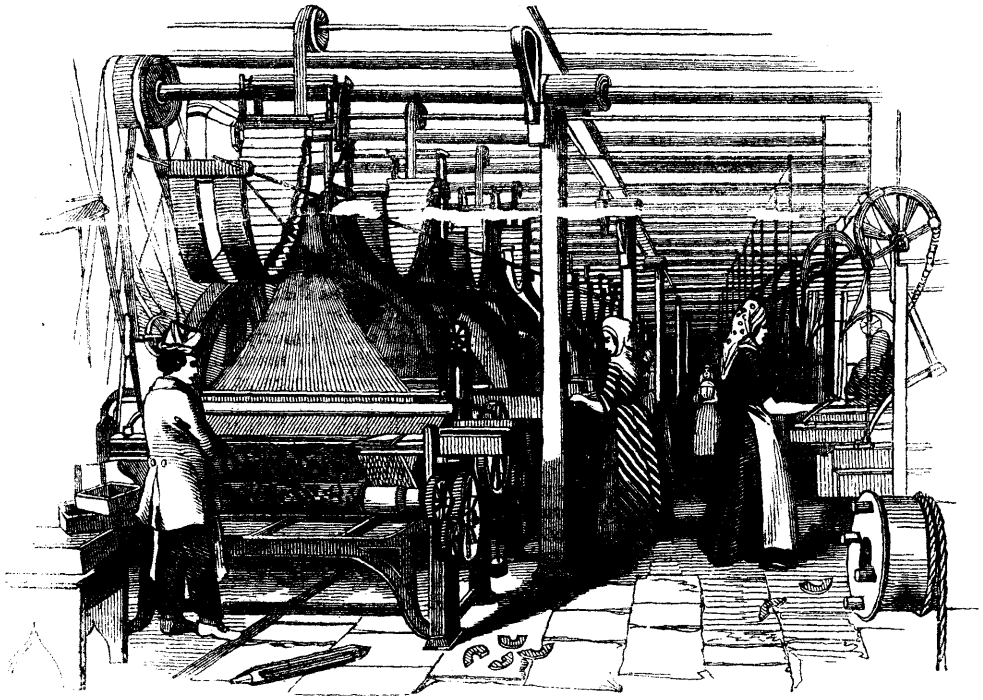
A DAY AT THE YORKSHIRE WORSTED-FACTORIES.



[Jacquard Weaving-Shed.—Akroyd's Worsted-Factory.]

Our present "Visit" will partake somewhat of a rambling character. It has on a few occasions happened that, as a means of affording a little information concerning any particular branch of manufacture, we have found it desirable to extend our observations beyond the walls of one factory, and to glance round the circumstances and arrangements which give to an entire district the character of one great workshop. It is often only thus that the bearings and mutual dependence of different trades can be properly appreciated. The "Day at a Leeds Woollen-Factory" has enabled us to glance at the general operations connected with the manufacture of *felted* or *fulled* wool; and we will now see what the West Riding of Yorkshire exhibits in respect to the manufacture of *worsted* goods; using the term worsted as applying to all wool which is not fulled after being woven.

It is very probable that many of the woven fabrics now made into dresses, and called by various fanciful names, although really made only of worsted, or of worsted mixed with cotton, may not be generally known as coming under the denomination of *worsted* goods. The trade-list of a large worsted-factory at Halifax contains the following enumeration:—'3-4 Lastings, 3-4 Fancy Lastings, 3-4 Crapes, 3-4 Serge, 3-4 Orleans, 6-4 Orleans, Cassinets, 3-4 Twills, 3-4 Linings, 4-4 Dobbies, 6-4 Dobbies, 6-4 French Figures, Alpaca, 3-4 Parisians, 6-4 Parisians, 3-4 Damasks, 6-4 Damasks, 3-4 Camlets, 4-4 Camlets, 5-4 Camlets, 6-4 Camlets, 5-4 Plainback, 6-4 Plainback, 7-4 Plainback, 6-4 Merino, Say Plainback, 5-4 Says, 3-4 Princettes.' Now all these goods are made either of worsted alone or of worsted mixed with cotton; none of them having undergone that peculiar process of fulling which forms the chief characteristic of woollen goods. There are also numerous forms in which worsted fabrics (or others in which either silk or cotton is combined with worsted) are prepared for sale, not included in the above list; such are those called 'Challis,' 'Mousseline-de-laines,' 'Fancy Waistcoatings,' 'Paramattas,' 'Shalloons,' 'Duroys,' 'Taminets,' 'Calimancoes,' &c. If all the kinds were enumerated, it would probably be found that in some instances the fabrics have gone or are going out of date, and that in other instances two names refer to the same material; thus, 'plainback' is a manufacturer's appellation for a kind of worsted stuff known by some other name by retail purchasers. There are two kinds of goods, in which worsted is mixed with silk, that afford remarkable instances of the tendency in manufactures to become located in particular districts; 'Poplins' being an Irish manufacture, and 'Bombazeens' a Norwich product, and neither of them being made to any considerable extent elsewhere.

