TEXTILE FACT SHEET

TEXTILES ON THE WANDLE

Not only did the River Wandle provide power for machinery, it was also highly suitable for the preparation and cleaning of fabrics, since it contained deposits of Fuller's Earth. Although there are few records available of fulling, we do know that there were fulling mills in the area at the beginning of the 17th century.

Many names have become well known as leaders in the expansion of the textile industry in the valley, one of them being Adryan Collande. Collande, also called Collins, was a Dutch whitster living in Mitcham in the early 17th century. Parish records of the time show that his family lived and worked in the area for almost a hundred years.

A court case of 1692 records that a Jonathan Welch owned three mills in the Merton area, one of which was a mill used for the grinding of Brazilwood for fabric dye. The Welch family also owned a mill at Merton Abbey between 1750 and 1820, which was engaged in the manufacture of silk.

The close proximity of the valley to London ensured a ready market for fashion and furnishing fabrics. Fashion trends and local skills were the main factors determining the textile processes used in the area. Because of the popularity of printed calico in the 18th century, many mills were built at that time , one of which was Ravensbury Print Works, which was owned by Peter Mauvillian and employed more than a hundred people.

In 1754, an Irishman, Francis Nixon, came to the Wandle to set up a works at Phipps Bridge with a local man, J.A. Rucker. Nixon brought with him his system of using special mordants to produce fine quality prints in fast, washable colours. Rucker built Wandle Villa, and canalised a large stretch of the river to increase the flow of water to his mill. Another Irishman, Edmund Littler, settled on the Wandle as a calico printer. He printed Arthur Liberty's Eastern Silks. In 1885, Liberty bought the Littler Mill at Merton Abbey.

The Wardle family is noted for its contribution to the development of textiles and printing in Merton. Thomas Wardle of Leek was one of the leading practical authorities on dyestuffs and the art of silk dyeing. He worked for some years with Morris, experimenting with and reviving the art of vegetable dyeing. His brother, George Wardle, was the manager, under Morris, of the Merton Abbey Works.

William Morris is known worldwide for his textile designs and fabric printing. Morris and Company moved to Merton Abbey in 1881, and the firm continued to operate on the site until 1940. Arthur Liberty, the founder of Liberty and Company of Regent Street, was also based at a Merton Abbey site between 1912 and 1971, when fire destroyed part of the works. He, like Morris, preferred to use natural rather than synthetic dyes, and he also worked alongside Thomas Wardle in order to obtain the best results in dyeing and printing.

TEXTILE FACT SHEET

TEXTILE MILLS ON THE RIVER WANDLE

	PRE1650	16-1750	17-1850	AFTER1850
WADDON MILL	-	-	-	CALICO
BRIDGE MILL	-	-	DYEWOOD	BLEACHING
FLOCK MILL	-	-	COTTON	FLOCK
LOWER MILL	-	-	CALICO	-
SHEPLEY MILL 1	-	FULLING DYEWOOD	-	-
SHEPLEY MILL 2	-	DYEWOOD	DYEWOOD	WOOL
DEEDS MILL 1	-	DYEWOOD	DYEWOOD	DYEWOOD
DEEDS MILL 2	-	LAMBSWOOL	-	-
MITCHAM CALICO PRINTWORKS (MAKEPEACE MILL)	-	CALICO BLEACHING	CALICO BLEACHING	-
CROWN MILL	-	-	-	FELT & FIBRE
GROVE MILL	-	-	-	FIBRE
RAVENSBURY PRINTWORKS	-	-	CALICO PRINTING	SILK CALICO & SHAWL PRINTING
RAVENSBURY MILL	-	-	DYEWOOD	-
PHIPPS BRIDGE PRINTWORKS	-	-	CALICO SILK PRINTING	BLEACHING & DYEING
LIBERTY MILL	-	CALICO	TEXTILE PRINTING	TEXTILE PRINTING
MERTON ABBEY	-	CALICO	TEXTILE PRINTING	TEXTILE PRINTING
AMERY MILL	-	DYEWOOD	-	-
GARRATT PRINTWORKS	FULLING	-	CALICO PRINTING	CALICO PRINTING
DUNTSHILL MILL	-	-	TEXTILE DYE/PRINTING	TEXTILE DYE/PRINTING FLOCK
DAVIDSON PRINTWORKS	-	-	CALICO PRINTING	-
ROYAL PAPER MILL	-	-	CALICO	-
DYEWORKS	-	-	DYES	-
MIDDLE MILL	DYEWOOD	-	-	-

TEXTILE FACT SHEET

TEXTILES

A textile is a fabric made from fibres, natural or synthetic, which have been processed to make a continuous thread, or yarn. Yarns are knitted or woven together to make fabric. The necessary qualities of a fibre suitable for textile purposes are length, fineness, strength and flexibility.

