Pathways in the Nineteenth-Century British Textile Industry

Edited by
Philip A. Sykas

Volume III

ROUTLEDGE

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VOLUME III: TIMELINE

1782	Thomas Hoyle established a dyeworks at Mayfield, Manchester
1785	Thomas Bell's cylinder printing machine was not successful at Livesey, Hargreaves and Co.
1787	Excise duty altered to 3½d. per square yard on printed calicoes
1787	Act 'for the encouragement of the arts of designing' grants two months' copyright to designs for printed linens, cottons, calicos and muslins
1790	Block printers' strike against machinery
1794	Copyright in designs extended to three months
1798	Chloride of lime for bleaching patented by Charles Tennant of Glasgow, no. 2209
1799	Charles Tennant's patent for bleaching powder, no. 2312. Bleaching powder made it possible for bleach to be supplied at less cost of carriage
c1800	James Halfhide sen. and jun. printing with engraved copper rollers at Merton, Surrey
1802	Commercial introduction of clamp-press discharge printing by Monteith in Scotland
1802	New method of block cutting entirely by brass and pin work
c1803	Edward Vint of Crayford used a printable indigo blue stabilised with orpiment
1808	Joseph Lockett of Manchester reportedly adapted Jacob Perkin's principles of mill engraving to textile printing
1808	Lane's net style reportedly introduced
1808	Beginning of *lapis* style, known in Britain as neutrals
1810	Peter Papillon, Turkey red dyer and printer, business failure at Neckinger Ground, Bermondsey
1811	Sale of blocks, plates and printing rollers of Old Ford printworks on the River Lea
1813	Turkey red discharge patented by James Thomson of Clitheroe, no. 3654
c1813	Steam colours reportedly introduced to Lancashire by a Scotsman

1814	Turnout of journeymen calico printers over reduction of work for block printers
c1815	Two colour engraved cylinder printing with both colours fitted in register begins
c1816	Start of stipple shading for cylinder printing
1818	Select Committee on the Duties on Printed Cotton Goods
1818	Improvement in dyeing cochineal pink by Frederick Steiner at Broad Oak printworks
1822	Beginning of manganese bronze styles; new variants in subsequent years kept the style in vogue until 1831 or 1832
1822	John Potts, engraver to calico printers, made his first fine stipple engraving for Broad Oak
c1822	Eccentric engraving experiments by Joseph Lockett
1823	Rainbowing process of block printing introduced
1823	Samuel Hall's improved gas singeing machine, patent no. 4799, brought this method into use by calico printers, replacing the red-hot plate technique
1824	Repeal of Combination Acts allows trade unions
1825	Regulation of export of machinery by Board of Trade until 1842, including copper cylinders
1827	Manganese discharge process with chrome yellow introduced by Thomas Lightfoot at Broad Oak
1828	Introduction of three-colour engraved cylinder printing (with three rollers fitting, not in promiscuous arrangement)
1828	Opaque white, known as grey white, printed in 'damask style'
1831	Duty on printed calicoes repealed, 1 March
1833	Select Committee on Manufactures, Commerce and Shipping
1834	Mechanical block printing with the perrotine spread in France but not adopted in Britain
c1835	Introduction of toby tub to block print multiple colours at a time
c1836	Printing of delaines (lightweight cotton and worsted garment fabric) introduced to London region
1838	Thomas Ridgway Bridson's stentering machine enabled a more regular finish on fine fabrics
1839	Dung substitute patented by John Mercer and John Dyneley Prince, no. 8183
1840	Parliamentary Select Committee on the Copyright of Designs
1841	William Newton's patent for high-pressure kier bleaching, no. 9196
1841–1842	Hydro-extractor (spin dryer) reportedly introduced from France
c1842	Mercer's chlorination of wool enabled cylinder printing of delaines, and also enabled deep royal blues
1842	New copyright act came into operation granting nine months protection to registered designs

1842	Six-colour cylinder printing machine exhibited in Manchester as a novelty
1843	Second Report of the Children's Employment Commission includes John L. Kennedy's report on the print-grounds of Lancashire
1843	Joseph Burch's punching machine, patent no. 9728, expands adoption of the cast metal process of hand-block making that had begun in England around 1840
1844	Alexander Alliott patented his centrifugal extractor (spin dryer), no. 10,070
1845	Revival of rainbow ground printing
1846	Thomas Welch began printing at the Merton Road printworks site
1848	Lactarine, a casein-based adhesive from buttermilk, patented by Robert Thomson Pattison, no. 12,316. This enabled pigment printing of artificial ultramarine in a more economical way than with albumen, enabling a wider proliferation of ultramarine blue styles
1849	Select Committee on the School of Design prints manufacturers' returns
1851	Frederick Steiner's 1843 patent for making garancine from spent madder was repealed through a court case, promoting widespread use of the dye
1853	Civil engineer Frederick Braithwaite surveyed the River Wandle
1854	William Rigby patented his method of transferring patterns with a pantograph, no. 819
1854	Sixteen colour cylinder printing machine made for Kershaw, Leese and Co., who operated the Ardwick printworks and Reddish Vale printworks
1856	The Companies Act allowed limited companies to be formed with a minimum of seven shareholding members
1857	William Perkins's mauve commercially introduced, the first aniline dyestuff
1857	Lockett and Watson patent (no. 1853) and William Shields patent (no. 2758) bring important improvements to pantograph etching or cylinders
1857–1859	Revival of block printing in order to produce particular colour combinations, such as using madder and steam colours
1859	Magenta dye introduced
1863	John Lightfoot's aniline black patented
1867	Printing blue and green alongside madder colours at the same time was achieved by John Lightfoot's 'L colours', patent no. 3668
1868	Rivers Pollution Commission appointed. Their report in 1870 contained evidence from around thirty calico printers
1869	Parliamentary Report on the Printworks Act and on the Bleaching and Dyeing Works Act

1870	Alizarine successfully synthesised
1872	Visit of the Japanese ambassadors to Manchester
1877	Rocceline, or Fast Red A, introduced, creating a substitute for cochineal
1880	Azo dye applied to cotton, patented by Robert and Thomas Holliday, no. 2757
1881	William Morris (Morris and Co.) took over the Welch Brothers printworks site at Merton
1882	Manchester calico ball highlighted cotton as a fashion fabric
1885	Duplex cylinder printing (double-sided) became more widely adopted with the inventions of James McNab (patent no. 14,864), and Alexander Stevenson Young (patent no. 14,975). But Thomas Gadd's earlier duplex machine also gained widespread use
1891	Calico Printing Syndicate formed to promote amalgamation in the calico printing industry
1892	Robert Dewhurst and Co. of Birstall purchased the machinery for printing flannels from Swaislands
1893	Swaisland's Printing Company sale, Crayford
1894	Baker Tuckers print works sale, Garratt Lane, Tooting
1895	Embossing fine lines for lustre perfected in the patent of Ludwig Schreiner
1895	Meister, Lucius and Bruning introduced Para Red which became a substitute for Turkey red
1897	Mercerising for lustre brought into commercial practice
1897	Hoyle's printworks sale
1897	Synthetic indigo commercially introduced
1899	Calico Printers' Association conglomerate formed
1901	Schreinering process opened to all by a court judgement against the Bradford Dyers Association

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INTRODUCTION TO VOLUME III

Calico Printing: A Showcase for Innovation

Part 1 The spectacle of technology

Smoking chimneys, the sound of the factory bell and the clatter of clogs on cobble signalled the shift to industrial modes of working, but inside the factory gate was a world little known to those not part of the manufacturing realm. Charles Babbage, in the preface to his *Economy of Machinery and Manufactures* published in 1832, incited the leisured classes of Britain to instruct themselves by visiting their country's workshops:

> The difficulty of understanding the processes of manufactures has unfortunately been greatly overrated. . . . to apprehend their general principles and mutual relations, is within the power of almost every person possessing a tolerable education. Those who possess rank in a manufacturing country can scarcely be excused if they are entirely ignorant of principles whose development has produced its greatness.[1]

For the industrial spectator, Babbage laid out a 'method of observing manufactories' complete with a list of incisive social questions. However, a decade later, when George Dodd penned his *Days at the Factories*, the progressive nature of Babbage's enquiry had become diluted. Dodd wished to persuade workpeople that machines were beneficial, creating employment and ultimately increasing wealth. He revealed the workplace seen by *day*, disclosing clean and orderly processes with little mention of smoke or suffocating atmospheres, long hours or sweat. His was the respectable face of industry, providing an opportunity to be awed by the ingenuity of invention, the immensity of production, and the great fortune it all represented. Taken inside Hoyle's printworks in Manchester or Monteith's in Glasgow, the reader is held in thrall to the material transformation, while being steadily conveyed through the processing stages. Advancements in technology, and the synergy of design, mechanics and chemistry are hailed as the future.

Such idealised visions of the industrial workplace similarly guide the contributor to Cassell's *Illustrated Exhibitor* who conducts the reader through Welch's tablecloth works in 1852. There, men working outdoors mid-river are presumed

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to enjoy fine weather, and block printers wielding a heavy maul all day find that 'it becomes lighter by use'. But the quieter artisanal manufactory of Surrey did provide a more humanised workspace, conveyed by illustrations depicting rooms rather than isolated machines, and capturing in the windows the decorative plants cared for by the workpeople. It is noteworthy to find at Welch's works, recent advances in velvet printing carried out alongside hot press embossing, a technique surviving from the early eighteenth century.

William Fletcher visited Hoyle's works at Mayfield in 1871, some two decades after Dodd; a local man, he felt at ease mildly subverting the accepted factory narrative of the wonders of mechanised production. He questions the extreme amount of capital tied up in copper metal engraved with 'patternless patterns' [see figure 13], and he doesn't hesitate to scoff at the chemists with their opposing theories about the dunging process, leaving them still attached to an ancient method employing foul ingredients. But Fletcher shifts to the expected narrative for his finish, with praise for the new dyes and the attainments of chemistry – and for an enlightened management that pays to retain its skilled employees. In the end, the dignity of productive work is held to outweigh the loss of a green field and a former trout-filled river.

The latter part of the century saw calico printers taking a greater part in civic affairs; financial success was expected to translate into a role as councillor, magistrate or charitable benefactor of local education, health or religious affairs. In parallel, the focus of the spectator of industry shifts to the town hall, and to the calico printer's most artistic end products. In 1882, a Manchester 'calico ball' thronged by 1200 guests provided the opportunity to show off the technological breakthroughs that finally made cotton able to substitute for silk and claim attention as fashion.

