

From these examples it is apparent that cloths of approximately the same ounces per yard and also composed of yarns of similar diameters on the face, may be obtained by distinct schemes of looming. This is a fundamental element in these classes of worsted manufacture, as the following examples selected for comparison indicate:—

TABLE XXI.
SETTING COMPARISONS: COMPOUND WORSTED FABRICS.

Example.	Warp.	Threads per inch.	Weft.	Picks per inch.	Weight per yard 56 × 36 in.
2	2-fold 48's worsted	80	2-fold 40's worsted and 20 skeins woollen	144	26 oz.
4	2-fold 40's worsted	64	20's worsted and 12 skeins woollen	91	23½ oz.
10	2-fold 36's and 2-fold 28's worsted	102	2-fold 36's worsted	64	19½ to 20 oz.
11	2-fold 50's worsted	144	30's worsted	148	20 oz.
12	2-fold 40's worsted	120	2-fold 40's worsted	96	21 to 21½ oz.
13	2-fold 40's worsted	112	2 fold 40's worsted	112	22 oz.

Comparing, first, Examples 2 and 4, the former is made of the finer yarns, and has 80 threads and 144 picks per inch or 16 threads and 53 picks per inch in excess of No. 4, yet the former is the heavier cloth due to the thicker backing weft, 12 skeins, as contrasted with the 20 skeins in Example 4. Second, compare Nos. 2 and 13, or a weft-backed with a double-make cloth. The face twill in No. 2 would have the finer and smarter appearance consisting of 2-fold 48's worsted, with an under surface, woven sateen, of woollen yarn. Both fabrics are sound in structure, but in tensile strength No. 2 is not as satisfactorily balanced as No. 13 which would test equally in length and width, whereas No. 2 would indicate a higher test on the weft than the warp. The wearing quality of the double-weave fabric would be the more adequate. Next examine Examples 10 and 11. No. 10 is warp-backed and No. 11 two-fold in both warp and weft. Now the breaking strain on the warp line of the fabric would be greater than the breaking strain on the weft line in the first instance, but almost the same in either

direction of the fabric in the second instance. Cloth 10 is much the cheaper to construct not allowing for the difference in the qualities of the yarns used, only having 64 picks as compared with 148 picks per inch in Cloth 11. Lastly contrast Examples 12 and 13, two interesting structures composed of 2-fold 40's yarns. The latter is the more correctly made, being balanced in the threads and picks, while the former is maximum set in the warp and minimum set in the weft. It is the less costly to manufacture, and would compare favourably with Example 13 in weave or twill definition and clearness. Per square inch it contains 216 threads as contrasted with 224 in the more correctly woven fabrics. Tested as to tensile property No. 13 would be uniform on both warp and weft, but No. 12 would be slightly higher on the warp than on the weft.

(143) PRACTICAL REQUIREMENTS AND CLOTH COMPOUNDS.

These examples make it clear that practical requirements determine the scheme of manufacture to utilize in the production of any particular style of cloth. Setting, as shown, may vary in corresponding or different counts of yarns in the warp or weft, and may be adjusted to yield medium or heavy cloths in each type of compound-weave structure. The latter is not necessarily a weight determinate. Backed and double weaves are, to a limited degree, applicable to fabrics light in substance and construction in addition to the groups of textures described. This, for example, is the case in the suiting cloth Fig. 118 (Plan, Fig. P, Plate IV), produced in a double-make, 2/2 twill face and plain woven back; and also in the simple striped vesting textures (Figs. 120a and 120b) and woven in a two-fold warp and weft plan (Fig. 120), the following being the orders of colouring:—

FIG. 120a (Design, Fig. 120, Plate VI, repeating the first 8 threads for 72).

<i>Face warp</i> :	2-fold 40's white worsted	2	2	2	—
	2-fold 40's black	„	2	2	2 2
	40's/2 white silk		—	—	2 —
			} 72		
			Threads.		

Backing warp : 2 threads of 2-fold 40's white.

2 " , 2-fold 40's black.

Face weft : All 2-fold 40's white.

Backing weft : All 2-fold 40's black.

FIG. 120b (Design, Fig. 120, Plate VI, repeating the first 8 threads for 72).

Face warp : 2-fold 40's white 2 2 2 —
 2-fold 40's black 2 2 — —
 2-fold 40's purple — — 2 2
 40's/2 white silk — — 2 —

72

Threads.

Backing warp : 2-fold 40's white 2 2 2
 2-fold 40's black 2 2 —
 2-fold 40's purple — — 6

72

Threads.

Face weft : 2 picks of 2-fold 40's white.

