of threads, called the warp and the weft: these traverse the piece of cloth in opposite directions, and are usually at right angles to each other. These threads, or, as the weavers call them, yarns, which run in the direction of the length of the web or piece of cloth, are called the warp, and they extend entirely from one end of the piece to the other. The cross thread, or yarn, runs across the cloth, and is called the woof or weft. This is in fact one continuous thread through the whole piece of cloth, being woven alternately over and under each yarn of the warp, which it croffes, until it arrives at the outside one. It then passes round that yarn, and returns back over and under each thread, as before; but in such a manner, that it now goes over those yarns which it passed under before, and vice versa; thus firmly knitting or weaving the warp together. The outside yarn of the warp, round which the woof is doubled, is called the selvage, and cannot be unravelled without breaking the weft. The strength of the cloth, in the direction of the length, must depend on the threads of the warp; but its strength in the opposite direction will depend upon the weft; and the strength of these two threads should be always proportioned to each other.

The combined arts of spinning and weaving are among the first essentials of civilized society, and we find both to be of very ancient origin. The fabulous story of Penelope’s web, and, still more, the frequent allusions to this art in the sacred writings, tend to show, that the fabrication of cloth from threads, hair, &c. is a very ancient invention. It has, however, like other useful arts, undergone a vail succession of improvements, both as to the preparation of the materials of which cloth is made, and the apparatus necessary in its construction, as well as in the particular modes of operation by the artist. Weaving, when reduced to its original principle, is nothing more than the interlacing of the woof or cross threads into the parallel threads of the warp, so as to tie them together, and form a web or piece of cloth. This art is doubtless more ancient than that of spinning, and the first cloth was what we now call matting, i.e. made by weaving together the shreds of the bark, or fibrous parts of plants, or the flaks, such as rush and straw. This is still the substitute for cloth amongst most rude and savage nations. When they have advanced a step farther in civilization than the state of hunters, the skins of animals become scarce, and they require some more artificial substance for clothing, and which they can procure in greater quantities. Nevertheless, some people are still ignorant of the art of weaving; for the cloth made in the islands of the South sea appears to be made by cementing or glueing the shreds together, rather than by weaving. From the description given by captain Cook, and other circumnavigators, and from the specimens which have been brought to Europe, their cloth, or rather matting, is in general produced by cohesion of the parts, rather than texture. This assimilates it more to the ideas which we attach to paper, or pasteboard, than to those which we form of cloth.

When it was discovered that the delicate and short fibres, which animals and vegetables afford, could be so firmly united together by twisting, as to form threads of any required length and thickness, the weaving art was placed on a permanent foundation. By the process of spinning, which was very simple in the origin, the weaver is furnished with threads far superior to any natural vegetable fibres in lightness, strength, and flexibility; and he has only to combine them together in the most advantageous manner. The art of weaving cloth has been so extensively applied in

WEAVER, in Manufactures, one who practises the art of weaving.

Persons using the trade of a weaver, shall not keep a tucking or fulling-mill, or dyeing, &c. or have above two looms in a house in any corporation or market-town, on pain of forfeiting 20l. a week: and shall serve an apprenticeship for seven years to a weaver or clothier, or shall serve for 21l. &c. 2 & 3 Ph. & M.

WEAVER’S Alarm. This contrivance is only a weight fastened to a packthread, which is placed horizontally, so that in a certain time a candle may burn down to it. Then the flame of the candle setting fire to the thread, the weight falls, and awakens the sleeping perfow. See Phil. Trans. No. 477. fe&. 14, where we have a figure to explain the invention, which has got its name from being in frequent use among the weavers.

WEAVER’S Lake, in Geography, a lake of New York; 3 miles N.W. of Otisgo lake.

WEAVING, in Manufactures, is the art of combining and uniting threads together, to form cloth. Stocking-knitting or weaving is a distinct art from cloth-weaving, the manner of combining the thread, being essentially different in the two. In the stocking fabric, the whole piece consists of one continuous thread, which is formed into a series of loops in successive rows; and the loops of each row are drawn through the loops of a former row. See STOCKING Frame.

Woven cloth is always composed of two distinct systems
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in almost every civilized country, and the knowledge of its various branches has been derived from such a variety of sources, that no one person can ever be practically employed in all its branches, and though every part bears a strong analogy to the rest, yet a minute knowledge of each of these parts can only be acquired by experience and reflection. We will endeavour to give the reader as comprehensive an idea of the history and progress of this ancient and invaluable art as the nature of the thing, and the limits to which we are necessarily confined, will permit.

The history of this art is very little known, and its great antiquity necessarily involves the earlier eras of it in the most perfect obscurity.

The art of making linen, which was probably the first species of cloth invented, was communicated by the Egyptians, the inhabitants of Palestine, and other eastern nations, to the Europeans. By slow degrees it found its way into Italy; and it afterwards prevailed in Spain, Gaul, Germany, and Britain. The Belgae manufactured linen on the continent; and when they afterwards settled in this island, it is probable they continued the practice, and taught it to the people among whom they resided.

When it is considered that the wants of mankind are nearly the same in all countries, it is not improbable that the same arts, however varied in their operations, may have been separately invented in different countries. It is not, however, certain that the art of making cloth is one which the Britons invented for themselves.

It is most probable that the Gauls learned it from the Greeks, and communicated the knowledge of it to the people of Britain. It is very certain that the inhabitants of the southern parts of Britain were well acquainted with the arts of dressing, spinning, and weaving, both flax and wool, when they were invaded by the Romans. Nevertheless, we have the authority of Julius Caesar, that when he invaded Britain, the art of weaving was totally unknown to the Britons.

Whatever knowledge the Britons might possess of the clothing arts, prior to the invasion, it is very certain that these arts were much improved among them after that event. It appears from the Notitia Imperii, that there was an imperial manufactory of woollen and linen cloth, for the use of the Roman army then in Britain, established at Venta Belgarum, now called Winchester.

Many public acts relative to the woollen manufacture, in the earlier period of English history, evidently prove that the greater part of our wool was, for a very long series of years, exported in a raw state, and manufactured upon the continent.

In bishop Aldhelm’s book concerning “Virginit,” written about A.D. 680, it is remarked, “that chaffily alone forms not a perfect character, but requires to be accompanied and beautified by other virtues.” This observation is illustrated by the following simile, borrowed from the art of figure-weaving: “It is not a web of one uniform colour and texture, without any variety of figures, that pleases the eye, and appears beautiful; but one that is woven by shuttles, filled with threads of purple, and many other colours, flying from side to side, and forming a variety of figures and images, in different compartments, with admirable art.”

Perhaps the most curious specimen of this ancient figure-weaving and embroidery, now to be found, is that preserved in the cathedral of Bayeux. It is a piece of linen, about 19 inches in breadth, and 57 yards in length, and contains the history of the Conquest of England by William of Normandy; beginning with Harold’s embattled, A.D. 1065, and ending with his death at the battle of Hasting, A.D. 1066. This curious work is supposed to have been executed by Matilda, wife to William, duke of Normandy, afterwards king of England, and the ladies of her court. Although it is certain that the art of figure-weaving was then known in Britain, it must be owned, that the piece of tapestry just mentioned owes most of its beauty to the exquisite needle-work with which it is adorned.

The silk manufacture was first practised in China, and the cotton in India. Both the woollen and linen were borrowed by the English from the continent of Europe; and for many ages, all the improvements in them in this country were first introduced into this country by foreign artificers, who settled among us.

About the close of the eleventh century, the clothing arts had acquired a considerable degree of improvement in this island. About that time, the weavers in all the great towns were formed into guilds or corporations, and had various privileges bestowed upon them by royal charters.

In the reign of Richard I., the woollen manufacture became the subject of legislation; and a law was made, A.D. 1189, for regulating the fabrication and sale of cloth.

The number of weavers, however, was comparatively small, until the policy of the wife and liberal Edward III., encouraged the art, by the most advantageous offers of reward and encouragement to foreign cloth-workers and weavers, who would come and settle in England. In the year 1351, two weavers came from Brabant, and settled at York.

The superior skill and dexterity of these men, who communicated their knowledge to others, soon manifested itself in the improvement and spread of the art of weaving in this island.

Many Flemish weavers were driven from their native country, by the cruel persecutions of the duke d’Alva, in the year 1567. They settled in different parts of England, and introduced or promoted the manufacture of baizes, ferges, crapes, and other woollen stuffs.

About the year 1686, nearly 50,000 manufacturers, of various descriptions, took refuge in Britain, in consequence of the revocation of the edict of Nantes, and other acts of religious persecution committed by Louis XIV. These improvements chiefly related to silk-weaving.

The arts of spinning, throwing, and weaving silk, were brought into England about the middle of the 15th century, and were practised by a company of women in London, called silk-women. About A.D. 1480, men began to engage in the silk manufacture, and the art of silk-weaving in England soon arrived at very great perfection. See Silk.

The civil discontents which followed this period, retarded the progress of these arts; but afterwards, when the nation was at rest, the arts of peace, and among others that of weaving, made rapid advances in almost every part of the kingdom.

In the latter part of the last century, the invaluable inventions of sir Richard Arkwright, introduced the very extensive manufacture of cotton, and added a lucrative and elegant branch of traffic to the commerce of Britain. The light and fanciful department of the cotton manufacture has become, in some measure, the staple manufacture of Scotland, whilst the more substantial and durable cotton fabric has given to England a manufacture inferior, in importance and extent, only to the woollen trade.

At the present day, our superiority in point of quality
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is universally acknowledged in the cotton manufacture; but in those of flax, linen, and woollen, it is still disputed by other countries.

Loom.—Weaving is performed by the aid of a machine called a loom. The common loom for plain cloth is a very simple machine; but some of the varieties which are used for weaving ornamental and figured cloth are very curious; still there are parts common to all. The principal of these are as follows:

1. The yarn-beam, which is a round wooden roller, on which is wound or rolled the warp, or yarns that are to form the length of the piece of cloth. 2. The cloth-beam is a similar roller, on which the cloth is rolled up when woven. The yarns of the warp are extended in parallel lines, between the yarn-roll and the cloth-roll, so as to form a horizontal plane, or flecht, and are combined together by the cross-threads, or weft. 3. The shuttle, which has a hollow to contain a bobbin or pirn of the weft. 4. The heddles, which are threads with loops or eyes, through which the yarns of the warp pass: the heddles are connected with the treadles, upon which the weaver places his feet, to draw down one set of heddles and raise up another, so as to open and separate the warp into two divisions, and allow a passage, called the shed, for the shuttle between them. 5. The reed, which is a frame containing a row of parallel threads of reeds or cane, and the yarns of the warp pass between them, as it were between the teeth of a comb. 6. The reed is fixed in a frame, called the lay or lathe, which swings upon centres of motion. The use of the reed and lay is to comb or pull the threads of the weft close to each other, and make the cloth close and dense.