The three main categories of textile fibre, to be looked into more fully below, are:

Proteinic (Animal) Fibres, such as wool, hair and silk.

Cellulosic (Vegetable) Fibres, such as cotton, flax and hemp.

Synthetic (Man-Made) Fibres, such as rayon, nylon and acrylic.

Yarns are made up of a number of fibres, the length and quality of which vary with each individual textile:

FILAMENT is the name given to a fibre of continuous length. An example of a natural filament is silk: The cocoon of a silkworm can contain 3,000 metres of unbroken twin filaments. In order to make yarn, groups of filaments are twisted loosely (two or three twists per inch) to keep them together.

STAPLE FIBRES are fibres of limited length. Staple fibres must be twisted so that they cohere into a continuous length of yarn. Cotton and wool are examples of staple fibres, as they are usually only two or three centimetres long. Staple fibre yarns are thick, fibrous and non-lustrous.

CONTINUOUS FILAMENTS occur in man-made fibres, and can be many kilometres long. Groups of filaments are twisted together as above, the number dependent on the yarn thickness required. The quality and sheen vary according to the synthetics used.

NATURAL FIBRES
Wool, hair, and silk are all fibres obtained from animals. Wool is warm and durable, ideally suited to making clothes and blankets. The hair of goats, rabbits, llamas, and camels is used to give us luxury fabrics.
Silk comes from the most unusual creature the silk moth. The caterpillar of this moth spins a cocoon from wispy filaments of silk. The quality of this fibre is dependant on the diet of the caterpillar. Fine silk is produced from those fed on mulberry leaves, wild silk from those fed on oak leaves.
Cotton is the most important and cheapest vegetable fibre. The cotton plant is grown on vast plantations where the round seed capsules or 'bolls' of cotton fibre are harvested.
Linen is woven from the stalks of flax plants. Although it is less available today, it is still used to produce high quality goods.

SYNTHETIC FIBRES
Nylon, polyester, and rayon are all man-made fibres. They are obtained as by-products of oil, through the chemical process of polymerization. Nylon was first commercially produced in 1938, since then synthetics have become hugely popular within the textile industry. When blended together they give a vast range of fabrics of differing weight and use.

TEXTILE FACT SHEET

Wandle Industrial Museum Project©

BLEACHING

Grey, or loom-state, cloths are 'finished' by bleaching and cleaning. There is archaeological evidence of the chemical bleaching of cloth before 300 B.C. Until the 18th century, the processes used remained the same:

SCOURING	Cleaning by soaking in an alkaline solution prepared by dissolving vegetable ash to produce a potash solution. This is known as 'bucking'.
SOURING	Treating the cloth with a mild lactic acid from sour milk, to remove any calcium salts and neutralize the alkaline.
CROFTING	A final thorough rinsing of the cloth, after which it was laid out in the sun to be bleached.

The distinctive bleaching fields, called **whistening grounds**, with their characteristic parallel channels of water separated by raised banks, were as prominent a feature of river valleys as the more imposing water mills.

Textiles being bleached were laid out on the banks, enabling the **whitster** to walk alongside and drench the cloth with water from the nearest channel. The cloth was bleached by the action of the light and the process of oxidation. It was then repeatedly soaked and dried and, given favourable weather and long hours of sunlight, it would be bleached in about ten days.

By the 18th century, there was a great demand for bleached cloth. Improvements were made to the **scouring** process (by the use of alkali solutions), and in the **souring** stage, oil of vitriol (dilute sulphuric acid) replaced sour milk as the neutralising agent. However, bleaching still took several weeks and required a large expanse of land.

Important developments in the late 18th century, affecting bleaching processes include:

1774 - Scheele discovered chlorine.

1790 - Bertholet found that chlorine could be absorbed by a caustic potash solution, forming potassium hypochlorite.

By the beginning of the 19th century, the three bleaching processes used were:

SCOURING	Cleaning, using lime and soda ash.
SOURING	Neutralizing, with oil of vitriol
CROFTING	Bleaching, using potassium hypochlorite.

BLEACHING GROUNDS ON THE WANDLE

1740-1860 REYNOLDS - calico and bleaching

1760-1825 ANSELLS - calico and bleaching

1780-1820 COOKSONS - bleaching

TEXTILE FACT SHEET

DYEING

The colour of a fabric is the first property which is noticed and is often the governing factor on fabric choice. Dyeing in its simplest form consists of the immersion of the textile material in a solution of dye stuff and water. When the temperature is raised sufficiently, the dyestuff passes from the solution into the textile and colours it uniformly.

