Turkey Red

AN INTRODUCTION

introduction

The first printed fabrics were produced in India and China around 4000 years ago although it was only in the tenth century that textile printing arrived in Europe. It was not until printing became cheaper that it became popular; patterns were usually the result of embroidery or weaving. The industrial revolution produced huge advances in technology which made the production of fabric much cheaper and easier.

As the industrial revolution in Glasgow gained pace, the textile industry became affected by the pollution in the air and water. Clean air and water were needed so that cloth and yarn could be washed and dried, a process that had to be done outdoors. The Vale of Leven provided plenty of clean water as the fast-flowing River Leven originated in Loch Lomond and the rural air was clear.

Andrew Johnstone established the first bleachfields in the Vale at Dalquhurn in 1715 these were acquired, in 1728, by Walter Stirling and Archibald Buchanan who established the Dalquhurn Bleaching Company and extended the bleachfields to more than 12 acres.

Early bleach works were simply fields intersected by channels of water with rows of beech hedge between them. The cloth was spread out on the grass and water from the channels, as well as soured milk, was sprinkled over it. The hedges prevented the cloth from being blown about. This was a seasonal activity as cloth could only be outside during the summer months. Seasonal workers from Argyll were employed as there were very few inhabitants of the Vale at this time.

Cotton was becoming increasingly popular as fashion changed from heavy materials, especially linen, to light, easily washable fabrics. This was partly due to the expansion of trade with the US, which increased the amount of cotton available. The first cotton arrived in Glasgow in the 1760s and by the 1830s linen manufacture had disappeared from Glasgow as cotton took over. As the fashion for cotton developed, demand grew for it to be dyed and printed so that the cloth could be made into clothing etc. Bleaching became only one step in the process.

The first printworks in the Vale were established at Levenfield by Todd, Shortridge and Company. Two years later, in 1730, William Stirling, nephew of Walter, moved his printworks from Maryhill to Renton. He feued the lands of the Cordale Printworks and then took over Dalquhurn Works for bleaching.

Printing, at this time, was either by block printing or pencilling.

Block printing originated in Asia over 4000 years ago and was the most widespread form of printing until the early nineteenth century. It is a very versatile printing method capable of producing a variety of colour effects and patterns. The earliest blocks had designs cut into their surface which could be surprisingly intricate. The main development in block printing was the use of metal pins and strips hammered into the surface of the block to form the designs. Metal castings followed which fitted together on the block, these were cheaper but could only be used for designs repeating a small pattern.

The fabric was gummed to a flat table and the colour was applied to the block by the printer's assistant, who was often a child. The block was placed carefully on the fabric before being struck with the shaft of a hammer, known as a maul. A different block was needed for each colour.

By the beginning of the nineteenth century block printing was being overtaken my the copper roller method of printing and, for a while, the methods were used together. Today only printing for exclusive designs would use the block printing method.

Pencilling was widely used in India where a brush or bamboo pen was used to paint dye onto the fabric. These began to be imported into Europe in the late sixteenth century where the floral motifs formed the basis of the early printed designs in Europe. Pencilling supplemented block printing and was popular until the early nineteenth century.

methods of printing

The technical term for a method of printing is a style. There are four main styles, these are:

- Discharge
- Direct
- Resist
- Dyed

Discharge Style
This involves the fabric initially being dyed all one colour. A paste (called a discharge paste) is then applied which will destroy the colour, either by itself, or when submerged into a vat of another chemical. The areas where the colour disappears are called discharged. These can be over printed with other colours or a colour can sometimes be added to the discharge paste, which will simultaneously bleach one colour and add another.

Direct Style
In this process, the colour is printed onto the fabric. The print paste contains the dye together with any other chemical that is necessary to fix the colour to the fabric fibres. The style was used very little until the development of synthetic dyes. It is the most important style in use today, when many fabrics are now printed with pigments rather than dyes. The process is cheap but not easy and the results are sometimes not of the highest quality.

Resist Style
This involves masking areas of fabric to prevent the dye being absorbed. In batik, the areas are covered with wax which is removed after dyeing, a method very common in Java and West Africa. Tie and dye is another method of the resist style in which the fabric is tied around with a small cord. This method is still used in Africa, especially Nigeria, and was extremely popular in Europe for much of the nineteenth century when a thick paste of gum or pipeclay was used to make a pattern.

