ing mills was indeed waste, there being at that time no use for it whatever, except for what could be combed and spun by distaff and spinning wheel, as still practised by peasantry in India and other Eastern countries. Considering that of all the silk spun by the silkworm more than half is useless for the throwster, it will readily be understood that there must have been a large accumulation of this material, and therefore a great future before an industry which could use up this so-called rubbish. Although there are a great many different grades and different classes of waste silk, there are really few distinct ways in which they are all produced, most, if not all, varieties being the waste from one or more of the following seven processes:

(*a*) The silkworm commences to spin its cocoon by first fastening itself to the twig of a tree or between two leaves. Where the worm is reared by the

COCOONS FROM WHICH THE MOTHS HAVE EMERGED,
Used in the Manufacture of Spun Silk.

peasants in their cottages, the peasants use straws, to which the worms attach themselves. All this silk is unwindable and too coarse and uneven to be of any use for the throwster, even if reelable. Naturally this first waste is very much mixed with straw and leaves, and is of a dull, coarse nature.

(*b*) The cocoons are made up of layers of silk, and the outside ones, or the first spun by the worm, are too coarse and uneven for reeling, so the outer coating is stripped off and cast aside as waste.

(*c*) As the silkworm nears the completion of its cocoon, the thread becomes finer and finer, insomuch that several of the last layers are made up of silk too fine to be strong enough to unwind, so that after the better or middle layers are reeled from the cocoon, the remaining part is discarded as useless for further reeling.

(*d*) Among the cocoons there are some which are altogether unsuitable for reeling, included among which are the pierced cocoons. Although of no use for reeling, they are very acceptable to the silk-waste spinner.

(*e*) During the process of reeling from the cocoon into hanks or skeins the silk sometimes breaks, and in consequence there is waste made by the attendant in finding the true and sound thread.

(*f*) Waste is produced in rereeling tsatlees into rereels.

(*g*) All the waste produced in the throwster's mill, as described fully under the heading "Throwing."

Practically speaking, the various wastes are divided into two general classes—gum wastes and knub, *i. e.*, ordinary wastes.

GUM WASTE

is the product of the reeler and throwster of net silk. The best classes of cocoon are reeled and thrown, and it follows that the waste produced is the best waste. It is long, strong, and lustrous.

KNUB WASTE

consists largely of that part of the cocoon which is considered to be of too poor a quality to reel; also the outer covering and the inner shell of the cocoon which are of poorer quality than the intermediate part.

(*To be continued.*)

Points on Fabric Structures.

In designing fabrics, there are several points which call for consideration, *viz.*,

(*a*) the theory of construction,
(*b*) the nature of the raw material,
(*c*) the cost of production,
(*d*) the purpose of wear, and
(*e*) the appearance of the finished fabric.

Each of these five points is important, and all are more or less dependent on each other; but for the present, we shall discuss simply the theory of construction, and that alone in its application to the simpler fabrics.

As a basis for fabric structure it is necessary to ascertain the diameters of yarns, and from these diameters to determine the threads which will rest side by side in one inch.

The diameter of any yarn of standard twist has been found by experiment to be approximately the square root of the number of yards to the pound of this yarn, less certain small percentages allowed for the roughness of the various fibres.

For example: Ascertain the number of threads of 20's cotton and 20's worsted which will lie parallel and just cover one inch.

$\sqrt{840 \times 20} - 7$ per cent, and
$\sqrt{560 \times 20} - 10$ per cent,
or 120 and 95 threads respectively. *Ans.*

After determining the diameter of any yarn by this rule, the next step is to ascertain the effect of interlacing another system of threads with the first system, as in the interweaving of warp and filling. That this results in a reduction in texture of one thread for every interlacing is at once evident, for where warp interlaces with filling, the former takes the place, as regards its diameter, of one thread of the latter.

Then, using the previous example, a fabric made of 20's cotton or 20's worsted, on a plain weave, will have 60 and $47\frac{1}{2}$ threads per inch respectively.

Should the warp in either one of these two cloths be so reeded that the space between two ends exactly equals the diameter of one end, the fabric is said to be perfectly balanced and to be theoretically correct so far as structure is concerned.

Since interlacings are necessary to produce cloth, and as these interlacings have such an effect on the texture, the question of weaves becomes very important, for it is obvious that *the greater* the number of intersections employed, *the lower* will be the texture, and *vice versâ.*

Such being the case, let us look at the three foundation weaves, the *plain, twill,* and *satin,* and see the effect of these different weaves on any particular fabric; and if from this inquiry we can deduce a rule for foundation weaves, then any derivative weave can be placed under the same law.

THE PLAIN WEAVE,

owing to its peculiarity of alternate interlacing, demands the lowest texture. Furthermore, it gives a perforated fabric, the size of the perforation in a well-balanced structure being in direct ratio to the diameters of the threads. As each thread supports and binds the other to the utmost, the plain weave will certainly result in a stronger fabric for the same number of threads than any other form of interweaving.

THE TWILL WEAVES,

in themselves give a much weaker construction than the plain weave, yet by their fewer interlacings permit not only of the introduction of more material with a corresponding closeness of texture and additional weight. Owing to this extra material, the fabric produced is actually much stronger as regards tensile strain than a plain cloth of the same relative texture. Twills present a further advantage in that they allow a great variation in bulk of fabric produced, for by altering the weave so as to interlace at greater intervals, the texture can be increased. However there is a limit to this, for the strength is not in proportion to the greater quantity of material present.