2 " , 2-fold 40's black.

Backing weft : All 2-fold 40's black.

96 threads and 96 picks per inch in both examples.

Neither of these two types of fabric (Figs. 118 and 120a) produce what may be termed standard cloths, being too loosely set, and 15 and 17½ oz. per yard respectively. They are useful as showing how in practice, to obtain special effects, double weaves are employed. By the methods of weaving adopted a texture is formed in Fig. 118 (Example 17, Table XX), with a 2/2 twill face and plain back, light in construction; and in Figs. 120a and 120b a double or compound plan is utilized, in reversing the positions of the face and backing yarns in the flat and twilled sections of the design, to develop the lines of colour, or in obtaining textural features not feasible in single-make structures.

(144) STRUCTURAL CONTRASTS.

Contrasts in fabric structure are as diversified as those applicable to setting, but have a different relation to the type of cloth produced. Setting defines the fineness of the texture and the compactness of the yarns. Structure, or build, defines the scheme of yarn interlacing, and therefore affects the firmness

and tensile strength of the fabric in different forms from fast or open setting. It modifies the frequency with which the warp and weft intersect and bind with each other, and, in compound weaves, the relative closeness of the face and backing fabrics. As explained, in the third group of compound cloths (Paragraph 84), a distinct weave is usable for each side of the piece, so that fabrics of different fineness, structure, and substance may be developed on the respective surfaces of double cloths.

Modifications in compound weave structures are made for the purpose of applying to the face and back of the fabric, yarns varying in materials and counts, and of appropriating each description of threads in the formation of a specific textural characteristic. Certain modifications practised would, in ordinary

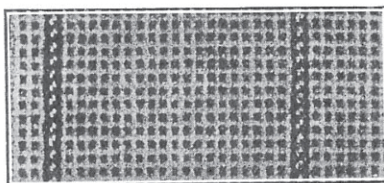


FIG. 120a.

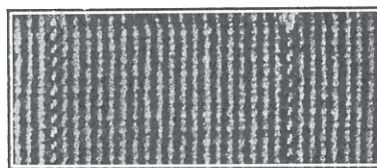


FIG. 120b.

Vesting striped patterns, developed in reversible double-weave compounds.

yarns and methods of construction, result in unsatisfactory manufactures. Design in these cloths has a two-fold relation, first, to the weave structure, and, second, to the yarn composition of the fabric. Two examples may be considered, Figs. 115 and 119, Plate VI. They are both irregular in arrangement, and contrary to the rules of backed and double-weave construction. Fig. 115 is a variation of the double-make cassimere in which the relation of the face to the backing weave should be that illustrated in Fig. M, Plate IV. The warp stitchings should, according to the rules of tying, be inserted in such positions in the plan as face warp threads are lifted on the picks on which they occur. Both these principles are transgressed in the construction of Fig. 115—the backing weft twill is inserted under the face warp twill, and the stitches in each instance between face threads depressed. Such a double-make twill is clearly not applicable to the regular

methods of double-cloth manufacture. On examining the weaving data (Table XIX) supplied, it will be seen that the face warp and weft consist of one shade of yarn but of different materials, which in the ordinary type of weave would conceal the effects due to the backing yarns, but in this illustration (Fig. 115a) a striped pattern obtains. In other words, the backing yarn colourings, by this change in the weave structure, are caused to appear on the face, and form in combination with the face yarns a definite style of design, and yet the backing warp interweaves 2/2 twill with the backing weft retaining the construction of a double-make cloth.

Fig. 119, Plate VI, is a further example. It is a compound plan in which the backing weft—picks 1 and 4—interlace 2/2 weft cord, and give no visible effect on the face of the fabric. The twist and white warp yarns (see Example 18, Table XIX) marked in solid squares in the plan, develop a stripe feature on both sides of the cloth, the black worsted warp and weft forming the dark portions of the pattern, Fig. 119a. This, and the preceding illustration, suggest the principles of modifying compound weaves in the production of definite pattern characteristics, and also of applying yarns of different counts, shades, and qualities in such a way as to compose a distinctive type of woven fabric.

CHAPTER IX.

OVERCOATING GROUP OF FABRICS.