Dyed Style
This method was used in ancient Egypt and was still of great importance in the nineteenth century. It is based on the use of dyes that need a mordant to fix them onto the fabric. By using the same dye but in different strengths and different mordants a wide variety of colours could be produced. This method involves printing the fabric with a mordant followed by immersion in a dye and then washing. This style was mainly used with the dye madder and Turkey Red is a good example of the use of this style.

the introduction of turkey red

George Mackintosh introduced Turkey Red to Scotland in 1785. He invited Pierre Jacques Papillon, a chemist from Rouen, to Scotland to show him the dyeing process. They set up Dalmarnock Works (later renamed Barrowfield) with David Dale and this became the first Turkey Red works. At this stage, only plain Turkey Red cloth and yarn were dyed.

In 1805 they sold to Henry Monteith who already possessed a Turkey Red factory in Blantyre as well as a factory in Bridgeton. By 1823 he could produce 224 handkerchiefs every ten minutes and exported most of them to Europe, where instead of being known as pullicates, they were known as Monteiths. The pattern of the handkerchiefs - red with white spots - became internationally famous and bandanas and scarves were also produced. These were first made using the tie-dyeing method and were imitations of earlier imports from Bengal.

It was not until 1827 when the next major breakthrough occurred. The Croftingea Works announced that it had produced dyed yarn in a commercial process and this was closely followed by Dalquhurn the following year (which, by 1850, was using 130,000 gallons of bulls' blood annually). By the late 1820s the Vale of Leven was well known for the production of Turkey Red.

Production costs could be kept down if the cotton yarn could be woven and dyed red afterwards. In the eighteenth century manufacturers had to weave checked cloth with yarn that was already dyed and then put the woven cloth through the finishing process. Patterns were added when customers took their fabrics to a shop or dye works and selected patterns from the pattern books. Designs were printed using carved wooden blocks with a different block for each colour, or engraved copper plates. In 1783 Thomas Bell of Glasgow invented a process that printed continuous lengths of cloth but this was not widely used until the nineteenth century.

At this time, only cotton yard could be dyed. The reason for this is that the oil (mordant) used to bind the yarn and the dye had to be applied evenly. Woven material could only be dyed after 1810 when there were improvements in the process. The yarn was taken to the dye works by the cotton factories, dyed and then returned to their factories. By the end of the nineteenth century cotton, calico and velvet were being produced and the Vale had developed into a specialised industry.

By the 1830s cloth printed in two colours became the main material for the clothing of working class women. With the invention of new technology, the development of new dyes and printing methods, colourful fabrics became available to everyone.

In 1835, John Orr Ewing leased Croftingea and was so successful that he retired ten years later with a mansion and estate he bought for £20,000. He gave his brother, Archibald, enough capital to lease Levenbank Works. He named the company Orr Ewing. He went on to buy Milton in 1850 and Dillichip in 1866. John Orr Ewing returned from retirement in 1860, buying the Works at Croftingea and Levenfield, which he amalgamated under the name of Alexandria Works, always known locally as The Craft.

In the early 1860s the three largest firms were: John Orr Ewing, Archibald Orr Ewing and William Stirling. Between them they employed 6000 workers who produced 25,000 lb of yarn and 10,000 pieces of cloth per day. Their buildings covered 10 acres of ground. The industry had a massive impact on the population of the Vale, between 1860 and 1891 it rose from 120 to 19,635.

The textile industry in the Vale was split into two groups:

- The Turkey Red group consisting of Croftingea, Levenbank, Cordale, Dalquhurn and Dillichip
- The Calico Printers' Group of Dalmonarch, Levenfield, Ferryfield and Kirkland.

There were many different types of job in the works including printers, engravers, pattern drawers and cutters, colourmen, dyers, bleachers, steamers, tearers, machine men, hurlie men, stove men, yarners, folders, cutters, ticketers, parcelers and finishers.

The US Civil War (1861-5) reduced cotton supplies to Scotland from 8,700 tonnes (17,055 cwt) in 1861 to 366 tonnes (7,216 cwt) in 1864. This was a period of major hardship for the companies in the Vale until India and West Africa became major exporters. They also imported the finished goods along with Morocco, the Philippines, Japan, China and South Africa. This would lead to major problems later on.