The rapid extension of the worsted manufacture in this country is very remarkable. So long as efforts were made by English wool-growers to compel the use of English wool in cloth-making—efforts which the legislature for many years sanctioned by legal enactments—the worsted fabrics made were chiefly of a coarse and heavy kind, such as 'Camlets;' but when the wool-trade was allowed to flow into its natural channels, by the removal of restrictions, the value of all the different kinds of wool became appreciated, and each one was appropriated to purposes for which it seemed best fitted; foreign wool became mostly in demand for woollen-cloth, the wool of one kind of English sheep continued in demand for hosiery and heavy worsted goods, a fine long wool from a new breed of English sheep became sought after as a material for fine worsted goods, and the wool of the Cashmere and Angora goats became imported for simi-

lar purposes. A glance at our exports will show how largely the production and sale of worsted goods have been increased under the operation of these circumstances; for the exportation of worsted stuffs, which in 1821 amounted to 828,824 pieces, rose by the year 1841 to 1,718,617 pieces; while the mixed goods of worsted and cotton, which in 1821 were exported to the extent of 407,716 yards, rose by 1841 to 3,628,874 yards.

Formerly, the manufacture of cloth for sale had been exclusively confined to cities, and corporate and market towns, the inhabitants of the villages and hamlets making little more than sufficed for the use of their respective families. But the towns could now no longer exercise their domination over trades to its former extent; and a numerous body of industrious men were gradually rising into importance who resided out of the towns, —"foreigners," as they are termed in the statutes, or "persons dwelling in the small towns of husbandry." Many of them were husbandmen or graziers, who made their own wool into cloth, with the assistance of their wives and families. The sorting of wool was performed by women. The cloths made out of the towns were generally of a coarse description; and, if we may believe various authorities, the country clothiers were not very strict in maintaining the assize, which fixed the length and breadth of each piece. The condition of some of these manufacturers was humble enough. Many of them were only enabled to buy their wool in small quantities, as "eight pennyworth and twelve pennyworth at a time," and therefore could not make their purchases of the wool-grower. A statute, passed in 1551 and 1552, which prohibited wool being bought except by the persons intending to use it themselves in the manufacture of cloth, did away with the intermediate dealers in wool, whose existence was of essential importance to the small clothiers; but it was eventually found necessary to make some relaxations on their account, so that wool might be bought by dealers and sold again in the open market. The clothiers of Halifax were relieved from this inconvenience in 1555, by an Act enabling the inhabitants of that town "to buy wool, and retail it to poor folk to work, but not to the rich and wealthy, nor to sell again." The preamble of this statute describes, with considerable minuteness, the circumstances of the humbler class of country clothiers, and supplies details of some interest of the manner in which they carried on their trade. It recites that "the parish of Halifax and other places thereunto adjoining, being planted in the great wastes and moors, where the fertility of ground is not apt to bring forth any corn or good grass, but in rare places, and by exceeding and great industry of the inhabitants; and the same inhabitants altogether do live by cloth-making, and the great part of them neither getteth corn, nor is able to keep a horse to carry wools, nor yet to buy much wool at once, but hath ever used only to repair to the town of Halifax, and some other nigh thereunto, and there to buy upon the wool-driver, some a stone, some two, and some three or four, according to their ability, and to carry the same to their houses, some three, four, five, and six miles off, upon their heads and backs, and so to make and convert the same either into yarn or cloth, and to sell the same, and so to buy more wool of the wool-driver; by means of which industry the barren grounds in those parts be now much inhabited, and above five hundred households there newly increased within this forty years past, which now are like to be undone and driven to beggary, by reason of the late statute made that taketh away the wool-driver, so that they cannot now have their wool by such small portions as they were wont to have; and that also they are not able to keep any horses whereupon to ride or set their wools farther from them in other places, unless some remedy may be provided."

At a later period Flemish clothiers were invited over, many of whom are supposed to have settled at Halifax; and there is said to be, even to the present day, a strong resemblance between the dialect of the labouring classes there and at Friesland in Holland,—a resemblance which has given rise to the following rather odd distich:—

> "Gooid brade, botter, and cheese,
> Is gooid Halifax, and gooid Friese."

The introduction of these Flemish clothiers into England is detailed by Fuller, in his 'Church History' (1655), in a very quaint manner. He justifies his entering on such topics in a work apparently unsuited for them, on the plea that they "reductively belong to the 'Church History,' seeing many poore people, both young and old, formerly charging their parishes, were thereby enabled to maintain themselves." After expressing strong contempt for the skill of the clothiers before Edward III.'s time, as "knowing no more what to do with their wooll than the sheep that weare it, as to any artificial and curious drapery, their best cloth being no better than freeze, such their coarseness for want of skill in their making;" Fuller proceeds to state that on the marriage of King Edward to the daughter of the Earl of Hainault, the intercourse between England and the Netherlands being thereby greatly increased, the king had facilities for introducing Flemish clothiers into England. Fuller, on what authority he does not say, states that the Flemish clothiers used their workmen and apprentices "rather like heathens than Christians, yea, rather like horses than men, early up and late in bed, and all day hard work, and harder fare (a few herrings and mouldy cheese)." He then contrasts the bright prospect which opened on these ill-used operatives:—"But, oh! how happy should they be, if they would but come over to England, bringing their mystery with them, which would provide them welcome in all places. Here they should feed on fat beef and mutton, till nothing but their fulnesse should stint their stomachs; yea, they should feed on the labours of their own hands, enjoying a proportionable profit of their gains to themselves; their beds should be good, and their bed-fellows better, seeing that the richest yeomen in England would not disdain to marry their daughters to them, and such English beauties, that the most curious foreigners could not but commend them." The result of this immigration he narrates in no less glowing colours:—"Happy the yeoman's house in which one of these Dutchmen did enter, bringing industry and wealth along with them. Such as came in strangers within doors, soon after went out as bridegrooms and returned sons-in-law, having married the daughters of their landlords who first entertained them; yea, those yeomen in whose houses they harboured, soon proceeded gentlemen, gaining them estates to themselves, arms and worship to their estates."