(145) Varieties of Overcoating Cloths ; (146) Venetian Group ; (147) Worsted Twill and Whip-cord Overcoatings ; (148) Warp-backed and Double-cloth Vicuna Overcoatings ; (149) Milled Worsteds ; (150) Felted Crossbreds ; (151) Manufacturing Data for Heavy Serges ; (152) Botany Worsted Face and Saxony Woollen Back Overcoatings ; (153) Stockingette Cloths with Woollen or Worsted Face and Woollen Backing ; (154) Ribbed Worsted Face and Woollen Back Fabrics ; (155) Worsted Lambskin Textures ; (156) Crossbred Qualities of Heavy Tweeds ; (157) Technicalities of Manufacture of Friezes, Shetlands, Fleeces, Curled Serges, and Nap Cloths ; (158) Blanket-finished and Napped Friezes ; (159) Heavily Milled Saxony Tweeds ; (160) Union Face Cloths. "Presidents" and "Moscow"; (161) Heavy Fabrics with Woven Linings ; (162) Golf Cloaking—Woollen-yarn Structure ; (163) Golf Cloaking—Cheviot and Saxony Yarn Compound ; (164) Lined Cloaking—Woollen and Worsted Yarn Structure.

(145) VARIETIES OF OVERCOATING CLOTHS.

SEVERAL of the ordinary classes of woollen and worsted fabrics are grouped as overcoating cloths. Cheviot and Saxony tweeds of medium and heavy weight are thus utilized. Strictly, however, the overcoating cloth is a distinct grade of manufacture. It should, with few exceptions, in both thin and substantial structures, be firm and strong in the make, and sound and durable in construction. Open or loose-woven fabrics, porous and flexible in nature, are not generally adapted for the purposes to which these cloths are applied. As now understood, it is practical to produce 26 to 36 oz. cloths—i.e. cloths of suitable overcoating substances—in thick yarns, open in structure. Rough-woven materials of this description are unique in hardness of wear, and in offering favourable resistance to atmospheric conditions. They have, therefore, some of the essentials of one group of overcoating manufactures, and are employed as such, and also for sporting suits and costumes, for which they are

peculiarly adapted, their porousness of texture, combined with good thermal properties, rendering them unequalled as hard wearing materials. But the ordinary class of "overcoating" must be characterized by other qualities. Whether 16 or 40 oz. per yard, the fabric should retain in use the even, smooth, and bright surface imparted in the processes of construction and finishing.

These manufactures for the purpose of analysis, may be grouped into the following classes and types:—

- (a) Thin cloths of light substance and texture such as Venetians and worsted twills.
- (b) Medium-weight fabrics: Vicunas and milled worsteds.
- (c) Heavy makes of fabrics: milled woollens: friezes, Shetlands, and naps.
- (d) Heavily milled and raised fabrics: meltons and boxcloths, beavers, doeskins, and p.lots; and unions such as presidents and "Moscows".

(146) VENETIAN GROUP.

Venetians are fine-twilled fabrics. They usually range from 15 to 20 oz. per yard. The warp yarns are twist or two-fold threads if the weave characteristic is clearly defined, and single threads, but firmly spun, if the twill effect is indistinct and the face of the texture is of a fibrous nature. The cloths are well made in the loom or fastly woven, and vary in reed width from 64 in. to 72 in. to agree with the finish to be applied.

Three standard methods of manufacture may be considered, comprising the systems of warp and weft combinations practised and proved by experimental investigation and actual work, to be in accord with the production of three distinctive grades and qualities of texture. These are tabulated below under the headings of Venetian cloths A, B, and C.

TABLE XXIA.

STANDARD VENETIAN FABRICS.

A. *Twist-warp Venetian* (Weave, Fig. 121, Plate VII).

Warp: 2-fold 36's worsted twist composed of 1 thread of 36's olive and white marl, and 1 thread of olive.

18's reed 4's, 66 in. wide in the reed.

Weft: 27 or 28 skeins woollen olive shade, to match the solid or self shade in the warp yarn.

50 picks per inch.

Length of warp woven : 60 yd.

„ „ piece woven : 56 to 57 yd.

„ „ piece finished : 51 to 52 yd.

Weight of warp yarns : 28 lb. 4 oz.

„ „ weft yarns : 25 lb. 12 oz.

Loss in finishing on woollen weft : 10 per cent.

„ „ „ „ worsted yarns : 5 „ „

Weight per yard finished : 15 to 15½ oz.

B. DRAB MIXTURE "COVERT" VENETIAN (Weave, Fig. 121, Plate VII,
Threads L=lists).

Warp : 21 skeins drab mixture right-hand twine.

13's reed 4's, 72 in. wide in the loom.

Weft : 14 skeins drab mixture right-hand twine.

33 picks per inch.

Length of warp woven : 60 yd.

„ „ piece woven : 55 „

„ „ piece finished : 50 yd.

Weight of warp yarns : 41 lb. 12 oz.

„ „ weft yarns : 36 lb. 7 oz.