Factory	Children below 12	Children 12-15	Women	Men	Total
Levenbank, Milton & Dillichip	100	30	97	188	415
Dalmonarch					800
Levenfield					2000
Alexandria	104		142	192	438

Number of employees per factory from New Statistical Account 1839

Patterns varied depending on the market. They could include abstract, geometric or floral motifs; peacocks, elephants, dancing girls and locally significant patterns. Feedback was always being sent from Scottish agents abroad as to what was fashionable and acceptable.

In the 1880s there were fifteen Turkey Red companies in the Vale, using natural dye extracted from the madder plant. German factories had a monopoly on the production of artificial alizarin, which drove prices down as it was considerably cheaper. This was compounded by restrictive tariffs on imports in India introduced in the 1890s. In response The United Turkey Red Company (UTR) was formed in 1897 uniting William Stirling, Alexander Reid and the two Orr Ewing brothers.

The chairman was John Hyde Christie, who was the first qualified chemist at the John Orr Ewing Company in 1856. In 1900 they bought Alexander Reid and Sons. The UTR tried the new colours - naphthol reds, available from the 1920s but found that the old system was much better. UTR developed the JF process, invented by J F Christie, the son of the chairman. He drastically reduced the time of process dyeing.

It was all too late. Ferryfield and Milton closed in 1915, Levenbank, Dalmarnock and Dillichip in 1930, Cordale and Dalquhurn in 1942 and The Craft in 1960, when the assets were purchased by the Calico Printer's Association, ending 250 years of textile industry in the Vale.

processes

Bleaching

Early bleach works were simply fields intersected by channels of water with rows of beech hedge between them. The hedges prevented the cloth from being blown about. The cloth was spread out on the grass and water from the channels was sprinkled over it. This was a seasonal activity, but could take about four months, cloth could only be outside during the summer months.

It was not until the chloride of lime process was discovered by Charles Tennant from Glasgow in 1749 that bleaching became independent of the weather and could be carried out indoors in a day. Later, chemicals such as chloride and sulphuric acid were also used. Between 1728-1768, the bleaching process stopped being an end in itself and became part of a production process.

Boiling off was the first stage in the Turkey Red process. Cloth arrived in a grey state and was washed in vats of boiling water with bleach to take the stiffness out of the material. This was stirred with poles. It was then left in piles to go into a dryer which was about 10ft high and 6ft across. Once the cloth was dry, it left the department.

Mordanting

Once the cloth had been bleached it was printed. The cotton or linen was printed with a mordant so that, when immersed in the vat of dye, it reacted to produce waterproof, permanent areas of colour. The dye was taken up by the unmordanted areas but could then be washed out. Depending on the type of mordant, different shades could be produced. Most mordants are metal salts which form a bridge between the dye and the cloth. The most popular is alum which produces red from madder, but iron could be used with cedar, logwood or on its own to create dull colours and blacks and browns. Copper brought out green.

The printer used a block containing one mordant down the whole length of the cloth and then repeated the process with a different block and mordant. Mordants based on different strengths of alum and eron produced red, browns and purples. Yellow and drabs were produced by mordants containing weld. Blue was pencilled in with a brush by using indigo and greens were made by pencilling indigo in over yellow. This task was normally carried out by women or girls. To save money, yellows were often blocked or printed in to avoid additional dyeing but the yellow dye in this method was fugitive and in many eighteenth century textiles, this has almost entirely disappeared. The cloth was then left for

a few days so that the mordant could bind with the cloth. Eventually, steam was used to set up the mordant in a process called aging. This also removed extra mordant or thickening agents left on the surface before it was dyed in the vat.

Dyeing

Then came immersion in the vat of dye to which dung, urine and blood could be added to make the mordant active. This was called animalising. By the second half of the nineteenth century, the dyeing agent in madder - alizarin could be extracted in a concentrate and applied as a paste in a steam chamber. It was not until 1870 that Turkey Red could be produced artificially, this was known as para red. The dyeing process took three and a half hours in the 1840s and three dyes per day were often completed by the teams of a man and a boy per vat.

