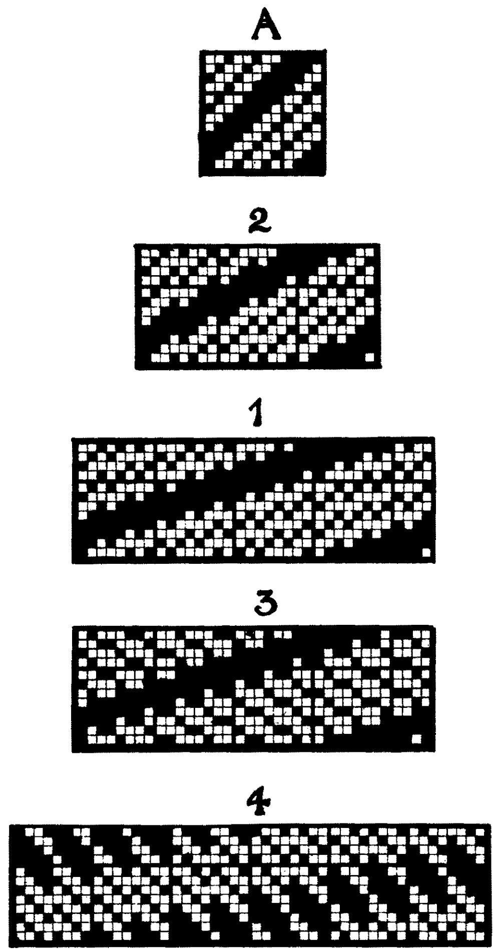
Weave A, Design Sheet 8, is the basis of all the effects here shown. The number of possible twills on this basis,



DESIGN SHEET 8.—ILLUSTRATING THE REARRANGEMENT OF TWILLS

for example, can most readily be worked out in figures, as follows :

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 representing the twelve threads.

(*a*) 123, 234, 345, 456, 567, 678, 789, 8 9 10, 9 10 11, 10 11 12, 11 12 1, 12 1 2 represent an arrangement three in a group (Design No. 1).

(*b*) 1234, 3456, 5678, 789 10, 9 10 11 12, 11 12 1 2 represent an arrangement four in a group (Design No. 2).

Following out these lines, it is evident that, so far as repetition of the design is concerned, *the number of threads in a group × the threads in the original twill divided by the move gives the repeat.* Thus :

In (*a*) $12 \times 3 = 36$ threads in the repeat.*

In (*b*) $[12 \times 4] \div 2 = 24$ threads in the repeat.

Designs 3 and 4 illustrate varieties which should be investigated by the student before reading further.

Again not only combinations of this type are possible, but also permutations ; thus the following is a permutation based upon (*a*) :

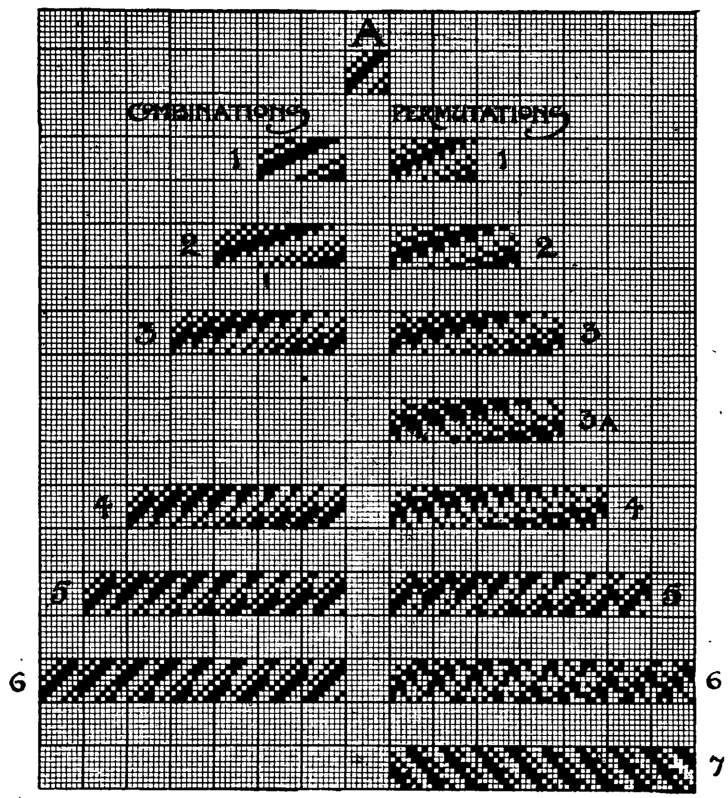
(*c*) 132, 243, 354, 465, 576, 687, 718, etc. (Design No. 3).

Other examples of combinations and permutations, given on Design Sheet 9, should make the student ask, How many combinations and permutations are possible under these conditions, and, finally, under all similar conditions ?

The possible combinations and permutations in such cases as these may best be ascertained by looking up the subject in a good algebra, but the few examples given here will enable the designer to *experiment on a systematic basis*, which is really the thing to be aimed at. Generally speaking, these effects are useful as giving the necessary

* Again the student should realize that, although there are 36 threads in the repeat of the pattern, there are only 12 orders of threads, and only 12 shafts will be required.

variety and interest to a cloth without damaging the structure. They possess, along with thread-and-thread combinations, the useful property of being producible on comparatively few shafts.



DESIGN SHEET 9.—ILLUSTRATING THE SYSTEMATIC WORKING OUT OF COMBINATIONS AND PERMUTATIONS

(*e*) Sateens and Sateen Twills.—The sateen structure is an interlacing on any given number of threads and picks, whereby a flat, unbroken, untwilled surface is produced (Fig. 49), The best example to be cited is what is known to all as 'satin.'* These weaves form a very large class in their

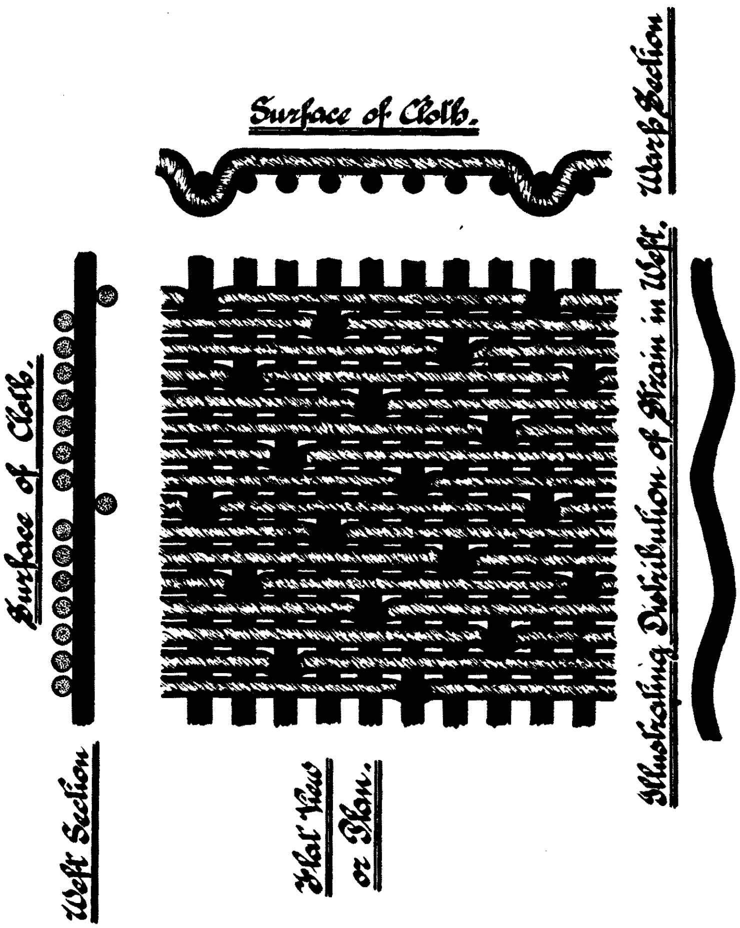
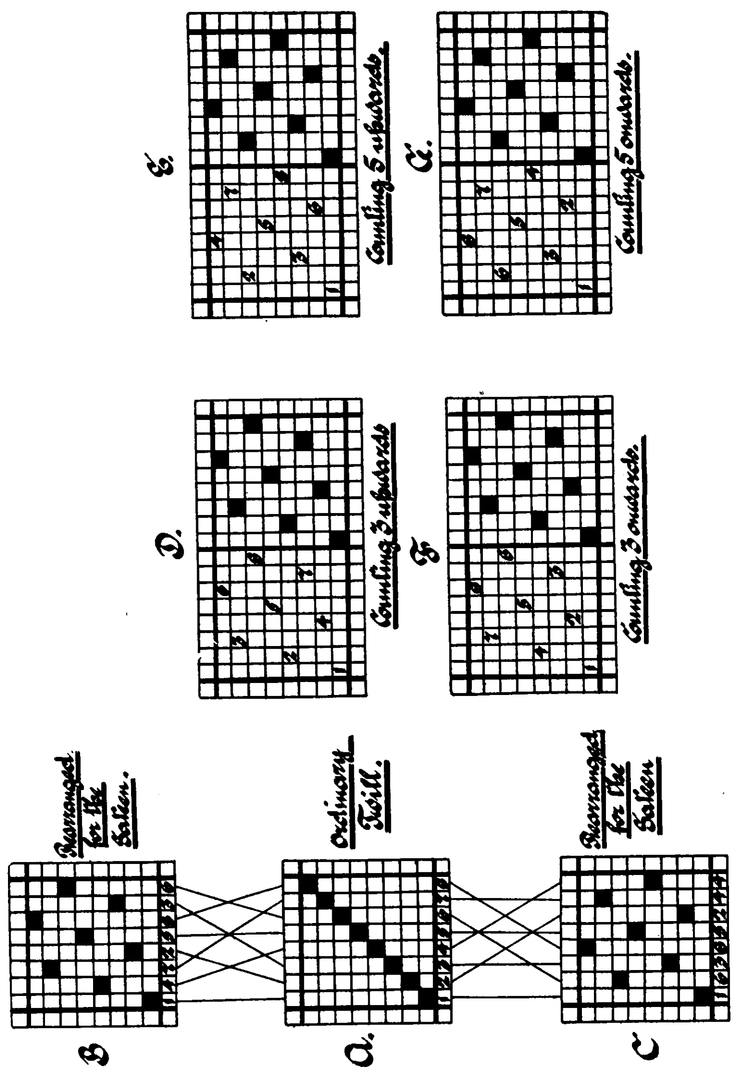


FIG. 49.—ILLUSTRATING THE CONSTRUCTION OF AN 8-WARP SATEEN FABRIC

pure form, and are even more important as useful bases for originating new weaves and also for distributing figures.

In Design Sheet 10 the origination of a sateen from a $\frac{7}{1}$

* These weaves being sometimes termed 'satins.'



DESIGN SHEET 10.—ILLUSTRATING THE VARIOUS METHODS OF ORIGINATING SATEENS
(Viz., by rearranging the threads of an ordinary twill, or by counting upwards or onwards)

twill is shown (B), being the threads of A rearranged in the following order :

1, 4, 7, 2, 5, 8, 3, 6.

The sateen or sateens on any number of threads can be similarly originated, but as the same arrangement can be made in less time by 'counting,' as it is termed, this latter method is almost universally employed.

In D, E, F, G the system of counting is fully illustrated.

If the student, from these examples, masters this system he will be able to systematize his work as follows:

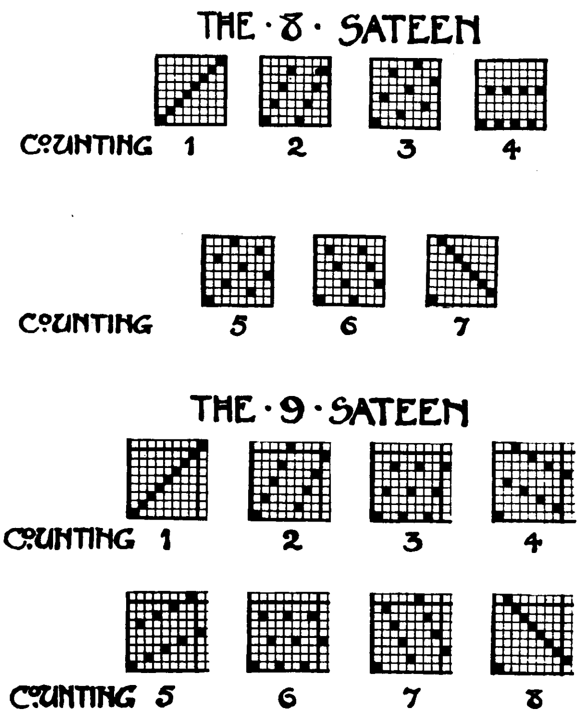
For the 5-sateen numbers from 1 to 5 may be counted.

Counting 1 gives the continuous twill.
,, 2 ,, the sateen twill.
,, 3 ,, the sateen twill.
,, 4 ,, the continuous twill.
,, 5 ,, no weave at all.

Consequently, the sateen numbers or counting numbers here are 2 and 3.

Passing to the 8-sateen (see Design Sheet 11)—

Counting 1 gives the continuous twill (twill to right).
,, 2 ,, no weave.
,, 3 ,, the sateen.
,, 4 ,, no weave.
,, 5 ,, the sateen.
,, 6 ,, no weave.
,, 7 ,, the continuous twill (twill to left).
,, 8 ,, no weave.



DESIGN SHEET II.—ILLUSTRATING THE ORIGINATION OF SATEENS

On experimenting for the 9-sateen—

Counting 1 gives the continuous twill (twill to right).
,, 2 ,, the sateen.
,, 3 ,, no weave.
,, 4 ,, the sateen.
,, 5 ,, the sateen.
,, 6 ,, no weave.
,, 7 ,, the sateen.
,, 8 ,, the continuous twill (twill to left).
,, 9 ,, no weave.

The complete set of countings for the 9-thread sateen is given in design 16.

These results may be recorded as follows :

Counting for 5-sateen— ~~1~~ 2 3 ~~4~~ ~~5~~

" " 8 " ~~1~~ 2 3 ~~4~~ 5 6 ~~7~~ ~~8~~

" " 9 " ~~1~~ 2 3 4 5 6 7 ~~8~~ ~~9~~*

From these clearly stated results the following deductions may be made :

1. The number upon which the sateen is based cannot be counted (viz., 5, 8, 9).

2. Counting 1, or one less than the sateen (viz., 4, 7, 8) simply gives a continuous twill (twill to the right or twill to the left), so that 1 and 4, 1 and 7, 1 and 8 practically correspond, and are not sateen numbers.

3. The numbers to be counted for the sateens (on any required number of threads) are not even numbers, nor odd numbers, but *any number may be counted which has not a measure in common with the number of threads upon which the sateen is based.*

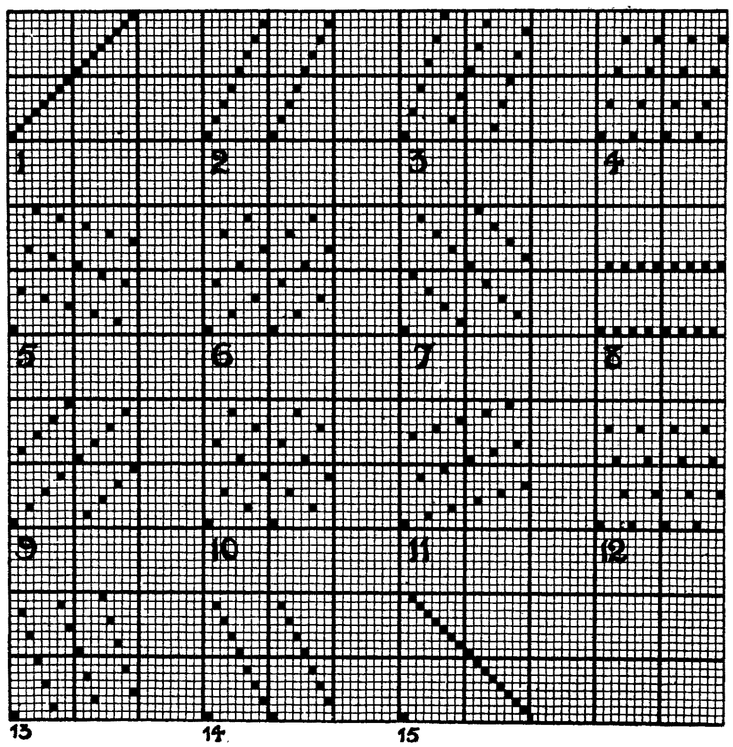
Thus, 2 and 3 for the 5-, 3 and 5 for the 8-, and 2, 4, 5 and 7 for the 9-sateen may be counted and will yield the sateen.

4. It will be further noted that, as with the continuous twills, so with the sateens—the numbers linked together are similar sateens but twilling to the right or left, as

* Before proceeding further, the student should ask himself, What is the rule for counting? Having originated this for himself, and tested it, he may now read on.

the case may be. Thus there is only one 5 and one 8 sateen, two (really one) 9 sateens, and so on.

Every designer should work out the complete set of sateens up to 24 threads, and keep them ready for refer-



DESIGN SHEET 12.—ILLUSTRATING THE ORIGINATION OF SATEENS
(The number at the left-hand corner of each design is the number counted)

ence. To assist him in doing this, Design Sheet 12 gives all the countings for the 16-sateen with the numbers which may be counted below.

The sateen structure in its simplest form is really a distributed weft or warp-rib style, as the case may be; the *picks or threads* respectively lying close to one another, the *threads or picks* being separated sometimes by the diameters of the picks or threads, sometimes by less, owing to the distribution of strain previously referred to and illustrated in Fig. 49. The designer must decide in practice whether he requires a warp or weft surface, and in which direction the twill is to run, or he may be astonished with the results he obtains. The flat view (Fig. 49) of a warp sateen structure will explain away most difficulties if thoroughly studied. Especially to be noted is *the relationship of each thread to its neighbours, which decides the direction of the twill.*

Sateen Derivatives

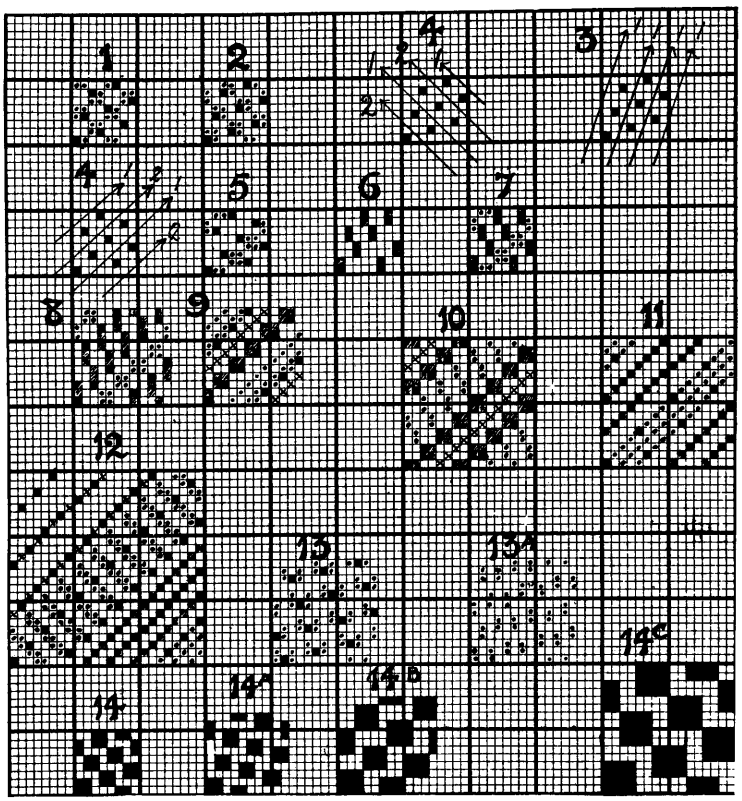
If the sateen weaves are useful in themselves, still more are they useful as a means whereby other weaves may be originated, these being usually spoken of as 'sateen derivatives.' It is convenient to consider sateen derivatives under two heads—regular and irregular.

(*a*) Regular sateen derivatives are formed by adding dots in a definite order to each sateen dot—whatever the sateen may be—as instanced in Design Sheet 13, No. 2, in which the sateen base is clearly indicated along with the addition. No. 1 is incorrect, and indicates what must be avoided—*i.e.*, the additional dots must be added to each sateen dot *in the same relative manner*.

(*b*) Irregular* sateen derivatives are formed by adding dots to each sateen dot in a *regular* yet varied manner; they are only irregular as compared with the regular derivatives. As shown in Nos. 3 and 4, the 8-sateen presents to the eye

* This, again, is only a 'convenient' term.

in one direction an upright twill, *which repeats upon itself*, and in the other direction an ordinary twill *in which there are two distinct repeats* in one repeat of the sateen. If the upright twill is made the basis of the addition it is im-



DESIGN SHEET 13.—ILLUSTRATING THE CONSTRUCTION OF IRREGULAR SATEEN DERIVATIVES

possible to make an irregular derivative; but if the ordinary twills are added to, then one twill may be filled in with one effect, and the other twill with another effect, as indicated in Nos. 4, 5, 6, and 7, which show the building in stages of what is termed the Mayo or Campbell twill.