Loss in finishing : 12 per cent.

Weight per yard finished : 22 oz.

C. INDIGO BLUE PIECE-DYE VENETIAN (Weave, Fig. 122, Plate VII,
Threads L = lists).

Warp : 23 skeins, right-hand twine.

14½'s reed 4's, 72 in. wide in the loom.

Weft : 16 skeins, right-hand twine.

34 picks per inch.

Length of warp woven : 60 yd.

„ „ piece woven : 55 „

„ „ piece finished : 49 yd.

Weight of warp yarns : 42 lb. 8 oz.

Weight of weft yarns : 32 lb. 13 oz.

Loss in finishing : 12 per cent.

Weight per yard finished : 21½ oz.

Fabric A is a typical twist warp production woven in the Venetian twill (Fig. 121). In such manufactures 15 per cent to 18 per cent may be allowed for width contraction on the loom width. Worsted yarns are used for warp crossed with a fine woollen weft. Drab, medium-brown, grey, and greenish-grey are the common shades in which the cloths are produced. The

ratio of the diameters of the warp and weft yarns should be approximately that suggested in the illustration, namely as $\frac{1}{90}$ in. (worsted) is to $\frac{1}{70}$ in. (woollen). To alter the counts of the worsted, without a corresponding change in the counts of the woollen, and also in the setting, is not a sound practice. The worsted warp should, in all cases, effectually cover the woollen weft. For this reason, on an average, the pieces are woven with one-third more threads than picks per inch, or, as in this cloth, with 72 threads of warp to 48 to 50 picks of weft per inch in the loom.

It is essential in each type of Venetian that the weft yarn should be loosely spun in order to impart milling property, fibrous density, and softness of texture.

Patterns B and C, though made of woollen warp and weft, are manufactured on similar principles as Pattern A. The warp yarns are again the finer in counts, and are more compactly grouped both in the loom and in the finished fabric than the picks, namely, as 52 threads are to 33 picks in B, and as 58 threads are to 34 picks in C; or as 65:37 and as 73:40, respectively, in the finished cloths. Thus, whereas in these manufactures the warp forms the face of the fabric, the weft constitutes a fair proportion of the weight per yard.

Comparing B and C in further detail, they are both set the same width in the loom and are composed of similar though not identical counts of yarns. They differ in threads per \square ", specimen C being firmer woven than specimen B. The shrinkages on length and width also correspond, so that the textures mainly differentiate in loom construction and also in the weave, the Venetian twill used in fabric C producing a firmer woven structure than the five-end sateen, the plan of fabric B. Attached to each of these weaves (Figs. 121 and 122) are the plans—marked L—of the lists or selvages. To protect fabrics of this and the doeskin class in the operations of milling, tentering, raising, and cutting, special listing weaves and yarns are employed. They should be of strong, sound yarns, and be at least in part of a different material and colour from the ground warp, to constitute a fast selvedge, as, for example, in fabrics of the

