they are not, unless 2-fold or hard twisted, selected for textures in which weave types are produced.

The loose, entangled filament on the circumference of the carded thread (Saxony or Cheviot) subdues and partially conceals the detail effects resulting from the interlacing of the threads in a twill, mat, diagonal, or other order. On the other

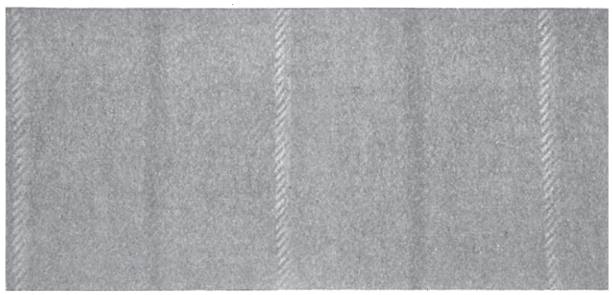


FIG. 56.

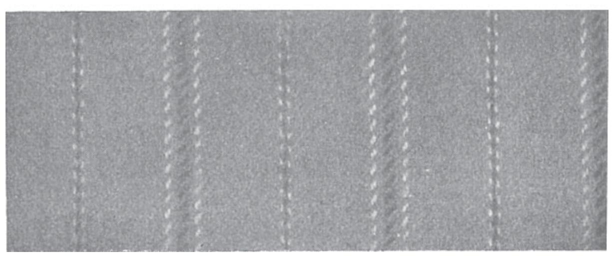


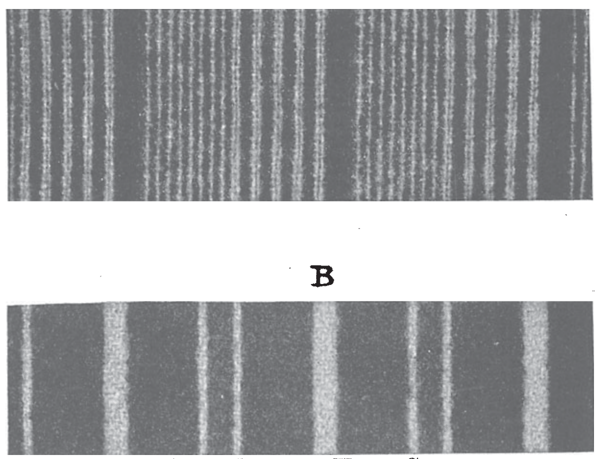
FIG. 57.
WORSTED-YARN SPECIMENS.

hand, the combed yarn (wool or cotton), and also the fine flax yarn, in which the fibres are grouped in a line with each other, as in the specimen of Botany top in Fig. 24, is the description of yarn to apply in all classes of dress goods when design definition and fabric smoothness are desiderate.

126. *Frame and Self-Actor Spun Yarns.*—The system of mechanical practice in spinning has an important influence on the weavable value and characteristics of the yarn. Frame or continuous-spun yarns (woollen or cotton) present an

evener surface than self-actor or intermittent spun yarns. The filament core and external features of the thread may not, in the operation of spinning, be radically modified. These are formed and established in the process of yarn preparation. Yet the same sliver or slubbing, when converted into yarn by self-actor and frame-spinning, gives two varieties of thread structure. This is exemplified in yarns F (Fig. 59) continuous-spun, and in yarns M, intermittent spun. Both are composed

A



B

FIG. 58.—WOOLLEN-YARN SPECIMENS.

of like materials, and made from the same counts of condensed sliver. Threads F have a less " wild " formation than threads M. Necessarily these two yarn types are not so pronounced as if one yarn had been obtained from a combed roving, and the other from a carded and condensed sliver. The minute differences between the two are, however, equivalent to having a real effect on the handle and appearance of the fabrics in which they are respectively employed. For dress goods, made of either cotton or woollen carded yarns in which filament property in the texture is desired, with the pattern softly defined, the self-actor yarn is the more suitable ; and for

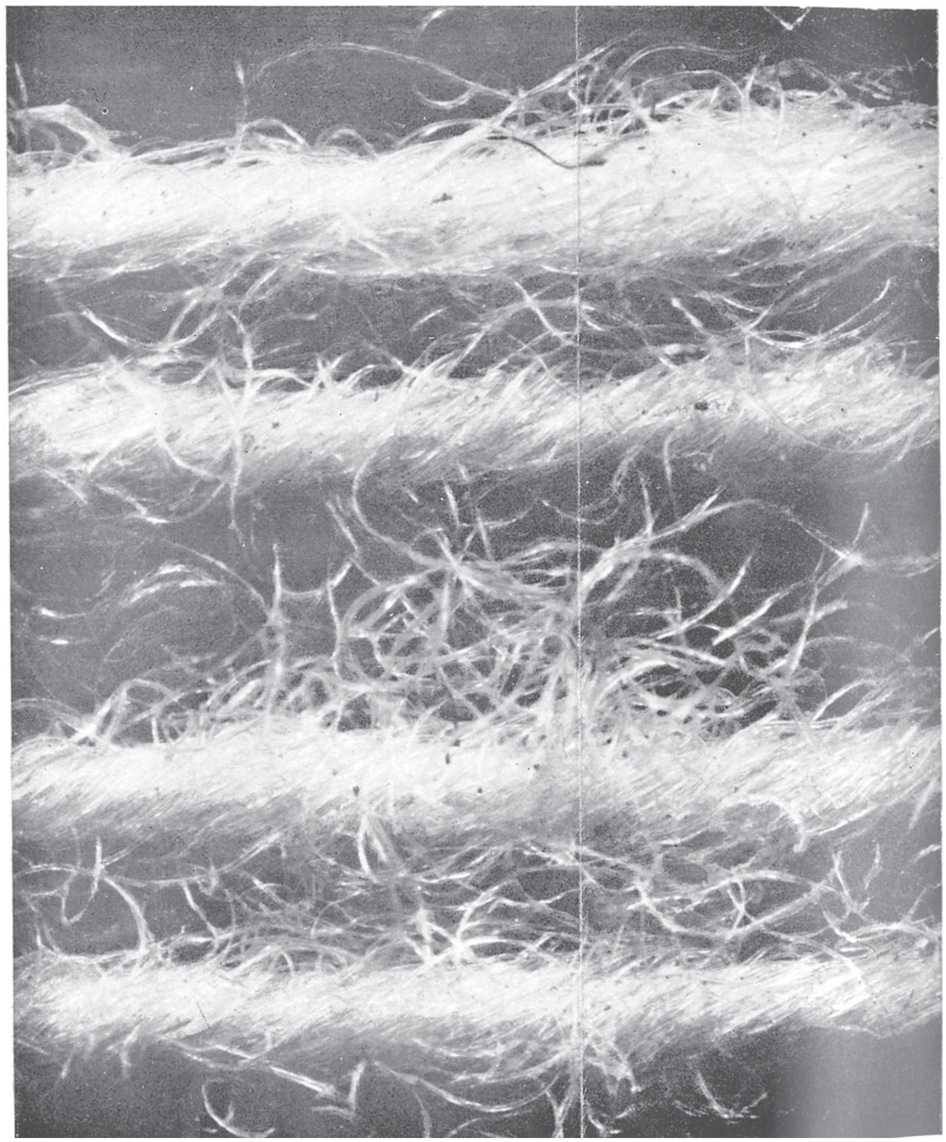


FIG. 59.—SELF-ACTOR AND FRAME SPUN YARNS.

5264—(*bet. pp.* 152 *and* 153)

manufactures made of similar counts of cotton or woollen threads, in which the texture is required to have a smarter and clearer character, with the design elements better defined, the frame-spun quality of yarn is preferable.

127. *Value and Utility of the Yarn Unit in Fabric Construction.*—The thread structures and qualities dissected are suggestive of the "Yarn Unit" having the following values and applications in dress fabric design and construction—

(1) In determining the brightness, lustre, smoothness, clearness of tone, handle and quality of the finished texture, as obtainable from the variety of fibre employed.

(2) In developing differences in fabric features arising from the practice of standard systems of yarn preparation. Similar varieties of raw material, treated by carding, condensing, and self-actor spinning, give thread types of distinctive textural utility and value from the thread types produced by combing, drawing, and frame-spinning.

(3) That the smoother, leveller, and more regular the formation and circumference of the yarn, the better it is adapted for developing pattern elements acquired (*a*) by diversity of weaving scheme, and (*b*) by diversity of colouring in the warp, weft, or both warp and weft.

(4) That the denser the thread in fibre, and also the more compacted the fibres in the yarn, though the surface of the thread may be serrated and rough, the more suitable the yarn for cloths intended for diversified finishing treatment, and the softer and more supple the texture manufactured.

128. *Yarn Diameter and Fabric Types.*—In all classes of woven and knitted manufactures, the count or diameter of the yarn selected is a controlling factor, but particularly is this so in the production of dress and costume fabrics. Here the lightest descriptions of texture are made, as in muslins, crepe de chine, delaines, and gauzes. Taking costume cloths, which represent the heavier classes of dress manufactures, these rarely exceed 10 to 12 ozs. per yard, 54 in. wide. This restriction in weight range has an important bearing on the

counts of yarn used. Fabric weight is regulated by (1) threads and shots per inch, and (2) by the size or circumference measurement of the yarns applied in weaving. The common rule observed in loom-setting, or in fixing the gauge of the cloth, is the smaller the diameter of the threads, the higher the number of threads in a given area of the texture; and, inversely, the thicker the yarns, the smaller the number of threads applicable in a like area of the cloth; hence, in the finer makes of fabric, cotton, and linen, from 110 to 180 threads may be inserted per inch, and in silk brocades and damasks up to 300 or 400 threads. Ordinary makes of dress fabrics, however, such as lustres and poplins, etc., average from 60 to 101; worsteds from 32 to 80, and woollens from 16 to 44, according to the counts of yarn applied.

129 *Basic Principles of Loom-Setting.*—The basic principles of fabric structure, as observed in the plain make, the prunelle, and the $\frac{2}{2}$ twill, and in the ordinary classes of weaves produced in silk, cotton, linen, worsted, and woollen yarns, are exemplified in the Table VIII.

Looming technicalities in all classes of woven texture, have elements in common. As the yarn counts govern the ends per inch, they also affect the fineness or the openness of the make of the fabric. Seeing that every sort of spun thread is of a definite diameter, and that this diameter is ascertainable by calculation, it follows that the denominator, as stated in a fractional portion of an inch, which the diameter represents, is equal to a number of threads, which, if laid side by side, and in contact with each other, would cover an inch. To take an example, single 100's cotton, according to the rule of yarn diameters, is equivalent to $\sqrt{100 \times 840} = 261$. That is without any allowance for extraneous fibre and degree of twine in the yarn, 261 such threads, when aligned with each other, measure 1 in., or the diameter of the yarn is $\frac{1}{261}$. The intersections of the warp and weft, as comprised in a repeat of the weave, deduct from this calculated number of ends per inch. Thus, in the plain, prunelle, and 2-and-2 twill weaves

TABLE VIII

Yarn Counts and Fabric Structures

Specimen No.	A Silk and Artificial Silk Counts.	B Cotton Counts.	C Spun Silk Counts.	D Linen Counts.	E Worsted Counts.	F Woollen Counts Skeins.	G Diameters of yarn in fractional parts of 1″.	Plain Weave. Ends per inch.	Plain Weave. Picks per inch.	Wt. of Yarn per yard, 30″ × 36″. Ozs.	Prunelle. Ends per inch.	Prunelle. Picks per inch.	2/2 Twill. Ends per inch.	2/2 Twill. Picks per inch.
1	28 denier organzine or trame	1/188½'s					358·3	179	179	1·1214	214·9	214·9	238·8	238·8
2	30·22 ,,	1/175's					345·2	172·6	172·6	1·1646	270·12	207·12	230	230
3	33 ,, ,,	1/160's					330·1	165	165	1·2176	198	198	220	220
4	37·7 ,, ,,	1/140's					308·9	154·4	154·4	1·3024	185·28	185·28	205·86	205·86
5	44 ,, ,,	1/120's					285·8	142·9	142·9	1·4062	171·48	171·48	190·66	190·66
6	52·8 ,, ,,	2/200's or 1/100's	100's/2 or 100's/1				261	130·5	130·5	1·541	156·6	156·6	174	174
7	66 ,, ,,	2/160's ,, 1/80's	80's/2 ,, 80's/1				233·4	116·7	116·7	1·7226	140	140	155·6	155·6
8	70·4 ,, ,,	2/150's ,, 1/75's	75's/2 ,, 75's/1	2/420's or 210's			226	113	113	1·7792	135·6	135·6	150·66	150·66
9	75·4 ,, ,,	2/140's ,, 1/70's	70's/2 ,, 70's/1	2/392's ,, 196's			218·3	109·1	109·1	1·8404	130·92	130·92	145·5	145·5
10	81·2 ,, ,,	2/130's ,, 1/65's	65's/2 ,, 65's/1	2/364's ,, 182's			210·4	105·2	105·2	1·9312	126·34	126·34	140·25	140·25
11	88 ,, ,,	2/120's ,, 1/60's	60's/2 ,, 60's/1	2/336's ,, 168's			202	101	101	1·9878	121·2	121·2	134·66	134·66
12	96 ,, ,,	2/110's ,, 1/55's	55's/2 ,, 55's/1	2/308's ,, 154's			193.5	96.7	96.7	2·0762	116·04	116·04	129	129
13	105·6 ,, ,,	2/100's ,, 1/50's	50's/2 ,, 50's/1	2/280's ,, 140's			184.55	92·27	92·27	2.178	108·72	108·72	123·06	123·06
14	117·3 ,, ,,	2/90's ,, 1/45's	45's/2 ,, 45's/1	2/252's ,, 126's			175	87·5	87·5	2·2962	105	105	116·66	116·66
15	132 ,, ,,	2/80's ,, 1/40's	40's/2 ,, 40's/1	2/224's ,, 112's	2/120's or 60's		165	82·5	82·5	2·4354	99	99	110	110
16	150·8 ,, ,,	2/70's ,, 1/35's	35's/2 ,, 35's/1	2/196's ,, 98's	2/105's ,, 52½'s		154·41	77·2	77.2	2.6048	92·64	92·64	102·94	102·94
17	176 ,, ,,	2/60's ,, 1/30's	30's/2 ,, 30's/1	2/168's ,, 84's	2/90's ,, 45's		142·95	71.5	71·5	2.8144	85·8	85·8	95·3	95·3
18	211·3 ,, ,,	2/50's ,, 1/25's	25's/2 ,, 25's/1	2/120's ,, 60's	2/75's ,, 37½'s		130·5	65.25	65.25	3.0822	78·24	78·24	87	87
19	264·1 ,, ,,	2/40's ,, 1/20's	20/'s2 ,, 20's/1	2/112's ,, 56's	2/60's ,, 30's	65·6's	116.7	58·3	58·3	3.4424	69·96	69·96	77·8	77·8
20	352 ,, ,,	2/30's ,, 1/15's	15's/2 ,, 15's/1	2/84's ,, 42's	2/45's ,, 22½'s	49·2's	101	50·5	50.5	3.9758	60·6	60·6	67·33	67·33
21	528·25 ,, ,,	2/20's ,, 1/10's	10's/2 ,, 10's1/	2/56's ,, 28's	2/30's ,, 15's	32·8's	82.5	41·25	41·25	4.8714	49·5	49·5	55	55
22	704·3 ,, ,,	2/15's ,, 1/7½'s	7½'s/2 ,, 7½'s/1	2/42's ., 21's	2/22½'s ,, 11¼'s	24·6's	71.4	35·7	35·7	5·62	42·84	42·84	47·6	47·6
23	880·4 ,, ,,	2/12's ,, 1/6's	6's/2 ,, 6's/1	2/33·6's ,, 16·8's	2/18's ,, 9's	20's.	63·9	31·9	31.9	6.2786	38·28	38·28	42·6	42·6
24	1760·8 ,, ,,	2/6's ,, 1/3's	3's/2 ,, 3's/1	2/16·8's ,, 8·4's	2/9's ,, 4½'s	9·84's	45·2	22.6	22.6	8·8964	27·12	27·12	30·13	30·13
25	5282.5 ,, ,,	2/2's ,, 1's	1's	2/5·6's ,, 2·8's	2/3's ,, 1½'s	3·28's	26.1	13	13	15·3522	15·66	15·66	17·4	17·4

quoted in Table VIII, the threads and picks per inch for 100's cotton, are—

PLAIN MAKE— $\dfrac{261 \text{ (dia. 100's cotton)} \times 2 \text{ (ends or picks in weave).}}{2 \text{ (intersections in weave, threads or picks)} + (2 \text{ ends or picks in weave})} = 130{\cdot}5.$

PRUNELLE TWILL— $\dfrac{261 \text{ (dia. 100's cotton)} \times 3 \text{ (ends or picks in weave).}}{2 \text{ (intersections in weave, threads or picks)} + 3 \text{ (ends or picks in weave)}} = 156{\cdot}6.$

$\frac{2}{2}$ TWILL— $\dfrac{261 \text{ (dia. 100's cotton)} \times 4 \text{ (ends or picks in weave).}}{2 \text{ (intersections in weave, threads or picks)} + 4 \text{ (ends or picks in weave)}} = 174.$

No allowance is made in these results for the true workable diameter of the yarns, which varies with the material of which the yarn consists, the diameter allowance added for silk being $2\frac{1}{2}$ per cent., cotton and linen, 5 to $7\frac{1}{2}$; worsted, $7\frac{1}{2}$ to 10 ; and woollen 10 to 15. These percentages reduce the possible ends per inch, or the actual diameter of the yarn for weaving purposes, but have not been taken into consideration in framing Table VIII, in which the ends and picks per inch of the respective fabrics are stated as they would approximately be in the finished texture. By allowing the different percentages named on each yarn, the loom-setting for each example could be arrived at.

130. *Elements in Practical Setting.*—In explanation of Table VIII, it should be stated that columns A, B, C, D, E, and F comprise the yarn counts, namely, silk, cotton, spun silk, linen, worsted, and woollen, or the principal sorts of yarn used in textile manufacture. Second, column G comprises the diameters of the threads in the respective counts, as acquired in all instances on the calculated basis. The adoption of this rule gives the diameters of corresponding sizes of silk, spun silk, cotton, linen, worsted and woollen yarns as identical. For example, in No. 19 the theoretical diameter is given as $\frac{1}{116{\cdot}7}$ for 264·1 denier silk, 2-fold 40's cotton, 20's 2-fold silk, 2-fold 112's linen, 2-fold 60's worsted, and 65 skeins woollen. Actually, as explained, the diameters of these several sorts of

thread, for cloth setting, would vary with the fibre of which they are composed, and also in some degree with the system of thread manufacture practised. The more level the structure of the yarn, and the harder its twine, the nearer to its calculated diameter. For practical purposes, by taking the threads per inch possible in the fabric as obtained from the diameters as representing the maximum threads per inch in the contracted or finished fabric, the comparative basis of weight calculation indicated in Table VIII would be satisfactory. The diameter of the yarn for setting in the loom, or for the average number of ends in the reed, and the shots per inch in the weaving of the fabric, requires to be increased in the ratio of the difference between (*a*) the calculated and the working diameter of the yarn, and (*b*) between the width of the contracted and loom-woven fabric. To take the counts of the yarn for specimen No. 20, with a maximum diameter of $\frac{1}{101}$, giving in the plain weave 50·5 ends and picks per inch, then, in the first place, for the loom setting, $2\frac{1}{2}$ per cent. would be allowed on the silk, 5 per cent. on the cotton, 10 per cent. on the worsted, and 15 per cent. on the woollen, and in the second place, the degree of contraction estimated or allowed between the loom and finished widths, would also be taken into account. Regarding the latter factor, it is one determined by the quality of manufacture intended. The settings illustrated are such as would give a firm or normal build of fabric ; but, in practice, a flimsy, loose, or super-flexible texture, as well as a super-hard and strong texture are producible. For the loose type, the setting fixed on the yarn diameter basis, less a percentage of allowance for the production of openness of fabric structure, would be made ; and hence for the firm type of fabric, the ends and picks in the loom, as determined by the rule of diameters and intersections, might be slightly increased.

131. *Thread Counts and Fabric Thickness.*—It will now be apparent that in the exact ratio in which the diameter of the warp and weft threads is diminished, the " set " of the cloth

may be increased; and, on the other hand, that in the exact ratio in which the threads are augmented in diameter, the set of the cloth may be decreased. Silk, as reeled from the cocoon, is a continuous thread, with a diameter of from $\frac{1}{1250}$ to $\frac{1}{1600}$ part of an inch; and, as shown in Paragraph 24, if applied in weaving in the natural size, would result in a plain interlaced texture of approximately 800 to 1,000 threads and shots per inch. In Table VIII, the finest silk thread specified, 28 denier, has a diameter of $\frac{1}{358 \cdot 3}$, and hence, as indicated, is weavable in a plain fabric, having 179 ends and picks per square inch. Such a texture has a weight of 1·2644 ozs. per yard. Clearly this is not the lightest woven silk structure producible; net or thrown silk may be used in smaller counts such as 20, 15, or 10 denier, with a relatively larger number of ends and picks per inch than the fabric defined in specimen No. 1 of this table. With the diminution of the size of the threads, the texture becomes more flimsy and gossamer-like in character.

Cotton and linen yarns, for special purposes, may be spun to a higher diameter than indicated, such as $\frac{1}{400}$ to $\frac{1}{500}$ part of an inch, but the commercial standards rarely surpass 2/180's cotton, and 2/490's linen for warp and weft, though in yarn tables the counts are theoretically carried out to 600's (cotton) and 1,620 (linen), or the equivalent of 8.803 denier silk.

132. *Textural Weight per Yard.*—The weight per yard of the woven product, when set on the intersection basis, rises proportionately with the size or thickness of the yarn employed. The data contained in Table VIII under this head are instructive, and need to be dealt with. Plain textures, varying from 1·1214 ozs. to 1·4062 ozs. per yard, 30 ins. wide, silk and cotton counts, are specified in 28 to 44 denier, and in 1/188's to 1/120's cotton. For textures ranging from 1·5401 ozs. to 1·7226 ozs., the counts of silk, cotton, and spun silk yarns are shown. For textures from 1·7792 to 2·2962 ozs. in silk, cotton, spun silk and linen, the counts quoted opposite examples 8 to 14 inclusive are suitable. In looming the fabrics (Nos. 1 to 14) the warp yarns would be 2-fold in cotton, spun silk, and linen, but the

number of ply in the silk would be in accordance with the quality of texture manufactured.

Analyzing these yarn counts further, it will be seen that for cloths of 2·4354 to 3·08222 ozs., worsted, as well as silk, cotton, and linen threads, are usable. Finer counts of worsted are spinnable than specified, such as 2/140's, 2/160's, up to 2/200's, but 2/120's and downwards are the commoner count bases. The equivalent to 2/60's worsted (No. 19) in woollen, is 65·5 yarns per dram. Sixty skeins and higher counts of woollen yarns have been experimentally prepared by redrafting in the process of spinning, but for ordinary practice from 44 to 48 or 50 yards per dram are the maximum. Hence, in the cloths averaging from 3·4424 to 6·2786 ozs. (Nos. 19 to 23) woollen, in addition to worsted, cotton, and linen yarns are utilized. Ordinarily, in the dress and costume trade, the extreme weight is reached in specimen 23, or as represented in a plain cloth made of 18 to 20 skeins woollen, and equivalent to about 6 ozs. per yard, 30 × 36 ins.

While the silk threads are quoted in the lower diameter of yarns, their chief utility is in the counts included in Nos. 1 to 18. Spun or waste silks may be economically employed in textures of a heavier quality than the pure or "net" silks, or in such counts as enumerated in Nos. 17 to 21, with a more general application to the type of manufacture comprised in examples 10, 11, 12, and 13.

133. *Technical Practice and Yarn Counts.*—The object in technical practice is to select and apply the yarn qualities in the counts in which they are standardized, adapting the loom setting to the weight and variety of texture desired. Silk is the kind of yarn to employ in the production of the finest and lightest fabrics. Waste silk yarn, warp and weft, are applicable to similar fabric structures as cotton and linen yarns. Cotton threads, as seen in column 2, Table VIII, to which might be added linen, provide the fullest range in cloth manufacture, inasmuch as they are suitable for the construction of the finer, the medium, and the thicker grades of fabric. The worsted

yarns, of the Botany class, are largely applied in the production of fabrics ranging in yarn counts from 2/30's to 2/120's, and of the Crossbred class, ranging from 2/12's to 2/32's, with, in both types of fabrics, either 2-fold or single yarn for weft. The woollen yarns are obviously the best adapted for the heavier sorts of costume fabrics—Saxony qualities in counts from 20's to 44 skeins; and Cheviot qualities, in 8 to 20 yards per dram.