With some sateens it is impossible to make an irregular derivative; with others—as, for example, the 12 and 16 sateens (Nos. 8, 9, 10, 11, 12)—it is possible to make either regular or irregular derivatives, so that the student should have a complete set of sateens at hand, and then he can select the sateen or sateens best suited to his immediate purpose. Note should be made that such weaves as illustrated by No. 1 are of no practical value, since the addition is so irregular that the result is a weave which has practically no base, and, in fact, cannot be considered as a true weave.

The possibilities of figuring by weave on a 12-sateen basis is well illustrated in No. 12.

The following are other methods of forming sateen derivatives:

(*c*) By employing the sateen dot as a means of obtaining the positions of other dots and then rubbing out, as indicated in Nos. 13 and 13 A.

(*d*) By enlarging or extending any small derivative on to a larger number of threads and picks, as shown in Nos. 14 and 14 A, B, C, for the latter of which the following is the calculation:

Weave = 8 twilled hop-sack—this is to be enlarged to four times the size, then—

$8 \times 8 = 64$ small squares for the effect as given at 14.

$64 \times 4 = 256$ small squares for the enlarged effect.

and $\sqrt{256} = 16$ threads by 16 picks for the enlarged effect 14 C.

Motive and Weave Effects

These effects are produced on similar lines to the sateen derivatives, one or more motives (*i.e.*, suitable weaves) being first put down on any suitable number of threads and picks, and then one or more effects added, the motive mark being used as a starting-point for every thread and pick. The method of working these out will be understood from the following examples :

Design Sheet 14, No. 1 is a combination of the two motives shown with one added effect, shown at the side and in dots on the design. No. 2 is a combination of two motives with two added effects. No. 3 is a combination of two motives with three added effects. No. 4 is a combination of four motives with four added effects.

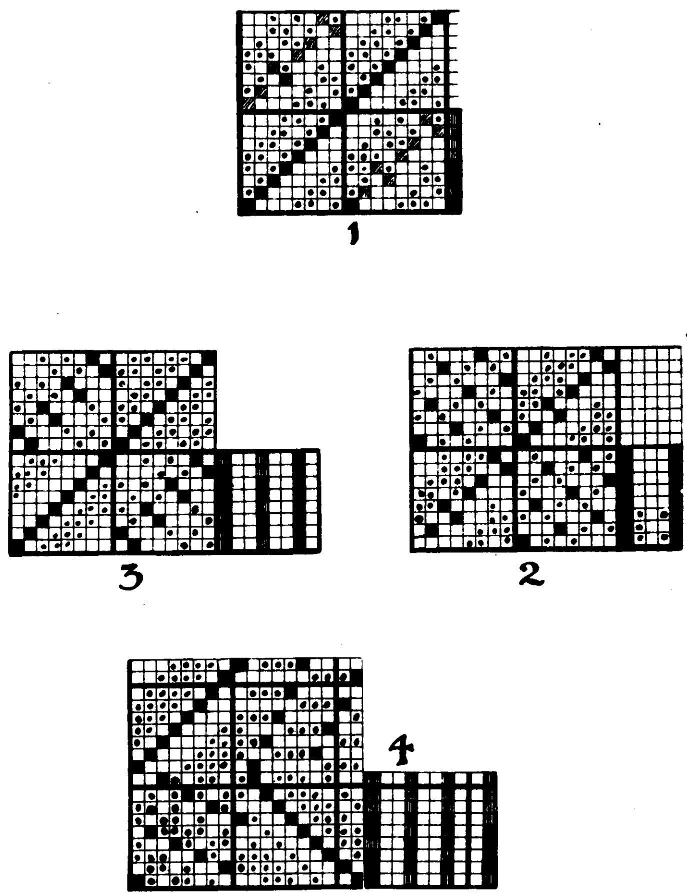
Many combination effects on these lines may be produced, being suitable for certain classes of either coatings or dress goods. Effects described as 'oatmeal' and 'granite' weaves may be produced thus.

There are, no doubt, other means by which a variety of weave effects may be obtained, which the student should now be able to work out on his own initiative.

The Sateen Rearrangement of Twills

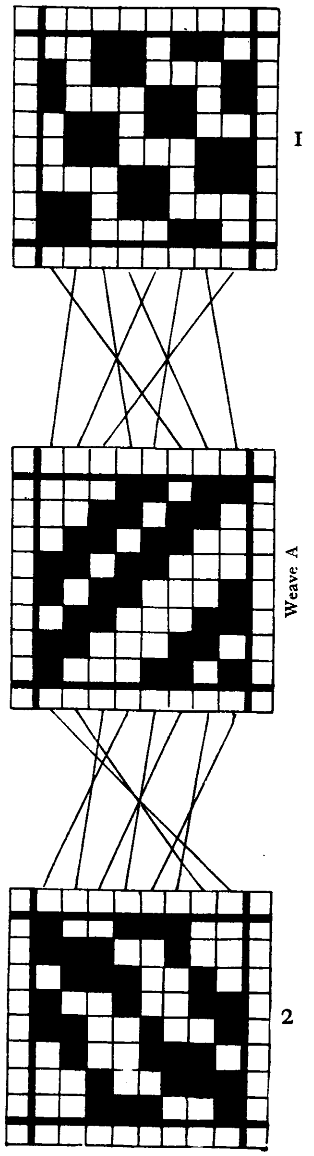
Sometimes useful effects may be obtained by rearranging the threads in a given twill in the sateen order. It is true that the results thus obtained will be similar to sateen derivatives, nevertheless it is well known that by this means new ideas are frequently obtained. There is a further advantage in working on these lines, since the shafts which will produce the ordinary twill

will produce the rearranged twill by fancy drafting, as is indicated in Design Sheet 15A, and fully explained



DESIGN SHEET 14.—ILLUSTRATING THE ORIGINATION OF MOTIVE WEAVE EFFECTS

in Chapter VII. The method of rearrangement is indicated in weave A and Nos. 1 and 2, the numbers being as follows :



DESIGN SHEET 15A

Standard A: Order of threads 1, 2, 3, 4, 5, 6, 7, 8.

Sateen rearrangement No. 1: Order of threads, 6, 1, 4, 7, 2, 5, 8, 3.

Alternate rearrangement No. 2: Order of threads, 4, 3, 6, 5, 8, 7, 2, 1.

It will be noted that No. 1 is the twilled hop-sack and No. 2 the Mayo twill. The student should experiment with other twills upon these lines to ascertain the possible variations.

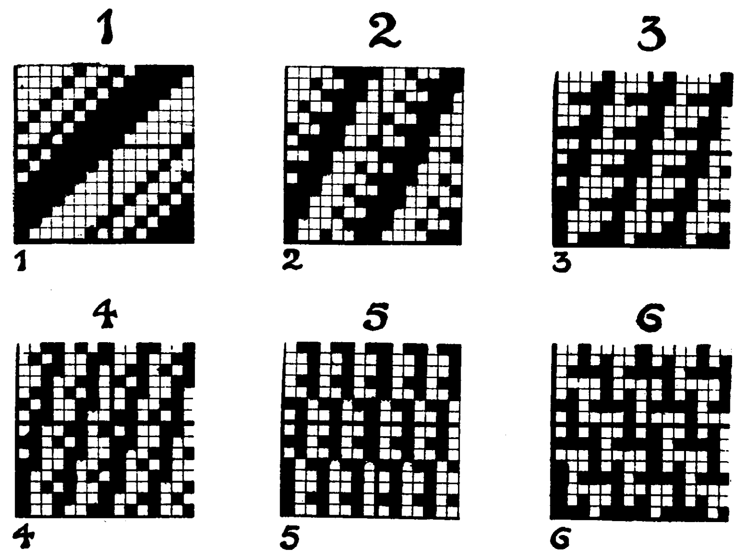
If the nature of all the sateen bases is fully understood, the possible sateen rearrangements on sateen bases of any twill will be realized. On Design Sheet 15B, Nos. 3 to 8, all possible sateen rearrangements of a 15-end twill are given.

Sateen Twills

These are based upon the various sateens and may consequently be considered under the headings of Ordinary Sateen Twills and Upright Sateen Twills.

Ordinary sateen twills must be based upon a sateen presenting a twill at the ordinary angle (45°). Thus in Design Sheet 16, No. 1, the 8-sateen is the basis, being modified into the Mayo twill and twilled hop-sack. The following order of construction has been adopted :

1. Mark off 32 × 32 picks.
2. Insert the 8-sateen all over—*i.e.*, sixteen times.



DESIGN SHEET 15B.—ILLUSTRATING ALL POSSIBLE REARRANGEMENT OF A 15-THREAD TWILL
(The number at the left-hand corner of each design is the number counted)

3. Taking the direction of twill giving 45°, convert, by addition, into any style of weave required, in twill form.

Upright sateen twills are based upon the upright twill. No. 2 is a good illustration of this, which has been worked out in stages as indicated for No. 1. The designer must use his judgment in selecting (*a*) the angle of twill most

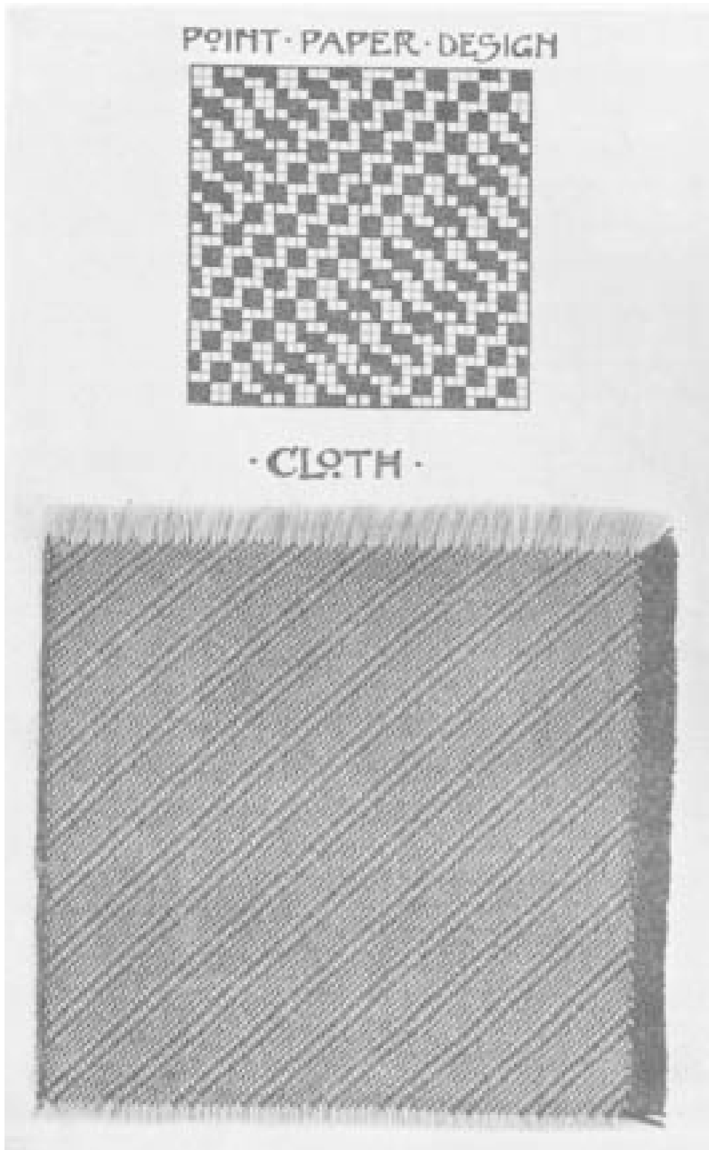
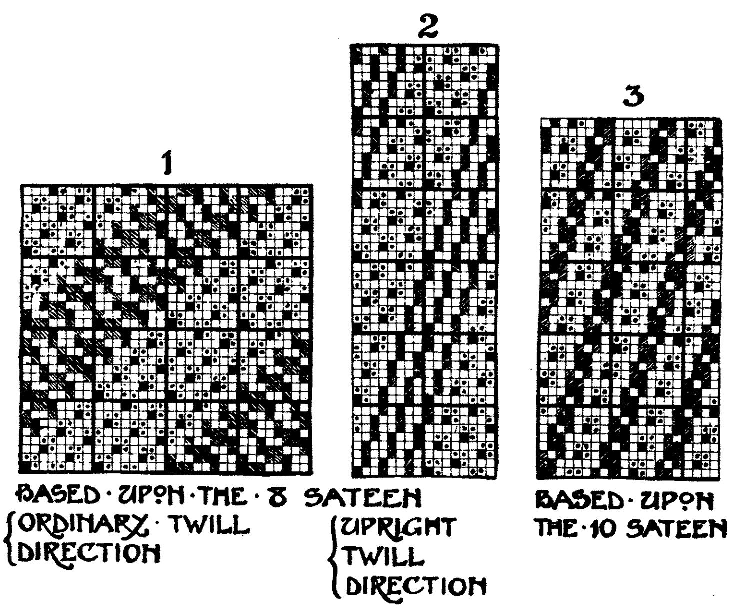


PLATE 5A.—ORDINARY SATEEN TWILL

suited to his requirements, (*b*) the type of weaves into which the pure sateen is converted.

In dealing with sateen diapers in the next chapter (p. 133), the advantage of the designer *selecting the conditions best suited to his immediate purpose* is strongly



DESIGN SHEET 16.—ILLUSTRATING THE ORIGINATION OF SATEEN TWILLS

emphasized. This may be considered as one of the golden rules of textile design.

The student may now with advantage study the repetition of designs illustrated in Design Sheets 17A and 17B; in each case he must ask himself—*Why* does repetition occur as indicated?

CHAPTER VI

SATEEN FIGURES

IF the student has worked through the previous chapter he must have been struck with the many uses of the sateen arrangements, and it may have occurred to him that there is a further field for the use of sateens in the origination of stripes, checks, figures, etc. These further uses may well be studied under the three following headings :

1. Sateen stripes and checks.
2. Sateen diapers.
3. Figures arranged in sateen order.

Sateen Stripes and Checks

These are formed by inserting any suitable sateen over the required number of threads and picks, and then converting it into two or more weaves in either stripe or check form as required.

Design Sheet 18, No. 1, has been formed by inserting 8-sateen over 32 threads $\times$ 8 picks, and then converting 16 of the threads into $\frac{2}{\quad 2}$ twill and 16 into Mayo twill in stripe form. There is thus a common base binding both weaves together, as indicated in the solid dots, but there is no reason why the weaves should not be put together in any relationship other than this—the two weaves should cut if possible, *i.e.*, at the point of juncture

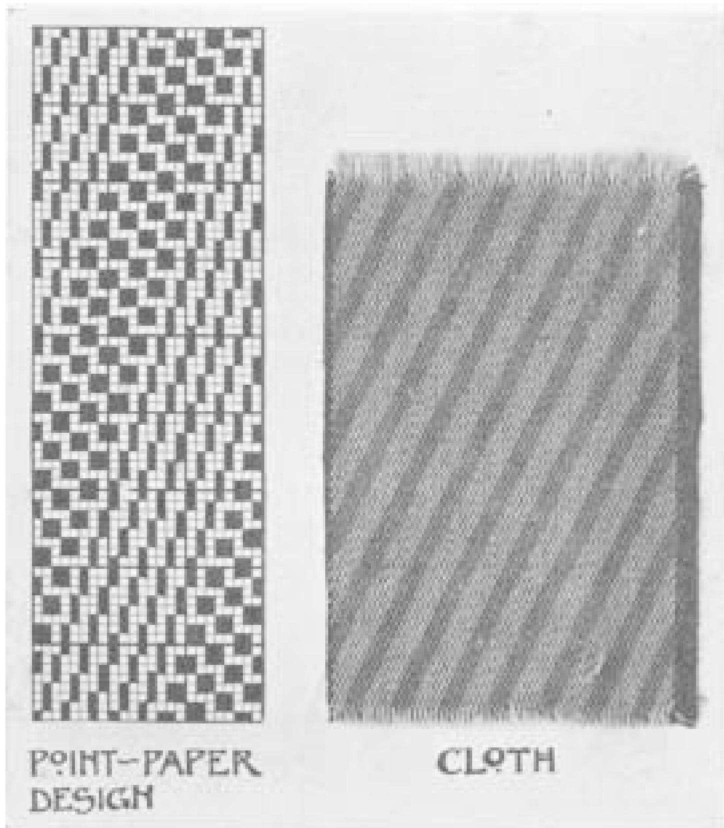
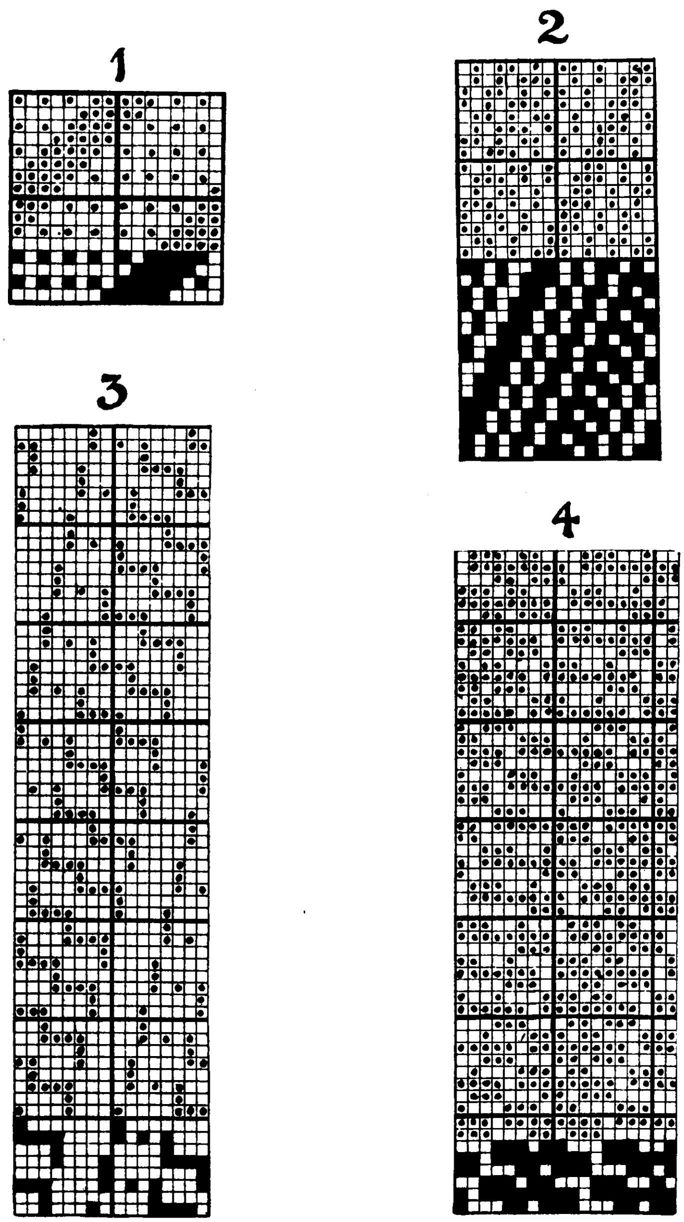


PLATE 5B.—UPRIGHT SATEEN TWILL

there should not be any unsightly floats.* If the designer can do better without the base he need not use it. All

* The student must realize that this question of 'cutting' is all-important in most stripes and checks. *That which is not the best is wrong.*



DESIGN SHEET 17A.—ILLUSTRATING THE COMPLETION OF WEAVE EFFECTS the systems here defined are *to aid, not restrict, the designer*, and he must use his judgment in such matters as this.

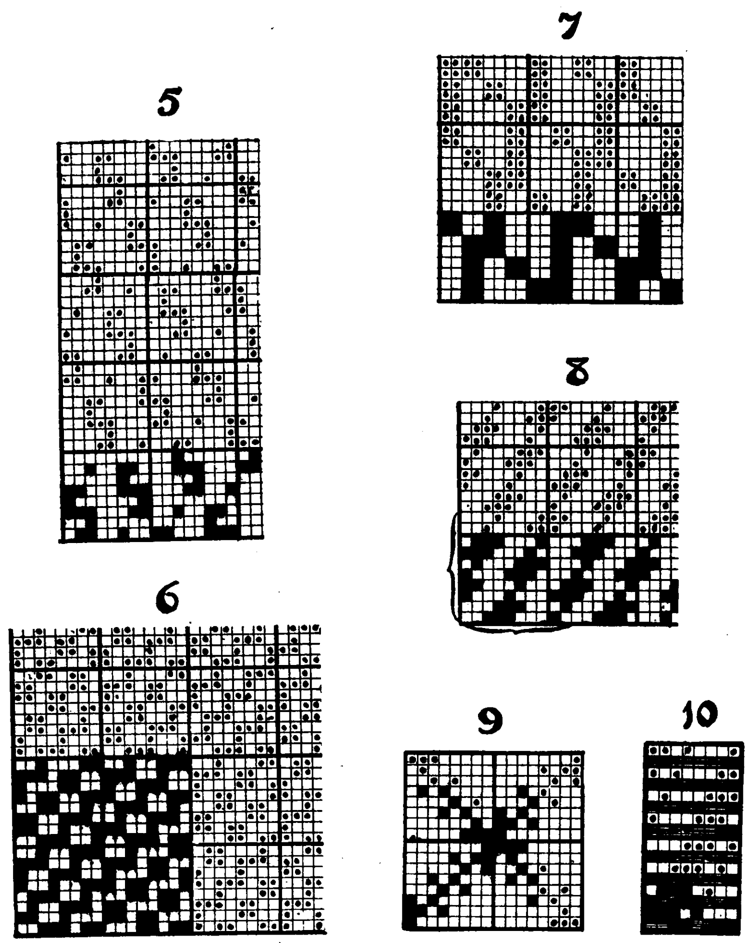
No. 2 is a check on similar lines to No. 1, and in No. 3 a check turned diagonally instead of horizontally and vertically is given.

