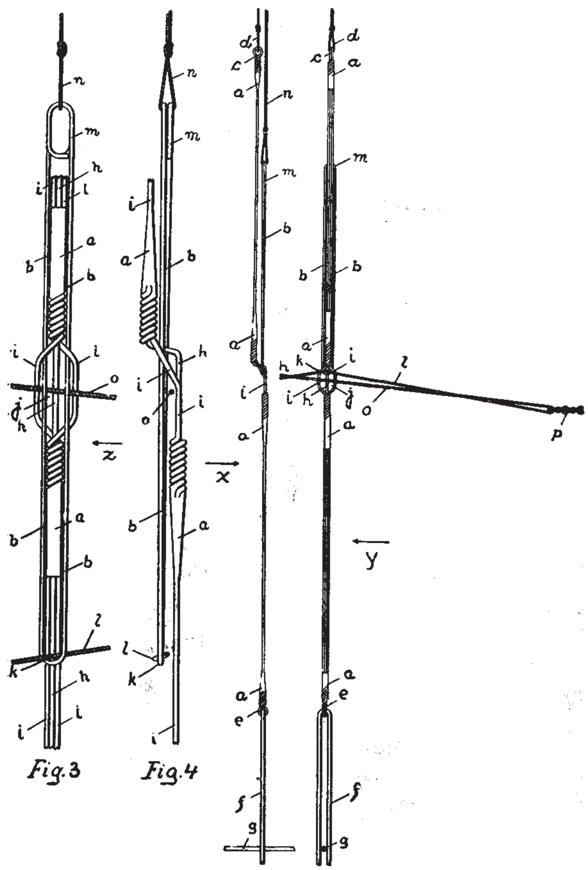
the entire length of the heddle. The two other strands i, extend alongside of the central strand h, and are twisted around and soldered to the central strand on



each end thereof. Member a has a central eye composed of these three strands, the central strand extending through the central portion of the eye, in the direction of the length of the heddle, the side strands i being twisted around and soldered to the central strand at the upper and lower ends of the eye j, which is made offset as shown.

The other member of the doup-heddle consists of a two strand wire loop b, having a loop at its lower end k for the doup-thread l. The upper ends of the loop wire b are bent over as shown at m, to receive the harness cord n.

Member b passes through and is movable in the eye j in member a; the two strands of wire i of said eye are on the opposite sides of the loop, the central strand h being within the loop.

o indicates a standard warp-thread operated by the jacquard machine in the usual way, to produce with the whip-thread l leno shown at p in the usual way.

In the whole of Ireland there is but one cotton-spinning mill, and that is located in Belfast. The company operating this mill is capitalized at £10,000 ($48,665), and employs 26,000 spindles. Only the finer counts of thread are spun, and for these cotton of long fibre is used, such as the Egyptian and sea-island staples, the annual imports being about 224,640 pounds.

FABRIC ANALYSIS.

(Continued from page 60, Vol. VIII.)

IV. ASCERTAINING RAW MATERIALS USED IN THE CONSTRUCTION OF FABRICS.

In order to determine of what raw materials any yarn or fabric under consideration is composed, there are two general methods to follow, *viz:* physical and chemical.

The first refers to the physical properties and characteristics of the various commercial textile fibres, while the second treats of distinguishing chemical reactions of the various fibres.

Physical Tests.

These tests are based upon the structure and consequent appearance and feel of the various fibres, and may be considered under two divisions, *viz:* (*a*) practical knowledge and (*b*) by means of the microscope.

In the mill, men who handle yarns and fabrics daily, year after year, can readily distinguish of what materials the same are composed of by feel and appearance. However, even the most experienced man may sometimes be in doubt and have to resort to one or the other physical or chemical test, in order to convince himself; more so will this be the case if dealing with yarns or fabrics composed of two or more kinds of raw materials used in their construction.

The other physical test, *i. e.*, that by the microscope, will in most instances reveal the constituent parts of a yarn or fabric, whether in pure or mixed condition.