Until 1856 all dyestuffs used on textiles were obtained from natural sources animal, vegetable and mineral based. Ancient dyes such as Tyrian purple, obtained from a species of shell-fish, and Indigo blue, extracted from indigo Ferratinctoria plants, needed complicated application techniques. In 1856 a British chemist, W.H.Perkin, discovered the first synthetic dye, when he produced a brilliant mauve dyestuff from coal-tar. By the end of the 19th Century the natural dyes were almost completely superseded by synthetic ones. These synthetic,'Aniline', dyes provided a wider,clearer and brighter,if rather harsh, range of colours.They could be made pure and constant in colour value, and were also much cheaper than natural dyes. Natural dyes varied greatly in quality and lack of precise chemical knowledge in applying them made it difficult to produce constant matching colour tones.

Dyeing is an extremely complex operation; a highly technical skill requiring years of experience even after training. A dyer has to know, for certain, which type of dye to use on which fibres.

1. Colour must stay in the fabric and not fade quickly.
2. Colour must not 'bleed' or run out of fabric if it is washed.
3. Colour must not rub off on to the wearer.

<u>Dyeing can be done at different stages.</u>

1. The fibres can be dyed during or before preparation for spinning. It is usual for fibre dyeing to be carried out on high-quality fabrics because it is more expensive and troublesome. Wool and other animal hair are the main natural fibres dyed at the fibre stage. Cotton and flax are never dyed as fibre. Silk is a filament and is prepared directly as yarn.
2. The yarn can be dyed after spinning,but before fabric construction.if a fabric is 'yarn-dyed' the yarn is left in hanks,or wound on 'cheeses' and is dyed in that state before weaving.
3. The fabric can be dyed after construction, during the finishing processes. Dyeing of fabrics, 'piece dyeing', is the cheapest and most common form of colour application by dyeing, and usually produces solid-colour fabrics.

Conventional dyestuffs are mostly used for printing. If a clearcut pattern of several different colours is required the dye cannot be applied in a simple solution

To hold the colours in position, a dye paste is made using various thickening agents,which prevent colour migration. The paste holds the dye until it has been fixed by steam or other processes and the the exhausted paste ingredients can be removed.

William Morris disliked the harshness of aniline dyes, preferring the more aesthetic quality of vegetable dyes. By the use of mordants, (chemical additives used in conjunction with dyes,) to bind the dyes to a fibre that would otherwise not accept them, it was possible to make certain vegetable dyes colourfast. Arthur Liberty was another fabric producer who found that the vegetable dyes produced superior and more subtle colours and had better ageing qualities than the synthetic alternatives which were then available.

DYEING

Arthur Liberty was another well-known fabric manufacturer who found that natural dyes produced superior and more subtle colours, which also aged better than the synthetic alternatives available at that time.

Dyeing can take place at three different stages of production:

FIBRE-DYEING	The fibres are dyed during or before preparation for spinning. It is usual for fibre-dyeing to be carried out only on high quality fabrics, because it is more expensive and troublesome. Wool and other animal hair are the main natural fibres dyed at the fibre stage. Cotton and flax are never dyed as fibre. Silk is a filament, and is prepared directly as yarn.
YARN-DYEING	The yarn is dyed after spinning, but before fabric construction. If a fabric is yarn-dyed, the yarn is left in 'hanks', or wound on 'cheeses', and is dyed in that state before weaving.
PIECE-DYEING	The fabric is dyed after construction, during the finishing processes. Dyeing of fabrics -'piece-dyeing' - is the cheapest and most common form of colour application by dyeing, and usually produces solid-colour fabrics.

Conventional dyestuffs are mostly used for printing. If a clear-cut pattern of several different colours is required, the dye cannot be applied in a simple solution.

To hold the colours in position, a dye paste is made, using various thickening agents, which prevent colour migration. The paste holds the dye until it has been fixed by steam or other processes, after which the exhausted paste ingredients can be removed.

TEXTILE PRINTING

The art of block printing was developed in China and India over 2000 years ago. In Europe, Germany was noted for its textile printing between the 10th and 14th centuries. In 1678, William Sherman introduced the process to England.

Today, a number of different printing methods may be used:

1. **Direct Printing** : This involves printing directly onto the cloth.

2. **Discharge Printing** : The cloth is dyed an even background colour, and a bleaching agent is then block printed onto the dyed background.

