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3D Representations of Heritage – understanding the Leavers lace machine through documents, ethnography and animation

The lace industry in the East Midlands of the UK was a major feature of the local, and wider, economy from the invention of the 'Leavers' process in 1813 to the end of mass manufacturing of lace early in the 21st century. The industry grew out of innovations in machine knitting technology that date back to William Lee's invention of the stocking frame in 1589. In 1816 it was exported to northern France, under conditions of trade embargo, where the industry grew in the towns of Calais and Caudry. In both Nottingham and northern France it generated parallel industries in machine manufacture and textile finishing.

Three firms survive in the UK, and one of these is Cluny Lace in Ilkeston, near Nottingham <http://www.clunylace.com>. Although the industry has shrunk from approximately 2600 machines in the first decade of the twentieth century to the 16 that remain at Cluny Lace, this important part of the region's industrial heritage does survive. Working closely with the company's owners over some years, researchers at Nottingham Trent University have conducted research since 2009 to understand this heritage and effectively represent it as the important element in the region's identity that it is. Collaborators in this work have included the Victoria and Albert Museum in London, as well as Nottingham's City Museums and Galleries, which has some examples of Leavers machines in their Industrial Museum collection.

The work described here combined film, photography, computer animation and interview and was conducted in 2013. It included an ethnography, in the Cluny Lace factory, as well as making a 3D animation of a Leavers lace machine. Both aspects of the work were represented in a short film that can be found online, here:

<https://www.youtube.com/watch?v=2mYtIPKmrwo>. The work is distinctive in industrial heritage research, because all the elements of the industry, human and material, are present in the factory. While it is important and useful to preserve the architectural and material remains of industrial heritage, and integrate them into economic and social regeneration in a post-industrial setting, these efforts are often made in the absence of the human elements that animated and 'completed' these historical artefacts and environments.

Generously given access to the factory by the company's owners, the Mason family, the ethnography could trace the movement of materials through the factory through the hands of the workers. The lace is made from Egyptian cotton, twisted round nylon thread, which is prepared for the Leavers machines on site. Having emerged from the machine, the lace pieces pass through the hands of skilled menders before being transported to Calais for finishing and dying, to return to Ilkeston to be packed ready for sale. The machines require a good deal of craft skill at all stages of the production process – this was always the case, and no machines exist that are less than seventy years old. The workers' skill is particularly evident when a machine is changed from one pattern to another, and when the supply of

threads is renewed. Pattern changing means replacing the jacquard cards that control the movement of the threads in the machine, as well as changing the set up of the threads that run upwards from the long poles or 'beams' below the machine. This latter task requires a combination of great dexterity and the ability to interpret how the pattern being run translates into particular thread positions in the machine. So as well as connecting ends and making sure they run in the correct path, the 'twisthand' uses sheets of figures to translate the pattern and the movements it requires into the machine's set up. The nylon threads round which the cotton twists are carried in brass bobbins. Each of these fits in a steel 'carriage', which move from front to back of the machine, between the cotton 'beam' threads,. Each machine has several thousand of these, which must be individually filled prepared and re-installed in the machine to keep production going. All the steps in this process are highly skilled.

The way the machine works, and how the components move relative to each other to produce complex and beautiful patterned lace, is dependent on those skilled processes, but understanding the skills on its own does not elucidate the operation of the machine. It was for that reason that the work included constructing a 3D computer model of the machine, which could be 'exploded' and animated to show its workings. Fortunately, the company was in the process of restoring one of its machines, made by the Jardine Company, which meant that it was possible to closely inspect, and measure the mechanism, to help to construct the computer model. The model will feature in the future re-display of the Nottingham Industrial Museum display, to 'animate' what is otherwise a static display of lace industry items.

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The Cluny Lace factory, Belper Street Works, Belper Street, Ilkeston, Derbyshire (picture credit: Julie Botticello)