At the end of the century, the British textile industry responded to growing competition and dwindling markets by forming large industrial combines. In 1899, the Calico Printers' Association, which amalgamated forty-six printing companies and thirteen merchant firms astonished contemporaries by its scale. To make the subject manageable, the *Illustrated London News* took up again the format of the factory visit, transporting the reader to one of 'those huge factories which nestle in the lovely valleys of the North, unseen and unthought of by the great world'. The wondrous spectacle of serried ranks of mammoth roller printing machines could now be shown in photographs, although the engraver had to black out distracting elements of industrial clutter. The writer here devoted rhetorical skills to senses other than vision, for example, contrasting the shattering noise of the beetling hammers with the quiet of the engraving room. As with antecedent factory visits, industry is idealised, but now focusing on the market for its products 'destined for transmission to the uttermost parts of the earth, where . . . the beautiful and wondrously varied productions of our calico-printers are welcomed with increasing appreciation'. To go behind the curtain of the staged spectacle of calico printing, it is necessary to hear directly from its players or those who knew them well. The next sections gather texts from designers, engravers, colourists and printers as they carry out their jobs, negotiate for recognition or explain their role to others.

Part 2 The empire of taste: role of the designer

William Kilburn (1745–1818) elevated the status of the designer by spearheading a successful campaign in 1787 to obtain copyright in designs. In 1832, a reflection on Kilburn's life, probably by a fellow designer, sketched the details of his career. Kilburn's petition to Parliament for copyright protection noted that Northern printworks were making cheapened versions of his patterns that harmed the marketability of the originals. This aroused much protest amongst the copyists in Lancashire but, by putting a stop to this abuse, passage of the copyright act stimulated the expansion of the design profession in Lancashire and eventually strengthened the Northern industry. The work of a Northern designer of the early nineteenth century is viewed here through a letter book begun in 1807 to record his design briefs. These set out clearly the universal dilemma of the designer; if a design is truly novel, it is pronounced 'too fantastical for our use', but if it lacks novelty, then 'It is of no use at all to be drawing old things that have been done before'.

Charles Swaisland's written regulations for his designers, drawn up in the mid-1840s, provide a wealth of detail concerning work in an in-house 'drawing shop' at a leading calico printing manufactory in the London region. By this time Southern printers concentrated on styles and qualities of work not produced in the North, with an emphasis on design for the fashion-led tastes at the higher end of the market. In the North, the industry focused increasingly on the mass market, and also the profitable export market that entailed colours and styles wildly at odds with prevailing British notions of taste. Northern printer Edmund Potter, lecturing in 1852, held the practical view that taste is ruled by demand – a matter of satisfying the consumer. But he was forced to reconcile this with the widely held opinion that there was a hierarchy of taste and the designer should work to improve the taste of the consumer. Thomas Bull, a freelance designer, took up defence of his profession in 1853, explaining the illogic of comparing French luxury design to British mass production. He challenged the detractors of British design to explain 'why mere lines, or stripes, should be called in good taste, excepting that they are produced just as the public want them!' Like Bull, the designer William Mercer spent several years working on the Continent. His description of a Parisian design atelier in 1857 exposes the fallacy of dividing design along national lines. Mercer's 'French' atelier contains a menage of Swiss, German, Dutch, Flemish, Alsatian, provincial French and Parisian figures along with a lone Englishman. If the designs emanating from Paris were superior, it was probably owing to this transnational creative stimulus.

The record of women's role in design for calico printing is fragmentary. An industry commentator of 1850 regretted that women were not offered training:

> It has often been matter of surprise to me that women are never educated as pattern designers. . . . [F]or, by a quick and vivid fancy, joined to a delicate and sensitive touch, women appear formed, with proper education,

> to excel in the art. And I believe that, generally speaking, with the same instruction, a young woman would from her greater quickness of perception, and innate love and appreciation of the beautiful, in five years arrive at a higher degree of excellence than a youth in seven.[2]

A letter of 1879 published in a trade journal helps to explain both women's continued exclusion through lack of training opportunities, and their inclusion by means of family-based enterprise.

The history of male designers is also compromised due to the anonymity enforced by Victorian employers. When a biography is available, it is often due to artistic accomplishments that succeeded the design career. Warwick Brookes provides a typical example; after a brief record of the artist's beginnings in design, the remainder of his design career is skipped over as beneath mention. In 1897, the designer George C. Haité attempted a broad survey of Victorian design that provided names of major figures and placed them into three stylistic groups: the early designers associated with the 1840s, the architectural designers of the 1870s, and his own contemporaries evolving what became called the Arts and Crafts style, that he saw as a true national expression. However, the majority of designers did not work on their own, but within a studio encompassing masters and apprentices. A description of the work of the Waterhouse studio in 1899 provides evidence of the employment of students from the schools of art, largely upon designs for export work. Arthur Wilcock sums up the status of the designer toward the end of our period in 1914, still anonymously working, 'content in his obscurity . . . without a representative guild, without degree or diploma'. Finally acknowledged as an artist, yet the designer could not 'quarrel with public taste'; 'the lines upon which the artist works are determined by the producer's knowledge of what the public demands'. The First World War was to decimate the design profession and end the status quo. A petition of 1918 records the startling figures:

> that prior to the War there were twenty nine Calico Print Designing establishments in Manchester and that these twenty nine establishments employed approximately one hundred and forty Designers, assistant Designers and apprentices. . . . [A]nd that at the present time there are only nine establishments working in Manchester and employing a total of fourteen Designers and Assistant Designers. That five of these Establishments have now only the Principal of the firm carrying on the work.[3]

It was this situation that finally opened up design as a career for women, and transformed design of the twentieth century.

Part 3 The principle of copying: role of the engraver

Continuous machine printing from engraved cylinders transformed the process of calico printing from an artisanal to an industrial production. Engraving was

central to the success of the process, and engraving for calico printing became a specialist trade with multiple subsidiary occupations. These were often carried on outside the printworks, in small workshops that have seldom left documentary records behind. The literature of engraving is sparse. There was only one English textbook on engraving, published near the end of our period, William Blackwood's *Calico Engraving* of 1913; its historical treatment is weak, and the technical treatment written for those with access to machinery and further instruction. The selection of texts favoured here are those that aid our understanding of the engraver's working life. We commence with the life story of the engraver William Greenhalgh, who began as an in-house engraver in the 1830s, before embarking on independent work in the 1840s, and finally emigrating to America to lead an in-house studio there. His career shows the esteem in which talented engravers were held, the lucrative potential of their work, and the pressures they faced. In 1871, his contemporary, Joseph Lockett junior, had the unusual honour of an obituary in the *Magazine of Art* that sketches the background of his family firm, the foremost in Britain. The story of the Lockett workshop is furthered by a newspaper article of 1894 that addresses technical developments in the field, and the important matter of recycling of engraved copper rollers. Finally, a 1923 lecture by a Scottish foreman engraver gives an insight into the multiple branches to which engraving for calico printing gave rise by the end of the century, each with its own apprenticeship: sketchmaker, hand engraver, pentagraph plate cutter, pentagraph engraver, etcher, die cutter, clammer (person who transfers the die onto the mill), and mill engraver. Even the semi-skilled roller polisher played a crucial role at the start and finish of operations. Engraving, which called for both artistic and technical proficiency, and entailed a high degree of tacit skill, left few documents behind; the work itself, executed on valuable copper, has been melted down. These imperfect texts give a glimpse, at least, of the engraver's workshop.

Part 4 The 'rainbow maker': role of the colourist

The practice of textile colouration was transformed over the course of the nineteenth century from a craft process based on trial and observation recorded through samples, to a rationalised one based on chemical principles and controlled by patent rights. Nevertheless, old ways and new continued side by side. Throughout the period, the ability to offer novel colour combinations and brilliancies remained a key factor in sales of printed textiles.

The notebook of calico printer Edward Vint of Crayford, around 1803–1805, is a representative example of the recipe-based practice at the start of the century. His notes reveal sharing of knowledge between printers, more than might be expected in an era of craft secrecy, including communications between the London and Lancashire regions. Enlightened self-interest promoted transmission of ideas once the initial novelty of discoveries had been exploited. John Mercer was a key figure in the next generation whose career spanned developments that saw the emergence of the specialist role of colourist. John Mercer junior outlined

his father's achievements at Oakenshaw printworks, especially in the 1820s and 1830s, formulating new methods and colour styles using variable systems of discharging and mordanting to offer novel colour combinations season-by-season. These methods, often with multiple stages, were made possible through experiential understanding of acids and alkalis, as well as oxidation and reduction agents, while still in the absence of precise formulas and valencies. Lyon Playfair, whose calico printing career began in the 1840s, shows the range of the colourist's activity, one directed toward finding cheaper and more direct methods of achieving ends spanning bleaching, water quality, and use of mordants. This work was not one of heroic discovery, but rather of incremental improvement under the control of economic factors. For example, printing of ultramarine blue pigment was possible using egg albumen as a binding agent, but the introduction of casein gum brought the price down to a popular level ensuring widespread application of the colour.

John Lightfoot's career encompassed the transition to synthetic dyes. His 1854 diary of visits to European printworks shows the approach of a professional eye to the factory visit, continually seeking out points of similarity and difference, alert to minor aspects like the way of straining colours, or the shape of buckets, along with more significant variations such as direct engraving with the ruling machine, or shearing rather than singeing cottons. Such observations portray the making of a young colourist outside the narrow confines of the laboratory. Of the same generation, Charles O'Neill also began with experience in the works, but was more accomplished in the literary way. His publications won him recognition as a knowledgeable voice on colouration, and made him sought after as a speaker and on exhibition juries. In 1862, O'Neill assessed advancements made in the decade after the Great Exhibition. Seeing how much-vaunted dyestuffs had been cast aside, he reserved judgement on the aniline dyes. He saw that the fundamental desire of the calico printer, and the direction for advancement, was to print colours directly, liberated from the need to print a mordant first and then develop the colour in a dye bath. O'Neill took the opportunity twenty-five years afterward to again look back at colouration achievements. On balance, he found little change in quality of work, mainly 'a lessening of cost of colour, and a lessening of labour to the colour mixer, and undoubtedly some colours are now brighter than then, . . . as to fastness of colour, except as regards the reds there has been no gain, perhaps even a loss'. But O'Neill staunchly defended the industry against those that condemned modern dyes out of hand, correctly noting that both fast and loose colours had existed in every age, and the important value was fitness for purpose.

William Henry Perkin was also of the generation born in the 1830s, himself credited with ushering the transition from natural to chemical dyes. In an address to the American Chemical Association in 1906 toward the end of his life, he recounts how he became involved in chemistry and his pioneering days as a manufacturer of aniline dyestuffs. Here, artisanal practices proved equally important as chemical understanding in creating workable procedures for mass production, including inventing suitable apparatus, and obtaining reagents from raw material

of indefinite quality. The workshop approach of the start of the century remained an essential support, not only for production of synthetic dyestuffs, but for establishing and demonstrating their practical application.

Part 5 In the workshop: the role of the printer

In this section we encounter voices that reveal the workings of the printing shop, the tensions arising from the move toward mechanisation, the attitude of workers and their uneasy relationship with employers. The progress of mechanical development is also outlined, sometimes at odds with later histories.