Whether or not this golden picture is to be accepted with implicit faith, it is certain that the use of English wool in home manufactures became from that time more and more extensive, Halifax being at first the centre of the Yorkshire product, and the division not being then so much marked as now between worsted and woollen goods.

If we station ourselves at Bradford, as a centre, we shall find that our position is in the heart of the clothing districts; a number of busy towns and villages, almost too numerous to specify, lying on all sides of us, and all occupied chiefly by cloth and stuff makers.

Bradford lies at the junction of three fine valleys, having the important towns of Leeds, Wakefield, Dewsbury, Huddersfield, Halifax, and Keighley almost equidistant from it. This is one of the many towns which, when approached just after dark on a winter's evening, present that curious species of illumination resulting from the countless windows of large factories. Five, six, seven stories of such windows are to be seen, extending to great width, and each throwing out its glare from the gas-lights within the long rooms or galleries of the factory. Those who, by residing in an agricultural county, or even in London, are not accustomed to such a sight, can scarcely form an idea of the singular effect which these symmetrical specks of light produce when viewed in the aggregate from a distance. The recent extension of the worsted manufacture has done great things for Bradford; it may now be deemed the centre of the worsted trade, inasmuch as there is more worsted yarn spun here than at any other town in the kingdom. Not only, indeed, do many of the worsted and stuff manufacturers of other towns in the West Riding procure their yarn from Bradford, but even the shawl-weavers of Paisley do the same; and we believe that many of the bombazeen-weavers of Norwich are beginning to act on the same plan. The abundance of cheap coal, the vicinity of numerous towns where worsted yarn is required, and easy communication with nearly all the great towns in the kingdom, are probably the causes to which we may attribute the formation of this flourishing state of things. There are at present more than one hundred firms at Bradford carrying on the occupation of worsted-spinners; some combining with it that of stuff-manufacturers. This congregation of worsted-spinners requires that a large and constant supply of wool should be at hand; and thus wool-staplers or wool-dealers have settled at Bradford. Then, again, the large supply of wool thus procured having made Bradford a kind of market, the spinners from other towns have gone thither to make their purchases; this in its turn has induced other woolstaplers to locate there; until at length by these successive steps Bradford has become the great wool-market of England, to which attention is always directed by those concerned in the price, quality, supply, and demand of wool. These woolstaplers make very large purchases of wool, not only from the English sheep-farmers, but from Prince Esterhazy and from other extensive wool-growers all over the world. There is a 'Stuff-Hall' in the town, consisting of a spacious building one hundred and forty-four feet long by thirty-six broad, and two stories in height, in which manufactured stuff goods are exposed for sale on market-days.

If we next go in a north-west direction from Bradford to Keighley, we pass through numerous clothing villages scattered along the ten miles of road, and come to a town of rising importance, which serves as a centre to many of these villages. There is a considerable number of worsted mills in Keighley parish, and numerous hand-loom weavers, working on woollens, linseys, and worsteds. Keighley, however, does not rank with Bradford or Halifax; for instead of having a cloth or piece hall of its own, its productions are sent to one or other of those two towns for sale at the piece-halls, and often pass through the hands of the Leeds merchants to the foreign customers.

Turning to the south-west of Bradford, we find Halifax, at a distance of seven or eight miles, a town more closely connected with clothing manufactures in early times than any other in Yorkshire. Its situation and appearance are very remarkable. It is placed on the western declivity of a gentle eminence; but being surrounded by hills of considerable elevation, it appears, on approaching it, to stand in a deep valley. The road from Bradford is a succession of hill and valley; and a traveller sees nothing of Halifax until he surmounts the hill at its eastern margin, when the whole town becomes suddenly mapped out before him in a valley beneath, with factory chimneys shooting up in every direction. A river runs through the town at the bottom of the hollow, and is so hemmed in by factories on both sides, that we can scarcely see either the width of the stream or the colour of its waters. At Halifax we find the two great divisions of woollen and worsted manufactures more equally divided than at any other of the clothing towns. There are woollen cloth manufacturers, woollen and worsted printers, woolstaplers, worsted spinners, stuff manufacturers having factories in the town, and stuff manufacturers who only attend the Piece-Hall on market-days. This Piece-Hall is the finest in the kingdom. It is a large freestone edifice, occupying an area of ten thousand square yards, and divided into three hundred and fifteen apartments, where the goods are exposed for sale. There have been frequently fifty thousand pounds worth of woollen and worsted goods exposed here for sale at once; but it is understood that the factory system of production is gradually lessening the amount of sales effected at the Hall. The kind of worsted stuff called *shalloon* has been a great staple at Halifax, it having been computed some years ago that ten thousand pieces of this material were annually made there, mostly for Turkey and the Levant.

