reelable thread, and in joining the ends, there is unavoidable waste. (5) Raw silk skeins are often re-reeled; and in this process part has to be discarded: this being known to the trade as gum-waste. The same term—gum-waste—is applied to “waste” made in the various processes of silk throwing; but manufacturers using threads known technically as organzines and trams call the surplus “ manufacturer’s waste.” Finally we have the uncultivated varieties of silks known as “ wild silks,” the chief of which is tussur. The different qualities of “ waste,” of which there are many, vary in colour from a rich yellow to a creamy white; the chief producing countries being China, Japan, India, Italy, France and the countries in the Near East; and the best-known qualities are: steam wastes, from Canton; knubs, from China and from Italy and other Western countries; frisons, from various sources; wadding and blaze, Shanghai; china, Hangchow; and Nankin buttons; Indian and Szechuen wastes; punjum, the most lustrous of wastes; China curlies; Japan wastes, known by such terms as kikai, ostue, &c.; French, Swiss, Italian, China, Piedmont, Milan, &c. There are yellow wastes from Italy, and many more far too numerous to mention.

A silk “ throwster ” receives his silk in skein form, the thread of which consists of a number of silk fibres wound together to make a certain diameter or size, the separate fibre having actually been spun by the worm, and this fibre may measure anything from 500 to 1000 yds. in length. The silk-waste spinner receives his silk in quite a different form: merely the raw material, packed in bales of various sizes and weights, the contents being a much-tangled mass of all lengths of fibre mixed with much foreign matter, such as ends of straws, twigs, leaves, worms and chrysalis. It is the spinner’s business to straighten out these fibres, with the aid of machinery, and then to so join them that they become a thread, which is known as spun silk.

There are two distinct kinds of spun silk—one called “ schappe ” and the other “ spun silk ” or “ discharged spun silk.” All silk produced by the worm is composed of two substances— fibroin, the true thread, and sericin, which is a hard, gummy coating of the “ fibroin.” Before the silk can be manipulated by machinery to any advantage, the gum coating must be removed, really dissolved and washed away—and according to the method used in achieving this operation the result is either a “ schappe ” or a “ discharged yarn.” The former, “ schapping,” is the French, Italian and Swiss method, from which the silk when finished is neither so bright nor so good in colour as the “ discharged silk ”; but it is very clean and level, and for some purposes absolutely essential, as, for instance, in velvet manufacture.

*Schapping.*—The method is as follows: If waste silk is piled in a heap in a damp, warm place, and kept moist and warm, the gum will in a few days’ time begin to ferment and loosen, and can then be washed off, leaving the true thread soft and supple; but the smell caused by the fermentation is so offensive that it cannot be practised in or near towns. Therefore schappe spinners place their degumming plant in the hills, near or on a stream of pure water. The waste silk is put into large kilns and covered with hot water (temperature 170° F.). These are then hermetically closed, and left for a few hours for the gum to ferment and loosen. When thoroughly softened—the time occupied depending on the heat of the water and nature of the silk—the contents of the kiln are taken out and placed into vats of hot water, and allowed to soak there for some time. Thence the silk is taken to a washing machine, and the loosened gum thoroughly washed away. The silk is then partly dried in a hydro-extractor, and afterwards put in rooms heated by steam-pipes, where the drying is completed.

“ Discharging ” is the method generally used by the English, and results in a silk having brilliance and purity of colour. In this process the silk waste is put into strong, open-meshed cotton bags, made to hold (in accordance with the wish of individual spinners) from I lb to 5 lb in weight. When about 100 lb of silk has been bagged, the whole is placed in a large wooden tub and covered with boiling water in which 12 to 20 lb of white curd soap has previously been dissolved. In this the silk is boiled from one to two hours’, than taken out and put through a hydro-extractor to remove the dirty gummy solution. Afterwards it is put into another tub of soapy liquor, and boiled from one to one and a half hours. It is then once more hydro-extracted, and finally taken to a stove and dried. “Discharged silk” must be *entirely free* from gum when finished, where “ schappe ” contains a percentage of gum—some­times as much as 20%.

From this stage both classes of silk receive much the same treat­ment, differing widely in detail in different mills and districts.

*Conditioning.—*The “ degummed silk,” after it is dried, is allowed\* to absorb a certain amount of moisture, and thus it becomes soft and pliable to the touch, and properly conditioned for working by machinery.

