weak); (3) organzine, the thread used for warps, made from two and rarely three twisted strands spun in the direction contrary to that in which they are separately twisted. Silks for sewing and em­broidery belong to a different class from those intended for weaving, and thread-makers throw their raw silks in a manner peculiar to themselves.

*Numbering of Silk.*—The metric system of weights and measures has been adopted so widely that it forms the most suitable basis for the *titrage* or counts of yams. The permanent committee of the Paris International Congress of 1900, which was held for the purpose of unification of the numerotage of counts, unanimously decided— (*a*) With reference to cotton, silk and other textiles spun from fibres, that they should be based on a fixed weight and variable length, the unit being one metre to one gramme. Thus number 100 would be 100 metres per gramme calculated on the single strand. (*b*) With reference to raw and thrown silk, in order to enable the count to show the degrees of variation incidental to this class of material, it was decided for a basis of a fixed length and variable count weight. The length of skein adopted was 450 metres and the unit of length the half decigramme. Thus the count of silk is expressed by the number of half decigrammes which the length of 450 metres weighs. This obtains whether in the single, double or more threads joined together in the doubling.

This latter differs very little in actual practice from the previous method of determination by the number of deniers per 476 metres, the denier being calculated on the equivalent of 0∙0531 gramme, the English equivalent showing 33⅓ deniers per one dram avoirdupois.

As the old systems of counts have some technical conveniences they will no doubt be retained for some time. In some districts, especially in Yorkshire, the count is based on the number of yards per ounce, and in others the older method of drams avoirdupois per 1000 yard skein. The English cotton yarn and spun silk counts are reckoned upon the number of hanks of 840 yds. in 1lb of silk, cotton being reckoned upon the single thread and spun silk on the doubled or finished thread. Thus 2∕408 cotton indicates single 408 doubled to 20 hanks by 840 yds. to the lb., while 40/2 fold spun silk means a single 808 doubled to give 40 hanks of 840 yds. to the lb. All continental conditioning establishments now formulate their tests for counts on the agreement arrived at by the International Congress of 1900.

*Conditioning.—*Silk in the raw and thrown state absorbs a large amount of moisture, and may contain a percentage of water without being manifestly damp. As it is largely sold by weight it becomes necessary to ascertain its condition in respect of absorbed water, and for that purpose official conditioning houses arc established in all the considerable centres of silk trade. In these the silk is tested or con­ditioned, and a certificate of weight issued in accordance with the results. The silk is for four hours exposed to a dry heat of 230° F., and immediately thereafter weighed. To the weight 11 % is added as the normal proportion of water held by the fibre.

*Scouring.—*Up to this point the silk fibre continues to be com­paratively lustreless, stiff and harsh, from the coating of albumin­ous matter (gum or *grès)* on its surface. As a preliminary to. most subsequent processes the removal of the whole or some portion of this gum is necessary by boiling-off, scouring or *décreusage.* To boil off say 300 lb of thrown silk, about 60 lb of fine white soap is shred, and dissolved in about 200 gallons of pure water. This solution is maintained at a heat of 195°, and in it the hanks of raw silk arc immersed, hung on a wooden rod, the hanks being continually turned round so as to expose all portions equally to the solvent influence of the hot solution. After being dried, the hanks are packed in linen bags and boiled for three hours in a weaker soapy solution, then washed out in pure warm water and dried in a centrifugal hydro­extractor. According to the amount of gum to be boiled off the soap solutions are made strong or weak; but care has to be exercised not to overdo the scouring, whereby loss of strength, substance and lustre would result. For some purposes—making of gauzes, crapes, flour-bolting cloth and for what is termed “ souples ”—the silk is not scoured, and for silks to be dyed certain dark colours half-scouring is practised. The perfect scouring of silks removes from 20 to 27 % of their weight, according to the character of the silk and the amount of soap or oil used in the working. Scouring renders all common silks, whether white or yellow in the raw, a brilliant pearly white, with a delicate soft flossy texture, from the fact that the fibres which were agglutinated in reeling, being now degummed, are separated from each other and show their individual tenuity in the yarn. Silks to be finished white are at this point bleached by exposure in a closed chamber to the fumes of sulphurous acid, and at the close of the pro­cess the hanks are washed in pure cold water to remove all traces of the acid.

