

THE MANUFACTURE OF WOOLLEN CLOTH

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In articles of this nature it has almost become a habit for the author to begin by remarking on the antiquity of the origins of the textile industry. This is done principally, I think, to emphasise the importance of the subject. Men have to satisfy three essential bodily needs, those for food, shelter and warmth, and the production of fabrics satisfies the third of these needs. Thus from the earliest days one of the first concerns of human beings was to keep themselves warm and dry. In some countries, of course, they may even have had to go to some lengths to keep themselves cool or to keep out hot dust and sand, but in either event this was achieved by a covering of some kind and fabrics have been made for thousands of years for these purposes.

Men have never been animals who have catered entirely for their bodily needs to the exclusion of all else—their aesthetic senses also crave satisfaction. Those of you who know of, and have seen reproductions of, the remarkable drawings of the stone-age men of 12,000 years ago will not need to be told that there were some wonderful artists as long ago as that. Man has been applying his artistic abilities to his own personal adornment for centuries and naturally, therefore, his artistic accomplishments have always been applied to the design of the cloths which he has produced. This consideration underlines the importance of the subject of cloth manufacture and shows that it has always served two purposes—those of utility and

comfort and of personal decoration and, if one had time to develop it, the story of the evolution of cloth manufacture could provide a most fascinating study.

It is still true to-day that, in the manufacture of woollen cloth, the main objects to be aimed at are utility, durability and the general fitness of the material for the purpose for which it is intended, combined with a design which appeals to man's aesthetic tastes. Both are equally important and certainly command equal attention in the woollen industry—the one is no good without the other.



PLATE 1 Weaving: note the shuttle passing swiftly through the warp shed, leaving the weft yarn behind

I have explained that textile materials are one of man's primary needs. It therefore seems to me that everyone should know something about a subject which so vitally affects them and I am afraid that most people know very little. This knowledge has been disappearing from the stock-in-trade of the ordinary citizen of this country for 200 years. Up to that time the production of all woollen cloth was carried out by hand, mostly in the homes of the people where the spinning wheel and handloom were everyday pieces of household furniture. The Industrial Revolution put an end to that. In fact the Industrial Revolution was the outcome of the work of men of whom you may have heard — Arkwright, Crompton, Kay and Hargreaves — who, in the second half of the eighteenth century, invented machines to do the work of many spinners and weavers. Their machines were the foundation of the factory system which grew up in the North of England for the production of cloth and, later, when the steam engine was invented its principal immediate value was to drive the textile mills. This was the dawn of the industrial age in Britain. One could fairly say that the manufacture of textile materials was a major factor in this rapid industrial development. At the present time the only places in the British Isles where hand methods are still used to any considerable extent for the manufacture of cloth are the islands off the coast of Scotland, where population is sparse, where power and fuel for power are not easily obtainable, but where sheep have been comparatively plentiful.

Apart from the fact that everyone should know something about so important a subject there are other reasons why it is worthwhile to be introduced to the subject of woollen cloth

manufacture. The designing of cloth and the carrying out of the designs on a handloom to a practical conclusion always appears to me to be a most fascinating hobby, one which I believe would appeal to many. It can satisfy one's creative instincts — a way to ease many people's sense of frustration in these days. The woollen industry itself is also a fascinating one, offering a wealth of opportunity and interest and many fields of work to anyone who is seeking a career — whether his bent is a scientific, artistic or commercial one. This is a good reason why people in schools should know about it. Furthermore, it would be to everyone's advantage if the public learned a little more of the details of textile materials and were able to recognise some of the finer points of the cloths which they buy. If the customers' appreciation of good cloth and poor cloth, good design and poor design, could be developed, there would be a lot of material on the market which would come in for severe criticism. This gives no cause for concern to those who have the best interests of the wool industry at heart, as they realise that it would lead to higher standards in the industry. It would encourage the most efficient producers, and would mean that this country could the more easily maintain its reputation for turning out the best woollen cloth in the world and expand its export trade.

In trying to tell you in a few words how woollen cloths are made I shall often have to generalise and I would like you to realise that generalisations are not always strictly accurate in every detail.