The Sateen Diapers

This type of effect is originated on similar lines to sateen checks, but the diagonal lines presented by the various sateens in their pure form are worked upon. In Fig. 50 the various divisions of space formed by the various sateens are shown, and in Design Sheet 19, No. 2, a simple sateen diaper based upon the 5-sateen, while No. 1 is a more complex diaper based upon the 12-sateen. No. 3 is specially interesting, as in this case weaves have been selected which fit the angle of the diaper twill in both directions, hence perfect cutting results. The young designer in experimenting would most probably have selected weaves which did not present this coincidence, but the experienced designer is always ready to select conditions likely to yield perfect, or, at least, the best possible results.

If the designer wishes to demark the sateen dividing lines he should adopt the method shown in No. 4 (not No. 5), in which *horizontal* lines are developed in *weft* and *vertical* lines in *warp*—*i.e.*, he must think in the cloth and not on point-paper.

Design Sheet 19A, again, shows a variety of a very suggestive type—in fact, there is no end to this style of design.



DESIGN SHEET 17B.—ILLUSTRATING THE COMPLETION OF WEAVE EFFECTS

Figures arranged in Sateen Order

It is not our intention to deal in any sense with figured fabrics in the present treatise, but there are a number of small figure effects in general use which are really nothing more or less than figured weaves; these must be considered here.

In Design Sheet 20, A is a small figure, and alongside

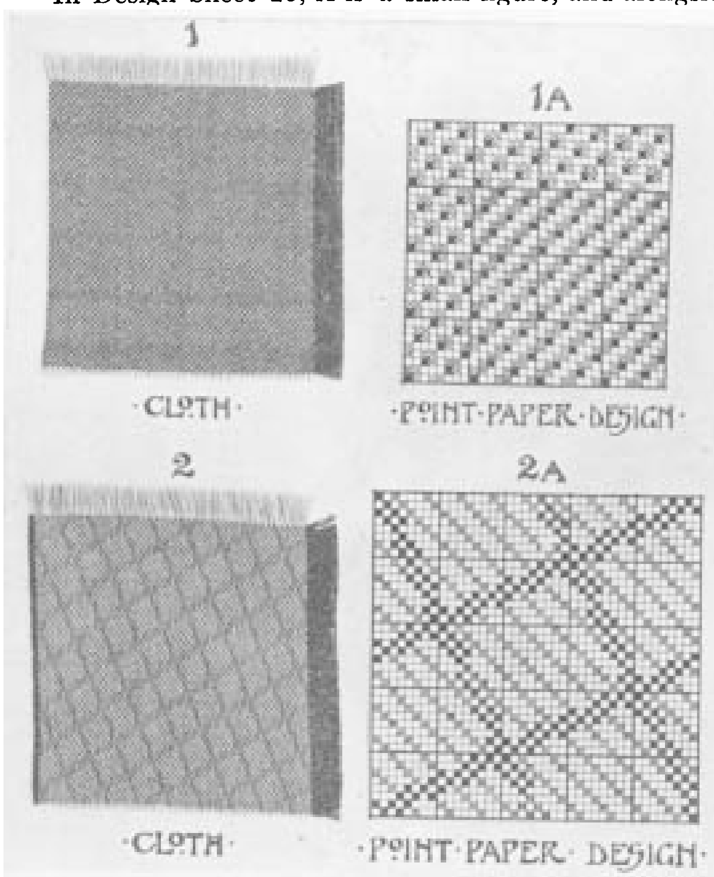
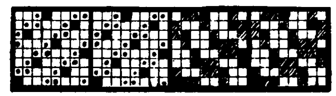


PLATE 6.—(1) CHECK WITH SATEEN BASE; (2) DIAPER WITH SATEEN BASE

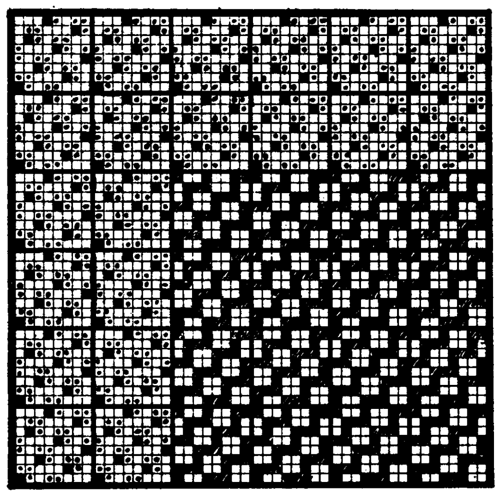
this same figure is arranged in sateen order. The *advantage* of such an arrangement is that even distribution is insured; the *disadvantage* from the designer's point of view is that practically in one repeat of the design there are

1



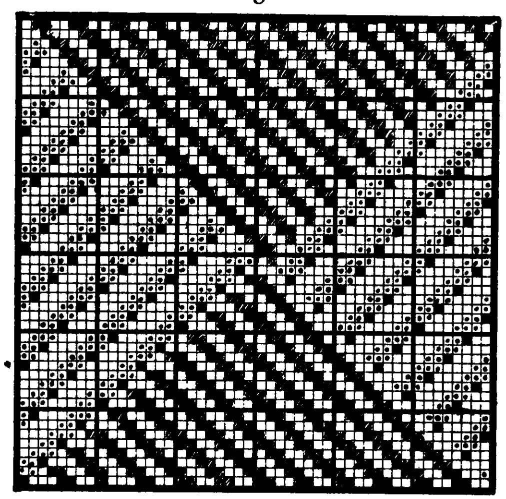
BASED · UPON · THE 8 SATEEN

2



BASED · UPON · THE · 8 SATEEN

3



BASED · UPON · THE · 12 SATEEN

DESIGN SHEET 18.—ILLUSTRATING SATEEN STRIPES AND CHECKS five repeats of the figure—*i.e.*, that the figuring capacity of a Jacquard (say, a 300) is reduced to 1/5 (60 threads). But as this system of design is chiefly devoted to pro-

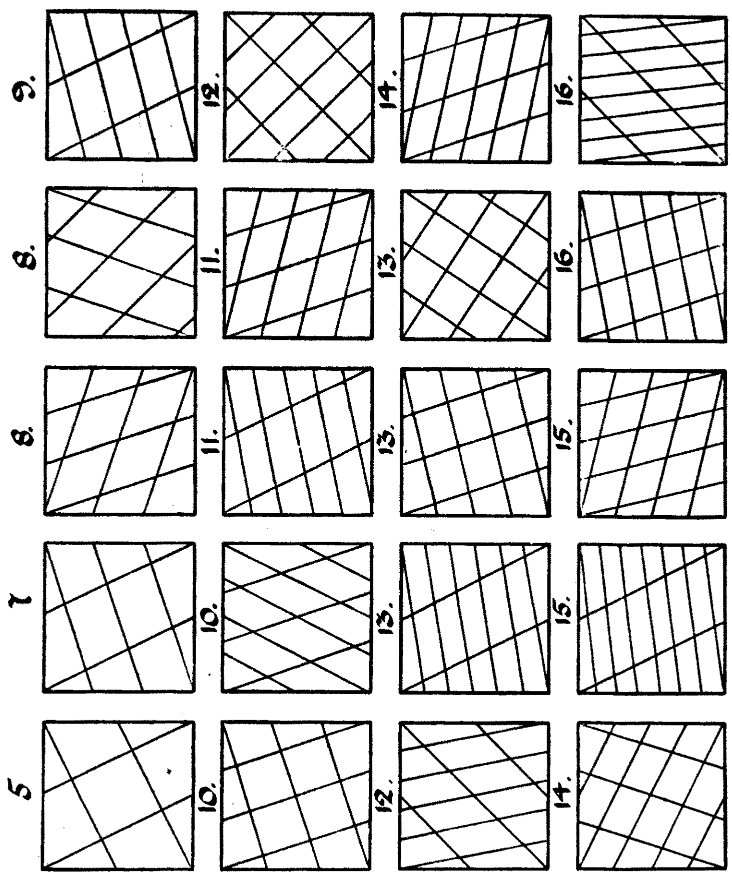


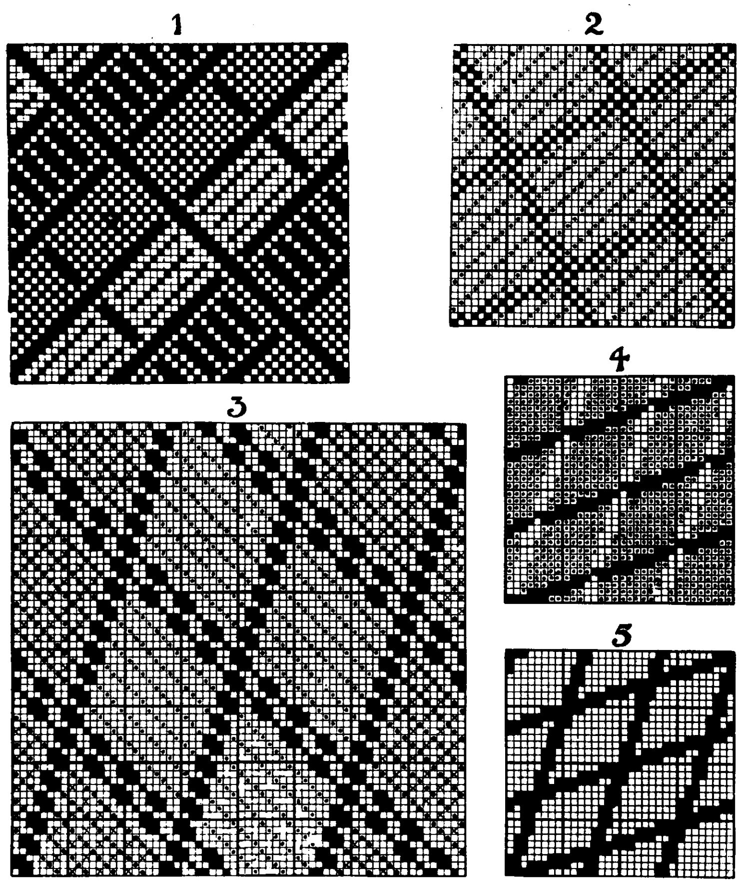
FIG. 50.—ILLUSTRATING THE DIVIDING UP OF A GIVEN SPACE IN SATEEN ORDER FOR EITHER SATEEN DIAPERS OR FIGURES

To Mr. Washington, of Dewsbury, these ideas of breaking-up a given space are due

ducing small weave effects for use as ground weaves in figured fabrics, the disadvantages are practically nil.

The following treatment will explain the method of working. Design Sheet 20, Fig. A, is to be arranged in 5-sateen order on 30 threads × 30 picks.

1. Divide the given space in both warp and weft direc-



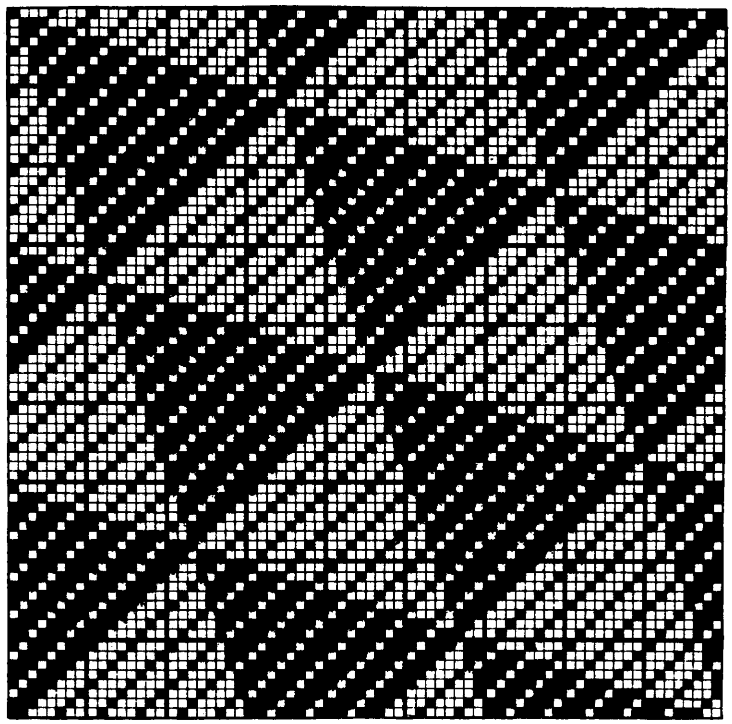
DESIGN SHEET 19.—ILLUSTRATING SATEEN DIAPERS

tions into the necessary number of sections (30÷5 = 6)—*i.e.*, 5 blocks of 6 × 6 in each direction.

2. Select positions for the required number of figures

(five), counting as for the sateen, but in sections of 6×6 as one.

3. Fill the figure into each sateen position thus selected *in the same relative manner*. These stages are all repre-



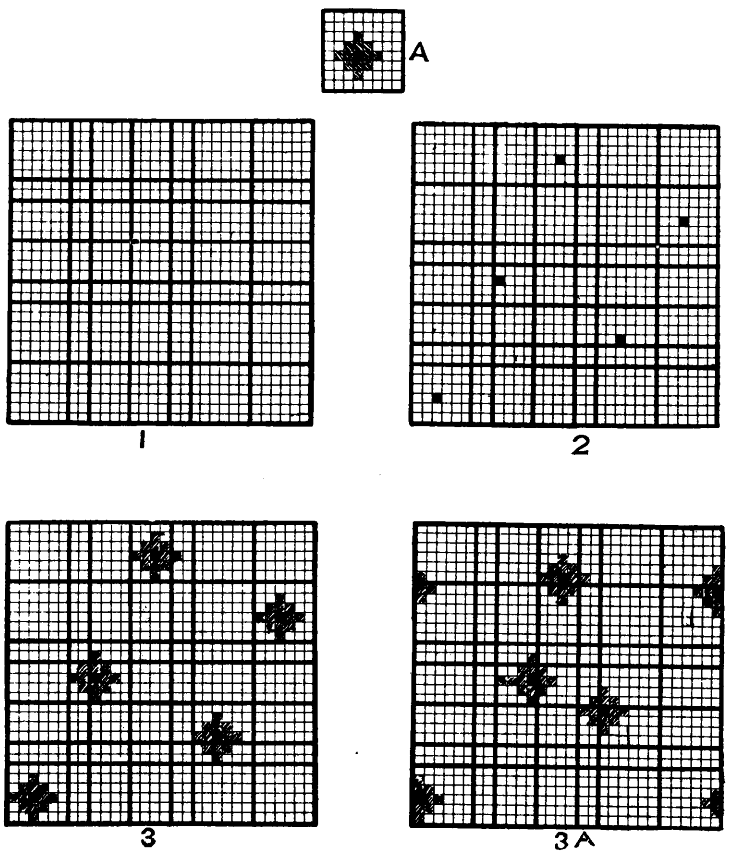
DESIGN SHEET 19A.—ILLUSTRATING SATEEN DIAPERS
Divisions based upon the 8-sateen ground base and sateen

sented, while No. 3A, illustrates the wrong filling in of the figure.

No. 4 in Design Sheet 20A, illustrates a figure in 4-sateen order, with a ground weave suitable for cutting well with the figure.

Reversing Figures in Sateen Order

The 8-sateen will give four figures in one direction and four in the opposite direction. Such sateens as the 5 or

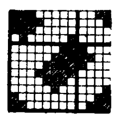


DESIGN SHEET 20.—ILLUSTRATING THE ARRANGING OF FIGURES IN SATEEN ORDER

7 arrangements must be repeated twice or four times. Figures may be placed in four or even more positions if

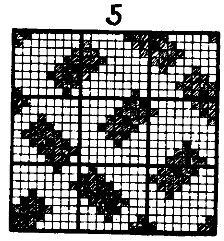
required,* but this does not concern us here, being an attribute of figure designing.

In reversing figures, the figure *must be turned upon its centre,* or else it will encroach upon the space of its neigh-

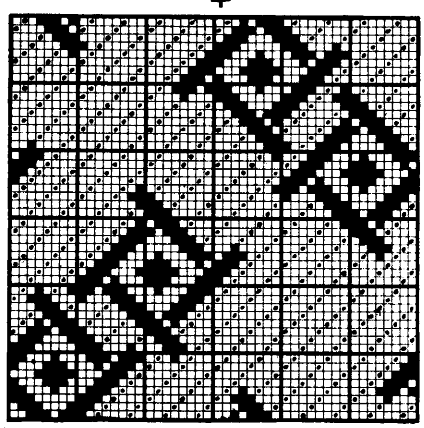


e & *e*¹

5



4



DESIGN SHEET 20A.—ILLUSTRATING THE ARRANGING OF FIGURES IN SATEEN ORDER

bour, leaving a corresponding blank space in the design. The following calculation for reversing two figures explains all that is necessary at this stage:

If *e e′*, Design Sheet 20A, are two figures occupying

* An interesting exercise here will be for the student to arrange a flower-head at five different inclinations for 5-sateen arrangement.

a threads and b picks, then the two figures occupy $a \times b$ small squares, and each figure occupies $(a \times b) \div 2 = c$ small squares.

Then for y-sateen order—

$c \times y = d$ small squares occupied by the full design, and
$\sqrt{d}$ = the number of threads and picks the design is on, if on the square.

Hence the following formula, which to young students looks terrible, but which is simply a complete statement of the above :

$$\sqrt{(a \times b) \times \frac{y}{2}} = \text{threads and picks which the full design will require.}$$

Figures e e' work out as follows :

$(12 \times 12) \div 2 = 72$
$72 \times 8 = 576$
$\sqrt{576} = 24$ threads by 24 picks for the full design.

Or put as the complete formula :

$$\sqrt{(12 \times 12) \times \frac{8}{2}} = 24 \text{ threads by } 24 \text{ picks.}$$

But all figures are not on the same number of threads as picks. Design 5, for example, is on 16 threads by 32 picks. (See Design Sheet 20B.)

If a and b are different numbers, then d must be apportioned out to threads and picks as follows :

As $b : a :: d : x$ and $\sqrt{x}$ = threads for full design.
As $a : b :: d : x'$ and $\sqrt{x'}$ = picks for full design.

Thus, the final formula fitting *all cases* is :

$$\sqrt{\frac{a\times b}{2}\times y\times\frac{a}{b}}=\text{threads.}$$

$$\sqrt{\frac{a\times b}{2}\times y\times\frac{b}{a}}=\text{picks.}$$

Apply these formulas for Design Sheet 20B :

$$\sqrt{\frac{16\times 32\times 8\times 16}{2\times 32}}=32 \text{ threads for full design.}$$

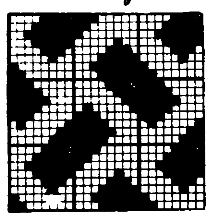
$$\sqrt{\frac{16\times 32\times 8\times 32}{2\times 16}}=64 \text{ picks for full design.}$$

A curious point may now be noted : If the figures in the second stage, Design Sheet 20B, be made rather larger, they do not overlap, but strictly maintain their independence. If, however, these enlarged figures be rearranged according to the above formulas they will overlap* and consequently a defective arrangement results. There seems to be here an analogy with certain scientific inductions, which may be true, say, 500 times, but untrue the 501st time. (See Jevons' 'Elementary Logic.')

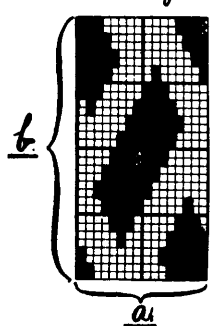
Two other points must here be noted : (*a*) the relationship of a to a' (Design Sheet 20A) must be designed by the student prior to working out this calculation ; (*b*) in cases where weft flush figures are thrown upon a plain ground it is necessary sometimes to move some of the figures slightly in order to make the plain ground cut with the edge of the figure. On Design Sheet 20C is given a good example of this class. All possible reversed arrangements for a figure in 5-sateen order are illustrated

* The student should prove this experimentally.

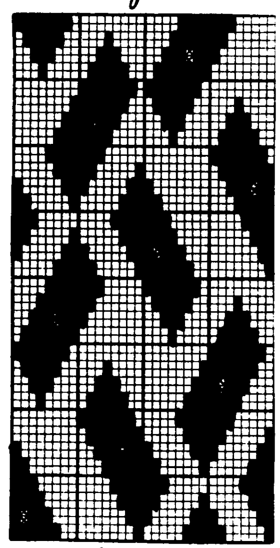
1st Stage.



2nd Stage



Design 5



8 Sateen Order

Formula

$$\sqrt{\frac{a \times b}{2} \times y \times \frac{a}{b}} = \text{Threads}$$

$$\sqrt{\frac{a \times b}{2} \times y \times \frac{b}{a}} = \text{Picks}$$

$$\sqrt{\frac{16 \times 32 \times 8 \times 16}{2 \times 32}} = 32 \text{ Threads}$$

$$\sqrt{\frac{16 \times 32 \times 8 \times 32}{2 \times 16}} = 64 \text{ Picks}$$

DESIGN SHEET 20B

on this design sheet and on Design Sheet 20D and 20E, from which the possibilities of other sateen arrangements may be gauged.