James Thomson's entries for Rees's *Cyclopaedia*, written in 1808, mark progress in engraved calico printing, and innovations in colouration at a time when there was scant practical literature. Cylinder printing was 'generally confined to one' colour, and mill engraving was notably absent. In an entry on indigo dyeing, Thomson clearly wished to be up-to-date, but not to fully reveal his discovery of the process that initiated the *lapis* style, quietly concealed by a generic technical description. However, Thomson was willing to be expansive on the discharge press developed by Montieth in Scotland, even signalling the latest development of hydraulic power. Samuel Parkes's description of calico printing, probably completed around 1811 but published in 1815, notes further technological advancements, most notably printing by surface roller and engraved cylinder. He makes the important observation that the engraved cylinder of the time, due to imperfect clearing, could leave colour on light grounds, and was thus favoured for 'styles which are full of colour', employing the surface roller for light ground styles.

Disputes with the journeymen calico printers over the introduction of machinery and the number of apprentices rumbled on from 1790 to 1815. A pair of tracts from the latter date allow us to hear the journeymen respond directly to their masters. Their resentments were focused on the surface printing machine rather than engraved cylinder printing as such. However, the London region is indicated as the source of a combined style of cylinder printing filled in by hand-blocking that did cause umbrage. We see here that cylinder printing was not a Northern development alone. The widening distance between social classes and the loss of power by workpeople is evidenced by a trade dispute of 1831 when the calico printing masters issued a reduced list of prices for piece work, blamed on the downturn of trade and strong competition. A strike was prompt but short-lived. Despite the repeal of the Combination Acts in 1824, employers effectively prevented collective bargaining not only through the use of 'blacklists', but because ordinary calico prints no longer required the high skill levels of former times. Rather than 'paying such wages as *valuable* and *ingenious* labour would deserve' as Edmund Potter predicted in his tract against the excise duty, a reduction resulted. Conditions for workers are more fully revealed in John L. Kennedy's report for the Children's Employment Commission, completed in 1841. Children under thirteen formed slightly more than a quarter of the calico printing workforce, about the same as those between thirteen and eighteen. Given the

earning potential of children, parents were increasingly tempted to take them from school at an early age. Kennedy's report gives voice to the children themselves, asking about working hours and cruelties, but also revealing kindnesses and spirit under adversity.

The chemist Edward A. Parnell lucidly classes the techniques and processes of calico printing in 1843, when at their most diverse. He marks at this time the phasing out of surface roller printing in Lancashire, although it continued in Ireland. The chance survival of a letter of 1849 from Charles Kenworthy, an elderly Manchester designer, relates the rise of surface roller printing in the 1780s, marking the other end of the date range. Kenworthy recollected surface roller printing at the Mosney printworks that was to fail so spectacularly in 1788, rather than Bell's engraved cylinders so often credited there.

This section ends with two expert accounts that contrast cylinder printing with block printing, bringing out their strengths and weaknesses in considerable detail. In 1881, William Turnbull, a consummate craftsman, wrote with the authority of practical experience on the cylinder machine, and the nuances of control, from the width and shape of a doctor blade, to the influence of speed on quality of work. Ernest Honey, in 1894, wrote with comparable depth about block printing, but from the manager's viewpoint, with cost and time constantly in mind.

Part 6 A seasonal and fancy trade

The excise duty on printed cottons was a long-standing grievance at the start of the century, forcing calico printers to endure daily intrusions on their premises for measuring and stamping of goods. A Select Committee of 1818 exposed the multiple problems of the system, but the tax remained. In 1830, a change of administration gave the Lancashire trade an opportunity to petition against the tax, and they pounced on it. Edmund Potter wrote an impassioned *Letter* to the Chancellor of the Exchequer reiterating all the arguments against the duty – from the fact that a tax per square yard fell most heavily on purchasers of cheaper prints, to the potential for fraud and the cost of administration. His *Letter* was felt to have played a significant role in annulment of the duty in March 1831, a cause of great celebration.

Another issue that gripped calico printers and print merchants was copyright. William Ross advocated against any extension of copyright in designs beyond the three-month period in force in 1840. The most convincing part of his argument concerned the rapid expansion of foreign competition, outside the reach of British copyright, and Ross authoritatively outlines the growth of European calico printing centres. The copyright debate was vociferous and at times acrimonious. While Ross's view that originality in design 'can scarcely be said to exist' runs counter to current tenets, it was in part justified by the open copying of patterns from other cultures that largely went unacknowledged in copyright discussions. Ross's nemesis was James Thomson, staunch supporter of design and defender of copyright. Thomson's 1841 riposte, focusing on the example of Belgium, demonstrated that European rivalry was exaggerated. His contacts revealed that cheap British prints,

left on hand at the end of the season, were dumped in Belgium under cost prices, undermining local production.

In 1849, design educator George Wallis delivered a lecture to the Society of Arts on the progress of calico printing. He traced the changes in design using the record books of the engravers Joseph Lockett and Son, perhaps the earliest archival approach to design history on the subject. Inevitably, his judgements are influenced by contemporary taste, and Wallis derides the patterns of 1828 to 1838 as broken and disconnected effects, barren of beauty. This intensely creative decade continued to reap disdain from nineteenth-century design reformers such as William Morris, but Wallis is probably the first to bracket its dates.[4]

In 1877, the *Textile Manufacturer* advocated for the reform of textile measurements in an article on the use and abuse of nominal measurements. In doing so, the journal recorded the conventions for technical specification in the trade, conventions that allow us to read what might otherwise seem like hieroglyphics in historical records, and also to appreciate that these have a customary interpretation as well as a literal meaning.

To close this section, an article comparing English and American calico printing in 1891 reveals that – contrary to mid-century expectations of printing in miles of cloth with the cylinder machine, English practitioners printed mainly short runs: 'small quantities as 300 yards to a colouring, and only two colourings to a design, are nearly the rule of the trade'. More time was spent in changing cylinders and creating short sample lengths than actual printing. But it was this ability to provide variety for customers that sustained the trade.

Part 7 Beginnings and endings

In the middle of the nineteenth century, the calico printing industry began to take notice of its own history. In Manchester, a public meeting was convened on 15 April 1856 to plan a written history and organise a museum of calico printing, albeit a project that did not reach fruition.[5] This awakening reflection on the industry's origins is the focus of three texts. In 1850, Benjamin Hargreaves looked back upon four decades of his family firm largely through a technological lens. He saw the record as one of innovation in colouration and engraving, and he ends with a contrast between 'then and now'. In the vein of reminiscence, Josiah Thomas Slugg recalled in 1881 the Manchester of his childhood a half-century before. He employed the city streets as a mnemonic device to run through the prominent calico printing warehouses, tying these to events and personalities, and evoking the character of the emerging industrial force in the town around the early 1830s. Finally, a contributor to the *Textile Mercury* in 1893, sensing the end of an era in the passing of the Swaisland calico printing firm of Crayford, took the occasion to attempt an account of block printing in the southern region. He found the industry largely faded from the memory even of the eldest inhabitants in the villages along the Wandle. The history of the calico printing industry perpetually came up against the same amnesia, and the unfinished nature of this article reflects that struggle.

While origins leave sparse trace, endings often leave a trail. James Thomson remarked only two endings for the calico printer, the *Gazette* or the grave, that is to say bankruptcy or death. Those who failed to pay their taxes faced the former end unless they fled the country. A series of manuscripts detailing excise debtors and inventorying their property provides rich information on the scale and equipage of printworks that would have otherwise escaped remark.

Newspaper sale notices often mark the end of calico printing at a site, documenting stripping the works of specialist machinery and utensils to make the land and buildings available for alternative industries. While summative rather than detailed in character, the items listed for sale tell of the design orientation and technological attainments of the company. The auction sales of Old Ford Print Works in 1811 offered an accumulation of over fifty years of block and plate patterns, but more surprising is that some 2000 patterns were claimed as no more than two years old. A pinned roller Stormont-printing device, and a two-colour surface machine by Adam Parkinson demonstrate that the London region did not leave the mechanisation of calico printing solely to the North, even at this early date.

A rare auction catalogue of the sale of Bridge Water and Shaw Bridge printworks of Clitheroe in 1848 provides a detailed room-by-room view of the arrangement and equipping of a mid-nineteenth century manufactory. Finally, the sale by public tender of the Garratt printworks details how sale 'as a going concern' with current orders on hand was handled. The particulars bring to light a specialist wax printing shop, possibly used for printing bandana-style handkerchiefs. Copperplates and copperplate presses would have been expected for a silk handkerchief printer, but the huge number of 60,000 printing blocks was unusual.[6]

Calico printing experienced intense change throughout the nineteenth century – in its patterns, its colouring materials and methods of engraving and printing – forming a showcase for advances in chemical and mechanical technology. In the first half of the century the industry also dealt with changes in its workforce and printing sites, while in the latter half, markets, scale of production and business organisation witnessed transformative disruptions. Nevertheless, new technologies and practices tended to be added on rather than fully ousting the old, equipping British calico printing for its wide market range. At the end of the century, simple indigo resists and traditional madder-dyed prints were still produced alongside multi-colour cretonnes and the latest fashion novelties.

In 1879, George Wagstaffe Yapp, compiler of the official catalogues of the Great Exhibition, edited a volume on art industries, including a section on calico printing. Outlining the challenges for the designer, his comments seem to summarise the key constant running across the century:

> In calico printing, as in all branches of textile manufacture, the grand difficulty is to have a constant succession of novelties; each summer and each winter must have its new patterns, however good were those of last summer and last winter; novelty is the only food with which fashion

> is satisfied. Old patterns are sent abroad, but at home, and also for the foreign trade, new must be provided. One difficulty connected with this demand is that it cannot be supplied in a day, nor a week, but requires a good deal of study and several months' time, so that in fact the preparation for the coming season is made when the preceding one is just commenced; the spring flowers are produced in the depth of winter, and the summer flowers blossom in fog and snow.[7]

Notes

1 C. Babbage, *On the Economy of Machinery and Manufactures* (London: Charles Knight, 1832), p. v.
2 *Manchester Examiner and Times*, 19 Oct 1850, p. 3.
3 TNA. NATS 1/1149. Petition to the Ministry of National Service, 1918.
4 It was a time period that presaged much of the imagery that became part of modern movements of the first half of the twentieth century.
5 *Manchester Guardian*, 19 Apr 1856, p. 5.
6 These blocks were taken to Langley printworks near Macclesfield. Some may have been included in the sale by Richard Stephens of 56,000 blocks to Giordano Zucchi, known as the Zucchi Collection of Antique Handblocks 1785–1935. See E. Mocchetti, *Il Passato Ritrovato: da antichi blocchi da stampa tessuti per abitare* (Milan: Giorgio Mondadori, 1991).
7 Yapp, G. W. (ed.). *Art Industry: Furniture, Upholstery, and House-Decoration illustrative of the arts of the carpenter, joiner, cabinet-maker, painter, decorator, and upholsterer* (London: J. S. Virtue & Co. Ltd, 1879), p. 73.