The operation of weaving or working the loom for plain cloth consists of three very simple movements, viz. 1. Opening the shed in the warp alternately, by preffing the two treadles with his feet in opposite directions. 2. Driv ing or throwing the shuttle through the shed when opened. This is performed by the right-hand, when the fly-shuttle is used, and by the right and left alternately, in the common operation, wherein the shuttle is thrown from one hand and caught in the other. 3. Pulling forward the lay or batten to strike home the weft, and again pushing it back nearly to the heddles. This is done by the left-hand with the fly-shuttle, or by each hand successively in the old way.

There are several different ways of setting up a loom for weaving plain cloths; but the principal parts are always made the same. We shall first describe which is used for weaving plain cloths: it is shewn in perspective in Plate II. Weaving. In this A is the yarn-beam, on which the thread to form the warp is regularly wound; B, the cloth-beam, or breast-roll, on which the finished cloth is wound up; D, the treadles, on which the weaver preffes his feet; d, d, c, are the heddles, or harness. These are each composed of two small rods d d and c, connected together by several threads, forming a fyllem of threads, which is called a heddle; c is another heddle, behind the former. In the middle of each thread of the heddle is a loop, through which a yarn of the warp is passed, every other yarn going through the loops of the heddle c, and the intermediate yarns passing between the threads of that heddle, and afterwards through the eyes or loops of the other heddle d.

The two heddles, d d and c, are connected together by two small cords going over pulleys, suspended from the top of the loom, so that when one heddle is drawn down, the other will be raised up. The heddles receive their motion from the levers or treadles D E, moved by the weaver's feet. The yarns of the warp being passed alternately through the loops of the two heddles, by preffing down one treadle, as E, all the yarns belonging to the heddle c are drawn down; and by means of the cords and pulleys, the other heddle d, with all the yarns belonging to it, are raised up, leaving a space, called the shed, of about two inches between the yarns, for the passage of the shuttle.

F, G, H, (fig. 2.) is a frame, called the batten or lay, suspenfed by the bar F, from the upper rails of the loom, so that it can swing backwards and forwards, as on a centre of motion; the bottom bar H is much broader than the rails G, and projects before the plane about an inch and a half, forming a shelf, called the shuttle-race. The ends of the shuttle-race H have boards nailed on each side, to form two short troughs or boxes I I, in which pieces of wood or thick leather k k, called peckers or drivers, traverse. The peckers are guided by two small wires, fixed at one end to the uprights G G, and at the other to the end-pieces of the troughs I I. Each pecker has a spring fastened to it, tied to the handle y, which the weaver holds in his right-hand when he works, and with which he pulls, or rather snatches, each pecker either to the right or left alternately. H is the reed: it is a small frame, fixed upon a shuttle-race H, containing a number of small pieces of split reeds or canes; or else of pieces of flat wire, of steel or brass; but the cane is most common, although the frame is called the reed. When fig. 2. is in its place in the loom, the yarns of the warp pass between the canes or dents of the reed. In fig. 2. the reed is represented without the top or piece which covers it, and which is called the lay-cap. It is a rail of wood with a longitudinal groove along its lowermost side, for the purpose of facilitating the upper edge of the reed. The lay-cap is that part of the machine in the middle of which the weaver lays hold with his left-hand when in the act of weaving.

The shuttle (see Plate I.) is a small piece of wood pointed at each end, from three to six inches long. It has an oblong mortise in it, containing a small bobbin or pirn, on which is wound the yarn which is to form the weft, and the end of this yarn runs through a small hole in the shuttle, called the eye. The shuttle has two little wheels on the under side, by which it runs easily upon the shuttle-race H.

Operation.—The weaver fits on the feet M, (fig. 1.) which hangs by pivots at its ends, that it may adapt itself to the eale of the weaver when it fits upon it. It is lifted out when the weaver gets into the loom, and he puts it in again after him. He leans lightly against the cloth-roll B, and places his feet upon the treadles D E. In his right-hand he holds the handle y, (fig. 2.), by which he turns the lever of the shuttle, which is attached to the slide p, which moves the batten or lay G G, and serves to support the upper edge of the reed R. He commences the operation by preffing down one of the treadles with his foot; this depresses one-half of the yarns of the warp, and raises the other, as before-described. The shuttle is previously placed in one of the troughs I, against the pecker K, belonging to that trough. By the handle of the shuttle, with a sudden jerk, he drives the pecker against the shuttle, so as to throw it across the warp upon the shuttle-race, into the other trough I, leaving the yarn of the weft, which was wound on the bobbin after it, in the space between the divided yarns. With his left-hand he pulls the lay towards him; and, by means of the reed, the yarn of the weft, which before was lying loose between the warp, is driven up towards the
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the cloth-roll; the weaver now presses down his other foot, which restores the operation, pulling down the heddle which was up before, and raising that which before was depressed. By the other weaver he then throws the shuttle back again, leaving the woof after it between the yarns of the warp; and, by drawing up the buttern, beats it close up to the thread before thrown.

In this manner the operation is continued until a few inches are woven; it is then wound upon the cloth-roll, by putting a short lever into a hole made in the roll, and turning it round, a click acting in the teeth of a ferrule wheel, prevents the return of the roll. At each end of the yarn-roll $A$, (fig. 1.) a cord is tied to the frame of the loom; the other ends of the cords have weights hanging to them.

The rope causes a friction, which prevents the roll from turning (unless the yarn is drawn by the cloth-beam), and always prefers a proper degree of tension in the yarn.

TT (fig. 1.) are two smooth sticks (cotton-weavers have usually three) put between the yarns, to prevent the leaf, and keep the threads or yarns from entangling.

In cotton-weaving these sticks or rods are kept at an uniform distance from the heddles, and are either held in the fingers, or by a small cord with a hook at one end, which lays hold of the front rod, and a weight at the other, which hangs over the yarn-beam.

The cloth is kept extended during the operation of weaving, by means of two hard pieces of wood, called a templet, with small sharp points in their ends, which lay hold of the edges, or selvages, of the cloth.

These pieces are connected by a cord passing obliquely through the heddles or notches, in each piece. By this cord they can be lengthened or shortened, according to the breadth of the web.

They are kept flat after the cloth is stretched by a small bar turning on a centre fixed in one of the pieces of wood. This stretcher is called the templet. Silk-weavers usually stretch their cloth by means of two small sharp-pointed hooks fastened to the ends of two firings, with little weights at the other ends; and the firings are made to pass over little pulleys in each side of the loom, at a suitable distance from the selvages of the cloth.

The perfection of the work depends very much upon the previous operations which the yarn must undergo. It is obvious that the yarns of the warp must be stretched with great parallelism and equality of tension, so that when the cloth is finished, every individual yarn may bear an equal share of any strain which tends to tear the cloth; hence great care must be taken to stretch the yarns of the warp to an equal length, and roll them with great regularity upon the yarn-roll. These operations are called warping and beamung. Previous to warping, the yarn must be prepared by sizing or slutching, in order to cement all the loose fibres, and render the yarn smooth.

The spinners of yarn, whether they employ machinery or not, usually reel the yarn into skeins and hanks of a determinate length; and the weight of these hanks, or the number which will weigh one pound, is the denomination for the fineness of the yarn. (See Manufacture of Cotton.) In this state the yarn is bought by the weaver. The hanks of yarn are first boiled in water; if it is linen-yarn a little soap and potash are put into the water, and for cotton-yarn a small portion of flour is added, to render the thread firm.

When the hanks are perfectly dry they are wound upon bobbins; each bobbin having a separate bobbin, and a certain length is wound upon each. This winding is performed by a very simple hand-wheel to turn the bobbin rapidly round, the hanks of yarn being extended upon a reel, or over two small reels placed at a distance under, which are called wicks.

Warping.—The object of this operation is to stretch the whole number of parallel threads which are to form the warp of the cloth to an equal length. For this purpose as many of the above bobbins are taken as will furnish the quantity of threads which is required in the warp of the piece of cloth. The bobbins are usually one-fourth or one-sixth of the number of threads required, and are mounted on spindles in a frame, so that the thread can draw off freely from them. All these threads are drawn off at once, fo as to combine them all into one clue, which will be ready for the warp. The ancient method was to draw out the warp at full length, and stretch it in a field; and this is still practiced in India and China, but is so very uncertain in our climate that it is seldom used. The present mode of warping is either by the warping-frame or warping-mill.

The warping-frame is a large wooden frame, which is fixed up against a wall in a vertical position. The upright fides of the frame are pierced with holes to receive wooden pins, which project sufficiently to wind the clue of yarns for the warp round them.

The operator having the threads which are to compose the warp wound on the bobbins before-mentioned, places those bobbins in a frame; then tying the ends of all the threads together, and attaching them to one of the pins at one end of the frame, he gathered all the threads in his hand into one clue; and permitting them to slip through his fingers, he walked to the other end, where he padded the yarns over the pin fixed there, and then returned to the former end of the frame and padded the warp over another pin, then went back again, and so on till he formed the required length of the warp. This being done, he secured the end of the warp by crossing it round the pin, and then he worked back and returned over all the same space again, laying the threads over the same pins, so as to double the clue; and he repeated the doubling until the number of threads necessary for the breadth was made up. The number of doublings would be according to the number of bobbins and threads which he took in his hand at once.

This method is used very much in France, particularly at Lyons: it is also used in Devonshire. It is adapted to the weaving carried on in cottages, because the frame is fixed close to the wall, and takes little or no room; but the warping-mill or reel is very superior, and is adopted in all improved manufactories where the warping is a separate business, and is usually done at the mill where the yarn is spun.

