving shed entrance gate [51°45'19.2"N 19°28'25.7"E], Scheibler multi-storey mill at Księży Młyn [51°45'14.3"N 19°28'56.5"E], a huge weaving shed by Sequinn-Bronner remains in ruin [51°45'04.2"N 19°28'23.9"E], impressive Art Nouveau power plant preserved with all the fittings [51°44'54.4"N 19°27'59.4"E], extensive paternalistic complex (500 ha) with numerous workers' houses and other facilities; I.K. Poznański, [51°46'42.5"N 19°27'00.8"E], a large factory complex with some buildings most likely designed by P.S. Stott, monumental workers housing and a grandiose owner's residence (now City of Lodz Museum); Widzewska Manufaktura (Wi-Ma), [51°45'46.0"N 19°30'04.5"E], a huge complex with aniline fibres and mechanical engineering branches; Łódzka Fabryka Nici (later "Ariadna"), [51°46'06.9"N 19°30'23.5"E], a thread mill owned by Coats; Naum Eitingon, [51°45'42.1"N 19°28'20.6"E], a Bauhaus-style multi-storey weaving department.

Wool: Julius Heinzel, [51°45'52.8"N 19°27'35.0"E], a factory and owners residence re-used a seat of local govenment; Schweikert, (later LODEX) and Paul Desurmont, Motte i S-ka (a worsted company of Roubaix) have been successfully converted into the campus of Lodz University of Technology [51°44'50.2"N 19°27'23.3"E].

Leon Plihal [51°45'15.7"N 19°25'36.2"E], a knitted-goods factory with a "Glockendach" tower and a post-war single-storey extension with arched roof and socialist-realist façades.

Mysłakowice, Orzeł, [50°49'41.4"N 15°47'04.0"E], a flax mill built for the King of Prussia; the oldest multi-storey building partially demolished, other buildings are still operational.

Opatówek, Fiedler, [51°44'19.5"N 18°12'51.9"E], a well-preserved cloth mill, now an industrial museum.

Pabianice, Krusche-Ender, [51°39'51.2"N 19°21'27.4"E], the largest factory in the town with a paternalistic complex; Bracia Baruch, [51°39'49.9"N 19°21'34.6"E], a woollen factory complex with a spectacular location on the Dobrzynka River; Pabianickie Zakłady Tkanin Technicznych, [51°40'08.7"N 19°22'47.9"E], a late-modern factory for the technical textiles production.

Prudnik (Neustadt), S. Fränkel Tischzeug & Leinwand Fabrik (later Frotex), [50°19'34.4"N 17°34'22.9"E], a major textile producer in Silesia, specialising in linen goods, towels and terrycloth.

Stargard, Zakłady Przemysłu Dziewiarskiego „Luxpol", [53°20'29.6"N 15°01'40.5"E], aan extremely-well preserved late-modernist industrial complex of a knitwear factory.

Zawiercie, the Ginsbergs from Berlin established factory known as Towarzystwo Akcyjne Zawiercie TAZ, [50°29'40.2"N 19°24'58.7"E], with an extensive paternalistic settlement in the vicinity [50°29'23.4"N 19°25'42.4"E].

Zambrów, Zambrowskie Zakłady Przemysłu Bawełnianego, [52°58'22.8"N 22°14'54.6"E], one of the largest industrial investments of the post-war reconstruction of Poland. The cotton factory, based on the shed principle with social-realist façades, is a spectacular example of a state paternalistic scheme of the Stalinist era.

Zgierz, woollen production was introduced in the 1820s, initially as cottage industry. Later, several mills built in the town and its outskirts. Well-preserved complex of weavers houses, Miasto tkaczy, [51°51'23.0"N 19°24'50.7"E].

Zielona Góra (Grünberg), Deutsche Wollenwaren Manufactur (later Polska Wełna), [51°56'12.2"N 15°30'35.5"E], a woollen factory complex of the 1920s, with workers' houses by Hermann Muthesius.

Żyrardów, Żyrardowskie Zakłady Przemysłu Lniarskiego (also known as Dittrich & Hielle), [52°03'22.0"N 20°26'16.9"E], a vast linen factory complex with a model company town, established with help from Philippe de Girard (hence the name of the town), later under Czech ownership and

Scottish management; some buildings designed by reknowned architects and engineers (e.g.: Pittel + Brausewetter).

Portugal

Textile production was an important branch of Portuguese industrial development. There were 15 textile companies among 25 largest industrial enterprises in Portugal as for 1881.

Cebolais de Cima, Empresa de Cardação e Fiação da Corga Lda., [39°45'00.9"N 7°34'17.5"W], a wool carding and spinning factory, now MUTEX – Museum of Textiles.

Chacim, Real Filatório de Chacim, [41°28'12.1"N 6°54'12.4"W], a royal silk twisting mill, based on the Italian technology (Piedmontese circular throwing machine).

Coimbra, several textile factories existed in the area, e.g.: Peig, Planas & Cª, [40°12'11.5"N 8°26'08.1"W], a wool weaving factory established in the baroque Franciscan convent and church. of 1609.

Covilhã, the woollen industry centre with more than 200 companies, with many remarkable buildings, such as: Royal Cloth Factory, [40°16'37.2"N 7°30'26.4"W], now the Wool Museum of the University of Beira Interior; Campos Mello & Irmão, [40°17'09.1"N 7°30'25.9"W].

Lisbon, Companhia de Fiação e Tecidos Lisbonense, [38°42'12.8"N 9°10'43.4"W], a large factory complex with workers' housing; Sociedade da Fiação Lisbonense, [38°43'31.1"N 9°06'47.5"W] in in the Palace of the Marquis of Niza; Francisco de Almeida Grandella, a well-preserved workers housing of a knitwear factory [38°44'47.5"N 9°11'01.4"W]; Companhia de Lanificos de Arrentela [38°37'08.2"N 9°06'23.3"W], a woollen factory on the southern side of the Tag River.

Porto, the city was one of prime locations for the textile industry, e.g.: Fábrica de Fiação e Tecidos da Areosa (Sociedade Azevedo, Soares & Cª SA), [41°10'43.3"N 8°35'12.9"W], a paternalistic complex of the first factory in Portugal to use electricity as a motive power.

Tomar, Companhia da Real Fábrica de Fiação de Tomar, [39°36'34.8"N 8°24'30.3"W], the first steam-powered cotton spinning mill of British type established in Portugal.

Vale of River Ave, the major cotton production region with Guimaraes, Vila Nova de Famalicao and Santo Tirso being municipalities with a greater industrial concentration: Fabrica de Fiacao do Rio Vizela, [41°21'31.7"N 8°24'43.7"W], one of the largest textile enterprises in Portugal; Fábrica de Fiação Tecidos e Tinturaria de Riba D'Ave (later Sampaio Ferreira & Cª

Lda), [41°23'35.7"N 8°23'50.3"W], a fully integrated cotton factory and a paternalistic complex; Fabrica de Tecidos de Santo Tirso, [41°21'00.6"N 8°28'31.9"W], a well-preserved cotton factory, the only steam-powered in the region; Companhia de Fiacao e Tecidos de Fafe, [41°26'11.8"N 8°10'25.5"W], on the Ferro River.

Pousada de Saramagos, Fábrica Têxtil Riopele, S.A.R.L., [41°25'41.1"N 8°25'43.4"W], built in the 1930s, one of the largest textile companies in Portugal.

Romania

The rich textile industry tradition in Romania suffered during post-communist transformations. Few factories survived to represent cultural values, but 'whirlpool' fulling mills are distinctive elements of vernacular technology.

Botoșani, a textile industry centre with several factories, developing since the early 20th c., Uzine Textile Moldova, [47°45'06.8"N 26°38'18.6"E], a large textile combine with single-storey buildings of the post-war socialist period.

Bucharest, Industria Bumbacului, [44°24'45.1"N 26°07'04.4"E], a cotton factory converted for creative industries.

Russia

Ivangorod, Steiglitz [59°21'38.0"N 28°12'17.7"E], a water-powered fireproof flax mill designed by William Fairbairn, with paternalistic complex on the Narva River.