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Part 1

THE SPECTACLE OF TECHNOLOGY

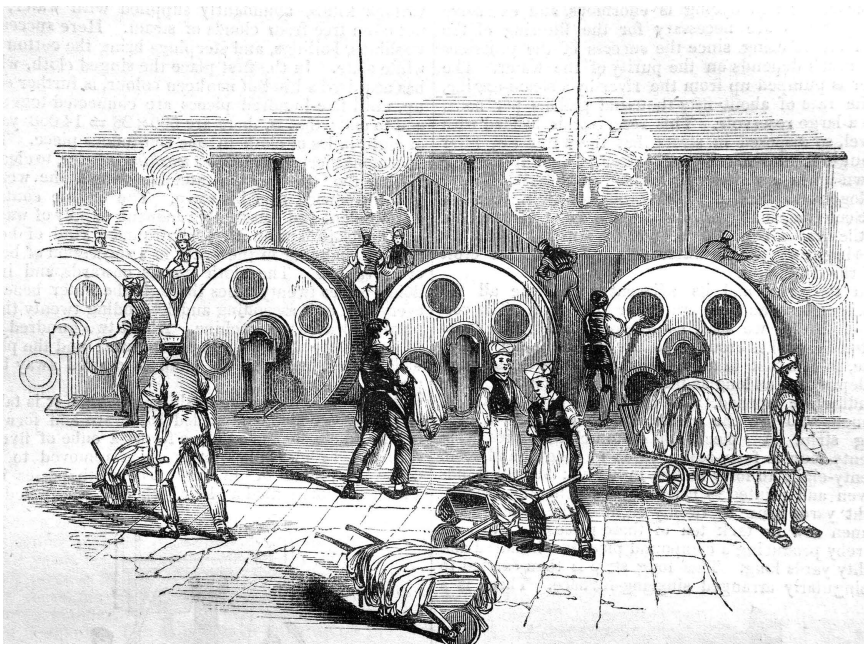


Fig. 1 Washing by dash wheels at Hoyle's printworks. Wood engraving.
Source: *The Penny Magazine*, 12:727 (29 Jul 1843), p. 289. Author's collection.

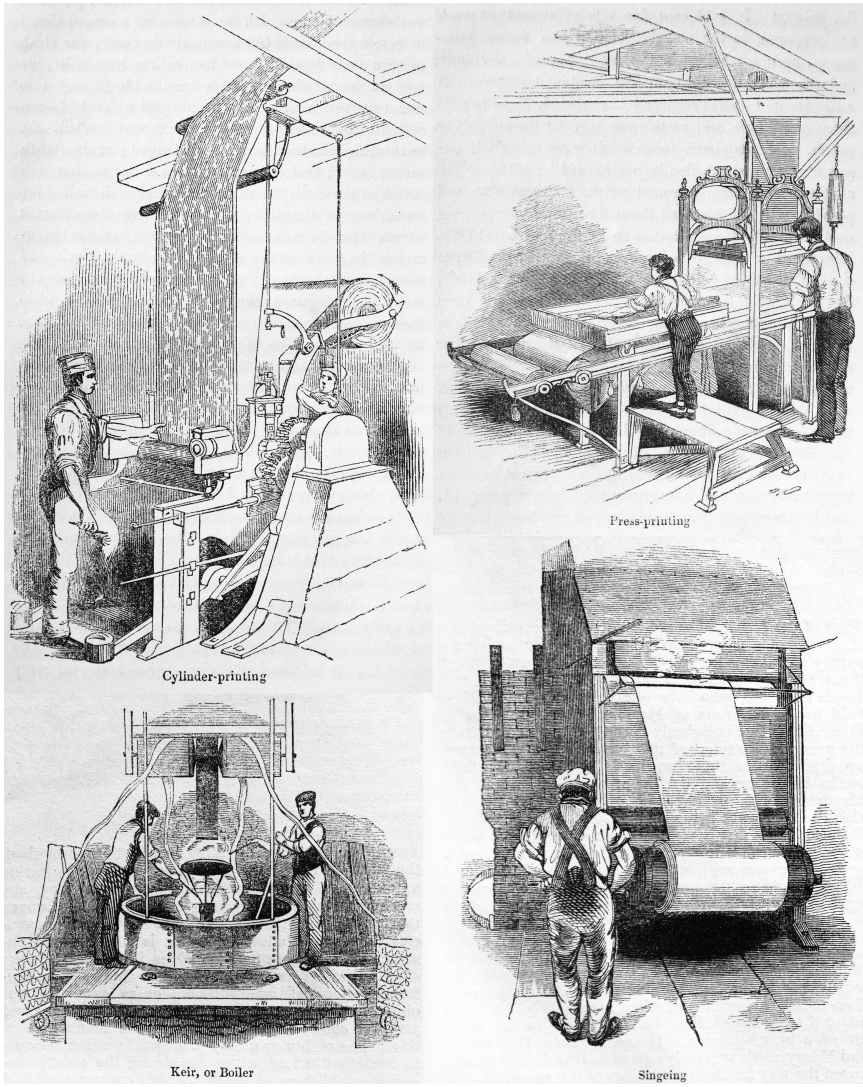


Fig. 2 Kier boiling and singeing at Dukinfield; cylinder printing and press printing at Mayfield, Thomas Hoyle and Sons. Wood engravings.

Source: *The Penny Magazine*, 12:727 (29 Jul 1843), pp. 290, 294, 296. Author's collection.

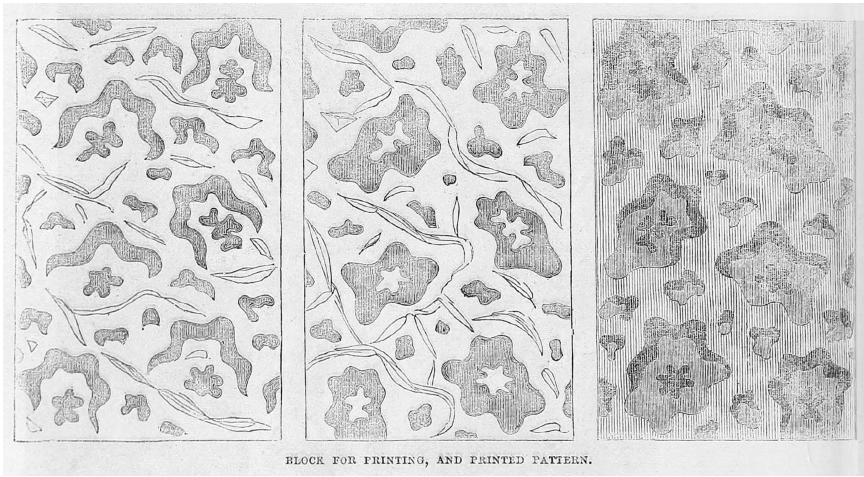


Fig. 3 Blocks for printing a leopard spot design, and the table cover pattern printed from the blocks.

Source: *The Illustrated Exhibitor and Magazine of Art*, 2:30 (24 July 1852), p. 54. Author's collection.

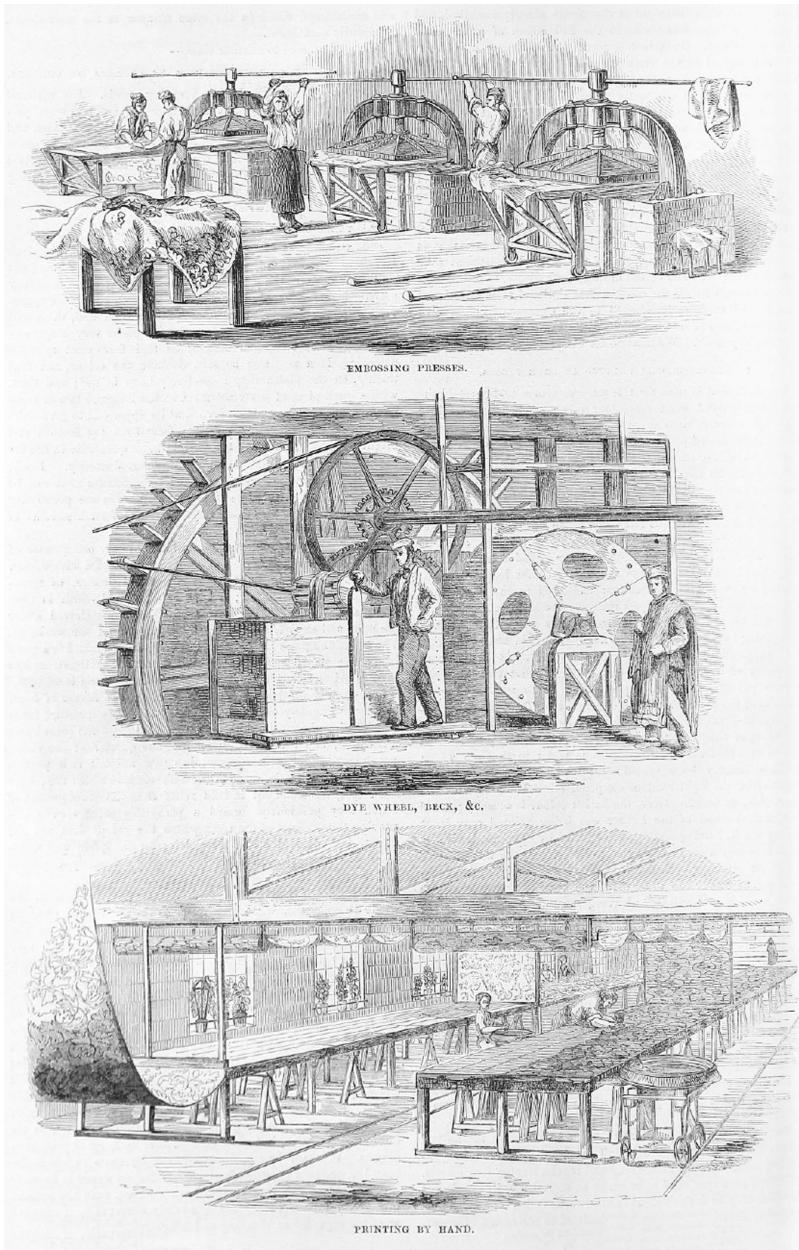
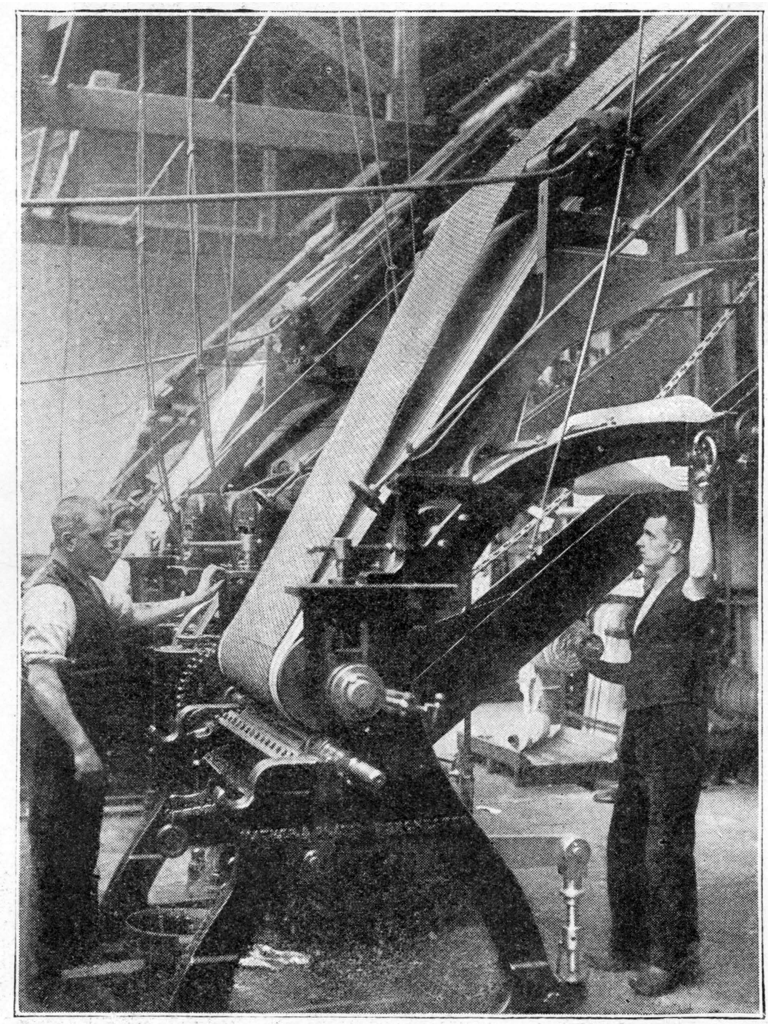