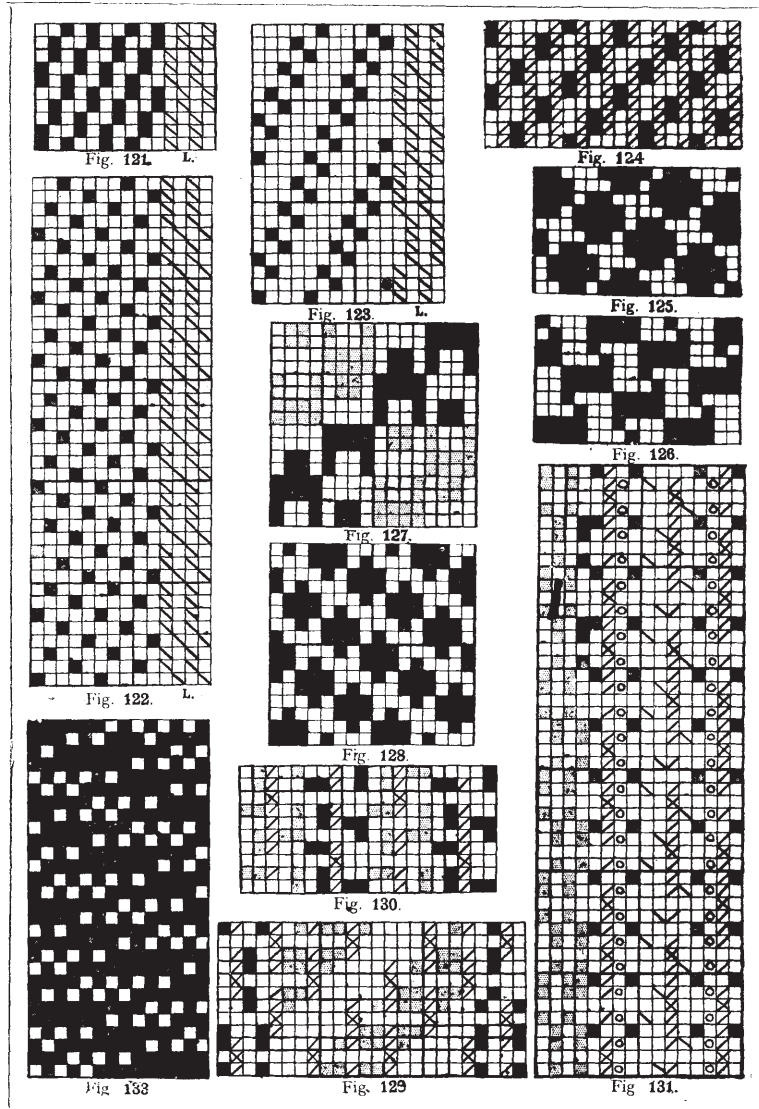


PLATE VII.—Examples in overcoating weaves of special structure.

- FIGS. 121, 122.—Venetian cloth weaves, L= selvedge.
 FIG. 123.—Worsted whip-cord twill.
 FIG. 124.—Venetian twill face, ten-shaft sateen back.
 FIGS. 125-128.—Milled serge weaves.
 FIG. 129.—Stripe design 4/4 twill and 4/4 warp cord face, backed with plain make.
 FIG. 130.—Stockingette weave face, backed with plain make arranged 2 threads face, 1 thread backing and 2 threads face, in both the warp and weft.
 FIG. 131.—Ribbed stripe on the face with cutting threads \square , and backed with the plain weave \boxtimes .

[To face page 236.]

C type, taking the left side of the piece: 2 threads of 2/30's cotton, 24 threads of ground warp, and 16 threads of 2/30's cotton.

In each variety of Venetian illustrated, the finishing routine is similar in character up to raising, in which process fabrics A are raised slightly in a damp condition, then cut sufficiently close to develop the fine twill effects consisting of the twist warp yarns. Textures C and D are raised in a more moist condition to leave a short fibrous cover on the surface of the cloth; yet so treated in the cutting operation, as to leave the twill a visible feature of the fabric.

(147) WORSTED TWILL AND WHIP-CORD OVERCOATINGS
(Fig. 123, Plate VII).

Worsted twills and whip-cords form another light build of overcoating cloths. They are made of worsted warp yarns and of worsted or woollen weft yarns. The fabrics are firmer in manufacture and a grade heavier than the typical worsted-warp Venetian. Usually they are piece dyed, a solid shade or colour giving better prominence to the twilled details than mixture or twist yarns.

Two methods of manufacture are practised: (1) that of making the fabric so closely woven as to reduce piece contraction in scouring and dyeing to a minimum; and (2) that of setting the pieces 70 or 72 in. in the reed and shrinking in the milling machine in the direction of the weft, but as little as practicable in the line of the warp yarns. Similar types of weave, such as Fig. 123, are employed in the construction of both classes of fabric. One standard system of manufacture applied to the unmilled variety of these fabrics is as follows:—

Warp: 2-fold 32's white worsted.

14's reed 8's, 63 in. or 64 in. in the loom.

Weft: Also 2-fold 32's white worsted.

74 picks per inch.

Weight per yard finished: 24½ oz.

Plan of weave: Fig. 123 with selvedge weaving 4/4 warp cord, and warped same as the piece with 4 threads of 2-fold 30's blue cotton yarns woven twill, dividing the listing from the piece proper.

Such fabrics, as in the example, are maximum set in the warp to develop a clear, full twill. Single weft yarns are also employed which improve, in some degree, the quality of handle, but have the effect of slightly reducing the transverse tensile strength of the piece. The same type of fabric produced by the second method of manufacture would be set 72 in. in the loom and in a $16\frac{1}{2}$'s reed 6's, and woven with 30 skeins weft and 68 or 70 picks per inch. A somewhat heavier cloth is thus obtained in consequence of increasing the diameter of the weft yarn by the equivalent of three worsted counts. It will be observed that in weaving, the picks are only reduced by four, but the threads by thirteen per inch. As the two finished cloths correspond in these yarn particulars, the ratio of difference in the loom is rectified by the degree of warp and weft contraction in milling. *Width* and not *length* shrinkage is practised—mechanical compression of the piece being adjusted to relate principally to the weft, the normal or woven length of the warp yarns is not affected. On this principle the woollen weft which interlaces ten and one or floats on the back of the fabric is rendered the felting factor. Two objects are attained by this species of milling treatment. (1) Additional substance and density of cloth by weft contraction mainly; and (2) shrinkage to the degree necessary to produce the correct compression, or compactness of the warp yarns, to agree with the unmilled fabric, the face warp twills not being thereby detrimentally affected.