*Silk* *Weighting.—Into* the dyeing of silk it is not here necessary to enter, except in so far as concerns a nefarious practice, carried on in dye-houses, which has exercised a most detrimental influence on the silk trade. Silk, we have seen, loses about one-fourth of its weight in scouring. To obviate that loss it has long been the practice to dye some dark silks “ in the gum,” the dye combining in these cases with the gum or gelatinous coating, and such silks are known as “ souples.” Both in the gum and in the boiled-off state silk has the peculiar property of imbibing certain metallic salts largely and combining very firmly with them, the fibre remaining to external appearance undiminished in strength and lustre, but much added to in size and weight. Silk in the gum, it is found, absorbs these salts more freely than boiled-off; so to use it for weighting there are these great inducements—a saving of the costly and tedious boiling-off, a saving of the 25 % weight which would have disappeared in boiling and a surface on which much greater sophistication can be practised than on scoured silk. In dyeing a silk black a certain amount of weight must be added; and the common practice in former times was to make up on the silk what was lost in the scouring. Up to 1857 the utmost the dyer could add was “ weight for weight,” but an accidental discovery that year put dyers into the way of using tin salts in weighting with the result that they were enabled to add 40 oz. to scoured silk, 120 oz. to souples and as much as 150 oz. to spun silks. This excessive adulteration quickly worked its own cure by a de­creased consumption, and the weighting in practice in 1910 is con­fined to moderate and safer limits. The use of tin salts, especially stannic chloride, SnCl4, enables dyers to weight all colours the same as black. In his "Report on English Silk Industry ” to the Royal Commission on Technical Instruction (1885) Sir Thomas Wardle of Leek says:—

“ Colours and white of all possible shades can very easily be im­parted to this compound of silk and tin, and this method is becoming extensively used in Lyons. Thus weighting, which was until recently thought to apply only to black silks, and from which coloured silks were comparatively free, is now cheapening and deteriorating the latter in pretty much the same ratio as the former. Thus the ρroto- and per-salts of iron, as well as the proto- and per-salts of tin, in­cluding also a large variety of tannin, sumac, divi-divi, chestnut, valonia, the acacias *(Areca Catechu* and *Acacia Catechu* from India), from which are obtained cutch and gambier, &c., are no longer used solely as mordants or tinctorial matters, but mainly to serve the object of converting the silk into a greatly-expanded fibre, consisting of a conglomeration of more or less of these substances.”

Sugar also is employed to weight silk. On this adulterant Sir Thomas Wardle remarks :—

“ With a solution of sugar, silk can have its weight augmented from 1 oz. to 3 oz. per lb. I am not quite sure that this method of weighting was not first used by the throwsters, as sugar is known to have been used for adulterating and loading gum silk for a very long time, and then the idea was afterwards applied to silk after the dyeing operations. It is much resorted to for weighting coloured silks by dyers on the continent, and, though a very clumsy method, no substitute has been found so cheap and easy of application. Bichloride of tin, having chemical affinity for silk fibre, bids fair to extinguish the use of sugar, which, from its hygrometric qualities, has a tendency to ruin the silk to which it is applied, if great care be not taken to regulate the quantity. There is not the slightest use or excuse for the application of sugar, except to cheapen the silk by about 15 to 20%.”

*Wild Silk Dyeing.—*Among the disadvantages under which the silks of the wild moths long laboured one of the most serious was the. natural colour of the silks, and the extreme difficulty with which they took on dyes, specially the light and brilliant colours. For success in coping with this difficulty, as well as in dealing with the whole question of the cultivation and employment of wild silks, the unwearying patience and great skill of Sir Thomas Wardle of Leek deserve special mention here. The natural colour of tussur silk is a greyish fawn, and that shade it was found impossible to discharge by any of the ordinary bleaching agents, so as. to obtain a basis for light and delicate dyes. Moreover, the chemical character of the tussur silk differs from that of the mulberry silk, and the fibre has much less affinity for tinctorial substances, which it takes up un­evenly, requiring a large amount of dye-stuffs. After protracted experimenting Sir Thomas Wardle was able in 1873 to show a series of tussurs well dyed in all the darker shades of colour, but the lighter and bright blues, pinks, scarlets, &c., he could not produce. Subse­quently Tessie du Motay found that the fawn colour of natural tussur could be discharged by solution of permanganate of potash, but the oxidizing action was so rapid and violent that it destroyed the fibre itself. Gentler means of oxidation have since been found for bleach­ing tussur to a fairly pale ground. The silk of the eria or castor-oil worm *(Attacus ricini)* presents the same difficulties in dyeing as the common tussur. A portion of the eria cocoons are white, while the others are of a lively brown colour, and for the dyeing of light colours the latter require to undergo a bleaching process. The silk takes up colour with difficulty from a strong vat, and is consequently costly to dye. Moonga silk from *Antheraea assama* has generally a rather dark­brown colour, but that appears to be much influenced by the leaves on which the worm feeds, the cocoons obtained on the champaca tree *(Michelia champaca)* giving a fine white fibre much valued in Assam. The dark colours are very difficult to bleach, but the silk itself takes dye-colours much more freely and evenly than either tussur or eria silk. (F. W. \*)

*Trade and Commerce.*

About the beginning of the 19th century the chief silk-produc­ing regions of the world were the Levant (including Broussa, Syria and Persia), India, Italy and France, the two first named sending the low-priced silk, the other two the fine qualities.