Textile fibres of commerce belong to two distinct varieties: (*a*) animal fibres, (*b*) vegetable fibres. Of these, the first variety comprises (1) wool, hair and fur, each having formed the covering of an animal, and (2) silk, as spun by the silk worm at its entry into the chrysalis stage. With reference to vegetable

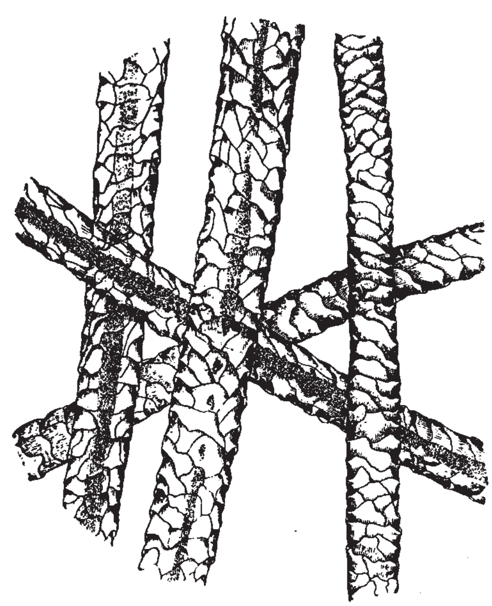


Fig. 12

fibres, the first place (1) belongs to cotton, the next (2) to flax jute, ramie, etc. Besides these two chief varieties, a third, artificial silk may have to be considered, the same being produced by treating vegetable or animal material chemically.

THE MICROSCOPE. By means of it yarns or fibres can be examined under a lens either by bringing them within or beyond focal length; in the first instance obtaining an enlarged picture on the side next the object, whereas in the other case, the enlarged picture is formed in an inverted position on the opposite side of the lens. In order to obtain high magnifying power, these two conditions are combined in the compound microscope, which consists in its main parts of a tube some six or seven inches in length, closed at the upper end by a large glass lens (of greater focal length—placed nearest the eye, hence termed "eye piece") and at the lower end by a smaller glass lens (of smaller focal length—placed nearest the fibres to be examined, hence "object piece"), both pieces being capable of vertical movement. This tube is blackened on the inside to exclude extraneous light. The total magnifying power of a microscope is thus the sum of the powers of the "object" and the "eye piece." The tube carrying the "eye" and the "object" piece, for adjustment in the regular microscope, is raised or lowered by a rack and pinion motion, while in connection with a high class microscope, an extra, *i. e.,* fine adjustment, is afterwards made by the micrometer screw, as provided to such microscopes. On the stand of the microscope we find fixed an arrangement for supporting the stage (pierced with a small circular aperture for the passage of the reflected light), as well as a small circular concave reflector, which is movable in any direction. The most important quality of a good microscope is, that its lenses produce a well defined, clear picture, distinctly showing every detail of structure in the object under examination.

The best source of illumination for carrying on investigation by means of the microscope is diffused daylight, with a sky evenly covered with a white veil of clouds. In connection with artificial light, a glass bulb, filled with a dark blue solution of ammoniacal copper oxide, interposed between the source of light and the condenser, will be found of advantage.

HOW TO PREPARE YARNS AND FIBRES FOR THE MICROSCOPE.

Yarns to be examined under the microscope, whether in their pure state or liberated from a woven or knitted, etc. fabric, after proper removal of all dirt, so that the passage of the light will be unrestricted, are then untwisted by hand, in order to transfer the yarn back into a mass of loose fibres; selecting then a proper amount of these fibres for testing. Immersing the fibres thus to be tested in boiling water, or better still, in glycerine or Canada balsam, will increase their transparency. The fibres thus prepared are then separately laid, side by side, on a glass slide and covered with a thin cover glass and are then ready for magnifying.

WOOL viewed under the microscope appears as a solid rod-shaped substance, the surface of which presents a peculiar scaly appearance, being covered externally with small plates or scales, the edges of which either protrude from the body of the fibre, or are only surface markings. These scales are more strongly and regularly developed in proportion to the fineness of the wool. The cylindrical shape of the wool fibre is best observed (when viewed under the microscope) where two fibres cross one another. A central core of medullary matter, running longitudinally in the fibre is sometimes visible, particularly in the coarser types.