3. **Resist Printing** : This takes two forms -
either a) A mordant or variety of mordants is printed onto the cloth in varying strengths. The cloth is then dipped into the dye bath, producing a variety of tones and shades within the colour group.
or b) A resist substance, often a starch paste or wax, is printed upon the cloth before piece-dyeing.

THE BLOCK METHOD

A design is traced onto the hard, smooth block surface and the block is then cut away, leaving the design standing in relief. The block is then coated with colour and stamped onto the fabric, transferring the design cut in the block. Each individual colour in the pattern requires a separate block. Hand block printing is still carried out to a small extent, but it is a very slow and highly skilled craft, and is therefore limited to exclusive designs.

ROLLER MACHINE PRINTING

In 1785, printing by means of rollers in a machine was introduced. This was a development of the engraved block method. The design is engraved on a copper cylinder. A separate cylinder is engraved for each colour, each representing a different part of the design. Dye is mechanically applied to the rollers. The fabric to be printed, backed by a soft absorbent cloth, is passed over the copper cylinders and kept in place at an even pressure by a large iron roller. As the printed fabric emerges, it is dried and finished. Roller printing is inexpensive once the copper rollers have been engraved. This method of printing is used where large quantities of fabric are required.

STENCIL METHOD

A design shape is cut out of a piece of thin, hard, non-absorbent material. This is placed on a fabric and the colour brushed or sprayed in. The cut out portion allows the colour to pass through to the fabric in the design shape. A separate stencil for each colour is necessary. Japanese craftsmen turned this technique into a fine art, using up to 80 separate stencils.

SCREEN PRINTING

Once referred to as silk-screen printing, because the fine screens were always made from silk, this method is a development of the stencil method. The design is applied either manually, using a water- or oil-based resist, or photographically, onto a series of fine mesh screens set in frames, one frame for each colour to be used. As the fabric passes along a conveyor belt, the screens are lowered in sequence, each one transferring a pattern of dye. The fabric is then dried. Screen printing is a very quick method of printing, and its main advantage is that many colours can be used to build up a design.

RESIST PRINTING

A resin paste is applied to the fabric in a pattern, after which the cloth is dyed. The dye cannot penetrate the paste. After dyeing, the paste is removed. This method does not allow the variety of colour usual with other methods.

TEXTILE FACT SHEET

Wandle Industrial Museum Project ©

SILK

Fabrics made from silk are expensive, but they are soft, luxurious, absorbent and very strong. They accept dyes readily but are difficult to launder. Silk has always been difficult and expensive to produce and it was the dream of producing 'artificial silk' which led to the production of man-made fibres.

The firm of Liberty and Co. of Regent Street, London, imported silk from India. It was then printed by Edmund Littler in the Wandle Valley. Later, Liberty bought Littler's print works , and all the Liberty silks were printed at Merton Abbey. Liberty Satin is the trade name for a very soft, piece-dyed satin fabric, with raw silk warp and single spun silk filling. Liberty fabrics are now exported to Japan, whence Arthur Liberty imported the first Oriental silks for his half-shop in Regent Street.

China was the first country to produce silk. Today there are six main silk producing countries:

Cultivated Silk		Wild Silk
China) Japan)	These two countries produce most of the world's cultivated silk.	India China Japan
Southern France		
Italy		
Parts of Asia		

The moth used in silk farming is the domestic silk moth, Bombyx Mori, of which there are nearly 300 varieties. The silk fibres are obtained from the cocoon which the silk worm spins around itself before emerging as a moth. It is a 'polymer' consisting of amino acids, the main components of which are glycerine and alamine.

The production of cultivated silk is known as 'sericulture'. Worms fed on mulberry leaves produce a fine silk, whilst worms fed on oak leaves produce a coarser and less even silk known as "Tussah" or 'wild silk'. Silk has traditionally been associated with wealth, as it has always been expensive and scarce. Waste filaments from all stages of production are spun as 'staple fibres' and converted into 'spun silk'. Spun silk lacks the lustre and fineness of filament silk.

Silk is the only natural filament used for textile purposes. Two very fine filaments, coated with a natural gum called seracin, are produced by the caterpillar. This makes a protective casing where it would normally remain until its metamorphosis. To obtain the silk filaments, the silk worms are stifled by steam and the cocoons are unwound. A single cocoon can contain up to 3000 metres of filament.

The unwinding process is known as REELING, and it leaves the silk harvester with a single thread or filament, which can be up to a mile long.These filaments are then twisted together by a process called THROWING to make a yarn, the thickness of which can be varied during the throwing.

