CHAPTER THREE

An Outline of the Process

ALTHOUGH jute had been used for many years in India for making cloth, the fibre was not known in Europe until the last years of the eighteenth century. Small quantities of jute were brought to England by the East India Company in 1796 and were sent to Abingdon in Berkshire, then an important centre of the twine trade. There it was spun by hand and used in a small way in the local manufactures. At this time Scotland, and in particular Forfarshire, had extensive trade in flax fabrics, and in 1823 a bale or two of jute was bought by a Dundee merchant. However, the local spinners were not impressed and it was largely due to the foresight and tenacity of one or two merchants that small parcels were occasionally brought to the town and finally in 1832 or 1833 a spinner succeeded in making an acceptable yarn. For the first year or two little pure jute yarn was spun, mixing with flax being considered essential but after it was discovered that the fibre could be spun more easily if water and oil were added, then yarns made wholly from jute became more and more popular. Dundee, being a whaling port, had plentiful supplies of whale oil and this was the oil used in jute spinning. The trade progressed rapidly and by the middle of the century 20,000–30,000 tons a year were being used in Britain, chiefly in Dundee and district, and by 1900, 277,000 tons were being used. The first Indian mill was set up in 1855, to be followed by a rapid growth of other mills in the Calcutta region. By 1885, 7,000 looms were working.

THE SPINNING PROCESS

In general terms the types of jute yarns manufactured can be classified according to the use to which they will be put.

(1) Fine Yarns: low count yarns for making fine fabrics for tailor's inter-linings and the like. The volume of trade in these is comparatively small since they are expensive and the top grades of jute must be used to enable such yarns to be spun.

(2) Hessian qualities: medium weight yarns for weaving cloths for general packing purposes, linoleum backings, carpet backings, etc.
(3) Carpet Yarns: usually medium/heavy weight yarns of good quality either single or two-ply for the carpet industry.
(4) Sacking Yarns: medium/heavy yarns of lower grade used for the manufacture of sacks and bags.

Types (1), (2), and (4) can be divided into warp and weft qualities, the warp being superior to the weft as it must withstand the tensions of weaving while the weft acts more as a filler and undergoes little strain.

The spinning process depends upon which class of goods is being made but there are features common to all systems, viz., all jute must be softened and lubricated with oil and water so that the fibre may be processed without excessive fibre breakage and waste; the meshy nature of the reeds must be split up and the fibres separated as far as possible; the fibres must be drawn evenly into a sliver or loose untwisted strand which is then drawn out to the desired thickness of yarn; the fibres must be twisted together to give cohesion and strength to the yarn.

FINE, HESSIAN, AND CARPET YARNS

These classes of yarn are made from long jute, i.e. jute from which the root ends have been cut. The first requirement is that several different types of jute be blended together so that long runs of uniform quality can be achieved and the desirable properties of the various types of jute can be utilized and the cost of the raw material kept to a reasonable level. If the jute comes from a pucca bale it is hard and stiff after being subjected to the high pressure of the baling press and must be made more pliable before any further processing can be carried out. This is done by passing the jute through a machine called the bale-opener which has two or more heavy fluted rollers between which the jute is fed. In its passage through this machine the jute is flexed back and forth and emerges quite pliable at the other side. At this stage, however, the fibres are still rather harsh and brittle and must be softened and lubricated before they can be further processed. This is done at a machine called the spreader which consists basically of two endless chains carrying heavy pins, one chain running faster than the other. The jute is fed on to the pins of the slow chain and traverses the machine until it is gripped by the pins of the fast chain

which tease and comb out the reeds. At the other end of the fast chain an emulsion of water and oil is applied, then the jute is wound up into a roll under heavy pressure. Usually the oil is a mineral oil of the light spindle variety but some of the fine yarns are still lubricated with whale oil. After this the jute is laid aside for one to two days to allow the water and oil to spread more evenly throughout the rolls of sliver.