The warping-mill is a large reel of a cylindrical form, or rather of a prismatique form, being made with twelve, eighteen, or more sides. The reel is usually about six feet diameter and seven feet high; it is turned round on a vertical axis by a band, passing from a grooved wheel which is turned by a winch, and is placed beneath the feat on which the warper sits. (See a figure of the warping-machine for flax Plate Silk, fig. 6.) The bobbins which contain the yarn are placed on a vertical rack suspended from the ceiling, and the threads from them are all collected together and padded between two small upright rollers in a clue, which is wound up by the reel when it is turned round. To guide the clue and distribute it equally on the length of the reel, the above rollers are fixed on a piece of wood, which slides perpendicularly on an upright bar fixed at one side of the reel. The战ping-piece is lapsed over a small cord, wrapped round a part of the perpendicular axis that lies above the reel. The cord passes over a pulley at the top of the upright bar, and goes down to the falling-piece which carries the two rollers.

When the reel turns round, the guide-rollers are slowly drawn
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drawn up by the coiling of this cord round the axis; and the yarn is wound in a regular spiral about the reel, until the length which the warp requires is wound upon it. When the full length of the yarn is wound on the reel, the clue of thread is crossed over pins projecting from the frame of the reel, and the mill is then turned the reverse way so that the slider and guide-rollers descend, and the yarn is laid downwards along the same spiral with it before ascended, so as to double the clue of thread; and this doubling is repeated until the required number of threads is collected together in one clue upon the reel.

When the warp is thus completed, it is taken off the reel and wound upon a flax into a ball; the croffings which distinguish the different returns or doublings of the simple clue being first properly secured, as a means of dividing the warp into as many equal portions as is necessary for the convenience of the weaver, in counting the threads in the succeeding operation of beaming.

There is likewise another kind of division of the threads of the warp; this is called the leaf, and serves to separate all the threads which are to go through one of the heddles of the loom, from those which are to go through the other heddle. To effect this separation, the bobbins from which the threads are drawn are arranged in two rows, and a thread is alternately drawn from the upper row and from the lower row. Then at the beginning and end of every doubling of the warp, the threads of one row of bobbins are crossed over the threads of the other row, and two pins are put into the croffings to retain them. These pins are put into holes made in pieces of board fixed to the warping-reel. One of these boards at the top of the reel is fixed fast, but the other is moveable, and can be fixed at any part of the reel, according to the length of the warp.

In the most improved warping-machines, the separation is made by an apparatus called in Scotland the heck. It consists of a row of fixed pins with eyes through one end of each for the threads to pass through like large needles. These are stuck into two pieces of wood, by which they are supported in a row near to the warping-reel. Every alternate pin in the row is fastened in one piece of wood, and the intermediate pins are fastened in the other piece, so that by lifting up one piece of wood the pins and threads belonging to it will be raised up, whilst the intermediate pins and threads are held down. This occasions the division of the threads, and a pin is put in to keep them so divided. The other piece of wood is then lifted up, which occasions all the threads to be crossed; that is, every thread forms a cross over that which is adjacent to it. A second pin is then put in, and before the warp is taken off from the reel, this crossing is secured by a firing.

**Beaming.**—When the weaver receives his warp in a large ball or bundle, he proceeds to roll it up regularly upon the yarn-roller of his loom; this is called beaming. For this purpose he employs an instrument called a separaor, or ravel, which consists of a number of threds of cane, fastened together, and fixed to a rail of wood, like the teeth of a long comb; the teeth are intended to be put into the spaces between these teeth, so as to stretch the warp to its proper breadth.

Ravels are somewhat like reeds, but much coarser, and are also of different dimensions. One proper for the purpose being found, one of the small divisions of the warp is placed in every interval between two of the teeth. The upper part of the ravel, called the cape, is then put on, to secure the threads from getting out between the teeth, and the operation of winding the warp upon the beam commence. In broad works, two persons are employed to hold the ravel, which serves to guide the threads of the warp, and to spread them regularly upon the beam; one or two other persons keep the threads at a proper degree of tension, and one more turns the beam upon its centre.

The knottings which secure the croffings or doublings made in warping, are very useful to the weaver in beaming, to ascertain the number of threads, and to distribute them with regularity. He cuts the knotting before he can put the warp in the ravel, but he still keeps them distinct by a small cord.

The French weavers use a small reel, upon which they wind the warp from the ball, and then from this reel they draw off the warp through the ravel, by winding up the beam. The reel is loaded with a weight, to make a regular friction, and draw the warp with a regular tension.

**Drawing.**—The warp being regularly wound upon the beam, the weaver must pass every yarn through its appropriate eye or loop in the heddles: this operation is called drawing. Two rods are first inserted into the loops formed by the pins in the warping-mill, and the ends of these rods are tied together; the twine by which the leafe was secured is then cut away, and the warp stretched to its proper breadth. The yarn-beam is furnished by cords behind the heddles, somewhat higher, so that the warp hangs down longitudinally. The weaver places himself in front of the heddles, and opens the eye of each heddle in succession; and it is the busines of another person, placed behind, to feel each thread in its order, and deliver it to be drawn through the open eyes of the heddles. The succession in which the threads are to be delivered is easily ascertained by the leaves, or seen through the croffings that next to it. The warp, after passing through the heddles, is drawn through the reel by an instrument called a fley, or reed-hook, and two threads are taken through every interval in the reed.

The leave-rods being passed through the intervals which form the leaf, every thread will be found to pass over the first rod, and under the second; the next thread passes under the first, and over the second, and so on alternately. By this contrivance every thread is kept distinct from that on either side of it, and if broken, its true situation in the warp may be easily and quickly found. This is of much importance, that too much care cannot be taken to preserve the accuracy of the leaf. There is likewise a third rod, which divides the warp into what is usually called split, for two threads alternately pass over and under it; and these two threads also pass through the space interval between the split of the reed.

These operations being finished, the cords or mounting which move the heddles are applied; the reed is placed in the lay, or batten, and the warp is knotted together into small portions, which are tied to a shaft, and connected by cords to the cloth-beam, and the yarns are stretched ready to begin the weaving.

**Manner of Weaving.**—The operations of weaving are simple, and soon learned, but require much practice to perform them with dexterity.

In preparing down the treads of a loom, most beginners are apt to apply the weight or force of the foot too suddenly. The bad consequences of this are particularly felt in weaving fine or weak cotton-yarn; for the body of the warp must sustain its force nearly equal to the force with which the weaver’s foot is applied to the treadle. The art of spinning has not yet been brought to such perfection as to make every thread capable of bearing its fair proportion of this force. Besides this, every individual thread is subjected to all the friction occasioned by the heddles and splits of the reed, between which the threads pass, and with which
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which they are generally in contrast when rifing and finknig. A sudden prelude of the foot on the treadle must cause a proportional increase of the threads upon the warp, and allo of the friction. As it is impossible to make every thread equally strong and equally tight, those which are the weakest, or the tightest, must bear much more than their equal proportion of the threads, and are broken very frequently. Even with the greatest attention, more time is lost in tying and replacing them, than would have been sufficient for weaving a very considerable quantity into cloth.

If the weaver, from inattention, continues the operation after one or more warp-threads are broken, the consequence is still worse. The broken thread cannot retain its parallel situation to the red, but crossing over or between them nearest to it, either breaks them also, or interrupts the passage of the shuttle; it frequently does both.

In every kind of weaving, and especially in thin wiry fabrics, much of the beauty of the cloths depends upon the warp being well stretched. If the motion given to the shuttle be too rapid, it is very apt to recoil, and thus to slacken the thread. It has also a greater tendency, either to break the thread altogether, or to unwind it from the pin or bobbin of the shuttle in doubles, which, if not picked out, would destroy the regularity of the fabric. The weft of mullins and thin cotton goods is generally woven into the cloth in a wet state.

This tends to lay the ends of the fibres of cotton smooth and parallel, and its effect is similar to that of dethreading the warp.

The perfon who winds the weft upon the pin ought to be very careful that it be well formed, so as to unwind freely. The belt shape for those used in the fly-shuttle is that of a cone; and the thread ought to traverse freely round the cone, in the form of a spiral, or screw, during the operation of winding.

The frame wheel which is used for winding the warp upon the bobbins preparatory to warping, is also fit for winding the weft on the pin. It only requires a spindle of a different shape, with a screw at one end, upon which the pin, or bobbin of the shuttle, can be fixed. The wheel is so constructed, that the spindles may be easily shifted, to adapt it for either purpose.

The reeds are formed of a number of short pieces of reed or cane, or of braids of wire, fastened parallel to each other between two flicks, and cemented with pitch. This frame is enclosed by two pieces of the frame of the loom, one of which is made wide, to form the shuttle-race; the other piece, which is the lay-cap, extends across the frame, but is fitted so that it can be easily removed to take away the reeds, and substitute a finer or coarser fort, as the nature of the goods to be woven require. The manufacture of reeds, both of cane and of flax, is a separate trade. These are fully described in Les Arts et Metiers, vol. 9 and 15.

To render the fabric of the cloth uniform in thicknes, the lay or batter must be brought forward with the same force every time.

In weaving some kinds of soft or light goods, the reed is not fixed fast to the lay-cap, but is held in its place by a long thin piece of wood, which is elastic, and yields or springs when the weft is beaten up. In some cafes the reed is fastened by a double wooden cord, stretched across the lay, just beneath the lay-cap, and twisted; this bears the reed, and is very elastic, but can be rendered more fliff by twirling the weft around it.

In the common operation of weaving, a regular force of the stroke for beating up the weft must be acquired by practice. It is, however, of consequence to the weaver to mount or prepare his loom in such a manner, that the range or swing of the lay may be in proportion to the thicknees of his cloth. As the lay swings backwards and forwards, upon centres placed above, its motion is similar to that of a pendulum. Now the greater the are, or range through which the lay paffes, the greater will be its effect in driving home the weft strongly, and the thicker the fabric of cloth will be, as far as that depends upon the closeness of the weft. For this reason, in weaving coarse and heavy goods, the heidles ought to be hung at a greater distance from the place where the weft is fruck up, and consequently where the cloth begins to be formed, than would be proper in light work. The line of the fall wrought from the weft is called by the weavers the fell. The pivots upon which the lay vibrates ought, in general, to be so placed, that the reed will be exactly in the middle, between the fell and the heidles, when the lay hangs perpendicularly. As the fell is constantly varying in its situation during the operation, it will be proper to take its medium; that is, the place where the fell will be when half as much is woven as can be done without taking it up on the cloth-roller, and drawing freth yarn from the yarn-roller.