The silk is woven like any other yarn, and there are three main weaves, Plain or Taffeta, Twill, and Satin. This raw silk is a grey colour and containsimpurities. To remove these the cloth is boiled in a solution os soap and chemicals which leave it clean, after which it is thoroughly rinsed. The next process is to pull the cloth out to the right tension and to a width of 36inches, first steam-softening it. An experienced operator knows how to handle silk, and will make sure that the threads are straight. The cloth is now ready for printing.

TEXTILE FACT SHEET

COTTON

Cotton is the cheapest natural fibre used for clothing. It grows in sub-tropical regions which lie roughly between the latitudes of 35° North and 35° South of the equator.

The ten major producers of cotton are:

U.S.S.R., China, Pakistan, Egypt, Mexico, U.S.A. (Southern States), Brazil, Turkey, Argentina, India.

The cotton plant grows to a height of 3-6 feet in cultivation, and up to 20 feet in the wild. Its flowers are about 2 inches across and live for three days. The petals are then shed, leaving green seed pods. These pods each contain 30-40 seeds, each of which is attached to a long, soft hair. Over a period of two months, the pods swell to the size of a hen's egg, and these 'bolls' then burst open, revealing a mass of tangled, fluffy fibres, the staple lengths of which vary in length according to region. The bolls are picked by hand or machine, and are then processed in a ginning machine. This machine separates the fibres from the waste vegetable matter and impurities. The fibres are then pressed into bales of 500 lbs for transportation.

Cotton is soft, strong and a good conductor of heat. It readily absorbs moisture and dyes easily, and it can be boiled or sterilised without any risk of disintegration. Its resistance to heat means that no particular care is necessary in its laundering.

The fineness of cotton is measured in 'counts'. The count is determined by the number of hanks (840 yard lengths) to the pound in weight. For example, if a cotton yarn is 'count one', one hank weighs one pound.

Cotton is classified according to its staple length - long, medium or short:

LONG STAPLE COTTON (Up to 55mm staple length)

This is the finest and most expensive type of cotton. The highest quality cotton of all is Sea Island cotton, which is grown in the West Indies. The next best is Egyptian cotton.

MEDIUM STAPLE COTTON (About 25mm staple length)

The most common type of cotton, comprising over half of total cotton production. Most of the world's clothing fabrics are made from this quality of cotton.

SHORT STAPLE COTTON (Less than 25mm staple length)

This is coarser, and is used in cheaper fabrics such as calico. Asiatic cottons fall into this category.

The principal manufacturing processes are:

CARDING	Combing to straighten fibres: Cotton emerges as a thick rope, or sliver.
DRAWING	The combing of several slivers to produce one finer sliver, by passing them between rollers. The resulting sliver is drawn and twisted, and wound onto large bobbins.
ROVING	Two further stages of drawing to increase the fineness of the yarn.
SPINNING	The cotton is drawn out into a thread and twisted, as it is wound onto bobbins.

The Devil was the first stage in preparing the cotton for spinning. It was like a carding engine, but had iron spikes instead of the card-clothing. It broke up the lumps of cotton from the bale.

At the beginning of the 19th century, a machine called a scutcher was developed. This cleaned the cotton after it had passed through the Devil. It also rolled the cotton up into a lap ready for the carding engine.

TEXTILE FACT SHEET

CARDING AND DRAWING

CARDING

Both wool and cotton fibres are tangled in their natural state. Carding is the process which disentangles the fibres and begins to lay them parallel.

Traditionally, carding is done with a pair of leather-covered boards, through which are stuck fine wire hooks or points. The hooks catch the fibres as one board is gently pulled acroos the other. When loosened, all the fibres are transferred to one board and pulled off in a roll, known as a 'sliver'.

In 1748, Daniel Bourn of Leominster patented a carding machine, on which the fibres were passed from one cylinder to another. The fibres still had to be removed manually.

In 1750, Robert Kay developed a machine for cutting, bending and inserting the wires through the leather. William Pennington developed a machine for making holes in the leather backing.

Larger cards, called 'stock cards' were tried. Sometimes the lower card was fixed to a table and the upper card was suspended by a series of pulleys and weights.

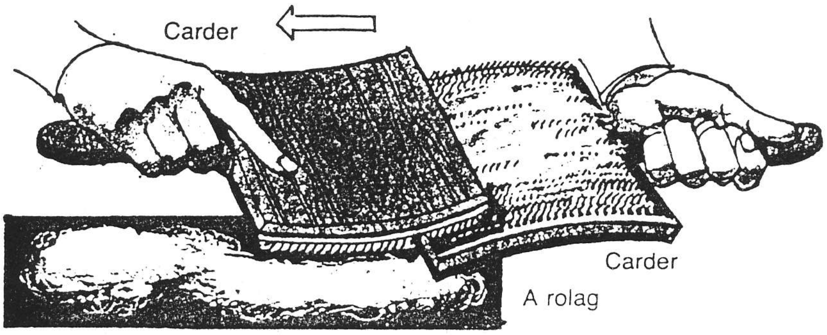
In 1775, Richard Arkwright patented a superior carding machine. The advantage of this machine was that a comb removed the fibres from the rollers mechanically.