Fig. 12 shows five wool fibres as seen by means of the microscope, and of which three of the fibres show this central core of medullary matter, previously referred to, which however is missing in the other two;

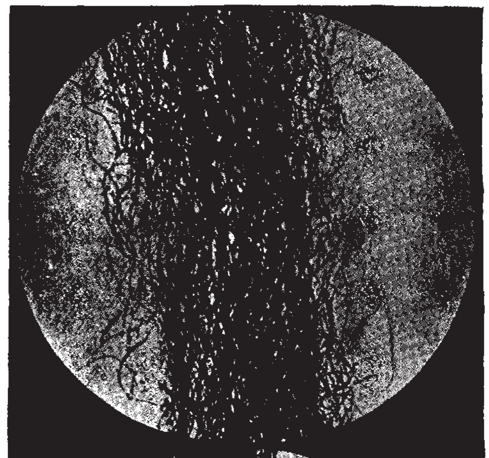


Fig. 13

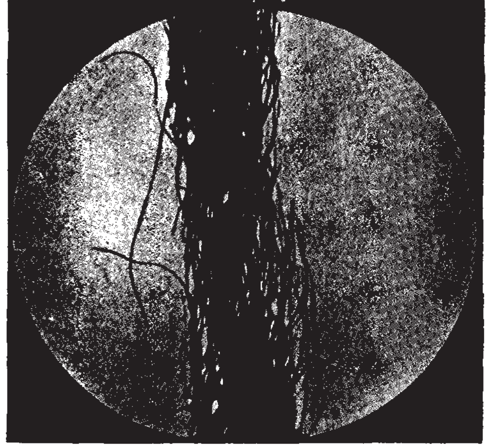


Fig. 14

all five fibres being specimens of coarse long staple wool fibres. In the better classes of wool, this medullary portion is entirely absent, its presence or absence depending upon the breed, health and care of the sheep and also the part of the body upon which the wool is grown. Besides their scaly surface structure, wool fibres are characterised by their wavy structure, technically known as the "wave of the crimp" being another item depending upon the breed of the sheep: the finer the quality, the more of these waves to one inch of fibre.

Yarns made of wool are classed as wool spun and worsted. The latter, in opposition to the woolen yarn consists of wool fibres brought by means of combing and drawing parallel to each other, the first mentioned process at the same time combing out of the stock any fibres below the standard length for which the machine is set, and for which reason worsted yarn means a yarn composed of wool fibres nearly all of a uniform length.

These two points, parallelization as well as equalization of the fibres, characteristic of worsted yarn, constitute the principle difference between worsted and woolen yarn. The parallelization of the fibres in a worsted thread will be readily noticed by its smooth surface as compared to that of wool spun yarn, which presents a fuzzy surface in order to assist in the formation of the nap in the finishing of the fabric. To ascertain the length of the fibres used in a thread, liberate the individual fibres composing the same by untwisting, and when a comparison of the length of fibres used can be readily made. To illustrate the difference between a woolen and a worsted thread, the appearance of its roving or sliver previously to spinning is given in Figs. 13 and 14, and of which Fig. 13 shows a condensed woolen sliver (roving) previous to spinning, Fig. 14 showing a combed and drawn worsted sliver previous to spinning.

Having given a description of a true wool fibre, the analyst may be called upon to ascertain of a lot of wool, yarn, or a fabric the cause of imperfections. Chiefly amongst those met with are untrue fibres and kemps.