So far, fabrics in the plain weave only have been considered, but, in the Table VIII, settings are also given for the prunelle and the $\frac{2}{2}$ twills. These, with the plain make, form the three standard types of weave in the dress industry. For showing how the number of interlacings in the weave unit modifies the ends and picks per inch in the texture, reference will be made to the sectional sketches of these types of woven fabric in Figs. 60, 61, and 62. Taking a group of twelve threads in each cloth, the intersections on each pick are—in Fig. 60, 12; in Fig. 61, 8; and in Fig. 62, 6. The fewer the intersections on a given number of threads, the larger the number of ends per inch possible in the loom in a given counts of yarn, which will be evident on comparing the ends per inch in the following examples from Table VIII—

No.	Diameter of the Yarn.	Plain Weave. Threads and Picks per inch.	Prunelle. Threads and Picks per inch.	$\frac{2}{2}$ Twill. Threads and Picks per inch.
6	261	130·5	156·6	174
8	226	109·1	130·92	145·5
11	202	101	121·2	134·66
13	184·55	92·27	108·72	123·06
15	156	82·5	99	110
21	82·5	41·25	49·5	55

The ratio of intersections in the respective weaves, causes the decrease in the threads per inch in a corresponding diameter of yarn; or in the ratio of the decrease of the intersections between the textures in Figs. 60 and 61 and between the textures in Figs. 61 and 62.

To take a further illustration, say that of the 8-shaft sateen, Fig. 63, with 3 intersections on 12 threads, and applied to 2/80's cotton, diameter $\frac{1}{165}$, it results in 132 threads per inch, as compared with 110 in the 2-and-2 twill, 99 in the prunelle, and 82·5 in the plain make, showing that as the number

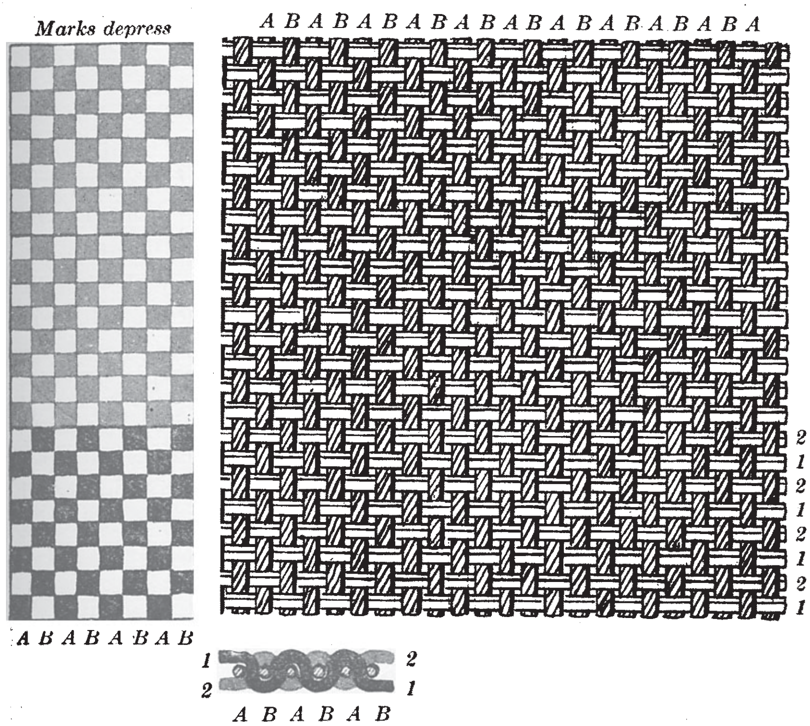


FIG. 60.—PLAIN FABRIC STRUCTURE.

of the intersections decreases, the number of threads per inch, as represented by the diameter of the yarns, is approximately diminished. This implies that the weight per yard of the fabric in any given counts of yarn, though the setting may be correct and adopted to the weave structure, augments with the looseness of the plan of yarn interlacing.

134. *Variations in " Warp " and " Weft " Settings.*—The specimens examined have been in fabrics woven on what is

technically termed the square, that is, corresponding in ends and picks per inch. In practice this rule is greatly varied. For economic weaving, it is common for the picks inserted per inch to be less than the threads per inch in the warp. The evener and better varieties of fabric may, as a rule, be produced

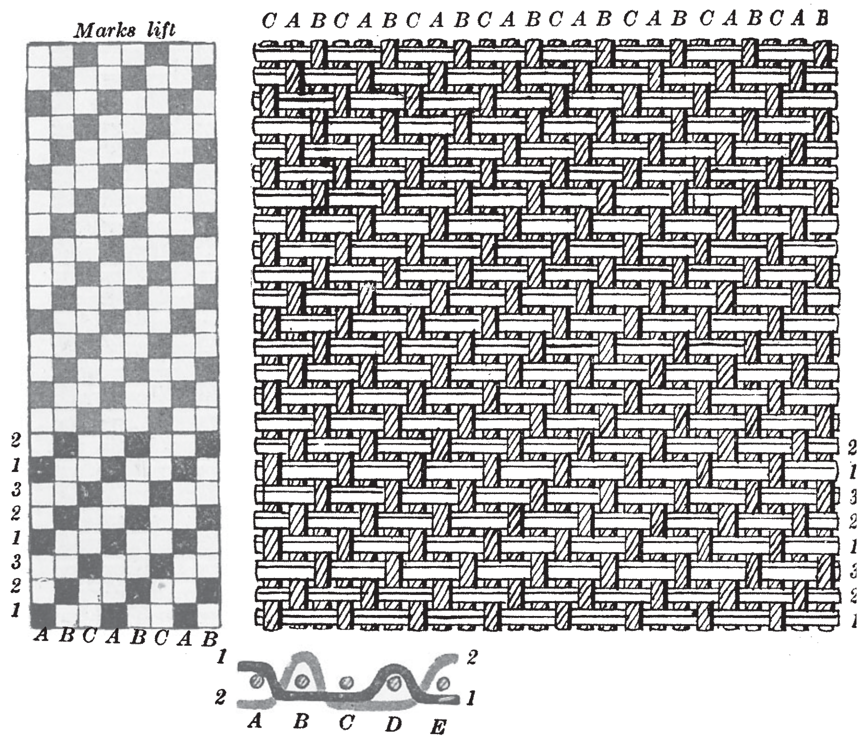


FIG. 61.—PRUNELLE TWILL FABRIC STRUCTURE.

on the basis shown in the Table, which results, when the counts of the warp yarn are the same as those of the weft yarn, in textures of an equal tensile standard, and of wearing strength, in length and width. Either a variation in the setting of the two sorts of yarn (warp and weft) or in their relative counts, alters the fabric in these characteristics. The tensile standard may be equalized, in some degree, by increasing the thickness of the weft yarn in the ratio with which the picks, as compared with the threads per inch, are reduced, but the surface quality of the fabric is modified. A cloth, for example, made of 2/100's cotton in the warp and weft, with 92 threads and picks per inch finished, would, on comparison, be found to differ from

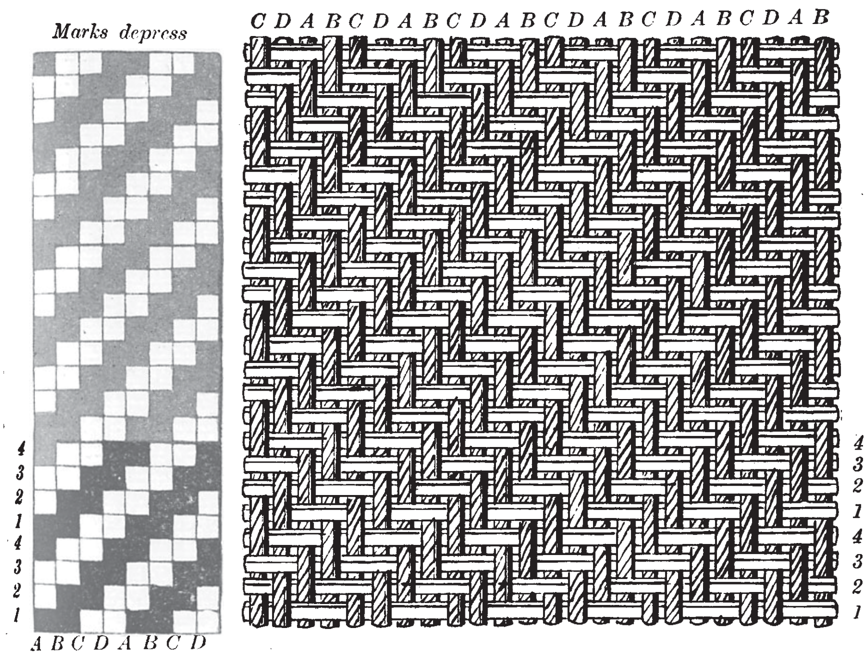


Fig. 62.—Cassimere or $_{2}^{2}$ Twill Fabric Structure.

a cloth in which the warp was 2/100's with 92 threads per inch, and the weft 2/60's with 72 picks per inch. Both cloths would be approximately of the same weight per yard, that is, of the same filament density, but the thicker counts of weft in the second cloth, though the picks should be proportionate in number with the difference in the diameters of 2/100's and 2/60's, or in the ratio of 184·55 to 142·95, would change the cloth structure and quality. Still, this method of fabric construction, with a view of reducing the cost in weaving, and also in manufacture, by employing in the weft a lower count of yarn than that used in the warp, is followed. The practice has another effect—it changes the character of the weave, especially if this is of a twilled type. In fabrics woven on the square, the angle of the common twills is 45°. By lowering the picks,

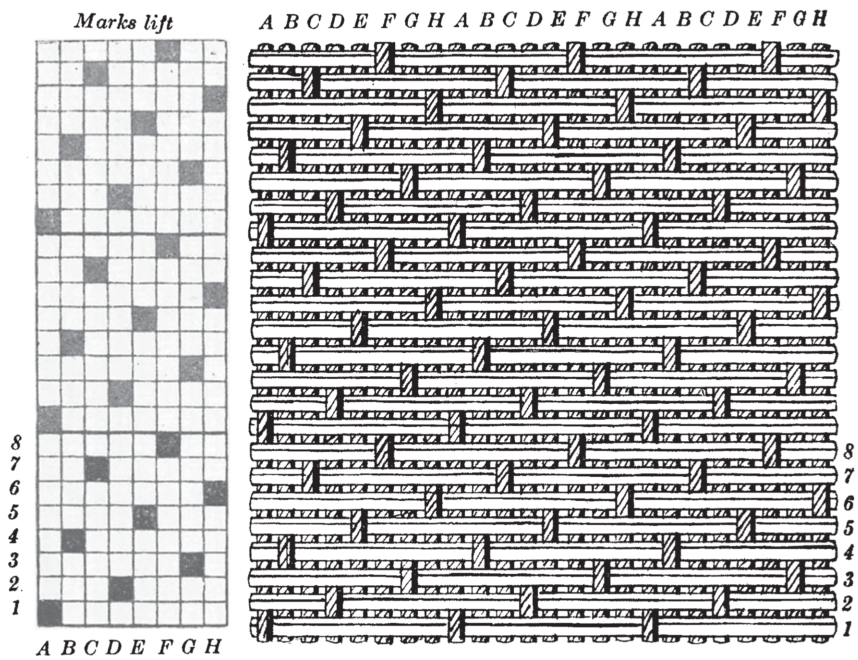


FIG. 63.—SATEEN FABRIC STRUCTURE.

in comparison with the threads per inch, the lines of the twill are elongated. Should, for instance, specimen 15, Table VIII, be woven in 2/120's worsted with 110 threads per inch, and wefted with 40's worsted, 80 picks per inch, the $\frac{2}{2}$ twill angle would be changed from 45° to one of about 70°. In a plain weave, this alteration of the picks, relative to the ends, also modifies the fabric character. For example, a spun-silk texture, No. 6, with 130 warp ends per inch, woven with 50's cotton and 92 picks per inch, would give a repp or cord texture.

The production of cloths on this basis, that is, unbalanced in the warp and weft setting, is practised in different branches of dress manufacture, especially in cloths of a repp, poplin, and a like character.

135. *Coloured Effects and Yarn Diameters.*—The manner and degree in which the counts of yarn modify the pattern development, resulting from the grouping of coloured yarns in the warp and weft, will be explained by comparing the textural styles in Figs. 64, 65, 66, 67, and 68. They are respectively woven in silk, cotton, linen, woollen and worsted yarns, and the several effects are produced in the plain weave. The orders of the colourings are as follows—

SILKS. Fig. 64—A, B, C, D, E, F, G

Specimen A—	*Warp :*	White	6	6	1	1	1	1	1	
		Black	4	2	1	1	1	1	1	2
	Weft :	All Black.								
,, B—	*Warp :*	White	6							
		Black	4							
	Weft :	White	4							
		Black	6							
,, C—	*Warp :*	White	9	3						
		Black	3	3						
	Weft :	White	10	2						
		Black	2	2						
,, D—	*Warp and Weft :*	White	6							
		Black	16							
,, E—	*Warp and Weft :*	White	8							
		Black	20							
,, F—	*Warp and Weft :*	White	8	8						
		Black	2	10						
,, G—	*Warp and Weft :*	White	4							
		Black	4							

COTTON. Fig. 65—A and B

Specimen A—	*Warp and Weft :*	White	8						
		Black	8						
			40						
,, B—	*Warp and Weft :*	White	2	2	2	2	2	2	2
		Black	2	2	12	2	12	2	12

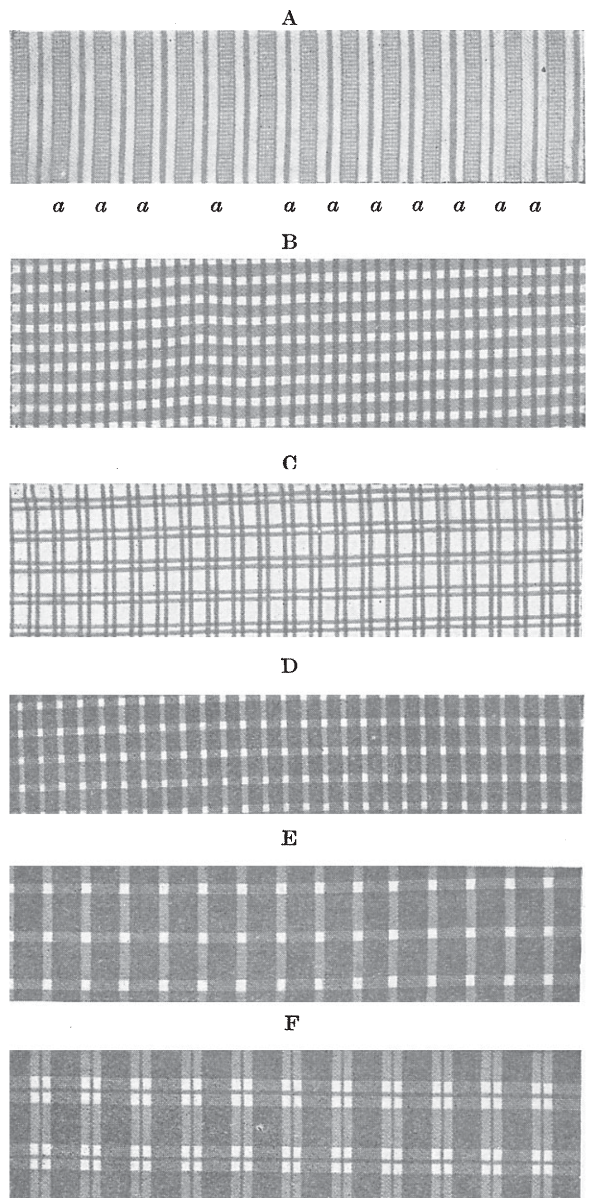


Fig. 64.—Coloured Silk Styles—Plain Woven.

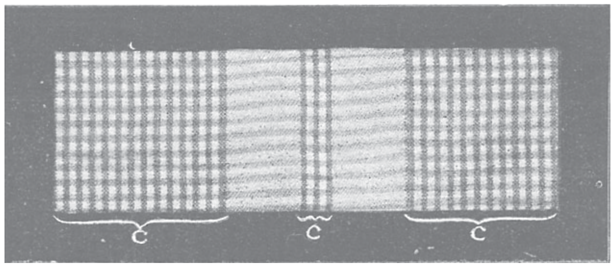


FIG. 64G.—SILK COLOURED STYLE.

LINEN. Fig. 66—A, B, C

Specimen A—	*Warp and Weft:*	White	3
		Black	3
,, B—	*Warp and Weft:*	White	4
		Black	2
,, C—	*Warp and Weft:*	White	5
		Black	5

WOOLLEN. Fig. 67—A, B, C, D

Specimen A—	*Warp and Weft:*	White	2
		Black	2
,, B—	*Warp and Weft:*	White	4
		Black	4
,, C—	*Warp and Weft:*	White	6
		Black	6
,, D—	*Warp and Weft:*	White	8
		Black	8

WORSTED. Fig. 68—A and B

Specimen A—	*Warp:*	White	15	15	1	1				
		Black	3	1	1	3				
	Weft:	All White.								
,, B—	*Warp and Weft:*	Black	1	1	1	1	2	2	4	
		Grey	1	1	1	1	2	2	4	
		White	1	1	1	1	2	2	4	

The yarn counts, ends, and picks per inch, and approximate weights per yard (30 in. × 36 in.) of the different specimens, being typical of the influence of the diameter of the loom setting, as well as of the fineness of the texture manufactured, are tabulated below—

Specimens.	Yarn Counts.	Yarn Dia.	Ends per inch.	Picks per inch.	Weight in ozs. per yd. 30″ × 36″.
Fig. 64 A, B, C, D, E, F.	52 denier silk	$\frac{1}{261}$	132	130	1·54
Fig. 64G.	72's/2 silk	$\frac{1}{218}$	108	106	1·84
Fig. 65A	2/80's cotton	$\frac{1}{165}$	82	80	2·40
Fig. 65B	2/60's cotton	$\frac{1}{142}$	70	70	2·81
Fig. 66 A and C	2/32's linen	$\frac{1}{64}$	32	32	6·4
Fig. 66B	2/20's linen	$\frac{1}{50}$	26	24	8·27
Fig. 67 A, B, C, D, E,	10 skeins woollen	$\frac{1}{42}$	21	21	8·7
Fig. 68 A and B	2/22's worsted	$\frac{1}{71}$	36	36	5·62

A primary feature for comparison in these plain-woven coloured styles, is the differentiation in their surface tone and character, which is particularly observed in the fineness of the

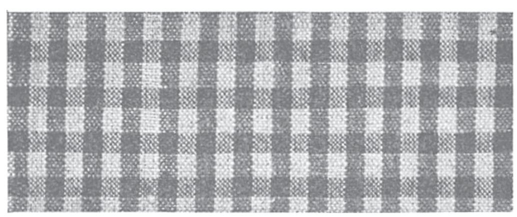


FIG. 65A.—SILK COLOURED STYLE.

silk, the clearness of the cottons, the thread-like definiteness of the linens, the softened pattern characteristic in the woollens, and the surface smartness of the worsteds. These distinguishing elements and qualities in the fabrics are primarily of a filament origin. The same series of effects, if woven in metallic threads of the different sizes, and in the different settings tabulated, would satisfactorily develop the several schemes of design detail, varying in scale from a minimum type in the smallest diameter of thread, to a maximum type in the threads of the greater circumferential area. But in threads of silk, cotton, linen and woollen, other textural properties are seen, and the species of patternwork produced are modified by (*a*) the variety of fibre of which the yarn is spun, and (*b*) by the system of yarn structure adopted in preparing and spinning.

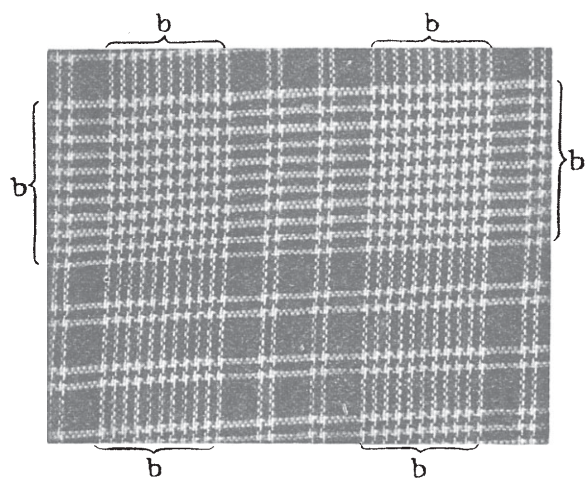


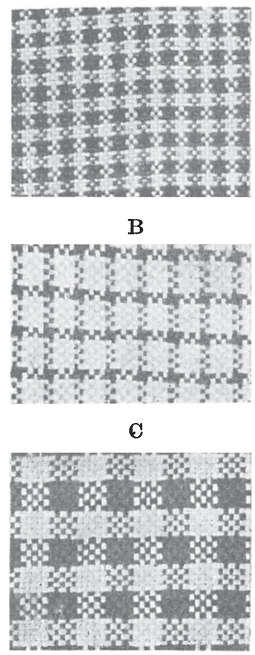
FIG. 65B.—COTTON COLOURED STYLE—PLAIN WOVEN.

136. *Pattern Contrasts.*—In each group of cloths represented, it is evident that clear and precise pattern delineation is feasible. Though the effects are minute in the silk specimens, they are clearly distinguishable ; and, in corresponding warping and wefting, conform in type with those obtained in the woollen yarns of five or six times the diameter. All descriptions of textural pattern derived from certain orders of weaving two or more shades of warp and weft yarns, agree in detail and in style in whatever class and counts of yarn produced. The fineness, openness, or structural compactness of the pattern, is, however, dependent on the size of the yarns, and on the sort of filament of which the yarns are made. This will be rendered more apparent by examining and comparing the coloured

specimens in Figs. 64, 65, 66, 67, and 68. These comprise the following series of pattern types and contrasts—

I. Contrasts in " 1-and-1 " colouring as exemplified in silk and worsted textures, parts *a* in Figs. 64A and 68A. The " 1-and-1 " forms the most elementary order of warp and weft

A



B

C

FIG. 66.—LINEN COLOURED STYLES—PLAIN WOVEN.

colouring, and gives the finest species of colour effect obtainable in woven fabrics. When the order of shuttling is in accord with the order of warping, lines in the two shades of yarn are formed in the length or in the width of the cloth. If the warping, as in these examples, should be arranged 1-and-1 and the wefting be in one colour, the lines become broken or specked. In Fig. 64A they are extremely fine in character, but in Fig. 68A—in which the yarns are of a thicker diameter, two threads as one—the lines are better defined, and produce what is known as the bird's-eye spot. The points to be

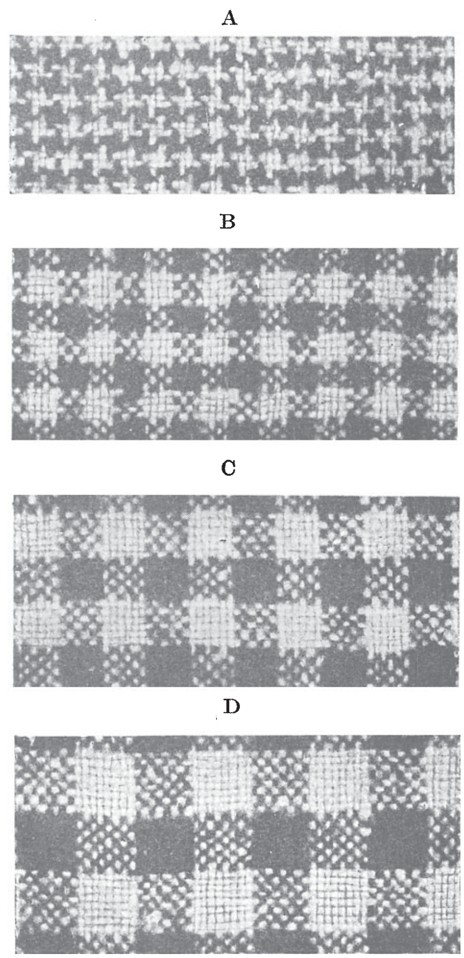


FIG. 67.—PLAIN WOVEN WOOLLEN COSTUME STYLES.

specially noted are the increased closeness and minuteness of the detail in the silk as compared with the worsted, and the perfect symmetry of the pattern type in both cloths.