If the student has experimented with and thoroughly comprehended all the foregoing methods of weave origination, he will have laid the foundations for success in whatever particular branch of textile designing he ultimately works.

CHAPTER VII

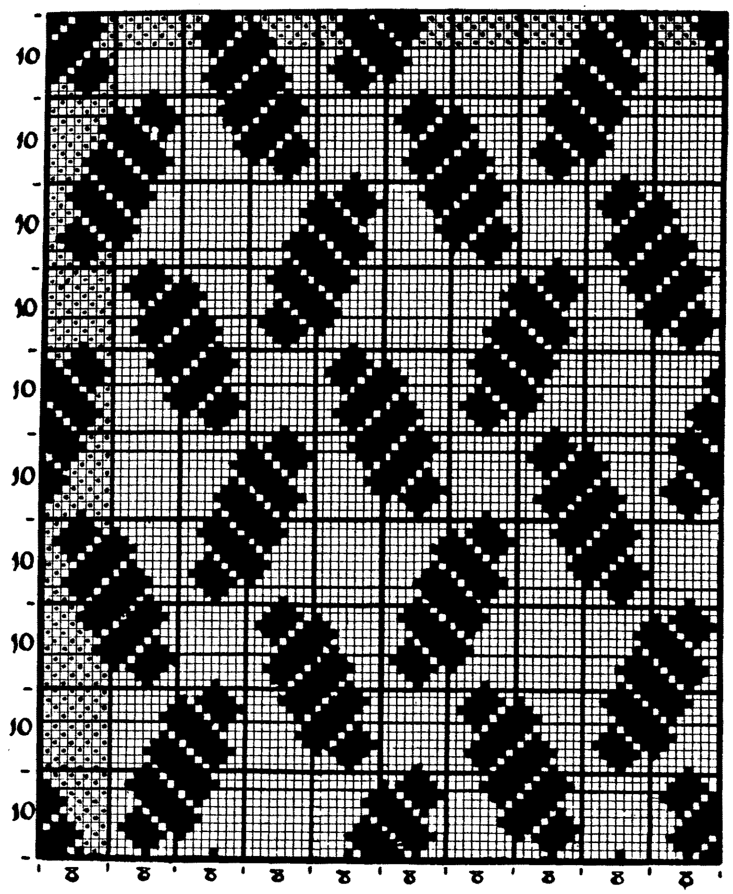
THE PRINCIPLES OF DRAFTING

WHILE the student has been studying the various methods of weave origination the question has arisen in his mind* as to how these effects are to be produced in the loom. 'Tackle one thing at a time' is a good maxim, so that the question of 'drafting' has been properly omitted in Chapters V. and VI. But the question of ways and means cannot be ignored, and it is now necessary to think of the actual production of weave structures in the loom.

As explained in Chapter II.,† there must be perfect coincidence between the number of threads in the warp, mails per inch, and dents per inch in the reed, in order that the cloth may be woven with the least possible friction. But from the weave point of view the important matter is the number of shafts required. Consequently, there are often calculations to work out for gears and certain interesting relationships to estimate and arrange for. Take, for example, the factors influencing the direction of the twill in an ordinary dobby loom.

* Refer to p. 24.

† The student is recommended to re-read the part referring to this in Chapter II., pp. 19 to 27.

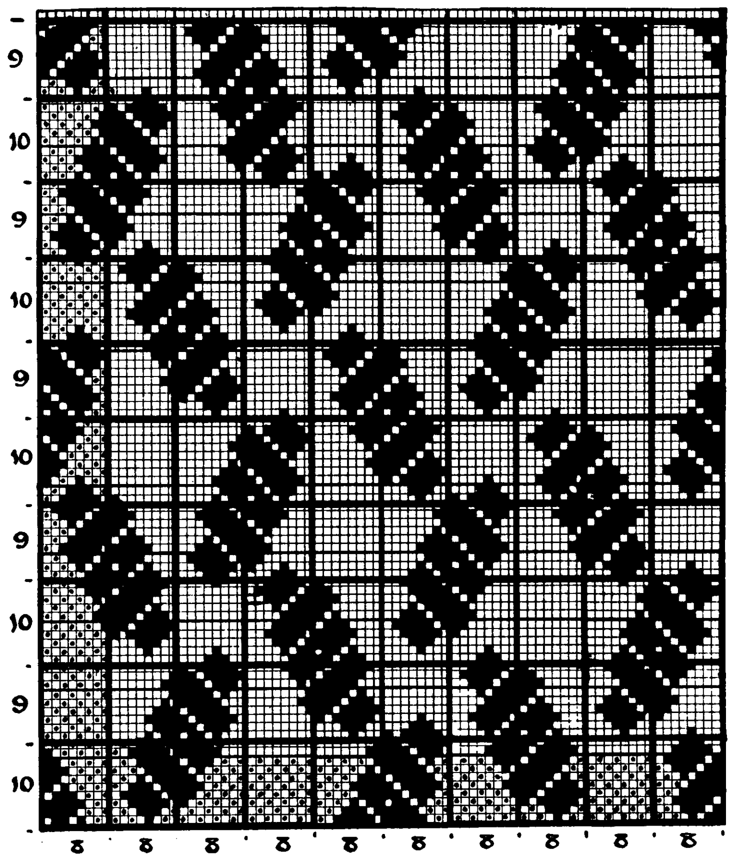


DESIGN SHEET 20C.—ILLUSTRATING A FIGURE IN 5-SATEEN ORDER (FOUR TIMES REVERSED, 20 FIGURES)

These are (1) the pegging of the lags ;* (2) the direction of the draft in the healds ; (3) the direction in which the card cylinder revolves; and (4) upon whether the loom is

* In the case of Jacquard (unless there is a cast-out) the cards can be ***turned inside out***, there not being the necessity of arranging or even lacing the cards one way or the other.

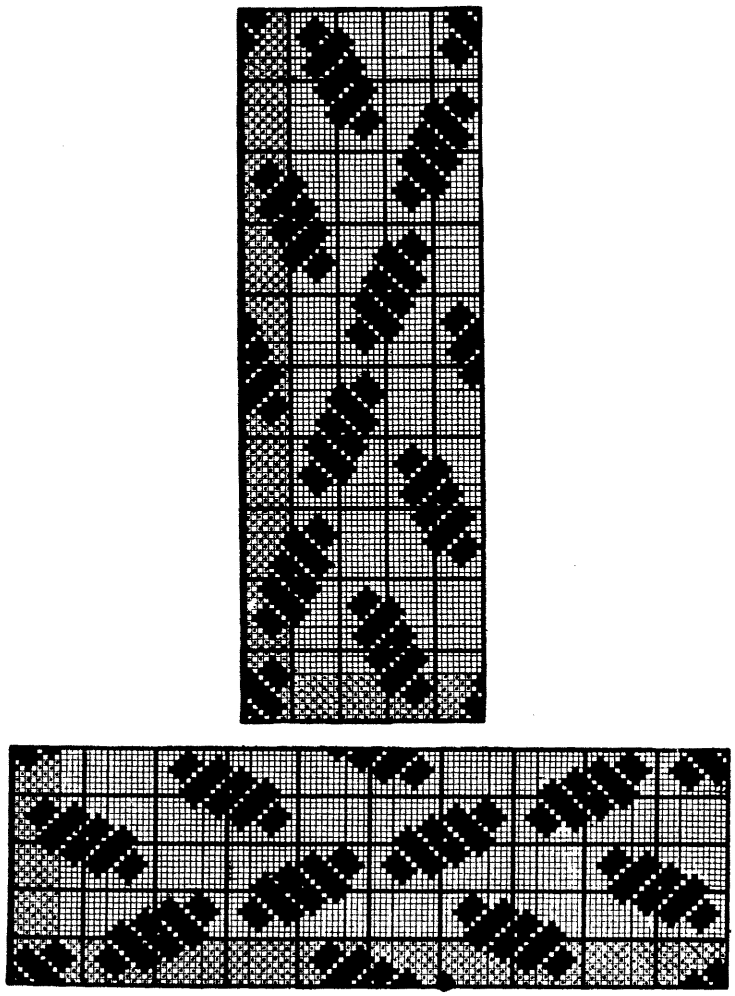
a right or left hand loom. These conditions will be understood by reference to Fig. 51.*



DESIGN SHEET 20D.—ILLUSTRATING THE ARRANGEMENT OF FIGURE IN 5-SATEEN ORDER (FOUR TIMES REVERSED AND MOVED FOR PLAIN GROUND)

If the student thoroughly understands the foregoing he will now have little difficulty in understanding what is meant by drafting.

* The student, while reading this and other paragraphs, should endeavour to see the same in his 'mind's eye.'



DESIGN SHEET 20E.—ILLUSTRATING A FIGURE IN 5-SATEEN ORDER (TWICE REVERSED, 10 FIGURES)

Definition of Drafting

In its simplest sense, as already explained, drafting simply means the drawing on to the same shaft (*i.e.*, through mails on the same shaft) of all those threads in a warp which are to work the same throughout the pattern and piece—*i.e.*, to be lifted over and left under the same picks. It is also obvious that the shafts must have mails on where required; hence the necessity for drafting and gear calculations.

On referring to Design Sheet 21* it will be realized that most elaborate effects may be produced by a few simple threads combined in various ways, for in this example there are, as shown, only 9 threads or orders of working, but as here arranged they give an effect on 56 threads.† If the student will think this out he will come to the following conclusions:

1. There must be as many heald-shafts as there are orders of threads—viz.: 9.

2. That these heald-shafts must work all the threads in a given warp, but the threads need not be drawn 'straight-gate'—*i.e.*, the 1st thread on to the 1st shaft, 2nd on to 2nd, 3rd on to 3rd, etc.—but that, having decided how the representative 9 threads shall be worked by the 9 shafts—*i.e.*, the 'pegging plan' for the shafts—then each thread of the warp must be drawn upon the particular shaft which works as this thread is required to work.

There is really nothing more in drafting than this, but unfortunately for the student questions on drafting will

* This example is from a work the title of which is unknown to the writer.

† The variation in the picks is only limited by the number of lags.

arise in practice in at least five ways (see Design Sheet 21A), viz. :

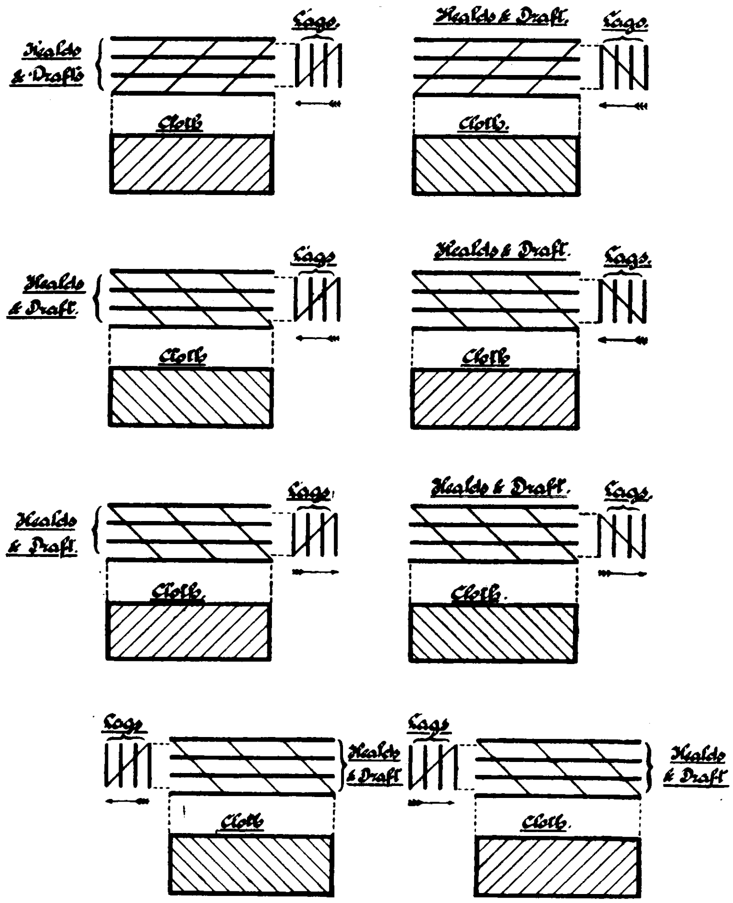


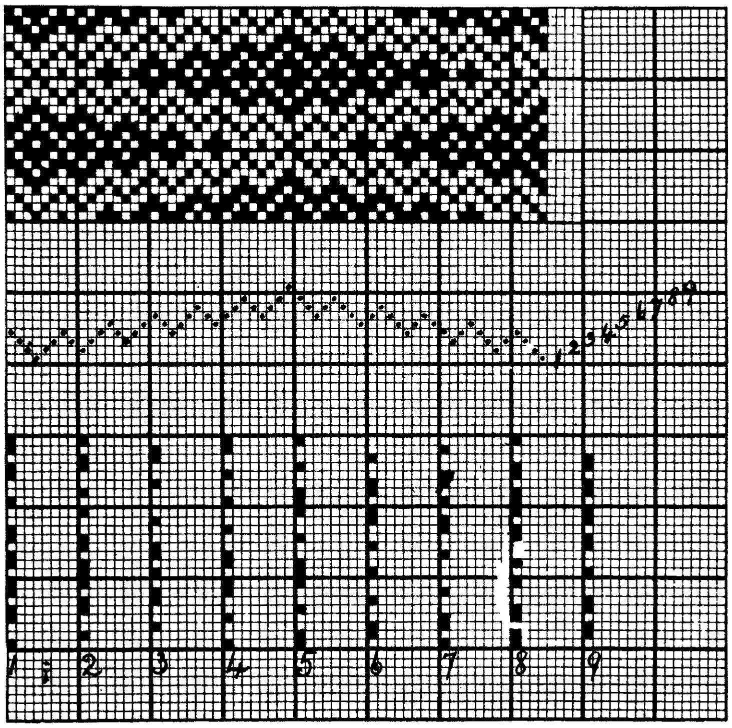
FIG. 51.—ILLUSTRATING THE INFLUENCE OF THE LAG-PEGGING POSITION AND WORKING OF THE DOBBY AND THE DRAFT ON THE TWILL OF THE RESULTANT CLOTHS

1. Having given the required design and draft, supply the pegging plan (No. 1).

2. Having given the required design and pegging plan, supply the draft (No. 2).

3. Having given the pegging plan and draft, supply the design (No. 3).

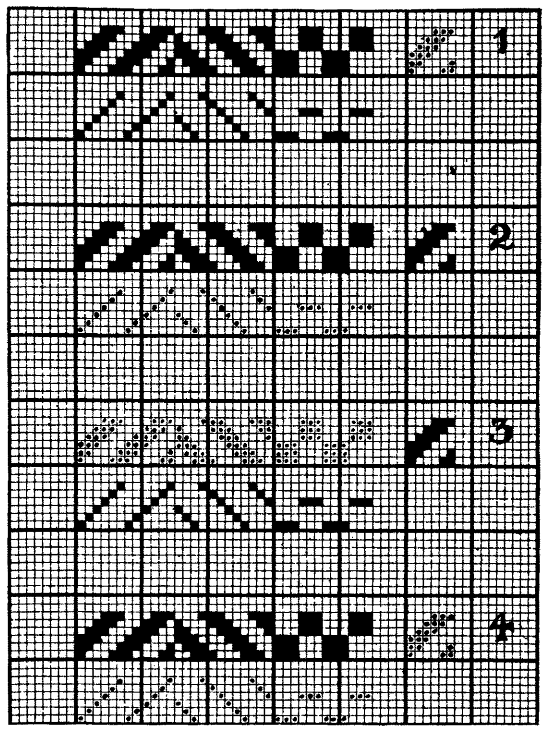
4. Having given the required design, supply the draft and pegging plan (No. 4).



ESIGN SHEET 21.—ILLUSTRATING DRAFTING

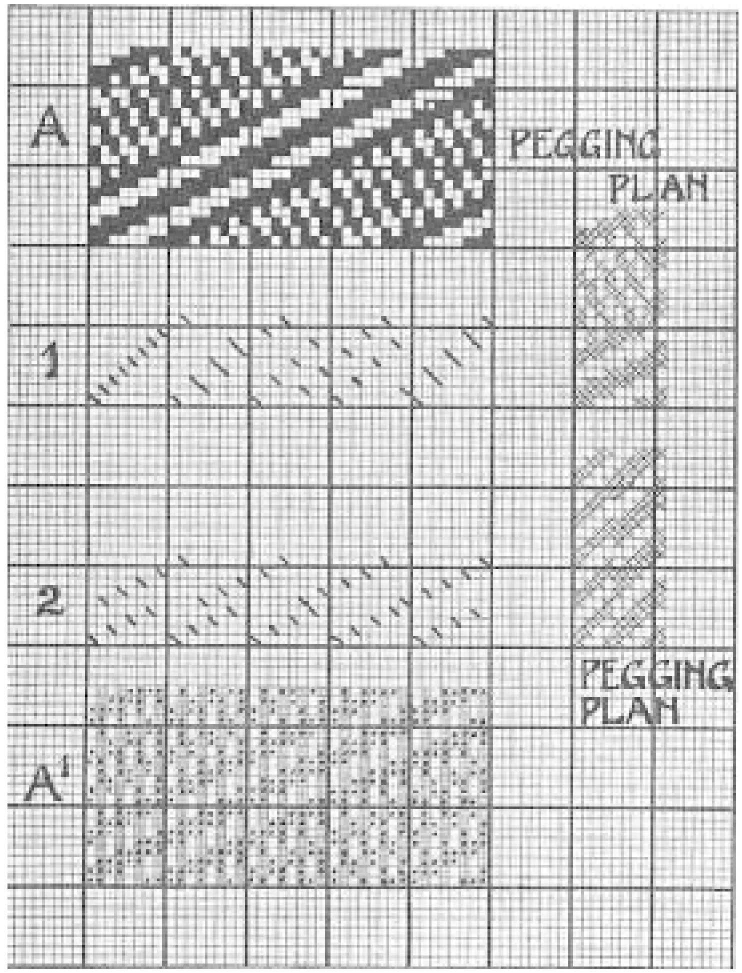
5. Having given the draft as already in the loom, to produce a series of suitable designs with their necessary pegging plans.

It will be well for the student to realize here that to him the 4th and 5th are by far the most difficult. Most young designers easily become capable of working out defined relationships such as the 1st, 2nd, and 3rd, but when they have *to select their own conditions* the difficulties *to them* are much greater, although possibly easier to the experienced designer. For example, the design in Design Sheet 21B may be produced in the loom in the two



DESIGN SHEET 21A.—ILLUSTRATING VARIOUS PROBLEMS IN DRAFTING
The parts in black are given, the parts in dots are to be thought out

ways shown; one designer would probably select one way and another another way, but so far as the student is concerned the point to note is that he should endeavour to realize all ways and select the one best suited to the conditions under which he must work. If the student thoroughly



DESIGN SHEET 21B.—ILLUSTRATING TWO SYSTEMS OF DRAFTING A THREAD-AND-THREAD COMBINATION ALONG WITH THE NECESSARY PEGGING PLANS studies these examples he should never be troubled with any drafting, however difficult such may be.*

But in practice he must go further than this—*i.e.*, *he must decide upon a definite system of working out his drafts and pegging plans and always keep to this system.* It is necessary to emphasize this because such a simple matter may mean hundreds of pounds profit or loss, as explained in Chapter II., p. 19.

A question, then, of some importance is, How are these drafts and pegging plans to be indicated ? Four methods of indicating drafts are shown in Fig. 52.

In A the shafts are supposed to be numbered 1, 2, 3, etc., and all threads 1 are drawn on shaft 1, all threads 2 are drawn on shaft 2, and so on.

In B—usually styled the English system—the threads are represented as passing from the cloth through the healds (plan view), a cross indicating upon which particular heald each thread is drawn.

In C—usually styled the German system—the threads are supposed to be hanging from the warp-beam ready for drawing on to the healds (see Fig. 52), a cross indicating upon which particular heald-shaft each thread is to be drawn.