New mordants could be applied after the cloth was dried. Henry Monteith improved on a process where several colours could be fixed to fabric at one time, enabling quicker production of his handkerchiefs. He used a perforated press in which layers of cloth were stretched and a discharge liquid poured through, this led to fast, efficient production. The colours used in discharge were limited to a bright citrus yellow, a bright mid blue and a mid green as well as black and white. This process was invented by Koechlin of Mulhouse in 1810.

Patterning

Patterns where, at first, simple designs using three colours. This was done by hand, and printing blocks cut out by a block cutter. Printing blocks were either wood or were made up of copper inlaid with felt. The maximum size was 460mm square. Pins on the end of each block allowed them to be placed on a track so that all the patterns were correctly aligned. A different block was required for each colour in the pattern. The spaces between the lines were cut away leaving the design standing in relief, as in letter press printing. The colour was then applied to the surface of the block and the coloured block pressed down on the cloth. The pigments for printing were mixed with starch, gum or varnish so that the colour was in a viscous state and didn't run from the raised portions of the block. Additional colours were applied by a brush. The first block printing was done at Levenfield. Thomas Bell invented a method of engraving the pattern onto a copper cylinder - the 'roll method' in 1783 although it wasn't widely used until the middle of the nineteenth century. The rollers were printed with a tar-like substance and the unpainted bits etched with acid. This method presented the foundation of the roller printing we still use today.

Finishing

After printing the cloth went into a steaming box, ammonia was then poured in which brightened the colours. The cloth was then sent to the calendaring department for gloss and then beetled by being hit with big metal or wooden

hammers to produce a soft finish.

Hurlie men transported the newly dried cloth in wagons to the folding women. They ranged from girls of fourteen to women of fifty. Piles of cloth were separated and sorted; graded to size and colour and pattern. Then they were then trimmed and folded. Tickets were used for identification, marks of quality and to indicate the destination and market for which the cloth was intended.

At the beginning of the nineteenth century the labels were black and white and were designed not to offend caste or religion and to appeal to as many people as possible. These evolved into colourful labels bearing the manufacturer's name. They served as a brand trademark and built up a strong loyalty among customers.
By the end of the nineteenth century, Hindu themes dominated the tickets as they were the largest and wealthiest sector of the population, as well as being the brokers and sellers of the cloth in the bazaars. The tickets were usually 7x10 inches and bore the company name (which was translated into three or four Indian languages) and had space at the bottom for the length of material in the bale to be added.

Transport
When Andrew Johnstone first set up his bleachfields, the Vale of Leven was remote and isolated with a population of 120. Bonhill was the main settlement, hardly more than a hamlet. Alexandria, Jamestown and Renton didn't exist. With the relocation and building of factories, towns grew up which relied on the local Works for their existence. Renton was founded in 1862 when Dalquhurn was converted into a printworks

Table showing how settlements fed into Works.

Settlement	Factories
Alexandria	Croftingea Levenbank Ferryfield
Bonhill	Dalmonarch Kirkland Dillichip
Jamestown	Levenfield Levenbank Dalmonarch
Renton	Dalquhurn Millburn Cordale

As technology progressed and work in the area became less seasonal and more permanent, and as industrialisation in the area continued, new transport links were built.

Most heavy goods haulage was carried out by water. Ships would sail down the Clyde from Glasgow and up the Leven to the tidal limit, which was just south of Dalquhurn when the cargo would be unloaded into barges or gabbarts. From here, the barges would be drawn by horses upriver as far as Balloch. Communication between factories was also by water, with a network of chain ferries established for ease. Smaller loads would be taken by road on carts to either Dumbarton or

Glasgow after the River Leven was bridged at Dumbarton in 1765, providing direct road communication with Glasgow. The Alexandria-Bonhill bridge, opened in 1856, was the second important road development in the area and made communication even easier. People were charged 1/2d for passage until workers objected so much that this was abolished.

Perhaps the most useful transport innovation was the railway. In 1850 the Bowling to Balloch line was completed. Each factory built their own sidings and developed internal rail networks. The transport of goods and people became easier and quicker.

conditions in the towns

"They have only one room, about seven feet high, nine wide and perhaps eighteen long. Pretty well furnished, and a small garden. For breakfast and supper, porridge and a Scotch pint of skim milk, for dinner, broth made of a small piece of meat, or herring and oat cake and potatoes. The class of house inhabited by printers, generally contains four families, each family having a kitchen and one room. Two families live on the ground and two in the upper story."

