the under side of the shuttle are two small wheels, travers­ing very freely on their axes, on which the shuttle travels to and fro along the shuttle-race.

This description will be perfectly intelligible to the reader by an examination of the annexed cuts, which we need not encumber by re­ference marks, as they appear to us to be rendered un­necessary by the manner in which our description is di­vided. Figure 1 represents the loom, with the warp ex­tended ; fig. 2 is the batten, with the reed, the picker, and the shuttle-race ; and fig. 3 is the shuttle.

Preliminary to the operation of weaving, there is much to be done in the way of preparation, which it is necessary that we should describe.

The yam, as it comes from the spinner, whether intended for the warp or the weft, is usually in hanks of a known length. The yarn destined for the warp is wound off upon little spools of wood called bobbins. For this purpose the hank is pla­ced upon a reel, from which it is wound upon the bobbin by a child.

The next process is that of warping, which is simply stretching the number of threads necessary to form the warp equally, and laying them parallel to each other. This is usually done by means of a warping mill, as it is usually called, which consists of two parts, name­ly, a vertical frame or rack in which the bobbins arc placed, and the reel on to which the warp is wound. The vertical frame is constructed so as to allow about fifty bobbins to be so fixed as to revolve easily, and as to keep the yarn as it leaves the bobbin at equal distances. The several yarns are then brought to a focus, as it were, and made to pass through what is called a heck-box, whcnce it is wound round a large reel, so constructed in point of size as to gauge or measure off the warp. The reel is six feet in diameter and seven or eight in height, and is made to revolve by an endless rope passing round two wheels, one of which is turned by the warper. In order that the warp may be wound spirally on the reel, the heck-box, containing the rollers which guide the yarns, is made to rise and fall by a simple contrivance. It is made to slide up and down one of the upright support­ers of the reel by being suspended from a cord, which, passing over a wheel or pulley, winds round the axle of the reel, or is unwound, according to the way in which the reel is turned. One sixth part of the warp is usually wound off the bobbins at once. When the first portion of yam is wound off, the clue or end of the yarns is crossed over pins projecting from the frame of the reel, and the reel is turned the reverse way, so that the yarn from the next set of bob­bins descends by the descending motion of the heck-box, containing the guide-rollers. This process is repeated backwards and forwards until the whole warp is completed, when it is taken from the reel, and wound upon a stick in­to a bundle or large ball, the different doublings of the suc­cessive portions of the warp, as above described, forming separate crossings, in appearance not unlike a ball of lamp cotton on a gigantic scale. The equal portions of the warp aid the weaver in counting the yarns thereof.

Besides this division, the warp-mill makes another, which separates the yarns alternately, so as to facilitate their alter­nate arrangement in the geer or heddles. In the heck- box, as we have already explained, are the guide-pins, which conduct the yarns from the vertical frame to the reel. The operation of these pins it is almost impossible to understand

distinctly without examination. The pins are inserted in two separate pieces of wood alternately. One piece of wood is raised by a handle for the purpose, which raises the alternate yarns. This occasions a space or division between the two sets of yarns, in which a wooden peg is placed. The other set of yarns is then raised by similar means, and the result is that the alternate yarns are crossed over the ends of the intermediate yarns. This is called the lease, and is carefully tied up so as to guide the weaver when he beams the warp.

In the state in which the warp is wound off the reel, as just described, it is delivered to the weaver ; but before he winds it on to the warping beam, it must be sized. This consists in treating the warp with some glutinous solution, size or starch, for instance ; the object being to render the yarns or threads of the warp smooth and even for wefting. This is done sometimes by the hand and sometimes by a machine. Generally it is dipped into the warm size, and squeezed by the hands and dipped again, until it is thoroughly soaked through. The machines in use merely imitate this process, the yarn being dipped and passed through rollers twice or thrice, by which the size or starch is introduced into the interstices of the yarn. It is then dried, in the case of woollen yarn, by being spread out in a field, and in other cases in a drying-house for the purpose. When thus sized, the yarn is ready for the loom.

The perfect equality of tension to which the warp is sub­jected in the loom, is of the greatest importance to the per­fection of the cloth. If some of the yarns be looser than the rest, the cloth will be of unequal strength, and uneven to the eye, and its value will be less in proportion. The first operation towards extending the warp is framing or winding it on to the warp-beam : equality of tension much depends on skilful beaming. In order that the warp may be laid evenly on the beam, an instrument is used similar to the reel already described, except that it is not so fine. It is called a ravel or separator, and is composed of strips of cane fastened into a rail of wood, and secured at the upper part or extremities of the teeth by another piece of wood called the cape. This cape is moveable, and before it is put on, the yarns of the warp are passed between the teeth of the ravel, and the cape is put down to secure the yarns in their places. This being done, the warp is gradually and carefully wound upon the beam in the order in which it is destined to be wound off in the process of weaving.

In very broad goods, whether of cotton, linen, or woollen, the co-operation of several hands is necessary to the effect­ing of this process. Two persons must hold the ravel, one at least must watch the proper tension of the threads, and a fourth gradually turns the beam. In this the weavers aid each other.

The French weavers have an additional process, which certainly produces better beaming, and perhaps even saves time. Before passing the yarns through the ravel, the warp is wound from the bale on to a small reel : from this reel the yarns are drawn through the teeth of the ravel by the mere winding of the beam, equality of tension being preserved by a weight attached to the reel.

The warp being now upon the beam, every yarn has to be passed through a loop or eye of the heddles : this is called drawing. Two rods of wood are first inserted into what is called the lease, that is, the two crossings formed by the guide-pins of the warping mill, as already described. These rods are tied firmly together at the ends, the original ties are cast off, and the warp is spread out to its proper breadth. The effect of these lease-rods is to keep the alternate yarns which pass through one heddle from the intermediate yarns which pass through the other.

The warp-beam is suspended behind the heddles, and the passing of the yarns through the loops is done by two per­sons, the weaver and his assistant. The former, being in