Wool is obtained from the sheep of the British Isles, but these are far outnumbered by the sheep raised in the Commonwealth

countries, so nowadays the greater part of the wool used in British mills comes from Australia, South Africa and New Zealand. There is a very wide variety in the character of the various types of wool; at one extreme we find the mountain sheep such as the Blackfaced breed of the Scottish Highlands, the Herdwick sheep of the Lake District and the mountain sheep of Wales. These sheep produce wool which is long, coarse and hairy and, as it is therefore not suitable for soft, comfortable wearing apparel, a large amount is used for making carpets and rugs. The finer grades of these wools are used — often in blends with less hairy types — to make rough woollens like Harris tweed.

At the other extreme the finest wools, which are also shorter in length, come from the breed of Merino sheep raised chiefly in Australia and South Africa. These wools are at the same time very soft and tough and therefore make materials which wear well, and can be used for garments in which comfort and a pleasant warm feeling is required. Underwear and knitted outerwear are examples of the use of this kind of wool and it is also used for costume cloths and suitings, when one wishes to have a soft-handling, fine, smooth fabric.

There are intermediate grades of fineness and softness between these two extremes, all having their particular applications. It is true to say that the finer and softer the wool the finer the yarns which can be made from it and, consequently, the finer and more dainty the fabric which can be produced. This is not to say that the finest wools are used only for the lightest and finest yarns and fabrics. One might need a heavy overcoating with a soft finish and one would then

have to use a soft, fine wool in its construction; or perhaps one requires a soft hand-knitting wool for babies' garments. For this purpose the soft, fine wool is made into thick yarns. Wool fibres of the finest grade have an average diameter of about eighteen microns (1 micron =0.001 mm.), whilst the coarsest ones have an average diameter of about forty microns, and the finer the wool the dearer it is. It also happens that the finer the yarn the more expensive it is to make, and the finer the texture of the cloth the more expensive it is to weave, so you can now see why the fine, woollen fabrics are expensive, since they are closely woven of fine yarns from fine wool. In general the fineness of the fibre used in the construction of a fabric is a good guide to its quality.

SORTING AND SCOURING

On the sheep's back wool is greasy; it also contains a certain amount of chemical salts which are exuded by the sweat glands of the sheep, and it may be contaminated by dust, dirt and vegetable seeds which the sheep collects in its wanderings. In the case of many sheep only about half the weight of the fleece may be wool, the rest being mainly wool grease. When they are received at the mill the fleeces, therefore, have to be cleaned, but first of all they have to be gone through individually by skilled sorters. This is because all sheep, even from the same flock, do not produce wool of exactly the same properties and even on one sheep wool on the back is different from that on the belly which, in turn, is different from that on the shoulders. So the wool is sorted and divided into batches of uniform quality before cleaning. The cleaning operation is done on the conveyor band principle in long baths or bowls about 50 ft.

long, 3 ft. wide and 3 ft. deep. The greasy wool is fed in at one end and is pushed through the scouring liquor in the baths by metal forks. The first bowl is filled with a warm solution of soap and soda ash, the second and third bowls give a milder wash in warm soapy water and, finally, the wool is rinsed in warm clean water. It then goes through a pair of mangle rollers — called squeeze rollers — and passes into a drying machine. Sometimes, if it is badly contaminated with vegetable burrs, it has to be carbonised after scouring. This process consists of soaking the burry wool in sulphuric acid solution and drying the acid wool. Dilute sulphuric acid does not damage wool, but when that in the burrs is heated up in the drying machine it becomes concentrated and attacks the vegetable matter, reducing it to dust which can easily be removed.