Fig. 4 Embossing presses, dye wheel, and hand-block printing at Welch's printworks in Merton.

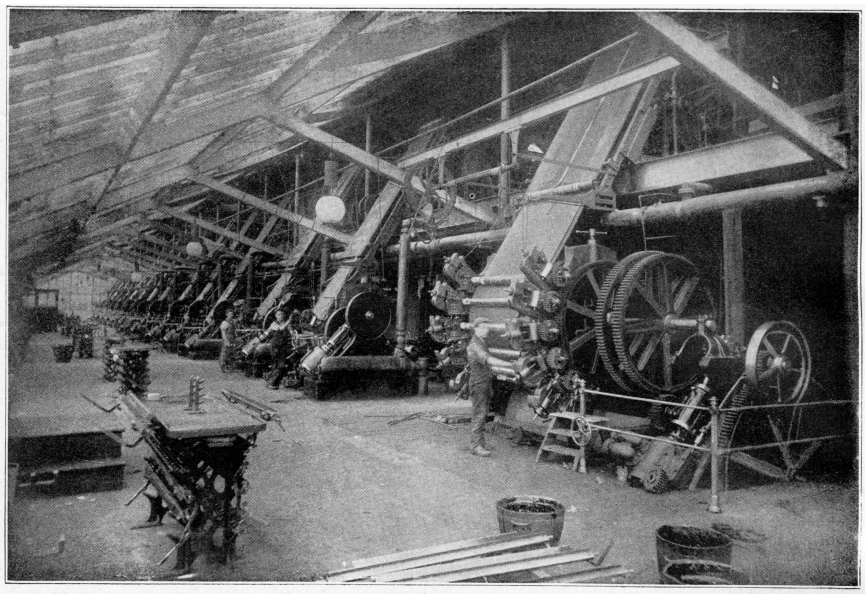
Source: *The Illustrated Exhibitor and Magazine of Art*, 2:30 (24 July 1852), p. 56. Author's collection.



A ONE-COLOUR CALICO-PRINTING MACHINE FOR SHIRTING STYLES, DRIVEN BY ELECTRIC MOTOR.

Fig. 5 A one-colour calico-printing machine for shirting styles, driven by electric motor, possibly at Buckton Vale printworks.

Source: *Illustrated London News*, 115: 3163 (2 Dec 1899), p. 801. ©Illustrated London News Ltd/ Mary Evans.



IN A CALICO-PRINTING MACHINE-ROOM.

Fig. 6 A large calico-printing machine-room, possibly at Buckton Vale printworks.

Source: *Illustrated London News*, 115: 3163 (2 Dec 1899), p. 802. ©Illustrated London News Ltd/ Mary Evans.

Editorial Headnote

Dodd, George. 'A Day at a Lancashire Print-Work', *The Penny Magazine of the Society for the Diffusion of Useful Knowledge*, 12:727 (29 July 1843), pp. 289–296; Dodd, George. 'A Day at the Barrowfield Dye-Works, Glasgow', *The Penny Magazine of the Society for the Diffusion of Useful Knowledge*, 13:791 (27 July 1844), pp. 289–293.

Charles Knight (1791–1873) published the *Penny Magazine* for the Society for the Diffusion of Useful Knowledge. This weekly periodical began 31 March 1832 with the aim of reaching a working-class readership, using illustrations as part of its appeal. Its didactic articles could not compete with the draw of popular fiction, but were eminently readable. Dodd's narrative of the operations of a printworks is admirable for its clarity of technical description, seldom achieved in writing about printed textiles.

George Dodd (1808–1881) was held as a 'veteran in the field of popular literature . . . for nearly half a century a diligent, painstaking, and conscientious writer' (*The Athenaeum*, Iss. 2779, 29 Jan 1881, p. 167). As a member of Charles Knight's literary staff, he wrote numerous articles on industrial subjects. Many of these were collected into published volumes, notably *Days at the Factories* in 1843. Workmen admitted the book would find public acceptance, but themselves found Dodd's industrial descriptions superficial and out of date:

> He makes a great deal too many claims upon the wonder and admiration of his readers, and is occasionally intolerably long-winded respecting some of the simplest and most familiar processes . . . antiquities are spoken of as if they were the perfection of modern practice. . . . This book is consequently of no authority with practical persons.
>
> (*The Artizan*, 5, 31 May 1843, p. 107)

One such outdated process that would have irritated artisan critics is the singeing of cotton over heated metal, by then superseded by gas singeing. To be fair however, Dodd reserves claims of recent introduction to appropriate techniques.

Dodd chose a factory visit to Thomas Hoyle and Sons as the framing device for the Lancashire printworks article. However, the narrative of the visitor experience, with the steamy atmosphere of the dye-works and the densely sited printworks buildings, is somewhat secondary to a generalised explanation of industry practices. When the article was modified as the second chapter of *The Textile Manufactures of Great Britain* (London: Charles Knight, 1844), it was a simple matter for Dodd to drop out site-specific aspects particular to the individual printworks visit, and treat it as a generic description of bleaching, dyeing and printing of cottons. The same erasure of place was practised with the visit to Monteith's Barrowfield works which Dodd merged with the calico printing article in the new chapter. Here we return to the original versions.

1

DODD, GEORGE. 'A DAY AT A LANCASHIRE PRINT-WORK' AND 'A DAY AT THE BARROWFIELD DYE-WORKS, GLASGOW'

The Penny Magazine (29 July 1843), pp. 289–296; (27 July 1844), pp. 289–293.

A day at a Lancashire print-work

There is, perhaps, no other occupation throughout the whole circle of the manufacturing arts requiring so extensive a combination of taste, chemistry, and mechanism as *calico-printing*, or the printing of woven fabrics. The combination of three such opposite agencies may sound oddly; but this is the very circumstance which places the operations in so high a rank; since, although we may meet with as fine taste, as dexterous chemical manipulation, or as exquisite machinery in many other manufactures, we nowhere find all three combined in so remarkable a manner as in this. The eighty or ninety print-works which are now in operation in Lancashire are among the most interesting establishments in the county;[1] and we shall find a 'visit' to one of them both pleasant and instructive.

When calico, muslin, or other cotton fabrics have been spun and woven, as described in our last Supplement,[2] they generally undergo one or more finishing processes before being brought to market. If they are to be sold in the white state, they require *bleaching*; if in a coloured state, they require *dyeing*; if in a decorated or ornamented state, they require *printing*; and hence it arises that there are in Lancashire, as also in the Glasgow district, *bleach-works*, *dye-works*, and *print-works*. As, however, a well-printed piece of cotton requires to be bleached and dyed as well as printed, the print-works have, in most cases, the means for carrying on the bleaching and dyeing, as well as the printing processes; and we have thus facilities for witnessing all three operations in one establishment. Most of the print-works are situated in the valleys at a short distance from Manchester, in order to have a supply of water from the streams which flow through them. The proprietors of the eminent firm of Thomas Hoyle and Sons, who have one establishment at Mayfield, in the environs of Manchester,[3] and another at Dukinfield, have obligingly permitted us to illustrate the general character of this branch of manufacture by reference to those works. At the Dukinfield works bleaching and

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dyeing are carried on;[4] at the Mayfield works, dyeing and printing; and we will visit the former, as being preparatory to the latter.

Bleaching is now a very different process from what it was in the last century. At that time it required a period of several months to bleach a piece of cloth, and this, too, only in the summer time: in some cases the cloth was sent in the spring of the year to Holland, to be bleached on the level grassy plains of that country, and returned in the autumn; while in other cases, when bleached in the English fields, there was so much depredation as to lead to an unhappy system of severe laws and general distrust. Chemists were thence led to inquire whether means might not be adopted more expeditious than exposure to the open air of a bleach-ground. Home, Scheele, Berthollet, and Henry,[5] made successive steps in this direction, and paved the way for the introduction of the use of *bleaching-powder*, by Mr. Tennant, about the year 1800.[6] From that date the present most efficient system of bleaching has been followed in the great works of the north;[7] and we shall be enabled to see how the processes are practically conducted.

The Dukinfield works occupy a very large area of ground on the banks of the Tame, about six miles from Manchester, comprising the *croft* or bleach-house, the dye-house, the reservoirs and water-filters, and subsidiary buildings. The supply of water required in bleaching and dyeing is enormous, and extensive arrangements are necessary for the filtering of the water before using, since the success of the processes very much depends on the purity of the water. The water is pumped up from the river by a steam-engine, into a large reservoir. This reservoir is bedded with gravel, so disposed in strata that the water can filter through it into a receptacle, from which it may be drawn up in a pure state: in fact, the filtering is very analogous to that of the 'thorough-draining' system in Scotch agriculture, in which the water is collected in tile-drains beneath the porous strata.[8] From this filtering reservoir the water is conveyed to the croft and the dye-house.