The periods for taking up the cloth ought always to be short in weaving light goods; for the less that the extremes of the fell vary from the medium, the more regular will be the arc or swing of the lay. Mr. James Hall had a patent, in 1803, for a method of perpetually winding up the cloth-beam, so as to take away the cloth as fast as it was woven, or frout by frout. This was effected in a simple manner by a ratchet-wheel fixed on the end of the cloth-beam, and a proper catch to move it round one tooth at a time: the catch was actuated by the motion of the lay. A similar method is used in riband-weaving.

The variations in the structure of looms from that which we have described, are not material. The framing is varied in almost every different kind of loom, and ought always to be suitable in strength to the kind of cloth which is to be woven. The loom used for silk is very light in all its parts; but for carpet and fail-cloth it must be very strong.

In looms for heavy goods, the cloth-beam is not placed at the breast of the weaver, as it is so large that it would impede his working; the cloth is therefore passed over a fixed bar in the place of the cloth-beam represented, and the beam is placed lower down, and near the weaver's feet, out of the way of his knees. The heidles are connected by levers, in some looms, instead of pulleys; but the effect is always the same: viz., to make the heidles ascend when the other descend. For weaving fine goods, the heidles would be inconveniently close together, if all the yarns went through two heidles; hence they use four heidles instead of two; but their action is just the same, because they are connected together in pairs, and when one pair rises the other pair sinks. Many looms are still made without the fly-shuttle; and in that case the shuttle is merely thrown from one hand to the other, and then thrown back again; this oblige the weaver to change his hands continually, and the operation is more complicated. For wide cloths, which are more than a man can reach across, two perfons were always employed before the fly-shuttle was introduced, which is only within a few years; but by its assistance one perfon can weave the greatest breadths. The fly-shuttle is the belt for all kinds of work, and its construction is so simple that no other ought to be used.

Treatment of different Kinds of Yarn. — The manner of weaving all kinds of plain cloth is much the same, whether it is wool, silk, flax, or cotton; except that the two latter require
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require what is called dreffing. Silk and woollen warps require little preparation after being put into the loom, except to clear the yarn occasionally with a comb, to remove knots or lumps which might catch in passing through the reed; the comb deteets such lumps, and they are removed with the assistance of a pair of scissors. Flax and cotton, but particularly the latter, require the warp to be dreffed with some glutinous matter, to cement the fibres, and lay them cloe. This is applied in a fluid state, and as the weaving does not proceed well after it is suffered to dry, the warp is dreffed with a brush when in the loom, a small quantity at a time, immediately before it is woven.

Dreffing.—The use of dreffing is to give to yarn sufficient strength or tenacity, to enable it to bear the operation of weaving into cloth. By laying smooth all the ends of the fibres of the raw materials, from which the yarn is spun, it tends both to diminish the friction during the process, and to render the cloth smooth and glossy when finished. The dreffing in common use is simply a mucilage of vegetable matter boiled to a consistency in water. Wheat-floor, boiled to a paste like that used by book-binders, or sometimes potatoes, are commonly employed. These answer sufficiently well in giving to the yarn both the smoothness and tenacity required; but the great objection to them is, that they are too easily affected by the action of the atmosphere. When dreffed yarn is allowed to stand exposed to the air for any considerable time, before being woven into cloth, it becomes hard, brittle, and comparatively inflexible. It is then tedious and troublesome to weave, and the cloth is rough, wiry, and uneven. This is chiefly remarked in dry weather, when the weavers of fine cloth find it necessary to work up their yarn as speedily as possible, after it is dreffed.

To counteract this inconvenience, herring or beef brine, and other saline substances which attract moisture, are sometimes mixed in small quantities with the dreffing; but this has not been completely and generally successful; probably, because the proportions have not been sufficiently attended to; for a superabundance of moisture is equally prejudicial with a deficiency. The variations of the moisture of the air are so great and frequent, that it is impossible to fix any universal rule for the quantity of salt to be mixed.

Some weavers put butter-milk in the paste.

To apply the dreffing, the weaver must first prepare the loom by weaving, whenever he has worked up that quantity of warp which he has dreffed, or within two or three inches; he then quits his seat, and applies the comb to clear away knots and burrs; next he pushes back the leafe-rods towards the yarn-roll, one at a time, and if they slide freely between the yarn, he knows they are clear from knots; he then brushes the yarn with the paife by two brushes, holding one in each hand. The superfluous humidity is afterwards dried by fanning the yarns with a large fan, and then a small quantity of glare is brushed over the yarn; the leafe-rods are returned to their proper position, and the weaving is resumed.

Dreffing is of the first importance in weaving warps spun from flax or cotton; for it is impossible to produce work of a good quality, unless care be used in dreffing the warp.

The same practice, when used upon silk, has a very destructive tendency; it injures the colours of the silk when used, as it is sometimes very improperly, by the weavers of white satin. The injury done to the work is irreparable. In cotton, the operation of dreffing is indispensible; but in flax, particularly the latter, very little; for the preparation of paife or sice for warp, has been subjected to several patents. Mr. Foden, in 1799, recommended a quantity of calcined gypsum, or plater of Paris, to be reduced to a very fine powder, and then mixed with alum, sugar, and the farina or flour of potatoes, or any other vegetable farina. This powder, when mixed with cold water, forms a soft paste, to which boiling water is to be added, and the mixture thoroughly stirred till it becomes sufficiently gelatious for use.

Another sice, for which Mr. Wilks had a patent in 1801, is prepared as follows:—The flour or flour is to be extracted from any kind of potatoes which are mealy when boiled, by grating them while raw (but washed clean) into a tub of water. The water, thus impregnated with the grated potatoes, is run through a sieve or strainer, which will retain the outer and fibrous parts of the potatoes, but admit the finer particles, constituting the flour or flour, to pass with the water into a vessel beneath the sieve or strainer. This water must remain in the vessel several hours undisturbed, to permit the flour to subside to the bottom; then the water is poured off, and the flour so obtained is put into fresh water, and passed through a fine sieve into another tub, where the flour is left to subside to the bottom as before, and the water is again poured off.

To about two-thirds the quantity of potatoes, which furnished the flour, are also to be boiled without peeling, so as to make them mealy when boiled; they are then mashed, and diluted with water, so that they will pass through a sieve into a boiler. In this the mashed potatoes are heated till they almost boil; and the flour from the grated potatoes is then to be added, and the whole boiled and stirred for 20 minutes, when it will become paste proper for use. It should be spread in a flat open vessel to cool.

Improved System of Weaving by Machinery.—In our article COTTON we mentioned that weaving-loomos, worked by mechanical power, were then coming into use: since the time that article was printed these have made great advances; but to use them with advantage, the preparatory processes of warping and dreffing must be conducted in a particular manner. Many attempts have been made to diminish the number of operations through which the yarn must pass before being delivered to the bobbin, and so that it would be ready to warp at once. Mr. Marland had a patent in 1805 for the same object; his plan was to expose the rolls of cotton to the action of the hot flarch in an exhausted receiver; the prelure of the atmosphere being thus removed, the fibre penetrated readily to the centre. It was found difficult to dry the cotton perfectly, and the threads were sometimeo glued together as to render the winding difficult.

Another plan has therefore been introduced both for flax and cotton: this is to wind off the yarn from the cop or bobbin in which it is spun, and gather it upon the bobbins ready for the warping; by this manner the reeling is saved. A small quantity of flarc is applied to the yarn during the operation, by caulsing it to pass over a horizontal wooden cylinder, which revolves on its axis in a trough filled with fluid flarc. The threads, in passing from the cop to the bobbin, are drawn over the upper surface of the cylinder, and receive the flarc with which it is covered. The winding machine for this actuated a great number of bobbins at once; the warping is then conducted, as we have before described, and the dreffing is performed in the loom whilst weaving, that is, if woven by hand; but for the power-loom it is dreffed previously to placing it in the loom, by no means the case.

Dreffing Machine.—Mr. Johnson, of Stockport, had a patent, in 1804, for a method of dreffing whole webs of warp at once,
once, by a machine. The yarns were wound off from the bobbins or cops of the spinning machines upon beams or rollers. Several of these rollers were placed parallel to each other, in an horizontal direction, at the opposite ends of the machine, from three to fix at each end; and the yarns from them were all combined together in one web, which was received and rolled up on the yarn-beam of the loom placed in the middle of the machine, and raised up considerably above the other rollers, so that the yarns proceeded from both ends of the machine towards the middle. In their passage they passed through several reeds to keep them separate, and were supplied with the pailte by passing over two cylinders revolving in a trough of fluid pailte. This pailte was drest or worked into the yarn by means of two brushes, of a length equal to the breadth of the web; one of the brushes acted upon the upper side of the yarn, and the other on the lower side. A similar pair of brushes were applied at both ends; each brush had a motion given to it by means of cranks, exactly similar to the movement with which the weaver brushes the yarn in the loom. Near the yarn-roller a fan was placed, like that used in a winnowing machine, which blew a current of air through the yarns of the warp to dry them before they were rolled up by the beams. To remove the leaf, the yarns were conducted through a pair of heddles, similar to those of the loom, but they remained slack to avoid friction.

The machine was moved by the mill with a constant and regular movement.

When a warp is thus warped, beamed, and dressed, the yarn-beam is carried to a loom, on which the yarn is just exhausted, and is made to replace the empty yarn-roll. The ends of the yarn are joined to the old yarns by twifling, and arc thus drawn through the heddles and reed, so that the weaving can be renewed with very little loss of time, and the weaver can proceed with his work without any interruption for dressing. The principal objection to the above machine is the friction which the yarn must undergo in brushing, and in passing through so many reeds; it was, however, practised in a large work at Stockport; but the weaving was performed by hand.

Another dressing machine was invented by Mr. M'Adam, and he obtained a patent in 1806: it is practised by Mr. Monteith, at Pollockshaws near Glasgow. This machine is very much like the former in its manner of action. Instead of using three, four, or six beams at each end of the machine, there are only two beams, each containing one half the number of yarns for the intended warp. The itarch is supplied in the same manner as the former, or sometimes by making the two yarn-beams themselves turn in a trough of itarch without employing a separate cylinder. The brushing is performed in a more simple and effectual manner by using cylindrical brushes, which revolve with a regular motion, two of them are applied upon the upper side of the warp, and two on the lower side; also four fanners are applied to dry the warp instead of one. The yarns were conducted between reeds and through heddles, like the itarch machine; and hence the same objection of friction applies to both.