Many people had attempted to design carding machines, and it was alleged that Arkwright had used other people's ideas. These allegations led to a trial in 1785 to contest Arkwright's patent. The verdict went against him, and his patent was annulled.

DRAWING

Drawing is the process of pulling out fibres until the sliver is thin enough for spinning. A sliver is an untwisted rope of fibres which are held together only by the friction caused by their own roughness. It has little strength and is easily broken.

In the 13th century the French invented a method of hand carding using wire-toothed boards. These are still used by hand spinners today.



TEXTILE FACT SHEET

SPINNING

If a rod or spindle is rotated, any length of string or yarn attached to it which is held in the same line as the spindle is pointing will be rotated too, and thus twisted. The twist binds the loose fibres together and changes the carded sliver into a length of yarn. If the yarn is held perpendicular to the spindle, it will be wound on.

THE DROP SPINDLE

From prehistoric times until the fourteenth century, women in this country used a simple spindle to spin wool and linen for their household use.

The spinner knotted a length of spun yarn to the top of the spindle and set the wheel turning. With her fingers, she pulled out the correct number of fibres from the sliver to form the required weight or thickness of yarn, and then allowed the twist from the spindle to bind them together. The piece of newly spun yarn gradually lengthened as the spindle descended towards the ground. A circular weight gave momentum to help keep the spindle turning. Once it had almost reached the ground, the spinner had to untie the knot and wind on a new length.

THE SPINNING WHEEL

Around 1350, the first spinning wheel was introduced to England. Known as the 'Jersey Wheel', it consisted of a large wheel with a flat rim, around which a band passed to a small pulley on the shaft of a horizontal spindle. The effect of this pulley system was to greatly increase the rate of the wheel's rotation, making it far more efficient than the drop spindle.

The spinner held the mass of carded fibres, or 'rollag', in her left hand, pulling them away from the spindle, whilst paying the fibres out through her fingers and, at the same time, turning the wheel with her free hand. Considerable skill was needed to produce a yarn of even thickness and quality, as the spinner had to be able to feed the fibres onto the spindle evenly, whilst keeping the wheel spinning at a constant speed.

The yarn left the spindle at an angle, and it was possible to spin a length of up to six feet before it had to be wound on. To wind on a length, the wheel had to be turned backwards to unwrap the spiral coils from the top of the spindle. Then, with the yarn held parallel to the wheel and perpendicular to the spindle, the wheel was turned in the original direction, and the yarn reeled up in a nicely shaped 'cop', or cone. It was possible to spin a thread directly from the carded sliver, but usually the sliver was drawn out on another spinning wheel and twisted into the finished yarn.

Towards the end of the fourteenth century, the 'Saxony Wheel' was introduced. This was operated with a foot pedal, thus leaving both hands free to pay out the fibres. On the end of the spindle, a horseshoe-shaped 'flyer' was fixed. This flyer, made of wood or metal, guided the yarn to the side of the bobbin where it was wound on.

Many people tried to invent a machine capable of spinning a number of threads or yarns simultaneously. The 'Spinning Jenny' was invented in 1763 by James Hargreaves, and could spin eight cotton yarns at once. In 1769, Arkwright patented his water frame spinning machine, and from then on, techniques for the spinning of fibres improved rapidly.

TEXTILE FACT SHEET

LINEN

Linen is the oldest textile fibre known to man. The first traces of linen have been found in lake dwellings dating from 8,000 B.C., and by 5,000 B.C. in Ancient Egypt, linen was being used to make shrouds for the preservation of the dead, as well as articles of clothing. The very fine, white Egyptian linen was regarded as a symbol of divine purity.

In Europe, the use of linen became widespread from the 11th century, and continued to develop until the industrial revolution, when it began to meet increased competition from cheaper imported cotton.

The major producers of linen are:	U.S.S.R.	The Netherlands
	France	Ireland
	Belgium	

Linen is the strongest natural fibre and, because it sheds a microscopic layer every time it is washed, it always keeps its fresh good looks. It is highly absorbent yet quick drying. This makes it one of the most comfortable fabrics to wear in tropical climates. Irish linen retains its reputation for the finest napery, and the best artists' canvases are of a linen base.