In the croft and its adjacent rooms are all the arrangements and apparatus for bleaching. The cotton-cloth (for we shall confine our details chiefly to cotton fabrics) is brought to the works in the 'grey' state, in compact bundles about a foot wide, as much in depth, and as long as the width of the cloth. These bundles are opened, and consigned to the care of women, who sew the pieces, end to end, into a very long strip. A 'piece' of cotton-cloth varies from twenty-four to forty-seven yards in length, and from twenty-eight to forty inches in width; but the kinds woven and printed in England are generally twenty-eight yards long by twenty-eight inches wide. The women sew or tack ten of these pieces end to end, thereby producing a compound piece two hundred and eighty yards long. This long strip is then carried to a singularly arranged singeing-furnace. There is a heated surface of copper, over which the strip of cotton is drawn rapidly one, two, or three times, by which the light hairy filaments are singed from the surface of the cloth; and the cotton passes round a wet roller to cool from the effects of the singeing.[9]

Matters are then ready for the bleaching process. The *croft* (so named probably because it renders the same service as the croft or bleaching-ground under the old

system) is a large and busily-occupied stone-floored building, filled with coppers and vessels of various kinds, abundantly supplied with water, and not often free from clouds of steam. Here successive washings, boiling, and steepings bring the cotton to a white state. In the first place the singed cloth, which has acquired a kind of nankeen colour,[10] is further sewn up, until five hundred pieces are connected together, end to end; that is, there are 500 x 28 = 14,000 yards, or eight miles of cloth in one continuous piece. This enormous piece passes into a *washing-engine*, to cleanse it from the 'dressing' or mucilage which the weaver had introduced into his warp. The engine contains an abundant and constantly renewing supply of water; and the cloth is wound spirally round a kind of beam above it, hanging in the water in a succession of bends or curvatures. The cloth travels onwards, and in so doing passes twenty times through the water beneath, every part of it ascending and descending twenty times before it leaves the machine. About two hundred and fifty yards are thus washed per minute; and the paste which is washed from the cloth is carried away by a pipe to the river.

As the cloth leaves the washing machine, it is taken by one or two men, and folded backward and forward till the whole connected piece forms a cube of five or six feet. From this heap it is again removed to undergo the process of 'liming.' The cloth passes into a kind of boiler called a 'kier,' where it is exposed for eight or ten hours to the action of a solution of lime, forty pounds of lime being used for the eight miles of cloth. In this kier the hot liquor is brought up a central tube in such a manner, that, being echoed or reflected from the surface above, it falls down on the cloth in a profuse shower, thus acting equally on the whole of the cloth. The cloth is next subjected to a second washing, to remove the lime which may be retained by its fibres. Then ensues the process of 'grey souring,' in which the cloth passes through a machine similar to the washing-machine, but containing very dilute sulphuric acid, instead of water; and after this there is a third washing in the machine, to remove all the adherent acid. After this comes the 'first ashing.'[11] Twenty-four miles of cloth (the real extent of operations will be better appreciated thus than by speaking of 1500 pieces)[12] are put into a kier, or cast-iron boiler, and exposed for sixteen hours to the action of a boiling-hot solution of soda: this constitutes the 'ashing.' Then, for a fourth time, the cloth is washed, preparatory to the process oddly named 'chemicking.'[13] Why bleaching-powder should be called 'chemick,' and the process of applying it 'chemicking,' we do not know, unless on account of its being the most important chemical agent in bleaching: but such is the language of the bleachery. A weak solution of bleaching-powder, or chloride of lime, is put into a machine something like the washing-machine, and the cloth is passed through it. After lying wet in a heap for six or eight hours, to allow the 'chemick' to act on the fibres, the cloth goes through the process of 'second souring' in weak sulphuric acid, somewhat as before. It is then washed for a fifth time in the machine; to which succeeds the 'second ashing;' then a sixth washing; then a 'second chemicking;' then a 'third souring;' and then a seventh washing. It will thus be seen that there is a succession of processes following in a certain order; the three agents, sulphuric acid, soda, and bleaching-powder being

separately applied, each more than once, and the cloth being washed in clean water after every such application. So powerful is the bleaching-agent, that 7 lb. of chloride of lime are said to suffice for the bleaching of 500 pieces of cloth. The machines here described are a late improvement; for until recently the cloth was dipped in tanks to be 'soured' and 'chemicked,' and thence hauled up by poles.[14]

After a process of 'hot-watering' and squeezing, the cloth leaves the bustling and well-filled croft, and passes up into an upper room, where it is formed into a pile on a wheel carriage, and wheeled to a long table or bench. Boys and girls than take the cloth in hand, and rip or pick the pieces asunder, so that each piece of 28 yards becomes again separated from the others. Each piece is folded into a flat square mass, and men beat these masses against the edge of a stone in a peculiar manner, for the purpose of removing creases from the cloth. The cloth is then hung up on wooden bars in a drying-room, which is heated to a high temperature by steam-pipes near the floor. Finally, the bleached cloth, which now presents a whiteness of the utmost purity, is brought into the warehouse, sorted, and tied up into parcels of ten pieces each.

Such is a brief sketch of the process of bleaching; and whether we notice it in connection with dyeing and printing, as in the present case, or take the instance of a bleachery independent of them (of which there are many in Lancashire), the preceding details will equally serve to convey a general idea of this important process.

Let us next visit the *dye-house*. The five thousand miles of cloth which are bleached in a year in the 'croft' are next dyed before they are printed, or else printed before they are dyed, according to circumstances; and the dyeing is in some cases effected here, at Dukinfield, and in others at the Mayfield establishment. The dye-house at Dukinfield is, we believe, deemed one of the finest in the kingdom. It is more than a hundred feet square, and is provided with a very complete system of drainage, to carry off the vast quantity of soiled water which every day's operations render useless. It is a low-roofed building provided with skylights, which can be opened when necessary. The chances are, when a stranger first visits the building, that he will be totally unable to see the machines, the workmen, or the processes within, on account of the dense atmosphere of steam from the various coppers and boilers; but upon becoming a little used to this source of discomfort, he sees that there are vessels of various kinds ranged in rows from end to end of the building. These vessels we may briefly describe thus: –

The 'dash-wheel,' of which there are several, is a hollow circular wheel, about six feet in diameter and two feet deep, having four compartments within, and four circular openings in one face, one to each compartment [see figure 1]. Water is admitted to the interior of the wheel by a pipe close to or concentric with the axis on which the wheel rotates. Cloth is put into each of the compartments, and water being also admitted, the wheel is made to rotate rapidly, and thus to wash the cloth by violent agitation. Another kind of vessel, of which the varieties are more numerous than any other vessels in the dye-house is the 'beck,' or tank, having over it a kind of frame-work rotated by a winch. In all such machines, whether called 'dye-becks,' 'soap-becks,' or others, the cloth is wound or wrapped on the

frame, so as to dip into liquor contained in the beck; and the rotation of the frame by means of a winch causes every part of the cloth to dip successively into the liquor. This is a very common method of saturating cloth with the various liquids employed in dyeing; the liquids being in most cases heated by steam. 'Cisterns' of various kinds are employed to steep the goods, without the aid of the winch apparatus above. There is also a beautiful machine, the operation of which is to drive out nearly all the water after steeping in any of the liquors. The machine consists of a double vessel, the inner one of which is perforated: the wet cloth being put into the inner vessel, and rotated with a velocity of nearly one thousand revolutions in a minute, the centrifugal force thus generated drives the cloth in close contact with the perforated surface, and forces all the water through the perforations, leaving the cloth nearly dry.[15]

The spot where this establishment is situated, viz. Dukinfield, is one of those to which we alluded in the last Supplement as having sprung up into importance solely through the agency of the cotton-manufacture. Cotton-factories are to be seen at a little distance from it on either side, comprised within the limits of Staley Bridge, Ashton, Dukinfield, and Hyde; and the Mersey, or, as it is here called, the Tame, winds past many a bleach-ground and dye-work in its progress towards the sea.

We will now follow the bleached cloth to the establishment at Mayfield, where it is to undergo the beautiful and important process of printing. Mayfield was at one time really a field, before Manchester made such giant strides on every side; but it is now part of Manchester, in the same way as Mayfair is part of London. The works at Mayfield have been gradually increasing in extent for sixty years, and now appear more like a small town than a single establishment, for there are so many open courts and small lanes and passages, so many distinct and isolated buildings, and the whole cover so large an area of ground, that a visitor is apt to lose sight of the connection between them, and to forget that they form, in fact, but one great workshop. There are several distinct departments, which, noticed separately, will serve to convey a notion of the general arrangement of a large print-work; such as the mechanical department, the chemical department, the reservoirs, the designing or artistic department, the printing department, the dye-house, and the finishing.

Many of the printing-machines, the mixing-machines, and other pieces of mechanism incidental to dyeing and drying, require frequent adjustment and repair, as well as constant and efficient moving-power. Hence steam-engines, engine-houses, millwrights' shops, smiths' shops, and other analogous arrangements, are provided, as in most large establishments in the manufacturing districts.

The chemical department is, however, infinitely more important, or rather, it is more characteristic of a print-work. Perhaps there is no one in any occupation or station of life more conversant with practical chemistry than a first-rate calico-printer. He must study not only the chemical effects of one drug upon another, but the degree in which the vegetable fibres of the cloth will retain those drugs and combine with them; and in endeavouring to imitate the colours of a selected

design, he must choose such colouring-agents as will impart to cloth the same tints as the design exhibits on paper. He has to determine also, by oft-repeated experiments, what combinations will make 'fast' colours, since the reputation of the firm greatly depends upon this. Hence in every large print-work there is either a partner or a manager thoroughly versed in practical chemistry; and the drug or chemical department in such establishments shows the importance attached to this matter. At the Mayfield works there is a laboratory fitted up with all the requisite apparatus, such as retorts, sand-baths, furnaces, &c. for making chemical experiments. The shelves are filled with phials and vessels containing most of the usual acids, alkalis, salts, and metallic oxides to be experimented on: and in an adjoining apartment is a chemical library, containing most of the standard works on the theory and practice of chemistry. The calico-printer must not lag behind in the march of science; he must know all new important facts relating to the chemistry of colours as soon as they are made public, and he must therefore have at command the requisite documents and sources of information. Near the laboratory is the colour-house, a large and lofty workshop in which the colours are prepared. Around are dozens and scores of boxes, barrels, jars, and bottles, containing the crude drugs as brought from the manufacturers; and near at hand are the vessels in which and the apparatus by which these drugs are brought into a fit state for use. Copper vessels heated by steam, like sugar-pans, mixing barrels, crushing and grinding apparatus, &c. form some portion of these arrangements.

The reservoirs for containing and filtering the water are similar to those at Dukinfield, and cover a considerable area of ground, almost close to the viaduct of the Manchester and Birmingham Railway: indeed we believe the railway was carried through part of the ground of the works. The reservoirs are emptied from time to time, in order that the layer of gravel at the bottom may be renewed, and a clean stratum laid down, as an efficient filtering medium. A very extensive system of pipes is provided to carry the water to the various vessels where it may be required for use.