Conditions in the towns were extremely poor, the conditions described above are extremely basic by today's standards. Yet printers were highly prized employees and paid at the top of the factory scale after serving an apprenticeship of seven years. Conditions for field workers, at the bottom of the hierarchy, would be far worse. All houses were lit by rushlight and it wasn't until the 1880s that water was pumped from Loch Lomond for indoor washing and toilet facilities. Before this, families were drinking the polluted water from the Leven.

All members of the family were required to work to bring enough money in for survival. However, children could still go to school. Many went to school from the age of five, although some schools had no minimum age. Children were taught to read first of all, and if they stayed on until they were eight they would learn writing and arithmetic. Most did not, usually, the only children that did stay on to learn were the children of foremen or shopkeepers. Families, unless they were in extreme poverty, had to pay for the children to attend school, Dalmonarch School charged 1s a month for reading and 2d for each additional subject; pupils also had to pay for their own pens and books. At Bonhill School, reading was 1s, writing 1s2d and arithmetic 1s4d.

William Leggatt, a teacher at Dalmonarch, states that "he has known cases of boys sent to work at six years old." John McLeish reports that his sister started tearing at five and a half years old.

For children and others who worked during the day, night school was provided. Again, there was no target age range. The 1843 Commission records three block printers attending night school to learn Latin so that they might go to theological college. The Parish School at Bonhill had 40 pupils at the night class. Many Works' owners and foremen tried to make an effort to see that the shift finished on time so that children could attend night school although this was not always

possible. Hugh McTaggart reported that his son, aged twelve
"Has not been home till one o'clock, it was not to say one night of the week, it was regular for about three months. The boy receives 6d a day and regular hours are from six to seven at night and two hours for meals."

The working day for everyone was upwards of twelve hours so that the children were "just that way at night, they are hardly able to stand."

Whole communities were governed by the sound of bells. Bells rang before work started to announce that the gates to the Works were closing, bells rang for lunch and again for the afternoon shift. If you missed getting in the gate you were docked 15 minutes worth of pay, or quartered. If you lost more than an hour's worth of pay in a month, you were sacked.

It was only in 1911 that workers of both sexes were unionised. The women formed a branch of The National Federation of Women Workers and the men formed a branch of The Amalgamated Society of Dyers, Bleachers, Finishers and Kindred Societies.

List of the main union events and strikes:

June 1816
Strike at Dalmonarch over pay.

May 1879
Female workers at Croftengea, Milton and Dillichip strike as the Factory Act reduces the paid working week to 56 hours.

February 1896
Cylinder Printers' Amalgamated Union demands a rise in wages.

January 1911
600 girls meet to form a branch of The National Federation of Women Workers.

February 1911
300 men form a branch of The Amalgamated Society of Dyers, Bleachers, Finishers and Kindred Societies.

December 1911
The first textile strike settled by the Board of Trade.

April 1931
National strike of The Amalgamated Society of Dyers, Bleachers, Finishers and Kindred Societies.

May 1931
Strike settled.

June 1934
Over 3000 members of the Amalgamated Society of Dyers, Bleachers, Finishers and Kindred Societies strike to gain a minimum wage of 1/- (5p) per hour for men and 8d (4p) per hour for women over 18. Also demand a working week of 54 hours.

Oral history states that:

There were a lot of radical people around at that time (1930), radical political people, but they just didn't have the guts to stand up. If you did stand up, you were out the gate. You just got bagged on the spot. They allowed us a quarter of an hour, last thing on Friday night before the horn, to go around and collect our union money

And that:

The printers were tin gods; you couldn't get enough printers. They always got their rise, but the lower workers were always underpaid. The UTR were always bad payers.

