than that of common silk, and the filaments under the microscope (fig. 11) present the appearance of flat bands, the exudation from the

two spinnerets being

joined at their flat edges.

On this account the fibres

of tussur silk tend to split

up into fine fibrillæ under

the various preparatory

processes in manufactur­

ing, and its riband struc­

ture is the cause of the

glassy lustre peculiar to

the woven and finished

fibres.

Silk fibre consists essentially of a centre or core of fibroin, with a covering of sericin or silk albumen, and a little waxy and colouring matter. Fibroin, which is analogous to horn, hair, and like dermal products, constitutes about 66 per cent. of the entire mass, and has a composition represented by the formula C15H23N5O6. It has the characteristic appearance of pure silk,—a brilliant soft white body with a pearly lustre,—insoluble in water, alcohol, and ether, but it dis­solves freely in concentrated alkaline solutions, mineral acids, strong acetic acid, and in ammoniacal solution of oxide of copper. Sericin, which constitutes the gummy covering (Fr. *gres)* of the fibre, is a gelatinous body which dissolves readily in warm soapy solutions, and in hot water, in which on cooling it forms a jelly with even as little as 1 per cent. of the substance. It is precipitated from hot solutions by alcohol, falling as a white powder. Its formula is Cl8H25N5O8. According to the researches of P. Bolley, the glands of the silkworm contain semi- liquid fibroin alone, and it is on exposure to the air that the surface is acted on by oxygen, transforming the ex­ternal pellicle into the more soluble form of sericin. Silk is highly hygroscopic, taking up as much as 30 per cent. of water without feeling perceptibly damp. It is a most perfect non-conductor of electricity, and in its dry state the fibres frequently get so electrically excited as to seriously interfere with their working, so that it becomes necessary to moisten them with glycerin or soapy solutions. Silk is readily distinguished from wool and other animal fibres by the action of an alkaline solution of oxide of lead, which darkens wool, &c., owing to the sulphur they contain, but does not affect silk, which is free from that body. Again, silk dissolves freely in common nitric acid, which is not the case with wool. From vegetable fibres silk is readily distinguished by the bright yellow colour it takes from a solution of picric acid, which does not adhere to vegetable substances. The rod-like appearance of silk and its absence of markings under the microscope are also easily recognizable features of the fibre.

*Silk Manufacture.*

Here we must distinguish between the reeled silk and the spun or waste silk manufactures. The former embraces a range of operations peculiar to silk, dealing as they do with continuous fibres of great length, whereas in the spun silk industry the raw materials are treated by methods analogous to those followed in the treat­ment of other fibres. It is only floss, injured and un­reelable cocoons, the husks of reeled cocoons, and other waste from reeling, with certain wild silks, which are treated by the spun silk process, and the silk thereby produced loses much of the beauty, strength, and brilliance which are characteristic of the manufactures from reeled silk.

*Filature or Reeling.—*When the cocoons have been gathered the chrysalides they contain are killed either· by dry heat or by exposure to steam. All cocoons stained by the premature death of the chrysalides *(chiques),* pierced cocoons, double cocoons, and any from other causes rendered unreelable, are put aside for the spun- silk manufacture. Then the uninjured cocoons are by themselves sorted into classes having similar shades of colour, size, and quality of fibre. This assortment is of great consequence for the success of the reeling operations, as uniformity of quality and evenness and regularity of fibre are the most valuable features in raw silk. The object of reeling is to bring together the filaments *(bave)* from two or more (generally four or five, but sometimes up to twenty) cocoons, and to form them into one con­tinuous, uniform, and regular strand, which constitutes the "raw silk” of commerce. To do this, the natural gum of the cocoons which holds the filaments together must be softened, the ends of the filaments of the required number of cocoons must be caught, and means must be taken to unwind and lay these filaments together, so as to form a single uniform rounded strand of raw silk. As the reeling proceeds the reeler has to give the most careful attention to the thickness of the strand being produced, and to introduce new cocoons in place of any from which the reelable silk has become exhausted. In this way a continuous uniform fibre or strand of raw silk of indefinite length is produced. The apparatus used for these purposes in some localities is of a very primitive kind, and the reeling being uneven and lumpy the silk is of inferior quality and low value. With comparatively simple appliances, on the other hand, a skilled reeler, with trained eye and delicate touch, can produce raw silk of remarkably smooth and even quality. According to the method commonly adopted in North Italy and France the cocoons are for a few minutes immersed in water a little under the boiling point, to which a small quantity of alkali has been added. A girl with a small hand brush of twigs keeps stirring them in the water till the silk softens, and the outer loose fibres (floss) get entangled with the twigs and come off till the end of the main filament *(maître brin)* is found. These ends being secured, the cocoons are transferred to a basin or tray containing water heated to from 75° to 85° Fahr., in which they float while the silk is being reeled off. If the water is too cold the gum does not soften enough and the cocoons rise out of the basin in reeling ; if it is too hot the cocoons collapse and fall to the bottom. The ends of the requisite number of filaments being brought together, they are passed through an eyelet or guide, and similarly another equal set are passed through a corresponding guide. The two sets of filaments are then crossed or twisted around each other several turns as if to make one thread, after which they are separated and passed through separate guides to the reel round which they are separately wound. When a large number of cocoons are to be combined into one strand they may be reeled from the tray in four sets, which are first crossed in pairs, then combined into two, and those two then crossed and after­wards combined into a single strand. The object of crossing *(croissage)* is to round, smooth, and condense the separate filaments of each set into one strand, and as the surface of the filaments are gummy and adhesive it is found on drying that they have agglutin­ated into a compact single fibre of raw silk. In the most approved modern filatures there is a separate cocoon boiler *(cuiseuse),* an oblong tank containing water boiled by steam heat. In these the cocoons are immersed in rectangular perforated boxes for about three minutes, when they are transferred to the beating machine *(batteuse),* an earthenware trough having a perforated false bottom through which steam keeps the water at a temperature of from 140° to 160°. In this water the cocoons are kept stirring by small brushes rotated by mechanical means, and as the silk softens the brushes gradually rise out of the water, bringing entangled with them the loose floss, and thereby revealing the main filament of each cocoon. The cocoons are next, in sufficient number, trans­ferred to the reeler’s tray *(bacinella),* where the water is heated to about 120°. From the tray the filaments are carried through a series of porcelain and glass eyelets, so arranged that the strand returns on itself, two portions of the same strand being crossed or intertwisted for rounding and consolidation, instead of the croissage of two separate strands as in the old method. The reel to which the raw silk is led consists of a light six-armed frame, enclosed within a wooden casing having a glass frame in front, the enclosure being heated with steam-pipes. To keep the strands from directly overlaying each other and so adhering, the last guide through which the silk passes has a reciprocating motion whereby the fibre is distributed within certain limits over the reel. A sectional view of the reeling apparatus and arrangements—now in common use in Italy—is shown in fig. 12.

*Throwing.—*Raw silk, being still too fine and delicate for ordin­ary use, next undergoes a series of operations called throwing, the object of which is to twist and double it into more substantial yarn. The first operation of the silk throwster is winding. He receives the raw silk in hanks as it is taken from the reel of the filature, and putting it on a light reel of a similar construction,