Next we come to the highly interesting and important *designing* or *artistic* department, in which all the devices[16] are produced for printing on the cloth. The mode in which these designs are imprinted is very little known, except in the immediate manufacturing districts; nor was the extent of the artistic arrangements at all generally suspected until the Parliamentary Committee on the Copyright of Designs made their Report in 1840.[17] The mode of printing, as we shall presently explain, is a kind of combination of the methods employed in floor-cloth printing, paper-staining, and common press-work, as also machine-printing and colour-printing; for it combines the principle of all these varieties. But before detailing these, we must speak of the designs themselves.

Every piece of printed calico, muslin, or "mousseline de laine,"[18] receives its impress from either a piece of metal or a piece of wood; the wood or metal having on its surface a device copied from a coloured drawing on paper. The drawing of these designs is an extensive branch of employment at Manchester; since a rapid succession of novelties in design is one of the points on which the calico-printer

relies for success. No matter how elegant a pattern may be, or how great a favourite it may become with purchasers, it will soon outlive its beauties and acquire that worst of all characters, *i.e.* being "out of fashion." There must thus at all times be new designs in preparation to replace not only those which have had a good run, but those which may from the first prove unsuccessful; for the public, in its wisdom, will sometimes refuse to countenance a design which the printer may have flattered himself is very elegant; and the printer himself may find that a design which looks well on paper will not turn out favourably on cloth. After a design is sketched, it is examined and studied in various ways before being engraved, since the engraving is a much more expensive operation than the designing; and it generally happens that only a very small proportion of the designs which are made are afterwards engraved for printing. Mr. Salis Schwabe, in his evidence before the Committee, stated that in the year 1838 he had between two and three thousand patterns designed, of which only about five hundred were selected for engraving. The whole of the patterns, in designing and engraving, cost more than five thousand pounds within the year; and this, it must be remembered, was for the patterns for one house only, and in one year. In such a case as this, after the two or three thousand patterns had been sketched, five hundred were engraved, as deemed likely to pay well;[19] but even of this number the printer cannot tell how many may utterly fail – either from the fickleness of the public taste, or from more attractive patterns being produced about the same time – to have a large sale. Mr. Schwabe stated, in illustration of this point, that of the five hundred engraved, only one hundred were decidedly successful; fifty others had a middling result; and the rest had a less favourable fate. Another witness estimated the number of designers in Manchester at five hundred, and supposed that they might produce, one with another, twenty designs per week each, making half a million in the year.[20] Three witnesses estimated that, taking the number of pieces per annum printed in Lancashire, and the wages paid to designers, that the designing costs from a halfpenny to three farthings per piece of cloth.[21] Some of the designs are intended chiefly for the home market; some especially gaudy patterns, find a more ready sale in foreign parts; while others are equally favourites both at home and abroad. Some patterns, again, are intended for "furniture prints;" that is, for window-curtains, bed-curtains, chair and sofa covers, &c.; while others, comprising the larger portion, are for "garment-prints," whose name sufficiently indicates the character. Furniture patterns are generally more elaborate than garment patterns, and become more expensive. Without entering upon the various opinions expressed before the Committee, as to the effect of a copyright in improving the quality of designs, we shall simply state, that at the time the Committee was appointed, three months' copyright existed; but in September, 1842, a new act came into operation, by which designs for garment-prints were awarded a copyright of nine months, while those for furniture-prints obtained a copyright of three years; every design being registered in a book kept by a registrar appointed by the Board of Trade.[22]

Some of the manufacturing firms purchase their designs from persons who offer them for sale; but the more eminent houses have an establishment of designers

and engravers under their own roof. Such is the case at Mayfield. In the designing-room are persons constantly exercising their taste in developing new designs. Sometimes they attempt a new "pattern;" sometimes a new "style;" for among calico-printers the term pattern is applied to disposition of forms, while style is applied to disposition of colours. In recesses and on tables in the room are large folio volumes containing specimens of all the patterns ever printed by the firm, as well as specimens of the finest foreign productions. The drawings are each about four inches square, and fully coloured. So numerous are the chances against success, that not more than one pattern in about a hundred is finally worked to a successful result; for probably eighty out of a hundred are rejected while yet on paper, and of the remaining twenty not more than one will stand all the severe tests to which it will be exposed, in respect to beauty of appearance on the cloth, facility of working, fastness of colour, and good fortune with respect to the public taste. Hence arises a necessity for an incessant addition to the stock of new patterns.

When the designs are drawn, they are transferred either to wood or to metal, according to the mode of printing adopted. The wood-blocks measure about twelve inches by seven. They have a smooth surface of sycamore on a substratum of some commoner kind of wood; and the design, after being sketched on the block, is cut as in common wood-engraving; the parts being left prominent which are to constitute and print the pattern. In some patterns, where there are fine lines, the wood would soon be worn away or brought to a defective state by use; and to obviate this, little slips of copper are inserted into delicate grooves cut for them, the copper slips all standing at an equal height, and forming the printing surface. Small pieces of felt are in some places introduced to fill up the interstices between the coppers, so as to imprint a broader patch of colour. One block can only print one colour; and therefore if five or six colours form the design, and all be printed by blocks, there must be five or six blocks, all equal in size, but the raised parts in each block corresponding with the depressed parts in all the other blocks. The principle involved is precisely the same as that displayed in Floor-cloth printing, which we illustrated with a wood-cut in p. 343 of the last volume.[23]

Another method, quite of modern introduction, is somewhat analogous to stereotype printing.[24] In the first place a model is formed from the design, comprising so much of it as may be included within a space of five inches long by an inch and a half wide. This model is formed of bits of metal inserted into a ground or block; and a mould is produced by stamping from the model. From the mould, fixed in a block and adjusted in a convenient way, stereotype pieces or copies are produced, in a mixed metal of tin, lead, and bismuth. When a number of these pieces are prepared, their surfaces are brought to a perfect level by means of a file, and they are then firmly fixed down upon a stout and carefully prepared piece of wood.

Down to about the year 1785, all woven goods were printed by the block method,[25] but the slowness of the process led to an invention in which the principle of copper-plate printing was employed instead of that of common or press-printing; that is to say, the device is cut *in* a surface of copper, instead of being

left *at* the surface of wood. In the 'roller-room' at Mayfield we see indications of the extent to which this method is employed. This room is filled with hollow rollers or cylinders, the external surfaces of which are engraved with devices. Some of the cylinders are about forty inches long, and others about thirty; but all are about five inches in diameter, and half an inch thick.[26] In preparing these cylinders for engraving, the exterior is first brought to the most rigorous exactness and smoothness of surface. The exact circumference of the cylinder is taken by a piece of paper, and on this paper is copied the design, so adjusted that exactly one repetition, or a complete number of repetitions, of the design, may occupy the entire width of the paper, and consequently the entire circumference of the cylinder. Each cylinder is for one colour only, and therefore the paper receives only that part of the design which is to be printed in one colour. The device is slightly marked on the surface of the copper by transference from a kind of waxed paper; and the cylinder then passes into the hands of the engraver who cuts it by the usual sorts of tools employed by the copper-plate engraver. A most scrupulous exactness of adjustment is requisite in marking and engraving the different cylinders for one device, in order that each one may imprint a particular colour in the precise spot required.

This was the original mode of engraving the cylinders, but Mr. Perkins's principle of multiplying steel plates has been most ingeniously applied to these cylinders.[27] Mr. Lockett introduced this method into Manchester about the year 1808, and it is thus carried on.[28] A small soft steel cylinder is provided, about three inches long by one inch in thickness; and this cylinder is engraved with so much of the device as its surface will contain. The cylinder is then hardened, and made to give an impress to a softer cylinder, the device being of course *raised* in the second cylinder instead of *sunk*; the second cylinder is then hardened, as the first had been, and becomes the instrument for impressing on the surface of the large copper cylinder the whole of its device. The small original cylinder is called the *die*; the second is called the *mill*; and this mill is applied successively, by the aid of great pressure, to every part of the copper cylinder. The advantage of this method consists in this: – That as the surface of the steel cylinder is not more than one-fiftieth as large as that of the copper cylinder, the amount of work to be done by the graver is proportionably less; and the engraver is thus enabled to devote his attention to the production of patterns which would be too minute, elaborate, and expensive if cut wholly by hand on the copper cylinder.

For some patterns the rollers are engraved by a kind of aquatint process,[29] and the electrotype process is also about being brought into use for the same purpose; but the two just noticed are the principal modes at present in operation. In the roller-warehouse at Mayfield we saw from three to four thousand of these rollers; and as they weigh on an average a hundred pounds each, the ponderous extent of the whole may be judged.

We must now pay a visit to the printing-shops, the scene of those operations to which the designing and engraving are preparatory. There are 'block-printing rooms,' and 'cylinder-printing rooms;' the operations carried on therein being

indicated by these names. But there are a few arrangements to which the cloth is subjected before being printed. In the 'cloth department' the rolls or bundles of cloth are opened, spread out on a table, and carefully examined, with a view to the removal of any loose threads that may appear on the surface. The cloth is then measured by being passed rapidly over a machine a yard in width; and after this twenty or twenty-five pieces are sewn end to end. It then goes to the 'winding-on-room,' where the cloth is wound uniformly round a thick beam or roller preparatory to the printing; passing, in its progress, over a very curious and ingeniously constructed roller, whose surface is so grooved as to take out all creases from the cloth.

The 'block-printing room' is a very long, busily occupied, and most interesting part of the establishment. It contains about fifty block-printing machines, the whole works containing about a hundred and fifty.[30] The whole of the machines are arranged in a double row along either side of the room; all are nearly alike; and all are the scene of operations which may be thus briefly described. The cloth roller is so adjusted that the cloth, as it is unwound, may lie on the surface of a table to be printed, and after printing may pass on to another roller; the printer regulating this movement. There is to each machine one man to print, and an attendant boy or girl called the 'tearer.' At the outer end of each machine is a small tub or pot containing the colour to be used, and near it a circular trough or drum supported by a water-bed to give it elasticity. The 'tearer' dips a brush into the vessel of colour, and spreads a layer on the elastic trough. The printer then takes his[31] engraved block,[32] holding it by a handle at the back; presses it down on the trough, whose elasticity allows every part of the raised device on the block to take up a layer of colour; and then prints a portion of the cloth equal to the size of the block. There are small pins or guide-marks at the corners of the blocks, by which the printer is enabled to adjust each successive impress from the block; and herein consists one of the niceties of block-printing. The printer goes on, step by step, until he has printed the whole of one piece with one colour; and then, at a subsequent operation, he works all over the same piece with a second; then perhaps, with a third; and so on, according to the number of colours in the design; a new block being taken with every new colour.

A second mode of printing, not long since introduced,[33] is the result of a remarkably ingenious arrangement, whereby all the colours may be printed at once. Let us, for the sake of clearness, suppose that the design contains five colours. In such case five sets of stereotype casts are prepared, in the manner detailed in a former paragraph, each set being for the imprinting of one colour, and the whole five forming the combined pattern. A well prepared tablet of wood is provided, from two to three feet square, and on this are fixed all the stereotype pieces. All the pieces for one colour are ranged in one row or stripe, about five inches in width; all those for another colour form a second stripe, contiguous to and parallel with the first; all those for a third colour form another parallel stripe; and so on for the fourth and fifth. The length of each stripe is about equal to the breadth of the cloth; and the whole form a compound printing block, divided into five compartments.