PLATE 2 Wool sorting: the wool in each fleece is sorted into different qualities. These men work in a north light as their judgement is based on what they see

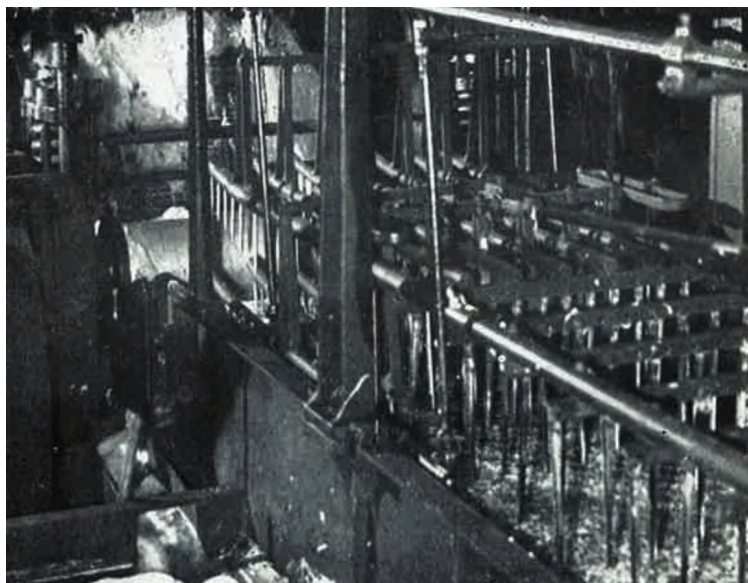


PLATE 3 Scouring: the greasy wool is pushed through the top layer of the scouring liquid by the forks

We now, therefore, have clean, white wool ready to make into yarn. Sometimes it may be dyed at this stage if coloured yarns are required, or we may wait until the yarn or cloth has been made before dyeing it. The wool, however, whether dyed or undyed, is then put into a large stack in the blending room. It may be that a few different types of wool or different colours of wool are being mixed for some reason. In these stacks the various lots are intermingled as thoroughly as possible, because the object of all processing is to get as uniform a blend as possible. This leads to yarn and cloth of uniform properties.

After blending, the wool is teased out by machinery to destroy

the major entanglements and matted pieces, and reduce the blend to fairly small tufts so that the next machine, the carding machine, can operate efficiently. During this teasing the material is again mixed and about ten per cent by weight of vegetable oil is added to lubricate the fibres in their passage through the yarn-making machines, and so prevent them being broken any more than is necessary.

CARDING

The process of carding, probably the most important in woollen cloth manufacture, follows. During this process the wool is first weighed out into equal quantities and these equal quantities are fed forward, at a regular rate, to be very finely teased out fibre by fibre, and then the fibres are reassembled into a number of thin ropes which are ready to be made into yarn. All this is done mechanically. The wool is emptied into a hopper which feeds it forward and drops it into a scale pan; when this balance has received its due weight it overturns and discharges its load on to a conveyor belt which feeds the wool into the carding machine. This is a machine 70 or 80 ft. long and 5 ft. wide which consists of a number of large, revolving cylinders whose surfaces are covered with very fine steel claws, which seize the wool and carry it forward at a speed of about 100 ft. per minute. Set very close to these large cylinders are smaller ones, called “workers”, which are also clothed with the steel, claw-like pins (about 500 per square in.). The claws are set to work in opposition to those in the main cylinder and, as the two are only one-hundredth of an inch apart, they tease the wool and shred it out as it passes along. The wool is transferred to successive cylinders, which work in exactly the same way,

and eventually it is reduced to a fine web of fibres, free from any obvious lumps, and comes out of the machine as a thin veil 5 ft. wide. This is split into narrow strips about half-an-inch wide by an ingenious mechanism. The same mechanism rubs these strips up into thin, soft ropes called rovings, which are wound on to large bobbins.