All these systems are useful—especially to the student, as he then clearly realizes what he is doing—but as the point-paper method D is so much more handy, it is almost universally employed. In the mill, however, the definite arrangement of pegging plan, draft, and design is rarely *thought out*, but a definite order of designing,

* The student will also find it good practice to reproduce the design from the draft and pegging plan, as indicated in A^1 on Design Sheets 21B and 21C.

drafting, and pegging arranged and always kept to. In Figs. 28 and 28A (pp. 46, 47) the pegging for two designs on different styles of lags is illustrated, the instructions being:

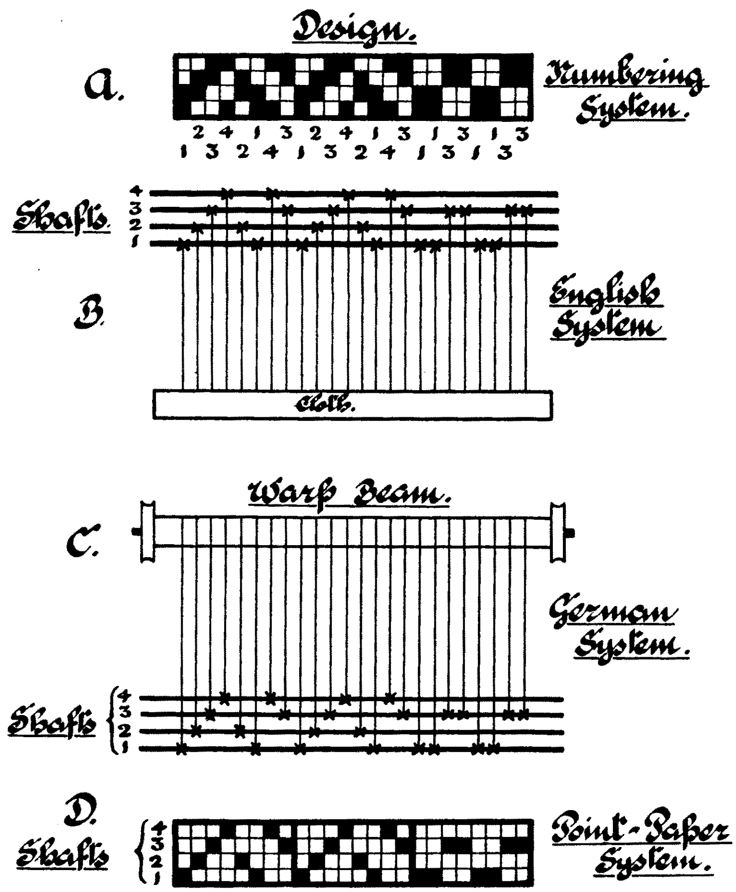
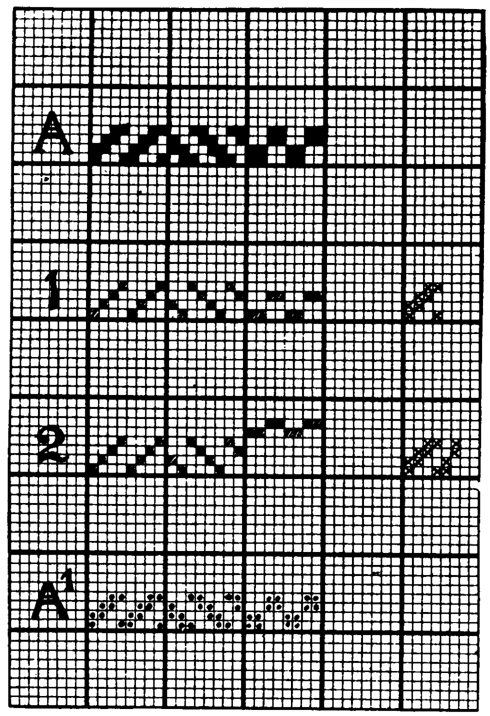


FIG. 52.—THE VARIOUS SYSTEMS OF INDICATING THE DRAFT

Peg White.—Always commencing at the top and with the first, that is the top, lag. Simple conditions such as these should always be arranged for if possible.

Calculations for Gears

In the foregoing drafts it has always been supposed that if a thread were to be drawn upon a given shaft there would be a mail for it. It is obviously the designer's work



DESIGN SHEET 21C.—ILLUSTRATING TWO SYSTEMS OF DRAFTING EFFECT A
In 1 with an unequal number of mails per shaft ; in 2 with an equal number of mails per shaft

to design his gears so that there is the required number of mails on each shaft—neither more nor less—and that these mails are in the right position for the threads to pass through.

An interesting example illustrating these points is given on Design Sheet 21A, in which there are only six orders of working the threads, so that a loom with six tappets would readily produce this pattern upon 36 threads.

In the calculation for the mails per shaft (1) the set, and (2) the draft, are the deciding factors. The draft is already supplied, but the set has yet to be decided on. Now, if 72t hreads per inch be taken as the set the draft will repeat exactly twice per inch (*i.e.*, $72 \div 36 = 2$ repeats), and the calculation will be easy; while if, say, 64 threads per inch be taken there will be $1\frac{7}{9}$ repeats of the draft per inch, and it will be better to work out the calculation for the full width of the healds, thus avoiding fractions. Of course, the designer should arrange his gears on the first method if possible, but he is not always his own master.

Example 1.—Calculate the mails per shaft for design and draft on Design Sheet 21A, for 72 threads per inch.

(1) $72 \div 36 = 2$ repeats of the draft per inch.

(2)	$2 \times 10 = 20$	mails	per inch	on shaft	No.	1
	$2 \times 4 = 8$	,,	,,	,,	,,	2
	$2 \times 4 = 8$	,,	,,	,,	,,	3
	$2 \times 10 = 20$	,,	,,	,,	,,	4
	$2 \times 4 = 8$	,,	,,	,,	,,	5
	$2 \times 4 = 8$	,,	,,	,,	,,	6
	72	mails per inch on 6 shafts.				

This gives the number of mails per inch per shaft, but not the *position of the mails*. In cases like this, where the pattern repeats on $\frac{1}{3}$ inch there is no need to knit the healds to pattern. To distribute the mails evenly will facilitate the knitting operation, reduce the cost, and not interfere with the practical weaving in the least. In special cases, however, it is necessary to specify to the heald-maker not only the number of mails per shaft, but also their exact position,* which, once obtained in the knitting, must be maintained in the 'donning' on to the heald-shafts.

If the mails per shaft for a given width are required, the following will be the order of procedure :

Example 2.—Calculate the mails per shaft for draft on Design Sheet 21C, No. 1, for 64 threads per inch, 48 inches wide.

(1) $64 \times 48 = 3{,}072$ ends in the warp.

(2) $3{,}072 \div 24 = 128$ repeats of the draft in the full width.

(3) $128 \times 8 = 1{,}024$ mails in shaft No. 1
$128 \times 4 = 512$,, ,, ,, 2
$128 \times 8 = 1{,}024$,, ,, ,, 3
$128 \times 4 = 512$,, ,, ,, 4

3,072 mails on 4 shafts in 48 inches.

The importance of arranging drafts for equal mails per inch is such that an example is given in No. 2 (Design Sheet 21C), illustrating how, by the addition of two shafts, an equal number of mails per shaft may be arranged for.

Orders to the Heald-Maker

The designer must remember that the heald-maker does not know what the healds he is knitting are required for,

* Refer to the writer's work on 'Pattern Analysis.'

therefore the two foregoing examples should be summarized in the order as follows :

Example 1.—1 set of gears, 2 shafts, each shaft 20 mails per inch, x inches wide.

1 set of gears, 4 shafts, each shaft 8 mails per inch, x inches wide.

Example 2.—1 set of gears, 2 shafts, each shaft 1,024 mails in 48 inches.

1 set of gears, 2 shafts, each shaft 512 mails in 48 inches.*

Attention has already been directed to the advantages to be gained by the designer selecting suitable conditions. Design Sheet 21B illustrates the advantages to be gained. In No. 1 a complex draft with no discernible order is given, along with a pegging plan of an equally mixed appearance. On the other hand, in No. 2 the same design is *drafted intelligently*. A well-marked order is now discernible in the drafting, which the workman may follow, and a well-defined pegging plan is also obtained, which the weaving overlooker or lag-pegger can glance over and be satisfied as to correctness.

The heald calculation for this draft works out as follows:

Example 3.—Calculate the mails per shaft for Design Sheet 21B for 80 threads per inch, 70 inches wide (to weave, say, 68 inches of cloth).

(1) $70 \times 80 = 5{,}600$ ends in the warp.

(2) $5{,}600 \div 40 =$ 140 repeats of the draft in the full width of the piece.

* For the full 'heald order form' refer to Chapter II., p. 25.

(3) $140 \times 5 = 700$ mails in 70 inches for each shaft, 1 to 4 (see draft No. 2).

$140 \times 4 = 560$ mails in 70 inches for each shaft, 5 to 9.

Proof:

700×4 shafts	$= 2{,}800$	mails	on shafts	1 to 4
560×5 ,,	$= 2{,}800$	,,	,,	5 to 9
	5,600	mails	on 9 shafts.	

In crammed stripes, double cloths, etc., difficulties occur in arranging and ordering gears, but if the student has thoroughly mastered the foregoing he will have little trouble in overcoming any drafting difficulties in whatever form they occur.

Casting Out

A set of gears once knitted cannot be adopted to every variety of pattern. Thus the gears for Examples 1 and 2 (p. 160) will only produce patterns similar, or practically similar, to that given and of the indicated set. On the other hand, the gears for Example 3 may be divided into two sets—viz.:

5 shafts giving 40 threads per inch, and
4 ,, ,, 40 ,, ,, ,,

so that these gears may be doubly useful as compared with those for Examples 1 and 2.

As already explained, in ordering gears, if possible the same number of mails per inch per shaft should be arranged for, even if this necessitates some alterations in the designing. But even if this is arranged for, it may be contended that the gears are only suited for the style (or, rather, set) for which they were originally ordered. Now, this is only partially true, for although a set of gears for, say, 64 threads per inch will not weave a cloth with *more* than 64 threads per inch, nevertheless they may be cast out to weave anything under 64 threads per inch. Again, although a set of gears for 16 shafts will not produce patterns on 24 or 32, etc.—shafts under normal conditions—nevertheless they may be 'cast out,' or, rather, 'cast down' to weave any weave upon a less number than 16 threads.

From these two cases it will be realized that there are two methods of 'casting out'—viz.:

(*a*) By casting out or taking away heald-shafts.

(*b*) By casting out mails—*i.e.*, leaving them empty without threads through.*

The student will readily realize the conditions under which one or both of the foregoing methods may be applied to advantage from the following simple example:

Example.—In what way may a set of gears for 16 shafts giving 64 threads per inch be cast out, and what will be the result of such casting-out with reference to (*a*) set, (*b*) weave capacity.

$$64 \div 16 = 4 \text{ mails per inch per shaft.}$$

1. *Casting off Shafts and the Effect on the Set:*

Employing 16 shafts for 2, 4, 8, and 16 thread weaves, the set will be 64 threads per inch.

Employing 15 shafts for 3, 5, and 15 thread weaves, the set will be 60 threads per inch.

* This is not advisable unless absolutely necessary, as empty mails wear quickly.

Employing 14 shafts for 2, 7, and 14 thread weaves, the set will be 56 threads per inch.

Employing 13 shafts for 13-thread weave, the set will be 52 threads per inch.

Employing 12 shafts for 2, 3, 4, 6, and 12 thread weaves, the set will be 48 threads per inch.

Employing 11 shafts for 11-thread weave, the set will be 44 threads per inch.

Employing 10 shafts for 2, 5, and 10 thread weaves, the set will be 40 threads per inch.

Employing 9 shafts for 3 and 9 thread weaves, the set will be 36 threads per inch.

Employing 8 shafts for 2, 4, and 8 thread weaves, the set will be 32 threads per inch.

Employing 7 shafts for 7-thread weave, the set will be 28 threads per inch.

Employing 6 shafts for 2, 3, and 6 thread weaves, the set will be 24 threads per inch.

Employing 5 shafts for 5-thread weave, the set will be 20 threads per inch.

Employing 4 shafts for 2 and 4 thread weaves, the set will be 16 threads per inch.

Employing 3 shafts for 3-thread weave, the set will be 12 threads per inch.

Employing 2 shafts for 2-thread weave, the set will be 8 threads per inch.

In addition to the foregoing it should be noted that the set of 16 shafts may be split up as follows :

Split into	2	sets of	8	shafts, the set being	32	threads per inch
”	4	”	4	” ”	16	” ”
”	8	”	2	” ”	8	” ”
Split into {	1	set of	2	shafts, the set being	8	threads per inch
	and 1	”	14	” ”	56	” ”
” {	1	”	4	” ”	16	” ”
	and 1	”	12	” ”	48	” ”

and so on, so that it is evident that in ordering a set of gears attention should not only be given to the set as a whole, but also to the way in which it may be split up for a variety of weaves and sets.

2. *Casting out Mails and the Effect on the Weave :*

Employing 16 shafts and filling-up the mails completely gives 64 threads per inch.
Employing 16 shafts and casting-out 1 gate and drawing-in 1 gate gives 32 threads per inch.
Employing 16 shafts and casting-out 1 gate and drawing-in 2 gates gives $42\frac{2}{3}$ threads per inch.
Employing 16 shafts and casting-out 1 gate and drawing-in 3 gates gives 48 threads per inch.
Employing 16 shafts and casting-out 1 gate and drawing-in 4 gates gives $51\frac{1}{5}$ threads per inch.

Again, working towards fewer threads per inch :

Employing 16 shafts and casting-out 2 gates and drawing-in 1 gate gives $21\frac{1}{3}$ threads per inch.
Employing 16 shafts and casting-out 3 gates and drawing-in 1 gate gives 16 threads per inch.
Employing 16 shafts and casting-out 4 gates and drawing-in 1 gate gives $12\frac{4}{5}$ threads per inch.

Or, again, the gears may be looked at entirely from the 'set' point of view, thus :

64	threads	per inch	requires	16	shafts
60	,,	,,	,,	15	,,
56	,,	,,	,,	14	,,
52	,,	,,	,,	13	,,
48	,,	,,	,,	12	,,

and so on.

This one example put in various forms will be quite sufficient to impress the student with the possible variation, and having realized these thoroughly as applied in one typical case, he should have no difficulty in applying the same principles in any other cases. In Fig. 54 (p. 156) the casting-out of four shafts is graphically represented.

CHAPTER VIII

THE STRUCTURE AND CORRECT USE OF YARNS

IT may seem to the student who has thoroughly studied the foregoing chapters that there is little more to learn respecting the manufacture of simple fabrics.* But success in the textile industries is built upon details; everyone duly attends to the main points, but true genius —defined as the art of taking infinite pains—is nowadays necessary to insure success. Therefore no apology is necessary for referring the student back to the materials and yarns from which he is to build his cloths. He must fully realize that a brief acquaintance with yarns is almost worse than useless, and that a full and complete acquaintance with the following points is absolutely necessary—

(*a*) The materials of which the yarns are constructed.

(*b*) The structure or arrangement of the fibres in the yarns.

(*c*) The type of weave structure to which each type of yarn is adapted, or

The type of yarn structure to which each type of weave is adapted.

* Excepting, of course, the finishing of the same, which is not touched on here.

(*d*) The weaving capabilities of various yarns.

(*e*) The finish to which each style of yarn adapts itself.

These, and many other minor points, must all be con-

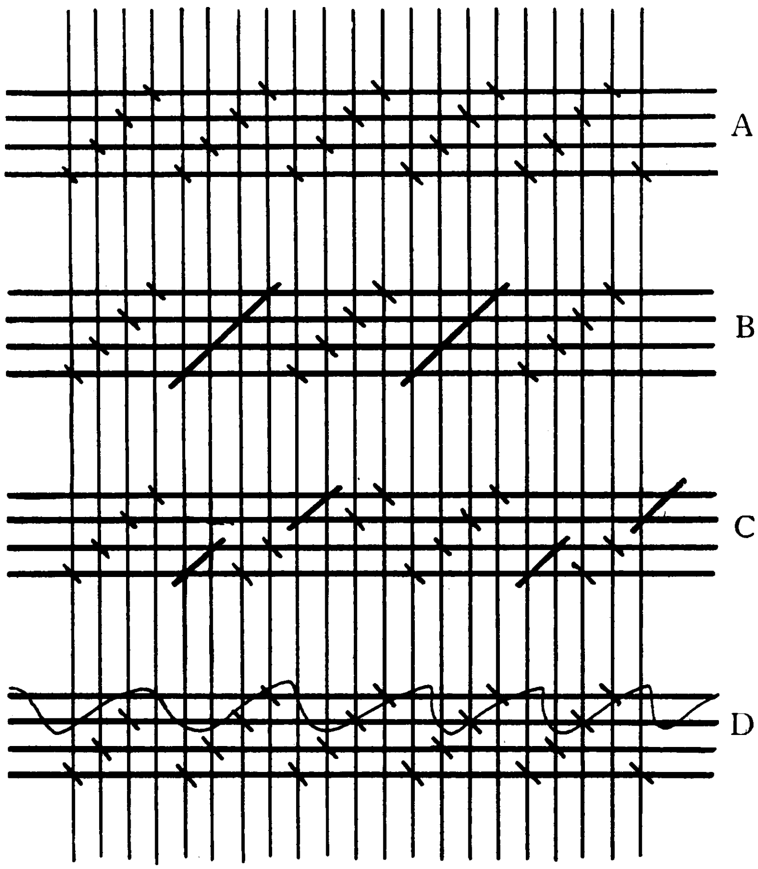


FIG. 54.—ILLUSTRATING CASTING-OUT IN GEARS

A, four shafts drawn straight gate and filled up; B, every other gate cast out; C, every third gate cast out; D, two shafts cast off

sidered by the manufacturer who would work to the greatest advantage.

Respecting (*a*), it is not only necessary that the designer should know whether to employ wool, cotton, or silk yarns, but whether to employ English,* English half-bred, Colonial cross-bred, Cheviot, mixed breed, South Down or botany wool yarns ; American, Egyptian, or Sea Island cotton yarns ; thrown silk, spun silk, mercerized cotton, or artificial silk yarns.

Respecting (*b*), it is not only necessary that the designer should know exactly the right material to employ, but he must also know whether the right material is rightly spun for his purpose. In making bright serges, for example, he must employ a yarn composed of English wool (Lincoln, Leicester, etc.), spun on the flyer and *not* on the cap frame. If making lustre goods there must be as little twist in as the yarn will weave with ; again, in making perfect lustre goods he must employ an Egyptian cotton yarn for the warp spun on the flyer frame, and gassed, to obtain as clear a thread as possible, and so on.

Respecting (*c*), those who have experimented with weaves know that—quite irrespective of the yarns employed—some tend to give a sharp crisp handle and some a soft handle. Again, some are specially liable to slipping, and must be employed very carefully with soft bright yarns (see pp. 81 to 85). Thus it is evident that material, yarn structure and cloth structure should be selected to favour the development of the exact style of finished fabric required.

Respecting (*d*), the chief point to be noted is that of economy. It would be false economy—or, rather, no ecomony at all—to select yarns for warp which would not

* The question of employing 'lustre' or 'demi-lustre' for examples must be considered with special reference to the cost of the resultant cloth.

weave or would weave indifferently. The designer must remember that cost of weaving is a very marked item, *especially when cheap materials are employed.**

Respecting (*e*), little can here be noted, but the designer must fully and completely realize that if he requires a special finish upon his goods he must lead up to that finish, commencing with his selection of raw material, following on with the yarn structure, the weave structure, and even the weaving. It is rarely that mistakes made in the preliminary processes can be rectified in the finishing operations. *The designer must from beginning to end bear in mind the cloth required, and adapt all his selections of materials and processes to the attainment of this end.*

The student must be impressed with the necessity of continually handling and noticing the effects various yarns, weaves, etc., produce in the resultant cloth; he must record these experiences in some convenient form, *and upon his experiences—well digested—he must base his practice.*

A convenient form of registering yarns is provided in the yarn-book designed by the writer to supply a long-felt want. This book allows an actual specimen of the yarn to be entered in convenient form, and along with this the 'Counts and Material,' 'Spinner' or 'Merchanting Firm,' 'Cost,' and 'Uses' are supplied.

If along with such a book the student can arrange a pattern-book illustrating the effect of given yarns in the finished cloth, so much the better.

* The speed of the loom is a factor which must here be considered. The quickest loom does not always weave the most cloth. *The machine must be adapted to the fibre or yarn to be dealt with, and not vice-versâ.*

CHAPTER IX

ANALYSIS AND SYNTHESIS, ILLUSTRATED BY COLOUR AND WEAVE STYLES AND BACKED AND DOUBLE-CLOTH STRUCTURES

RIGHTLY considered, the value of 'analysis' in most of its forms cannot be overestimated. The value placed upon pattern analysis in Germany is well illustrated by the time spent on this subject in the textile schools. Mere pattern copying is certainly to be deprecated, but in order that a student may fully realize what has already been done, and so *base his experiments and developments on past experiences*, it is absolutely necessary that he should analyse patterns—in short, *pattern analysis will serve as the base from which excursions may be made into the field of original design.*

Synthesis, the putting together or combining of, say, colour and weave to produce various effects—in other words, research by combining several factors in various ways—is, needless to say, to be commended to the designer, but he will most certainly find that if his synthesis is coloured by analysis better effects will result. Thus, just as in the comprehension of animate nature an analytico-synthetical thought process goes on almost unconsciously, so in textile designing the designer practically bases his research on both analytical and synthetical processes of thought.

Again, in all scientific work the importance of accuracy is so marked that no pains should be spared to ensure it. Thus important results may well be checked over first, say, by analysis, and, secondly, by synthesis.

Perhaps a word on the value of clearness of thought, comprehensiveness of view, mobility of mind, and accuracy in deduction, may here prove useful.

FIRSTLY, WITH REFERENCE TO CLEARNESS OF THOUGHT. —A simple example may be cited which will demonstrate what is required.

Example.—What are the advantages and disadvantages of employing extra warp or extra weft for figuring purposes ?

These advantages and disadvantages may readily be summed up under the heading of Advantages, for what is an advantage to the one is a disadvantage to the other. Again, to render the summing-up clearer and more decisive, balancing advantages should be placed alongside one another where possible. Thus the first advantage for extra warp is at least partially balanced by the first advantage of extra weft, and so on.

ADVANTAGES OF

Extra Warp.	*Extra Weft.*
1. One shuttle only required.	1. No extra warp-beam required.
2. No long box-chain or lags required.	2. No complex draft and pegging plan.
3. No difficulty in setting-up and letting-off.	3. No extra figuring capacity required.
4. Sooner woven + 25 per cent. more speed.	4. Figure and colouring more readily changed.
5. More colours can be employed.	5. Cheaper material may be employed.
6. Less waste.	