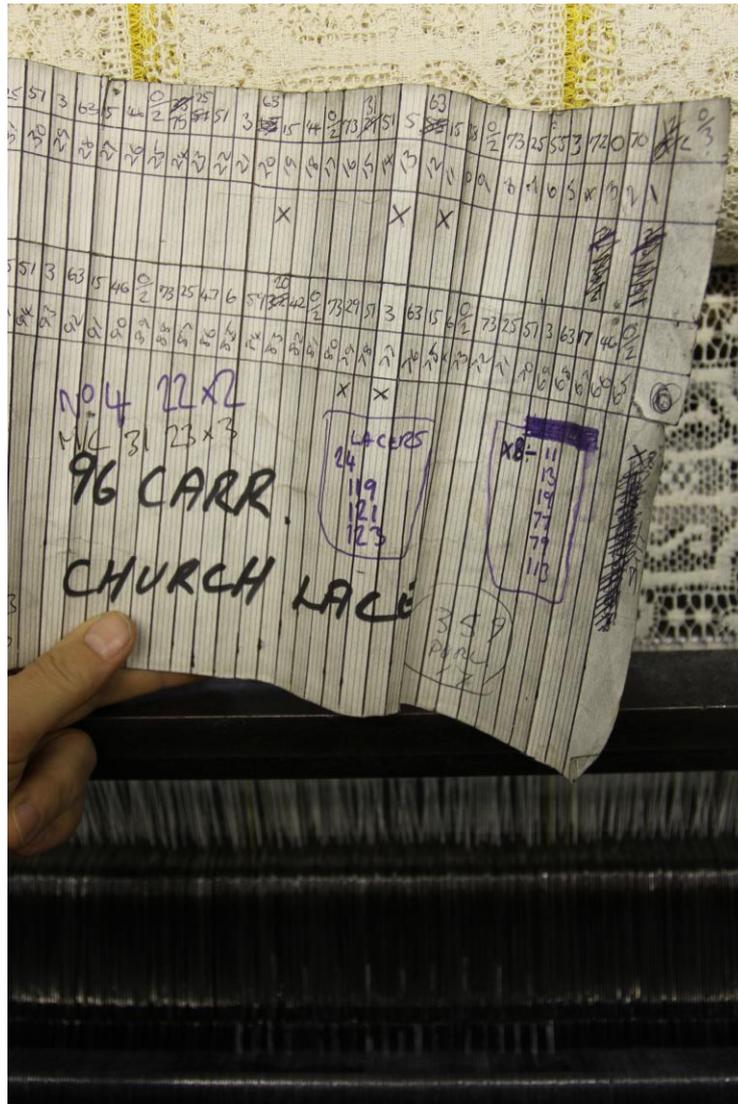
Changing the 'beams' that hold the cotton threads below the machine, Cluny Lace, 2013 (picture credit: Julie Botticello)



Jacquard cards that control the movement of the threads in the Leavers Machine, Cluny Lace, 2013. (picture credit: Julie Botticello)



Tying in a new thread, Cluny Lace, 2013 (picture credit: Julie Botticello)



Figures to assist machine set-up, Cluny Lace, 2013 (picture credit: Julie Botticello)



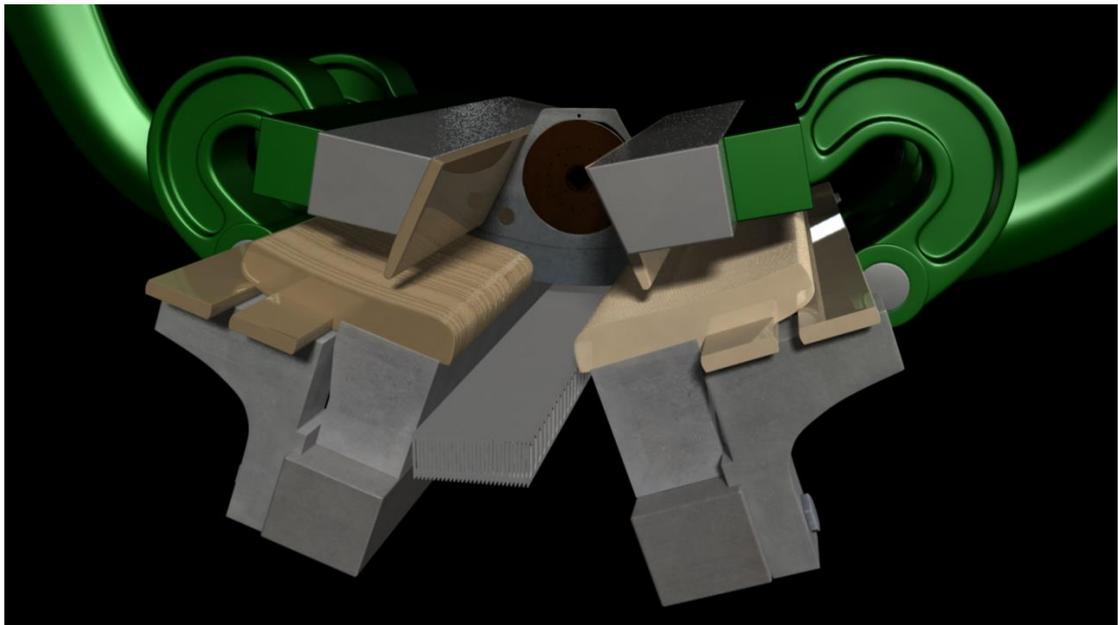
Filling brass bobbins, Cluny Lace 2013 (picture credit: Julie Botticello)



Inserting 'threading' bobbins into their carriages, Cluny Lace, 2013 (picture credit: Julie Botticello)



Installing carriages in the machine, Cluny Lace, 2013 (picture credit: Julie Botticello)



Partial computer model of Jardine lace machine, 2013 (picture credit, James Thompson)