II. Contrast in " 2-and-2 " colouring, as seen in the cotton and woollen specimens in section *b*, Fig. 65B, and in Fig. 67A. This grouping of warp and weft threads constitutes the simplest check basis, and is applicable to the different varieties of weave and fabric structures. In cotton and woollen yarns it is suggestive (1) of the perfect agreement of the pattern types producible in small and thick threads, the diameter of the

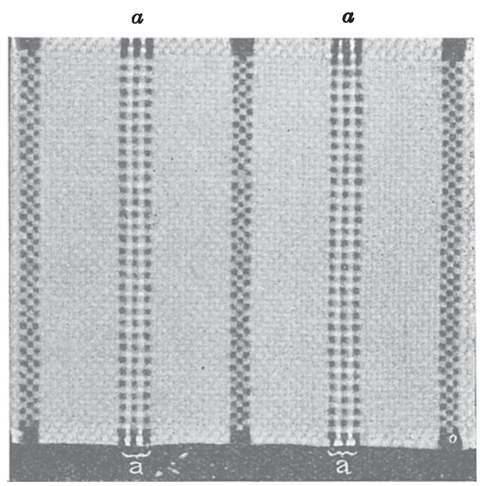
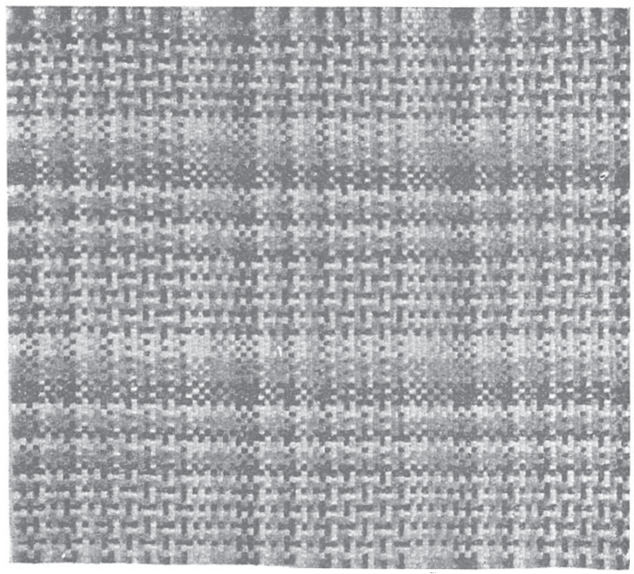


FIG. 68A.—WORSTED COSTUME STYLE.

cotton threads in Fig. 65B being $\frac{1}{142}$ and of the woollen threads in Fig. 67A, $\frac{1}{42}$; and (2) of the clearness of the effects when woven in cotton textures, and of the rougher character the effects possess when woven in woollen textures.

III. Contrasts in the " 4-and-4 " colouring in silk and woollen yarns, as observed in section *c*, Fig. 64G, and in Fig. 67B. This order of checking, as that in the " 2-and-2," is a standard colouring in each class of fabric—linen, silk, cotton, woollen, and worsted. It is a severer rectangular pattern than that obtainable by warping and wefting 2-and-2. The difference in the textural style in these examples is very pronounced, owing, in the first place, to one repeat in the woollen being equal to several repeats of the checkings in the silk; and, in the second place, to the fine, smooth surface of the silk (Fig. 64G) as compared with the somewhat irregular and broken surface of the woollen (Fig. 67B).

IV. Contrasts in the "8-and-8" colouring as illustrated in the silk specimen in Fig. 65A, and in the "3-and-3" colouring



b a c b a c b a

FIG. 68B.—WORSTED COSTUME STYLE—COMPOUND COLOURING.

in the linen specimen in Fig. 66A. Here the two patterns differ in dimensions, but, in the finer yarn, a repeat of the pattern contains twelve threads, and, in the heavier counts of yarn, only six threads. The interlacings of the yarns are consequently more marked in the linen than in the silk texture. It should be observed that the grouping of the threads and picks in odd multiples (Fig. 66A) such as 3-and-3, 5-and-5, 7-and-7, etc., produces a more diversified form of checking than the grouping of threads and picks in even multiples, such as 4-and-4, 6-and-6, etc.

V. Contrasts in strong or pronounced checkings and as typified in the silk textures in Figs. 64E and F, in the cotton sample in Fig. 65B, in the linen fabric Fig. 66C, and in the woollen cloths in Fig. 67, C and D. In these specimens the qualities of the pattern due to the yarn unit are better observed than in the smaller variety of checkings. The warp and weft lines, forming the checks, are the most distinctly developed in the silk fabrics (Fig. 64, E and F) which indicates that the smoothness of this yarn, combined with its fineness, makes it adapted for the delineation of pattern style as acquired from the grouping, and in a specified order, of warp and weft threads. The cotton check (Fig. 65B) is looser in structure, and the lines, whether in warp or weft, are less smartly defined. If the yarns had been mercerised the checking would have more closely corresponded with the patterns obtained in silk; but, in the case of ordinary cotton threads, the rawness of the pattern tone is quite appreciable as contrasted with the neatness and brightness of the pattern tone in specimens E and F, Fig. 64.

The straightness and evenness of the linen yarns (Figs. 66A, B and C) assist in developing the clear checkings characteristic of this class of fabric. The detail features in the patterns, produced by crossing the warp and weft yarns, are also better distinguished in linen than in cotton manufactures.

The size of the pattern forms in these several examples, emphasizes the coarser and rougher grain of the woollen-yarn cloths, C and D, Fig. 67. The thickness of the threads and their undulated and fibrous surface, and also the open setting practised in weaving such specimens, develop broadness of character in the checkings. In the intermediate sections between the solid squares of black and white, in which the two yarns are equally intermingled, the plain build of the cloth is clearly brought out.

VI. Contrasts in patterns having a light-tinted ground as in the examples reproduced at C and D (Fig. 64), at Fig. 66B, and at Fig. 68A. It will be seen that the checking lines in the silk and linen (Figs. 64C and 66B) are precisely accentuated with the repeats of the patterns formed in a small number of ends and shots; while the stripings in the worsted (Fig. 68A) being crossed with white weft, are less continuous in character but well pronounced in tone. In light-coloured yarns the make of the fabric is more visible than in dark-coloured yarns, and this adds to the interest and structure of the woven style. Without magnification, the interlacings of the warp and weft, especially in medium and coarser-set cloths, are traceable, as is apparent in the linen style in Fig. 66B and in the worsted style in Fig. 68A.

VII. The contrasts in worsted yarns, as observed in sections *a*, *b*, and *c* of Fig. 68B, are suggestive of the degree of pattern emphasis possible in the use of three shades of yarn, and also of the special adaptability of Botany worsted yarns for the development of colour effects. This intermingled check style is obtained by combing three orders of colouring, namely the 3-odd thread, the 3–2's and 3–4's methods of warping and wefting. Each section of the pattern thus composed, contains twelve threads and twelve picks. The medium shade, in neutral grey, is a yarn consisting of 50 per cent. of black and of 50 per cent. of white fibre, mingled together in the drawing operations. Both woollen and worsted yarns are suitable for use in coloured pattern work, in the form of "mixture" or "*mélange*" yarns. In such shades, they provide scope for pattern schemes, resulting in toned or graduated styles, as in dark, intermediate, light, and very light colourings. If the tinted ingredients, admixed in the processes of yarn-making, are in strong contrast with each other, each hue or colour in the yarns may give tone to the composite colour of the fabric; but in other yarns, where the colours blended are analogous in hue, the yarns have, in the fabric, a solid colour quality.

The range of tinting in dress and costume cloths, is widened and varied by this practice in woollen and worsted yarn manufacture. The worsted threads also provide for the smart development of "weave" design, in addition to the clear expression of the pattern types acquired by the system of grouping the warp and weft yarn units on the principles defined.

137. *Comparison of Standard Cotton Yarns.*—For the purpose of indicating the relative sizes and qualities of the cotton yarns standardized and employed in the dress fabric industry, the following varieties of yarns are reproduced to scale, in Figs. 69, 69A, B, C, D, E, and F—

Group I. Fig. 69, Hard Twisted Mule-Spun Yarns—
Specimen A = 2/16's, B = 2/20's, C = 2/30's, and D = 2/40's counts.

Group II. Fig. 69A, Frame Spun-Yarns—
Specimen E = 2/16's, F = 2/20's, G = 2/30's, and H = 2/40's counts.

Group III. Fig. 69B, Carded Yarns, Ordinary Twine—
Specimen I = 2/20's, J = 2/40's, K=2/60's, and L=2/100's counts.

Group IV. Fig. 69C, Combed Yarns, Ordinary Twine—
Specimen M = 2/20's, N = 2/80's, and O = 2/100's counts.

Group V. Fig. 69D, Carded and Gassed Yarns, Soft Twine—
Specimen P = 2/20's, Q = 2/40's, R = 2/60's, and S = 2/80's counts.

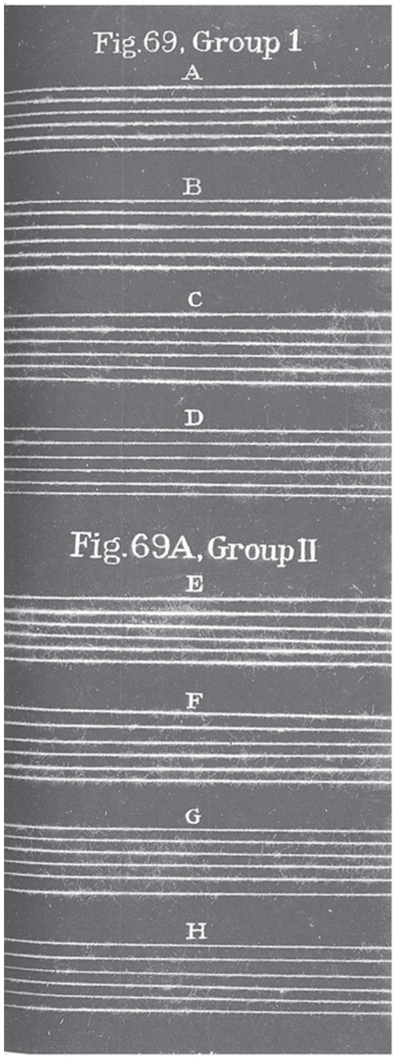
Group VI. Fig. 69E, Combed and Gassed Yarns, Soft Twine—
Specimen T = 2/20's, U = 2/40's, V = 2/60's, W=2/80's, and X = 2/100 counts.

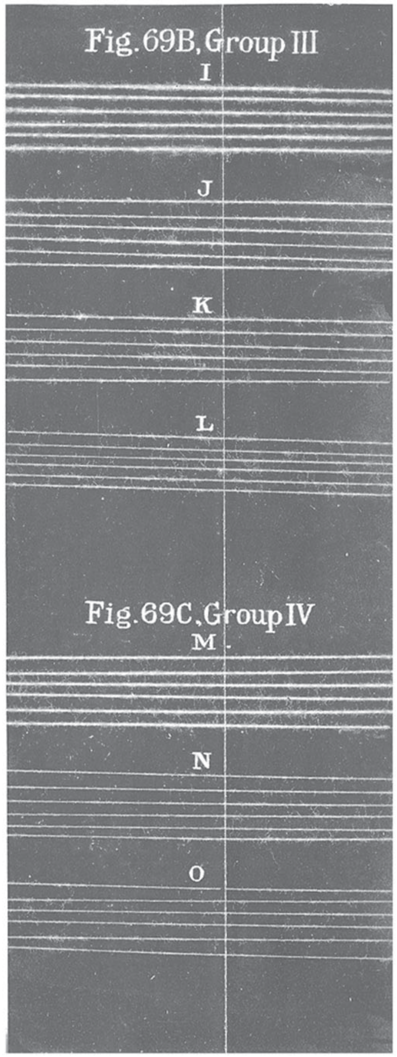
Group VII. Fig. 69F, Voile Yarns, Gassed—
Specimen Y = 1/50's, A^1= 2/80's and A^2 = 2/100's reversed twine.

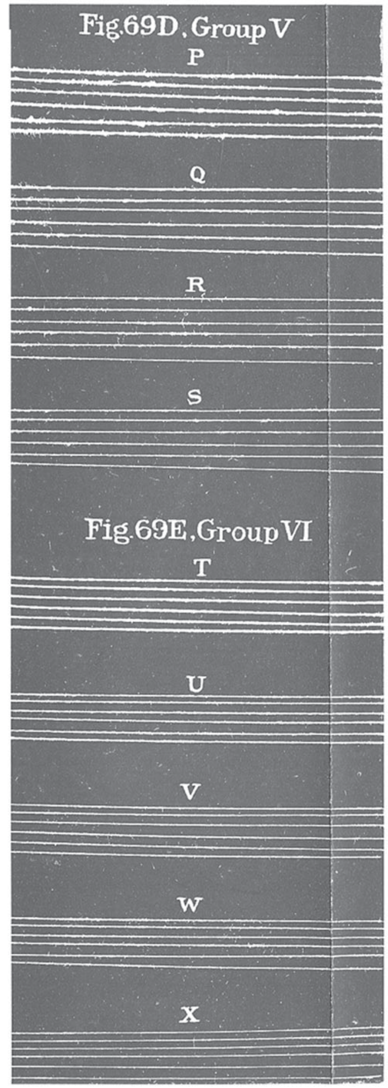
Examining these threads under magnification reveals the following features—

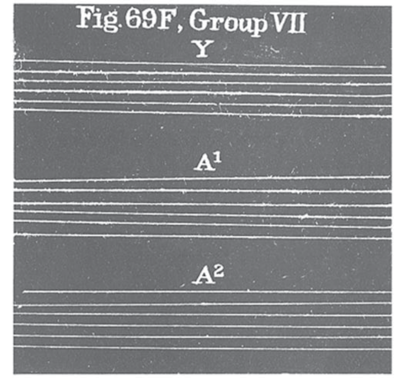
(1) The comparative firmness of the hard-twisted mule-spun yarns (A, B, C, and D) making them adapted to the manufacture of the stronger builds of fabric, and the comparative evenness of the frame-spun yarns (E, F, G, and H) rendering them valuable in the production of cloths of a true and fine character. Both these yarns are useful in the development of textural or weave effects.

(2) That in the ordinary degree of twist, the two yarn types (carded and combed) differ in levelness and smoothness, which is evident on magnifying and comparing samples I, J, K, and L, with M, N, and O. These differentiations are equally









COTTON YARN SPECIMENS

FIG. 69.—SELF-ACTOR SPUN YARNS.

FIG. 69A.—FRAME SPUN YARNS.

FIG. 69B.—CARDED YARNS—ORDINARY TWINE.

FIG. 69C.—COMBED YARNS—ORDINARY TWINE.

FIG. 69D.—CARDED YARNS—GASSED.

FIG. 69E.—COMBED YARNS—GASSED.

FIG. 69F.—VOILE YARNS—GASSED.

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observed in the lower as in the higher counts of yarn. The carded and mule-spun yarn is obviously suitable for producing cloths with a filament surface, as acquired by ordinary practice, and also by raising; while the clear, even formation of the combed yarn, in 2/20's, 2/80's, and 2/100's counts, is, as now understood, the sort of yarn for defining pattern detail due to the methods of crossing threads of warp with shots of weft.

(3) The effect of gassing, in cleaning the surface of the yarns of extraneous fibre, is apparent in both the carded threads Q, R, and S, and in the combed threads T, U, V, W, and X. The quality of fabric obtainable from such yarns, as compared with like counts of yarns ungassed, is one of distinctness of structure, supplemented by smartness of textural face.

(4) The mechanical equality of thread, of a hard-twisted nature, applicable to the making of voile fabrics, is illustrated in Fig. 69F, or in the single fine-spun yarn Y, in the 2-fold twist A^1, and in the 2-fold thread, reversed twine, A^2. For voile cloth manufacture, these structural features in the yarn are essential in acquiring (*a*) clearness and fineness of texture, and (*b*) strength, fineness and firmness of fabric build.

CHAPTER V

WEAVE ELEMENTS AND CLOTH CONSTRUCTION

138.—Fabric Build. 139.—Weave Diversification and Loom Mechanism. 140.—Weave Classification. 141.—Uses of the Plain Weave. 142.—Loom Setting and Cloth Variation. 143.—Systems of Weave Extension. 144.—Prunelle and Warp and Weft Face Twills. 145.—Cassimere and Twills of a Similar Formation. 146.—Two-and-two Twill Derivatives. 147.—Four-end Serge Twills. 148.—Balanced Twill Effects. 149.—Range of Twill Derivatives. 150.—Points in the Construction of Derivative Weave Plans. 151.—Elongated Twills. 152.—Crêpe Effects. 153.—Warp Cords and Cord Twills. 154.—Compound Twills and Diagonals. 155.—Checkings or Dice Patterns. 156.—Waved Effects. 157.—Diamond, Diaper and Lozenge Structures. 158.—Transposed Types. 159.—Mock Lenos. 160.—Honeycomb Plans. 161.—Huckabacks and Weaves giving a Rough Surface. 162.—Sateens. 163.—Twilled Mats. 164.—Point Paper Plans. 165.—Weave "Gamut" and Shaft Mountings. 166.—Six, Seven, and Eight-Shaft Weaves. 167.—Weaves on Nine, Ten and Eleven Shafts. 168.—Weaves on Twelve, Thirteen and Fourteen Shafts. 169.—Weaves on Fifteen and Sixteen Shafts.

138. *Fabric Build.*—The build or construction of the woven fabric is dependent on the order of interlacing the warp and weft threads in the operation of weaving. Four fundamental systems of intertexture are sketched in Figs. 60, 61, 62, and 63 pages 161 to 164.

The looming plans, as prepared on ruled or square paper, are shown at the side of the drawings. These respectively comprise 2, 3, 4, and 8 threads of warp and picks or shots of weft. In Fig. 60 the point paper is marked in alternate squares; in Fig. 61 in twilled arrangement, marking one square and omitting two squares on each pick; in Fig. 62 squares A and B are marked on pick 1, B and C on pick 2, C and D on pick 3, and D and A on pick 4; and, in Fig. 63, square A is marked on pick 1, and D on pick 2, following this scheme of distribution of the marks to the 8th pick in the plan. The textures produced by the different crossings are seen to be dissimilar in formation. In each example the plan of marking the point paper exactly coincides with the system of interlacing, or with the fabric " make " or " build," giving in Fig. 60 a *plain*, in Fig. 61 a *prunelle*, in Fig. 62 a $\frac{2}{2}$ twill or *cassimere*, and in Fig. 63 a *sateen* cloth. In the plain and the $\frac{2}{2}$ twill textures, the warp and weft yarns are equally floated on the face and on the underside of the cloth; whereas, in the prunelle, there are two parts of warp to one part of weft on the face, and on the back two parts of weft to one part of warp; and in the sateen $\frac{7}{8}$ of warp on the upper surface to $\frac{1}{8}$ of weft, and on the lower surface $\frac{7}{8}$ of weft to $\frac{1}{8}$ of warp; or, as in Figs. 61 and 63, the positions of the yarn units may be reversed.

The alternate principle of intersection in Fig. 60 represents the first principles of cloth construction. The prunelle is typical of all ordinary twilled weaves, in which one thread of warp in the series of threads combined, i.e. 4, 5, 6, 7, etc., is crossed or covered by one pick of weft—an order of intersection which enables either a warp or a weft face twilled cloth to be woven. The cassimere is the most elementary type of twilled weave producible in which the warp and weft lines are equal in dimensions on both sides of the texture. The sateen is a different type of weave, being illustrative of the varieties of texture, having either a warp or weft surface, in which the interlacings are at least one thread and one pick apart, the distance of one intersection from the other being mathematically fixed by the ends and picks occupied by the weave.

139. *Weave Diversification and Loom Mechanism.*—Weave diversification is restricted by the capacity of the loom, or by the practice in " warp shedding," and also by the practice of shuttling or of inserting the picks of weft. In shedding, the warp threads are displaced in consecutive groups (each group corresponding to a fraction of a repeat of the weave) for the passage of the shuttle, by " shafts," " staves," or " heddles," as in the treadle, tappet, and dobbie looms, or by " harness cords," as in the Jacquard machine. In the use of shafts,

the possible individual movements of the warp ends are limited to the number of shafts or shedding units employed, which rarely exceeds 8 in the tappet motion and 32 or 36 in the dobbie. In the harness mounting, the range for textural design is much greater, being equivalent to the number of control wires in the machine—100, 200, 300, 400, 600, or as many as 1,200 to 2,000. Cloth planning is, however, mainly restricted to weave elements obtainable on 2, 3, 4, and other numbers of shafts. The weave elements formable in each series of shafts are extensible in the picks, for the repeat of a weave may be confined to a small number of threads but comprise a larger number of shots, as, for example, in the origination of fancy twills and diagonal patterns.

140. *Weave Classification.*—Dress-fabric construction, owing to the diversity of fibrous materials in which the goods are manufactured, and also the diversity in the thickness of the yarns utilized, and to the range of " settings " in the warping and wefting, offers the fullest latitude for variation in cloth build, arising from, and determined by, the methods of yarn interlacing. In this connection " weave " might be studied in respect to the units of effect obtainable in specific shaft mountings, i.e. mountings consisting of different numbers of heddles. Taking the plans made on 2, 3, 4, 5, etc., shafts as representative of different varieties of intertexture, this system of classification would include, in these several shaft mountings, weaves of a like category in addition to the special types of weave workable in each series of shedding units comprised.

The subject will, therefore, be dealt with as it is divisible into weave principles of special application to dress goods, blouse textures, and worsted and union costume cloths. At the same time attention will be given to the numbers of shafts employed in forming weave types. Weaves of one healding denominator will be considered as such, and it will be shown in what way they differ in textural utility from weaves of a similar construction having other working denominators.

Thus examined, " weave " structures and " weave " patterns are reducible to following distinctive classes—

TABLE IX

GROUP CLASSES OF ELEMENTARY WEAVES

I. The Plain Weave and its Derivatives.
II. Warp-Face and Weft-Face Twills.
III. Balanced Twills, e.g. Twills of an equal number of Warp and Weft intersections on both sides of the cloth and with the lines of Warp and Weft equal in size.
IV. Derivatives of the Common or Standard Twills included in Classes I and II.
V. Elongated Twills—(*a*) in the Warp, and (*b*) in the Weft.
VI. Crêpe Twills and Crêpe Weaves.
VII. Cords, Cord Twills and Stripes.
VIII. Compound Twills and Small Diagonals.
IX. Checkings or Dice Patterns.
X. Waved and Serpentine Patterns.
XI. Diaper, Diamond and Lozenge Effects.
XII. Transposed Effects.
XIII. Mock-leno Plans.
XIV. Honeycombs.
XV. Sateens.
XVI. Twilled Mats.
XVII. Irregular Weaves.

141. *Uses of the Plain Weave.*—The plain make is used in all the different branches of the dress-fabric industry. It is applied to cloths of one colour, and to cloths of one colour of warp and of a second colour of weft, and results in the production of silk, cotton, linen, worsted, and woollen manufactures. The loom setting is, in each method of application, adapted to the style of fabric required. Thus plain textures are made in such yarn qualities and counts, and in such settings as typified below—

A.—SILKS

I. *Crêpe de Chine*—
Warp : 52 denier organzine.
Weft : 52 denier trame.
120 threads and shots per inch.

II. *Spun Silk variety*—
Warp : 60's 2-fold silk.
Weft : 60's silk.
96 threads and 90 shots per inch.

B.—Cotton Textures

I. *Muslins*—

(a) Common or "Book" Variety.	(b) Medium Variety.	(c) Fine Variety.
Warp: 60's cotton.	Warp: 80's cotton.	Warp: 120's cotton.
Weft: 60's cotton.	Weft: 100's cotton.	Weft: 190's cotton.
40 threads and 30 shots per inch.	80 threads and 62 shots per inch.	112 threads and 120 shots per inch.