The material at this stage is still visible in the form of reeds and the next step is to open up the reeds and separate the fibres. This is one of the functions of carding. Two cards are employed, the breaker and the finisher, each consisting of a large central cylinder covered with small sharp pins with a series of smaller pin-covered rollers set around its periphery. As the jute is fed into the machine it meets the rapidly moving cylinder pins and is combed and teased out. As it passes further round the machine it comes into contact with the pins on the smaller rollers which continue the combing, splitting, and opening action and by the time the jute has been put through both cards it is in a finely divided state showing no signs of the original fibre complexities at all. Two additional functions of the cards must be mentioned here, drafting and doubling. If jute is fed on to a pair of rollers which have a surface speed of 5 yd/min and then moved forward to meet another pair of rollers which have a linear speed of 40 yd/min then the jute will be drawn out, or drafted, and the fibres will slip past one another. The amount by which they will slip past each other, the draft, depends upon the relative surface speeds of the two rollers and in the example quoted the draft would be 8 ($40 \div 5$) and each yard of sliver going in would be drawn out to 8 times its original length. Since there has been no change in the total weight of jute it follows that if the sliver is 8 times longer than it was at the beginning then it must be 8 times thinner. These are the two important features of drafting which will be referred to again and again at all stages since they are vital to the spinning process.

The other function of the cards is to provide doublings. In all textile yarns it is desirable that the weight of the yarn should be the same, or nearly so, at all points; if some parts are very thick and others very thin then the yarn will be of low value. If one examines the sliver issuing from the spreader it will be readily seen that this desirable regularity is conspicuous by its absence, but if one places several such slivers side by side it is immediately apparent that some of the thick places coincide, purely by chance, with some of the thin ones and the resultant product is more uniform in weight along its length.

This is known as doubling and usually at each stage in the process several slivers are fed into each machine at the same time so that the thicks and thins in them will be evened out. Commonly 6 to 8 slivers are fed to the breaker card and 10 breaker card slivers to the finisher card.

After carding, the yarn is given two, three, or four passages through drawing frames. These are machines which continue the drafting and doubling begun at the cards so that by the time the material emerges from the last drawing frame it weighs about 1 lb per 100 yd. For the fine yarns four drawing passages are usual so that the slivers are drafted in easy stages and a large number of doublings can be obtained, for not only do these yarns demand the best grades of jute but the material presented to the spinning frames must be as even as possible. The last drawing passage in this case is done on a machine called the roving frame. As the sliver is now in such a tenuous state some slight degree of twist must be put into it so that it will hold together; this twist is inserted at the roving frame by inverted U-shaped flyers which rotate at about 800 r.p.m., twisting the thin sliver into a rove as they do so. The rove is wound on to a bobbin on the roving frame and is ready for the final stage of spinning.

Hessian yarns are given two or three drawing passages, the latter number being commoner. Just as the sliver at the roving frame is thin, tenuous, and weak, and must be twisted, so the sliver emerging from the final drawing frame must be strengthened to allow it to be handled. This is done by crimping the sliver, i.e. forcing small waves or crimp into the fibres to increase their grip on one another and give stability to the sliver.

At the spinning frame the material is given its final drafting down to the required weight of yarn and the fibres are twisted together to form the yarn, which is then wound up on bobbins. Twisting is done by flyers rotating at speeds of 3,500–4,000 r.p.m.

SACKING YARNS

Sacking qualities are made from poorer quality jute, the weft being composed of cuttings, mill wastes, and low-grade long jute. Because of the short nature of the raw material the spreader cannot be used, so the fibre is fed into a machine known as the softener which comprises about 70 pairs of fluted rollers. As the jute passes between these rollers it is flexed and, as the name of the machine implies, softened.

