SPINNING is the art of combining animal and vegetable fibres into continuous threads fit for the processes of weaving, sewing, or rope-making. The most primitive spinning apparatus is the spindle and distaff, representations of which are to be seen on the earliest Egyptian monuments. The distaff was a stick or staff upon which a bundle of the prepared material was loosely bound, and which was held in the left hand or stuck in the belt; the spindle was a smaller tapering piece to which the thread was attached. By a dexterous twirl of the hand the spindle was made to spin round and at the same time recede from the spinster, who drew out between the forefinger and thumb of the right hand a regular stream of fibres so long as the twisting of the spindle lasted. It was then drawn in, the new length of thread wound upon it, and the operation was renewed. An obvious improvement on this was to set

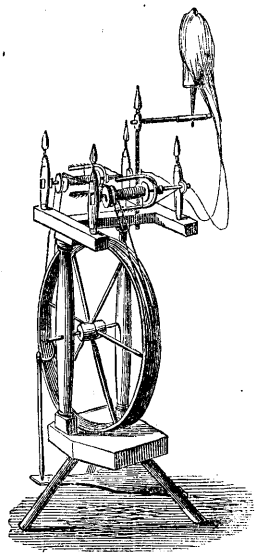

Fig. 1.—Two-handed Spinning-wheel.

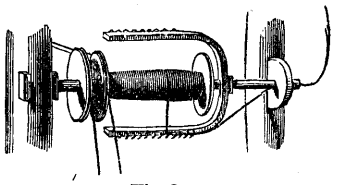

Fig. 2.
Spindle, Bobbin, and Winding-arm on a larger scale.

the spindle in a frame and make it revolve by a band passing over a wheel driven either by occasional impetus from the hand or by a treadle; this constituted the *spinning-wheel*, which is said to have been invented in Nuremberg as recently as 1530. In the spinning-wheel in its most improved form, and as used for flax, a bobbin or 'pirn,' with a separate motion, was placed on the spindle, which had a bent arm—a flyer or flight—for winding the yarn on the bobbin. The spindle and bobbin revolved at different rates, the revolutions of the spindle giving the twist, and the difference of the rate causing the winding on. The two-handed wheel had two spindles and pirns a little apart, with the distaff or 'rock' stuck into the frame between them, and the spinster produced a thread with each hand. The spinning of flax on such wheels for the manufacturer was an important branch of domestic industry in the northern counties of Scotland as late as 1830, if not later.

Neither the spinning-wheel nor the hand could spin more than one, or at most two threads at a time, and therefore, with the rapid increase of population, and the improvements made in the process of Weaving (q. v.), they became quite inadequate to supply the demand for yarn: but an accident, it is said, about the year 1764, led to an invention by which eight threads could be spun at once; and this was soon improved upon until eighty could be produced as easily. This was the invention of the *spinning-jenny* for cotton-spinning, by James Hargreaves, at Standhill, near Blackburn in Lancashire. In this machine, a number of large reels of cotton formed into a thickish coil, called a *roving*, were set on upright fixed spindles, and the ends of the rovings were passed between two small movable bars of wood placed horizontally and under the control of the spinner, who could thus make them press more or less on the roving, and consequently increase or decrease the draw upon it from the spinning spindles, which were set in a row at the other end of the frame, and all capable of being set in motion simultaneously by the wheel. The success of the spinning-jenny (fig. 3) was considerable, but its history has been too often told to be required here; and even previous to its invention, a better idea had been started and acted upon by others, and was afterwards brought to such perfection, that the invention of Hargreaves soon passed into obscurity.

In order to understand the operations of spinning as now practised, and as improved by the invention alluded to, it is desirable, in this place, to say a few words upon the preparation of the fibres for the process of spinning. In the first place, if wool or cotton, it has to be 'opened;' that is, it must be relieved from its original knotted and lumpy condition; this was formerly done by hand, but is now easily managed by machines called 'willows or willeys,' 'blowers' and 'openers.' By the first of these, which consists of a drum covered with small spikes moving in a hollow cylinder, also lined with spikes, but so arranged that those on the drum pass close to, but do not come into collision with them as it revolves, the cotton or wool is fed in on one side, is dragged forward by catching on the spikes, and is delivered at an opposite opening to that by which it entered, in a loose state and free from knots. It is not, however, quite loose enough for the subsequent operations, and it is more or less mingled with impurities. It is therefore taken to the 'blower' or 'opener,' and being put into a shaft, is there acted upon by a stream of air violently