(148) WARP-BACKED AND DOUBLE-CLOTH VICUNA OVERCOATINGS (Fig. 124, Plate VII, and R, Plate IV).

As in the preceding variety of cloths, this group of fine overcoatings are manufactured of worsted or of worsted and woollen yarns, the latter being applied in the weft. Two standards may be analysed, the first a 2-ply warp fabric woven 5-end venetian on the face and 10-end sateen on the back (Fig. 124), and the second a 2-fold fabric plain woven on the back and $2/2$ twill on the face. This is the sounder and better wearing cloth. Taking the first example, the warp yarns are 2-fold 48's worsted, 19's reed 8's, 72 in. wide in the loom; and the weft yarns single 32's worsted with 80 picks per inch, giving

a 19 to 19½ oz. cloth. An important point in the construction of this fabric is the use of a single weft yarn somewhat smaller in diameter than the 2-fold warp yarn, and with slightly more picks than face threads per inch. Milling is practised, the pieces, as in the foregoing illustration, being felted chiefly in the width to retain some distinctness of the twilled effect. This feature is, however, varied by the finishing routine. If a woollen yarn is employed in the weft, the weave is not left so clearly pronounced, and 5 to 10 per cent in length, and 11 to 20 per cent contraction in width are allowed.

Two-fold weft yarns do not give the same quality of texture, lessening the softness and suppleness of handle, and also not contributing in a sufficient degree to the smooth surface obtained by the method of binding the face and backing warps to each other. To acquire a clear twill, the amount of shrinkage is decreased and the pieces are set 66 in. or 68 in. in the reed.

One method of producing the second type of this variety of compound weave Vicuna is thus :—

Warp : 2-fold 48's worsted for face and backing (6 yd. of face warp to equal 7 yd. of backing warp).

Weft : 34 skeins woollen for face and backing.

15's reed 6's, 70 in. wide in the reed, 78 picks per inch.

Weight per yard : 19 to 19½ oz.

Plan of Weave : Fig. R, Plate IV.

It is a correctly balanced fabric, well-made in the loom, and simple in yarn composition. The picks per inch are in agreement with the yarn diameters and the threads per inch. Analysing the face structure, there are 52 picks of woollen yarn $\frac{1}{80}$ in. diameter, and 60 threads of worsted yarn $\frac{1}{100}$ in. diameter. The minute inequality in density is adjustable in the felting. The satisfactory scheme of production practised, is evident in the firmness and soundness of the fabric combined with suppleness of handle, and also in the permanent nature, in the wear, of the qualities imparted in finishing. A heavier cloth of similar characteristics is manufactured by applying a 30 skeins woollen backing warp. Tensile strength is not in this way improved—a 2-fold 48's worsted being a thread of higher breaking strain than a single 30 skein woollen thread, but a fuller degree of

fibrous density is developed on the under surface of the fabric, and neither the face nor back of the texture are thereby changed in appearance.

To obtain the true Vicuna handle, the finishing technicalities are varied to accord with the qualities of yarns used, the weave structure, and relative compactness of the warp and weft threads in looming. The first of these examples is, on these grounds, chiefly felted in the weft; whereas the second cloth is felted equally in both length and width. Raising treatment is similarly regulated. The utilization of a weft yarn, as in the latter method of manufacture, of suitable fibrous structure and property, facilitates work of this nature on the piece. A general routine is to impart the finished qualities to the cloth prior to dyeing. After scouring and milling to 60 in. or 62 in.—adapted to agree with the amount of raising to be practised—the pieces are raised damp, run in the milling machine or worked in the fulling stocks for a short time, washed off, tentered, blown with steam or *decatted*, dyed, then washed off, re-tentered, raised (when thoroughly moist), followed by brief fulling treatment (to soften the fabric and secure the surface filament), dried and cut. The degree of closeness in cutting is adjusted to give the character of face or weave effect required. Subsequent to cropping the pieces are hot pressed, steamed and brushed; and, if necessary, cold pressed to further level and straighten the surface of the cloth. One paramount element to be obtained in this detailed routine of finishing work, is the production of a full quality of softness of texture, which is mainly developed in the operations of milling and raising.