These blocks are used in a printing-machine something like one of the modern varieties employed in type-printing; but with peculiar adjustments to adapt it to the present object. A man manages the press-work, while a 'tearer' applies the colour [see figure 2]. The block is fixed with its face or device downwards to the bottom of a descending beam or frame, capable of receiving a vertical motion; and the cloth being laid out on a table beneath, the block is brought down at intervals upon it, by means of a lever managed by the pressman. But before he does this, the block must receive its coating of colour; and this is effected in a very remarkable manner. The 'tearer' has five little troughs of colour (supposing, as we have in this case, five to be the number) ranged in a row before him; and he has a long piece of wood so formed as to dip into all these five and to take up a small portion of colour from each, which he dabs upon a flat felt cushion. He then takes a kind of brush so adjusted as to spread out these five colours in an equal number of patches over the surface of the felt, without combining or smearing one over the other. He next slides the cushion along a kind of railway till it comes underneath the block, which is made to descend upon it, and to imbibe a layer of colour all over its surface, each one of the five rows of device falling upon one particular colour on the cushion, without touching the others. The 'tearer' than draws out the cushion again, and the man guides the block in its descent upon the cloth, which it imprints upon five different places in five different colours. All this is repeated a second time; but before the wetted block actually descends, the cloth has been made to shift about five inches lengthwise, or equal to the width of one row on the block. By this arrangement each colour falls upon a part which had been printed with a different colour in the former descent. At the third descent the cloth is again shifted; at the fourth descent again; and once more at the fifth; so that each portion of the cloth is brought in contact with each of the five divisions of the block, and thus receives five different colours. The utmost exactness is requisite in the arrangement of the five divisions of the device on the block, and in the moving parts of the press, in order that all the colours may conduce to the production of a pattern, without confusion or distortion; but this adjustment once attended to, the action of the machine is very beautiful. There are twenty-four of these press machines.[34]

Next we come to the cylinder-printing, by which such wonderful advance has been made in the capabilities of calico-printing. We will first consider the action of the machine in its simplest form, when only one colour is used. The engraved cylinder is placed horizontally, in the lower part of the machine. The cloth, descending from a beam or roller above, passes over and in close contact with the cylinder. The lower part of the cylinder dips into a long trough containing colour; and as it is kept rotating, every part of the surface of the cylinder of course becomes coated with the colour. Now if the cloth were brought in contact with the cylinder in its present state, it would receive merely a confused mass of colour without device or pattern. The means have to be found, therefore, of cleaning off every particle of colour except from the depressed parts of the engraving; and this is effected in a way which is well calculated to excite surprise in a stranger.

A long knife is applied to the cylinder, so exquisitely smooth and regular, and so accurately adjusted to it, as to scrape off every particle of colour from the surface leaving colour only in the depressed engraving, all the rest being so thoroughly cleansed as to pass over the cloth without soiling it. This important appendage to the machine is called the 'doctor,' a name which has been thus oddly accounted for in Lancashire: – When one of the partners in the firm by whom cylinder-printing was originally applied was making experiments on it, one of the workmen who stood by said, "All this is very well, sir, but how will you remove the superfluous colour from the surface of the cylinder?" The master took up a common knife which was near, and placing it horizontally against the revolving cylinder, at once showed its action in removing the colour, asking the workman, "What do you say to this?" After a little pause the man said, "Ah, sir, you've *doctored* it;" thus giving birth to a name for the piece of apparatus. Others seek for an explanation a little more classical, and would derive the name from *ductor* or *conductor*.[35]

The mode, then, in which cylinder-printing is effected is this. After the cylinder has gathered its coating of colour by rotating with its lower portion in the colour-trough, and has been cleansed by the 'doctor,' the cloth passes in a continuous strip between it and a large roller or drum above, by which it is pressed sufficiently close to the cylinder to imbibe the colour from the sunken device on its surface. As the cylinder is continually revolving, and the cloth as continually passing in contact with it, the printing goes on uninterruptedly without stoppages or breaks, thus presenting a striking difference from block printing. On one occasion, while the cloth was travelling upwards from the cylinder, a portion became disarranged so as to be printed a second time, but in a different direction from the first. This accidental circumstance produced a new pattern which was one of the most successful ever published by the firm in whose establishment the incident occurred.[36]

We have next to suppose that the machine prints several colours at once instead of a single colour. In this case there are as many cylinders as colours, each one scrupulously adjusted to produce its particular part of the pattern. Each cylinder dips into a trough appropriated to itself; each has a 'doctor' to remove the superfluous colour; and the cloth passes in contact with each in turn. What must be the nicety of adjustment to bring all the cylinders to print at the proper places can scarcely be conceived, except by those practically engaged in the process.

Each cylinder machine, of which there are about a dozen at the Mayfield Works, prints a piece of cloth in about a minute and a quarter, or about three quarters of a mile in an hour![37] Few things are more extraordinary in this department of manufacture than the substitution of *miles* for *yards* in the measurement of the quantity of work done. There are more firms than one in Lancashire, in each of which the length of cotton printed in a year would thread the earth from pole to pole.

We have spoken of the printing process without interrupting the details by allusion to the *dyeing* of the cloth; but a few words must be here offered on this matter. If we had before us one hundred patterns of printed cotton, we should probably find that nearly one hundred different modes of proceeding were necessary in the printing; for not only must the colours be different, but each colour may

perhaps require a peculiar groundwork to make it adhere to the cloth. Herein lie the delicacy and complexity of the calico-printer's operations; and hence arises a different chemical formula for almost every different pattern. Sometimes a piece of cloth is partially printed, then dyed, and then printed again; at other times the printing is effected at once; and at others a portion of the printing is to lay on colour which is to be afterwards visible, while the other portion is merely to imprint the cloth with a chemical agent which shall exert some peculiar effect on the colours. This may perhaps be rendered intelligible by alluding to four different kinds of liquids or mixtures, which are printed on the cloth by means of the cylinder, the press, or the block. These four are *colours*, *mordants*, *discharges*, and *resists*. The name *colours* speaks for itself; it relates to the pigments or pastes which impart colour to the cloth, and includes a very wide range of vegetable and mineral substances. A *mordant* is a liquid mixture which enables the colouring substance to combine permanently with the textile fibre; and this is used when the mordant has a combining affinity with the cloth as well as with the colour, although the two latter, used singly, have not affinity for each other. Thus, if a red colour were imparted to cloth by madder, it would wash out, or not be a 'fast colour;' but if the cloth were previously wetted with an aluminous salt, the madder colour would be permanent. In most cases the mordant is a body of liquid, into which the cloth is immersed; but sometimes it is used in the same way as a paint or ink by the cylinder machine. *Discharges*, instead of being intended to fix the colour to the cloth, are used to drive off or discharge the colour after the latter is applied. This kind of chemical agent is used in combination with mordants, thus: – the cloth is wholly saturated with the mordant, but certain parts are also printed with a discharger formed of lemon-juice or some other substance; the result of which is, that when the dye-colour is afterwards applied, it combines with the cloth at the parts where the mordant has been unaffected, but becomes a 'loose' colour at the parts printed with the discharger, so as to be easily washed out from those parts. *Resists* are mixtures which enable the printer to produce white portions of pattern by a process rather different from the discharge-method. The mordant is printed, not dipped, in those parts which are to be coloured in the pattern; while those which are to be kept white are previously printed with a chemical mixture called a *resist* or *resist-paste*. The cloth is then wholly immersed in a dye-vat, but those portions which had been printed with the resist refuse to receive the dye, and hence remain white. It will be seen, therefore, that in 'discharge-work,' as it is called, the white portions are retained by driving out the mordant which would otherwise fix the colour; while in 'resist-work' they are retained by shielding the cloth at those parts from the action of the colour.

The chemical manager of a print-work has to study innumerable points connected with the action of different chemical agents on each other, and on the fibres of the cloth; and hence a description of the precise mode adopted would vary with almost every particular pattern produced. For instance, we have now before us (and should have inserted in this printed sheet, but for certain practical difficulties) a few pieces of different printed cottons, which were thus prepared: – One

specimen consists of purple squares separated by white lines: the cloth was first bleached at Dukinfield, and transferred in the bleached state to Mayfield; the squares were printed by cylinder with a mordant of acetate of iron; then stoved; then passed through a hot emulsion of cow-dung; then washed in water; then immersed in phosphate of soda; then dyed with madder, which gave the purple tint to the parts printed with the mordant, but left the rest white; then soaped; then 'chemicked,' to clear or bleach the unmordanted parts; and lastly squeezed, dried, &c. In another specimen, displaying white spots and black flowers on a purple ground, the white and black parts were printed both at once by a two-cylinder machine; the white with lemon-juice to act as a *resist* and the black with acetate of iron to act as a *mordant*; the purple part was printed by a different cylinder; and the dyeing, clearing, &c. were superadded to these printings. In a third specimen, comprising three different shades of pink, acetate of alumina in three different degrees of strength were employed as the mordants, so as to retain with three different degrees of force the pink dye upon the cloth: two of the shades were printed at once by a double-cylinder machine; and the other was afterwards printed by a third cylinder.[38] A fourth specimen, comprising yellow, green, black, and two shades of red, upon a white ground, went through between thirty and forty processes connected with the printing; it passed twice through cylinder machines, and three times through the hands of the block printers, to apply either the colours themselves, or the mordants or resists by which those colours are effected.

From these few details it will be seen how complex are the labours of the calico-printer. Indeed these do not comprise all the varieties; for in printing 'mousseline de laine,' and some kinds of cotton goods a particular routine of processes is employed, called 'steam-work,' in which the distinguishing characteristic is the precipitation of the colours on the cloth by the action of steam, in lieu of some of the intermediate processes employed in the other methods.

There are certain finishing processes, such as mangling, starching, drying over steam-heated cylinders, examining, folding, &c., to which the cloth is more or less subjected, according to its quality and the purposes to which it is applied; and many of which would be deemed curious, were not their importance eclipsed by the combination of taste, chemical skill, and mechanical exactness, displayed in the preceding processes. Altogether, this must be acknowledged to be one of the finest of all our manufacturing arts.

A day at the Barrowfield dye-works, Glasgow

Were it not that the subject of calico-printing has already occupied our attention in the 'Supplement' for June, 1843,[39] the fine establishment of Messrs. Monteith, at Glasgow,[40] would afford ample opportunity for illustrating many varieties of that beautiful process; but as the differences observable in such establishments, although very marked in the eyes of a manufacturer, are of no moment to those who wish merely to gain a slight insight into the general processes, we shall dispense with any further notice of calico-printing in general. There are, however,