Huddersfield is about as far from Halifax as Halifax is from Bradford, and is, like it, a busy clothing town, and the centre of a cluster of clothing villages. It is at Huddersfield that we may look, more perhaps than at any town except Bradford, for evidence illustrating the recent spread of the worsted manufacture. Although there is a large number of firms there engaged in the woollen cloth manufacture, just as at Leeds, and although the Piece-Hall affords a market to a great extent of clothing district around, yet 'fancy goods' may be deemed the chief feature presented by the Huddersfield manufactories at present. These fancy goods are such as are termed 'waistcoatings,' and the like, or fabrics of worsted, worsted and cotton, or worsted and silk, in which there is a pattern of some kind or other worked by the loom, different coloured yarns being employed. There is an astonishing number of firms at Huddersfield engaged in this kind of fancy-worsted work, besides a still larger number, residing chiefly at Honley and other towns and villages in the vicinity, who only attend Huddersfield market on Tuesdays. When it is considered that Huddersfield was very insignificant both in trade and population until the beginning of the last century, its present position appears the more striking, and is principally to be traced, like that of Halifax, to its admirable local advantages. The Piece-Hall is a remarkable building, being an extensive circular range, two stories high, with a diametrical range one story high, dividing the internal area into two semicircles. The light is wholly admitted from within, there being no windows on the outside; and it thus partakes somewhat of the character of the *caravanserais* of the East. The hall is subdivided into streets, which streets consist of rows of stalls, such as in the two cloth-halls at Leeds; and six hundred country manufacturers requently attend here on market-day.

If we go westward from Huddersfield to Saddleworth, Rochdale, or any of the towns and villages in that vicinity, we find manufactures to be in a curious position with respect to the two great staples, wool and cotton. Lancashire may be termed a cotton county, Yorkshire a woollen county; and the towns here named, being near the borders of the two counties,

present a mingled assemblage of these two departments of productive industry. Thus at Saddleworth there are cotton manufacturers, cotton spinners, cotton waste dealers, and others, connected with the one department; and woollen cloth manufacturers, woollen cloth printers, woollen millers, wool-staplers, cloth-dressers, and flannel manufacturers, connected with the other. At Rochdale, again, there are the two kinds; but here a remarkable difference is observable, for which it does not seem very easy to account. Although Rochdale is not far from Saddleworth, and both have cotton factories of various kinds, yet in respect to wool, Saddleworth is almost wholly limited to woollen cloth, while Rochdale is chiefly distinguished for flannels and baizes. So singularly has this last-named manufacture settled at Rochdale, that there are nearly a hundred and fifty "manufacturers of flannel and baize" in the town; and it has become the centre whence all the home and foreign markets are supplied with Yorkshire flannels.

Eastward of Huddersfield we meet with two towns which present yet another feature of the clothing district, viz. the manufacture of *blankets*. These articles, in many details of their manufacture, are distinct from the flannels of Rochdale, the stuffs of Halifax, the fancy-goods of Huddersfield, or the cloths of Leeds; and their production and sale have gradually centred at a particular spot. Dewsbury and Heckmondwike are the two towns here alluded to, both lying in the road from Halifax to Wakefield. Nearly all the manufacturers in these two towns are engaged in the blanket-trade; and there is also a 'Blanket-Hall' at the latter place, where the Leeds merchants make their purchases for the home and foreign markets.

When we have touched at Wakefield, and gone thence northward to Leeds, we shall have made the tour of the very remarkable "clothing district" of the West Riding. Wakefield, considered as a clothing town, has fallen from its once high position: it has been superseded by other towns. Leeds, Halifax, and Wakefield were once the three great centres: the two former still retain their eminence; while Wakefield has given way, and Bradford and Huddersfield have risen to distinction. In Leland's time we are told that "Wakefield standeth now al by clothying;" and at a later period woollen cloth, stuff goods, and worsted yarn were the main products of the place; but now, although there are still woollen and stuff manufacturers in the town, the number of them bears but a small proportion to those in the other towns we have named. The wool-market, too, is gradually leaving Wakefield for Bradford. Wakefield, on the other hand, has greatly risen as an emporium for the corn and malt trade, and also as a cattle and sheep market; so that the prosperity of the town has not declined, it has merely taken a different direction.