Rate of pay 1843:

Position	Pay per month £.s.d
bleacher	0.18.0
cylinder engraver	3.0.0
printer	3.15.0
tearer	0.2.6
finisher	0.6.0

Working in any of the Works was an extremely dangerous job. Streamers spent most of the day in the Leven, washing cloth. The youngest were fifteen. Dyers had to climb inside the coppers to clean them and also had to set up the kindling so that the dye would be boiling, at this stage of the process, the temperature could be 110 degrees Fahrenheit in the store. In the printing shed the temperature was 76 degrees Fahrenheit. Arms and fingers were lost as the printing machines were cleaned while still in motion. Another oral history report states that:

There was this worker who went missing. It only when they opened up the lade at the summer holidays to let the settling tanks into the river that they found him. That was not long after Christmas and they got him after the fair holidays (July). Apparently the dyes preserved him well.

biographies

George Mackintosh
Mackintosh was a successful manufacture of another dyestuff, cudbear which was only suitable for dyeing silk and wool, neither of which were major Glasgow industries, while cotton was developing swiftly. He was also a successful chemist, inventing the first waterproofing for fabrics. His partner, David Dale also came from a successful manufacturing background and went on to establish the famous cotton mills at New Lanark. Papillon became a partner in their company and they opened a new dye factory at Dalmarnock in 1785. Dale and Macintosh sold their factory at Dalmarnock to Henry Monteith, Bogle and Company in 1805 and it was renamed Barrowfield. Before Papillon, the Turkey Red process was little understood and there was a tendency to buy impure ingredients and chemicals to cut cost, which led to failure.

Henry Monteith
Monteith had factories in Bridgeton and Blantyre by 1789 where he was dyeing Turkey Red. The purchase of Dalmarnock was the next step and by the 1820s he was the most powerful dyer in the Turkey Red trade. In 1815 a process was invented to bleach white spots for bandannas and handkerchiefs automatically and by 1823 Montheith's works could produce 224 handkerchiefs in 10 minutes. In the 1830s his monopoly ended with his death.

William Stirling
Was born in 1717. In 1769 S Turnbull, Arthur and Company moved to Cottingsea. Stirling followed, moving to the Vale of Leven at Dalsholm, from Glasgow due to the cleaner air and pure water from Loch Lomond. He started producing Turkey Red in 1828. Cloth had to be dried outside as it wasn't until the 1830s that a method of cloth drying inside was invented. They started Turkey Red dyeing at Dalquhoun and printed calico at Cordale. The demand for staff created Renton. In 1876 Stirling sold his factory and it become the property of the Wylie brothers. In 1886 they employed 7000 people and dyed and printed 150 million metres of cloth.

The Orr Ewings
In the mid 19th century, the industry was dominated by two brothers, Archibald and John Orr Ewing. They bought Cottingsea in 1835 and ten years later, John Orr Ewing sold his share to retire. Archibald formed his own company and bought the Levenbank works from John Stewart as well as the Milton works, which he bought in 1850. He continued until 1860 when he offered the company back to his brother who amalgamated Croftingea and Levenbank under the name Alexandria Works, although it was known locally as The Craft. He died in 1878.

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turkey red recipe 1818

John Lightfoot

Step 1 or Cleansing Operation

For 100 lbs of cotton take
100 lbs of oilicans barcilla
20 lbs of pearl ashes
100 lbs of - lime

Mix the barcilla with soft water in a deep tub having a small hole near its bottom which is to be stopped at first with a peg but covered within by a cloth supported by two sticks or bricks, in order that the ashes may be hindered from wither running through the hole or choking it, while the Lime filters through it. Under the tub another is to be placed to receive the Laye (lye) and pure water is to be replaced by half again through the first tub to form layers of different strength, which are to be kept separate till the strength has been examined. The strongest required for use must swim or float an egg and is called the lye of six degrees of the French hydrometer or Areometer of Baume. The weakest are afterwards brought to this strength by papering them through fresh barcilla; but a certain portion of the lye which is to mark two degrees of the above hydrometer must be reserved for dissolving the oil, the gum and the salt which are used in subsequent parts of the process. The lye of two degrees is considered the weak Barcilla liquor , the other the strong.

Dissolve the pearl ashes in 40 gallons of soft water and the lime in 56 gallons. Let all the liquors stand till they become quite wet and then mix 40 gallons of each. Boil the cotton in the mixture five hours then wash in running water and dry it.

Step II or Grey Steep

Take a significant quantity (40 gallons) of the strong barcilla water in a tub and dissolve in it eight gallons of sheeps' dung, then pour into two quart bottles of sulphuric acid, one pound of gum Arabic and one pound of sal ammoniac, both previously dissolved in a sufficient quantity of weak barcilla water, and lastly, twenty five pounds of Gallipole oil which has been previously dissolved, or well mixed, and 8 gallons of weak barcilla water.