Ivanovo, the principal centre of textile production in the entire Russian Empire and therefore dubbed "Manchester of Russia", "Calico Region", "Textile Capital of Russia" and even "City of Brides" (due to a disproportionately high number of women among its population). There were several dozen textile businesses in the city including the largest and most developed cotton factories owned by entrepreneurial families as the Garelins, Zubkovs, Polushins, Vitovs, Fokins, Derbenevs, Gandurins, Burylins, Novikovs and others: The Big Ivanovo Factory (Большая ивановская мануфактура, БИМ), [57°00'13.1"N 40°58'24.7"E], initially linen, later cotton manufacture, subsequently overtaken by Kuvaevskaya Manufacturing Co (Товарищество Куваевской мануфактуры), [57°00'07.3"N 40°58'37.8"E], both complexes play an important role in the Ivanovo townscape; Samoilovsky Cotton Combine (Хлопчатобумажный комбинат им. Самойлова) and Pokrovskaya Manufacturing Co (Покровская мануфактура П. Н. Грязнова), [56°59'50.6"N 41°00'14.8"E], two neighbouring cotton factory complexes representing industrial development

from the late 18th c. to late 19th c.; Red Talka factory (Красная Талка), [57°00'37.7"N 41°00'13.3"E], a factory with paternalistic complex, notable for a modernist reinforced-concrete building of the 1920s.

Krasnoye Selo, the first textile factory in Russia, established by the Britons: Richard Cosens and William Chamberlain for cotton and silk prtinting, later part of a writing-paper mill [59°43'46.7"N 30°06'05.9"E].

Moscow, the city was a major textile production centre in the Russian Empire, with large numbers of preserved industrial premises, e.g.: Albert Hübner printing factory (Товарищество ситцевой мануфактуры Альберта Гюбнера), [55°44'01.8"N 37°33'48.4"E], a large woolen factory specialising in bleaching, dyeing, printing and finishing; Danilovskaya Manufacturing Co (Товарищество Даниловской мануфактуры), [55°42'02.9"N 37°37'17.0"E], a cotton weaving factory; Emil Zindel Manufacturing Co (Товарищество «Эмиль Циндель»), [55°43'21.6"N 37°39'08.4"E], a large print mill; Red Rose Factory (Красная роза, earlier Шелкоткацкая фабрика К. О. Жиро Сыновья), [55°44'07.0"N 37°35'15.7"E], silk-weaving factory; Prokhorov Trekhgornaya Manufacturing Co (Товарищество Прохоровской Трёхгорной мануфактуры), [55°45'25.1"N 37°34'00.1"E], a cotton-printing manufacture; The Moscow Golutvinskaya Manufacturing Co (Товарищество Московской Голутвинской мануфактуры), [55°44'22.6"N 37°36'51.6"E], a factory for woolen and semi-woolen fabrics; The Vishnyakov, Alekseev and Shamshin factory (товарищество «Алексеев, Вишняков и Шамшин»), [55°44'42.8"N 37°39'44.9"E], a factory specialising in the production of gold and silver gimp - a thin metal thread used to make ceremonial clothes, uniforms and church vestments, with an impressive Art Nouveau building.

Naro-Fominsk, Naro-Fominsk Silk Combine (Наро-Фоминский шёлковый комбинат), [55°23'14.2"N 36°44'02.0"E], a large factory complex with workers housing.

Orekhovo-Zuevo, Nikolskaya manufactory (Никольская мануфактура), [55°48'32.5"N 38°59'20.3"E], an integrated cotton factory established by Savva Morozov. One of the most important strikes in Russian Empire took place there in 1885; Zuevo Zimin Manufacturing Co (Товарищество Зуевской мануфактуры И. Н. Зимина), [55°48'22.3"N 38°58'12.4"E], a prominent factory complex on the opposite side of the Klyazma River.

Ramenskoye, Ramenskaya Cotton Spinning and Weaving mill (Раменская бумагопрядильная и ткацкая мануфактура), [55°34'05.1"N 38°13'24.1"E], a company town with several factory buildings, houses for

employees and workers, a hospital, a school and a theatre hall, a consumer store and other infrastructure. *Company Town*

Rodniki, an important textile centre in the vicinity of Ivanovo, with Rodniki-Textile, [57°06'18.7"N 41°43'42.1"E], a giant combine of the Soviet period, where the peak employment was ca. 15.000 people! Still operational.

Shlisselburg, Shlisselburg printing manufacture (Шлиссельбургская ситценабивная мануфактура), [59°56'16"N 31°1'23"E], the second-oldest textile (cotton-printing) factory in Russia; badly damaged during the WW II, and preserved buildings were transferred to Shlisselburg shipyard.

St Petersburg, one of the largest textile-production centres in Russia: Curtain and lace company (Товарищество тюлевой фабрики в С.-Петербурге), [59°57'52.8"N 30°20'02.4"E], a curtain and tulle factory complex, still operational; The Nevskaya Thread Manufactory (Товарищество Невской ниточной мануфактуры) later Cotton-spinning Manufactory "Nevka" (Бумагопрядильная мануфактура «Невка»), [59°58'28.7"N 30°19'55.1"E], a thread factory with an impressive five-story spinning mill and several workers' houses, bought by the Coats in 1892, remains operational; Chernorechensk L.E. Koenig Cotton-spinning Manufacture (Чернореченская бумагопрядильная мануфактура Л.Е. Кенига), [59°54'22.4"N 30°15'43.0"E], initially a cotton-spinning mill, later amalgamate with "Nevka" and converted into thread spinning; Red Banner Textile Factory (Красное знамя), [59°57'41.3"N 30°16'50.5"E], a knitwear factory, notable for an extension by Erich Mendelsohn - a masterpiece of modernist industrial architecture of the 1920s; Russian cotton-spinning mill "Spindle" (Российская бумагопрядильная мануфактура «Веретено»), [59°54'33.9"N 30°16'19.3"E], one of the first large cotton factories in Russia, with an initial project by William Fairbairn; Thornton Woolen Company (Товарищество шерстяных изделий Торнтон), now Nevskaya Manufactory (Невская Мануфактура), one of the largest woollen factories in Russia established by Englishman James Thornton, still operational.

Serpukhov, an important centre of the textile industry - in 1814 eleven manufactures operated here, one of them developed into M. M. Konshin's Society of Manufactures in Sierpukhov (Товарищество мануфактур Н. Коншина в Серпухове), [54°55'13.9"N 37°23'04.0"E], a giant paternalistic complex with workers' houses (including 200 single-family cottages), a factory shop, a bakery, a hospital, two schools, a security guard, a tea room with a theatre, sports and leisure facilities. *Company Town*

Tver, there were three textile factories in the mid 19th c., including the Morozov's Tver Manufactory Partnership (Товарищество тверской мануфактуры), [56°51'3"N 35°51'45"E], an extensive paternalistic complex development of which (factory, workers housing and other facilities -more than 50 buildings in total), took some 50 years and was completed by 1915. *Company Town*

Vichuga, Manufacturing Partnership Ivan Konovalov and Son (Товарищество Мануфактуръ Ивана Коновалова съ Сыномъ), a large textile company with paternalistic complexes in Bonyachki [57°12'47.7"N 41°56'21.6"E] and Kamenka [57°23'36.8"N 41°47'46.8"E]. *Company Towns*

Vysokovsk, Vysokovsk Manufacturing Co (Товарищество Высоковской мануфактуры), [56°19'02.2"N 36°33'24.2"E], a spinning and weaving factory with workers' housing.

Yaroslavl, Yaroslavl Big Manufactory (Ярославская Большая мануфактура), later "Krasny Perekop" (Красный Перекоп), [57°36'44.5"N 39°49'46.2"E], a linen manufactory developed into a cotton factory, the second largest in the Russian Empire, with a paternalistic complex, Valentina Tereshkova - the first female cosmonaut – worked here in the 1950s; CORD (КОРД), [57°38'44.3"N 39°52'31.9"E], a factory for technical fabrics with well-preserved early 20th century industrial buildings, still operational.

Yegoryevsk, Yegorevsk cotton combine (Егорьевский хлопчатобумажный комбинат), [55°22'54.9"N 39°02'00.7"E], an impressive cotton factory with a mill by Thomas Godson and a modest workers housing complex.

Yuzha, Asigkrit Yakovlevich Balin Manufacturing Co (Товарищество Мануфактуры Асигкрита Яковлевича Балина), [56°35'02.2"N 42°00'54.2"E], a significant cotton spinning and weaving factory with paternalistic village (workers' housing, a hospital, a pharmacy, an Orthodox church, a school, a library and even a theatre) and the owners' residential house. *Company Town*

Serbia

The main textile centers in Serbia were, among others, Belgrade, Leskovac, Vranje, Ivanjica, Paraćin, Kula etc.

Leskovac, the region was known as "Serbian Manchester" due to the development of woollen and cloth industry. During the post-war period textile factories were merged into a big combine Leteks, [43°00'22.3"N 21°56'31.0"E], forming a whole textile district, now mostly disused; Textile industry museum [42°54'19.8"N 21°55'23.4"E], a rural mill in Strojkovce on the outskirts of Leskovac, equipped with authentic furniture and utensils.

Loznica, Preduzeće u razvoju Viskoza Loznica, [44°31'37.6"N 19°11'38.4"E], an artificial silk and viscose factory complex from the 1950s, then the biggest European and one of the biggest world producers of chemical fibres.