(149) MILLED WORSTEDS.

Botany as well as Crossbred worsteds are milled or felted in the manufacture of overcoating cloths. They differ, however, in character from the Vicuna fabrics just considered, not having the same suppleness of handle, but possessing either a clearer weave development, or the close fibrous compactness of a felted woollen but of a smarter and brighter character. Milling imparts textural solidity, tensile strength, and wearing property.

Examples in the methods of manufacture applicable to fabrics made of Crossbred and Botany yarns are as follows:—

MILLED CROSSBRED OVERCOATING (SINGLE WEAVE, 4/4 TWILL).

Warp : 2-fold 24's Crossbred, 36's quality.

15's reed 4's, 80 in. in the loom.

Weft : Same as warp.

60 picks per inch, 23 to 23½ oz. per yard.

MILLED BOTANY OVERCOATING (DOUBLE-CASSIMERE WEAVE).

Warp : 2-fold 40's Botany, 60's quality.

Single yarn = right-hand twine, 14·6 turns per inch.

Double ,, = left-hand twine, 12·3 ,, ,, ,,

Warp : 15's reed 8's, 70 in. in the loom.

Weft : Same as warp.

108 picks per inch, 24 to 24½ oz. per yard.

Both are good wearing fabrics. The strong staple and fibre of the wool, used in the manufacture of the Crossbred, yield a cloth simple in construction, and well adapted, by its firm and compact texture, for overcoating wear. In finishing, all surface fibre is removed, and the make or twill rendered clear and distinct. Stripe and other colour patterns, in plain and mixture yarns, are also applied in the making of this class of fabric.

The weave details in the Botany are more or less indistinct, the surface of the texture being fibrous, with no resemblance, however, to the pile in a doeskin or beaver. It is a fine quality of worsted overcoating made of 60's quality of "top," and a wool of good milling property. The finishing routine is of a similar character to that described as practised in relation to the double-make Vicuna, with the acquirement of a cloth less supple but firmer in make and of greater wearing strength.

(150) FELTED CROSSBRED SERGES (Figs. 125, 126, 127, and 128, Plate VII).

The felted Crossbred serge overcoating is typical of a different group of fabrics from the medium quality of milled Crossbred cloths just considered. The two classes of fabrics differ in textural properties, weave construction, and surface characteristics. The finer Crossbred, as pointed out, is treated in

finishing to develop the twill effect. In the felted serge, weave structure is varied—see Figs. 125 to 128—but the processes of finishing subdue rather than develop pattern due to the methods of warp and weft interlacing. After milling, the pieces are tented, trimmed in cutting, pressed, and steamed. Yarn qualities are not emphasized—the rough fibrous nature of the wool being one of the distinguishing features of the cloth. Diversity of weave is rendered practicable by the comparative coarse counts of worsted yarns used and the pronounced structure of the plans. Ordinary twills, and their derivatives, do not result in the production of such effective textures as those obtained by weaves of the types illustrated.

Four methods of manufacture adapted to the application of these distinctive weave bases are given in Table XXII:—

(151) MANUFACTURING DATA FOR HEAVY SERGES.

TABLE XXII.

Weave Plan.	Counts of Warp.	Counts of Weft.	Counts of Reed.	Picks per inch.	Reed Width.	Finished Width.	Loom Length.	Finished Length.	Weight per yard.
Fig. 125	2-fold 9's worsted	3's worsted	14's 2's	23	70 in.	56 in.	70 yd.	60 yd.	28½ oz.
Fig. 126	2-fold 9's worsted	3's worsted	13's 2's	21	71 in.	56 in.	66 yd.	62 yd.	26 oz.
Fig. 127	2-fold 9's worsted	2-fold 9's worsted	15's 2's	31	68 in.	56 in.	63 yd.	58 yd.	26½ oz.
Fig. 128	2-fold 9's worsted	2-fold 9's worsted	13's 2's	26	67 in.	56 in.	58 yd.	54 yd.	22 oz.

Two-fold 9's worsted forms the warp in the four examples, Figs. 125 and 126 being crossed with 3's single yarn, and Figs. 127 and 128 being woven as warped. The threads and picks per inch, and the length shrinkages, are responsible for the differences in the weights per yard. The 22 oz. cloth (Fig. 128) has 26 threads and picks per inch with a minimum of length shrinkage, whereas the 28 oz. is 3 in. wider in the reed, woven with a thicker weft with 28 threads and 23 picks per inch, and has a maximum shrinkage in the length. The examples em-

phasize the value of shrinkage as a controlling factor in the acquirement of weight per yard in this class of fabrics.