We have thought it desirable to give this rapid sketch of the clothing district generally; for the worsted manufacture, taken in its widest sense, cannot be understood without noticing the subdivisions to which it is subjected, and the tendency which each branch has to centre itself in some particular spot. There is a feature observable, too, in this district, which we do not remember to have seen noticed by any writer; that is, the prevalence of particular *names* among the manufacturers. The domestic system of manufacturing, which was for many generations the one followed in Yorkshire, led naturally to children being brought up to the same occupation as that pursued by their parents. There were many parts of the process which boys could perform, and these boys thus learned by degrees the trade of their parents, especially when all this was done under the father's roof. Added to this, a certain fixity of habits and tastes, the absence of a tendency to roam, has caused the same family to remain in the same spot for one generation after another. Whether we have rightly explained the cause, it is certain that this recurrence of names among the manufacturers is very observable. If we take that curious record of personal statistics, a 'Directory' of Yorkshire, we shall have the means of testing this. From such a volume, published a few years ago, it will be perceived that there is hardly a town in the clothing district which has not got its Akroyd, Ackroyd, or Akeroyd, among the woollen or worsted manufacturers, the name being spelt in all three different ways. Among the woollen manufacturers at Huddersfield are seven Croslands, six Crowthers, seven Haighs, six Schofields, eleven Shaws, eleven Sykeses, and so forth. At Saddleworth it is yet more remarkable; for here there are recorded, as distinct manufacturers of woollen cloth, six Bottomleys, fifteen Bradburys, seventeen Broadbents, thirteen Buckleys, seven Kenworthys, eight Rhodes, eleven Schofields, eleven Shaws, eleven Whiteheads, and nine Wrigleys. Similar repetitions of the names Ashworth, Butterworth, Clegg, Schofield, and Whitworth occur among the flannel manufacturers at Rochdale; as also those of Bailey, Blakeley, Brearley, Day, Hirst, Newsome, Senior, and Sheard, among the drugget manufacturers of Dewsbury; and of other names among the blanket manufacturers of Dewsbury and Heckmondwike. It is not unworthy of remark that these recurrences of similar names are not nearly so much observable among the *worsted* as the *woollen* manufacturers, the latter having been more associated than the former with the domestic system of manufacturing.

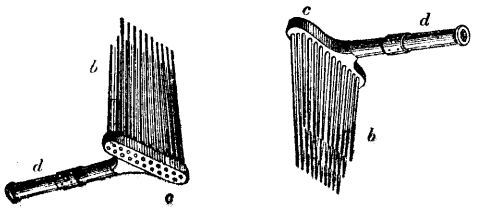
Whatever be the kind of worsted fabric about to be manufactured—and that there are many such, our list on a former page will sufficiently indicate—the wool is first brought into the state of worsted yarn; and we may now shortly describe the mode in which this is effected, so far as that differs from the spinning of the woollen yarn described in our November Supplement.

The wool employed for worsted is always longer than for felted woollens, and generally coarser; and the processes which it undergoes, so far from being calculated to make the individual fibres lock into each other by the little serrations on their surfaces, are intended to facilitate the production of a fine, even, and smoothly spun thread. Indeed it is one object of the processes preparatory to the spinning to impair the felting property of the wool.

The wool is very carefully washed before being fitted for worsted work. The washing is effected with soap and water, the greater part of the moisture being afterwards pressed out by rollers. The wool, after washing, is carried to a drying-room, where it is spread out on the floor to dry. In most modern factories or mills where wool is thus prepared, matters are so arranged that the drying-room shall be immediately over the boiler-room belonging to the steam-engine; so that the heat of this lower room, which would otherwise be wasted, is usefully employed in imparting warmth to the drying-room. When the wool is dried, it is passed through a machine called a *plucker*, consisting of a pair of spiked rollers fed by an endless apron. By the revolving spikes of this machine the fibres of the wool are cleansed and straightened, preparatory to the next process. This 'plucker' is generally attended, or 'tented,' to use a factory phrase, by a boy of twelve or fourteen years of age, whose business is to lay the tufts of wool pretty evenly on the endless web or apron which acts as a feeding-cloth.

The wool is next ready for *carding*, or *combing*, according to the fineness and quality of the worsted to be made from it. The process of combing the wool is sometimes performed with apparatus so simple, that

the workman can carry it on at his own house; while at other times it involves the complexity of factory machinery. A very large quantity of the wool used around Halifax and Bradford is hand-combed; indeed, all the wool-combing machines yet invented are said to have failed in respect to the working of *fine* worsted, although they are well adapted for the coarser qualities. The hand-comb consists chiefly of a piece of wood shaped something like the letter T. Through the head or transverse part of it, which is generally about three inches broad, a number of very long sharp teeth are thrust. These teeth, which are made of well-tempered steel, are finely tapered, and are generally arranged in three rows, about thirty in each, placed nearly at right angles to the face of the wood. The angle of the comb is represented by the perpendicular part of the T, as in the annexed cut, where *b* are the teeth, *c* the head or stock into which they are fixed, and *d* the handle. In using this instrument, the wool is carefully hung upon the teeth, in such a manner as to project over the front of the head, and when sufficiently filled and firmly fixed, another comb of the



same kind is drawn through the wool, so as to unravel and lay all the fibres smooth and even. Mr. Luccock, while describing this process, aptly remarks: "If we consider the full comb as the human head, disgraced by a quantity of neglected, long, and dishevelled hair, which we reduce to its elegant order, we shall have a very just idea of the operation and use of this instrument in the worsted manufacture. The very name shows its origin, application, and use." This process of hand-combing is very laborious, and is generally carried on in rooms which are close and hot, arising from the presence of stoves for heating the combs. If the combs were cold when used, the woolly filaments would not acquire the necessary pliancy and ductility, and the teeth of the comb are therefore heated in a stove. The stove usually consists of a flat iron plate, heated by fire or by steam, and surmounted by another plate to confine the heat; and into the small space left between the two plates the teeth of the comb are introduced. A considerable quantity of oil is employed in the combing process, and this renders the process rather a dirty one. There is a kind of knotted portion of all the fibres left uncombed, on account of the teeth of the comb not being able to reach it: and this, under the name of *noyl* or *noil*, is afterwards carded and spun into coarse woollen yarn.