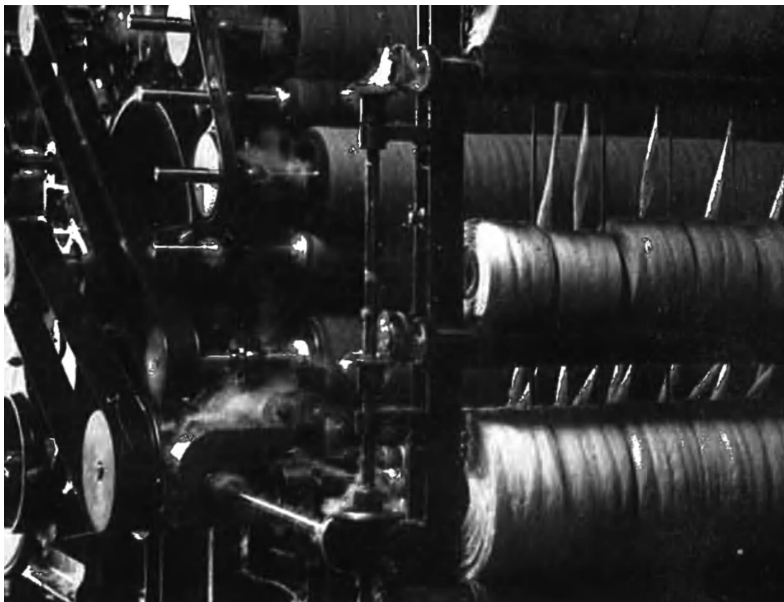


PLATE 4 Carding: here the wool emerges from the last set of card rollers and is split up into narrow strips

It may be difficult to see how this is done, but if you rub carded wool backwards and forwards between the palms of your hands you will see the rope-like roving formed. On the machine it is done continuously and the roving is wound up as

it is made.

Such machines may turn out an average of between 20 and 30 lb. an hour of roving, but it is not yet yarn. The rovings are fragile and would fall to pieces if they were handled very much. They are also too soft and thick to form the basis for a suitable cloth. To make a thread or yarn from a roving it has to be made strong and to give it strength it has to be twisted. This is done on a spinning mule (a machine developed from Hargreaves' Spinning Jenny) ; revolving spindles turn and twist the wool ; this twist binds the fibres tightly together and the cohesion of the fibres makes the thread strong.

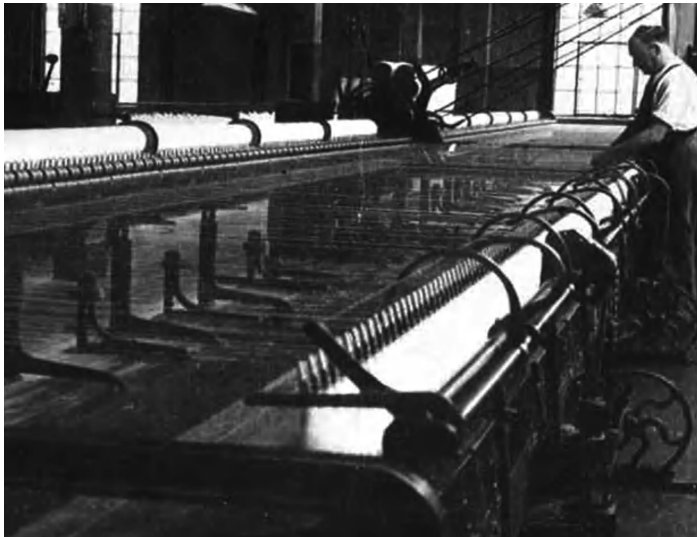


PLATE 5 Mule spinning: the bobbins of roving are fitted to the standing part of the machine at the back. Each roving is drawn out, twisted and wound on the spindles as yarn

I cannot describe the subsequent operations of cloth manufacture in such detail. Suffice it to say that there are many kinds of yarn developed from the single threads whose manufacture I have just described. By combining yarns of various thicknesses, colours, or degrees of twist into 2-ply, 3-ply, and so on, many fancy types of yarn can be produced, all of which add interest to the cloths which can be made from them. When the yarn has been spun it next has to be woven into cloth.