SATIN WEAVES,

allow a high texture in only one direction, this depending on whether the fabric is interlaced with a warp or a filling effect satin.

For instance, in a warp effect, the ends will lie as closely as their diameters will permit, whereas the picks must be separated from each other by at least the diameter of one warp-thread. This results in a cloth with a high tensile strength warp-ways, but proportionally as weak filling-ways. Then, laying aside for a moment the question of appearance or cost, it may be generally stated as follows:

A *plain* weave gives great strength with low texture; *twills* are stronger only through the introduction of more material; and a *satin* will give strength chiefly in one direction.

Influence of Texture.

It will be remembered that in the example of a fabric made of 20's cotton, the number of threads of this count which could rest side by side in one inch (120) was reduced one-half (60) by the introduction of another system of threads interlacing on the plain weave, owing to the alternate interlacing of warp and filling in this weave.

Suppose, now, we take this same example and formulate a general rule for fabric textures as follows: We will reed this fabric at 60 ends per inch. Then the interlacings of warp with the filling along any pick for one repeat of the pattern (2 ends) equals two in number, and instead of two diameters for every repeat, the actual number is 2 and 2, or 4 units, so called. Then in this piece of goods the threads per inch while 60, occupy the space of 120, as found by the following proportion:

2 : 4 : : 60 : 120.

In other words, should the counts of the yarn be such as to permit 120 threads to lie parallel in one inch, by the introduction of another system of threads interlacing with the first, this number is reduced proportionately to the number of interlacings.

From this we can deduce the following rule:

Multiply the number of threads of the given count which will rest side by side in one inch without riding, spacing, or interlacing, by the threads in one repeat of the pattern, and divide this product by the units for that particular weave.

The result will be the theoretical structure for that particular yarn and weave.

Consider again the example of a cotton fabric made of 20's cotton. Using 8 threads of a plain weave as a basis, we get

$$\frac{120 \times 8}{8 + 8} = 60 \text{ ends per inch}$$

for a perfect structure, *Ans.*

With 8 ends both of a 2-and-2 twill and a 8-shaft satin, we get the following results:

$$\frac{12 \times 8}{8 + 4} = 80, \text{ and } \frac{120 \times 8}{8 + 2} = 96 \text{ ends per inch respectively.}$$

(To be continued.)

THE DYESTUFF SITUATION IN THE TEXTILE INDUSTRIES.

(Continued from April issue.)

Silk Manufacture.

The accompanying table summarizes the data for the consumption of dyestuffs and chemicals in 1913 and 1916 for eight representative silk manufacturers. Separate totals are given for 26 dyestuffs the value of which represents 43 per cent and 62 per cent, respectively, of the total value of all dyestuffs and chemicals used by the eight establishments in 1913 and 1916. Nineteen of these dyes are coal-tar products, while the remainder are natural or vegetable dyestuffs.

Dyestuffs Used by 8 Important Silk Manufacturers, 1913 and 1916.

Dyestuff.	Total Amount Used.				Average price paid per pound	
	1913		1916			
	Pounds	Value	Pounds	Value	1913	1916
Sulphur black	79,858	$13,183	103,165	$120,841	$0.17	$1.17
Direct black	31,833	7,035	39,636	44,053	.22	1.11
Azo yellow	10,303	4,482	5,400	23,920	.44	4.43
Fast gray	12,411	11,131	4,377	12,812	.90	2.93
Chrysophenine	1,222	878	3,991	34,028	.72	8.53
Primuline	4,400	1,598	3,318	17,778	.36	5.36
Induline	3,700	2,133	3,255	3,042	.58	.93
Orange II	1,237	222	3,133	2,975	.18	.95
Soluble blue	1,728	1,576	2,308	9,517	.91	4.12
Fast silk yellow	7,020	4,203	2,253	1,516	.60	.67
Methylene blue	1,225	658	1,980	2,971	.54	1.50
Quinoline yellow	2,405	817	1,667	2,537	.34	1.52
Brilliant green	2,176	1,087	1,177	1,717	.50	1.46
Methyl violet	1,647	1,214	1,057	1,788	.74	1.69
Rhodamine	1,190	1,253	967	3,878	1.05	4.01
Fast red	1,440	450	953	1,887	.31	1.98
Alkali blue	688	523	936	5,553	.76	5.93
Palatine black	13,474	3,836	896	1,032	.28	1.15
Patent blue	2,027	2,190	440	3,183	1.08	7.24
Gambier	167,829	9,417	214,162	23,063	.06	.11
Logwood	31,000	2,550	169,623	48,236	.08	.28
Cutch	32,400	2,250	77,549	9,635	.07	.12
Hematine	62,021	6,190	54,117	20,249	.10	.37
Sumac	42,203	1,951	18,770	1,522	.05	.08
Fustic	7,000	420	9,917	1,641	.06	.17
Archil	8,829	942	3,537	1,149	.11	.33
	531,266	$82,189	728,584	$400,523	$0.15	$0.55
Chemicals and other dyestuffs	1,508,033	110,802	1,714,289	240,960	.07	.14
Total	2,039,299	$192,991	2,442,873	$641,483	$0.09	$0.26

Sulphur black and direct black, which in 1913 were used in larger quantities than any other coal-tar dyestuffs, showed substantial increase in 1916. The only other coal-tar dyes which were used in increased quantities in 1916 are orange II, soluble blue, methylene blue, alkali blue, and chrysophenine. Orange II, according to a statement from one of the manufacturers, has been made in this country for some time