Dr. Cartwright, whose mechanical inventions have been recorded in the recently published 'Memoirs' of that ingenious man, invented a machine for combing wool; and since his time many others have been invented, of which one consists mainly of two large wheels, ten feet in diameter, having teeth at their peripheries so placed as to comb out the wool. Whenever such machines are used, the wool leaves them in the form of a continuous *sliver* or riband.

Considerable change has recently been introduced into the worsted trade by the substitution of *carding* for *combing* the wool. In this instance the fibres of wool are straightened and laid parallel, somewhat in the same way as the cotton in cotton-carding. By this mode of proceeding, the *noyl* of long fleece-wool and a great deal of skin-wool, which used to be employed only in blanket and coarse woollen work, can now be worked up into coarse worsted yarn; and the price has been so lessened by the change, that nearly all

[Drawing the Worsted into Slivers.]

coarse worsted yarn is now produced by carding. Mr. Bischoff, in his 'History of the Wool-Trade,' mentions a circumstance connected with the origin of this improvement, which shows the imperfect state of our present patent-laws:—"The application of the cotton process was patented by Mr. William Lister of Halifax. A somewhat similar plan was also about the same time adopted by Messrs. Haddens of Aberdeen; both parties considered their individual patents invaded, and eventually brought actions against each other, the result of which was, that both were thrown open to the public on the same day, whereby the patentees were never able to realize the fruits of their industry." The process of carding is one of those that have led to the vast increase in the production of worsted goods within the last few years; for wool to be hand-combed must have not less than six inches length of fibre, whereas carding can be applied to the *noyl* and all the short fibres. The system of sheep-farming, too, recently followed, has had the effect of giving to the English fleece very long wool, so that all the wool now grown in England can be spun into worsted yarn of one kind or other; while the woollen-cloth manufacturer is well content to have his supply of felting wool from foreign sources —circumstances which, combined, have placed the wool-trade on a more healthy footing perhaps than at any former period.

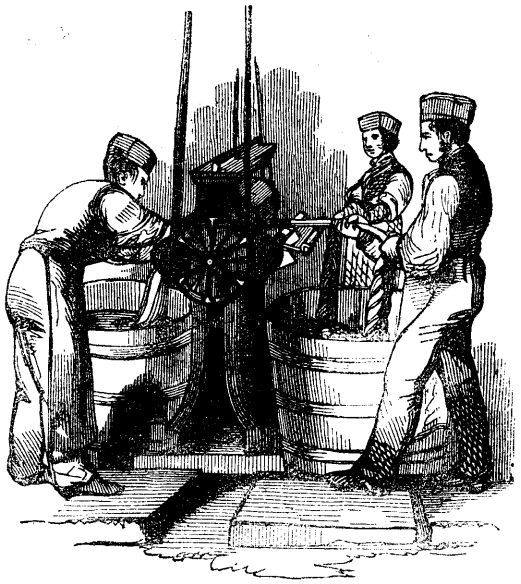
The chain of processes whereby the fibres of wool are wrought up into worsted yarn, occupies a medium place between the preparation of cotton yarn and of woollen yarn; it partakes of both, and is yet somewhat different from either. A very brief sketch of these processes will here suffice, after what has been given in former numbers.

In the large establishment of Messrs. Akroyd, at Halifax—one, indeed, among several establishments owned by the same firm in and near that town—we witnessed the process of worsted manufacture, not from the commencement, but from the state of 'sliver.' The worsted prepared being generally for the finer fabrics, the hand-combing process is still the one generally employed; and this being what we may term a domestic process, or a species of handicraft, may be carried on at the houses of the workmen. The number of workmen so employed in and around Halifax and Bradford is very large, the firm above mentioned giving employment, in brisk times, to several hundreds of them.

The wool comes to the factory in narrow bundles or 'tops,' about eighteen inches long, and weighing about a pound and a half or two pounds each. These 'tops' are taken to one of the upper rooms of the factory, filled with the machines for 'drawing' and otherwise preparing the worsted; such as are represented in the cut on the preceding page. Each top is first opened, and the wool laid upon an endless band, which carries it between drawing-rollers, whereby it is elongated, ranged parallel, and conveyed into a cylindrical can as a delicate kind of riband. This riband is transferred from one machine to another, and drawn between rollers so repeatedly, that, like the rod of metal in wire-drawing, it becomes gradually reduced in thickness, until it assumes the form of fine cord, or 'roving,' ready for the spinning-frames.

The spinning is effected in a different range of workshops, but by machines analogous in principle to those employed in other branches of textile manufacture. The quality of the yarn produced, and the mode of spinning it, depend of course on the purpose to which it is to be applied. Thus, for 'mousseline-de-laine,' or for 'challis,' a fine and soft worsted yarn is required; whereas for 'camlet,' and other stout goods, a stronger and thicker yarn is essential. The warp, too, of almost all kinds of goods is made from yarn rather different from that employed in the weft. It has been made a matter of calculation among the spinners at the factory above noticed, that they spin enough 'weft' yarn every day to reach from London to New Zealand. In one of the lower warehouses of the factory, we saw vast piles of the yarn thus prepared, made up into bundles, and ready to be used by the weavers within the same factory, or for sale to other manufacturers. There are dye-works belonging to the firm in another part of Halifax, where the worsted is dyed before or after weaving, according to the nature of the fabric; and there is also a process of warp-scouring effected in a certain stage of the manufacture.