Note - it is highly important after this and each of the succeeding operations, that the cotton should be thoroughly and completely dryed by a stove heat, that of the open air in this climate not being sufficient, even in the summer.

Step III The Which Steep

This part of the process is precisely the same as the last in every particular, except that the sheeps' dung is omitted in the composition of the steep

Step IV The Gall Steep

Boil 25 lbs of Galls bruised in 40 gallons of river water until 16 or 20 gallons be

boiled away; strain the liquor into a tub and pour cold water on the Galls in the strainer, to wash out all their tincture.

As soon as the liquor is become milk-warm, dip the cotton into it husk by husk, handling it carefully all the time, and let it steep 24 hours, then wring it carefully and equally and dry it well without washing.

Step V First Alum Steep
Dissolve 25lbs of Roman Alum in 56 gallons of warm water, without making it boil, stirring the liquor well, and add eight gallons of strong barcilla water and then let it cool until it be luke-warm. Dip your cotton and tumble it husk by husk and let it steep 24 hours, wring it out equally and dry it well without washing.

Step VI The Second Alum Steep
This is performed, in every particular like the last but when the cotton is dry, steep it six hours in the River, and then wash it and dry it again.

Step VII Dyeing Steep
The cotton is dyed in parcels of about 10lb at once for which take about two gallons and a half of ox blood and mix in the copper with 112 gallons of milk, warm water, which are to be well stirred; then add 25lb of Turkey Madder (rubia perogrina) and stir the whole well together; then having beforehand put the 10lbs of cotton on sticks, dip it into the light and move and turn it constantly one hour, during which gradually increase the Heat so that the liquor may begin to boil at the end of the hour. Then sink the cotton and boil it gently one hour longer, and lastly, wash and dry it.

Take out so much of the boiling liquor as will leave the Remainder only milk-warm. When mixed with as much fresh water as may be required to make up the 112 gallons, as at first, then proceed to make up a dyeing liquor as before, for the next ten pounds of cotton and so proceed in occupation with the whole.

Step VIII The Fixing Steep
Mix equal parts of the grey steep liquor and of the white steep liquor, taking 20-24 gallons of each. (Put) down the cotton into this mixture and let it steep six hours, then wring it moderately and equally and dry it without washing.

Step IX Brightening Steep
Ten pounds of white soap must be dissolved carefully and completely in from 64 to 72 gallons of warm water because if any little bits of soap remain undissolved they will make stripes in the cotton. Add to this 16 gallons of strong Barcilla water and stir it well. Sink the cotton in the liquor, keeping it down with crop sticks, and cover it up; boil gently two hours, when being washed and dryed, it will be finished.

At Rouen in France they boil the cotton five or six hours with six or eight pounds of white soap, previously dissolved in 145 gallons of water and in the vessel covered at the top so as to leave a very small opening for the necessary escape of the steam; which might otherwise occasion an Explosion. The effect of this (immersion) with soap is to dissolve and separate from the cotton all the yellowish brown part of the Madder colour which may have been applied to it in the dyeing operation; and by this operation to change the colour from dull brownish Red, which would otherwise remain, to a bright lively colour nearly equal in that of the finest cochineal scarlet.

It is only by singular degree of fixity which the pure red part of the madder colour requires, in consequence of the operations just described, that this beautiful Red can be stained: for though the Reds given from Madder in Calico Prints, are sufficiently available for all commercial works, they are not fixed sufficiently to bear without injury that extent of boiling with soap, which is necessary to separate the yellowish-brown part of the colour and produce the pure Vivid Red which results from the operations under consideration. Such, indeed, is the stability of the Turkey Red, which well dyed, that some of the Persons employed in dyeing have reported that their colours would sustain boiling with soap for the space of 36 hours without injury.

NB. Mr Vitalis reports that the stove heat for drying the cotton ought not to be (more) than 158 degrees of Fahrenheit thermometer.

Muslins and calicos may with care, be made to receive the Turkey Red Dye as well as yarn or thread, and truly also be variegated by a preservation of white spots - for if previous to the dyeing operation, a strong paste of oxalic or lime acid be laid on the parts intended to be preserved while, the mordant will be discharged in those parts which all the remained of the piece will remain as before, and, when dyed. Where the paste is laid will be white and all the rest red.

Bancroft's Philosophy of Permanent Colours in two vols 1813