As the jute comes along the rollers the emulsion of oil and water is applied. At the exit from the softener the hard root ends of the long jute are cut off, the roots being used for weft and the remainder of the reeds for warp. The warp material is laid aside to mature for 24 hr and then is fed to a breaker card and a finisher card. The root ends, plus additional supplies of cuttings from the hessian grades, bale ropes, and other low-grade materials are softened and then matured for up to 10 days—a longer period being required because of the barky, dirty nature of the jute. The sacking weft material is given a preliminary carding in a teaser card. This machine is similar to a breaker card but with stronger, more rugged pins to cope with the hard material. The jute issues from the teaser as a fleecy tow which is then fed to the sacking weft breaker card, along with mill waste and rejections from higher grades. A finisher card follows the breaker in the usual way. Sacking warp and weft is given only two drawing passages and then is spun into yarn on large flyer spinning frames.

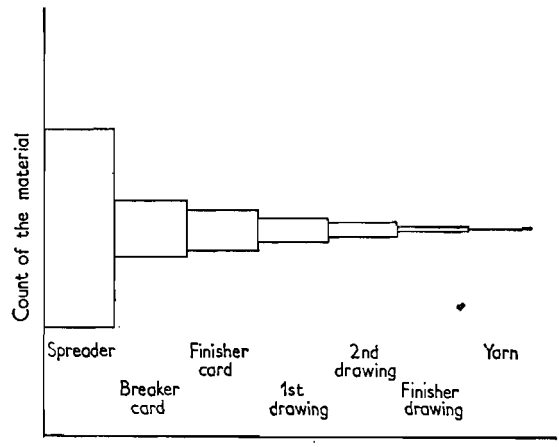

Figure 3.1. Relative counts in the jute process

Figure 3.1 shows the relative sizes of the slivers at the various stages in a hessian mill, giving some indication of the amount of drafting which must be done in reducing spreader sliver with some 137,000 fibres in its cross-section to a yarn with only about 140 fibres in its section.

COUNT SYSTEMS

The traditional units for describing the weight per unit length, or 'count', of jute slivers, roves, and yarns are as follows.

Sliver: pounds per 100 yd

Rove and yarn: pounds per spyndle

(1 spyndle (sp) = 14,400 yd)

In this volume the tex system will also be used. The count in tex being the weight in grams of 1 kilometer of material. Since jute slivers may be as heavy as 320,000 tex, the term kilotex will be used where appropriate (1 ktex = 1,000 tex). The factors for conversion from one system to the other are

$$\text{ktex} = 5 \times \text{lb/100 yd}$$
$$\text{tex} = 34{\cdot}5 \times \text{lb/sp}$$

The range of yarns spun from jute is indicated in Table 3.1, and Figure 3.2 gives a summary of the different manufacturing systems.

Fine Yarns	Medium Yarns	Sacking Warp	Sacking Weft
Bale selection, top quality essential	Bale selection, medium grade	Bale selection, lower grades	Root cuttings, bale ropes, tangled fibre
Bale opening	Bale opening		
Spreader—water and oil applied	Spreader—water and oil applied	Softener—water and oil applied	Softener—water and oil applied
Stand at least 48 hr.	Stand 24–48 hr.	Stand 24 hr.	Stand up to 10 days
			Mix with mill waste
			Teaser card
			Mix with long jute (X-bottoms, etc.)
Breaker card	Breaker card	Breaker card	Breaker card
Finisher card	Finisher card	Finisher card	Finisher card
First drawing	First drawing	First drawing	First drawing
Intermediate drawing	Intermediate drawing (optional)		
Finisher drawing	Finisher drawing	Finisher drawing	Finisher drawing
Roving frame			
Spinning	Spinning	Spinning	Spinning

Figure 3.2. Flowsheets for jute spinning

TABLE 3.1. JUTE YARNS

	tex	*lb/sp*
Fine Yarns	120–200	3·5–6·0
Hessian Warp	240–300	7– 9
Hessian Weft	240–400	7–12
Sacking Warp	270–350	8–10
Sacking Weft	700–1400	20–40
Carpet Yarns	480–820	14–24