Most questions may be summed up in some such clear, comprehensive form as this.

SECONDLY, WITH REFERENCE TO COMPREHENSIVENESS OF VIEW.—In no industry is this more important than in the textile industries. Again and again cases have occurred where omitting to consider an apparent detail has thrown most excellent work and endeavours completely away.

Example.—If an inventor worked upon and brought out an improved hand card-cutting machine, but failed to realize that the days of hand card-cutting were over,* all his endeavours would be thrown away, however good and praiseworthy. From this point of view it is evident that a good all-round knowledge of allied industries is a practical necessity if true and useful advance is to be made.

THIRDLY, WITH REFERENCE TO MOBILITY OF MIND.—With the specializing of work so prevalent in the present day there is great risk of the mind becoming 'set' and incapable of thinking in anything but the particular work engaged upon. This may readily be counteracted by taking interest in things outside one's own particular employment, but the question is not how to counteract the tendency, but how to develop the opposite tendency—*i.e.*, to obtain perfect mobility so that the mind is capable of approaching any question from several points of view.

Example.—The question arises as to whether botany wool will rise or fall in price during the next few months.

To answer this the question must be viewed from—

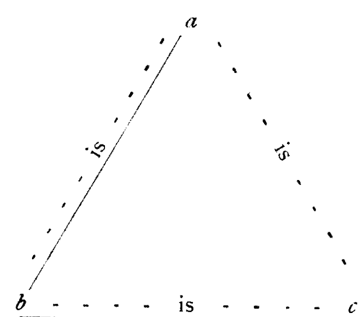
1. The Australian climate and soil point of view.
2. The Australian financier's point of view.
3. The 'mutton' point of view.

* This is not true at present, but the position of the card-cutter is being assailed by the Szczepanik and Zerkowitz electric card-cutting machines.

4. The competitors of the Australian sheep-growers' point of view.
5. The home and foreign wool and yarn merchants' point of view.
6. The manufacturers' and merchants' point of view; and
7. The consuming public's point of view and 'length of purse.'

This example illustrates well both comprehensive study and the necessity of such mobility of mind as will enable one to view the same problem from the several standpoints, and so attain to right judgment on the matter.*

FOURTHLY, ACCURACY IN DEDUCTION.—This is a quality of mind perhaps only to be attained to by constant practice and at least a few failures; in this case one perhaps learns more from one's failures than from one's successes. The 'syllogism,' a form of reasoning employed by logicians, is here most useful, taking the simple form:



Or, expressed in words:

Iron (*a*) is a metal (*b*).
Every metal (*b*) is an element (*c*).
Therefore iron (*a*) is an element (*c*).

* The same principles may well be applied to effectively criticise the Northrope Loom.

Some such form as this, varied in application, will well serve the textile designer or manufacturer.

Example.—Which is most advantageous, to ship wool from Australia in the grease or scoured? In this case the wool merchant may have all the facts of the case, such as less bulk to carry, less freightage charge for unwashed wools, scoured wools more readily judged, etc.; but he must also bear in mind the *proportionate value* of each point if he is to make the true deduction that usually wools are better shipped in the grease.

It is almost needless to repeat that accuracy is the first essential, without which clearness of thought, comprehensiveness of view, mobility of mind, and accuracy in deduction are impossible. It is, in fact, *quality of mind rather than quantity of absolute knowledge* which is required for success.

In the following examples, in which both analysis and synthesis are employed, the value of the foregoing remarks will be realized.

The Analysis of Colour and Weave Effects

In the first place, what is a colour and weave effect? A colour or weave effect may be defined as '*a small form in two or more colours produced by colour and weave in combination, but in appearance usually quite distinct from either the colouring or the weave* (see Plate 7).

Starting from the known proceed to the unknown. In Fig. 55 a well-known colour and weave style* is given.

* The student should always select a simple style, of which he already knows all particulars, to base his research upon; then, having obtained an *order of procedure*, he should check this by applying it to more difficult styles.

What is the order of warping and wefting, and what is the weave required to produce this effect in its simple form ?

1. Select the most likely warping and wefting plan,

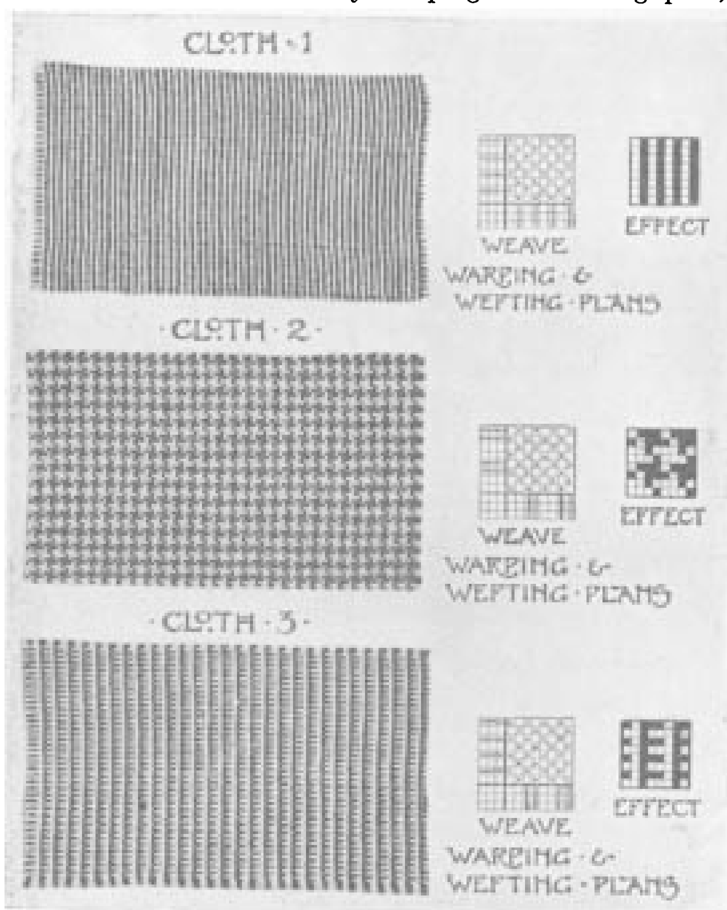


PLATE 7.—COLOUR AND WEAVE EFFECTS

indicating this along with the effect on point-paper (Design Sheet 22).

NOTE.—The finest line in the style will usually be formed by a single thread or pick.

2. Indicate by ⊡ where the warp *must* come up—*i.e.*, (*a*) when dark picks enter the cloth—where the design shows light; (*b*) when light picks enter the cloth—where the design shows dark (Design Sheet 22, No. 2).

3. Indicate by ⊠ where the weft *must* come up—*i.e.*,

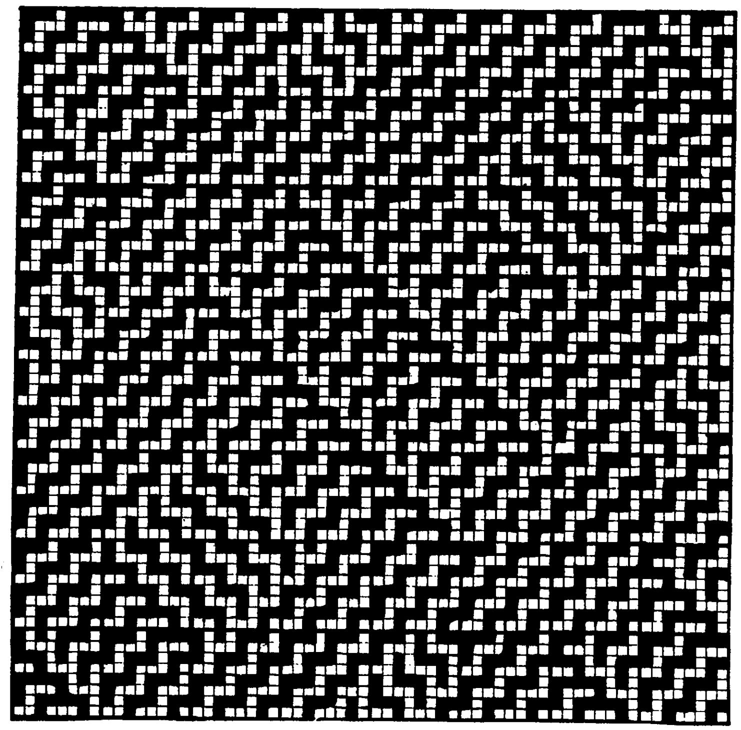


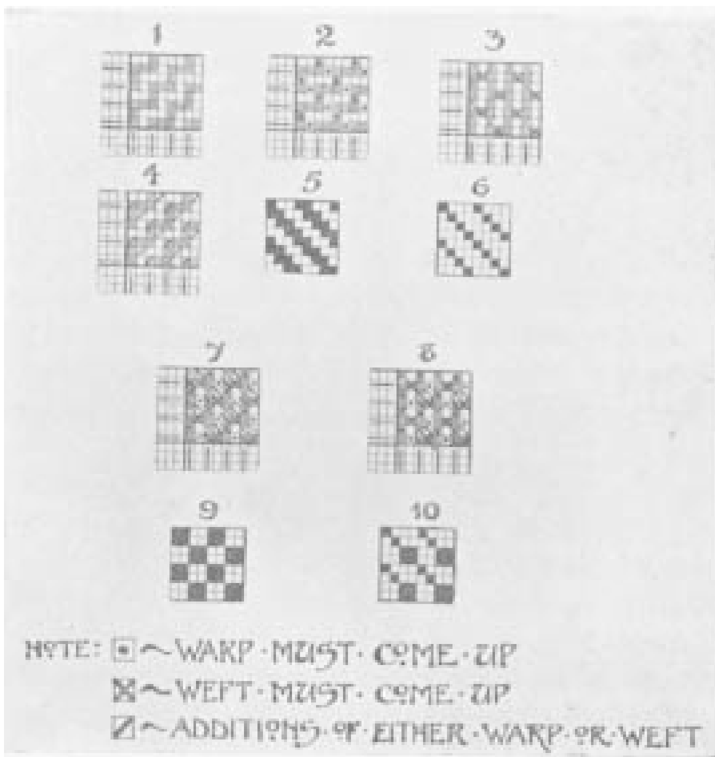
FIG. 55.—ILLUSTRATING RIGHT AND LEFT STEP PATTERN FIGURE

(*a*) when dark threads enter the cloth—where the design shows light; (*b*) when light threads enter the cloth—where the design shows dark (Design Sheet 22, No. 3).

4. Follow out the weave, which has already commenced to appear, by ⧄ marks over the sections of the design

which, so far, have no marks on, and *which may be either warp or weft* (Design Sheet 22, No. 4).

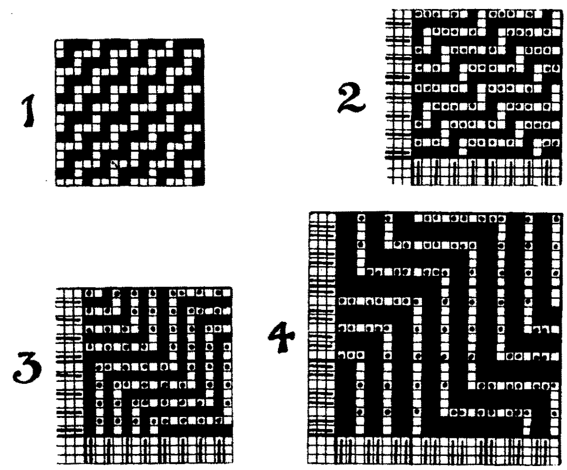
5. Transfer the weave on to the ordinary principle of representing intersections (marks = weft).



DESIGN SHEET 22.—ILLUSTRATING THE ANALYSIS OF COLOUR AND WEAVE EFFECTS IN STAGES

NOTE.—It will be frequently found that No. 4 decides what the weave shall be.

In order that the student may fully realize the difficulties to be met, the effects on Design Sheet 22A are given, any of which—being varieties of step pattern—may be the effect required, and not the style given on Design Sheet 22. In this case the designer would simply select the effect which he could most readily produce. Thus, if he has only tappet looms, a 4-thread weave would be more easily produced than a 6, 8, or 12 thread weave; but he must be sure that *he is producing the right effect.*

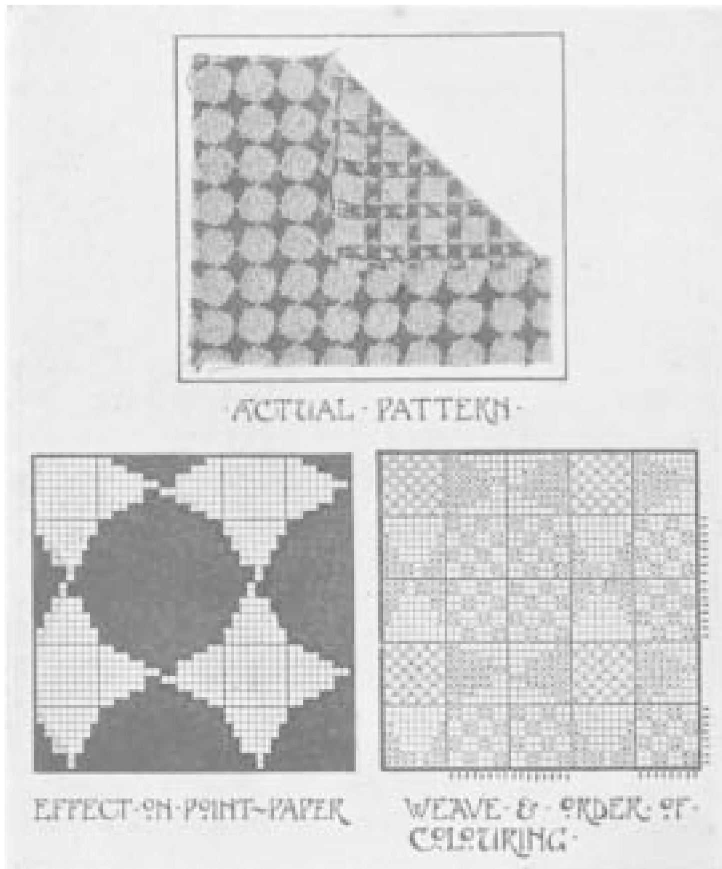


DESIGN SHEET 22A.—ILLUSTRATING COLOUR AND WEAVE (SYNTHESIS) STEP PATTERNS

No. 4, for example, will not do in place of No. 1. In Design Sheet 22B the analysis of a more elaborate style is given. In this case the filling-in required for stage 4 will be any interlacing giving the requisite firmness of handle to the cloth.

THE SYNTHESIS OF COLOUR AND WEAVE EFFECTS

If the student has fully comprehended what 'colour and weave' effects are from the foregoing, he may now begin to explore their possibilities by synthetical study. In the following brief treatment two points are kept in view : (1) to illustrate perfect and complete results, and



DESIGN SHEET 22B.—ILLUSTRATING COLOUR AND WEAVE (ANALYSIS)

the method by which such are obtained ; (2) to give some idea of the thousands of patterns which may be thus produced.

Example 1.—Work out all the possible effects producible by combining plain weave and 1 dark, 1 light colouring in both warp and weft.

In the first place it will be noted that the 'footing' of either colouring or weave may be changed; also that there will be four changes of 'footing'* for the colouring (warp and weft), and two changes of 'footing' for the weave. These may be summed up as follows:

Plain Weave $\frac{1\quad}{\quad 1}$.

	1	2	3	4†
Warp:	1 dark, 1 light	1 dark, 1 light	1 light, 1 dark	1 light, 1 dark
Weft:	1 dark, 1 light	‡1 light, 1 dark	1 light, 1 dark	1 dark, 1 light

Plain Weave $\frac{\quad 1}{1\quad}$.

	1	2	3	4†
Warp:	1 dark, 1 light	1 dark, 1 light	1 light, 1 dark	1 light, 1 dark
Weft:	1 dark, 1 light	‡1 light, 1 dark	1 light, 1 dark	1 dark, 1 light

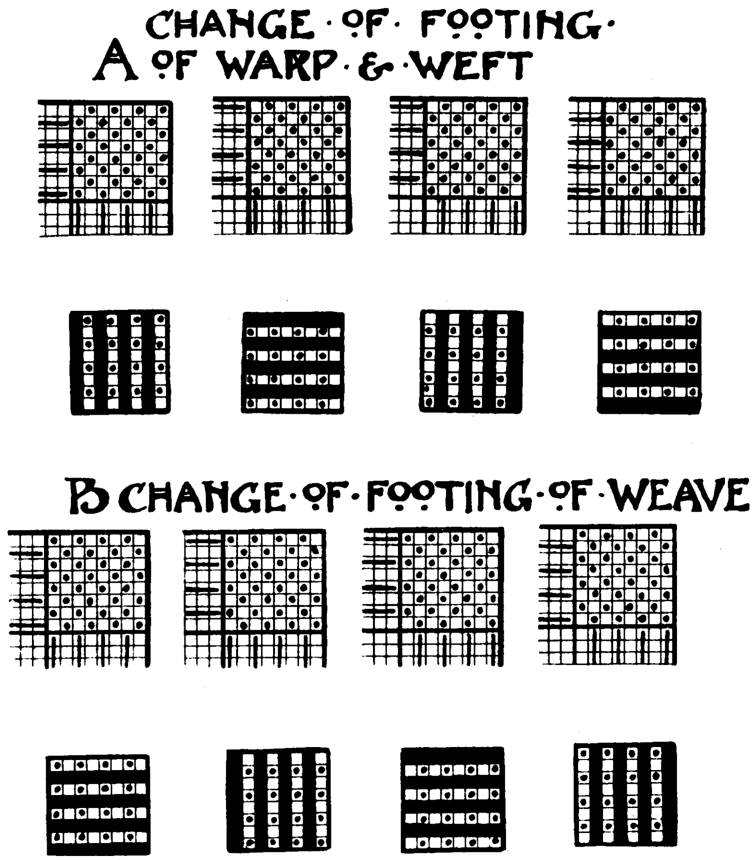
From this example the student should understand what is implied by changing the footing of the colouring and of the weave. Upon working out these effects on point-paper (Design Sheet 22c) it will be noticed that there are only two distinct effects, and the fact that the weave is on two threads and two picks, and the colouring on two, suggests the explanation.

* This is simply a technical word for order *and* position.

† The four changes of footing of the colouring possible.

‡ The order of the shuttles will be more readily changed than the order of the warping.

Example 2.—Work out all the possible effects producible by combining $\frac{2}{2}$ twill weave with 4 dark, 4 light warping, and 2 dark, 2 light wefting.



DESIGN SHEET 22C.—ILLUSTRATING COLOUR AND WEAVE (SYNTHESIS)

There are here four possible footings for the weave, four possible footings for the warp colouring, and two possible footings for the weft colouring. Upon due consideration it will be found that here it is best to keep the footing of warp and weft colouring stationary, and to change the footing of the weave, thus :

Warp : 4 dark, 4 light; *Weft :* 2 dark, 2 light	Weave in (1) $\frac{2}{\ \ 2}$, (2) $\frac{1\ \ 1}{2}$, (3) $\frac{\ \ 2}{2}$, and (4) $\frac{\ \ 2}{1\ \ 1}$.
	(*Weft Sections.*)

These effects are illustrated in Design Sheet 22D.

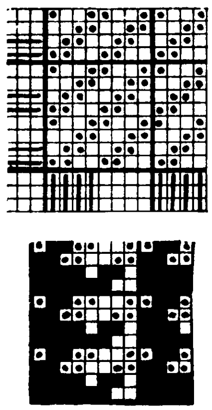
The following list includes most of the standard colour and weave effects.

Colouring.	*Weaves.*							
1 dark, 1 light	$\frac{1}{1}$,	$\frac{2}{1}$,	$\frac{3}{1}$,	$\frac{2}{2}$,	$\frac{3}{3}$,	$\frac{4}{2}$,	$\frac{4}{4}$,	$\frac{6}{2}$
2 " 1 "	"	"	"	"	"	"	"	"
3 " 1 "	"	"	"	"	"	"	"	"
2 " 2 "	"	"	"	"	"	"	"	"
3 " 3 "	"	"	"	"	"	"	"	"
4 " 2 "	"	"	"	"	"	"	"	"
4 " 4 "	"	"	"	"	"	"	"	"
6 " 2 "	"	"	"	"	"	"	"	"

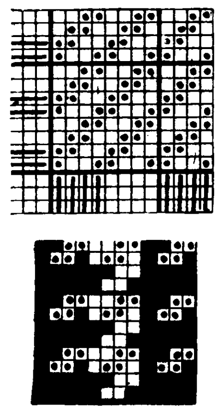
If the designer wishes to explore the possibilities of any given weave—say, Mayo—in yielding colour and weave effects, he should apply the following orders of warping, and check each pattern with its own weft, thus obtaining 18 × 18 = 324 patterns.

	Pattern Nos.																	
Order of Colouring*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Dark	1	2	1	2	3	1	3	4	2	4	6	2	6	8	4	8	12	4
Light	1	1	2	2	1	3	3	2	4	4	2	6	6	4	8	8	4	12

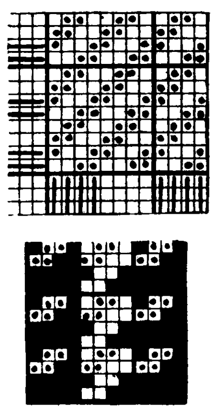
* The designer should always endeavour to arrange his colourings and weaves in the most convenient manner for his immediate purpose.