Paraćin, Vlada Teokarević i komp, [43°51'28.4"N 21°24'12.1"E], a woolen factory complex with an owners' villa and workers' housing.

Slovakia

Bratislava, a major industrial city of Austro-Hungarian monarchy - "Manchester of Hungary" with several textile factories, e.g.: Henrich Klinger [48°08'40.4"N 17°07'26.5"E], a jute factory specialising in wallpaper, imitation leather, waxed canvas, bags, etc. with a small workers' colony; Cvernovka, [48°08'52.8"N 17°07'50.8"E], a thread mill established in co-operation with J. & .P. Coats, a paternalistic complex with a director's villa, dining room, fire station and other facilities, gardens and greenhouses for growing vegetables, sports fields and other amenities; Danubius, [48°09'28.4"N 17°07'58.1"E], a large cotton mill having spectacular architectural treatment and advanced structural solutions, designed by Pittel + Brauseweter of Vienna. *Company Town*

Ružomberk, TEXICOM (BZVIL - Bavlnárske závody Vladimíra Iľjiča Lenina), [49°05'07.1"N 19°16'48.8"E] a cotton combine of the socialist era based on an earlier Mautner factory.

Slovenia

Maribor, Mariborska tekstilna tovarna (MTT), [46°33'25.3"N 15°39'55.6"E], considered as the most prestigious textile factory in all Yugoslavia, based on several earlier developments (Hutter, Roteks, Jugosvila and Jugotekstil): brick-modernist architecture.

Spain

Alcoy, there is a complex of old textile factories along the Molinar River [38°41'14.8"N 0°28'05.7"W], in spectacular loactions.

Arsèguel, Fàbrica de llanes, [42°21'42.7"N 1°35'20.0"E], a water-powered wool-spinning mill on the Segre River, equipped with 18th-century machinery including spinning mules (jennies).

Brihuega, la Real Fábrica de Paños, [40°45'34.2"N 2°52'05.1"W], the royal cloth factory of an exceptional circular shape.

Balmaseda, Fábrica de boinas La Encartada, [43°10'35.7"N 3°12'45.0"W], an industrial complex of a woollen knitwear factory (berets, blankets, scarves, socks, etc.) with workers' housing and other paternalistic facilities, the whole

integral production line (machinery, mostly English, from the late 19th and early 20th c.) survived intact, now museum. *Company Town*

Barcelona, Vapor Vell, [41°22'36.0"N 2°08'03.5"E], co-owned by Güell, the oldest steam-powered factory preserved in Barcelona, now a library and a school; La Casaramona, [41°22′17″N 2°08′59″E], a cotton mill by Puig i Cadalfach, now the Caixa Forum cultural centre. Fabra i Coats, San Andreu -thread mill now houses the Art Factory and the Barcelona Contemporary Art Centre.

Igualada, La Cotonera, [41°34'44.6"N 1°36'38.8"E], the oldest preserved Manchester-style cotton mill in Catalonia, possibly erected by British technicians, a well-preserved structure with impressive entrance gate.

Madrid, La Real Fábrica de Tapices, [40°24'22.3"N 3°40'57.2"W], the royal tapestry manufactory managed by the Vandergoten Stuyck family of Flemish origin, Francisco de Goya was providing cartoons for tapestries, tapestry-making is continued.

Manresa, Fàbrica dels Panyos, [41°43'24.4"N 1°48'55.8"E], an early cloth mill on the Cardener based on the British model, later converted into cotton production.

Pampeluna, Iwer Navarra, [42°49'45.6"N 1°38'56.5"W], a silk-weaving factory of a very interesting H plan, with two parallel wing – one for the weaving halls and another for offices and social facilities.

San Fernando de Henares, Real Fábrica de Paños, [40°25'31.0"N 3°32'05.2"W], the royal cloth manufactory, located in the front of a great square, opening towards the factory workers' dwellings, distributed on a radial plan.

Sóller (Mallorca), Sa Fàbrica Nova, [39°46'08.1"N 2°42'55.1"E], a modest-size cotton mill with well-preserved machinery and equipment including looms transferred from the old factory of La Solidez, the boiler of the old steam engine and the Deuz gas engine.

Terrassa, major textile production centre of Catalonia with numerous textile factories, of which the most spectacular example is Vapor Americh, Amat y Jover, [41°33'54.1"N 2°00'26.5"E], a woollen mill complex in Modernista (Art Nouveau) style, with Catalan brick vaulted roof, now the headquarters of the Catalan Museum of Science and Technology (Museu Nacional de la Ciència and de la Tècnica de Catalunya, MNACTEC).

Vales of Rivers Llobregat and Ter, industry in Spain in the 19th century was concentrated almost exclusively in Catalonia. Such a location was due to excellent hydrotechnical conditions and at the same time the lack of coal deposits. The textile industry developed mainly north of Barcelona, along

two river valleys, Llobregat and Ter, where 72 factories and associated residential complexes were established, linked as a cultural route, e.g.: L'Ametlla de Merola, [41°54'33.1"N 1°53'01.1"E], an extensive paternalistic settlement in a spectacular location; Borgonya, [42°03'52.7"N 2°14'30.4"E], the most important factory complex and paternalistic settlement in the Ter valley, with a thread factory established by J&P Coats; Colònia Güell, [41°21'43.0"N 2°01'48.1"E], a large factory, the only one in the Llobregat valley which used steam power, with a company village, substantial welfare programme and a chapel by Antonio Gaudi, itself part of a multi-site WHS; Colònia Sedó D'Esparreguera, [41°32'53.0"N 1°52'18.0"E], a cotton spinning and weaving factory and a large workers' housing complex, now a branch of the Catalan Museum of Science and Technology in Terrassa, focused mainly on a remarkable, advanced water-power system with aqueducts and tunnels; Colònia Vidal de Puig-Reig, [41°56'39.6"N 1°52'51.2"E], a cotton factory and paternalistic village - a rationally planned complex with a mill, a theatre, workers' housing, and two residences, is notable for advanced technology, structural solutions, high quality architecture and extensive paternalistic programme - a branch of the Catalan Museum of Science and Technology, MNACTEC.

Sweden

Älvängen, P. A. Carlmarks Repslageri, [57°57'39.4"N 12°07'19.0"E], a ropery preserved with the equipment and the 300-metre ropewalk, now a museum.

Borås, has long been known as Sweden's textile capital, with a number of production facilities, including: Åkerlunds Bomullsspinneri, [57°42'56.4"N 12°56'21.4"E], an impressive cotton-spinning mill by P.S. Stott, later textile museum, now business centre; Svenskt Konstsilke, [57°43'34.7"N 12°56'15.7"E], an artificial silk factory complex with a viscose department of interwar modernist architectural form, now textile design centre and textile museum.

Gothenburg, Göteborgs Remfabrik, [57°42'10.0"N 11°59'29.1"E], a weaving factory preserved with complete machinery and power transmission belting of British make, Hall's now a "living working museum" and a textile heritage centre. *Time capsule*

Jonsered, Jonsereds Fabrikers, [57°44'54.6"N 12°10'35.6"E], a large industrial (cotton, linen and jute) complex founded by Scotsmen Alexander Keiller and William Gibson 1832-1839.with a substantial company town including quarter design by S. Ericson, inspired by the garden city concept. *International interchange. Company Town*

Norrkoping, known as "Sweden's Manchester", is scattered with former factories (wool, knitting, tailoring, cotton), with the largest and most spectacular group of mills on the Motala River rapids, including: Tuppens spinneri, [58°35'17.4"N 16°10'24.3"E], a spinning mill, now creative business centre; Strykjärnet bomullsfabrik, [58°35'21.5"N 16°10'46.0"E], a cotton mill nicknamed "flat iron" because of its uncommon layout, now Arbetets Museum; Holmen Tower, [58°35'15.1"N 16°11'04.5"E], marks location of the first mill established by Dutch merchant and entrepreneur Louis de Geer in 1642; Bomullsspinneriet, [58°35'17.8"N 16°10'54.3"E] a cotton spinning mill, now part of an education campus; Stadsmuseet [58°35'22.2"N 16°10'49.3"E], a city museum in a former weaving and dyeing mill. The whole area is recognized as an important industrial landscape.

Rydal, Sven Erikson spinneriet, [57°33'19.7"N 12°41'36.9"E], a water-powered spinning mill and a paternalistic village on the Viskan River, now the Rydals Museum, where spinning machines of English make are demonstrated.

Stockholm, K.A. Almgren Sidenväveri, [59°19'03.0"N 18°04'13.4"E], a silk-weaving mill complex with original Jacquard looms preserved in situ and still working, now museum.