II. *Crimps*—
Warp: 2/60's cotton.
Weft: 25's cotton.
70 threads and 60 shots per inch.

III. *Voiles*—
Warp: 2/80's cotton.
Weft: Reversed twine.
80 threads and 65 shots per inch.

IV. *Flannelettes*—
Warp: 30's cotton twist.
Weft: 15's cotton.
60 threads and 70 shots per inch.

C.—Linens

I. *Thin Structures*—
Warp: 2/336's linen.
Weft: 1/164's linen.
96 threads and 90 shots per inch.

II. *Canvas Structures*—
Warp: 2/56's linen.
Weft: 28's linen.
40 threads and shots per inch.

D.—Worsted

I. *Botany*—
Warp: 2/60's worsted.
Weft: 30's worsted.
54 threads and 52 shots per inch.

II. *Cross-breds*—
Warp: 2/16's worsted.
Weft: 2/16's or 8's worsted.
24 threads and 22 shots per inch.

E.—Woollens

I. *Saxony-Hailines*—
Warp and Weft:
1 thread of 32 skeins dark shade.
1 ,, ,, ,, light ,,
40 threads and shots per inch.

II. *Cheviot*—

Warp and Weft :

16 Threads. { 2 threads of 12 skeins medium shade.
2 ,, 12 ,, light ,,

8 Threads. { 1 thread of 12 skeins medium shade.
1 ,, 12 ,, light ,,

20 threads and 18 shots per inch.

F.—Unions

I. *Delaines*—

Warp : 30's cotton.
Weft : 30's Botany worsted.
60 ends and picks per inch.

II. *Lustres*—

Warp : 2/120's or 1/60's cotton.
Weft : 32's Lustre worsted or mohair.
60 ends and 56 picks per inch.

III. *Costume Cloths* (*Face Finished*)—

Warp : 2/40's cotton.
Weft : 28 skeins woollen.
48 ends and picks per inch.

142. *Loom Setting and Cloth Variation.*—The above settings illustrate the manner in which cloth variation is acquired in any description of yarn for giving a definite class of woven manufacture. In the cotton crimp, the warp is woven slackly tensioned, which has the effect of developing the creased effect in the fabric. The yarn for the flannelette cloth requires to be of a condition suitable for raising, that is, soft in twine, while that for voile should be of the hard-twisted type defined previously. For developing the plain weave intersections clearly in the linen, examples C, the weft may be 2-fold as well as the warp, but the use of the single weft imparts a degree of softness of handle to the cloths.

Colour effects and styles are largely woven in the plain make as illustrated in Figs. 64, 66, and 67. In settings E, the colour practices in producing hairlines in Saxony yarns, and small checkings in Cheviot yarns, are exemplified. Of the orders of warp and weft colouring applicable to this weave in all kinds of yarn the following are standards—

1-and-1, 2-and-2, 3-and-1, 2-and-2, 3-and-3,
4-and-4, 4-and-1, 2-and-1, 6-and-6, 8-and-8, etc.,

wefting in one shade of yarn, or in the same order as warped.

143. *Systems of Weave Extension.*—The plain make, and many of the elementary weaves—those occupying 3, 4, 5, 6, 7, and 8 shafts—are subject to three forms of extension, first in the warp, second in the weft, and third in both warp and weft. On the first principle, the picks are duplicated variously as in A^1, A^2, A^3, A^4, and A^5, Fig. 70, giving, on the basis of the plain weave, different species of warp cords, such as 2-and-2, 3-and-3, and 4-and-4, and the nondescript types at A^4 and A^5. By an extension of the threads as in A^6 and A^7, or by inverting weaves A^1 to A^5, weft repps or cords are formed. The construction of mats or hopsacks as in A^8, A^9, and A^{10}, is the result of duplicating both the ends and shots of the weave A. If, in this double extension, the process of duplication is irregular elongated mats are produced as at A^{11} and A^{12}. Combining these three systems of extension, mat, and warp and weft cord effects, of the character illustrated in A^{13}, A^{14}, and A^{15}, are acquired. Makes of the mat and compound mat and cord class are usually woven on the square, but for correct cloth production, in *warp* cords, there should be a larger number of threads than picks per inch, and, in the *weft* cords, a fuller number of picks than threads. This is the general rule observed in the manufacture of all descriptions of repp and cord textures.

144. *Prunelle and Warp or Weft Face Twills.*—The prunelle (Fig. 71) is the twilled weave obtainable on the lowest series of heddles. It is the weave used in the making of Cashmere shawls, possibly on account of the advantage it offers in the process of weaving over the $\frac{2}{2}$ twill, only one-third of the threads in the warp being lifted for each pick of weft inserted into the piece. The "cassimere," a corruption of "kerseymere," makes a firmer build of cloth, but the prunelle is also

largely used in producing fine fabrics in either worsted or woollen costume cloths. Stripes and check patterns are obtained by combining plans A and B (Fig. 71) sectionally. The prunelle only yields a small group of derivatives. An

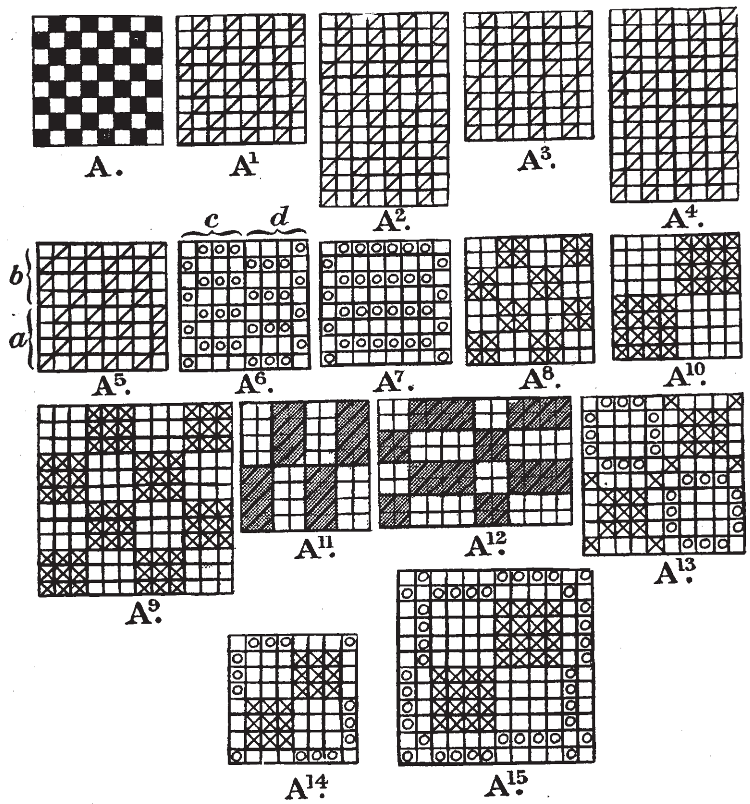


FIG. 70.—EXAMPLES IN WEAVES DERIVED FROM THE PLAIN MAKE.

extension of the picks gives the upright warp twill, A^1, of the threads the oblique twill, A^2 ; and of the picks and threads, the mat twill, A^3. The two weaves A and B are also arranged pick-and-pick and thread-and-thread, yielding, first, the cut twill effect, A^4, in which the warp twill moves to the right, and the weft twill to the left; second, the weft-backed prunelle, A^5, and third, A^6, the warp-backed prunelle A^6.

145. *Cassimere and Twills of a Similar Formation.*—These include the common varieties of twilled weaves, and are only producible on an even number of threads and picks as shown in weaves A and B (Figs. 72, 75, and 77). As both warp and weft interlacings in such weaves have a like function and prominence in the fabric, they make the truest type of cloth structure, agreeing in this particular with the plain or calico weave. By unbalanced loom-setting, emphasis may, however, be given to either the warp or the weft elements, and the normal angle of the twill modified. For example, in a cloth with 64 ends and picks per inch, the twilled lines, in the $\frac{2}{2}$ weave (A, Fig. 72), in the $\frac{3}{3}$, (A, Fig. 75), and in the $\frac{4}{4}$ weave (A, Fig. 77), would have an angle of 45°, or they would present the same angle as that of the twilled lines in the point-paper plans. Should these plans be prepared on 8×16 and on 16×8 paper, they would show, in a theoretical form, the approximate lines of the twills due to changing the loom setting to 64 *picks* and 32 *threads*, and to 64 *threads* and 32 *picks* per inch. It follows that a departure from the plan of uniformity of threads and picks per inch, in the weaving of a twilled fabric, the angle of the twilled lines in the piece becomes altered. It is a method practised, to a limited extent, in changing a common into a more or less upright or a more or less oblique twill; and also in reducing the cost of fabric construction by lowering the number of picks as compared with the threads per inch.

146. *Two-and-Two Twill Derivatives.*—The larger the number of ends and picks occupied by weave, the greater as a rule the range of weaves derivable from a given plan of interlacing. This is seen on comparing the type of effects obtainable by the re-arrangement of the threads or picks of the weaves A and B (Fig. 71) and the weaves A and B (Fig. 72). Whereas from the prunelle twill only three distinctive weave types are obtained, from the $\frac{2}{2}$ twill such different weave elements result as those illustrated at A^1 to A^6 and at B^1, C^1, and C^2 (Fig. 72). Here plans A^1, A^2, and A^3 are respective

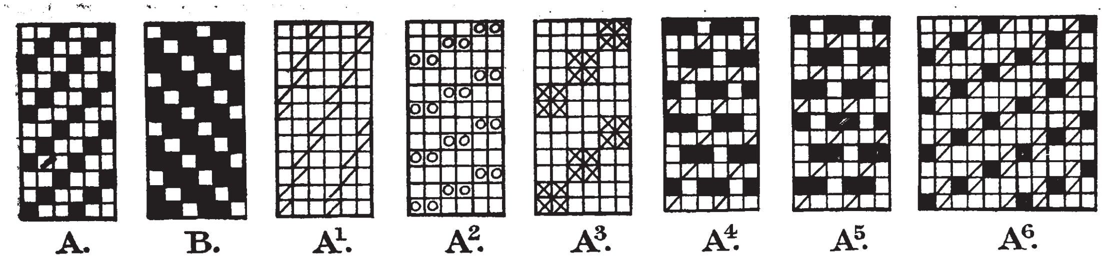


FIG. 71.—EXAMPLES IN PRUNELLE-TWILL DERIVATIVES.

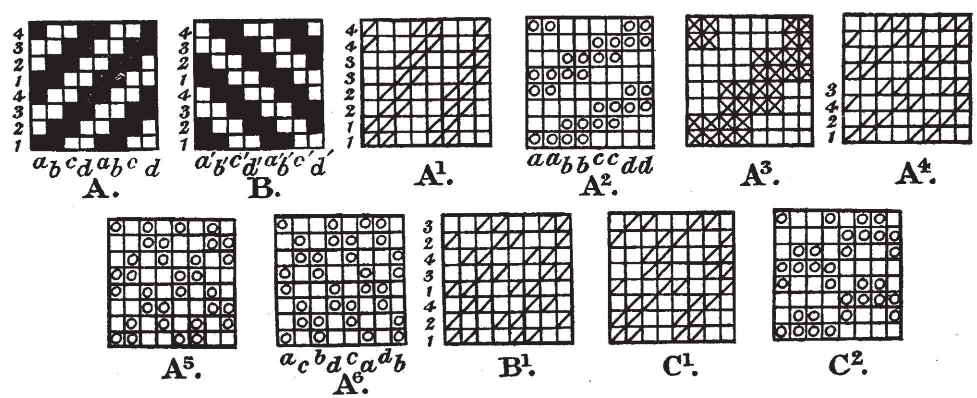


FIG. 72.—EXAMPLES IN CASSIMERE-TWILL DERIVATIVES.

extensions of the picks, the threads, and of both the threads and picks of the weave. Further, the re-grouping of the picks in the order of 1, 2, 4, and 3 forms the crossing at A^4 or a weave-cutting in two's in the picks, and the re-grouping of the threads in the order of *a*, *c*, *b*, and *d* gives the crossing at A^5, or a weave-cutting in two's in the threads. Combining the two plans A and B, Fig. 72, pick-and-pick, makes the small broken mat effect at C^1, cutting on the 3rd and 4th, and on

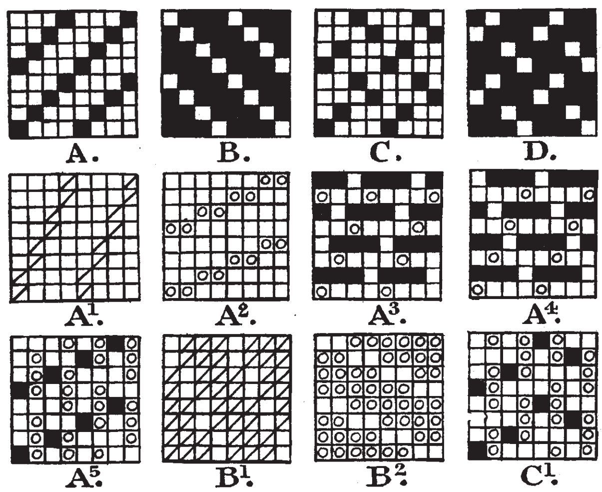


FIG. 73.—EXAMPLES IN SERGE-TWILL DERIVATIVES.

the 7th and 8th picks ; and combining the same two weaves thread-and-thread, produces the broken mat weave at C^2, cutting on the 4th and 5th and on the 7th and 8th threads. Other methods of thread and pick re-arrangement are shown at A^6 and B^1.

147. *Four-end Serge Twills.*—Extensions of these weaves (A and B, Fig, 73) are given at A^1, B^1, A^2, and B^2, and modifications of the weaves, by transposing the order of the threads, are given at C and D. The two latter are known as the broken "swansdown," and have a specialized application in the weaving of cloths with a smooth surface and a fibrous finish,

The combination of either plans A and B or C and D in pick-and-pick, or thread-and-thread grouping, give *weft* and *warp*-backed structures, as shown in weaves A^3 and C^1. The crossings A^4 and A^5, derived from twills A and B, are typical of the "satara" and "stockingette" builds of fabric, which may also be acquired by similarly grouping the picks and threads

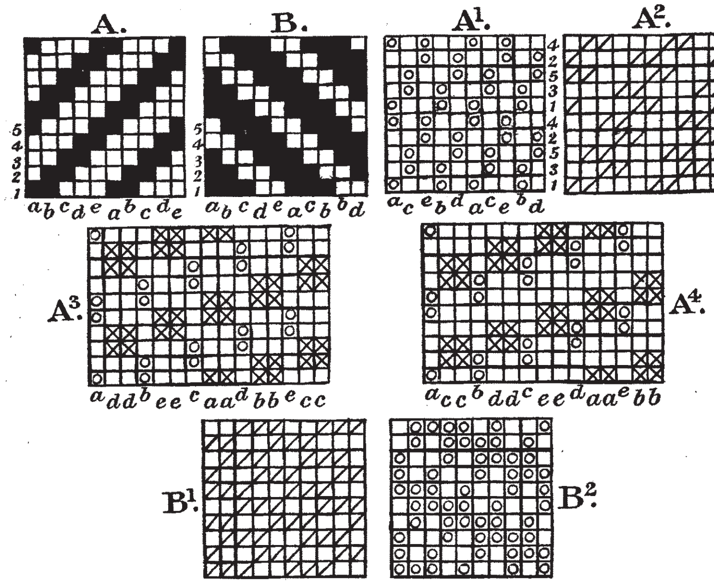


FIG. 74.—EXAMPLES IN FIVE-END TWILL DERIVATIVES.

of weaves C and D. The "satara" is a cloth with the cutting lines weftways. If these run in the direction of the warp, as in Plan C^1, a "stockingette" effect is produced. Both types of make are usable in reversible fabrics.* Employing the 2-ply *warp* structures (Fig. 73, A^5 and C^1) the warp yarns conceal the shots of weft, and employing the same weaves, turned round, and converting them into 2-ply *weft* structures, causes the shots of weft to conceal the threads of warp. Faced-finished costume cloths (Saxony woollen or Botany worsted), are producible in either of these systems of weave-planning. On economic

* See *Standard Cloths: Structure and Manufacture.*

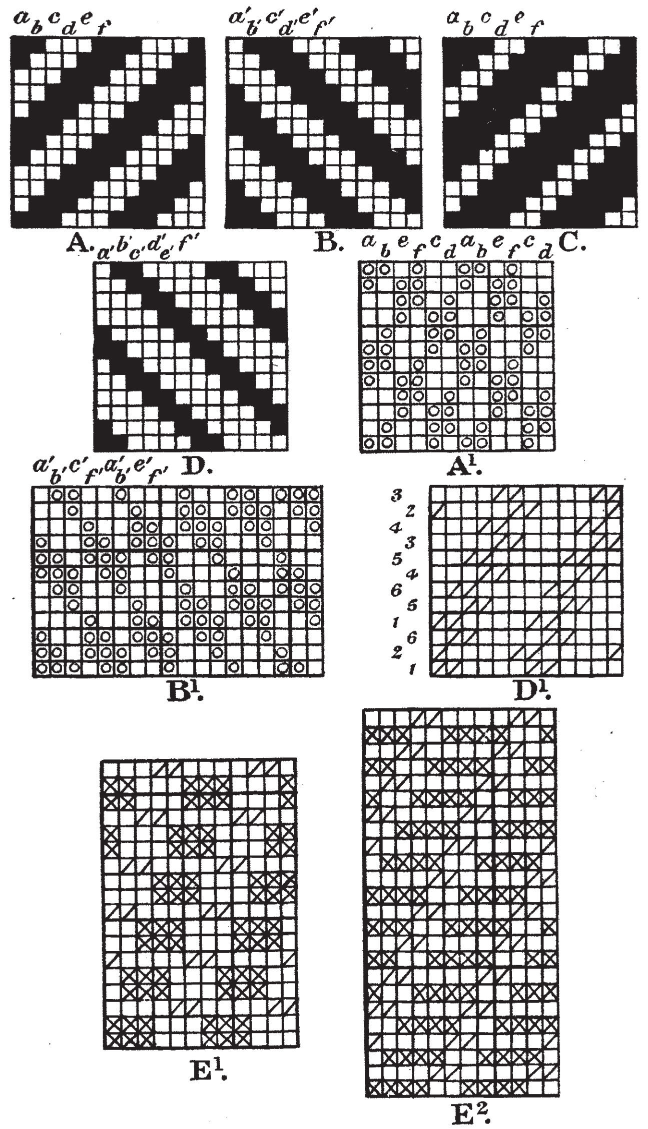


FIG. 75.—EXAMPLES IN SIX-END TWILL DERIVATIVES.

weaving grounds, the warp practice has advantages, and is requisite if a "stockingette" kind of cloth is intended. On the other hand, if cotton yarns are used in the warp, and crossed with woollen or Botany worsted yarns, and the "satara" effect is desired, the weave essential is that formed on the reversible weft principle.

148. *Balanced Twill Effects.*—Textural effects from weave types may be readily designed by selecting twills in which the warp and weft interlacings either coincide in size or approximately balance each other on the two surfaces of the cloth, that is, such twills as $\frac{2}{2}$, $\frac{3}{2}$, $\frac{3}{3}$, $\frac{4}{3}$, $\frac{4}{4}$, $\frac{5}{4}$, etc. In addition, twills occupying 10, 11, 12, or more threads and picks, and also twills of a larger construction (on 16 to 24 shafts) and varied in the lines of warp and weft, are also extensively utilized for re-arrangement purposes, but these are mainly applicable to special grades and descriptions of cloth. Examples in the weave units, derived from the more ordinary classes of twills, are illustrated in Figs. 72 to 78 inclusive. The scheme of weave-planning, varied in the origination of each effect, as well as the basic weave from which the effect has in each instance been obtained, are defined in Table X.

TABLE X

DERIVATIVES OF TWILLED WEAVES

Twilled Base.	Order of Thread or Pick Transposition or Grouping.	Derivative Types.
Fig. 72A, $\frac{2}{2}$ Twill or Cassimere	Plan A^1—Duplicated in the picks	Upright Twill
	„ A^2 „ „ threads	Oblique Twill
	„ A^3 „ „ „ and picks	Step Twill
	„ A^4—Picks 1, 2, 4, 3	Weave cutting two's in the weft
	„ A^5—Threads *a, c, b, d*	Weave cutting two's in the warp
	„ A^6 „ *a, c, b, d, c, a, d, b*	Granite Twill, angle 15°
Fig. 72B	Plan B^1—Picks 1, 2, 4, 1, 3, 4, 2, 3	Granite Twill, angle 60°
Fig. 72A and B	„ C^1—Alternate picks of A and B	Irregular Make
„ „	„ C^2—Alternate threads of A and B	„ „

TABLE X—(*contd.*)

Twilled Base.	Order of Thread or Pick Transposition or Grouping.	Derivative Types.
Fig. 73A, ${}_{1}^{3}$ Twill, Warp-face	Plan A^1—Duplicated in the picks	Upright Warp-face Twill
	,, A^2 ,, ,, threads	Oblique Warp-face Twill
Fig. 73B, ${}_{3}^{1}$ Twill, Weft-face	,, B^1 ,, ,, picks	Upright Weft-face Twill
	,, B^3 ,, ,, threads	Oblique Weft-face Twill
Fig. 73A and B	,, A^3—Alternate picks of A and B, both twilled to the right	2-ply Weft-face Twill
,,	,, A^4—Alternate picks of A and B, twills in reverse direction	2-ply Weft-face Weave.
,,	,, A^5—Alternate threads of A and B, twills to the right	2-ply Warp-face Twill
Fig. 73C, ${}_{1}^{3}$ Broken Twill, Warp-face, and Fig. 73D Broken Twill, Weft-face	,, C^1—Alternate threads of C and D	2-ply Warp-face broken "swansdown"
Fig. 74A, 5-end Twill	Plan A^1—Threads *a, c, e, b, d*	Venetian Twill
,,	,, A^2—Picks 1, 3, 2, 4, 3, 5, 4, 1, 5, 2	Whipcord
,,	,, A^3—Threads *a, d, d, b, e, e, c, a, a, d, b, b, e, c, c*	Mat and Twill
,,	,, A^4 ,, *a, c, c, b, d, d, c, e, e, d, a, a, e, b, b*	Fancy Twill
Fig. 74B, ${}_{3}^{2}$ 5-end Twill	,, B^1—Picks 1, 3, 5, 2, 4	Weft Twill
	,, B^2—Threads *a, c, b, d, c, e, d, a, e, b*	Step Twill
Fig. 75A, ${}_{3}^{3}$ Twill	Plan A^1—Threads *a, b, e, f, c, d, a, b, e, f, c, d*	Twill, cutting 2's in the Warp
Fig. 75B, ${}_{3}^{3}$ Twill to the left	,, B^1— ,, *a′, b′, c′, f′, a′, b′, e′, f′, a′, d′, c′, b′, c′, b′, d′, b′, a′, f′*	Twill, cutting 3's in the Warp
Fig. 75D, ${}_{2}^{4}$ Twill to the left	,, D^1—Picks 1, 2, 6, 1, 5, 6, 4, 5, 3, 4, 2, 3	Whip Cord
Fig. 75 A and D	,, E^1— ,, 1A, 1A, 3D, 2A, 2A 2D, 3A, 3A, 1D, etc.	Mat Twill
,, 75 C ,, D	,, E^2— ,, 1C, 4D, 2C, 2D, 3C, 1D, etc.	Weft-Cord Twill

TABLE X—(*contd.*)

Twilled Base.	Order of Thread or Pick Transposition or Grouping.	Derivative Types.
Fig. 76A, $\frac{4}{3}$ Twill	Plan A^1—Threads *a, e, b, f, c, g, d*	Corkscrew or Warp-Cord Twill
	,, A^3—Picks 1, 5, 2, 6, 3, 7, 4	Weft Corkscrew
Fig. 76 C and D	,, C^1—Threads arranged alternately or thread and thread of C and D	Modified Warp Corkscrew
,, 76 A ,, D	,, C^3—Threads arranged alternately 2 ends of A and 1 end of D.	Compound Twill
Fig. 76D	,, D^1—Threads *a′, f′, d′, b′, g′, e′, c′*	Fine Whipcord
Fig. 77A, $\frac{4}{4}$ Twill	Plan A^1—Picks 1, 3, 7, 1, 6, 7, 3, 5	Step Twill, cutting 2's
Fig. 77B, $\frac{4}{4}$ Twill to the left	,, B^1—Threads *a′, a′, c′, c′, g′, g′, a,′ a′, e′, e′, g′, g′, c′, c′, e′, e′*	Open Twill, mat character
Fig. 77C, $\frac{1}{3}\frac{3}{1}$ Twill	,, C^1—Picks 1, 4, 7, 2, 5, 8, 3, 6	Crêpe Twill
	,, C^2—Threads *c, b, d, c, e, d, f, e, g, f, h, g, a, h, b, a*	Elongated Twill
Fig. 77D, $\frac{1}{2}\frac{3}{2}$ Twill	,, D^1—Threads *a, d, g, b, e, h, c, b*	Twilled-mat
,,	,, D^3 ,, *a, h, b, a, c, b, d, c, e, d, f, e, g, f, h, g*	Elongated Twill
Fig. 78A, $\frac{5}{4}$ Twill	Plan A^1—Threads *a, f, b, g, c, h, d, i, e*	9-shaft Corkscrew
,,	,, A^2 ,, *a, b, f, g, b, c, g, h, c, d, h, i, d, e, i, a, e, f*	Twill skipping in 2 threads
Fig. 78B, $\frac{1}{3}\frac{3}{2}$ Twill	,, B^1 ,, *a, f, b, g, c, h, d, i, e*	Oblique Twill
Fig. 78C, $\frac{1}{3}\frac{2}{1}\frac{1}{1}$ Twill	,, C^1—Picks 1, 6, 2, 7, 3, 8, 4, 9, 5	Crêpe Twill
Fig. 78D, $\frac{1}{2}\frac{4}{2}$ Twill	,, D^1—Threads *a, f, b, g, c, h, d, i, e*	Whipcord inverted