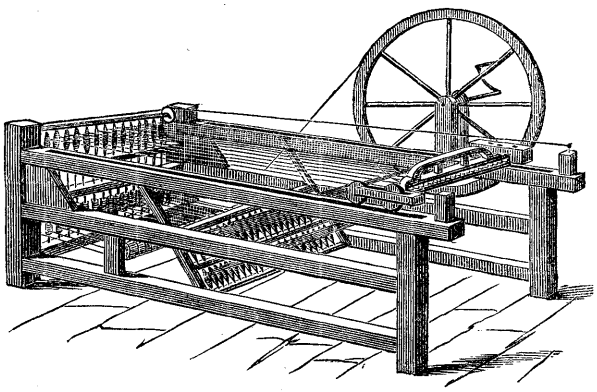

Fig. 3.

driven in by machinery, which blows it forward, removes extraneous matters, and so separates the fibres that they pass out at the other end in an

exceedingly light flocculent state, and ready for being formed into *laps*. This operation consists in laying the material very equally on an endless apron made of small bars of wood, and of the width of the frame of the machine in which they are placed. This apron (*a*, fig. 4) passes round two rollers, placed at

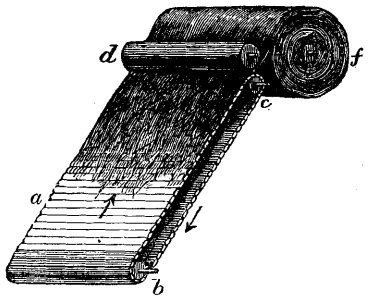


Fig. 4.

a little distance apart, as in fig. 4, *b*, *c*, the rollers being moved by machinery. The arrows indicate the direction in which the apron moves; and as the operator covers its entire surface with a thin layer of the fibre, it passes under the roller *d*, and is taken on to the roller *e*, in the form of a compressed layer of cotton or wool, called a *lap*. When the roller *e* is full, it is removed, with its lap *f*, to make way for another. Much care is taken in weighing out and distributing the material of these laps, because upon this first operation the ultimate size of the yarn depends.

The laps are taken to the *carding-machine*, consisting of a series of cylinders revolving in a frame, and placed so close together that they almost touch each other. Each cylinder is covered with a coating of fine steel wire points, which are stuck in leather, or some other flexible material, and are technically called *cards*. The production of these cards by machinery is in itself a marvel, and the automatic machines for making them are wonderfully effective. Each piece of wire is bent as in fig. 5, and is put through two holes in the leather, as in fig. 6; *a* shews a bent wire going in, and *b*, *b*, wires completely in the holes in leather,

Fig. 5.

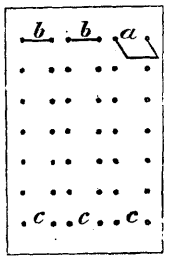


Fig. 6.

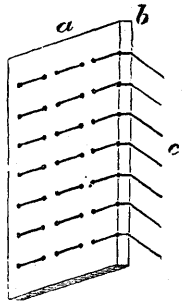


Fig. 7.

*c*, *c*, *c*, so as to form two points on the other side, and these are slightly bent all in one direction, as in fig. 7, where the piece of card *a* is seen cut through at *b*, to shew the direction given to the wires *c*. There are many variations upon this arrangement of the wires, but the general principle is the same in all. The machine for making the cards cuts the wire to the right lengths, bends them, pierces the holes in the leather, inserts the wires, and finishes by giving them the slight sloping direction which is essential.

The lap is made of the same width as the cylinders of the carding-machine, and is so adjusted that, as it unwinds from its roller, it passes in between a pair of the carding cylinders, the steel wire teeth of which seize hold of the individual fibres, and drag them in one direction until they are caught by other cylinders, and so carried from one to another, always being pulled in a straight direction until they are laid as nearly as possible side by side, and are given off in a thin cobweb-like film at the last cylinder, where it is prevented from continuing its journey round the cylinders by a small bar of metal called the *doffer*, which, with a gentle and peculiar motion, removes it from the cylinder. The film of fibre is of the same width as the cylinder of the carding-machine, but it is gathered together by the operator, who passes it through a smooth metal ring, and between two small polished rollers, the revolutions of which carry it forward, and deposit it in a deep tin can in the form of a loose untwisted column of cotton or wool, about an inch in thickness, which is called a *sliver*. A small portion of this arrangement is shewn in fig. 8, which represents a carding-machine