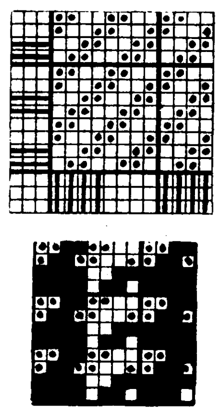
1



2



3

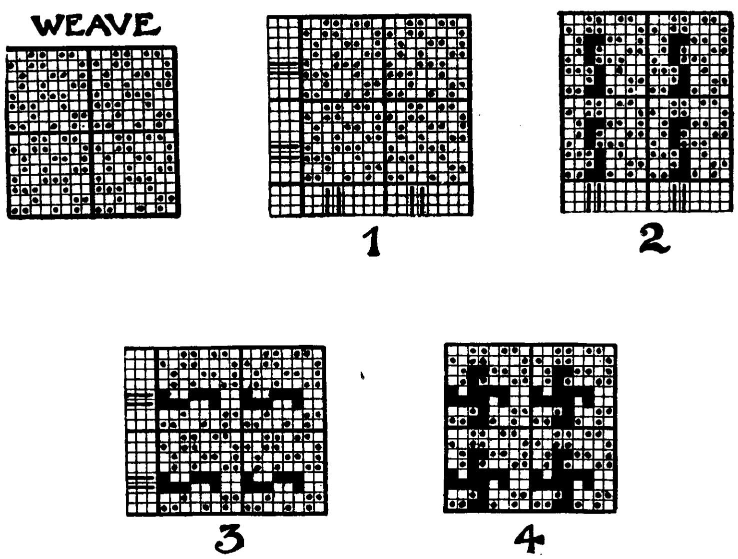


4

DESIGN SHEET 22D.—COLOUR AND WEAVE (SYNTHESIS)
Designed to illustrate the effect of changing the footing of the weave

Method of Working-out Colour and Weave Effects

The following order of procedure in originating 'colour and weave' effects should be adhered to until the student has become perfectly conversant with the possibilities of these styles, when he may adopt this or any other order he thinks best.



DESIGN SHEET 22E.—COLOUR AND WEAVE (SYNTHESIS)
From a given weave and colouring to ascertain the colour and weave effect in four stages

1. Put *lightly* on to point-paper at least four repeats of the weave to be employed (see Design Sheet 22E, Weave).

2. Alongside this weave indicate the order of warp and weft colouring (Design Sheet 22E, No. 1).

3. Where dark threads come to the surface (*i.e.*, blanks in the point-paper design) paint in black (Design Sheet 22E, No. 2).

4. Where dark picks come to the surface (*i.e.*, marks in the point-paper design) paint in black (Design Sheet 22E, No. 3).

5. Treat any other colours in the same way.

Double Cloths Treated Synthetically

The various problems in backed and double-cloth construction are most interesting, and if rightly ‘ tackled ’ by the young designer will serve him both as knowledge and discipline ; as discipline in orderly and consecutive work and seeing in the ‘ mind’s eye,’ it is impossible to overestimate their value.

Double cloths may be classified under four heads—

1.	Those warped	and	wefted	1	face and	1 back.*
2.	,,	,,	,,	2	,,	1 ,,
3.	,,	,,	,,	3	,,	1 ,,
4.	,,	,,	,,	in a mixed order.		

Whichever of the foregoing classes is required, the following order of working out the necessary point-paper plan is recommended, being illustrated in Design Sheet 23.

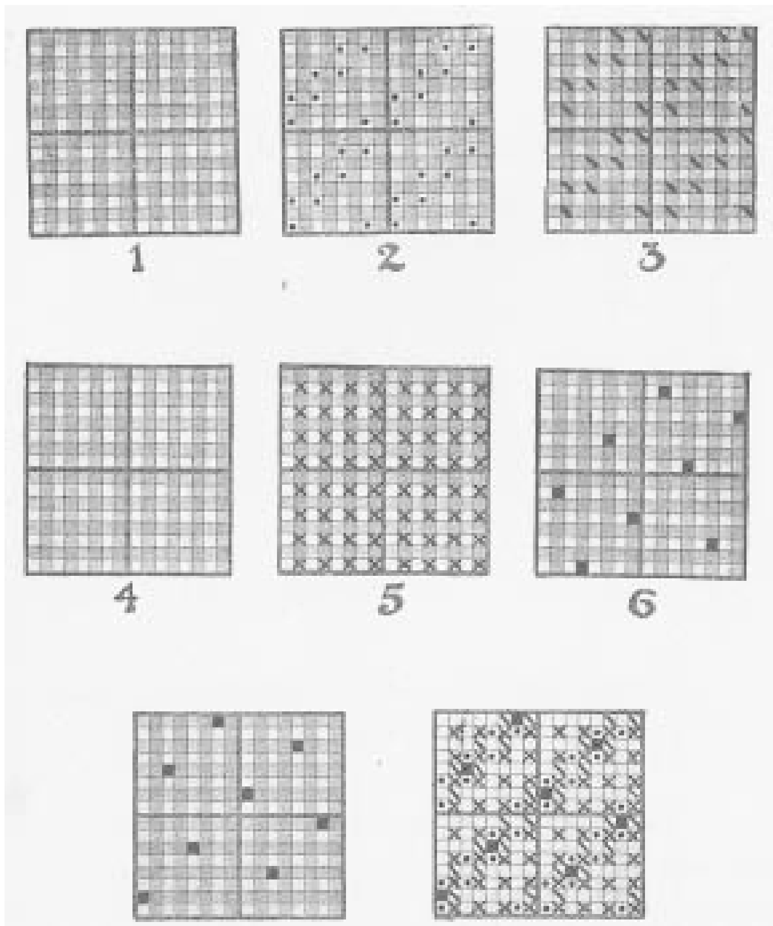
The Construction of Double Cloths

1. Indicate the backing threads and picks in some light transparent colour (No. 1).

2. Insert the face weave *where face threads intersect with face picks* (No. 2).

* An important exception occurs when the loom has only boxes at one end, when a 1 and 1 style becomes a 2 and 2 style, but the resultant effect is usually exactly the same. Refer to p. 187.

3. Insert the backing weave *where backing threads intersect with backing picks* (No. 3).



DESIGN SHEET 23.—DOUBLE CLOTHS (SYNTHESIS)

Illustrating the combination of a point-paper plan for $\frac{2}{2}$ twill in stages

4. When backing threads enter the cloth indicate all face threads up (No. 4).

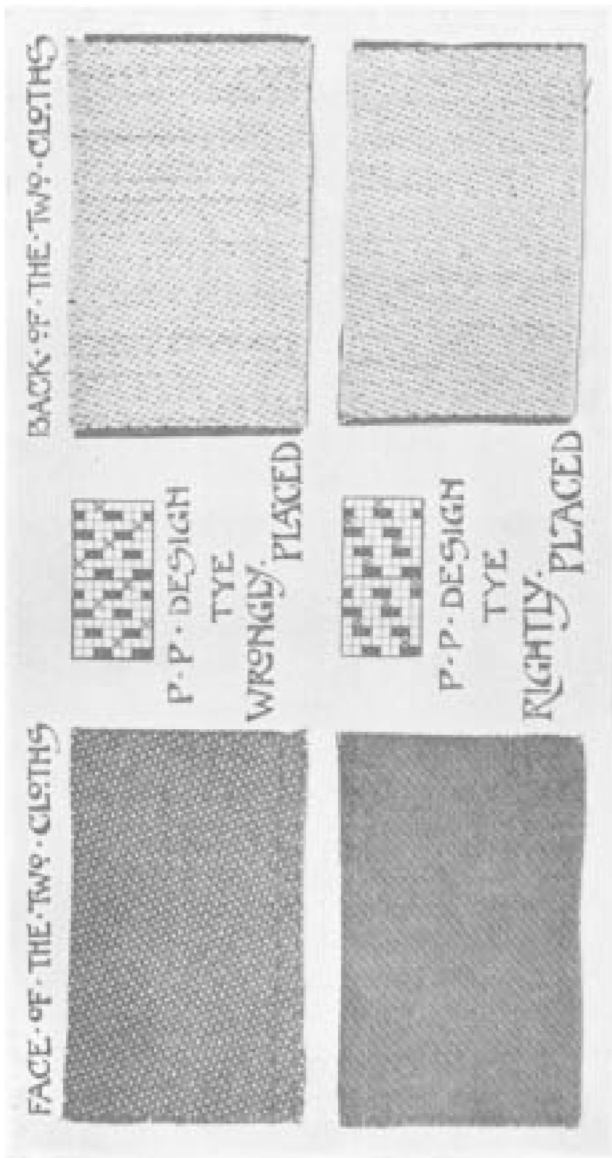
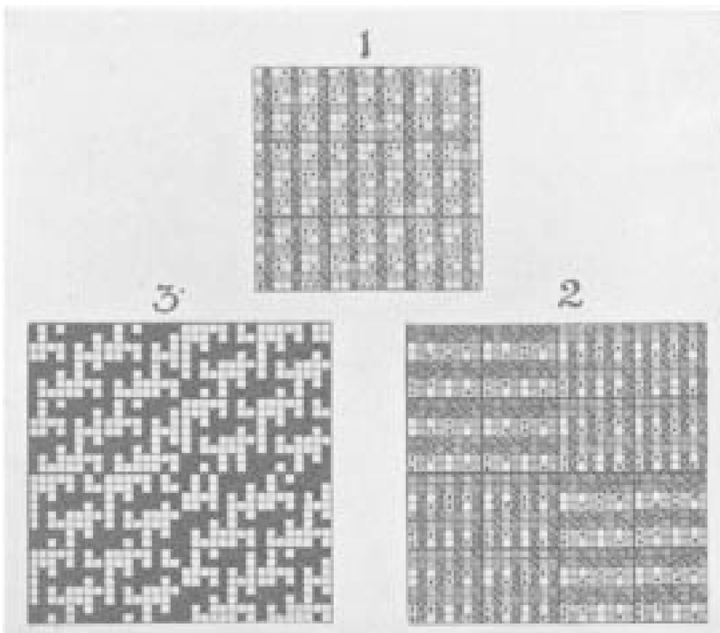


PLATE 8.—THE TYING OF BACKED OR DOUBLE CLOTHS

5. When face picks enter the cloth mark all backing threads down (*h*).*

6. Tie the two fabrics together by bringing a backing thread over a face pick *with face threads up on each side*, or by bringing a backing pick over a face thread *with face picks up*



DESIGN SHEET 23A.—ILLUSTRATING DOUBLE CLOTH (SYNTHESIS)
A 2 and 1 style and a double-pick style

on each side, thus hiding the tie effectively. The ties should be distributed in sateen order if at all possible. The first method of tying here indicated is usually the better.

On Design Sheet 23A, No. 1, an example of the second class is given (2 face to 1 back), the face weave being $\frac{2}{\quad 2}$

* If marks are taken to equal warp up No. 4 will be marked and No. 5 left blank: just the reverse as here given.

twill, and the back plain weave, the tying being effected by bringing backing warp over face picks in 8-sateen order (see Fig. 53).*

In No. 2 another double $\frac{2}{\quad 2}$ twill cloth is given, but in this case, while the threads are 1 and 1 the picks are 2 and 2, being so arranged for a loom with boxes at one

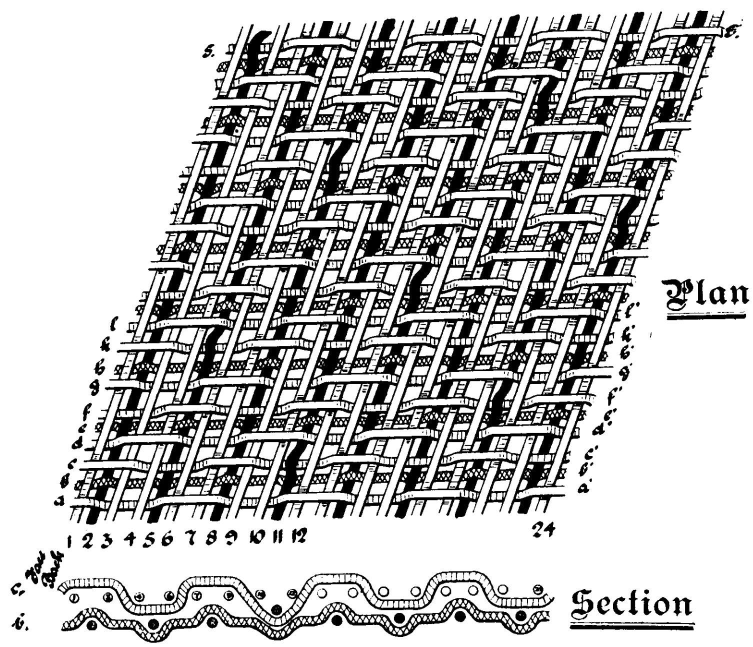


FIG. 53.—A PLAN AND SECTION OF A 2 AND 1 DOUBLE CLOTH

end only. The ultimate effect will be similar to that produced in Design Sheet 23, but in this case the two cloths are not bound together, a check figure being formed by the back cloth coming to the face and the face cloth going to the back—*i.e.*, *by reversing*. This is typical of a large class of figured fabrics, including some crepons.

* The student should make the point-paper plan from this flat view.

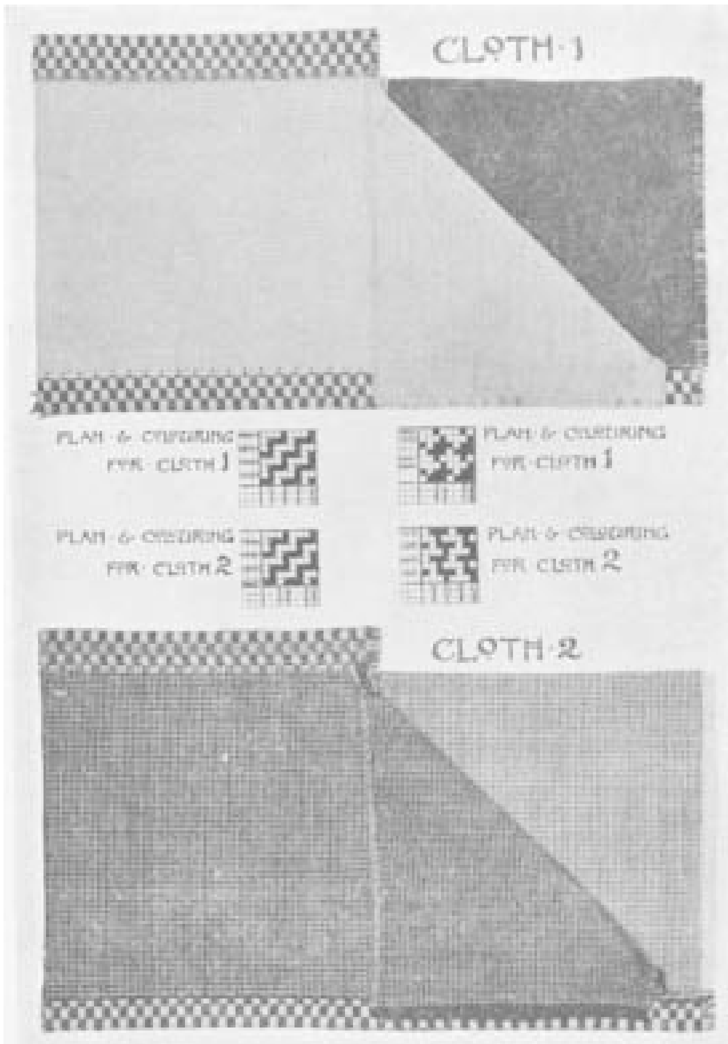
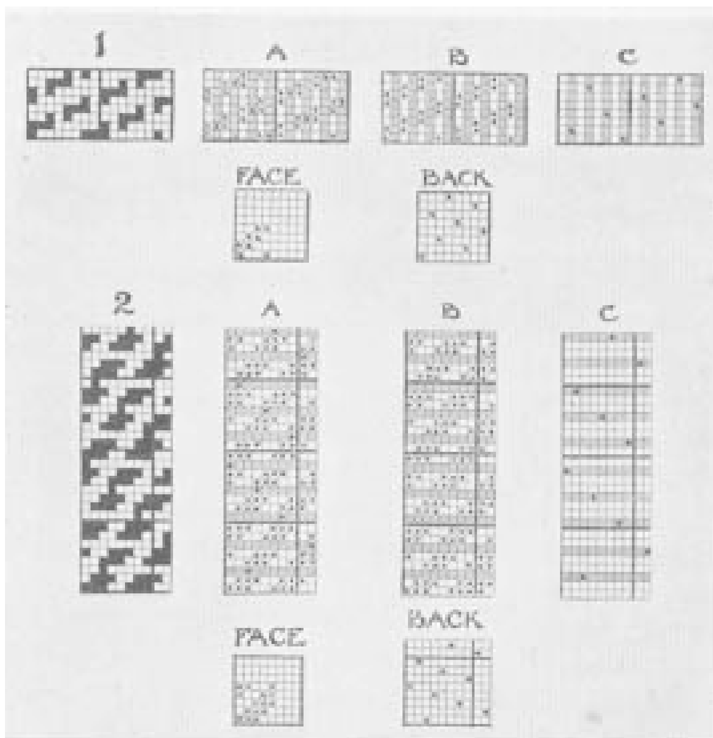


PLATE 9.—DOUBLE PLAIN CLOTH EFFECTS

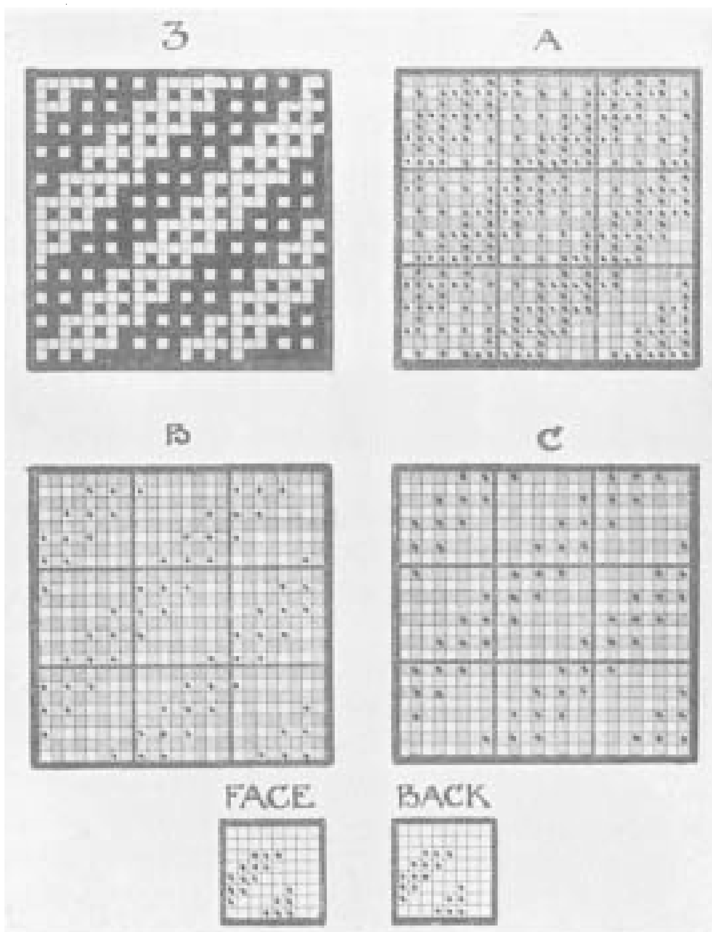
The Analysis of Backed and Double Cloths

Weight may be added to fabrics by adding a backing weft, by adding a backing warp, by adding another cloth (double cloth), and, further, by adding a wadding pick



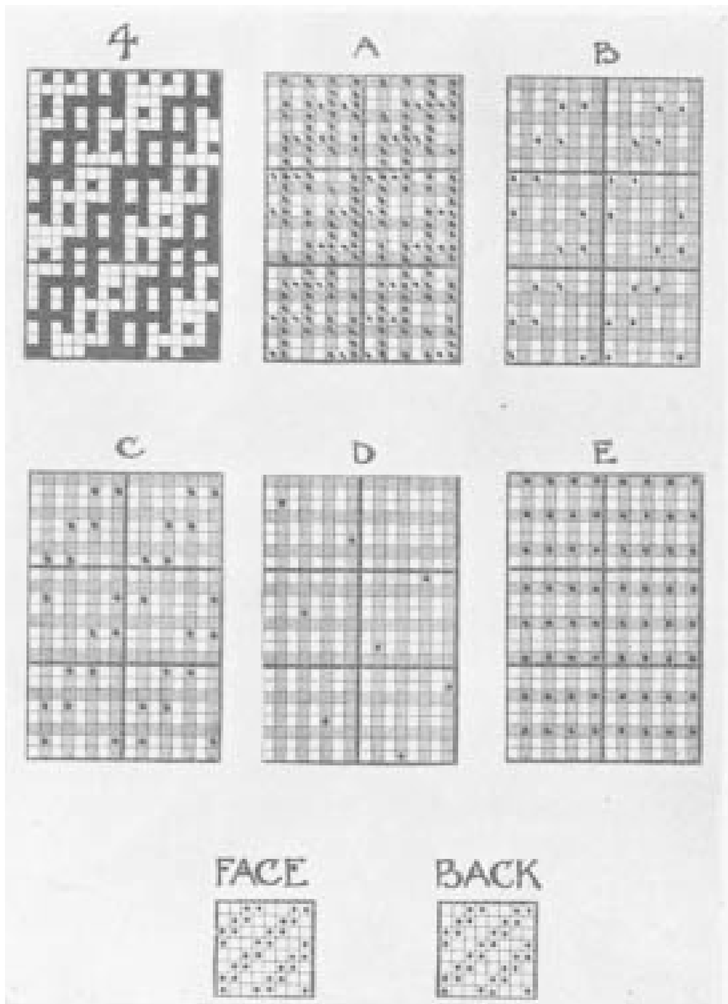
DESIGN SHEET 24.—ILLUSTRATING THE ANALYSIS OF WARP AND WEFT BACKED CLOTH DESIGNS

between the two cloths. Whichever style is to be analysed, the following order of procedure will apply, and if the student has fully realized the previous treatment he will now have no difficulty in analysing most styles; some, of course, puzzle even the expert.