Switzerland[109]

Aathal (Zürich), Spinnerei Streiff, [47°20'6"N 8°46'12"E], a large spinning company with an almost unbroken chain of factories and workers' estates between the outlet of Lake Pfäffikon and Oberuster.

Adliswil (Zürich), Seidenstoffweberei MSA, [47°18'24"N 85°15'24"E], once the largest silk weaving mill in Switzerland with workers' housing at Sihlau estate and Albisstrasse.

Bäretswil (Zürich), Baumwollspinnerei Neuthal, [47°21'34"N 88°39'13"E], an interesting four-storey cotton spinning mill.

Bern (Bern), Tuchfabrik Schild AG, [46°56'42"N 6°51'28"E], a prime example of the "factory on the outskirts" erected in 1958-59 by Henry Daxelhofer, now converted for Bern University of the Arts.

Cortaillod (Neuenburg), Fabrique Neuve, [46°56'41.9"N 6°51'28.6"E], a mid-18th century factory, then one of the largest in Europe, closed in 1854, now museum.

Degersheim (St. Gallen), was a major embroidery production centre: Stickereifabrik Isidor Grauer, [47°22'23"N 9°11'36"E], a large embroidery

[109] Contribution by Theresa Hahn and Detlef Stender.

factory complex and an owner's villa with park and several apartment buildings for workers' families.

Dietfurt (St. Gallen), Spinnerei Weberei Dietfurt AG (later Buntweberei Schönenberger AG), [47°20'41"N 9°4'51"E], a paternalistic ensemble includes the factory's own power station, spinning mill building with gable roof, twisting mill with the classicist portal tower from 1912, as well as cotton warehouses, villas, a girls' boarding house and and workers' houses.

Emmen (Luzern), Viscosuisse Kunstseidenfabrik, [47°4'15"N 8°16'46"E], the first artificial silk factory in Switzerland, and later the largest textile factory in Switzerland, now "Viscosistadt" industrial park.

Flums (St. Gallen), Baumwollspinnerei Spoerry, [47°5'16"N 9°20'28"E], a cotton spinning factory complex, the largest in Switzerland, including two factories, four villas, ten water turbines and 30 workers' houses, now an industrial park.

Islikon (Thurgau), Greuterhof, [47°32'40"N 8°50'26"E], Bernhard Greuter's factory complex, one of the earliest large manufactories in Switzerland – originally there were man-made ponds, an irrigation and power generation system and around 20 buildings, the core of the manufactory has been preserved until today.

Kollbrunn (Zürich), Spinnerei Hermann Bühler, [47°27'31"N 8°46'11"E], an important example of a factory-villa-workers' house ensemble with a larger-than-average spinning mill, owner's residence with significant tree population, and an extensive water power system.

Lichtensteig (St. Gallen), Spinnerei Marti, Schweizer & Würth, [47°19'24"N 9°5'6"E], one of the first mechanical spinning mills in Switzerland.

Liestal (Basel-Landschaft), Tuchfabrik Schild AG, [47°29'29"N 7°43'38"E], a large cloth and blanket factory complex, now an industrial and commercial centre.

Luzern (Luzern), Kleiderfabrik der Schild AG, [47°3'49"N 8°18'18"E], a clothing factory to further process fabrics produced in Liestal, a shed and the workers' housing estate are preserved.

Sennhof (Zürich), Spinnerei Hermann Bühler, [47°27'59"N 8°45'21"E], a factory complex with a particularly deep five-storey factory building, three large low-rise buildings and workers' housing estate, factory notable for the world record for finest, combed cotton yarns of the highest quality.

Uster (Zürich), Baumwollspinnerei Kunz, [47°20'54"N 8°29'14"E], a large cotton spinning mill with an ensemble that consists of residential building, wash house and workshop building with high chimney, later supplemented by

crèche, Art Nouveau villa, girls' house and workers' houses; reused for services and housing.

Wädenswil (Zürich), Seidenweberei Gessner, [47°13'51"N 8°40'11"E], initially dispersed manufacture (putting-out system) for silk production, later mechanical silk weaving factory, then an international company with branches in France, Germany, Italy and the UK.

Wattwill (St. Gallen), Textilwerke Heberlein, [47°17'49"N 9°5'31"E], established as dye works, later one of the largest Swiss textile companies through expansions and takeovers.

Winterthur (Zürich), Sidi-Areal/Mechanische Seidenstoffweberei Wintherthur, [47°29'51"N, 8°44'21"E], a large factory complex with an L-shaped building designed by Joseph Bösch; Spinnerei Hard, [47°31'2"N 8°40'33"E], founded in 1802 as the first modern factory in Switzerland, later significantly expanded.

Zürich (Zürich), Seidenfirma Henneberg/Stünzi Söhne Seidenwebereien/Rote Fabrik, [47°20'34"N 8°32'10"E], a silk weaving mill, extended by architect Karl Arnold Séquin, later used use by "Standard Telephon & Radio AG" and currently as a culture factory.

Syria

The first modern silk reeling factory in Ottoman Syria was established in 1840. There were 10 silk reeling plants operating in Syria in 1913. During WWII the Levantine factories supplied silk fabric for parachutes. Major silk production centres included: Aleppo, Damascus, Dreikish, Hama and Homs. The factories were mostly demolished there.

Deir Mama, [35°08'23.7"N 36°19'51.8"E], typical NW Syrian village with economy based on silk-related agriculture; Mohammed Saud's small private museum in an old workshop has all stages of traditional silk production including "Arab wheel" and hand loom.

Dreikish, Al-Dreikish Natural Silk Factory, a state-owned enterprise operational 1963-2008, equipped with fully-automatic reeling machines; As'ad and Othman Factory, a private business, remained in use until 2007.

Taiwan[110]

Wang Tien Woolen Mill was Taiwan's oldest woollen factory, established during the Japanese Ocupation as a Japanese Navy Blanket Factory. Later, when the KMT government moved to Taiwan Island in 1949, many wool textile

[110] Contribution by Sandy Tsai.

companies successively relocated to the island. There were six woollen mills by 1952, including Zhong Ben Weaving Factory, Taiwan Furs Manufacturer, Fu Hua Wool Spinning and Dying Factory, Taiwan GTM Weaving Company, Mei-Feng Wool Spinning and Dying Company.

Taipei. Wang Tien Woolen Mill and Chung Ho Spinning Mill.

Tajikistan

Dushanbe, [38°33'05.7"N 68°46'49.2"E], a large cotton factory.

Khujand, The Kujand Atlas (Khudzhandatlas), [40°18'05.0"N 69°36'12.4"E], an important silk factory.

Kayrakkum, [40°15'36.0"N 69°46'24.0"E], a carpet factory.

Tanzania

Dar Es Salaam, Urafiki Textile Mill (Friendship Textile Company), [6°47'52.0"S 39°13'21.7"E], a factory established from China to support Tanzania's independence, the complex represents a socialist model space of production and livelihood which includes workshops, office, hospital, dining hall, worker's dormitory, warehouse, water towers. It was one of the five most important state-own enterprises of Tanzania and one of the largest factories in east Africa.

Turkey

Antalya, a major cotton production centre with several ginning, spinning and weaving mills since the early 20th c., also later developments such as Antalya Pamuklu Dokuma Fabrikası, [36°54'46.8"N 30°40'37.0"E], a large cotton-weaving factory of the 1950s, now converted into various purposes.

Bursa, Sümerbank Merinos Yünlü Sanayi Dokuma Fabrikası [40°12'02.1"N 29°03'06.8"E], a state-funded woollen factory, opened by President Atatürk in person in 1938, after extension the largest integrated woollen fabric factory in the Middle East and the Balkans, now the Merinos Textile Industry Museum.

Istanbul, Feshane, [41°2'38"N 28°56'15"E], a factory producing fes and woolen cloth for the Ottoman army, the first textile institution in Turkey in the real sense, notable for an internal structure assembled from cast-iron and steel elements from Belgium, now a congress hall.

Kartepe, Izmet, Kartepe Çuha Fabrikası, [40°43'10.8"N 30°00'08.8"E], a water-powered single-storey wool spinning and weaving mill by William Fairbairn, 1843. *International interchange*

Turkmenistan

Mary (Merv). A region of cotton plantations with several ginning factories established in the 19th c., such as that of Association of Russian Cotton Growers from Moscow; the city on the silk route (WHS).

Ashgabat. Ashgabat cotton mill named after S.A. Niyazov, [37°57'25.0"N 58°21'57.0"E], a factory notable for its crisp architecture of the 1920s and a prominent clock tower.

Ukraine

Kiev, Darnitskiy sholkovyy kombinat, [50°27'43.3"N 30°38'24.8"E], a large silk factory re-used as a shopping, business and cultural centre; there was another (smaller) silk factory also established in the mid-1940s [50°28'25.9"N 30°29'40.5"E].