149. *Range of Twill Derivatives.*—It will be observed that, with the enlargement of the weave base, the range of weave derivatives is increasingly diversified. Compare, for example, the plans acquired from the 4-end and 5-end twills, or those from the 6-end and 8-end twills. The $\frac{2}{2}$ twill units (Fig. 72) are of a more stereotyped variety than the $\frac{3}{2}$ twill units (Fig. 74), the latter comprising the Venetian A^1, the weft face Venetian B^1, the whipcord A^2, and the open fancy oblique twills A^3 and A^4. Similar forms of weave, as the open makes, are also got by

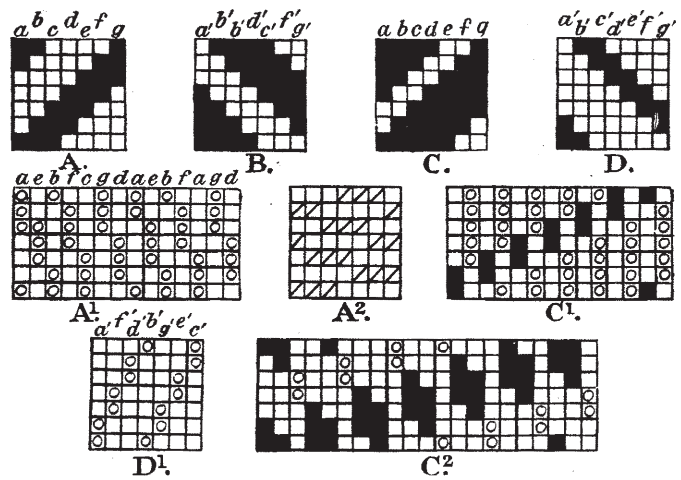


FIG. 76.—EXAMPLES IN SEVEN-END TWILL DERIVATIVES.

following the same systems of thread grouping and using the $\frac{2}{2}$ twill, but less pronounced in the warp effects. The 6-end twill units (Fig. 75), by transposing the threads, include the step twills A^1 and B^1; and, by transposing the picks, the standard whipcord twill D^1; and by combining two picks in a shed of plan A with single picks of plan D, running to the right, a simple variety of diagonal, E^1. The 8-end plans (Fig. 77) are capable of other schemes of elaboration than those illustrated, but clearly these plans are fuller in intersection details than those comprised in Fig. 75. With the possibility of changing and diversifying the lines in the basic twill, as seen at C and D

(Fig. 77), the re-arrangement of the ends or picks gives the twilled mat D^1, and the crêpe twill C^1, and also the elongated and compound twills C^2 and D^2.

150. *Points in the Construction of Derivative Plans.*— Other points for consideration are (1) the different classes of weave structures as derived from plans on an even and odd number of threads respectively; (2) the principles of weave

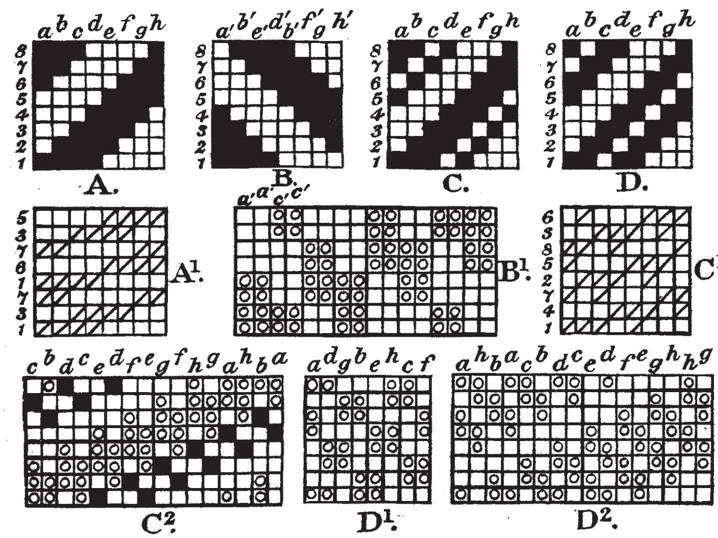


FIG. 77.—EXAMPLES IN EIGHT-END TWILL DERIVATIVES.

formation common to twills generally; and (3) the methods practised in acquiring a new or distinctive type of crossing from a particular twilled weave.

(1) In using twills composed of 5, 7, 9, 11, etc., threads, weaves of a twilled warp or weft cord class may be correctly formed, as in A^1 and A^2 (Fig. 76), which are also made by the same system of thread or pick transposition on 9 and 11 shafts, by employing the $\frac{5}{4}$ and the $\frac{6}{5}$ twills. Further, this variety of cord or corkscrew plan is also formable in twills consisting of an even multiple of threads, but the effects, due to the warp interlacings, are less accentuated as compared with those due

to the weft intersections. This might easily be proved by producing plans of a like arrangement to C^2 (Fig. 76), using plan A (Fig. 75), and to A^1 (Fig. 78), using plan A (Fig. 77). One system of weave definition, in employing the even-thread twills, not applicable to twills of an odd number of threads,

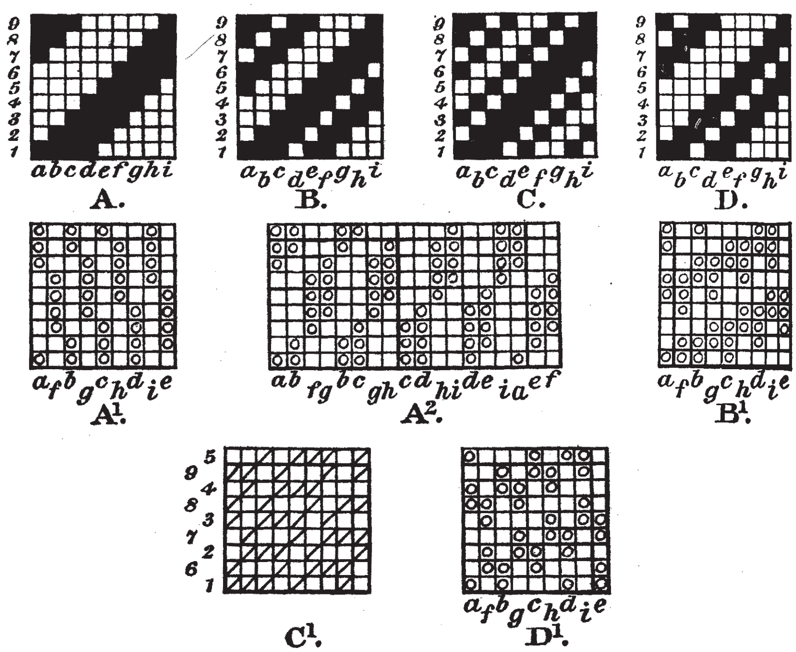


Fig. 78.—Examples in Nine-end Twill Derivatives.

is that of cutting the original twill into equal sectional parts; thus, in constructing plans A^1 and B^1 (Fig. 75) twill A is divided into thirds and halves, and these fractional parts are combined on an extended twill base. The 8-shaft twill, A (Fig. 77), is divisible into fourths as well as halves; and 10-shaft twills into fifths, and 12-shaft twills into sixths, fourths, and thirds, in addition to halves. While, however, equal parts of odd-thread twills are not ascertainable, the threads or picks may be grouped in two's, three's, etc., and in corresponding sections as in the weaves referred to; but the system of construction, in this instance, results in the acquired weave being composed of a similar number of threads as that obtained by multiplying the threads in the twill selected by the number of threads in the motive applied; for example, to combine the ends in groups of 2, 3, or 4, using 7 and 9-shaft twills, would give designs on 14, 21, and 28 threads, and on 18, 27, and 36 threads respectively.

(2) All the standard twills are suitable for modification on sateen weave principles of interlacing, which provide the orders of re-arrangement or transposition of the threads or picks in the different twills specified below—

Weave Base.	Sateen Order of Thread or Pick Arrangement	
4-end Twills	Threads or Picks	1, 2, 4 and 3.
5-end Twills	" "	1, 4, 2, 5 and 3, or
	" "	1, 3, 5, 2 and 4.
6-end Twills	" "	1, 3, 5, 2, 6 and 4.
7-end Twills	" "	1, 5, 2, 6, 3, 7 and 4, or
	" "	1, 3, 5, 7, 2, 4 and 6.
8-end Twills	" "	1, 4, 7, 2, 5, 8, 3, and 6.
9-end Twills	" "	1, 6, 2, 7, 3, 8, 4, 9 and 5, or
		1, 3, 5, 7, 9, 2, 4, 6 and 8.
10-end Twills	" "	1, 4, 7, 10, 3, 6, 9, 2, 5 and 8.
11-end Twills	" "	1, 3, 5, 7, 9, 11, 2, 4, 6, 8 and 10, or
		1, 4, 3, 10, 2, 5, 8, 11, 3, 6 and 9.
12-end Twills	" "	1, 6, 11, 4, 9, 2, 7, 12, 5, 10, 3 and 8.

Certain of these methods of re-arrangement are exemplified in Fig. 74, A^1 and B^1; Fig. 76, A^1, A^2, and D^1; Fig. 77, D^1; and Fig. 78, A^1, B^1, and C^1.

(3) The simple twills are also adapted for re-arrangement by taking sectional parts thereof, and running them in a symmetrical plan either in the direction of the warp or weft. A "motive" or "motives," composed of given threads or picks in the twill selected, is first originated. Such "motives" are next worked into a complete design as in A^4 (Fig. 74), C^2 (Fig. 76), and B^1 (Fig. 77).

151. *Elongated Twills.*—Small diagonals or elongated twills are of two categories—(1) elongated in the direction of the warp

line, that is in the picks on the point paper; and (2) elongated in the direction of the weft line, that is in the threads on the point paper. Elementary examples of these patterns are comprised in certain of the twill derivatives, as at E^1 and E^2 (Fig. 75) and at C^2 and D^2 (Fig. 77). The practice consists in combining two or more simple twills of a suitable scheme of interlacing in pick-and-pick or thread-and-thread order; or in 2-and-1, 2-and-2, 3-and-1, and 2-and-3, and other systems of combination, the plan of grouping agreeing with the type of effect required in the cloth. Examples of a simple character are reproduced at A, B and C (Fig. 79). These are severally formed of two-weave units, and are contrived on the pick-and-pick, basis of plan-onnstruction indicated below—

		Twill Move—
Fig. 79A.		
Odd picks—Weave a =	${}_{2}{}^{3}{}_{1}{}^{2}$	One thread for each pick of the two weaves a and b.
Even ,, ,, b =	${}_{1}{}^{2}{}_{1}{}^{3}{}_{1}$	,, ,, ,,
Fig. 79B.		
Odd picks—Weave a =	${}_{1}{}^{4}{}_{1}{}^{2}$	,, ,, ,,
Even ,, ,, b =	${}_{1}{}^{2}{}_{1}{}^{2}{}_{2}$	,, ,, ,,
Fig. 79C.		
Odd picks—Weave a =	${}_{2}{}^{2}{}_{1}{}^{3}$	,, ,, ,,
Even ,, ,, b =	${}_{1}{}^{2}{}_{2}{}^{3}$	,, ,, ,,

Transposing the plans and substituting threads for picks, would produce twills elongated in a weft line, while grouping the picks of the respective weave units in such orders as two picks of weave a and one pick of weave b, or two picks in a shed of weave a and one pick in a shed of weave b in each example, would further elongate the twilled effect.

Another scheme of plan-making involves the amalgamation of several twilled units in a diagonal form, as in examples D to I, in Fig. 79. These introduce additional principles in design-planning, both in the order of composition and in the selection of weave elements of a suitable structure. The types illustrated in Fig. 79 are formulated thus—

Fig.	79D,	composed of	$\frac{3}{1}$ twill and $\frac{3}{3}$ warp cord.	Approx.	angle 70°
,,	79E	,,	$\frac{1}{3}$ and $\overline{1}\underline{3}$ twills.	,,	,, 70°
,,	79F	,,	Sateen and weft Venetian twills.	,,	,, 63°
,,	79G	,,	Sateen, $\frac{2}{3}\frac{1}{1}$ and $\frac{2}{1}\frac{1}{3}$ twills.	,,	,, 63°
,,	79H	,,	$\frac{2}{2}$ twill and Venetian twill.	,,	,, 70°
,,	79I	,,	Venetian, upright and $\frac{1}{3}$ twills.	,,	,, 70°
,,	79J	,,	Plain, mat and lines of warp twill.	,,	,, 75°
,,	79K	,,	$\frac{3}{3}$ and $\frac{3}{1}$ twills.	,,	,, 80°
,,	79L	,,	Weft, corkscrew, and buckskin twills.	,,	,, 70°

152. *Crêpe Effects* (Fig. 80).—The object in the origination of this group of plans is a texture light in character in which the warp and weft threads are frequently and systematically interlaced. The weave should produce, in the first place, a satisfactory build and grade of fabric, and in the second place, a subdued but distinctive class of woven effect. The types of plans sketched at A to F (Fig. 80) are suggestive of the constructive practice in acquiring closeness and fineness of textural grain, and, at the same time, a specific style of weave pattern. Plan A is an intermingled crossing almost plain, but showing faint twillings in the cloth; B and C are similar to each other in formation, but C yields a faster structure. The twills in C also follow a more oblique line than in B, while the warp elements in the latter tend to develop an indefinite mat quality. Type D is devised on a sateen base containing eight spottings in the weft, and a like number of a smaller size in the warp, with the plain make for the ground. In E and F still clearer twilled lines are developed, retaining the principle of frequency of warp and weft intersection. The use of either cotton or Botany warp yarns, harder twisted than the weft yarns, would develop the twills in E, and the small diamond elements in F. The tensioning of the warp threads in piece

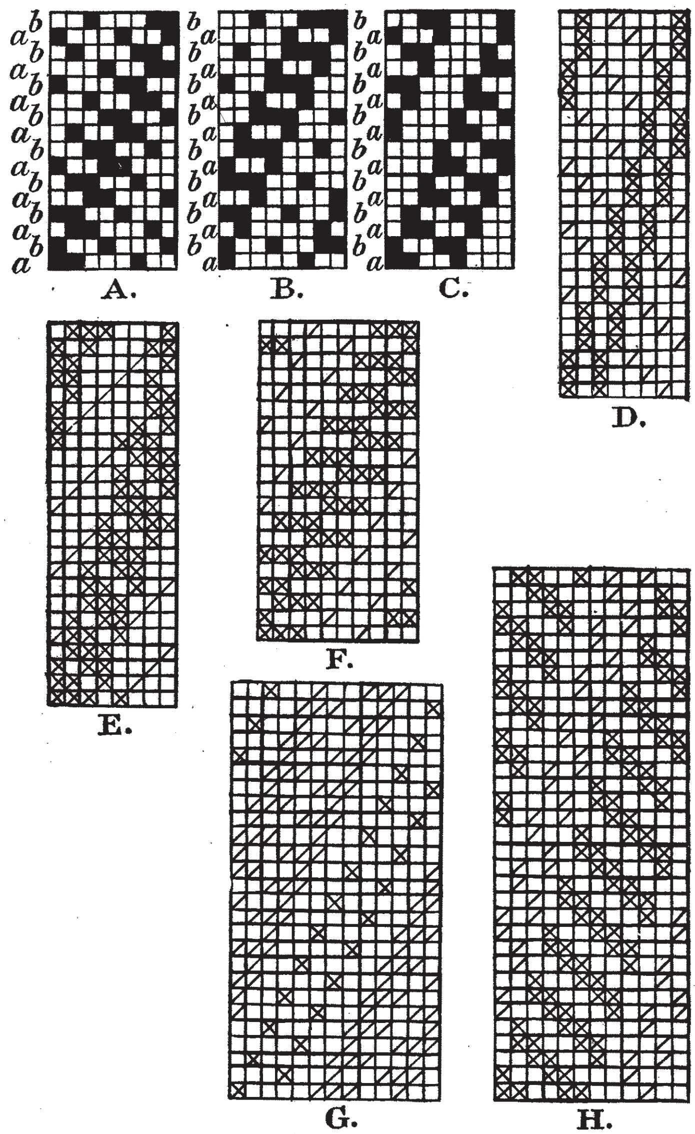
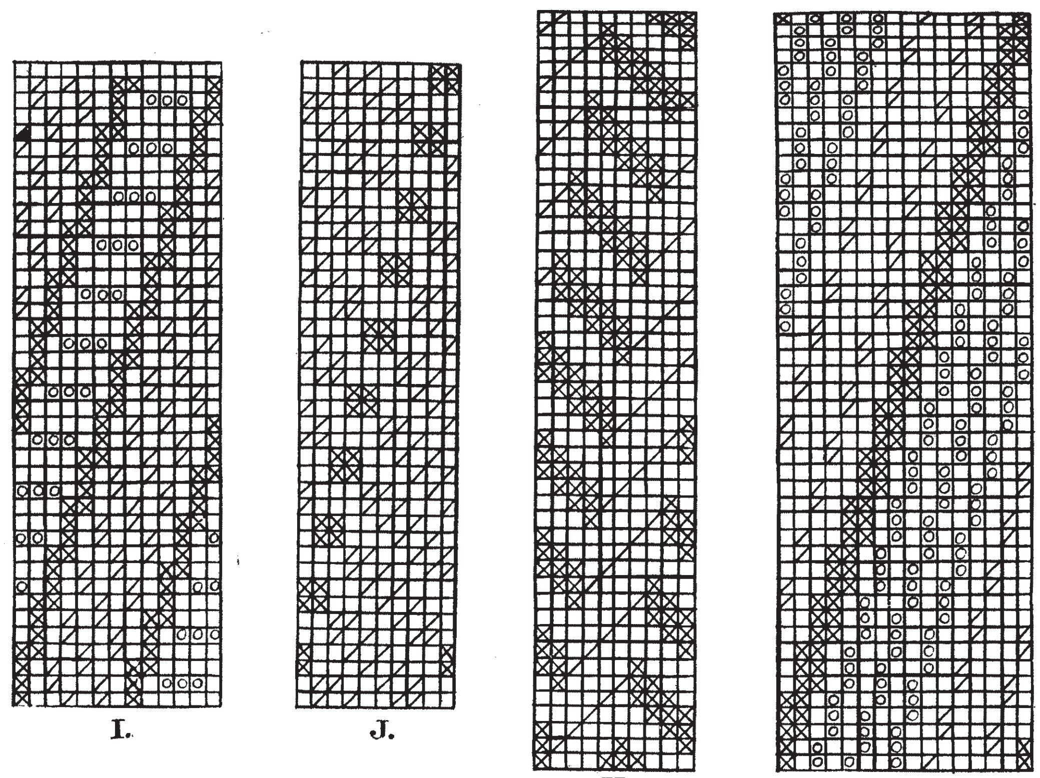


FIG. 79, PLANS A TO H.—EXAMPLES IN ELONGATED DIAGONALS.



I. J. K. L.

Fig. 79, I, J, K, and L.—Examples in Elongated Diagonals.

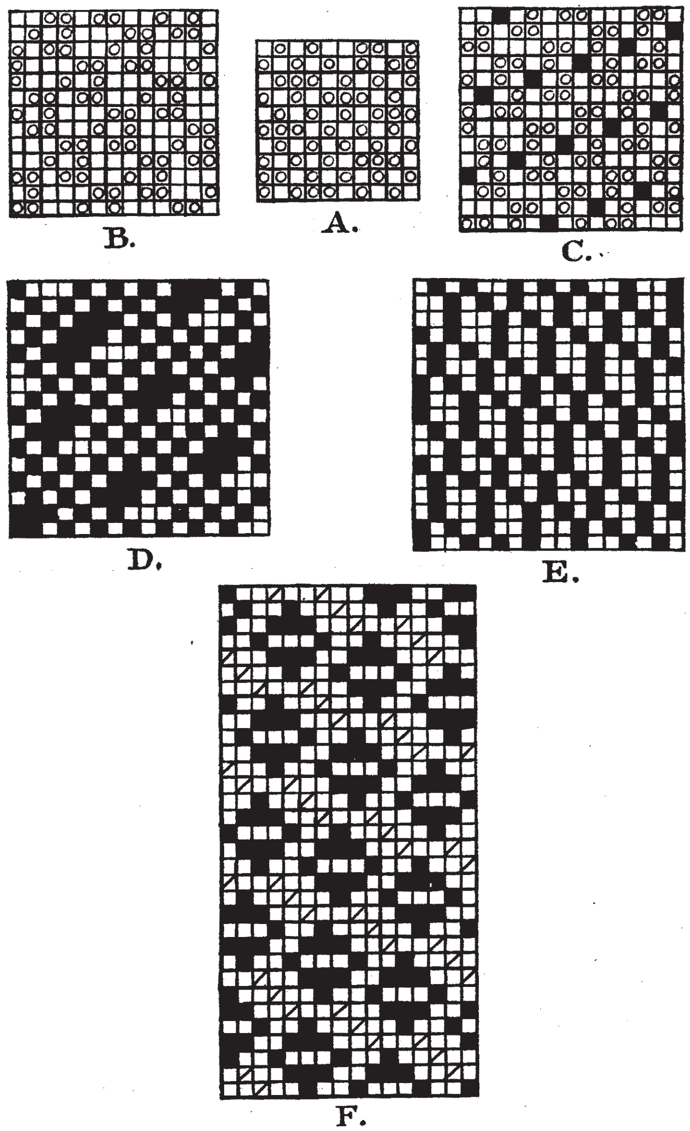


Fig. 80.—Examples in Crêpe Weaves.

weaving is an important technicality in obtaining the crêpe characteristic in these goods. With the yarns easily delivered from the warp beam, the surface of the cloth becomes of the right formation, but with undue strain on the yarns, the weave features and the crêpe quality of the cloth become less defined. This applies in the application of weaves of this category, whether produced in cotton, silk, or worsted yarns. So-called

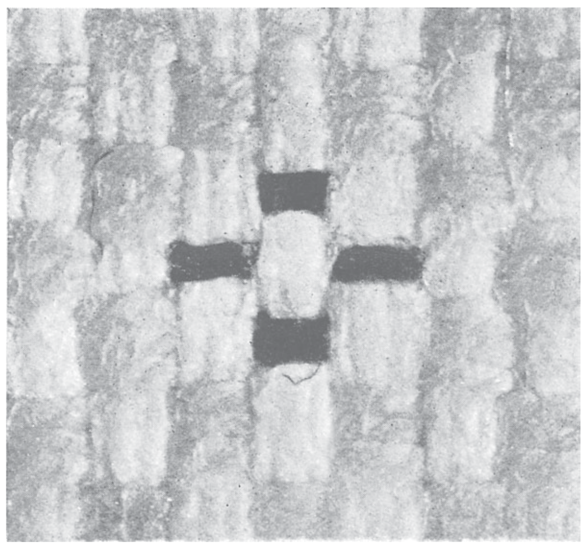


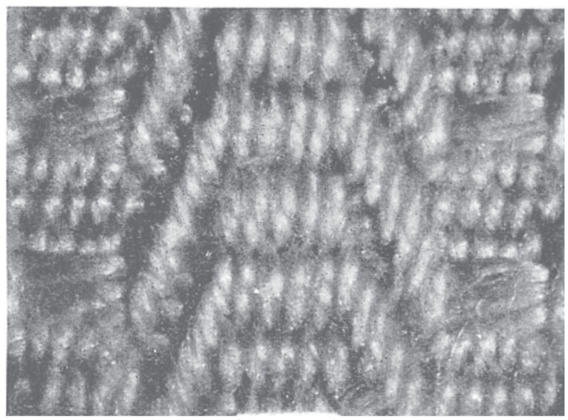
FIG. 81.—THREE-AND-THREE MAT FABRIC-SPOTTED.

sponge cloths are also obtainable in crossings of a similar structure to those in plans D and F.