Mr. Dunlop, in his Essay on Weaving, describes another method of dressing warp, which is practised by Mr. Dunlop at Barrowfield. In this the yarn is warped and beamed in the usual manner, upon a yarn-roll: from this the yarn is unwound, and taken up upon another beam; and in its passage from one to the other it is extended, so that the picking and clearing can be performed in the usual way by hand with a comb and felts, and the dressing is applied with brushes passed in the usual way: beneath the warp a fan is placed, to blow a current of air up through the yarns and dry them. In this machine all the operations, except the fanning, are performed by hand; the advantage, therefore, consists only in the division of labour, by making the dressing and weaving distinct operations.

Power-Looms.—In the article Cotton we have mentioned Mr. Dolignon's claim to the invention of weaving by mechanical power.

The original process, we believe, was by M. De Gennes, and is published in the Philosophical Transactions for 1768, No. 145. See also Lowthorp's Abridgment, vol. i. p. 499. This is a very ingenious invention. The fly-shuttle was not then invented, and he supplied the want of it by a contrivance which held the shuttle as it were in a hand by fingers; this carried it half way through the cloth, and then it was transferred to another similar hand, which drew it through the remainder. By this means there was a greater certainty than in throwing the shuttle from one side to the other, because the shuttle always continued engaged with the mechanism: the whole machine is ingenious and worthy of notice.

M. Vanconen, the celebrated French mechanist, made a machine for weaving ten ribbons at a time, which was worked by a circular motion given by the workman; and it might, therefore, have been worked by mechanical power. This is described in the Encyclopaedia Methodica in great detail, with ten folding plates, and is a ingenious machine.

We believe both these inventions were prior to that of Mr. Dolignon; and also that the merit of inventing the machine, and first reducing it to practice, is due to Mr. Aultin, of Glasgow. In this gentleman's memoir to the Society of Arts, he states, that his first attempt was made in the year 1798, when he entered a caveat for a patent, but did not apply for it further; since that time he made many improvements upon the original plan. In 1798 a report in its favour was made by the Chamber of Commerce and Manufacturers at Glasgow; and in 1798, a loom was set at work at Mr. J. Monteith's spinning works, at Pollockshaws near Glasgow, which answered the purpose so well, that a building was erected by Mr. Monteith for containing thirty looms, and afterwards another to hold about two hundred.

Mr. Aultin's Power-Loom.—The model from which our drawing (Plate I. Weaving) was made, is deposited in the Society of Arts; it is an improvement upon the looms constructed for Mr. Monteith.

The drawing Plate I. is a perspective view, exhibiting the whole loom at one glance; it is viewed from the back rather than from the front.

A is a square iron axis extending through the whole length of the machine; to this the power of the lift mover is applied by a cog-wheel B, of thirty-fix teeth, turned by a pinion of twelve leaves fixed to the axis of the fly-wheel D. A handle is fixed to one of the arms of the wheel to give motion to the model; but in the large machine a live and dead pulley are adapted to the axis of the fly-wheel; and by means of an endless strap, the power is communicated from any convenient part of the mill in which a great number of looms are placed together.

The axis A has several eccentric wheels or cams fixed upon it; these revolve they give motion to a number of levers or treadles, by which all the usual operations of the loom are performed at the proper intervals; these are,

First, To separate the two parts of the yarns of the warp, as shown at G, and admit of the passage of the shuttle.

Secondly, To throw the shuttle, in order to lay the weft or croft-thread of the cloth.

Thirdly, To move the lay 7, 8, and return it; so that the reed will beat up the weft close to the fell, or pre-
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ceding float of the weft: this renders the cloth of uniform texture.

Fourthly, To wind up the cloth upon the cloth-roll, as fall as it is formed by the preceding operations.

The yarns, which are to form the warp of the cloth, are warped in the manner before described upon the yarn-roll F; and from thence they are extended horizontally to the cloth-roll E, of which only a small part can be seen at the opposite side of the loom; in which the yarns pass through the eyes of the heddles G, which effect the first operation above-mentioned. Each heddle is composed of a number of perpendicular threads equal to half the number of yarns in the warp; these are flanked between two small rods a a and b b, and in the middle of each thread is a small eye, through which a yarn of the warp is passed; thus, the first yarn of the warp is passed through the eye of the heddle G, but has no connection with the heddle H, because it passes between its threads. The second yarn is put through the eye of the heddle H, but has no connection with G; the third yarn is attached to H; the fourth to G, and so on alternately throughout the whole number. By this means if one heddle is raised up, and the other at the same time depressed, a separation of the yarns will take place as shown at G, every other yarn being raised up, whilst the intermediate ones are drawn down, so as to admit the passage of the shuttle and weft between them.

The two heddles are moved by camms upon the main axis A; and they are so connected by short levers I I, which are suspended from the upper part of the loom, that when one heddle is pulled down, the other will be drawn up at the same time, because they are suspended from the opposite ends of the levers.

The camms on the main axis for the heddles are marked L; the two are exactly similar, but are reversed upon the axis; that is, the shortest radius of one is placed on the same side with the longest of the other. They act upon two levers, which are the as the threads in a common loom; only one of these threads or levers (viz. that which belongs to the camm L) can be seen at M, the other lever being concealed from the view; both levers move on centres at a between the small uprights d d; the other ends glide freely up and down between similar uprights at the opposite side of the frame, which cannot be seen in the figure; the levers are connected with the heddles, being suspended from the levers I as before mentioned, the levers will therefore move in contrary directions, the one raising when the other is pressed down by the action of the camm on the axis A.

The connection between the levers or threads M and the heddles G H, is made by cords communicating with two counter-levers O P, which are centered in uprights supported by the frame at the ends of the machine. The counter-levers O P are connected with rods b b and k, and these by a double cord are attached to the heddle-threads a a and b b.

This machinery which we have now described effected the separation of the warp thus: when the axis A turns round, every revolution of its camms L will cause two separations of the warp, and each one in a different manner, for these yarns which are raised up at one time are drawn down the next.

The second operation, viz. throwing the shuttle, is performed by two camms R S, which are reversed to each other upon the axis A. They act upon two levers, only one of which can be seen at T; they are placed beneath the camms. The shuttle requires to be projected with a sudden jerk; these levers are therefore centered at d on the frame pin as the levers M and N, but the other ends press down smaller levers W, which are centered at the opposite end of the frame, and lie beneath the long levers. The extreme ends of these smaller levers are connected by a flap f with a segment of a wheel, which has a long limb of whalebone Y fastened to it; and by means of two springs, one of which is shown at q q, it moves the peckers or drivers z upon the wires 3 3; and throws the shuttle. The shuttle, which is shown in a separate figure, is pointed at each end, and glued with iron: it contains two small rollers 31 31 upon which it runs; and as they project through both surfaces, it will run either way upwards, or either end first. In the centre of the shuttle is an oblong mortise, containing the pin or bobbin 33, on which the thread for the weft of the cloth is wound; and the end of the weft marked 34, is brought through a small glass tube, called the eye of the shuttle.

The action of the mechanism for throwing the shuttle is as follows:—By the revolution of the camm R, the long lever beneath it is depressed, and at the same time the extremity of the shorter lever W-defends, but with an increased velocity; this by means of the flap f turns the segment of a wheel on its centre, and its tail Y fastens the spring q of the pecker z, and makes it strike against the shuttle with such a velocity, as to drive the shuttle out of the trough O, across the shuttle-race, into the opposite trough, where it will push back the pecker, and remain at rest in the trough ready for the next stroke; by this stroke it will be returned back again with an action similar to the last, but occasioned by the other camm S, and its corresponding levers.

The threads of the warp, which are lowest when the separation takes place, are drawn down by their heddle G or H, so as to lie close upon the shuttle-race, and cause no obstruction to the passage of the shuttle. To facilitate this, the shuttle must be very smooth on its surface, that it may not catch the threads and be stopped. The shuttle-race is inclined towards the reed, both that the yarn may lie flat upon it, and that the shuttle may not be liable to run off its race; for as it leaves the weft, which is drawn off from its bobbin, in the space between the divided yarns of the warp, it might be drawn off its race sideways, without this precaution. In this manner the second operation is performed.

The third motion is that of the wheel g: this is fixed close behind the shuttle-race, and is a frame containing a great number of parallel slips of reed cane; between these yarns of the warp pass, and when the whole frame of reeds is moved towards the cloth-roll E, they will act in the manner of a comb, to beat up the thread of the weft, which is left by the shuttle lying loofly between the yarns of the warp.

For this purpose, the shuttle-race, reeds, peckers, &c. and their stem Y, with its segment of a wheel, are all placed on a frame which moves on hinges at the lower ends, S, of the two upright sides 7 8. This frame, which is termed the lay, is drawn backwards by means of flaps 10, 10, rolled upon pulleys 11, fastened upon the axis 12; upon this same axis are two other smaller pulleys, upon which two flaps, 13, are rolled, to connect with the long levers 14, which are moved by the camms 15, upon the axis A.

The long levers, 14, are centered at one end of the frame, and the pulleys on the axis, 12, being of different diameters, the motion of the reeds will be performed very quickly. To move the lay in a contrary direction, and give the stroke to beat up the weft, two large weights, like m, are suspended by flaps from pulleys on a horizontal axis, which carries two larger wheels x; on these, flaps are wound, to communicate...
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icate with the upright sides, 7 8, of the lay, and draw it forwards.

When the loom is acting very quickly, these weights would not act with sufficient sharpness to throw the reeds against the threads of the weft with the proper force.

The weights are therefore connected by spiral wire-springs, with long levers 16, which are pressed down by a cam or rather tappet 17, fixed on the main axis. These levers act before the lay is at liberty to move, and by pressing down the levers extend the springs; consequently, as soon as the cam 15 suffices the lever 14 to rise, the springs act instantaneously, to throw the lay and the reeds forwards to beat up the weft.

The inertia after the blow has been given, the lay is drawn back again by the cam 15, and returned into the vertical position, in which situation the lay must continue whilst the shuttle is thrown; for this purpose, the outsides of the camms 15 are portions of circles. This completes the third motion.