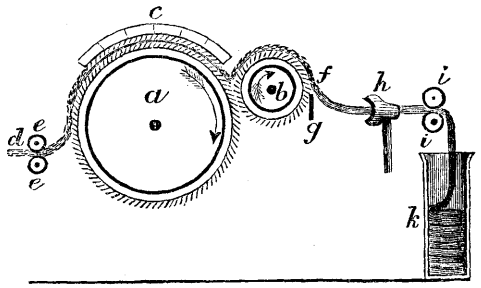


Fig. 8.

with only two carded cylinders, *a* and *b*; they are, however, much more numerous. There is also a concave piece of carding, *c*, which was formerly much used, but has lately given way to additional cylinders, but it makes the action more apparent in a drawing; *d* is the lap drawn on by the action of the two small rollers *e*, *e*, which slightly press it as they revolve. It is quickly distributed all over the surface of the large cylinder *a* by means of its numerous wire-teeth; and as it passes the roller *b*, the teeth of which move in an opposite direction, as indicated by the arrows, the fibres are caught off the large, and are carried round the small cylinder until they reach *f*, where they are stripped off by the doffer *g*, and are passed through the ring *h*, and the rollers *i*, *i*, into the tin receiver *k*. The sliver is now in the first stage of spinning; it has next to be drawn out very gradually until it is not thicker than a quill; and in drawing it out, the operator gives it a very slight twist, still leaving it so loose in structure that it will break with a slight touch; in this state it is called a *roving;* and it was at this stage that the spinning-jenny began to operate upon it. The rovings, which were wound as they were drawn upon large reels, were unwound by the machine, and were still further drawn out and firmly twisted and wound on to spindles or cops, the drawing being regulated by the pressure of the wooden bars of the jenny, which was within reach of the operator's hand.

The *throstle-machine*, patented by Arkwright in

1769, had for its object the drawing of the rovings through a succession of pairs of rollers, each pair in advance of the others, and moving at different rates of speed. The first pair receive the sliver, compress it, and pass it on to the second pair, which revolve at a greater speed, and thus pull it out to exactly the number of times greater length that their revolutions exceed those of the other pair—in number it is usually eight times—and as the first roving is passed through a second, third, and sometimes fourth machine, the finished roving is 32 times longer than the sliver. As the roving issues through the last rollers of each machine, it is received on *spools* or *reels*, calculated to hold a given quantity; and these are transferred to the *spinning-frames*, which resemble the *roving-frames*. Here the roving takes the place of the sliver; and as it unwinds from the spool, is drawn through successive pairs of rollers, moving as before at different rates, each succeeding pair faster than the backward ones, so that the roving gets thinner and thinner, until the tenuity is carried as far as desirable. It is then carried on to a spindle which revolves with great rapidity; and by means of a simple arrangement, is made both to twist the thread and wind it on the spindle ready for the weaver.

This system produces too great a strain upon the thread in its progress to admit of its being drawn so fine as is wanted for many purposes, and this led to the invention of the *mule-jenny* by Crompton (q. v.) in 1779, which has a travelling frame upon which the spindles are set. This frame is now made long enough to carry hundreds of spindles, and it gently draws out and twists the thread after it leaves the last pair of rollers; and when it has reached its limits—now several yards, but in Crompton's time only five feet—it rapidly returns, winding up the spun thread on the spindles as it goes back. These machines are now applied, with various necessary modifications, to cotton, wool, flax, silk, and other textile materials, and the effect they have exerted upon our manufactures is more wonderful than anything in the whole history of commerce. Previous to the invention of the mule, few spinners could make yarn of 200 hanks to the pound (the hank being always 840 yards). At the same time, the natives of India were weaving yarn of numbers ranging between 300 and 400. Now, however, our manufacturers have reached such extraordinary perfection, that Messrs Houldsworth of Manchester have succeeded in making No. 700, which was woven by the French firm Messrs Thivel and Michon of Tavare, and others far too fine to weave, the greatest tenuity reached being 10,000, a pound of which would reach 4770 miles. This was made to test the perfection of the machinery, but was of no practical value.

The most modern improvements in spinning are in the machines of Messrs Platt & Co. of Oldham, which combine all the operations of carding, roving, and spinning in one machine. These and similar machines are now coming into almost universal use for cotton and wool.