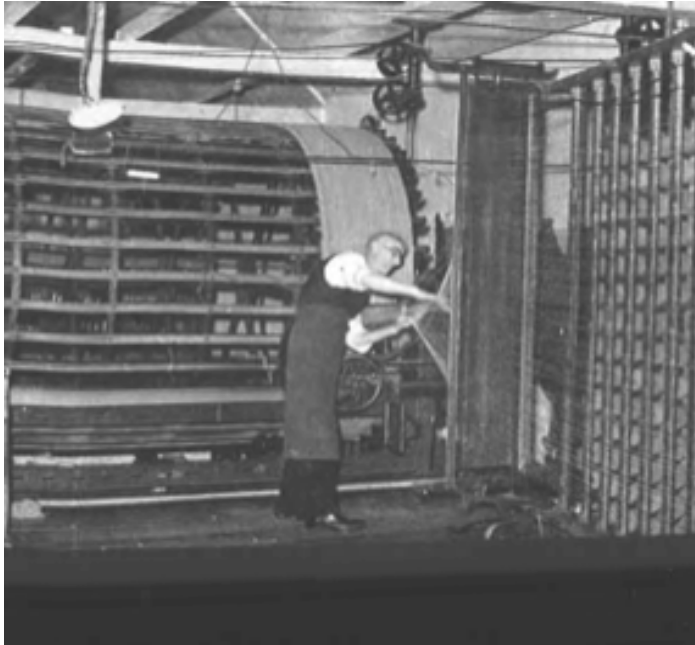


PLATE 6 Warping: Before cloth can be woven the warp must be built by arranging parallel and equidistant, and running them on to the warp mill at an even tension

Processes intervene here in which the yarn is prepared for the weaver's loom. Some of the yarn must be dealt with to make the warp—the collection of threads which runs lengthwise in a piece of cloth—and some must be wound on bobbins—called pirns—which fit in the weaver's shuttle and take the weft yarn backwards and forwards across the loom to interlace with the warp threads.



PLATE 7 Weaving: the healds lift and lower sections of the warp creating the shed through which the shuttle flies. This interlacing of warp and weft constructs the cloth



PLATE 8 Mending: girls rectify small faults that have occurred in the weaving

Examine a few pieces of cloth and you will see that there are many different types of interlacing. In some, alternate weft threads pass under the same warp threads, the ones in between coming up over that warp thread. At the next warp thread they do the opposite. This is a plain weave. In some cloths two adjacent weft threads go under a warp thread, the next two go over it. At the next warp thread this arrangement is repeated but is staggered one thread to the left and a simple twill is formed. More complicated interfacings are possible and the pattern of the cloth is built up by the type of thread interlacing chosen and the variation of colours and other characteristics

of the yarn which are used. The design of cloths is in the hands of the cloth designer and the actual production takes place on the loom, whose mechanism nowadays can be fully automatic. The designer says how the cloth must be made, the loom tuner adjusts the loom mechanism to do it, and the weaver tends the loom, correcting faults such as those caused by yarn breakages as the work proceeds.

FINISHING

When a woollen cloth comes from the loom it is not the cloth as you know it — it is more like a piece of canvas, harsh and thready to the touch. To give it the familiar woolly “handle” it has to be “finished”, and the remarkable properties of wool enable a wide variety of finishing effects to be obtained. First it is scoured to remove the ten per cent of oil which, you will remember, was put on the wool when the yarn was being made. Then it is probably milled. This is a process in which the cloth is pounded or squeezed under pressure in warm conditions after being soaked in soap solution. Under these conditions wool “felts” and the cloth shrinks and gets thicker. The fibres work out of the yarn and give the cloth a soft, hairy cover or nap and so the familiar handle is produced. By varying the conditions of milling a wide variety of finishes can be obtained.

There are other processes in finishing; one is called “raising”. In this process the fibres are brushed into a pile on the surface of the cloth by wire brushes or teasels, the latter being a kind of thistle head grown especially for the purpose. Some cloths are raised dry, others are moistened before raising. Another operation which all cloths undergo is called “cropping”, in

which high-speed knives, operating rather like a lawn mower, pass over the cloth and crop the surface hairs to a uniform level.

Afterwards the cloth is pressed and put into bales for despatch from the mill. It will be seen from this brief and somewhat sketchy description that there is an extremely wide variety of interest in woollen cloth manufacture. It provides opportunities for the application of a very great range of skills and a knowledge of many subjects.