Poltava, Poltavs′ka bavovnopryadyl′na fabryka, [49°36'00.2"N 34°30'57.8"E], a large cotton-spinning mill, an interesting constructivist-modernist main building of the 1930s.

Odessa, Tovarishchestvo bumago-dzhutovoy fabriki v Rossiyskoy imperii (later Odesskaya fabrika tekhnicheskikh tkaney), [46°27'41.1"N 30°41'17.1"E], a large jute factory of the late 19th c., after 1918 nationalized, rebuilt and reconstructed, state paternalistic management methods implemented, subsequently transformed into a factory of technical fabrics, currently re-used by various businesses.

Rivne, Rovenskiy l'nokombinat, [50°38'32.6"N 26°16'31.5"E], Europe's largest flax mill of the 1960s, notable for a symmetrical layout of two sheds linked by an office building at the end of an urban axis.

United Kingdom

Aberdeen (Aberdeenshire), Broadford Works, [57°09'06.2"N 2°06'29.4"W], linen factory developed 1808-1914, Bastille flax warehouse is now flats; Grandholm Works, [57°10'38.8"N 2°07'27.7"W], a 18-century large flax, later wool mill, with Boving water turbine, developed for housing.

Belfast (Northern Ireland), nicknamed "Linenopolis"; Linen Quarter, [54°35'41.9"N 5°55'52.9"W], a great concentration of linen trading companies and their warehouses; city was also known for its tailoring tradition. Conway Mill 1842/ 1910. [54°35'58.6"N 5°57'04.7"W]

Blairgowrie and Rattray (Perthshire), 12 flax and jute mills with 4 waterwheels, 2 turbines and 2 steam engines, exemplified by Keathbank Mill [56°36'00.8"N 3°20'26.5"W] 1865, which has been converted to housing.

Bolton (Lancashire), a major production centre for fine spinning of Egyptian cotton, notably: Atlas Mills [53°35'13.9"N 2°27'18.0"W], with displays by Northern Mill Engine Society of working steam engines; Swan Lane Mills [53°33'51.3"N 2°26'30.1"W], a large scale flagship complex of 3 mills.

Bradford (West Yorkshire), a major woollen and worsted trade centre, with Little Germany conservation area filled with mercantile warehouses, a wool exchange and a conditioning house; Manningham Mills, [53°48'29.4"N 1°46'40.3"W], Lister's artificial silk factory with 1873 campanile chimney dominating the town, parallel blocks of a spinning mill and warehouse adapted to flats by Urban Splash; Moorside Mills, [53°48'39.4"N 1°43'21.5"W], a worsted spinning mill, is now Bradford Industrial Museum.

Burnley (Lancashire), Queen Street Mill, [53°48'36.8"N 2°12'04.1"W], a steam-powered cotton weaving mill, still operational as a working museum. Other weaving mills in the 'Weavers' Triangle', such as Oak Mill, with a steam engine, and there is another engine that is steamed at Barnoldswick.

Carlisle (Cumbria), Shaddon Mill, [54°53'30.0"N 2°56'44.5"W], a cotton mill by William Fairbairn and Richard Tattersall with "Dixons chimney" then the tallest chimney in England, now converted to flats.

Castle Cary (Somerset), John Boyd Textiles (Higher Flax Mills), [51°05'22.5"N 2°31'23.0"W], a horsehair fabric factory in an former flax mill, notable for well-preserved operational looms of the 1870s. *Time capsule*

Chatham (Kent), Chatham Dockyards, [51°23'35.5"N 0°31'33.9"E], working hemp rope-making machinery within the Naval Dockyard (UK WHS tentative list). *Time capsule*

Clackmannanshire, a spectacular hilly backdrop to several mills that emerged in the 1820s and 1830s in Alva, Menstrie and Tillicoultry: Strude Mill [56°09'22.3"N 3°47'45.6"W] now flats; Clock Mill, [56°09'25.9"N 3°44'58.5"W], now small business centre; Devonvale Mill, [56°08'56.4"N 3°44'18.8"W], a large shop; Kilncraigs in Alloa [56°06'49.0"N 3°47'23.8"W] was the biggest of those mills. Co-operative-built housing (from 1851) and Institutes (1859, 1864) in Tillicoultry illustrate the self-help of mule spinners.

Cromarty (Highland), Hemp Factory, [57°40'53.6"N 4°02'17.2"W], a handpowered factory, now converted to housing.

Deanston (Perthshire), [56°11'23.9"N 4°04'21.8"W], now a whisky distillery with pioneer vaulted weaving shed by James Smith, 1830, (the model for Marshall's of Leeds), terraced tenements by the power canal. *Company Town*

Derwent Valley (Derbyshire), "cradle of textile industry" - several towns and villages with early cotton mills: Cromford, [53°06'33.3"N 1°33'18.9"W];

Masson, [53°06'44.7"N 1°33'45.0"W]; Belper, [53°01'45.0"N 1°29'13.1"W]; Milford, [53°00'08.9"N 1°28'44.7"W]; and Darley Abbey, [52°56'36.1"N 1°28'32.0"W]; along the same river, linked by canal, and later railway (WHS). *Company Town; Pioneer.*

Dundee, a complex jute and linen historic urban landscape. Dens Works, [56°27'56.0"N 2°57'43.8"W], Baxter Bros' four spinning mills, engineering dept, warehouses, office, workers' housing and Baxter Park (by Paxton, 1863); Scouringburn (for engine feed water) with 13 flax and jute spinning mills (1799-1889), 4 weaving factories (1839-1865), 3 finishing works, and Ward Foundry (Carmichael steam engines, est. 1810), a Girl's Industrial School and the pioneering Logie council housing estate (1919), interpreted at Verdant Works [56°27'41.9"N 2°59'01.1"W]; Camperdown Works, [56°28'22.7"N 3°00'27.5"W], established in Lochee by the Cox Brothers, the largest integrated jute and hemp works, with a campanile chimney, half-time school, a public library, baths and park, now converted to housing and retail.

Dunfermline (Fife), several damask linen factories of the mid 19th c.: Pilmuir Works, [56°04'25.4"N 3°27'40.7"W]; St Margarets Works, [56°04'29.6"N 3°27'46.5"W]; Victoria Works, [56°04'31.7"N 3°27'38.3"W]; Albany Works, [56°04'27.3"N 3°27'17.0"W], now swimming baths; St Leonards Works, [56°03'55.0"N 3°27'12.1"W], warehouses mostly converted to flats; Andrew Carnegie's house (the US steel magnate, son of linen weaver) is now a museum.

Eaton and **Beeston** (Nottinghamshire), well-known for lace making, e.g.:, Anglo Scotian Mills, [52°55'44.2"N 1°13'04.0"W], the F. Wilkinson lace and shawl factory, notable for its Gothic Revivial architecture.

Galashiels (Scottish Borders), Netherdale Mill, [55°36'32.5"N 2°47'05.5"W], 1874 woollen mill now Scottish College of Textiles.

Glasgow, James Templeton & Son, [55°51'02.5"N 4°14'06.1"W], a large-scale manufacturer of Axminster-style carpets in a factory modelled on the Palazzo Ducale in Venice, overlooking Glasgow Green; Merchant City, [55°51'36.0"N 4°15'09.7"W], urban district well-known for tailoring; also of interest Wallace Scott Tailoring Institute in Cathcart, [55°49'16.2"N 4°16'00.6"W]. Fireproof cotton spinning mills in Gorbals (1814,) and Dalmarnock (1884, Joseph Stott), and weaving factories in Bridgeton.

Halifax (West Yorkshire), a major woollen trade and manufacturing centre: Piece Hall, [53°43'19.1"N 1°51'25.2"W], 18th century wool exchange; Dean Clough Mills, [53°43'43.0"N 1°51'59.4"W], huge carpet factory complex owned by the Crossleys, who also provided workers' houses and People's

Park by Joseph Paxton, [53°43'16.7"N 1°52'21.8"W]; Akroydon, [53°43'50.6"N 1°51'50.2"W] and Copley, [53°41'54.6"N 1°52'22.5"W] are Edward Akroyd's factories and model villages. *Company Town*

Harris and **Lewis** (Outer Hebrides), The Orb mark registered by the Harris Tweed Association in 1909 defines tweed made from pure Scottish wool, spun, dyed and finished locally, and hand woven by self-employed agricultural crofters in small tin sheds, while yarn is spun in Stornoway, Lewis. There are around 400 of these weavers on Harris and Lewis. Interpretation by the Harris Tweed Authority, [58°12'29.3"N 6°23'17.2"W]; weaving demostrations e.g.: Gearannan Blackhouse Village [58°17'47.5"N 6°47'34.5"W].