Untrue Fibres. Under true or even fibres, we classify those having a nearly uniform diameter throughout their entire length, whereas, fibres wanting this character are termed untrue or uneven, the latter being characterized by variations in diameter on the same fibre, a feature which will seriously interfere with the working quality of the wool. A specimen of an untrue fibre is shown in Fig. 15 which will readily show that where these abnormal forms occur, there are changes in the form and size of the outer scales as well as in the diameter of the fibre, consequently the internal structure of the fibre must be equally affected, thus reducing the strength and elasticity of such fibres. It is well known that a chain is no stronger than its weakest link, and, in a similar manner, we may say that the strength of a wool fibre is proportionate to its smallest cross section; so that the buyer, in judging of such a wool would measure its value to him by this very defect. Untrue fibres are found most frequently in the fleece of inferior bred or neglected sheep, or are the result of sickness of the animal. In some instances we find a sudden contraction in diameter of the fibre at certain points, which is frequently sufficient to give the edge of the fibre a decidedly notched appearance, whereas in other cases we find a more gradual contraction.

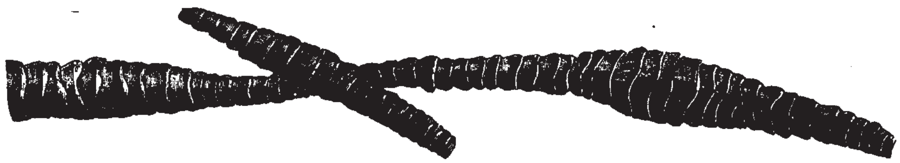


Fig. 15

Kemps are another kind of imperfect fibres met with in wool. The characteristics of an ordinary kemp fibre is a hair of dead silvery white, thicker and shorter than the good wool. Kemp fibres do not seem to differ considerably in their chemical composition from the good or true wool fibres, but possess no absorbent power, thus resisting either entirely, or partly, the entrance of dye-stuffs, in the latter case producing a different shade from that imparted to the good fibres of the same lot, hence kemp fibres will be readily detected in dyed lots of wool, yarns or fabrics. The presence of kemp fibres in a lot of wool will also result in poor spinning and poor yarn, since they will not thoroughly combine with the good wool, neither will they felt. Figs. 16 and 17 illustrate various degrees of these kempy fibres. Fig 16 *A* is a fibre in which the kempy structure continues throughout the entire fibre, and which looks more or less like a glass rod, yet has short and faint transverse lines which indicate the margins of the scales. When the change is a complete one, even the application of caustic alkali fails to bring out the lamination of the scales with any degree of distinctness. In Fig. 16 *B* a fibre is shown in which the change from true wool to kemp is only partial. Figs. 16 *A* and *B* are representations of fibres seen by reflected light; whereas Figs. 17 *A* and *B* show kemp fibres seen by transmitted light. In Fig. 17 *A* we see again a gradual passage of wool structure into kemp. In this case the kempy part retains almost the same transparency as the wool, but exhibits none of the interior arrangement of cells. The fibre shown in Fig. 17 *B* is practically kemp structure.

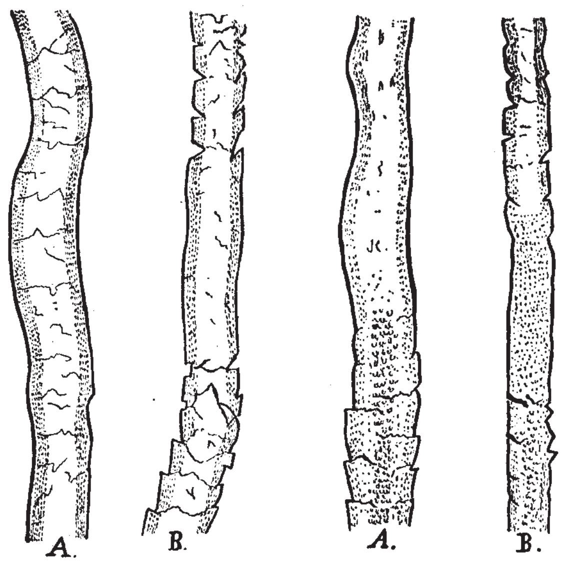


Fig. 16 *Fig. 17*

(*To be continued.*)

Elasticity of yarns depends upon the staple, the evenness of the thread, the twist per inch, the percentage of size on the yarn, and the hydroscopic moisture.