Some parts of the processes connected with the spinning require that the worsted shall be in a damp state. This is effected in a curious manner. In one of the rooms of the factory are a number of tin boxes, perforated on all sides. The wool is put into these boxes, and the boxes themselves are placed in a large chest connected with the receiver of an air-pump. The air is exhausted from the chest, which necessarily involves



[Warp-Scouring.]

the exhaustion of the air from between the fibres of wool contained in the perforated boxes. Water is next admitted, and then the air is re-admitted, by which the water is instantly forced between all the fibres, so as to saturate every individual fibre equably and completely.

All the processes incident to the arrangement of the yarn for the loom are carried on in the usual way; such as the 'warping,' the 'beaming,' and the 'drawing-in' of the warp, and the 'winding' of the weft. It is, however, worthy of remark, that modern improvements have been introduced for spinning weft on the very 'spools' which are afterwards to be used in the shuttles, so as to get rid of the after-process of 'winding.'

We next descend to the 'weaving-shed,'—a building not only the most remarkable connected with the factory, but one which is particularly calculated to illustrate the rapid progress made in the worsted manufacture within the last few years. Here we find eight hundred and forty power-looms in one room, all working at once in the production of merinos, damasks, camlets, lastings, Paramattas, Orleans, Parisians, cassinets, and the host of worsted or stuff goods now made. But this is not the only observable feature. There are cotton

['Drawing in' the Worsted Warp for Weaving.]

factories in Lancashire and Cheshire which can boast of a yet larger number of power-looms, amounting in some instances to fifteen hundred; but in such cases the weaving is nearly always of a simple kind, consisting of plain fabrics, such as calico or twills, figured devices, if introduced at all, being very sparingly effected by the power-loom. In worsted weaving, however, the application of the power-loom has been most remarkable; and there is an observation on this point in Mr. Bischoff's 'History' which may be appropriately introduced here. After speaking of the use of the *Jacquard* machine in silk weaving, Mr. B. remarks:—"Until the introduction of this machine, the production of the superior figured silks depended wholly on the skill of the weaver, and that to a degree which few attained; the necessity of extreme carefulness and skill is now considerably diminished; in other words, the production of the most costly fabrics is laid open to a large number of operatives. The Jacquard engine may be attached to almost any loom, and is generally owned by the manufacturer, and is furnished to the weaver with the warp. These looms were introduced into Yorkshire in the weaving of figured and flowered stuffs, by the late Mr. James Akroyd, of Halifax. The manufacture of moreens was also brought there by him and his brother, Mr. Jonathan Akroyd; they next imitated the article of cotton jeans, in worsted, with success, to which they gave the name of 'plainbacks,' out of which has sprung that immense and valuable branch of 'merinos.' They also introduced the mode of weaving stuff damasks, and were the first to use the Jacquard engine in Yorkshire." The allusion here to the custom followed between the manufacturer and the Jacquard-weaver relates to hand-loom weaving only, power-weaving being conducted wholly and necessarily on the factory system. In the magnificent room where these eight hundred and forty power-looms are at work (for it may be called magnificent in relation to the mind, the mechanism, and the capital there represented), are looms producing almost every variety of complex texture known to the weaver. In some there are no fewer than thirty-two 'heddles,' or systems of strings by which the warp-threads are drawn up to admit the shuttle, and yet all are worked by steam-power; one person, generally a female, being required merely to tend the machine and make a few adjustments, the steam-engine doing all the work. In other instances the exquisite "Jacquard" machine, one of the most complete of all mechanical inventions, is fitted to the top of the loom, where it regulates the raising of the warp-threads so as to lead to the production of figures having almost an exhaustless variety of size and form.

We have in two or three former papers had to speak of the Jacquard machine as being in use in textile manufactures; but we have not described the mode in which the *cards* are made. These cards are slips of pasteboard (or sometimes of tin) from one to two feet in length, and two or three inches wide, each card perforated with a great number of holes about a quarter of an inch in diameter. For the production of any particular pattern there must be as many cards as there are weft threads in the pattern; for instance, if the pattern consisted of a flower, the full space of which occupied two hundred weft threads, or required that number of weft threads to represent it, then there must be two hundred cards prepared for that one pattern, all of the same size, and all pierced with holes. But the holes thus pierced are not alike in number in the different cards; in some there may be twenty holes, in some fifty, and in others a number greater or smaller than either of these; and the determination of these numbers is a very singular part of the arrangement. The pattern is drawn on a piece of paper intersected by black cross-lines, to represent the warp and weft threads. A man or boy has before him a row of strings to represent some of the warp threads, and into and among these he passes a cross-thread to represent one row of weft, passing it above and below according to the pattern. By this means he divides his imitative warp-threads into two parcels, analogous to the raised and depressed portions of the real warp when in the loom; and these two portions are so far represented on the punched cards, that the raised warp threads are connected with the holes in the cards, while the depressed threads are connected with blanks or uncut parts of the card. The boy's row of threads are attached to an ingenious machine, whereby several punches are passed through holes in a leaden plate, the number and disposition of the holes depending on the pattern; and a piece of cardboard being then placed beneath these punches, a machine something like a cylinder-press presses all the punches upon the cardboard, and punches the holes. The best description we have seen of the process of Jacquard card-making is by Mr. Porter, in his 'Treatise on the Silk Manufacture;' but we have not room to give details at greater length: suffice it to say, that the disposition of the holes in each card depends principally on the nature and size of the pattern in the direction of the weft; that the number of cards depends on the pattern in the direction of the warp; that the cards for one pattern frequently amount to four, six, or eight hundred; that all are connected in an endless chain when attached to the loom, and that each set of cards will be available for one pattern only. Adjoining the card-making room, at the factory, is a room where the pattern cards are preserved, each set tied up in a bundle, and numbered for future use. An instance was once afforded at this establishment, probably as a trial of skill in fancy worsted weaving, in which the enormous number of *eleven thousand* cards were used in producing one pattern. What has been the highest number ever employed with the