Hawick (Scottish Borders), a living textile landscape of hosiery factories, once hand-, water- and steam-powered: Tower Mill, [55°25'15.9"N 2°47'17.4"W], a spinning mill that spans the River Slitrig on a bridge, now cinema; some knitwear factories were founded as tweed weaving mills: Eastfield Mills, [55°25'47.5"N 2°46'46.2"W], now Johnstons of Elgin; Glebe Mills, [55°25'44.5"N 2°46'37.6"W], with wide-span sheds. Hosiery makers like Hawick Cashmere offer mill tours.

Helmshore (Lancashire), Higher Mill, a wool-fulling mill and Whitaker Mill, a cotton mill [53°41'21.2"N 2°20'15.5"W], notable for *in situ* condenser mules, a free-standing chimney on a hill; now both mills are the Helmshore Mills Textile Museum,

Holywood, Ulster Folk Museum, [54°38'55.7"N 5°47'55.5"W], an open-air museum with a water-powered scotching mill from Gorticashel (Co Tyrone), the cottage of a handloom weaver of linen cloth from Ballyduggan (Co Down), and a bleach green in the centre of which is a circular stone tower from Tullylish (Co Down).

Huddersfield (West Yorkshire), a large wool manufacturing town, some mills now used by the University: Canalside East and West, [53°38'28.4"N 1°46'39.8"W].

Kidderminster, Stour Vale Mills, [52°23'05.6"N 2°14'44.3"W], an impressive factory of distinctive architectural treatment, now Museum of Carpet, which presents traditional cloth weaving techniques on 19th century handlooms as well as magnificent 19th & 20th century power looms still weaving carpet.

Kirkcaldy (Fife), Nairn's Scottish Linoleum Works, [56°07'23.3"N 3°09'07.7"W], also flax industry: Coal Wynd Mills, 1809/1864, [56°06'53.1"N 3°09'16.0"W]; West Bridge Mill, 1856, [56°05'53.9"N 3°09'53.7"W] converted to a foyer for supported living.

Knockando (Moray), and **Islay** (Argyll), small wool mills, carding, spinning, weaving and finishing machinery preserved in situ and still weaving, e.g.: Knockando Woolmill, [57°27'57.3"N 3°21'19.5"W], once combined with a small agricultural croft, operated by a trust. *Time capsule*

Leeds (West Yorkshire), Holbeck Conservation Area contains Marshalls Mills, [53°47'25.4"N 1°33'10.2"W], 4 flax spinning mills, 1817-1841 including Temple Works with remarkable Egyptian style façade; other flax mills include: Hunslet Mill and Victoria Works, [53°47'04.1"N 1°31'29.9"W]; Castleton Mill, [53°47'46.1"N 1°33'58.0"W]; while woollens are represented by Armley Mills, [53°48'09.2"N 1°34'58.1"W], now the Leeds Industrial Museum; Burton Factory, [53°48'21.7"N 1°30'38.6"W], a garment factory in a vast shed building with a remarkable Art Deco façade.

Llandysul (Wales), where 40 mills once clustered around Dre-fach Felindre. Cambrian Mills, [52°01'32.8"N 4°23'55.9"W], the only mill left in the village, now the National Wool Museum.

London, Spitalfields was initially settled by French Huguenot silk weavers; hanging wooden spools indicate houses where Huguenots once resided, e.g.: 17 Fournier Street [51°31'09.4"N 0°04'24.0"W].

Londonderry/Derry (Northern Ireland), a garment industry centre, known for linen shirts, with several factories, e.g.: Tillie and Henderson, [54°59'30.3"N 7°19'17.0"W]; Rosemount [55°00'11.4"N 7°20'04.1"W].

Macclesfield (Cheshire), Paradise Mill, [53°15'21.4"N 2°07'29.5"W] a silk mill, now museum; Paradise Street, [53°15'23.1"N 2°07'47.0"W], a row of houses with domestic weavers' shops at top floors. Several other early 19th C silk and cotton mills.

Manchester (Lancashire), Ancoats, [53°29'00.7"N 2°13'36.1"W], the first steam-powered cotton manufacturing urban district of in the world with Murrays Mill and McConnell, Kennedy and Co Mills along the Rochdale Canal, later developments represented by concrete-floored, electric-powered Royal and Paragon Mills. Beehive, 1813, Brunswick, 1818 and Brownsfield (Avro lofts, Urban Splash) Mills nearby. Victoria Mills, Miles Platting, further along |Rochdale Canal, with chimney clasped by a staircase, Further mills around Oxford Road inc the first MacKintosh waterrooofed factories.

New Lanark (Lanarkshire), [55°39'51.1"N 3°46'53.9"W], water-powered cotton mills with a factory village, famous for its place in shaping Robert Owen's ideas (Owen was manager and part-owner 1800-1827) and, indirectly, socialism, the ideas of Fourier, and the co-operative movement; spectacular location in a rural landscape (WHS). *Company Town*

Newmilns and **Darvel** (Ayrshire), a town of lace mills e.g.: Morton Young and Borland Ltd (MYB), [55°36'16.7"N 4°20'13.3"W], which is still operational with old madras and lace machinery, though computerised.

Nottingham (Nottinghamshire), Lace Market, [52°57'07.3"N 1°08'31.4"W], an urban district of lace factories, some of them tenemented, for finishing and merchandising the product.. The warehouses are mostly adaptively re-used.

Oldham (Lancashire), had 12.4% of the world's cotton spindles in 1890, more than any single country other than the UK and USA, peaking at 17.7 million spindles, mostly mule (some ring from 1884), spinning medium and coarse counts. Amongst the best in landscape terms are: Ace, [53°31′48″N 2°09′25″W], Belgrave, [53°31'39.6"N 2°06'17.2"W], Cairo, [53°32′53″N 2°04′30″W], Devon, [53°31'21.6"N 2°08'05.5"W], Durban, [53°31′28″N 2°07′52″W], Gorse, [53°31'52.1"N 2°09'23.9"W], Heron, [53°31'28.5"N 2°07'34.9"W], Majestic, [53°32′52″N 2°04′23″W], Manor, [53°32'55.5"N 2°08'08.3"W], Nile, [53°32'06.2"N 2°08'39.6"W], Orb, [53°33′02″N 2°04′19″W], Orme, [53°32′52″N 2°04′26″W], Ram, [53°31'57.9"N 2°09'25.5"W], Vine, [53°33'49.9"N 2°07'38.6"W]. Surviving parts of engineering works - Hartford Works, East Works and Asa Lees'- represent the largest textile machinery maker in the world (15,000 employees at 1906 peak), Platt Brothers.

Paisley (Renfrewshire), handloom weaving demonstrated in Sma' Shot Cottages, contrasted with a world-wide cotton thread empire formed by the United Thread Mills of J&P Coats and JJ Clark. Coats' Ferguslie Mill is mostly demolished, but Clark's Anchor Mills survives as three substantial buildings: Domestic Finishing Mill (Anchor One), [55°50'30.4"N 4°25'04.2"W], 1889, notable for steel floor joists around a lightwell includes Paisley Mill Museum, Shawl factory (Old Embroidery Mill), [55°50'32.9"N 4°24'60.0"W], Mile End ring mill [55°50'34.5"N 4°24'40.2"W]; paternalistic facilities include: workers' housing and bowling green; Coats Memorial Baptist church, town hall and observatory also provided by the mill owners.

Queensbury (Yorkshire), Black Dyke Mills, [53°46'02.1"N 1°50'35.8"W], John Foster's woollen mill with a factory village dominated by a mill chimney and intangibly associated with a famous brass band.

Saltaire (Yorkshire), [53°50'13.7"N 1°47'23.8"W], an extensive paternalistic complex - Titus Salt's famous creation in 1851-3 for Alpaca worsted cloth; the mill was engineered by William Fairbairn; the model company town has an institute, a school and a park (WHS). New Mill 1868 with a campanile chimney. *Company Town*

Selkirk (Scottish Borders), three big water-driven woollen mills built 1835-8 by Galashiels manfacturers: Ettrick Mill, [55°33'15.9"N 2°50'19.2"W] now a "Business Gateway"; Forest Mill, [55°32'59.4"N 2°50'45.3"W], still weaving; Dunsdale/Riverside Mill, [55°33'24.2"N 2°50'09.6"W].