Linen cloth is produced from the fibres of the flax plant, Linum Usitat-issimum. The flowers are pale blue, white or sometimes pink. Sown in late March or early April, the plant takes 100 days to reach its full height of 80-120 cm. The crop must then be pulled up rather than cut, and subjected to five further processes:

RETTING — After pulling, the flax is left out in the field so that the actions of dew, rain and sun cause natural decomposition, eliminating the natural gummy substances called pectins which bind the fibres to the rest of the plant. This is known as 'dew retting' or 'ground retting'. An alternative to this slow process is 'water retting', involving the immersion of the flax for 3-5 days in tanks of water kept at a constant 37°C.

SCUTCHING — A mechanical process where the retted stalks are beaten and crushed to separate the woody parts from the fibres. The waste matter, or 'shiv', is used to make chipboard for the building industry.

HACKLING — The beaten fibres are combed to separate the long fibres, called 'line', used for luxury fabrics, from the short, called 'tow', which go to make coarse canvases and upholstery fabric.

SPINNING — The linen is spun by one of two processes; dry spinning, which gives a rough, coarse yarn, or wet spinning (where the fibre is first soaked in water at 60-70°C), which produces very fine, regular yarns.

WEAVING — This is by the normal method. Linen can be woven alone or with other fibres, notably cotton to give the popular fabric known as 'linen union'.

TEXTILE FACT SHEET

WEAVING

Cloth, made from any type of fibre, is woven on a loom. The technique originated in Ancient Egypt. The looms were originally hand-operated, usually by men. Each weaver would need three or four spinners to keep him supplied with yarn.

There are two sets of threads in a weaving operation:
WARP threads, which run along the length of the fabric, and

WEFT threads, which pass across the width of the fabric, interlacing with the warp.

THE MECHANISATION OF WEAVING

1733 The flying shuttle was invented by John Kay. This was a new shuttle device which passed more quickly and easily across the loom. Kay fitted small wheels to an ordinary shuttle, so that it could run on a ledge fitted to the reed of the loom. The shuttle was driven from side to side by hammers.

1760 The flying shuttle was in general use.

1840 A satisfactory stopping device was invented. This enabled the weaving industry to go ahead with full mechanisation.

1786 Edmund Cartwright patented the power loom. This first machine was at a very experimental stage. It was found that it was important to be able to stop the loom immediately something went wrong.

The warp threads pass through a central hole in a **heddle**, which is a simple device for separating them. Each warp thread has its own heddle. The warp threads are usually thicker and stronger than the weft, as they have to be able to withstand strain. The heddles are set into a framework called a **harness**, which is used to allow alternate warp threads to be raised, in order that the weft yarn may be inserted. For basic weaving, the set of harnesses are raised and lowered alternately. However, to create a more intricate weave, like Herringbone, it is necessary to follow a more intricate lifting pattern. Also, the machine must be threaded so as to ensure that the correct harness will raise at the correct time, bringing with it the correct number of warp threads.

The weft threads are inserted crossways into the fabric during weaving by the **shuttle**. In the original manual looms, this was a slow and awkward process. The shuttle, as it is driven across the loom from side to side, leaves a tail of weft behind it. To make a firm, compact cloth, the weft must be beaten up hard against the preceding **shoot**, or thread. This is done by the reed, which is like a comb, its teeth sliding along the warp threads. Weft threads are also referred to as 'filling yarns', because thay fill the spaces in the warp and complete the weave. As the shuttle passes back and forth, it creates a finished edge on each side. This is called the **selvedge**, and is usually of a slightly closer weave than the rest of the fabric.

William Morris and Company had begun weaving cloth by 1877, with four hand-operated Jacquard Looms, and four master weavers. The Jacquard Loom operates by setting a pattern for lifting warp threads in preparation for the shuttle passing through horizontally to form weft threads. Original designs were marked onto 'point paper' to check accuracy, and were then transferred to a card by punching holes to indicate the lifting sequence. This punch card system allowed the shafts to lift the warp threads automatically, providing a quicker and more accurate weave.

TEXTILE FACT SHEET

WOOL

Wool is a natural fibre which grows on the bodies of sheep in the form of a protective layer known as a fleece. The fleece is sheared from the sheep, usually once a year. The amount of wool obtained depends on the breed of sheep, but the average weight of a fleece is under 4 kilogrammes.

The main wool producing areas of the world are:

Australia New Zealand South Africa South America India	These 5 countries are the major exporters of wool to Britain and other countries.
U.S.S.R. U.S.A. Canada	These 3 countries produce wool mostly for the home market.