As fast as the cloth is fabricated by the foregoing movements, it is gathered upon the cloth-roll E. This is turned slowly by a small crank 19, on the extreme end of the main axis A; the crank moves a small rod 20 up and down, in order to turn a small ratchet-wheel round one tooth each revolution of the main axis; the return of the ratchet is prevented by a click. On the axis 21 of the ratchet-wheel is an endless screw, to engage the teeth of a cog-wheel upon the end of the cloth-roll, and give it a slow motion.

The yarn is kept to a proper degree of tension by the friction occasioned by a line 28 passed twice round the yarm-roll, one end being fastened to the frame, and the other to a lever 30, loaded with a weight.

The framing of the loom is too evident to need description. In the construction of the machine, the principal circumstance to be attended to, is the figure of the different camms; also that they are placed upon the axis A in the proper position relative to each other. These camms will ensure the accurate performance of the machine.

The cam R or S, for throwing the shuttle, is formed with a sudden beak or projection, that it may strike the levers T down instantaneously, and throw the shuttle; from this beak the curve continues circular for some distance, that the lever may be held stationary; the remainder of the camm gradually diminishes its radius like a spiral, and quits the lever, in order to leave it at liberty to rise up when its corresponding lever is forced down by the beak of the other former camm S.

The camm L for the heddles is made circular where it is to come in contact with the lever, and which is all the time it is in action. This occasions the levers and heddles to be stationary whilst the shuttle is thrown.

The inventor states that, by the addition of some simple improvements, his looms have the following advantages; viz. 300 or 450 of them may be worked by one water-wheel, or steam-engine, all of which will weave cloth in a superior manner to what can be done in the common way. They will go at the rate of 60 picks in a minute, making two yards height of what is called a nine hundred web in an hour. They will keep regular time in working, flop and begin again, as quick as a flot-watch. They will keep constantly going, except at the time of shifting two shuttles, when the weft on the pirns is exhausted. In general, no knot is tied by a small lever more than one in place of two, which are requisite in the common way when a thread breaks. In case the flutes flop in the shed, the lay will not come forwards, and the loom will instantly flop work-

ing. They will weave proportionally flower or quicker, according to the breadth and quality of the web, which may be the broadest now made. They may be mounted with a harness or spot-heddles, to weave any pattern, twilled, figured, &c.

There is but one close shed, the same in both breaths, and the strain of the working has no effect on the yarn behind the rods.

The fell and temples always keep the same proper distance. There is no time lost in loomming, or cutting out the cloth; it is done while the loom is working, after the first time.

The weft is well stretched, and exactly even to the fabric required.

Every piece of cloth is measured to a straw's breadth, and marked where to be cut at any given length.

The loom will work backwards in case of any accident, or of one or more shott's milling. Every thread is as regular on the yarm-beam as in the cloth, having no more than two threads in the runner. If a thread should appear too coarse or fine in the weft, it can be changed, or any fix is altered at pleasure. They will weave the finest yarn more tenderly and regularly than any weaver can do with his hands and feet.

When a thread, either of warp or weft, breaks in it, the loom will instantly flop, without flopping any other loom, and will give warning by the ringing of a bell. A loom of this kind occupies only the same space as a common loom; the expence of it will be about half more; but this additional expence is more than compensated by the various additional machinery employed for preparing the yarn for the common loom, and which this loom renders entirely unnecessary.

The preparatory processes of reeling, winding, warping, beaming, and loomming, and the interruptions occasioned by combing, dressing, fanning, greasing, drawing bores, shifting heddles, rods, and temples, which is nearly one-half of the weaver's work, do not happen in these looms. The general waiste accompanying the above operations is stated at about six per cent. of the value of the yarn, all which occur in the operations of the common loom. The power-loom, without further trouble, performs every operation after the spinning, till the making of the cloth is accomplished, by which a saving is effected of about twenty per cent. of the yarn.

The heddles, reed, and brushes, will wear longer than usual, from the regularity of their motion. More than one-half workmanship will be saved; one weaver and a boy being quite sufficient to manage five looms of coarse work, and three or four in fine work.

Mr. Miller's Power-Loom.—A patent was taken out for this in 1796. It is so much like Mr. Aulfin's in its general principle, that it is unnecessary to enter into the description. The motions are all produced by camms fixed on a horizontal axis, and operate upon a number of horizontal levers, dipping beneath the loom, in the situation of the treadles; in other respects the arrangement of the parts is very different. This is sometimes called the wiper-loom, wiper being a different name for a camm.

Crk Loom by Power.—In this the treadles are actuated by cranks, instead of camms or wipers. The reciprocating motion produced by a crank is not uniform, but accelerated at one time, and retarded at another. This is an advantage in some of the operations of a loom. It is true, that, by means of wipers, any required law of acceleration may be produced; but in a crank, the acceleration must proceed according to one law. The superiority of cranks arises from
from the circumstance, that they will communicate motion in both directions; whereas a cam will only push a lever in one direction, and the return of the motion must be made by a spring or counterweight. Now, if this counterweight is too large, it makes unnecessary loss of power and friction; and if it is too small, there is some uncertainty in the return of the lever.

Mr. Todd of Boulton had a patent, in 1803, for improvements in power-looms.

Mr. Horrocks of Stockport had three successive patents for this kind of machinery, in 1803, 1805, and 1813. The machine described in the latter is a crank-loom; that is, the lay is actuated by a crank to beat up the web. The principal improvement consists in a system of levers, which transmit the action of this crank to the lay, and fo modify it, that the lay will advance quickly, and give an effective stroke to the weft, and then withdraw quickly to a stationary position, in which it will remain whilst the shuttle is thrown. The advantages which are自负 are, that a large shuttle may be used, sufficient to hold a full-sized cop of woof: the warp and lefs of time by renewing the cop will, therefore, be less. From the smarterk of the stroke, less weight will be required on the yarn-beam, and this will occasion the heddles to work more lightly, so as to break fewer threads. From the same cause, more threads of the weft may be laid in an inch, and make closer work.

Mr. Johnson of Preston had a patent in 1805, and another in 1807, for a power-loom, in which the warp is stretched on a vertical plane, instead of horizontal, as in former machines. The advantages of this are flated to be, 1st, that it takes less space; 2d, the reed serves for the shuttle-race, because the shuttle runs on the reed itself, and, therefore, makes no friction upon the yarns; 3d, also in dressing, picking, and clearing the warp, the attendant always remains in front of the machine, and can continue to watch the machine; whereas, in the other looms, he must quit his post in front, and go round behind the looms for these operations. When the dressing is to be applied to the warp, whilst it is in the loom, that part of the warp is conducted horizontally for that purpose, and a fan is applied to dry the warp.

The latest inventions of power-looms are Mr. Peter Scott's patent, 1813; and Mr. Duncan's loom, which he calls a vibrating loom.

The Indian Loom.—This is a striking contrast to our power-looms; it consists merely of two bamboo rollers, one for the warp, and the other for the finished cloth; and a pair of heddles. The shuttle performs the double office of shuttle and reed; for this purpose, it is made like a large netting-needle, and of a length somewhat exceeding the breadth of the piece of cloth which is to be woven.

This apparatus the weaver carries to any tree which affords a shade mol; grateful to him: under this he digs a hole large enough to contain his legs, and the lower part of the geer or heddles; he then flitches his warp, by fastening his bamboo rollers at a due distance from each other on the turf, by wooden pins; the balances of the geer or heddles he fastens to some convenient branch of the tree over his head; and two loops underneath the geer, in which he inerts his great toes, serve instead of treads; his long shuttle, which performs also the office of a batter, draws the weft, throws the warp, and afterwards flitches it up clofe to the web. In such looms as these are made those admirable muslins, whose delicate texture the Europeans can never equal, with all their complicated machinery.

The weaving, even of their finest muslins, is thus conducted in the open air, exposed to all the intense heat of their climate. We know well that this would be impracticable with fine work in this country, even in an ordinary summer day, on account of the sudden drying of the dressing. It is not known what is the substance which the Indian weavers employ for dressing their warps. It might be of ufe to our manufacturers, were this investigated in a satisfactory manner. It is said to be a decoction of rice, formed by boiling the rice in a small quantity of water, and exprefsing the juice: when this is cool, it forms a thick glutinous substance, which undergoes some kind of fermentation before it is ufed.

Figure-weaving.—Having given an account of the nature and process of plain weaving, we must notice the fanciful and ornamental parts of the business. The extent to which this species of manufacture is carried renders it an object of very great national importance, and deserving a more minute description than our limits will admit.

Figures or patterns are produced in cloth, by employing threads of different colours, or of different appearance, in the warp, or in the weft. By the weaving, the threads must be so disposed, that some colours will be concealed and kept at the back, whilst others are kept in the front; and they must occasionally change places, so as to shew as much of each colour, and as often as it is necessary, to make out the figure or pattern.

The weaver has three means of effecting such changes of colour: First, by using different coloured threads in the warp, or threads of different sizes and substances; these are arranged in the warping, and require no change in the manner of weaving. This is confined to striped patterns, the stripes being in the direction of the length of the piece.

Secondly, by employing several shuttles charged with threads of different colours or substances, and changing one for another every time a change of colour is required. This makes stripes across the breadth of the piece; or, when it is combined with a coloured warp, it makes chequered and spotted patterns of great variety.

Thirdly, by employing a variety of heddles, instead of two, as we have hitherto described; each heddle having a certain portion of the warp allotted to it, and provided with a treadle. When this tredle is depressed, only a certain portion of the yarns which belong to that heddle will be drawn up, and the rest will be depressed; consequently, when the warp is thrown, all those yarns which are drawn up will appear on the front or top of the cloth; but in the intervals between them, the web will appear over other threads which are depressed. The number of threads which are thus brought up may be varied as often as the weaver chooses to prefer his foot upon a different treadle, and by this he produces his pattern.

All these may be combined together, and give the weaver the means of representing the most complicated patterns.

The principal varieties of woven cloth, including only those which require a different process for their fabrication, are the following:

Stripes are formed upon the cloth either by the warp or by the weft. When the former of these ways is practised, the variation of the process is chiefly the business of the warper; but in the latter case, it is that of the weaver, as he must continually change his shuttle.