Sion Mills (Tyrone, NI), Herdman's Mill, [54°47'12.1"N 7°28'02.8"W], a fire-damaged linen mill at the heart of this paternalist company village of uniform architectural image (half-timber buildings by William Frederick Unsworth). *Company Town*

Shrewsbury (Shropshire), Ditherington Mill (Shrewsbury Flaxmill Maltings), [52°43'09.6"N 2°44'37.1"W], 1797 flax mill that was the first factory with a "fireproof" skeleton structure, now being developed by Historic England. *Pioneer.*

Spinningdale (Highland), Spinningdale Mill, [57°52'28.3"N 4°14'04.0"W], permanent ruins of an early spinning mill (co-owned by David Dale of New Lanark) burned out since a fire in 1808.

Stockport (Cheshire). Wellington Mill, [53°24'31.0"N 2°09'44.6"W], a seven-storey fire-proof cotton mill of the 1820s, now the Hat Works Museum.

Styal (Cheshire), Quarry Bank Mill, [53°20'36.7"N 2°14'59.7"W], an early cotton mill complex with apprentice house and company village. Museum contains relocated textile machinery and a suspension waterwheel. *Company Town*

Stanley (Perthshire), Stanley Mills [56°28'46.0"N 3°26'27.9"W], an early rural cotton mill complex, Arkwright mill of 1787 with cruciform iron columns, and with impressive water systems, mostly converted to housing in 1995-2005; workers' housing in planned village. *Company Town*

Trefriw (Wales), Trefriw Woollen Mills. [53°09'02.7"N 3°49'27.7"W], a small-scale water-powered cloth mill, with weaving demonstrtaions.

Uffculme (Devon), Coldharbour Mill, [50°54'06.3"N 3°20'07.7"W], a wool and worsted yarn spinning mill, notable for a classical façade; now working museum with with water- and steam-powered shafting.

Whitchurch (Hampshire), Whitchurch Silk Mill, [51°13'42.5"N 1°20'18.2"W], a small-scale mill of elegant classical architectural forms, now a museum with machines for throwing, doubling and weaving silk powered by a big waterwheel.

Wigan (Lancashire), Trencherfield Mill [53°32'30.3"N 2°38'15.1"W], with large operational steam engine, Eckersleys mills [53°32'20.7"N 2°38'24.0"W], a ring spinning mill complex; canal basin making a literary connection to George Orwell's *Road to Wigan Pier*. Gidlow Works (Rylands Mill), [53°33'12.6"N 2°38'08.7"W], an impressive integrated cotton spinning and

weaving mill complex with a park, source of the funds for Rylands Library in Manchester University.

Yorkshire Pennines: Golcar, Hebden Bridge and Sowerby Bridge possess typical mullioned "weavers' windows" at hand-operated proto-industrial factories, interpreted by Colne Valley Museum, [53°38'19.3"N 1°51'22.7"W]. Water-powered mills built of local millstone grit and a scatter of steam-powered mills dominate a landscape, cut through by canals, and railways, tunnels and viaducts due to the topography.

USA

Fall River (Massachussetts), the biggest concentration of steam-powered cotton mills in New England, the majority of stone, with central Italianate campanile towers; some mills are arranged in parallel pairs, with an office/warehouses between the two. Notable examples include: Durfee Mills [41°41'54.0"N 71°08'59.0"W]; Union Mills [41°41'44.0"N 71°08'32.0"W]; Metacomet Mill [41°42'10.5"N 71°09'39.3"W]. Fall River overtook Lowell for cotton production, having low transport costs for coal.

Graniteville (South Carolina), Gregg cotton mills [33°33'57.6"N 81°48'30.2"W] and paternalistic company town with 90 homes, several boarding houses, six stores, two churches, and a school for the mill workers and their families. The community got its name because most of those original buildings were constructed of blue granite. *Company Town*

Harrisville (New Hampshire), two small wool mills, Harris and Cheshire, [42°56'42.4"N 72°05'38.0"W], with associated boarding houses, store, library, owner's and worker's houses, turbines and a mule. Now a Historic Landmark District. *Company Town*

Lawrence (Massachusetts), a planned cotton city on the Lowell model along two power canals, including: Everett Mill, [42°42'27.8"N 71°09'12.5"W], absorbing the earlier Lawrence Machine Shop; Pemberton Mill and Duck Mill, [42°42'20.8"N 71°09'13.9"W]; Pacific and Atlantic Mills [42°42'20.5"N 71°09'31.1"W]; several were converted to wool production and some large new wool mills were built, e.g.: Ayer Mill, [42°42'09.6"N 71°09'18.2"W], with a dominant clock tower; Wood Mill, [42°42'09.9"N 71°09'02.1"W], a complex of exceptional length; there are some boarding houses and terraced houses for the mechanics of the Essex Company. *Company Town*

Lewiston (Maine), a cotton manufacturing town on the Androscoggin River, with impressive mills, such as: Continental Mills, [44°05'30.5"N 70°13'12.6"W]; Bates Mill, [44°05'41.2"N 70°13'04.3"W], now lofts and a museum.

Lowell (Massachusetts), a city laid out from 1821 by the Boston Associates to suit water-powered cotton mills, notably: Boott Mills, [42°38'51.2"N 71°18'27.4"W]; Suffolk Mills, [42°38'58.6"N 71°19'00.1"W]; Lawrence Mills, [42°39'07.1"N 71°18'53.6"W]; Massachusetts Mills, [42°38'47.5"N 71°18'18.2"W]; Market Mill, [42°38'40.7"N 71°18'44.7"W]; Hamilton Manufactoring Company and Appleton Mills [42°38'30.2"N 71°18'41.8"W]; power canals with planted promenade walks; early turbines and flood control systems; reconstructed boarding houses for the "Yankee girls" and then waves of immigrants (Greek, Portuguese etc). Industrial district designated as National Park, with the Museum of American Textile History in the Kitson Machine Shop. *Company Town*

Ludlow (Massachusetts), initially Jencksville cotton mill village with radial planning, later Ludlow Manufacturing Company [42°09'24.4"N 72°28'48.5"W], one of the wolrd's largest jute factories, a company town with Polish and French Canadian immigrant communities. *Company Town*

Manchester (New Hampshire), Amoskeag Manufacturing Company, [42°59'46.6"N 71°28'00.7"W], a vast cotton factory complex on the Merrimack River, was the largest in World (15,500 workers, 1912), a *company town* in accordance with Lowell system.

Natchitoches (Louisiana), Magnolia Plantation, [31°32'58.4"N 92°56'29.2"W], a cotton plantation, with cotton gins & presses (Webb Press), and slaves' cabins; Melrose Plantation, [31°36'00.2"N 92°57'58.3"W], now a museum with nine historic buildings including African House, Yucca House, Weaving Cabin, Bindery and the Big House.

New Bedford (Massachusetts), a large group of late-19th c. steam-powered fine-cotton spinning mills, e.g.: Wamsutta Mills, [41°38'56.5"N 70°55'35.7"W], Whitman Mills, [41°39'51.6"N 70°55'13.9"W], Manomet Mills, [41°40'00.8"N 70°55'13.7"W], Hathaway Mills, [41°37'03.3"N 70°55'01.5"W]; workers' housing mainlfy for French Canadian/Portuguese/ Cap Verde immigrant communities.

New York (New York), SoHo, [40°43'18.5"N 73°59'59.4"W], an extraordinary collection of cast iron facades from the second half of the 19th century, and a magnet for immigrant tailors.

Pawtucket (Rhode Island), Slater Mill, [41°52'39.8"N 71°22'58.1"W], the first cotton mill in the new world, built of timber, and with Belper know-how smuggled across the ocean; now together with stone-built Wilkinson Mill, form Slater Mill National Historic Site; further developments represented by Conant Thread, [41°52'46.6"N 71°23'43.6"W], a large industrial complex

owned by J & P Coats, now a creative industry business park. *International Interchange*

Saco-Biddeford (Maine), [43°29'40.7"N 70°27'08.8"W], a historic district on the Saco River waterfalls with a collection of well-preserved 19th and early-20th century cotton mills: York Manufacturing Co in Saco, opposite Biddeford, which has a distinctive bell tower.

Seaford (Delaware), DuPont Nylon Plant, [38°38'01.6"N 75°37'38.9"W], the first nylon plan in the world established in 1939.

Troy (New York), a major textile production centre on the Hudson River, with several massive red-brick cotton mills, e.g.: Troy Waste Mfg. Co. [42°44'11.4"N 73°41'13.4"W], specialising in "shoddy" products from wool and cotton waste; Wilbur, Campbell & Stephens Co. [42°44'32.6"N 73°41'08.1"W], notable for distinctive architectural treatment; Van Zandt, Jacobs & Co. [42°44'34.5"N 73°41'06.1"W]; Searle, Gardner & Company Cuff & Collar Factory [42°44'46.7"N 73°41'00.3"W]; all of them well-preserved and reused.