Wool is more expensive to produce than cotton and, as the demand for wool is always high, it usually sells for three times the price of cotton. High quality wool is that made from the shortest, finest fibres. Also, the natural 'crimp' or kink found in wool fibres is at its most pronounced in quality wool.

MERINO or BOTANY WOOL

Obtained from the Merino sheep, mainly in Australia, this is the highest quality wool, its fibres being 50-100mm long. It is fine and soft and, although not the strongest or most durable wool, it is however the warmest, and is used for luxury fabrics requiring softness and warmth. Apart from Australia, the main producers of Merino wool are South Africa and South America.

CROSS BRED WOOL

This, the largest group, covers a vast range of qualities, with fibre lengths ranging from 75 to 200mm. These wools are thicker and stronger, some varieties possessing a high lustre. The fabrics made from cross bred wool are economical, strong, resilient and durable. New Zealand and South America are the world's major producers of cross bred yarn.

CARPET TYPES

Long, coarse wool whose fibres are 150-400mm long. They are used mainly for carpet making, where strength and resilience are the most important requirements. These wools come from Asiatic sheep.

TRADITIONAL PROCESSES

Raw wool was hand sorted and graded by skilled sorters. It contained impurities such as grease, dirt and vegetable matter, and therefore had to be scoured, by washing in an alkaline solution. Dilute sulphuric acid was then used to burn away the remaining waste matter. The wool fibres were then either combed, to separate the long hairs from the 'whort', or 'carded' to make a fleecy roll of roughly parallel fibres. It was then spun, woven, fulled, 'tentered' (stretched), bleached, dressed and sheared.

TEXTILE FACT SHEET

TAPESTRY

Tapestry is decorative, handwoven fabric, usually of silk and/or wool, with a non-repetitive pattern. The designs are made by weaving coloured weft threads alternately over and under the warps, with each differently coloured yarn on a separate bobbin. Weavers copied the design from a **cartoon** (full-scale preliminary design), and the tapestries were woven on either a **high-warp** or a **low-warp** loom.

High-warp tapestry is woven on a loom with a vertical arrangement of warp threads. This method is slower and therefore much more expensive than low-warp tapestry, but usually produces a higher quality finished article. On a high-warp loom, the cartoon stands behind the warp threads, and the weaver places a mirror so that he can see what he is doing, as he works from the back of the tapestry. The weaver transfers the main outlines of the cartoon onto the warp threads, referring back to it for details of design and colour as the work proceeds with the weft.

Low-warp tapestry is woven on a loom where the warp threads are arranged horizontally. In the Middle Ages, this method was considered inferior to high-warp tapestry. On a low-warp loom, the weaver places the cartoon underneath the warp, so that he can follow it easily and faithfully. However, as he works from the back of the tapestry, the design is produced in reverse, so the cartoon must show a reversed version of the composition. Good examples of this are the famous Raphael cartoons, where the figures all appear left-handed. Raphael's design "The Acts of the Apostles" (1516), was first woven in Brussels and copied in many factories.

TAPESTRY MAKING IN EUROPE

Tapestries were probably introduced to Europe by the Arabs in the eighth century. The Crusades increased European contact with the Middle East, and it is likely that tapestries were brought home by the Crusaders. In the latter Middle Ages, the craft of tapestry making flourished. Tapestries were used as wall-hangings, to cover large expanses of bare wall, and were also draped over beds and tables. Tapestries were displayed on ceremonial occasions as symbols of prestige, and in churches they were hung over altars and choir stalls. Although there were tapestry workers in England from the 14th century, these were mainly immigrants who had learnt their skills in their native lands.

1560-1613 The first English tapestry factory was started by William Sheldon at Barchester. This factory produced small hangings.

1619-1703 Sir Francis Crane imported 50 Flemish weavers to work at the Mortlake factory, which was under Royal patronage.

1881 William Morris began tapestry weaving at Merton Abbey. Sir Edward Burne-Jones, Walter Crane and Phillip Webb assisted Morris in producing designs for the factory.

There were many tapestry factories in Europe. Two of the best known were:

The Arras Tapestry Factories, which were established in the late 13th century, and by the mid 14th century were considered the most important in Europe. In 1384, Arras was annexed to the Duchy of Burgundy, and thus gained Royal patronage. The factories remained open until the early 16th century.

The Gobelins Tapestry Factory, which was the most important factory in the late 17th and 18th centuries. The artist Le Brun provided finished cartoons in oils for the factory. The factory survived by adapting its output to the prevailing style, such as with the Neo-Classical revival of the 18th century. The Gobelins factory is now under state ownership.