153. *Warp Cords and Cord Twills* (Fig. 83).—Warp and weft cords or repps have been referred to as derived from the plain weave. *Warp* cords of this class form lines across the texture by one group of threads (1, 3, etc.), and a second group of threads (2, 4, etc.), floating in turn on the two sides of the fabric, as in sections *a* and *b* of plan A^5 (Fig. 70); and the *weft* cords form lines lengthways of the cloth by the odd and even picks successively covering the warp ends as at *c* and *d*

in plan A^6 (Fig. 70). These two kinds of woven effect are seen in stripings *a* of Fig. 84D[1] and in lines *d* of Fig. 54.

The difference in the textural surface thus produced, in forming the effects either in *warp* or *weft*, will be better understood on comparing the specimens in Figs. 81 and 82, one a 3-and-3 mat, and the other, Fig. 82 (section *a*) a 3-and-3 warp cord. In the mat cloth, where the warp threads are brought on to the face, the weft picks float solid underneath them, but in the cord stripe (Fig. 82) odd threads cover the even threads,



a

FIG. 82.

and the latter the former, so that each surface of the fabric is composed of warp yarns. Turning the specimen round, and taking threads for shots and shots for threads, would convert the effect into a weft cord structure, or one in which the odd picks would conceal the even picks and thereby produce a fabric with both sides developed in *weft* yarn. Such principles of fabric building provide for certain descriptions of pattern development by 1-and-1 colouring in the *warp* in simple *warp* cords, and in the *weft* in simple *weft* cords. The striped lustre cloth in Fig. 83 is suggestive of the kind of design features which may in this way be developed. The plain sections of the pattern are woven in 2/40's cotton warp and shuttled with

30's lustre weft, and the apparent mat effects are woven in 4-and-4 warp cord, coloured one thread of black and one thread of white. Under the black threads the white are floated, and under the white threads, the black. The plan

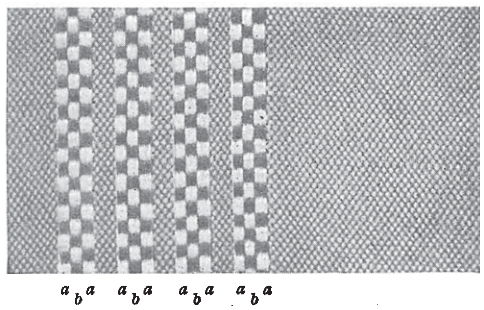


FIG. 83.—LUSTRE STRIPE.

(Fig. 83A) shows how the 4-and-4 war pcords are combined for weaving the stripings in this specimen. The black and white threads in the texture are marked in ☒'s and in ⊡'s in the design. As the order of warp is 1-and-1 and the two

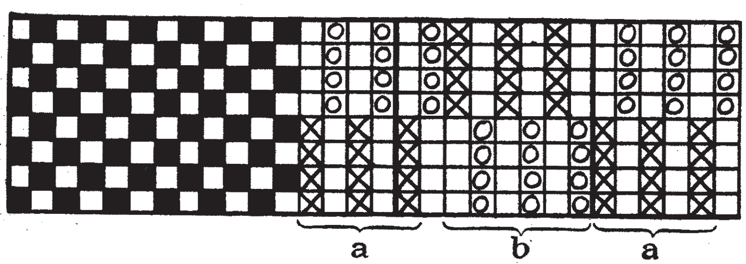


FIG. 83A.—DESIGN FOR SPECIMEN IN FIG. 83.

groups of threads *a* and *b* (Fig. 83A) change positions relative to the colouring, they also alternate the positions of the two yarns on the face and back of the cloth. If the warp arrangement should be altered to one black and one white for 4 threads, and to one white and one black for 4, the weave usable would be the ordinary warp cord This system of pattern-work, and of cloth construction in repp weaves, is utilized in striping, checking, and figuring, combining *warp* and *weft-face* cord plans.

Strictly, the effects defined are repps, and differ from the cord type of weave illustrated at A, B, and C (Fig. 84). These plans make corded stripes, and combine the effects of a cord and a repp type of cloth. In A, Fig. 84, and also in sections a and a^1 (D Fig. 84) groups of threads interlace plain or prunelle twill on the face, with the weft yarn passing underneath. Plan A shows the correct system of plain repp or cord construction, and the fabric structure is clearly illustrated at Fig. 84A[1]. Picks 1 and 3 interlace plain on the face with threads a, and picks 2 and 4 interlace plain on the face with threads b, so that the plain texture made by threads a and the odd picks, cut the plain texture made by the threads b and the even picks, which produces the "cord" stripe. For making a weft line, in combination with the cord stripings, the weaves are arranged as in plans B and C (Fig. 84). Here the even picks, while floating under threads a, as in plan A, cover the four threads in section b, and this gives the weft piping seen in Fig. 54, the design for which consists of 8 threads of plain rib, and 4 threads of weft cord. Plan C is a prunelle-twill cord with weft stripe effect, and plan D a striped prunelle-twill rib stripe, parts a, a^1, and a being combined with a warp cord d. This plan forms the looming design for the pattern in Fig. 84D[1]. Twilled ribs may be plain, weft, or warp effect on the face, and composed of one or more weave units. The example E (Fig. 84) is a plain twilled rib, F a weft repp twill, G a compound of weft cord and prunelle twill, and H a compound of warp cord and plain rib, G giving a twilled cord in the weft, and H a twilled cord in the warp.

Corduroy and Bedford cords are an extension of the principle of plain rib weaving illustrated in A, Fig. 84. The unwadded type of plan is that seen in I, Fig. 84, and the wadded type, that given at J, Fig. 84. For acquiring a full rib or cord in this make of cloth, the several ribbed stripes not only cut each other, as

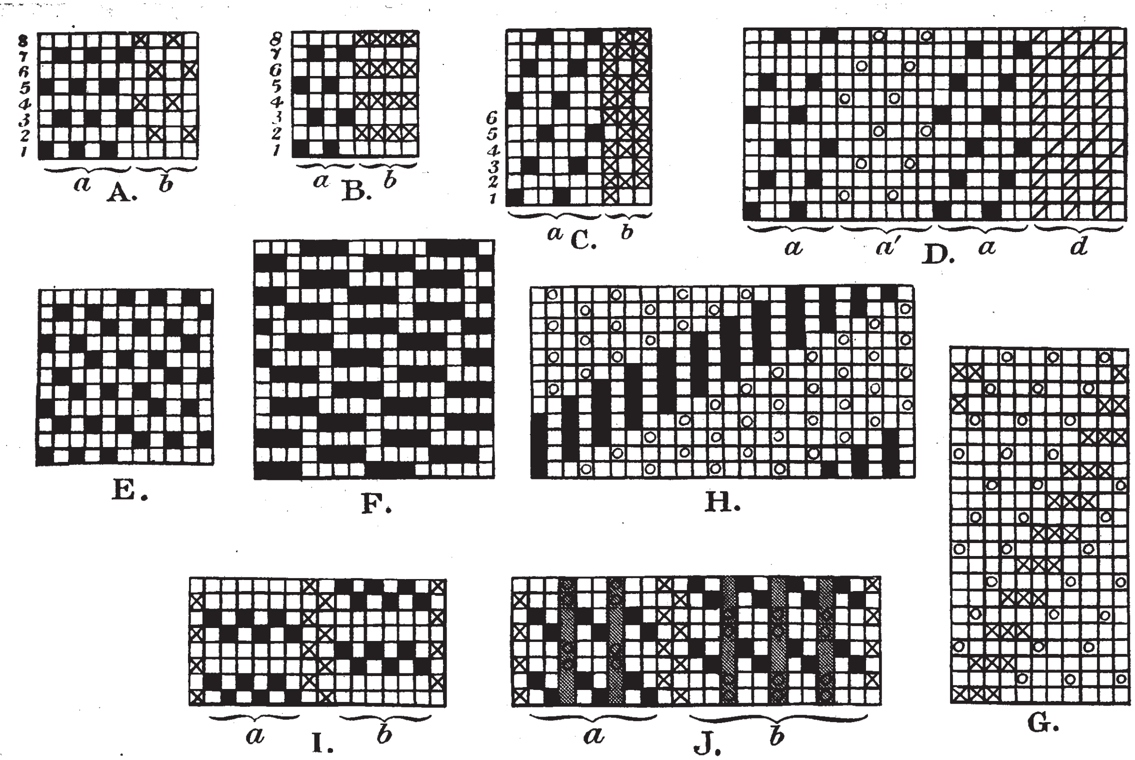


FIG. 84.—EXAMPLES IN REPP OR CORD WEAVES.

in an ordinary cord, but plain interlacing threads—marked in ☒'s in plans I and J—divide one cord from another. It will be observed that picks 1 and 2, and 5 and 6, intersect in plain

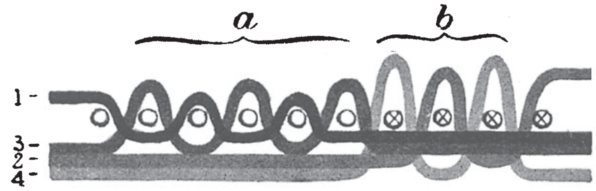


FIG. 84A[1].—PLAN A, FIG. 84.

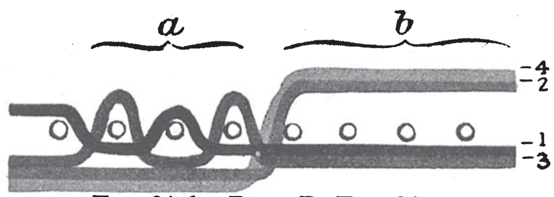


FIG. 84B[1].—PLAN B, FIG. 84.
SECTIONS OF CORD STRUCTURES.

order on the face in section *a* and float underneath the threads in section *b*, and that picks 3 and 4, and 7 and 8, float underneath

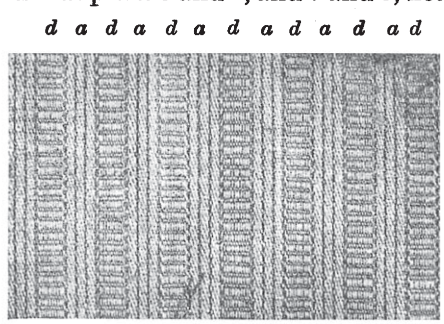


FIG. 84D[1].

the threads in *a* and intersect plain on the face in section *b*. This method of alternately intersecting and floating the two series of picks has the effect of drawing the two groups of threads, composing the ribbed stripes *a* and *b*, into a compact cord form. The two plain ends, marked in $\boxtimes$'s and intervening the stripings, develop an indented or cut line lengthways of the cloth. The "wadding" threads, printed in grey in J, Fig. 84, pass between the plain-woven surface and the weft-flushed back of the texture. Such yarns impart fullness to the rib or cord character.

154. *Compound Twills and Diagonals.*—The *diagonal* is a pronounced or bold style of twill composed of lines of different

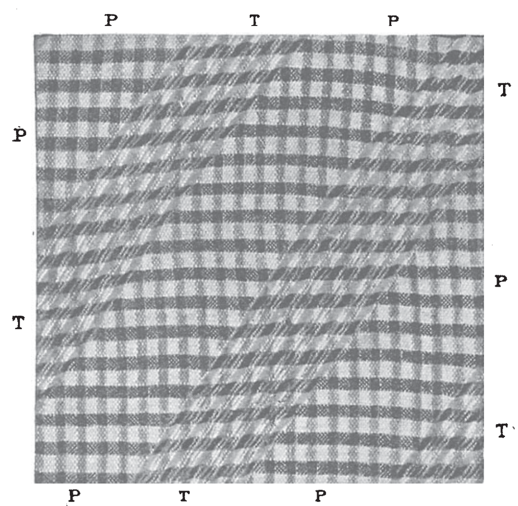


FIG. 85.—CHECKED DIAGONAL.

widths and traversing the cloth at a definite angle. It may be defined as a variety of *twilled* stripe with each sectional part filled in with similar or various weave details. Being thus formed, it may be either a combination of simple or complex weave units. As a rule the weaves should contrast in the textural effects they produce. Fig. 85 is an example consisting of broad lines of plain make in contrast with lines woven in weft twills, that is, of the two weave units seen in the sectional plan (Fig. 85A). Though this dress pattern is warped and wefted 6 threads of white and 6 threads of dark blue, which gives in the plain and twilled parts a plaid or check, yet the effects due to the diagonal formation are distinctly visible. If portion T of the design is examined, it will be seen that here the checkings in the fabric lose their symmetry of structure, owing to the shots of weft being floated to a larger degree on the face than the threads of warp, whereas in the parts P, the effect of both yarns are alike in character. One result of combining weave units on this principle is the production of a cloth in which the interlacings—however diversified these may be in the plans combined—are equally balanced in the repeats of the woven style; whereas to combine weaves P and T (Fig. 85A) in a striped or checked form would give parts of the fabric in a fast, firm structure and other parts in a loose, open structure. The angle at which the assorted

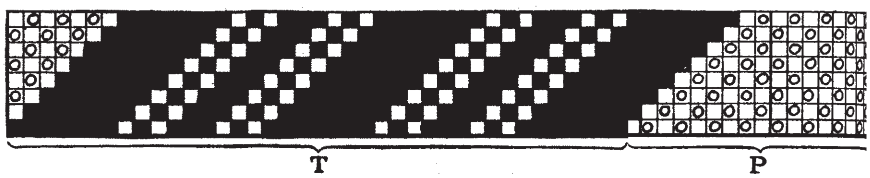


FIG. 85A.

twills run in the cloth obviates irregularities of this quality in all varieties of diagonal designs.

Four factors have to be taken into account in this class of pattern origination: (1) the capacity of the loom, which determines the scale of the design; (2) the proportionate sizes of the "effect lines" in the pattern; (3) the selection of weaves which harmonize and contrast with each other in textural detail; and (4) the set of the cloth and the yarns of which it is made.

In shaft mountings the scale of the designs, unless drafting is practised in the healding of the warp, is limited to 24, 32, and 36 threads, or to plans of the dimensions seen in Figs. 86, 87, and 88. The two former have the fancy warp mat in common, but Fig. 86 consists of two lines, A and B, with the irregular hopsack line the larger in size; and Fig. 87

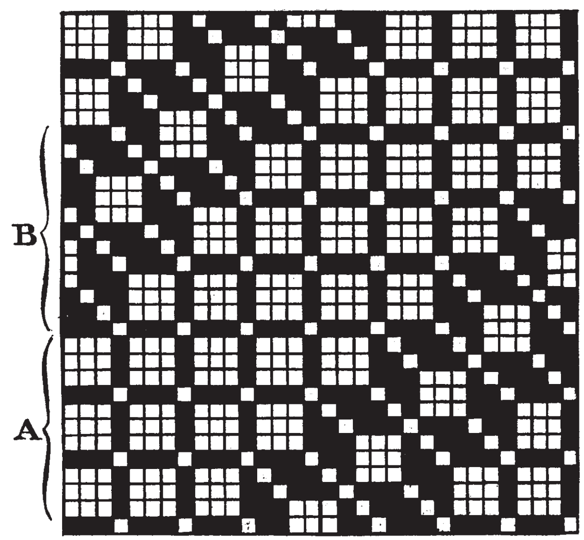


Fig. 86.

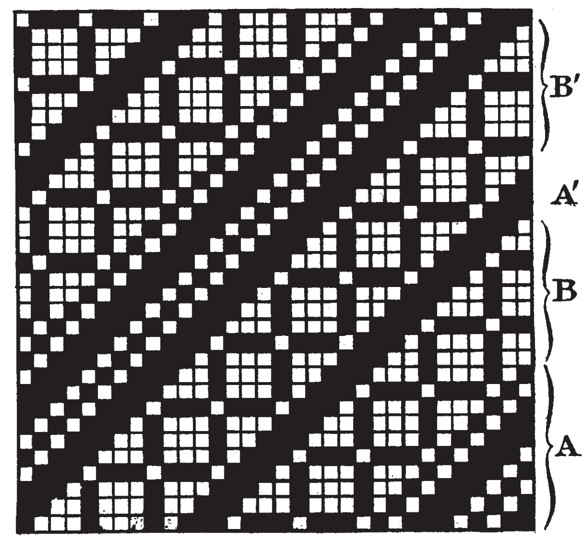


Fig. 87.

Examples in Diagonals.

consists of four lines, A, A^1, B, and B^1, with the two latter equal in width, with A^1 formed in a single weft twill, and with A in a 6-end twill arranged $\frac{1}{3}\frac{1}{1}$. Here the manner of attaining diversity of style is due to the difference in the structure of the weave elements, and to a variation of " line " breadth.

Fig. 88 suggests the practice of combining warp and weft face weaves (diamond makes) and of separating the two effects from each other by small knitting lines in plain, while Fig. 89 is suggestive of the method of using weaves gradually decreasing in weft floats. For instance, band A is composed of $\frac{1}{5}$, $\frac{1}{4}$, $\frac{1}{3}$, and $\frac{1}{2}$ twills, and band B of the same weaves reversed, namely of $\frac{2}{1}$, $\frac{3}{1}$, $\frac{4}{1}$, and $\frac{5}{1}$ twills. The demarcation between the two effects is again acquired by dividing lines in plain make. For shaded diagonal patterns, either this description of weaves or sateens (Fig. 90) are utilized. The shading does not originate from the use of light and dark tones in the warp and weft yarns, but from a gradation from a maximum to a minimum warp ingredient, as indicated in this example, consisting of 5-end sateen weaves, or of the $\frac{4}{1}$, $\frac{3}{2}$, $\frac{2}{3}$, and $\frac{1}{4}$ crossings. Seven, eight, nine and ten-shaft sateens are also employed on this basis, with the angle of the diagonal running as shown in Fig. 90, or in a more oblique direction, as would be the case by inverting the whole design.

155. *Checkings or Dice Patterns.*—The form of checking here implied is that derived by taking a simple weave unit (twill, irregular mat, etc.), and reversing and transposing it as shown in plans A, B, C, and D (Fig. 91). The effects marked in ■'s make the basic factor in each example. First, this factor is reversed in the picks and turned to the right as at *b*; second, it is reversed in the threads and similarly turned at *c*; and, third, detail *d* is obtained by reversing either the threads of *b* or the picks of *c*. Many varieties of neat and effective weave styles are framed in this manner. Simple and fancy twills, or parts thereof, are selected as a " motive " or " motives " of a special design on a fixed number of ends and picks, and then dealt with on this principle.

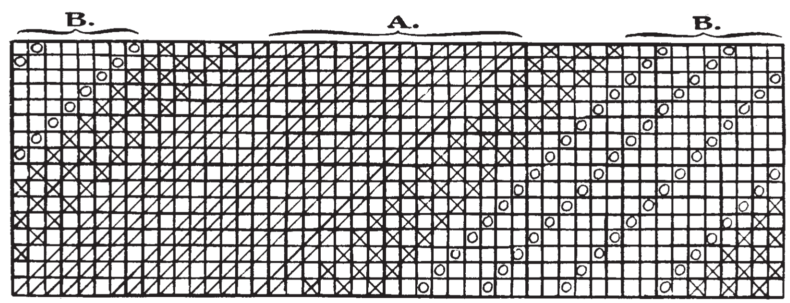


Fig. 89.

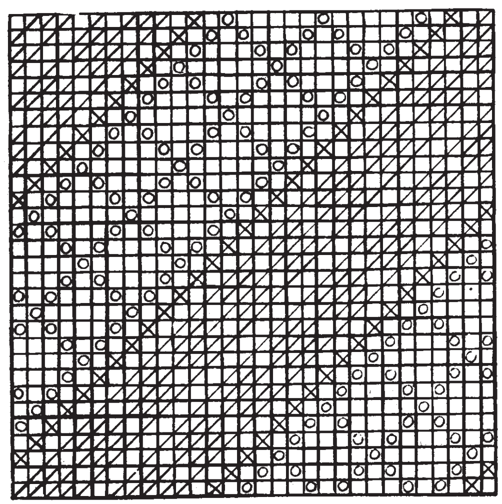


Fig. 88.

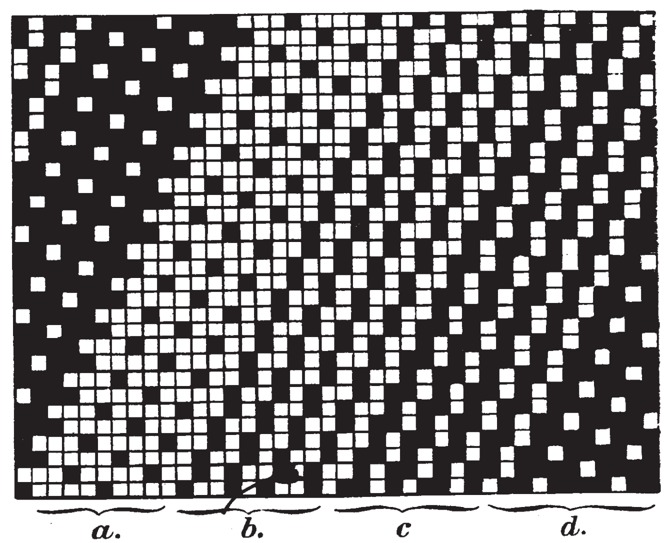


Fig. 90.

Examples in Diagonals.

156. *Waved Effects* (Figs. 92 and 93).—Wave, zig-zag, or serpentine weave patterns, are primarily derived from a twilled base. The waved lines may run in the direction of the warp as at A and C (Fig. 92) obtained from the prunelle and the cassimere twills, or in the direction of the weft as at B and D, and obtained from the $\frac{3}{1}$ and the $\frac{3}{3}$ twills. It should be noted that these differ from " angled " and " herring-bone "

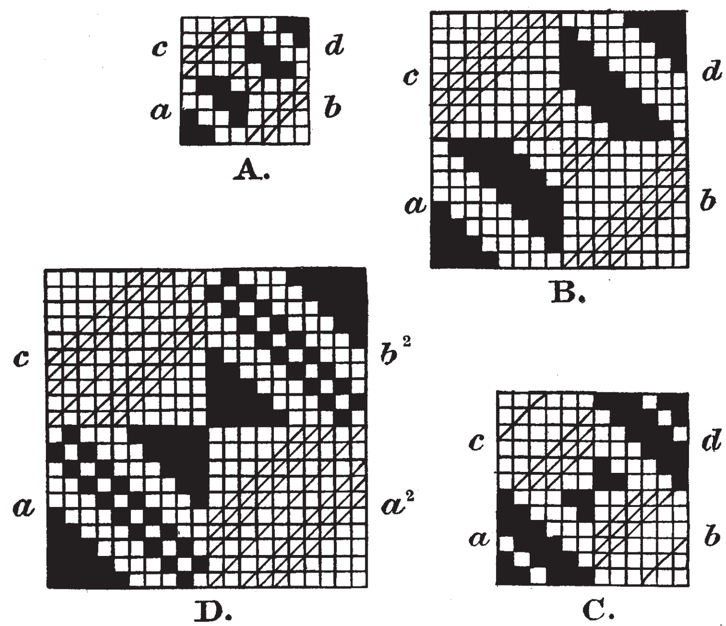


FIG. 91.—EXAMPLES IN CHECKING.

twilled stripes, inasmuch as the waved effect is constructed by turning the movement of the twill at a point, whereas in the " angled " patterns, the twill is turned at a juncture which provides for the warp and weft intersections opposing or cutting each other. In addition to the ordinary twills being adapted for this class of design, warp and weft cord twills are also suitable for the production of serpentine or zig-zag, styles as seen in plans E, F, G, and H, composed of A^1 (Fig. 74), A^1 (Fig. 78), and A^2 (Fig. 76). The size of the bands of which the wave is formed, and also the size of a repeat of the design, are variable. In E the waved lines consist of 3, and in F of

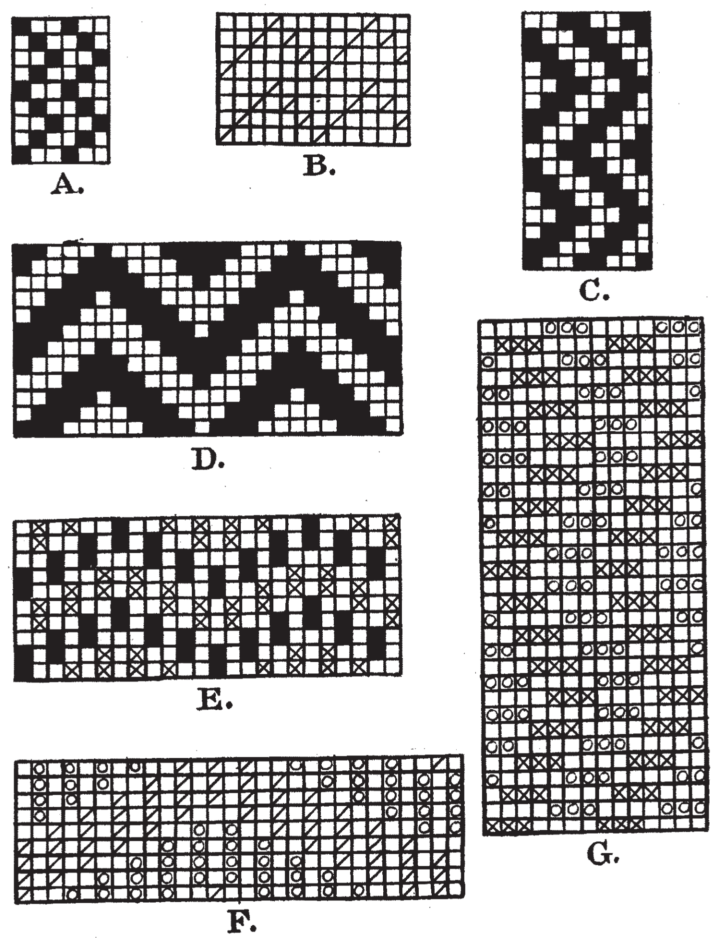


FIG. 92, PLANS A TO G.
EXAMPLES IN WAVED OR ZIG-ZAG WEAVES.