Watkins Wool Mill (Missouri), [39°24'47.8"N 94°15'35.1"W], a woollen mill with all processes preserved and operated, in a rural landscape; a paternalistic village with schools and a church. *Time capsule*

Uruguay

Juan Lacaze. Fábrica Textil "La Industrial", [34°26'13.3"S 57°26'09.7"W], a large woollen factory complex by Peter Behrens, a *company town* with social, sports, educational, union, health facilities.

Uzbekistan

Transcaspian railway - cotton supply for Russian empire: 1886 Bukhara, 1888 Samarkand, 1898 Andizhan and Tashkent. In the late 19th century, there were approximately 100 cotton mills in Russian Turkestan, with most of the cotton gins imported from the United States. After 1900 cotton gins of Moscow and Lodz companies were also established in Turkestan.

Bukhara, an important trade centre for traditional silk carpets, with many bazaars and retailing facilities [39°46'35.3"N 64°24'57.1"E], a historic city on the Silk Road (WHS).

Ferghana, The Ferghana Textile Company, [40°22'19.3"N 71°49'24.0"E], factory complex of the 1930s with paternalistic facilities.

Margilan, Yodgorlik Silk Factory, [40°28'34.1"N 71°43'03.4"E], well-preserved operational silk weaving factory; Margilan silk combine, [40°28'35"N 71°44'59"E], the largest establishment in silk industry in the USSR.

Samarkand, Samarkand Bukhara Silk Carpets ("Khudzhum"), [39°39'47.9"N 66°59'28.7"E], manufacturing traditional carpets; Samarkand silk weaving factory [39°38'29.5"N 66°56'17.3"E], a large shed complex.

Tashkent, [41°16'31.8"N 69°14'59.3"E], a vast textile production complex of the 1930s – one of the largest textile factories in Central Asia – with Soviet state-paternalistic workers housing.

Fig. 8.1. Jute calender puts a glaze on woven cloth at the finishing stage in Fort William jute mills, Howrah, Kolkata, India. Source: Aishwarya Tipnis.

9

Summary and conclusions

Plate IX. A jacquard loom in the carpet factory in Sedan, France. Source: Bartosz M. Walczak, 2006.

9.1 Summary

Some 60 million people are employed in textile and clothing industries worldwide. Globalisation has made the industry highly mobile, driven to seek out the fewest regulations and lowest wages. In the wake of those changes are lives and landscapes transformed, urban and rural. New habits of work, and economic power in the hands of women where they might form the majority of the workforce, have had wide repercussions, good and bad. So how has that importance been reflected in the UNESCO world heritage list?

Table 1. Textile sites on the World Heritage List.

Property	*Inscribed*	*Criteria*	*TICCIH Textile categories*	*textile*
Shirakawa-go and Gokayamama, Japan	1995	iv, v	Landscape	silk
Crespi d'Adda, Italy	1995	iv, v	Urbanism, Flagship	cotton
Caserta, Italy	1997	i, ii, iii, iv	Urbanism	silk
Derwent Valley Mills, UK	2001	ii. iv	Pioneer, urbanism, landscape	cotton
New Lanark UK	2001	ii, iv, vi	Urbanism	cotton
Saltaire, UK	2001	ii, iv	Urbanism, Flagship	alpaca
Liverpool, UK	2004-21	ii, iii, iv	International interchange	cotton
Tomioka silk mill Japan	2014	ii, iv	International interchange	silk

Source: Mark Watson, on the basis of the WHC UNESCO website: https://whc.unesco.org/en/list/.

Reviewing these, only three countries so far have textile sites on the world heritage list[111]. Other state parties have not brought forward nominations, only partly excused by the UK, Japan and Italy having produced significant volumes of textiles, and influenced other countries, at different times. Wool, the bast fibres (flax/ hemp/jute) and man-made fibres are not represented. Cotton and silk predominate, which with alpaca from South America involved significant global trading routes. In two cases, Derwent Valley Mills and New Lanark, that cotton included the produce of enslaved labour, a dark heritage recently being researched. The Silk Route is beyond the scope of this study.

The biggest port for cotton was Liverpool Maritime Mercantile City, which had joined the World Heritage List from 2004-2021 and still has all the attributes

[111] https://whc.unesco.org/en/list/ (access: 27.10.2021).

of its cotton importing past. In 1913 it was estimated that if all the cotton stocks held in New York, New Orleans, Bremen, Le Havre, and Bombay were grouped together, they would only just exceed the stock of cotton held in Liverpool. Therefore UNESCO delisting of Liverpool has reduced the already low profile of the textile industry in the world heritage list. The travails of Liverpool were noticed in nearby Manchester, which has withdrawn its place from the UK tentative list. This will present an obstacle to the many cities around the world considered "The Manchester of…"

UNESCO refers to "Technological ensemble" for these sites, but their technology is simple, and it is as urban landscapes that opinions are strident about future management. Criterion (iv) "an outstanding example of a type of building, architectural or technological ensemble or landscape which illustrates a significant stage in human history" is a common factor. Next most successful, (ii), applied where there was influence to or from elsewhere. (i) "outstanding work of human creative genius", really applied to other aspects of Caserta designed landscape, and (vi), about ideas, namely the influence of New Lanark on the ideas of Robert Owen, are very specific to those places. (iii) "a unique or at least exceptional testimony to a cultural tradition or to a civilization which is living or which has disappeared" might apply to some vernacular landscapes, but is less often accepted for living urban landscapes.

A factor common to these world heritage properties is the company town, shortened by TICCIH to 'Urbanism', with hints of utopia at San Leucio (Caserta) and New Lanark. None of the sites are within large cities, and more of them relied on green energy than was typical. The only mill chimneys in these world heritage sites are at Masson Mills in Derwent Valley, Saltaire, and Crespi d'Adda.

The TICCIH category 'Time Capsule' has not yet resulted in a world heritage textile mill. The 'giant' category would cover Belper in Derwent Valley Mills and New Lanark if set at the date 1800-1820 but not the mills of 90 years later (Amoskeag, Kreenholm). 'Pioneer' and 'Flagship' might become terms for the lead factories in various industries, and 'international interchange' of ideas, goods and people might share synergy with UNESCO ambitions.

Might any other world heritage sites accidentally include textile heritage? St Petersburg did, at least until the delimitation of 2012 excluded some industrial zones. Lyon's world heritage boundary encloses the silk weaving district La Croix Rousse used by les canuts, such as la Cour des Voraces. The Naval Port of Karlskrona and the Arsenale in Venice are world heritage properties in Sweden and Italy that each contain historic ropeworks, and so do Rochefort and Chatham

dockyards, on the French and UK tentative lists. Chatham at least qualifies as Time Capsule, having original and unique machinery in operation.

Tentative lists of places that might be nominated by states parties in future include two of note. “Industrial Heritage of textile in the central Plateau of Iran” and “Iconic Saree Weaving Clusters of India” each indicate exploration of possible living heritage sites based on hand produced textiles, but where there are mechanised factories too. They would be so called ‘serial’ sites scattered across large territories, like the sites in Japan but much more widespread, whereas the current sites in Europe are each single connected landscapes. World textile heritage is taking new directions!

Therefore, out of 1154 world heritage properties in 2021, 987 of them cultural, around five to ten properties contain notable textile heritage, less than 1%. That number is unlikely to dramatically increase, and the writers do not expect this report to achieve such a shift. But we do hope that people seeking to better understand their local textile mill will now have something to go on. For that we thank the many people who shared their understanding.

9.2 Scope for further research

What started from a need to compare a small number of world heritage nominations has become a tool for understanding industries that employed, and on occasion exploited and exploits hundreds of thousands of people across the world. The few that are at the pinnacle as world heritage sites are on reflection not so important for their intrinsic heritage value as for their ability to demonstrate best practice in adaptive re-use and conservation. Their interpretation must mean the highlighting of global networks in supply chains of commodities and of stages in manufacture. The textile industry has a long history of making connections across the world.

This publication is not the last word on the topic. It is likely that, and indeed the authors hope, it will inspire further contributions via the TICCIH website.

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The textile industry is a global phenomenon. It was the impetus for industrialisation, the growth of cities, the creation of company towns and world-wide trading routes in staple goods: silk, wool, linen, cotton, jute and artificial fibres. Facing global economic changes, textile mills have proved adaptable to new purposes. Many spearhead urban regeneration and secure the future identity of places. Which lessons do mill conversions give?

Which are the pioneers, the flagships, the giants, and the time capsules - machinery, and related skills? Which networks best demonstrate international interchange? Did associated company towns fail or prosper? Some are World Heritage Sites - is the balance correct? What attributes do these places share, what makes them different, and what is missing? This book condenses input by several researchers into the better understanding of textile mills worldwide.

Lodz University of Technology
Monographs
ISBN 978-83-66741-23-2