Jacquard we do not know; but in some few instances complete pictures have been thus produced; and we have seen, at an exhibition of works of art in the Mechanics' Institution at Leeds, a beautifully distinct fac-simile of the will of Louis XVI. entirely woven by the Jacquard machine.

To return to the weaving-shed. The large size of many of the looms for weaving fancy goods, especially those in which the Jacquard apparatus is employed, gives to this room an extremely busy appearance, much more so, indeed, than that presented by the power-loom weaving-galleries in the cotton manufacture, where the looms are very much smaller. Although this room is more than two hundred and fifty feet long by one hundred and fifty broad, yet there is only just space enough to pass along the avenues which separate the looms; while the clatter resulting from the movement of nearly a thousand shuttles, as many battens or lays, and many thousands of wheels, levers, and other kinds

Jacquard-Card Making.]

of machinery, is most deafening. Some of the worsted fabrics now woven by these looms are as much as ten quarters wide; while others, much smaller as to dimensions, are far more complex in respect to pattern.

It is curious to mark the changes which time, fashion, and a love of cheapness induce in the quality of the woven fabrics produced. Allusion was made in a former paragraph to the introduction of a particular variety of worsted goods called 'merinos.' But a more recent change has been the substitution of cotton for a considerable proportion of the worsted originally introduced in stuff goods. For instance, there are two kinds of stuff now made, called 'Orleans' and 'Paramatta' (why so named, it would probably be difficult to say), apparently formed of worsted; but the weft only is of worsted, the warp being cotton. The production of cotton-warped worsted goods is now perhaps the greatest feature at Bradford and Halifax, so largely have fabrics of this kind come into use. Another new material which we saw under process of weaving, called 'Khybereen' (has the fame attached to the Khyber Pass of Afghanistan had anything to do with the invention of this name?), consists wholly of worsted, of which the warp contains threads of two colours alternately, and weft of a third colour, thus forming a kind of combination of 'stripe' and 'shot' in the pattern. Another kind is a peculiar sort of camlet, or stout worsted, for making into the 'poncho,' or South American cloak, of which specimens are to be seen in the smart shops of some of our London tailors.

We have before observed that there is one point which marks clearly the distinction between woollen and worsted goods, viz., the rubbing, or friction, or beating to which the former are subjected after weaving; whether the rubbing by which the little knots on *friese* or *frize* are produced, or the beating which the fulling-stocks give to woollen cloth in the process of felting or fulling. In other respects the progress of manufactures and other circumstances are leading to the introduction of materials and processes intermediate between the two. Thus the changes in the growth of English fleece, the introduction of the Australian fleece, the introduction of a remarkable and beautiful kind of black wool called *Alpaca*, the admixture of a silky kind of goat's hair with the harsher fibre of sheep's wool, the removal of the restrictions to the interchange of different kinds of wool between England and other countries, the invention of wool-carding and wool-combing machines—all have led to the production of goods quite unknown to our earlier manufacturers. But there is one material employed to which we hardly know where to assign a place, although it seems certainly to belong to woollens. This is *shoddy*, or woollen rags, torn up fibre from fibre, and made to do double duty by entering into the composition of new cloth. Sir George Head, in his 'Home Tour through the Manufacturing Districts,' gives a humorous account of the operations at a shoddy-mill, of which there are several in the clothing district. "How to make a new coat from old rags" is not exactly the problem to be solved; for the fabric produced is only used for drugget, padding, and other inferior purposes. The rags are collected from all quarters, at home and abroad, and are consigned to dealers at Leeds, Halifax, and other places. Whether they are washed previously (a somewhat necessary process, as it would appear) we do not know, but they are carried to a mill and 'devilled,' that is, dissected to utter fragments by the spikes in the machine called a 'devil.' They are then, or after some further preparation, mixed with a portion of new wool, and carded, spun, woven, &c. with some coarse fabrics. In a body of evidence given before the House of Lords on the wool trade in 1828, it was stated that at that time a kind of cheap cloth, called 'stroud,' made from woollen rags, was exported to the North American Indians, the tribes on the shores of the Mississippi, and the natives round to the west of Cape Horn. The cheap goods are often made of mixtures of Scotch wool, English skin-wool (*i.e.* wool taken from the dead sheep, which is not considered equal to sheared wool), the waste from factories, and shoddy, all inferior ingedients; and of this mixture the articles made are the cheapest druggets, carpets, and paddings. We believe, however, that within the last few years there has been a tendency to exclude the use of woollen rags in the manufacture, tney being now used rather for manure than for anything else.