DESIGN SHEET 24A.—ILLUSTRATING THE ANALYSIS OF A DOUBLE CLOTH IN STAGES

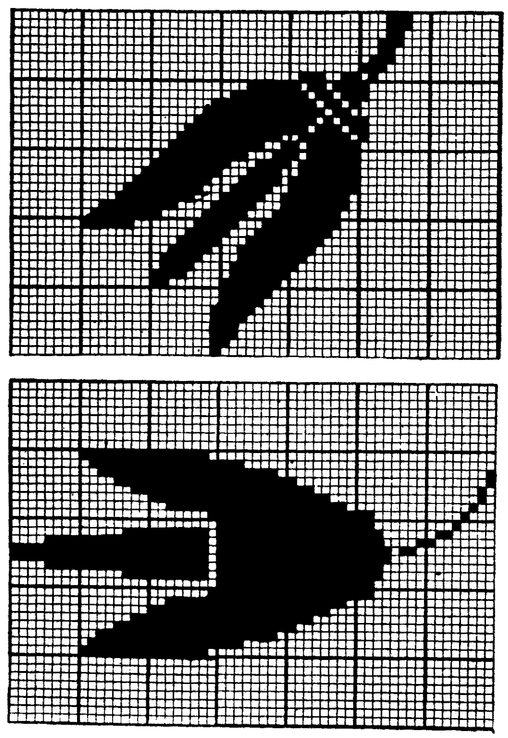
METHOD OF ANALYSIS.— 1. Carefully examine the point-paper plan and ascertain whether backed with warp, or weft, or both (Design Sheets 24, 24A, and 24B).



DESIGN SHEET 24B.—ILLUSTRATING THE ANALYSIS OF A WADDED DOUBLE CLOTH

2. Paint out the order of backing (warp way, weft way, or both) lightly on point-paper, and dot the weave in ink over this; thus backing threads and picks will come on the colour, and face threads and picks on the white (A).

3. Take out carefully the face, as shown at B (from



DESIGN SHEET 25.—ILLUSTRATING EFFECTIVE AND INEFFECTIVE TEXTILE DESIGN

intersections of face threads with face picks), and the backing weave, as shown at C (from intersections of backing threads with backing picks), and finally note the tie by a distinct colour.

With reference to structure it will be noted that—

Design Sheet 24, No. 1, is a simple warp-backed structure; No. 2 is a simple weft-backed structure.

Design Sheet 24A illustrates every stage in the analysis of a double $\frac{3}{\quad 3}$ twill cloth, ties being omitted.

Design Sheet 24B illustrates the analysis of a double $\frac{2}{\quad 2}$ twill cloth of the second class, with the addition of a wadding pick.

If the designer has any trouble with these styles after experimenting thus, he should construct some double-cloth plans on point-paper and then endeavour to analyse these; from the knowledge thus gained he may draw up an order of procedure which will apply perfectly in unknown cases; but he must be certain that his method is correct.

If he still has difficulties he should draw a diagram of the structure, and from this make out the point-paper plan. Such a flat view as might be thus employed is shown in Fig. 53.

In conclusion, it may be noted that, while this latter section of the chapter has little value as 'knowledge,' it has considerable value as 'discipline,' and that through work of this kind a *quality of mind* may be attained which successfully faces and surmounts all difficulties. Thus the student who has conscientiously worked through this chapter will find that, in addition to having gained much absolute knowledge, he can with confidence face and successfully surmount many difficult problems not even referred to in this work.

CHAPTER X

THE MANUFACTURE OF LUSTRE GOODS

PERHAPS no industry so much as the textile requires such care, comprehensive study, and forethought; the omission of one detail may negative all previous care and labour. The manufacture of lustre goods, variously spoken of as 'glacé,' 'Orleans,' 'alpaca linings,' etc., will serve as an excellent example to demonstrate this.

Required.—From a cotton warp and mohair, English or demi-lustre weft the most lustrous plain piece possible.

This subject may be studied conveniently under the headings:

1. Materials (warp and weft)—quality of lustre.
2. Spinning—thread-construction processes and effect of twist.
3. Warping and dressing—study of possible defects.
4. Weaving—cloth construction and loom setting.
5. Finishing—effects on cloth and possible defects.

All these points must be carefully studied by the designer if he is to obtain satisfactory results, and we are disposed to think that a sixth point—character and capabilities of the weavers and others through whose hands the pieces pass—should be added.

1. MATERIALS (WARP AND WEFT)

In some fabrics one material—warp or weft—is all important; in this case, although the warp plays a subservient part, both materials are of equal importance, the weft, as will be shown, depending upon the warp.

The warp is invariably a good quality of cotton yarn; in fact, it must be the tightest and best spun cotton obtainable, for the lustre of the piece will ultimately depend upon the warp bending the weft, and if it is soft how can it do this?

The best cotton yarn for the purpose, therefore, will be made from a good Egyptian cotton, combed and flyer spun. The chief point to note, however, is that the yarn must be compact and clean. The cotton-yarn merchant must be asked for this by the lustre goods manufacturer, and he should see that he gets it.

The quality of weft is equally important. The lustre of the piece, in the first place, resides in the lustre weft; thus the manufacturer must be certain that he is getting the lustre for which he is paying. The most lustrous yarn will be yielded by a good quality of Turkey mohair, this being closely followed by Cape mohair, and perhaps, in the near future, it will be followed by American and Australian* mohair. English and demi-lustre wools yield decreasing lustre, although, if rightly employed, quite sufficient for this purpose. It is interesting to note that the effect of climate upon wool is such that on the north bank of the river Welland, separating Lincolnshire from

* The rearing of the Angora goat in Australia is yet in the experimental stage.

the neighbouring counties, a pure lustre wool grows, and on the south bank a much inferior lustre; feed the lustrous Lincoln sheep on the south bank and away goes its lustre.

2. Spinning

The method of preparing and spinning and doubling the warp yarn is important*; still more important is the preparing and spinning of the weft yarn. Defective scouring may spoil the lustre and colour, imperfect parallelism of the fibres will take from the lustre, too great a speed in spinning will leave a like effect—twist and lustre will probably be in inverse ratio.

Thus, for the typical lustre yarn the natural lustre of the fibre must be fed, if possible, and not impoverished; the fibres in the thread structure must be as parallel as possible, little twist being inserted, and compactness—adding lustre—must be obtained by flyer spinning as distinct from 'cap' spinning which is employed for non-lustrous yarns.

3. Warping and Dressing

As the ultimate lustre of the piece depends upon the hard warp bending regularly the lustrous weft, an absolutely regularly tensioned warp must be obtained. Thus the warp should be made from cheeses of an equal diameter and weight, warped from, say, a semicircular creel, and, in fact, everything done to obtain an absolutely regular tension in the resultant cloth.

The dressing is of equal importance: what has been attained in the warping must be retained in the dressing.

* A ring-spun yarn is fatal to quality in a lustre piece.

In the case of the warp being delivered in two balls these should be dressed 1 and 1 or 2 and 2, so that any difference in them is equalized.

4. Weaving

This simply resolves itself into obtaining a piece from which 'reed marks' have been eliminated, in which the *warp* bends,* and in which there are considerably more picks than threads if the cloth is ultimately to be on the square.

To fulfil these requirements the top and bottom parts of any given shed must be crossed *before* beating-up takes place, thus insuring heavy wefting and bending of the warp. If possible, the piece should be woven one in a reed. Of prime importance is the picking. The overlooker who with little 'pick' can weave a lustre yarn with little twist will certainly carry off the palm. Even the angle of the reed against the fell of the cloth may influence the resultant cloth.

5. Finishing

Practical experience has shown that if a perfect lustre-piece is to be obtained without crimps it must be wound on dry, and that to obtain the greatest amount of lustre the weft must be bent by pulling the warp perfectly straight.

It will now be realized that if the warp is soft it will be impossible to make the lustre weft bend. For example, if the warp by accident was made 4 threads soft twist, 4 threads hard twist, the finished cloth would show dull and lustrous stripes of 4 threads each.

* This is partially effected by the 'sink' of the shed.

In order that the student may fully understand the change which takes place in a lustre cloth, the following particulars are given, being based upon practice.

CLOTH IN LOOM.

Warp.	*Weft.*
All 2/100's cotton ($\frac{1}{185}$ of an inch).	All 1/32's mohair ($\frac{1}{120}$ of an inch).
64 threads per inch.	76 picks per inch.

CLOTH FINISHED.

Warp.	*Weft.*
All 2/100's cotton.	All 1/32's mohair.
72 threads per inch.	70 to 72 picks per inch.

Thus, if these particulars were for a figured style the figure would be designed on the square, although the cloth in the loom is *not* on the square.

Reference to the Science of Cloth Construction, Chapter IV., will render the 'why and wherefore' of this change more apparent. The compression of the lustre yarn in one direction, its consequent extension in another direction, the straightening of the cotton warp, and the effect of all these influences on the set are well worth investigating from the practical point of view, and really prove most interesting.

Perhaps the chief lesson which the student has here to learn is that plain fabrics are the most difficult fabrics to make perfect in appearance; colour and figure may be made to cover a multitude of sins.

APPENDIX

Elementary Yarn Calculations

1. SUPPOSING you are supplied with a pack of wool to spin into yarn of this thickness , would you measure the diameter and spin to that, or give instructions that every yard or metre should weigh, say, 1 dram, or 1 gramme, or state that each 1 pound or kilogramme of material was to be drawn out to, say, 1,000 yards or metres? Look at this question from the *spinner's* point of view.

2. Looking at the above question from the cloth constructor's point of view, will it be better to state the 'counts of yarn' in diameter, in area (weight), or in length?

3. Can you explain why there should be the following number of yards per hank?—

Worsted ..	.. 560
Cotton ..	.. 840
Woollen ..	.. 256
Metric ..	.. 1,000 metres
French ..	.. 2,000 metres (1,000 per $\frac{1}{2}$ kilo).

What is the 'count' of a yarn, and why is it useful to know what the counts of a yarn is?

4. Represent by diagrams 1 pound of yarn spun to 20's cotton counts, and 1 pound spun to 30's worsted counts; also 20's cotton counts and 20's worsted counts. Why has a different count the same length per pound, and the same count a different length per pound? Experiment in a similar manner with woollen, linen, silk, etc., and draw up the rule for converting counts of yarn from one denomination to all other denominations.

5. Represent by diagrams the twisting of two threads of 40's worsted together, explaining why they give 20's counts. Also a thread of 30's cotton with a thread of 60's cotton, explaining why they yield a 20's counts.*

6. What will be the 'resultant counts' and the price per pound of the following?—

2 threads of	60's	botany	@ 3s.	per pound.
1 thread of	30's	,,	@ 2s.	,,

Also give the average counts.

7. What thread would you twist with a 60's count in any denomination to yield a 30's count? Explain by means of a diagram. Also what thread would you twist with a 30's to yield a 20's? Why is denomination omitted?

8. What will be the 'average' counts and price per pound of the following?—

4	threads	1/20's cotton	@ 1s.	per pound.
2	,,	1/30's worsted	@ 2s.	,,

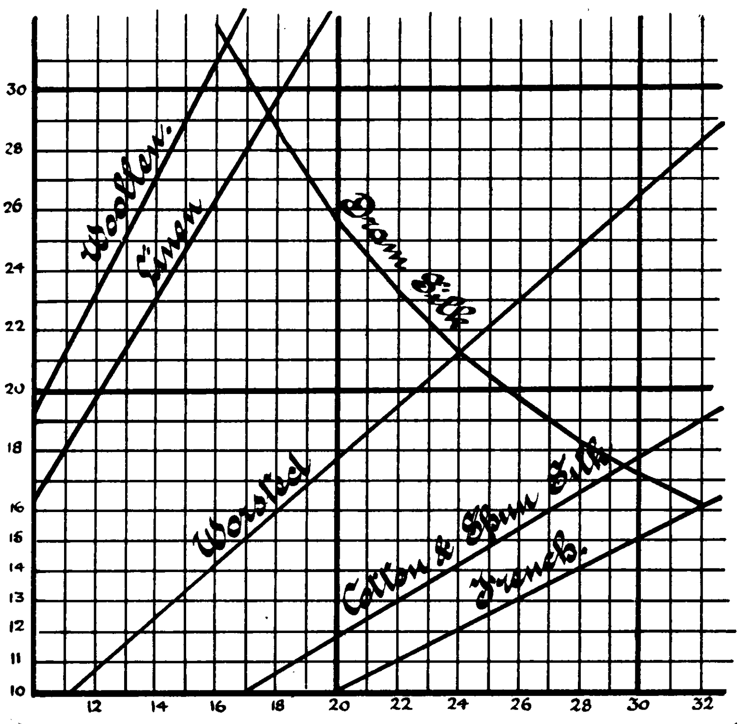
Will you state your answer in cotton or in worsted counts?

9. Can you give an explanation as to why weft yarns for the lining trade are sold by the gross (144) of hanks—

* There is no allowance made for 'take-up' here.

i.e., length, as distinct from yarns for the coating trade, which are usually by weight ?

In the case of silk yarns the count is sometimes ex-



Metric count numbers

FIG. 48.—CONVERSION OF YARN-COUNT DIAGRAMS*

pressed by 'drams per 1,000 yards.' Would this method answer for worsted weft yarns ?

In the case of weft yarns why should 144 ÷ counts give the pounds per gross of hanks ?

* The student, on his own account, should find out how to use this diagram by means of a few simple experiments.

Elementary Cloth Calculations

1. What factors must be taken into account in calculating the weight of a warp, and which are the most convenient letters to represent these factors ?

2. In the case of a calculation for the weight of a warp why should

$$\frac{N \times W \times L}{C \times H} = P\ ?$$

Illustrate this by diagrams.

3. A worsted warp is composed of 1,800 ends, is 56 yards long, and weighs 10 pounds. What is its counts? Explain clearly why this calculation works out so easily.

4. Is it convenient to always state the number of threads in a warp ? If not, do you prefer to (*a*) state the dents per inch, threads per dent, and the width, or (*b*) the set and threads per dent, and the width ? Look at the question from the point of view of the spinner, the warper, the manufacturer, the dresser and twister, the weaver, and the designer. Convert a 12's reed 4's set into a Bradford, Leeds, Manchester, etc., and state in the form of a list. Convert a 60's Bradford set, a 9 portie Leeds set, and an 1800 Manchester set into the threads per inch denomination.

5. Calculate by two methods the cost of the following cloth in the finished state :

Warp.

2 threads 1/30's worsted @ 2s. per pound.
1 thread 40/2 silk @ 12s. per pound.
$16\frac{1}{2}$ reed 4's.

Weft.

All 1/40's worsted @ 2s. 6d. per pound.
60 picks per inch.

Warp 70 yards, grey cloth 66 yards, finished cloth 64 yards long. Width in loom 60 inches. Add 5 per cent. for waste of weft, or calculate weft on the warp length.

6. Illustrate by diagrams the following changes which take place from the cloth in the loom to the finished cloth:

(*a*) As finished width : loom width : : threads per inch in loom : threads per inch finished.

(*b*) As finished length : loom length : : picks per inch in loom : picks per inch finished.

(*c*) As threads per inch in loom : threads per inch finished : : finished width : loom width.

(*d*) As picks per inch in loom : picks per inch finished : : finished length : loom length.

(*e*) $\left.\begin{array}{l}\text{As finished weight : grey weight}\\ \text{As finished length : grey length}\end{array}\right\}$: : grey counts of warp : finished counts of warp.

(*f*) $\left.\begin{array}{l}\text{As finished weight : grey weight}\\ \text{As finished width : grey width}\end{array}\right\}$: : grey counts of weft : finished counts of weft.

NOTE.—(*e*) and (*f*) are only true on the supposition that warp and weft lose weight in a similar proportion in finishing.

ELEMENTARY DESIGNING

NOTE.—*The questions should be worked out in the first instance without reference to the book, but subsequently corrected.*

1. Draw a section and flat view of plain cloth, a section and a flat view of gauze, and a section of plush.

2. By means of sketches explain how point-paper represents the woven fabric. Also how weaves are repeated on point-paper and in the loom.

3. Design a system for originating all possible twills on 16 threads by 16 picks.

4. What is the difference between an ordinary and a compound twill? Give four examples of each.

5. State clearly the principles which enable you to

estimate the possible number of thread-and-thread or pick-and-pick combinations resulting from—

(*a*) $\frac{4}{4}$ twill and $\frac{4}{2}$ twill.

(*b*) $\frac{2}{1}$ twill and $\frac{4\quad 2}{4\quad 2}$ twill.

(*c*) $\frac{3}{4}$ twill and $\frac{5}{4}$ twill.

6. How many distinct effects may be obtained by combining weaves 44 and 46 (Design Sheet 1, p. 23) thread and thread, or 2 threads of 44 to 1 thread of 46?

Supply the simplest draft and pegging plan for one of these combinations, and give the calculation for a set of gears to weave a piece of cloth with this draft—set to be 60 threads per inch, 48 inches wide.

7. What possible variations of crape weaves are you acquainted with (thread and thread *and* pick and pick combinations)?

Give at least two examples of each, illustrating clearly the method of origination.

8. Taking twill No. 22 (Design Sheet 1, p. 23) work out—

(*a*) All possible combinations of these threads.
(*b*) All possible permutations of these threads.

9. Explain clearly the origination of the sateen—

(*a*) By rearranging the threads of, say, $\frac{7}{1}$ twill;
(*b*) By counting on the desired number of threads and picks.

10. What is the difference between a regular and an irregular sateen derivative?

Give as many methods as possible of employing the sateens as a basis for small weave origination.

11. Explain briefly, by means of examples, the use of the sateen as a basis in—

(*a*) Fancy twills.
(*b*) Stripes.
(*c*) Checks.
(*d*) Diapers.

12. If design 42 (Design Sheet No. 1) is pegged upon a dobby loom mounted with ten shafts, explain how, by drafting, sateen rearrangements of this twill may be produced.

13. What type of weaves usually results from the 'motive and weave' method of origination? Illustrate the possible variations by at least twelve examples.

14. Design eight small figure effects suitable for arranging in sateen order—

(*a*) Two which are not reversible.
(*b*) Two which are reversible.
(*c*) Two which may be turned in four positions.
(*d*) Two which may be turned in five positions.

15. Arrange the foregoing figures in the most suitable sateen orders. In (*c*), for example, 4 or 8 sateen order should be adopted; in (*d*) 5 or 10 sateen order.

16. Complete an extensive series of the weave and explain in each case why repetition occurs on the ascertained number of threads and picks.

17. Take any two suitable weaves and combine them thread and thread. Give the draft, pegging-plan, and gear calculations for, say, four different sets.

Advanced Yarn and Cloth Calculations

1. The weft woven into a cloth is supposed to be the same throughout. Upon testing, two distinct twists are found, one averaging 16 turns per inch and the other 20 turns per inch. What is the percentage of difference ?

2. The statement has been made that the counts and areas of yarns vary in direct proportion; also that diameter varies as the square root of the area, and consequently as the square root of the counts. Prove these statements by diagrammatic illustrations.

3. It has been suggested that instead of indicating the twist for yarns by 'turns per inch,' the angle of twist should be stated. Show by diagrams why this would be a good method. Also state why it has not been adopted.

4. Compare the English, French, and Metric systems of calculating yarns and cloths. Which do you consider preferable, and why ? Give one simple example stated in each system. Give also the 'gauge-points' for conversion.

5. Show by diagrams that to make a cloth heavier it must be made thicker and that consequently—

Diameter of yarns (square root of counts) must be increased in the required proportion.

Number of threads and picks per inch must be decreased in the same proportion.

6. Explain by extreme examples why the scientific rule for changing the weight of a piece is sometimes impracticable, and how an empirical rule may be constructed of considerable practical value.

7. Taking a 2/40's botany yarn, proceed as follows:

   (*a*) Calculate the threads and picks per inch for $\frac{4}{4}$ twill in the loom.

   (*b*) Change the cloth to one-eighth lighter weave to be $\frac{3}{3}$ twill.

   (*c*) Prove that your resultant cloth is of the correct weight and perfect in structure.

8. Draw diagrams illustrating the sections of—

   (*a*) Equal counts of warp and weft in $\frac{2}{2}$ twill weave.

   (*b*) Unequal counts of warp and weft in plain weave, warp straight, weft bending.

INDEX

THE END

BILLING AND SONS, LTD., PRINTERS, GUILDFORD