5 floats of warp, so that the pattern repeats occupy 12 and 29 threads respectively. Plan H is formed of repp weaves of different sizes.

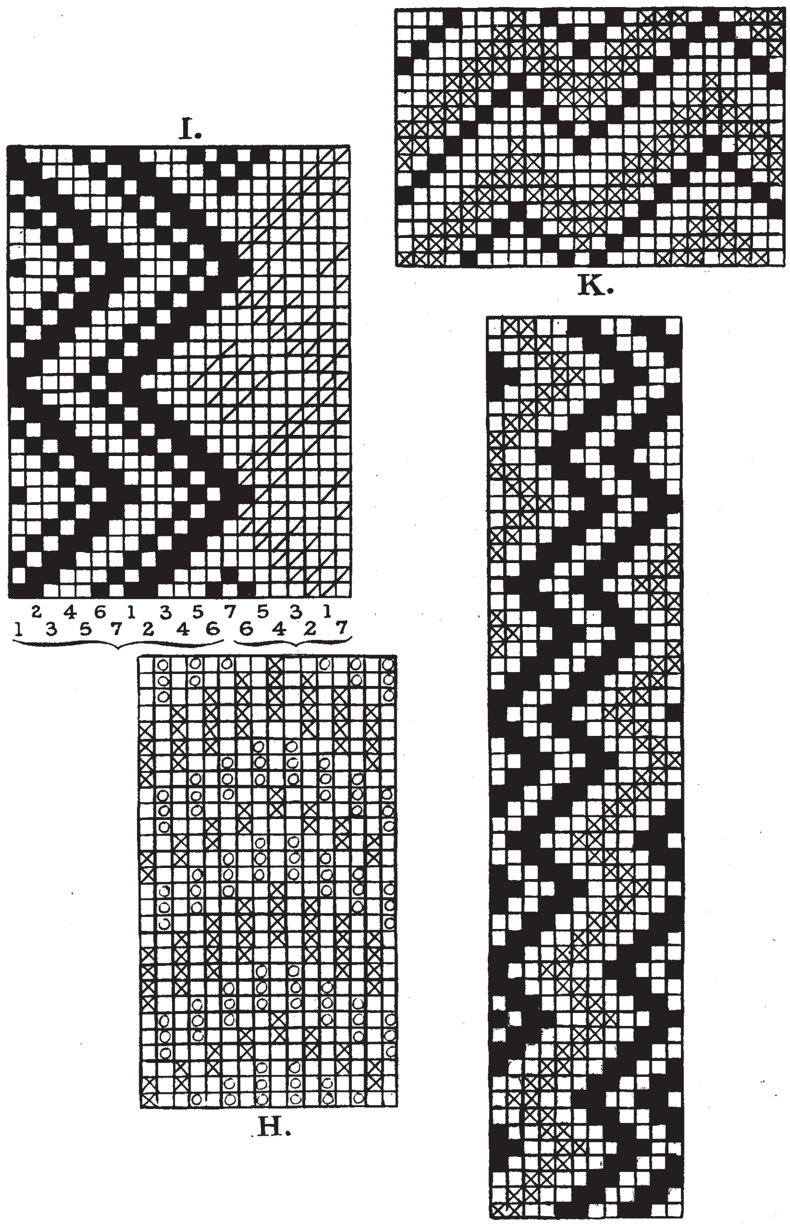


FIG. 92, PLANS I TO J.
EXAMPLES IN WAVED, SERPENTINE OR ZIG-ZAG WEAVES.

Such serpentine lines may be developed in types C and D by using a light warp and a dark weft yarn, and in types E, F, and H by colouring thread-and-thread in two shades of the warp, and in type G, by shuttling 1-and-1 with two colours of weft. Drafting the designs in the order of the numerals at the base of plan I gives a series of waved lines diversified by a striped band in diamond formation. Either the diamond or the serpentine sections are repeatable to give any definite scale of design. Healding the warp, as indicated,

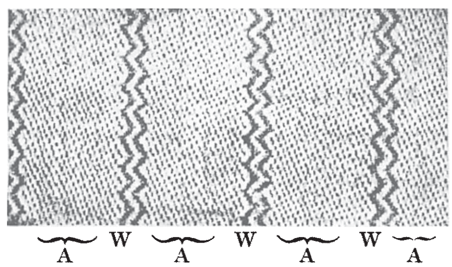


FIG. 93.

involves the employment of the first seven threads in the weave as the reduced or looming design. The zig-zag effect may be worked into a twill or diagonal as in examples J and K, the former being in the $\frac{2}{2}$ twill and the latter in the 8-shaft twill, $\frac{1\ \ 3}{3\ \ 1}$. Waved lines are also used for striping in combination with ordinary twilled weaves on the system shown in the specimen at Fig. 93, where the effects W are produced in weft twill and the effects A in fine warp twill.

157. *Diamond, Diaper, and Lozenge Structures.*—These form a common and useful variety of fabric design. Plans A and B (Fig. 94), developed in warp effects and consisting of the $\frac{2}{1}$ and the $\frac{3}{1}$ twills, are composed of 12 and 16 ends and picks respectively. Patterns of this character are also producible on a larger scale, but, as sketched, they adequately suggest the method of acquiring the diamond pattern in both ordinary and fancy twills. The basic lines of the diamond to be

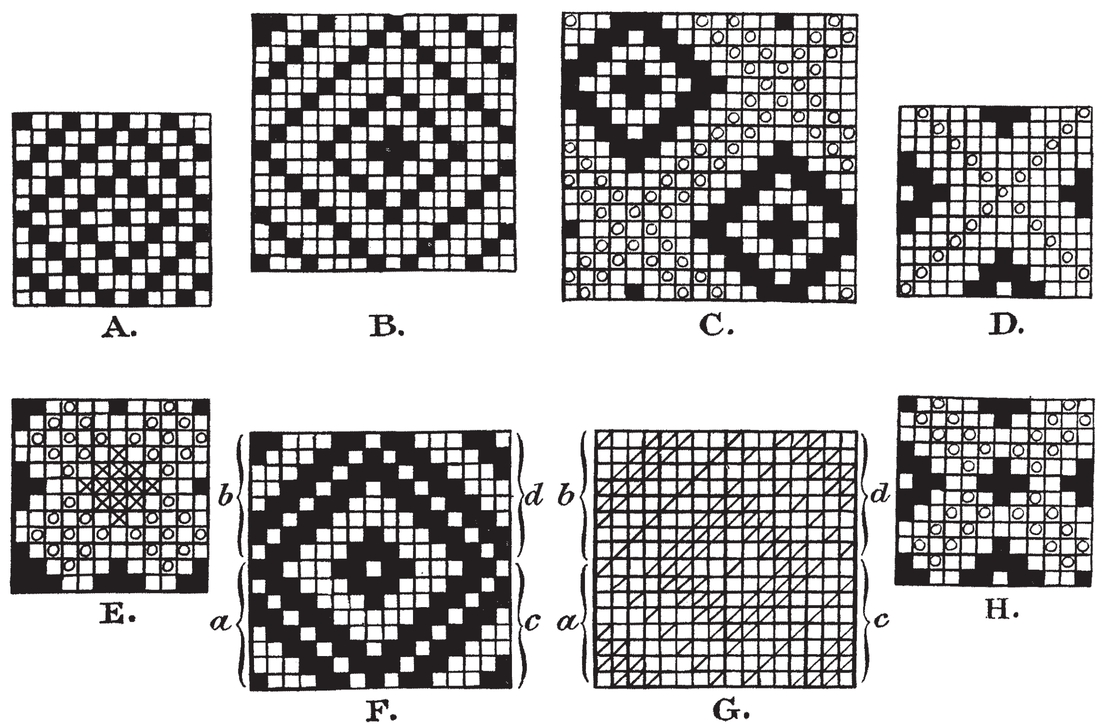


FIG. 94, PLANS A TO H.
EXAMPLES IN DIAMOND WEAVES.

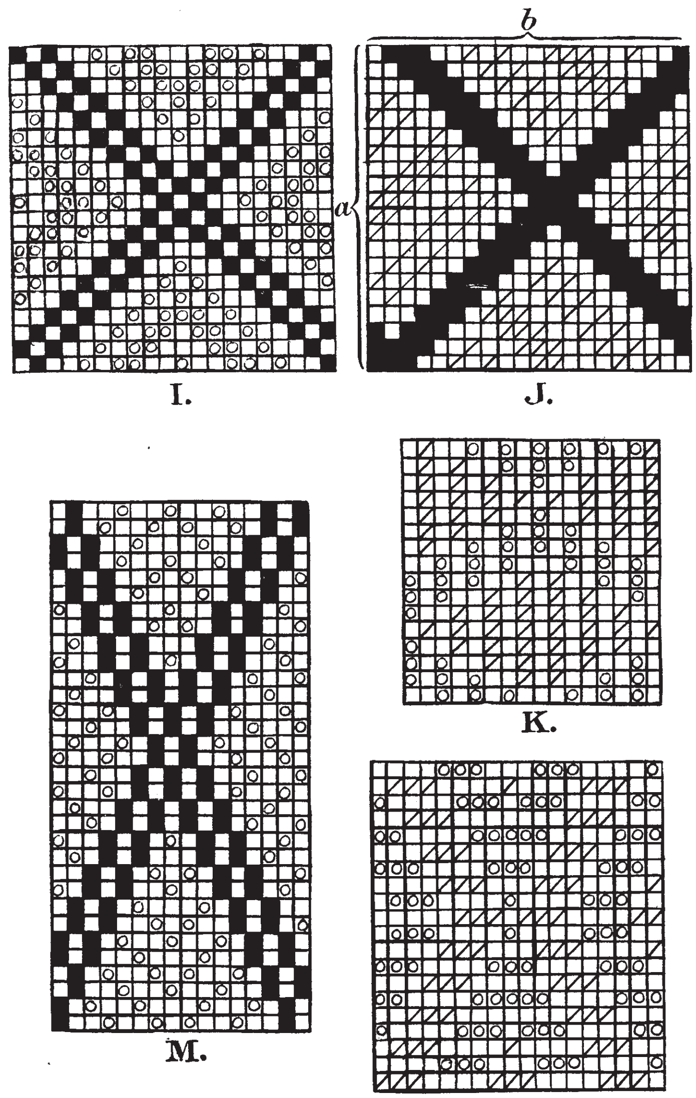


Fig. 94, Plans I to L.
Examples in Diamond Weaves.

originated are first determined, and then these are transposed as in making dice checkings. This principle of work is also followed when the twills are elaborated as in F and G, where section *a*, occupying the first 8 threads and picks, is the weave element transposed at *b*, *c*, and *d*. A further method of

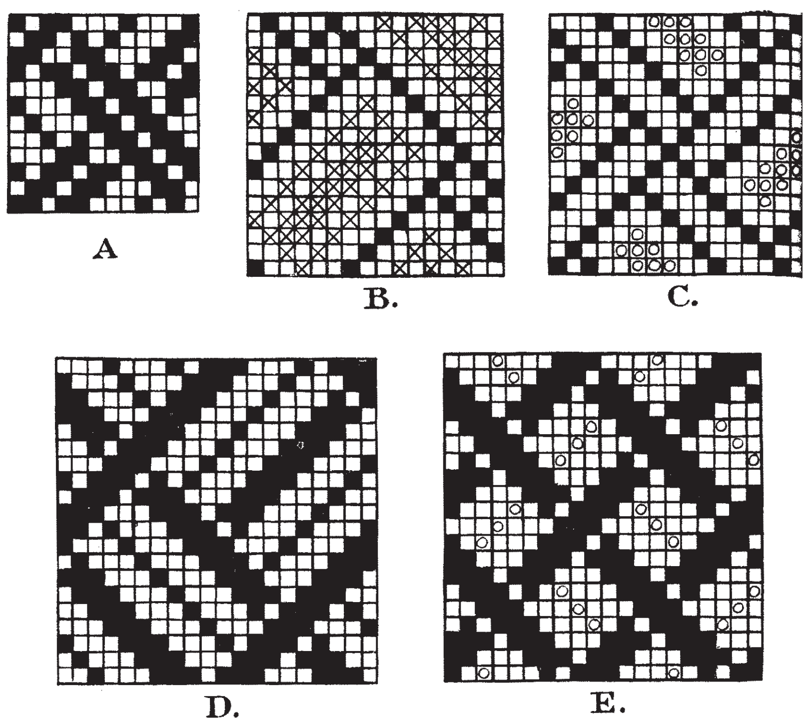


Fig. 95.—Examples in Transposed Weaves.

construction is to mark intersecting lines centrally on the point paper as in D. This divides the area of threads and picks equally into diamond spaces, which are then filled in with small details as in the portions marked in ■s. The intersecting lines may be duplicated one or more times as at G, H, and I, allowing, in the construction of the design, of the intermediate spaces being composed of a weft spot as at F and H, and of a diamond spot as at I. These lines may be further formed in weft or fancy twills, e.g. plan J in a 3-weft float twill, with the diamond area composed of intersecting lines, or of lines of warp and weft twills running to the right in section *a*, and to the left in section *b*.

The lozenge is but an elongated diaper or diamond. At K it is made in warp cords and elongated transversely, at L in weft cord and elongated in the direction of the picks. Obviously by using the twills with a " move " of two or several picks for each thread, as at plan M, the elemental lines divide the area of the design into lozenge figures, which are decoratively treated as in the diagonal patterns described.

158. *Transposed Types.*—In devising weaves of this class an " effect " is first formed and then geometrically transposed. In plan A (Fig. 95) the " effect " consists of two simple twilled lines, and in plan B, of a rectangular spot. When such are correctly set in relation to each other, and leaning in opposite directions, they leave a series of threads and picks unintersected. If the " effects " are minute in character, as in plan C, the intermediate or ground spaces may be filled in with supplementary lines, transposed to agree with the basic features. Other schemes of construction are typified at D and E with more pronounced twilled lines. All such principles of patternwork are extensible, and may be further elaborated, in large designs, by the type and variety of the weave elements combined.

159. *Mock Lenos.* (Fig 96).—From this description of crossings, imitation gauze, leno, and more or less perforated fabric structures are obtained. Openness of structure is emphasized by the system of reeding or sleying, vacant dents being allowed between the several groups of threads into which the weaves are divisible. For example, the different plans under Fig. 96 may be sleyed as shown in the table on page 222.

Weaves A, B, and C are made on the same basis, only being modified by the insertion of 2 picks in a shed on shots 3 and 4 and 6 and 7 in plan B, of 3 picks in a shed on shots 2, 3, and 4 and on 7, 8, and 9 in plan C. A looser and more matted

PLANS. FIG. 96.	METHOD OF REEDING.
A, B and C	3 threads in a dent and one dent vacant.
D and E	4 ,, ,, ,, ,,
F	Dent (1) threads 1 and 2, one dent vacant. ,, (3) ,, 3, 4, and 5. ,, (4) ,, 6, 7, and 8, one dent vacant.
G	,, (1) ,, 1, ,, (2) ,, 2, 3, 4, 5, and 6, ,, (3) ,, 7, ,, (4) ,, 8, 9, 10, and 11.
H	5 threads in a dent and one dent vacant.

character of fabric is obtained by this principle of intersection than by using type A. Weave B is the standard canvas make; E gives a faint twilled effect, and F a fine checked feature in the texture. In plan G, the warp is floated on the face and the weft on the back between the threads and picks marked in ☒'s, while the intersections in ■'s give a plain central structure. This method of plan-making is shown in another form at H, where sections *b* are the reverse of sections *a*.

160. *Honeycomb Plans.*—Several plans of this category are reproduced at A to I (Fig. 97). They result in a species of cloth resembling in effect and in appearance the structural formation of honeycomb. Their application, in dress fabric weaving and designing, is varied, for the plans may be rendered, by the system of loom-setting practised, useful in the manufacture of cotton, worsted, cotton and silk, linen and silk, and worsted and mercerized cotton goods. Weave construction is carried out on the diamond schemes of plan making, with, however, one series of effects, either warp or weft, similarly or better emphasized than the other. With the enlargement of the plans, and also with the method of grouping the knitting ends and picks surrounding the diamond-shaped

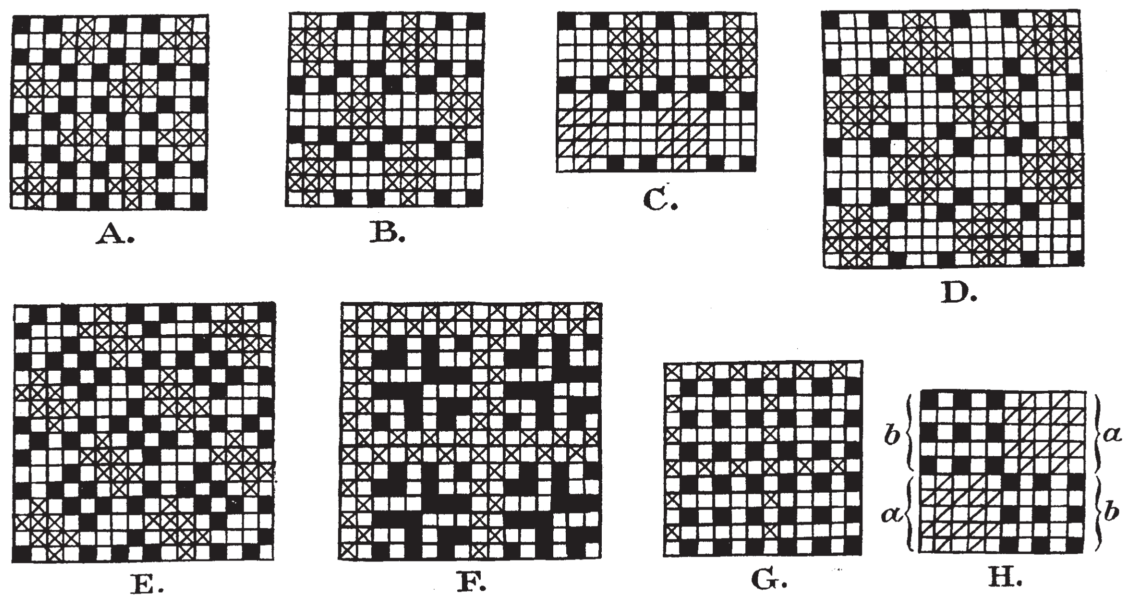


FIG. 96.—EXAMPLES IN MOCK LENO WEAVES.

spottings, the styles obtainable may be considerably modified. In all instances the build of the fabric is comparatively loose or unstable in character, a technicality which is not lessened, but somewhat aggravated by the system of open reeding which is adopted. In the examples, weaves A, B, D, and G are of the standard type, that is, with one diamond figure in weft opposing a similar diamond figure in warp. Weave C is the reverse or underside effect produced by using plan B, and E, the reverse of plan D. Plan F shows the system of adding to the plain details, which would give a stronger build of cloth, but the diamond spottings are not in immediate contact with each other as in C and E. A further elaboration of the structure is given at H in which the diamonds are foreshortened, and picks of weft cord take the place of plain interlacings. This type of design is also made with threads of warp as well as picks of weft cord. The grouping of the effects observed in plan I is the one used in the making of the "Brighton" class of honeycomb.

161. *Huckabacks and Weaves giving a Rough Surface.*—Another description of rough surfaced cloths, only slightly resembling the honeycomb, is acquired in huckaback weaves, such as A and B (Fig. 98). These have generally a plain ground with certain ends and picks floated on the face and on the back of the fabric. The simple form of this weave is given at A, where alternate sections of the plan interchange with sections woven in weft on the face and in warp on the back, with plain interlacings laying between the warp and weft floated yarns. In plan B the effects at *a* are seen reversed at *b*. The reversing of the two structures is, in this example, done in checked order, but it will be understood that the ground of the fabric may be plain, and that the effects in *a* and *b* may be distributed in twilled lines, or they may be arranged on a striped or spotted base. In manufacturing cloths of this kind, the character of the details, due to the weave plan, is well developed by using yarns firm or hard in twine in both warp and weft, whether worsted, cotton, or linen.

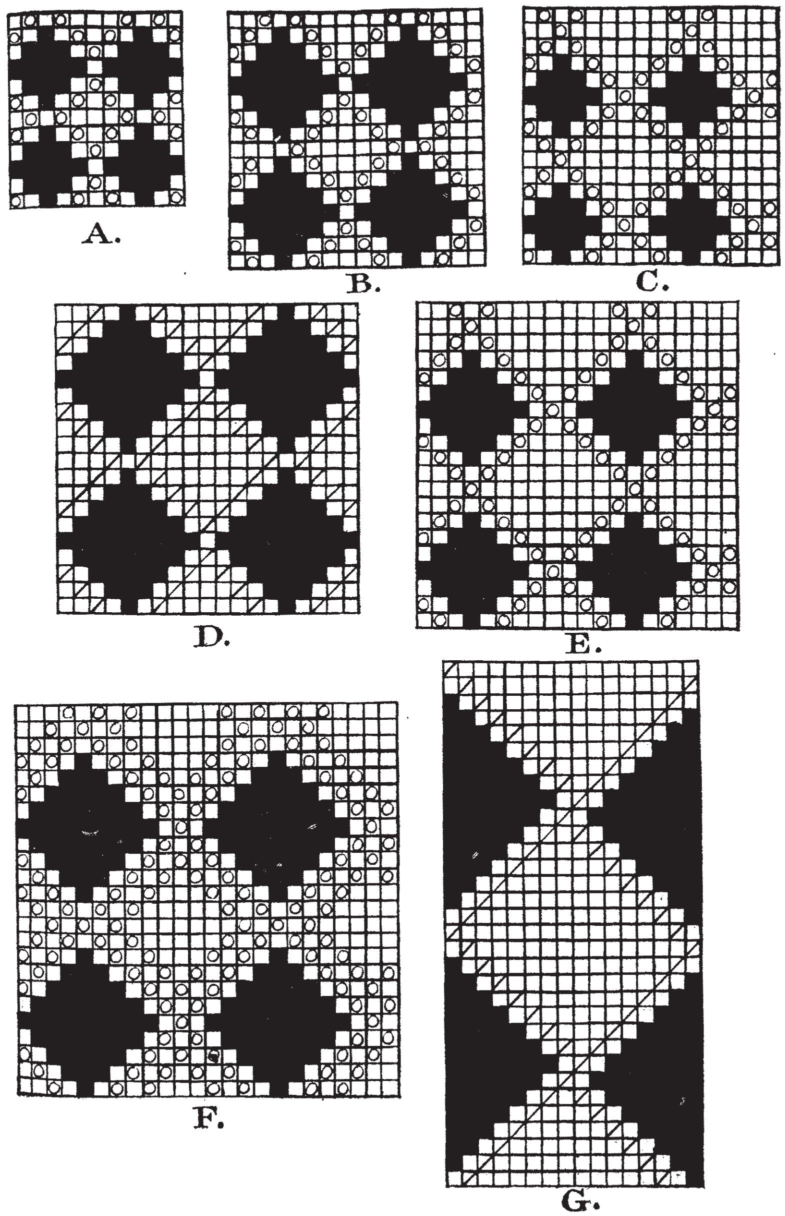
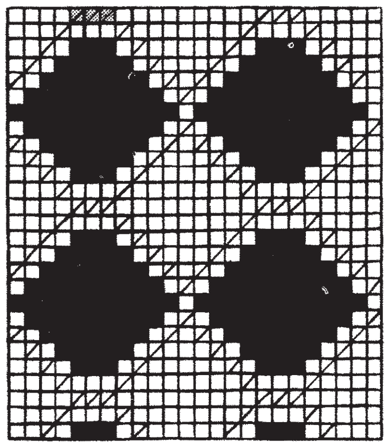
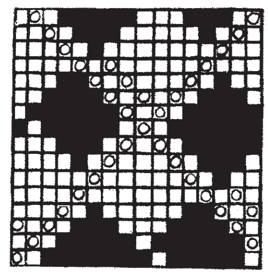


Fig. 97, Plans A to G.
Examples in Honeycomb Weaves.