*Beating.—*When the waste contains any large percentage of worm or chrysalis, it is taken to a “ cocoon beater, a machine which has a large revolving disk on which the silk is put, and while revolving slowly is beaten by a leather whip or flail, which loosens the silk and knocks out the wormy matter. After the beating, the silk presents a more loose appearance, but is still tangled and mixed in length of fibre. The object of the spinner at this point is to straighten out the tangles and lumps, and to lay the fibres parallel : the first machine to assist in this process being known as an opening machine, and the second as a filling engine.

*Opening and Pilling.*—The silk to be opened is placed on a latticed sheet or feeder, and thus slowly conveyed to a series of rollers or porcupines (rollers set with rows of projecting steel pins), which hold the silk firmly while presenting it to the action of a large receiving drum, covered with a sheet of vulcanized rubber, set all over with fine steel teeth. As the drum revolves at a good speed, the silk is drawn by the steel teeth through the porcupines into the drum in more or less straight and parallel fibres. When the teeth are full the machine is stopped, and the silk stripped off the drum, then presenting a sheet-like appearance technically known as a “ lap.” The lap is taken to the filling engine, which is similar in construction and appearance to the opener as far as the, feeding arrangements are concerned, but the drum, in place of being entirely covered with fine steel teeth, is spaced at intervals of from 5 to 10 in. with rows of coarser straight teeth, each row set parallel with the axle of the machine. The silk drawn by the rows of teeth on the drum through the porcupine rollers (or porcupine sheets in some cases) covers the whole of the drum, hooked at certain intervals round the teeth ; and when a sufficient weight is on the machine, it is stopped, and an attendant cuts, with a knife, the silk along the back of each row of teeth, thus leaving, a fringe of silk hooked on the pins or teeth. This fringe of silk is placed by the attendant between two hinged boards, and whilst held firmly in these boards (called book-boards) is pulled off the machine, and is called a “ strip ”; the part which has been hooked round the teeth is called the “ face,” and the other portion the “ tail.” By these means the silk has been opened, straightened and then cut into a certain length, the fibres now being fairly, laid parallel and ready for the next operation, known as silk dressing.

*Silk Dressing.—*This is the process equivalent to combing in the wool industry. Its purpose is to sort out the different lengths of fibre, and to clear such fibres of their nibs and noils. There are two well-known principles of dressing: one known as “flat frame,” giving good result with discharged silk, and the other known as “ circular frame” dressing, suitable for schappes.

The flat dressing frame is a box or frame holding a certain number of book-boards from the filling engine, which boards when full of silk are screwed tightly together m the frame. The frame is capable of being raised into contact with travelling combs, affixed to an endless belt placed round two metal rollers about 6 ft. apart. The attendant allows the silk to enter gradually into close contact with the combs, which comb through the silk in exactly the same manner as a lady combs her tresses. In a circular frame the silk is clamped between boards, and these are fixed on a large drum. This drum revolves slowly, and in its revolution conveys the fringes of silk past two quickly running smaller combing drums. These combing drums being covered with fine steel teeth penetrate their combs through the fringes of, silk depending from the large drum, thus combing through the silk. In each machine the object is the same. First the filled silk is placed into a holding receptacle, clamped fast, and presented to combing teeth. These teeth retain a certain proportion of shorter fibre and rough places and tangled portions of silk, which are taken off the combs in a book-board or wrapped, round a stick and again presented to the combs. This fibre again yields combings which will also be combed, and so on for five or six times until the combings are too short, and are taken from the machine and known as noils. The productions from these several combings are known as “ drafts ” and are of different lengths: the product of the filled silk first placed in the dressing frame being the longest fibre and of course the most valuable.

The flat frame is the most gentle in its usage of the silk, but is most costly in labour; whilst the circular frame, being more severe in its action, is not suitable for the thoroughly degummed silks, but on the other hand is best for silks containing, much wormy matter, because the silk hanging down into the combing teeth is thoroughly cleansed of such foreign matter, which is deposited under the machine. This method also has the advantage of being cheaper in cost of labour. Recently a new machine has been invented giving the same results as circular frame : the silk depends from boxes into combs, and at the same time has the gentle action of the flat frame. The cost of the operations is as cheap as the circular frame, therefore the machine combines the advantages of each of its predecessors.