By unravelling any thread of striped cloth, it may easily be discovered whether the stripes have been produced by the operation of the warp or of the weaver.

When the fly-shuttle is used, the changing of the shuttle is very readily effectuated by a simple contrivance. One of the shuttle-boxes or troughs, as we have before called them,
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(Plate II. Weaving, fig. 2.) is made in two parts, so that a part of the trough I near the pecker, where the shuttle lies during the time it is at rest, can be removed, and another trough substituted, which contains a different shuttle. For the purpose of making the change with facility, a movable shuttle-box is suspended by two perpendicular strings from a wire or centre of motion attached to the lay, as shown by the dotted lines. The movable box is jut in the same level with the shuttle-trough, and is divided by partitions into two or three separate troughs, each exactly the width of the regular trough, and as long as is necessary to contain a shuttle. The pecker k, and the wire upon which it slides, remain exactly as before described; but by swinging the movable box n on its centre any one of its compartments may be brought to line with the real place for the shuttle-trough in which the pecker runs. The movable box must have proper catches to hold it exactly in its true positions.

In working with this contrivance a shuttle of a different colour must be placed in each cell or division of the movable box n; and when the weaver desires to change the shuttle he pulls the connecting string. This moves the shuttle-troughs either way, and forwards, so as to carry away that which had been jut before in use, and place another before the pecker. Then if he pulls the pecker-handle the new shuttle will be thrown across the shuttle-race, just as the old one was in the former instance. If only one movable shuttle-box is used there will be some limitation in the pattern, because the treads of different colour must always consist of an even number of the same coloured thread, as two, four, six, &c. This may be obviated, and a greater change of treads be introduced, by using two movable shuttle-boxes, one at each end of the shuttle-race; in that case the two movable boxes are provided with cranks and strings, so that the weaver can reach either of them with ease.

Checks are produced by the combined operations of the warper and the weaver. Twisted cloths are so various in their textures, and so complicated in their formation, that it is difficult to convey an adequate idea of the mode of constructing them without the aid of several drawings.

In examining any piece of plain cloth, it will be observed that every thread of the weft crosses alternately over and under every thread of the warp which it comes to; and the same be laid of the warp: in short, the threads of the warp and weft are thus interwoven at every point where they cross each other, and are therefore tacked alternately.

Tweedled cloth is rather different, for only the third, fourth, fifth, sixth, &c. threads cross each other, to form the texture.

Hence two, three, four, or more, of the successive threads or shoots of the weft will be found to pass under or over the same thread of the warp; or, in other words, by tracing any thread of the warp it will be found to pass over two, three, four, or more threads of the weft at once, without any interweaving the warp. Then it crosses and palles between the threads of the weft, and proceeds beneath two, three, four, or more threads, before it makes another passage between the threads of the weft.

Tweedled cloths are of various descriptions, and produce different kinds of patterns; because at all the interweaving points where the threads actually cross or interweave both threads of warp and weft are seen together, and these points are therefore marked on the eye, even if the warp and weft are of the same colour. These points in plain tweeds form parallel lines extending diagonally across the breadth of the cloth, with a different degree of obliquity, according to the number of weft-threads over or under which the warp-threads pass before an intersection takes place. In the coarser kinds every third thread is crossed; in finer fabrics they cross each other at intervals of four, five, six, seven, or eight threads; and in some very fine tweeds the crossing does not take place until the sixteenth interval.

Tweedling is produced by multiplying and varying the number of heddles, or, as the weavers express it, the number of leaves in the harnesses, which is the same given to the whole number of heddles employed in a loom; by the use of a back-harness or double-harness, by increasing the number of threads which pass through each rising point of the reed, and by using a variety of motion of drawing the yarns through the heddles, by increasing the number of treadles, and changing the manner of treadling them.

The number of treadles requisite to raise all the heddles which must be used to produce very extensive patterns, would be more than one man could manage; for if he placed his foot by mistake on a wrong treadle he would disfigure his pattern. In these cases, recourse is had to a mode of mounting or preparing the loom, by the application of cords to the different heddles of the harnesses; and a second person is employed to raise the heddles in the order required, by pulling the strings attached to the respective heddles of the back-harnesses, and each heddle is returned to its first position by means of a leaden weight underneath. This is the most comprehensive apparatus used by weavers for all fanciful patterns of great extent, and it is called the DRAW-LOOM. For the article, see that article.

The manner of mounting the harnesses of looms, to produce all the principal varieties of fabrics, is detailed in our articles DESIGN, DRAUGHT, and CORDING OF LOOMS; also DAMASK, DIAPER, DIMITY, DORNOCK, FUSTIAN, and TAPESTRY. A perusal of those articles will render it unnecessary for us to proceed farther on that subject in the present article. We shall, however, describe a most valuable invention, which has of late years come into use, as a substitute for the second perfon or draw-boy, who must be employed in the draw-loom, by which loom alone all the complicated patterns can be woven.

Machine called the Draw-Boy, because it performs the Office of a Draw-Boy in Weaving.—The saving of labour is not the only advantage of this machine; the certainty of its operation and security from mistake are obvious. The weaver produces the required action upon the most complicated harnesses by two treadles only, in which he works alternately, just with the same motion as in plain cloth-weaving. The machine, when once set up, performs every thing else.

Like most other inventions, this was at first imperfect, but has been gradually improved. We do not know its history, but we have seen great numbers of machines, for carpet-weaving and coarse goods, which have been some years in use. The machine is situated in a small square frame, not larger than a chair, which stands at the side of the loom, and cords from all the different heddles are conducted from the draw-loom down to this frame, where they are arranged in order. Each cord has a knob answering to the handle, which the boy must pull in the common draw-loom; and there is a piece of mechanism actuated by the treadles which at every stroke select the proper cord, and draw it down so as to raise the heddles belonging to it. The next time it changes its position to another cord, and so on until the whole number of cords has been drawn and the pattern completed.

These original machines have a great defect, viz. that they only proceed with regularity to raise up all the heddles, until all the cords have been drawn, and one series of changes
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has been gone through; but when this is completed, and a
repetition of the pattern is wanted, the weaver must flop
and restore the machine to its original position by pulling a
firing. This appears very easy, but it diverts his attention;
and if he does not do it at the exact moment his pattern
may be spoiled. This defect was remedied by Mr. Alexan-
der Duff, who received a small and inadequate premium
from the Society of Arts in 1807, probably because they
were rapid in the value and importance of its value and
but in 1810 we find them with a liberality truly discouraging to
real merit, giving an equal reward to another performer, for the
most trivial alteration of Duff's machine. The latter ma-
chine is alone described in their Transactins; see vol. xxviii.

Mr. Duff's Draw-Boy.—Fig. 4. Plate II. Weaving, is a
plan of this machine, and fig. 2, a perspective view. It is
fixed at the side of a draw-loom, in the same place as a draw-
boy would stand, and H shew the cords which are to draw the
harness. The same letters are used in both figures. A A
is a square wooden axis, mounted so as to turn backwards
and forwards in the frame B B, on points or centres of mo-
tion. At one end of it a pulley D is fixed, to receive a line
a a fastened to it at the highest point, by means of which
the axis receives motion from the two treadles of the loom,
one of the treadles being attached to one end of the line, and
the other to the opposite end of it. C C, D D, E E, are two rails of
wood, fixed across the frame parallel to the axis; and e e,
are two brafs plates screwed to the rails, and pierced with
a great number of holes to receive as many cords. Each
cord is tied by one end to a central rail F of the frame be-
neath the axis; and after passing through one of the holes
in the above plate e, and turning over a round wooden rod
G G, has a lead weight fastened to the other end of it.
These weights are shown at h h. The rods G G are sup-
ported by slings at their ends from the ceiling of the room.
To each of the above cords another is tied just before it
passes over G. These are represented by H H, and hang
loosely. The upper ends of these cords are tied to hori-
zontal cords extended across the ceiling of the room, and
made fast to the ceiling at one end; the other ends pass over
pulleys situated at the top of the loom, in a frame called
the table of wickets, and the harness or heddles are sup-
ported by them.

By this arrangement it will be seen, that when any one of
the cords fastened at F is pulled down, it must draw one of
the slings H, and raise such an arrangement of the har-
nesfs or heddles as is proper to produce the figure which is
to be woven. The weight k draws the cord so as to keep it
straight; all that is therefore necessary is to draw down the
cords at F one at a time, but to take a different one each
time, and thus raise a different series of the heddles each
time; this is the business of the machine, and which it ac-
complishes in the following manner.

The bar, or axis, A A, has an iron semicircle, d d,
grooved like a pulley, and each of its ends divided, so as
to form a cleft-hook or claw.

Each of the slings made fast at F has a large knot tied
in it, just beneath where it passes through the brafs plate e e,
and which knot stops the farther acent of the cord, in con-
sequence of the pull of the weight k. Now when the axis
A turns backwards and forwards by the treadles of the loom,
as before mentioned, the hook of the semicircle d seizes the
knot of one of the cords F, and draws down that
cord, and raises the heddles belonging to it. The weaver
throws the shuttle, and then returns the treadles, and the
axis A with the semicircle returns back again, and allows
the cord F to take its original positio. When the semi-
circle d inclines over to the other side, its opposite hook
takes hold of the cord F, which is next to the one op-
oposite to that which it just quitted; it draws down this
cord, and the weaver again throws his shuttle, then re-
turns the semicircle to the opposite side, and it will tak-
e the cord next to the opposite one, and so on; so that the
semicircle will in succession take every alternate cord in each
of the rows e e, and leave every other.