162. *Sateens.*—For making smooth and even-surfaced fabrics, sateens are the weaves to employ, on account of the intersections of the warp and weft failing to support each



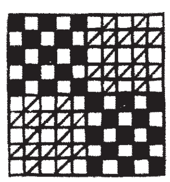
H.



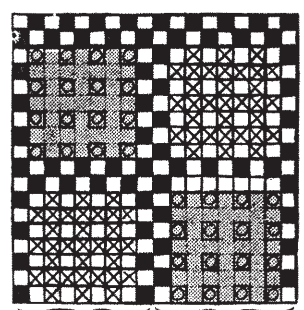
I.

FIG. 97, PLANS H AND I.—EXAMPLES IN HONEYCOMB WEAVES.

other, as in the plain make, the common twill, and the mat. The broken $\frac{1}{3}$ twill is regarded as the simplest sateen, but it



A.



a B *b*

FIG. 98.—HUCKABACK WEAVES.

is not strictly a weave of this type, for two out of the four interlacings of which the plan is composed, are in contact with each other, and this is not in accordance with the rule of

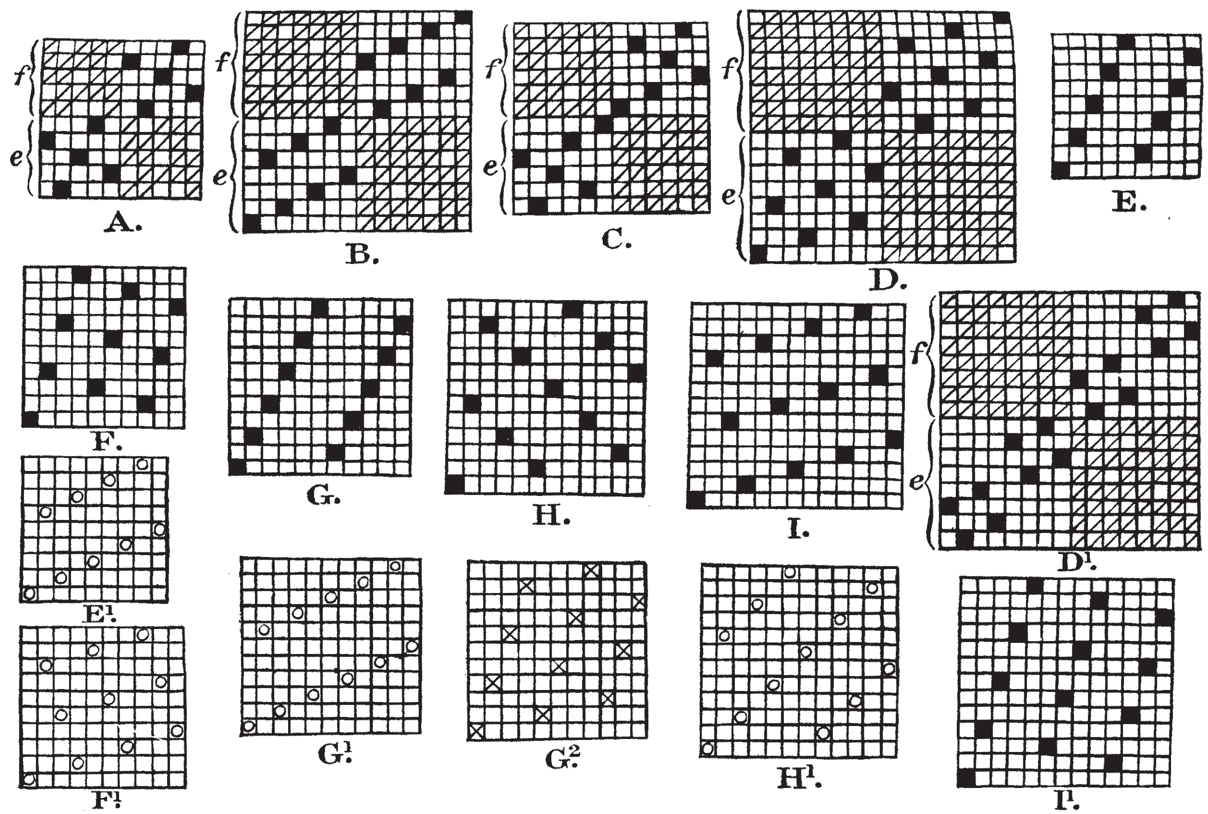


FIG. 99.—SATEENS.

sateen construction, where the intersections are separated by single or multiple threads and picks.

Sateen crossings on 5, 7, and 8 threads are standardized in the silk satin, in the linen, cotton or worsted damask, in the cotton satinette, and in the doeskin or faced-finished woollen or worsted cloth. These several builds of fabric are reproduced in modified forms in dress goods, in which they widely differ in substance and quality with the loom setting applied. As understood, a sateen may result in cloths with either a preponderance of warp or weft on the upper surface, so that in the combination of two sateens such as *e* and *f*,

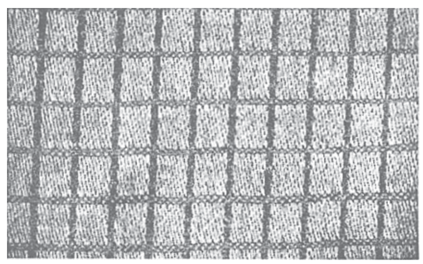


Fig. 100.

plans A to D (Fig. 99), section *e* would yield *warp-face* and sections *f weft-face* effects. This plan of using the two weave units is practised in the production of figured designs as well as of patterns of a spotted, striped and checked composition. The checked linen fabric in Fig. 100 is, for example, obtained in a design consisting of 25 ends and 5 picks of weave *f*, 20 threads and picks of weave *e*, and 5 ends and 20 picks of weave *f* of plan A, Fig. 99.

Textural contrasts in such compound weave styles are clearly defined, the warp and weft surfaces being equally smooth and lustrous, if the threads and picks per inch in the cloth are balanced, and if the warp and shuttling yarns employed are of similar counts and quality. In accordance with the differentiations in these technicalities, special decisiveness of tone is imparted to either the warp or weft unit in the woven manufacture.

The 6-end sateen is irregular in formation. It should be constructed as at *e* and *f*, plan C (Fig. 99). While not frequently used in the production of piece goods on account of developing a striped twill feature in the fabric—3 threads or picks running to the right, and 3 to the left alternately—yet it is an effective basis for figure arrangement and distribution, in common with the 5-shaft and 8-shaft weaves. The 8-shaft sateen is constructed in two forms, namely, as at D, with the interlacings in regular twilled order, and as at D^1, with the interlacings grouped in sets of four. The latter type is well adapted for duplicated spotted designs on the principles dealt with in Chapter VII. Nine, 10, 11, 12, and 13-shaft makes are given at E, E^1, F, F^1, G, G^1 G^2, H, H^1, and I, I^1. Each plan is capable of being used as a basis of weave origination, for which purpose it is only necessary to add to each intersection mark in the sateen, as illustrated in plans B and E (Fig. 101), made respectively on the 11 and 13-shaft sateens. This method of utilizing the sateen is common in originating weave styles. With the mathematical plan of intersections which the sateen weave provides, the makes built on this basis are necessarily symmetrical in arrangement. Detail changes in the distribution of the supplementary intersections are sufficient to completely modify the character of the weave design acquired. This will be noted on comparing E and F (Fig. 101). The former is based on I and the latter on I^1 (Fig. 99), or on two types of 13-shaft sateens. In making F, five dots have been added to each sateen mark, giving an elongated weft effect ; while in making E, four dots have been added to the sateen base, forming squares of weft, with other intersections running in twilled lines.

Further, weaves of another category are obtained on this system by enlarging the bases themselves either in the picks or in the threads, or by the duplication of both threads and picks. Weaves formed on the first of these principles of extension, are of an oblique twilled type, on the second of an upright twilled character, and on the third of a fancy mat structure.

163. *Twilled Mats.*—Mats or hopsacks, in which the squares of either warp or weft run in a twilled direction, constitute one of the principal varieties of weave design. They are well adapted for producing cloths level in build and neatly diversified in pattern results. Unlike the common mat, in which the minute rectangular effects are alternately woven in warp and weft floats, these weaves (A to F, Fig. 101) give the mat details in *weft* floats in section *a*, and in *warp* floats in section *b*. The possibility of producing in this way the "mat" in the fabric in the warp or in the weft yarn, renders the crossings applicable to reversible styles of pattern, or cloths in which the effects on the face and on the back, due to either the scheme of interlacing or to the colourings of warp and weft yarns used, are exactly transposed. The weaves are therefore suitable for combination with each other. Taking plan A (Fig. 101) if produced in a light warp and dark weft, the mat interlacings on the face in section *a* would be in dark colour, and in section *b* in light colour. Without, however, using any contrasts in yarn colour, the weaves themselves are sufficiently different from each other, when thus transposed, to produce clear pattern forms. The examples illustrated have the mat spaces, in section *a*, in *warp* effect, and the mat spaces in sections *b* in *weft* effect, and comprise—

Fig. 101A 8-Shaft Twilled Mat
,, 101B = 11-Shaft ,, ,,
,, 101C = 12-Shaft ,, ,,
,, 101D = Modified 12-Shaft Twilled Mat
,, 101E = Modified 13-Shaft ,, ,,
,, 101F = Elongated 13-Shaft ,, ,,
,, 101C′ = 16-Shaft Twilled Mat
,, 101F′ = Modified 16-Shaft Twilled Mat

These several mats are grouped in striped pattern forms to show the method of weave combination, and also how the types of effect obtainable, in each weave, differ from each other

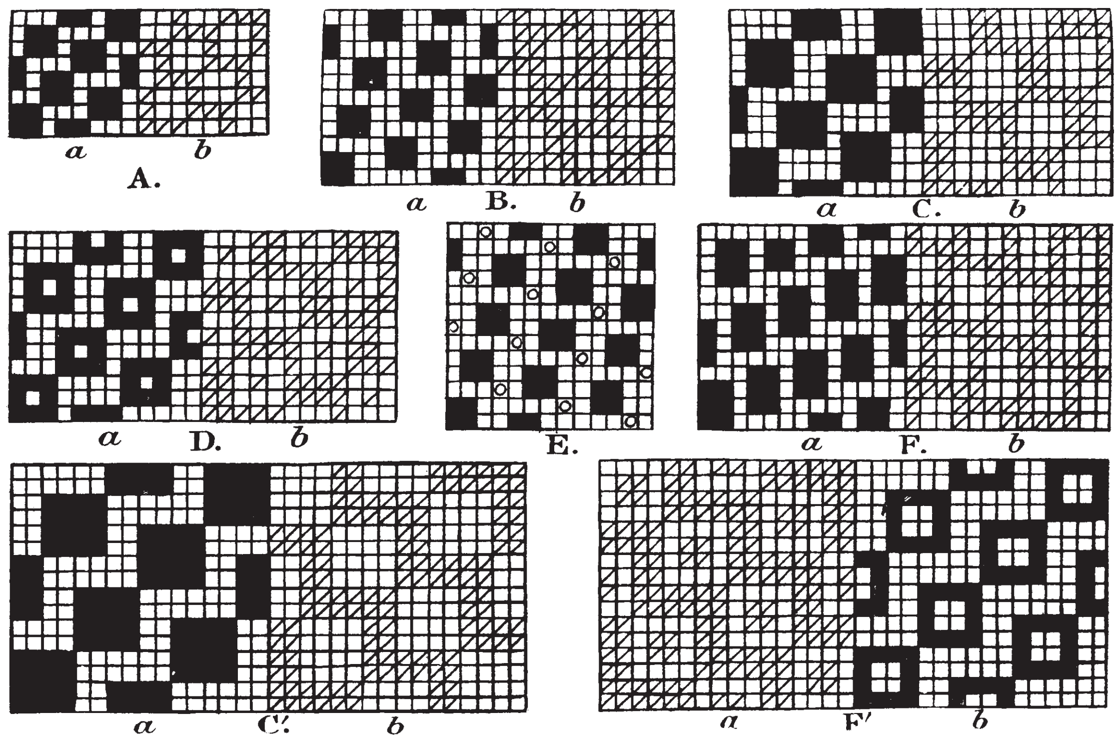


FIG. 101.—EXAMPLES IN WEAVES IN SATEEN BASES.

by developing the mat or hopsack features in *warp* and *weft* interlacings. The modified mats on 12 and 16 threads give a faster build of texture than the mats from which they are derived, but the squares of effect formed are less accentuated than in plans C and C′.

The distinctive and uniform structure of twilled mats, arranged on the sateen base, is evident in these examples. Sateen weaves such as the 10, 14, and 15-shaft units, are also employed in the origination of this class of hopsack, in addition to the weaves as constructed on the 11, 12, 13, and 16-shaft bases, and seen at B, C, D, E, and F in Fig. 101.

164. *Point Paper Plans and Fabric Construction.*—Cloth building and designing, as so far analysed, has been shown to consist in weave origination and in loom-setting. The two factors are inseparable and give to the subject both a theoretical and experimental aspect. The point paper plan is illustrative of the theory of warp and weft interlacing, and the textural product this plan is made to give by the yarn counts and qualities employed, and by the ends and picks inserted per inch in the piece, is representative of the practice in cloth making. In theory, as is evident in the weave bases and types dissected and explained, plans are formable diversified in effect and in scheme of fabric production. These theoretical designs are also varied in manufacturing possibilities. Plans of intersection which prove satisfactory and result in new and successful cloths when correctly set in the loom, result in cloths imperfect in surface and deficient in wearing property, when the setting is disproportionate with the schemes of intersection of which the plans are composed.

There are certain general elements in applying different weaves to all classes of dress, blouse, and costume goods, which have to be considered, such as—

(1) *Warp-face* weaves as a rule provide for fuller setting in the threads than in the picks, and *weft-face* for fuller setting in the picks than in the threads.

(2) Weaves balanced in the warp and weft intersections,

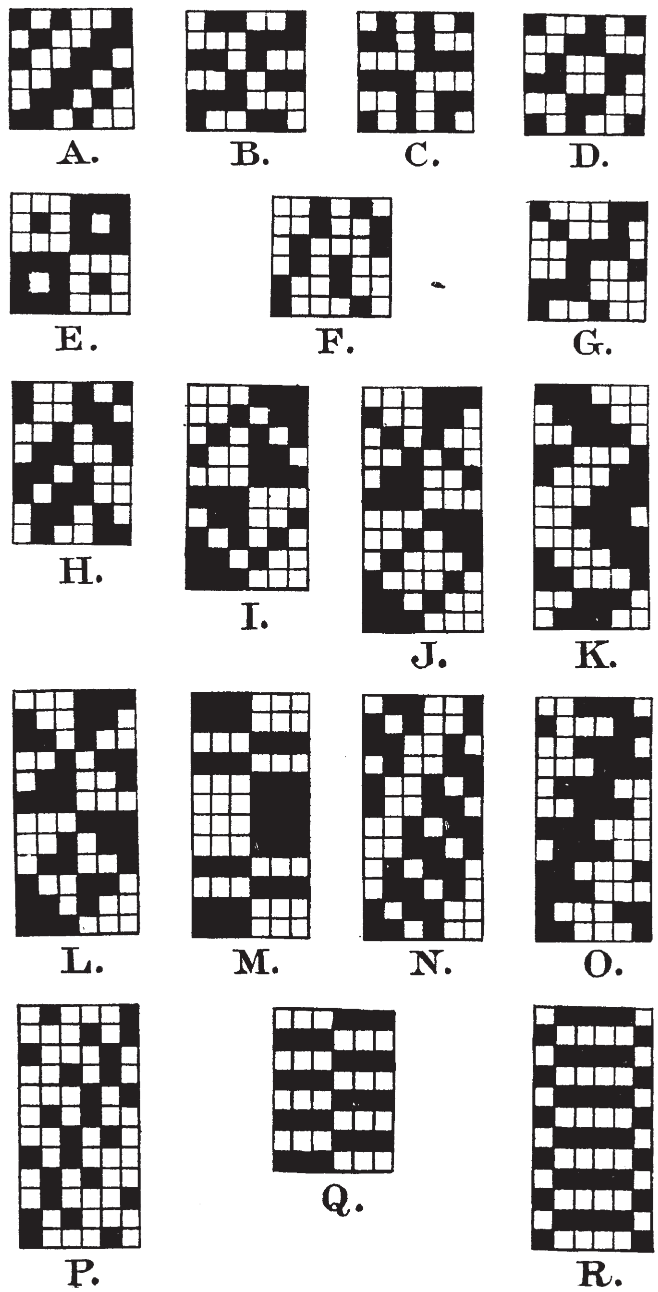


FIG. 102.—EXAMPLES IN SIX-SHAFT WEAVES.

or nearly so, allow normally of equal setting in both ends and picks per inch.

(3) In acquiring open cloths of a canvas description including loose mat structures and broad textural details, the setting,

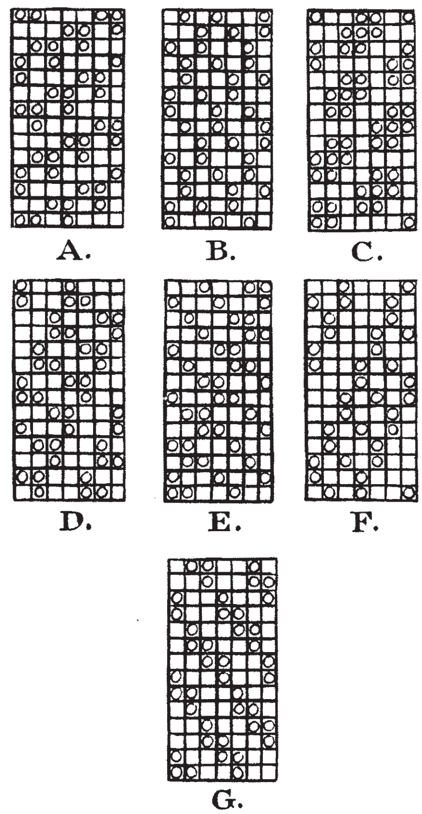


FIG. 103.—EXAMPLES IN SEVEN-SHAFT WEAVES.

should the weave be composed of groups of alternating fast and loose interlacings, as in weaves of the imitation gauze class, should be comparatively loose both in the reeding and in the wefting, but should the weaves be of the type seen at G, H, and J (Fig. 112) fairly firm setting is desired to give stability of fabric construction.

(4) For developing in a special degree the warp details,

as in plan F, Fig. 103 ; A, Fig. 105 ; C, Fig. 109 ; and C, Fig. 111, about 5 to 10 per cent. closer warp than weft setting might be adopted ; but for developing the weft features in a special

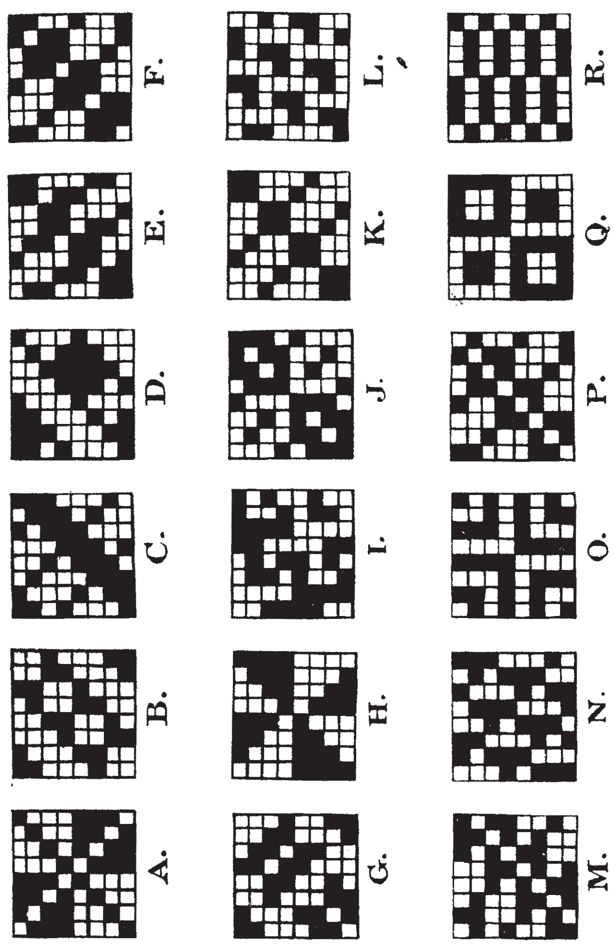


FIG. 104.—EXAMPLES IN EIGHT-SHAFT WEAVES.

degree, the density of threads and picks per inch may be approximately the same, with, however, the weft yarns thicker in counts, as, for example, in producing cloths in plans built on the principles indicated at E (Fig. 108) and D (Fig. 111).

(5) Cloths intended for contraction in finishing, allow of the setting being from $7\frac{1}{2}$ to $12\frac{1}{2}$ per cent. below that ascertained in any particular weave on the yarn diameter and intersection basis, with the pieces proportionately wider in the loom for the standard finished width.

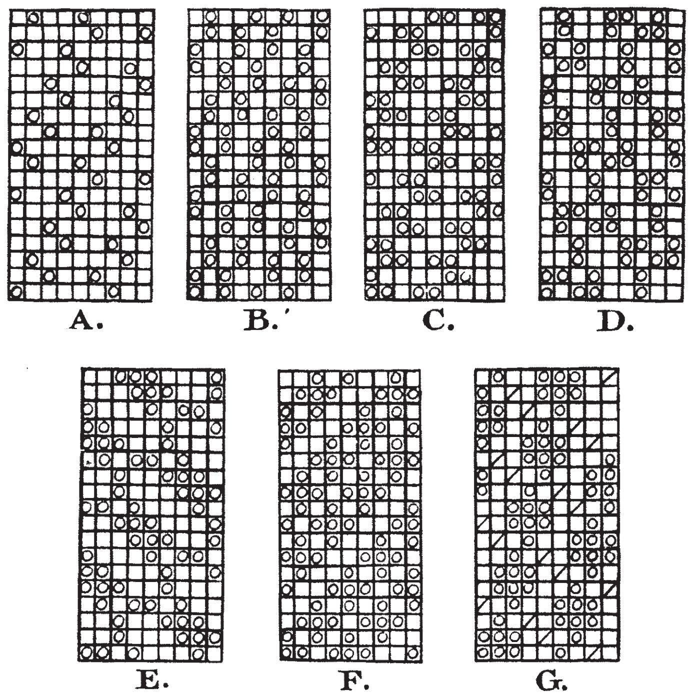


FIG. 105.—EXAMPLES IN NINE-SHAFT WEAVES.

Apart from these radical principles, there are other governing technicalities only realizable and adjustable in so far as experiments are carried out in the loom. The whole subject bristles with difficulties, but the difficulties are exactly of that kind which, in the solving, give types of design yielding effective woven styles.

165. *Weave " Gamut " and Shaft Mountings.*—The study of " weave " design as originated from and elaborated on the