This is effected by the semicircle sliding along its axis A
every time, by means of two wooden racks, h h, and i i,
in the plan, which are let into grooves in the axis A A; these
racks have teeth like faws, but inclined in contrary direc-
tions. The racks move backwards and forwards in their
grooves, the extent of a tooth at each vibration of the axis,
by the action of two circular inclined planes of iron fastened
to the frame at L M, against which the ends of the racks
are thrown by spiral springs concealed beneath each rack.
The semicircle is fixed on a box or carriage N, which slides
upon the axis A A, and has two clicks upon it; one at i i,
which falls into the teeth of the rack h h; the other at m m
for the rack i i: n n is a roller fixed over the box, and connected
with the two clicks i i and m m, by threads wound in opposite
directions; so that one click is always raised up, and disengaged
from its rack, while the other is in action. O O is a piece of wire
fixed to the frame, so as to intercept a small wire projecting
from the roller when the axis is inclined, and turn the roller
a small quantity; P P is another wire for the same purpose,
but fixed to a crofs bar, Q Q, which is moveable, and can be
fastened at any required place, farther or nearer from the
end of the axis. Suppose the roller n n to be in such a posi-
ton that the click m m is down, and / drawn up, the action
will be as follows: the semicircle first inclines to the direction
of fig. 2, its hook taking down one firing, during this mo-
tion the end of the rack i i comes to the inclined part of the
circular inclined plane M M, and moves by its spring towards
D D, the space of one tooth, which the click m m falls onto.
On the return of the axis, the rack i i is thrust back, and the box
N N and semicircle with it towards L L, causing the hook to take
the next opposite firing: in this manner it proceeds, ad-
vanving a tooth each vibration, till it gets to the end of its course;
the tail of the roller n n then strikes against the pin P P, and turns
the roller over, raises the click m m, and lets down the others, i i,
to the teeth of the rack h h; this was all the time moving-in
a contrary direction to i i, by its inclined plane L L, but had
no action, as its click / was drawn up; this being let down,
the semicircle is moved back, a tooth at a time, towards M M,
until it meets O O, which upsets the roller n n, and sends the
semicircle back again.

Tasselled Silks.—In weaving very fine silk twills, such as
those of sixteen leaves, the number of threads required to
be drawn through each interval of the reed is so great, that
if they were woven with a single reed, the threads would
obstruct each other in rifing and Pinking, and the shed, or
opening of the divided warp, would not be sufficiently open
to allow the shuttle a free passage. To avoid this inconve-
ience, other reeds are placed behind that which strikes up
the weft; and the warp-threads are so disposed, that those
which pass through the same interval in the first reed are di-
vided in passing through the second, and again in passing
through the third. By these means the obstruction, if not
entirely removed, is greatly lessened.

In the weaving of plain thick woollen cloths, to prevent
obstructions of this kind arising from the clovenesfs and rough-
ness of the threads, only one-fourth of the warp is funk and
railed by one tready, and a second is pressed down to com-
plete the shed between the times when every shot of weft is
thrown across.

Double Cloth is composed of two webs, each of which
confi-
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confined of separate warps and separate wefts, but the two are interwoven at intervals. The junction of the two webs is formed by passing each of them occasionally through the other, so that any particular part of both warps will be found sometimes above and sometimes below.

This species of weaving is almost exclusively confined to the manufacture of carpets in this country. The material employed is dyed woollen, and as almost all carpets are decorated with fanciful ornaments, the colours of the two webs are different, and they are made to pass through each other at such intervals as will form the patterns required. Hence it happens that the patterns at each side of the carpet are the same, but the colours are reversed. Carpets are usually woven in the draw-loom, or with the machine called the draw-boy before described.

Marfile is a fabric woven of cotton, which is a double cloth. The loom for weaving Marfile is somewhat similar to the diaper loom. A good idea of the manner in which it is worked may be had, by conceiving two webs woven one under the other in the same loom, which are made to intermingle at all the depressed lines, and form the reticulations on the surface, in imitation of the quilting performed by hand.

When the species of Marfile, called Marfilels quilting, is made, a third warp, of softer materials than the two others described, lies between them, and merely serves as a fort of fluffing to the hollow squares formed by them.

Quilting is another fort of cotton stuff, solely appropriated to quilts, which should, in friezenet, be set down exclusively to the cotton manufacture, although there is nothing to prevent its being made of other materials.

The web of those quilts is of very coarse and thick yarn, which is drawn out by a small hook into little loops, as it is woven, that are so arranged as altogether to form a regular pattern; every third or fourth loop of the shuttle, the weaver has to flop to form those loops from a draft, which causes the weaving of those quilts to take up more time than that of any other stuff, except tapestry; which accounts for the great expense of the prices at which they are sold, in proportion to the value of the materials of which they are principally composed.

Gauze differs in its formation from other cloths, by having the threads of the warp crossed over each other, instead of lying parallel. They are turned to the right and left alternately, and each shot of weft preserves the twine which it has received.

This effect is caused by a singular mode of producing the frills, which cannot easily be described without the aid of drawings.

Crofe, or Net Weaving, is a separate branch of the art, and requires a loom particularly constructed for the purpose.

Spots, broacades, and lappets, are produced by a combination of the arts of plain, tweed, and gauze weaving, and as in every other branch of the art are produced in all their varieties by different ways of forming the division of the warp by the application of numerous heddles, and their connections with the treadles which move them. Indeed the great skill of the art consists in the proper management of this part of the apparatus of a loom.

Ribband Weaving.—This was formerly performed by a small common loom, weaving one ribband at a time. Ribbands are commonly striped in the length by laying a striped warp, and patterns are produced by changing the colour of the weft occasionally; sometimes an ornamented edging is formed by a succession of open loops at the borders of the ribband. Figured ribbands are also woven by a great number of treadles, but as they rarely extend to a greater number than the weaver can manage by his feet, they seldom employ a draw-loom.

Engine Loom for weaving Ribbands.—The weavers at Coventry, which is the principal seat of the ribband trade, universally employ what they call an engine-loom: it is worked by the hands and feet like a common loom, but weaves twelve, sixteen, or even twenty ribbands at once. The shuttles are of course fly-shuttles, and are driven by what is called a ladder, because it is a small frame exactly like a ladder, which slides horizontally in a groove in the lay; and every cross-bar of the ladder acts upon one shuttle in the manner of a pecker: the ladder has a handle to give it motion.

Another peculiarity of this loom is, that the ribbands are taken away as they are woven, with very few interruptions to wind up the work: for this purpose they conduct the warps over pulleys, and the ribbands also, so that both hang down in long loops. Thee looped parts are conducted through pulleys, which are loaded with weights, and tend always to draw the loops down, and keep the warp tight. The weight which is thus suspended by the finished ribband tends to draw it forwards at every stroke which the lay makes; and the weight which is suspended by the yarn of the warp is drawn up. When thee weights have run through their respective courses, the weaver turns flop to wind up the finished ribband, and unwind a fresh length of yarn. In some looms this is rendered unnecessary by a simple mechanism, which continually winds up the ribband as fast as it is woven.

In 1801 the Society of Arts rewarded Mr. Thomas Clulow, for an improved loom for weaving figured ribbands.

This loom differs from the common figured ribband-looms in the method of forming the figure, which, in the old mode, was tedious, from the work being flopped, whilst the figure was drawn by hand.

In the present loom, the tire-cords which form the figure are drawn or worked by a cord or leather-strap fixed to the centre-treadle, which strap passes over two vertical and one horizontal pulley to the back of the loom, and has a weight hung to the end thereof. Upon this strap above the weight is fixed an iron, of a bevel or sloping form, which when the strap is pulled up by preening with the foot upon the treadle, raises a wire-lever placed across the main-wheel of the movements placed vertically, and allows this main-wheel to move one-fourth of its circumference, where it is stopped by an iron pin, placed on its rim, and prevented from returning by a clutch or catch on the edge of the wheel on its right side.

Within the rim of the main-wheel is a small catch-strap connected with the strap above-mentioned; this catch-strap pulls forward the main-wheel one-fourth of its circumference, until it is stopped by the wire-lever and one of the pins on the rim, of which there are four in number in the ground.

There are also four iron pins projecting from the left side of the main-wheel in opposite quarters of it; these act on a hanging lever, to the lower part of which a string is attached, which passes behind the box containing the whole machinery, and raises four clicks or catches on four rollers, which permits any one of the four rollers to run back as the figure may require, each roller by such motion drawing up the number of threads necessary to form the figure, by cords extending from these rollers over pulleys to the pafs-cords, which draw the figure.

Machine Loom for Ribbands.—We have before mentioned M. Vaucancon’s loom for weaving ten ribbands by a rotary motion. We do not know that this is in use in this country.
Mr. James Birch invented an improvement on the swivel-loom, so as to weave satin-guard or figured laces, and received a reward from the Society of Arts in 1804.

This loom is worked by a circular motion of the hands, without treadles, or any application of the feet.

A wooden bar, to which the hands are applied, works two cranks on a large iron axle, extending the width of the loom; one crank is near each end of the above axis. A fly-wheel is attached to one of the ends of the axis, to regulate the motion of the machinery; an endless screw is placed upon the axis, works a star-wheel underneath it, which turns a barrel that has a resemblance to that of a hand-organ, and has wooden pegs fixed in different parts around it: these pegs catch upon levers, which draw forward the cords that form the figure, and pull them down by a claw, which secures the cords thus brought within its power, and by these means raises the upper g eer connected with the cords.

In this loom fourteen pieces of satin-guard or bed-lace are wove at the same time, either one pattern and breadth, or all of different patterns and breadths, as may be required. The figure may be extended to any number of floats desired.

The loom takes up no more space than a common swivel-loom, such as is employed in plain-work. It appears to work with ease and expedition, to make good work, and to be easily managed. It does not break or chafe the silk during its working. The weaver can move to any part of the front of the loom to inspect the work, and to continue the motion during that time; and the figure or pattern may be formed double the length of those usually done in the engine-loom. The loom can be stopped when required, at any one float of the shuttle; and it will answer to weave articles made of silk, wool, cotton, or linen, or mixtures of these articles, or gold or silver lace, and performs its work in half the time of an engine-loom.

The want of uniformity in the technical phraseology of the art of weaving, and the intricacy of the subject, have compelled us to render our descriptions far more intricate and difficult than they otherwise would have been.

We must acknowledge the assistance which we have derived from the very excellent "Essays on the Art of Weaving" by Mr. Duncan, 1808, in 2 vols. 8vo. It is a most curious and valuable publication, embracing almost every thing necessary to be known concerning the art on which it professes to treat; if we except some of the recent improvements in machine-weaving, which are only slightly noticed.

The French have long excelled in the various branches of figure-weaving; but this is more from dexterity of their weavers, than from their machinery. Descriptions and drawings of all looms used by them, with every detail of their structure, will be found in the different articles of L'Encyclopedie Methodique, and Les Arts et Metiers, D'Art de Fabriquer le Soie, &c.
WEAVING.

Mr. Austin's Engine Loom.

PLATE I.