(152) BOTANY WORSTED FACE AND SAXONY WOOLLEN BACK OVERCOATINGS.

There are several varieties of these manufactures in piece-dyes, mixtures, and simple weave and colour patterns. Fig.

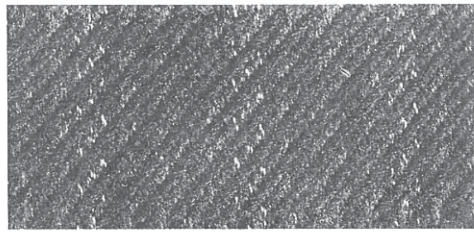


FIG. 129a.

129a (Weave, Fig. 129) is a typical fabric of this character. It is striped in colour on the face and plain woven on the back,

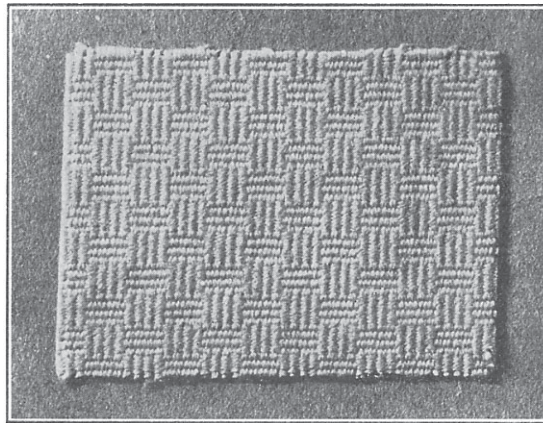


FIG. 132.—Warp and weft cord check.

the backing threads floating with the face warp on the right side of the texture. A wool of good raising quality is used in making the woollen backing weft so that, in finishing, the under

side of the cloth may be covered with fibre imparting suppleness of handle and causing the compound fabric to be warm in the wear. If necessary, such is the degree to which the backing yarns "cover" when raised, the reverse surface may be woven a different colour, as in the example, from the ground shade yarns composing the face pattern. The distinctiveness of the face from the backing texture in yarn characteristics, counts, and setting, renders it feasible to apply a variety of elementary weave designs, and schemes of colouring, of the type of that illustrated, a combination of 4/4 twill and 4/4 warp cord. In any case, the backing structure should be plain, twill, or sateen. The face of the fabric should, in the finishing routine, be treated as a fine Botany worsted, and the back of the fabric as a raised Saxony woollen; hence in looming 10 per cent to 15 per cent is allowed for contraction in scouring and milling, the latter operation being preferably performed in the fulling stocks.

WEAVING DATA (Figs. 129—Plate VII.—and 129a).

	6	6	12	6	6		6	6	6
<i>Warp</i> : 2-fold 18's medium shade worsted	1	1	--	1	1	--	1	1	1
2-fold 48's dark shade worsted (backing yarn to match the shade of the backing weft)	1	--	1	1	--	1	--	1	1
2-fold 18's dark shade worsted	--	1	1	--	1	1	--	2	1
25's worsted and 60's/2 silk twist	--	--	--	--	--	1	--	1	--
13½'s reed 4's, 70 in. wide in the reed.									
<i>Weft</i> : 1 pick of 2-fold 18's dark shade worsted.									
1 " " 12 skeins woollen doubled for backing.									
1 " " 2-fold 18's dark shade worsted.									
54 picks per inch.									

Pattern 129a is woven in the section marked in grey in the plan, Fig. 129, Plate VII, but the same scheme of warping is also applicable to the design as illustrated.

(153) STOCKINGETTE CLOTH WITH WOOLLEN OR WORSTED
FACE AND WOOLLEN BACKING (Fig. 130, Plate VII).

As this term denotes the face effect of this fabric resembles a knitted or fine ribbed texture. The double-plain weave striped four-and-four (Fig. O¹, Plate II) is used in the production of both medium and heavy cloths. It is used in this example (Fig. 130) in conjunction with a centre or binding warp and a backing warp and weft interlacing plain. The sections in grey and solid squares form the stockingette effect in the fabric.

Warp : (Fig. 130) 28 skeins woollen.

17's reed 4's, 75 in. in the loom.

Weft : 2 picks of 28 skeins woollen and organzine silk (20,000 yd. per oz.) twist.

1 pick of 10½ skeins woollen.

2 picks of woollen and silk twist.

63 picks per inch.





Thus woven, about a 30 oz. cloth (clear finish) is produced. A worsted-face stockingette is obtainable, in the same weave, by warping with 2/40's worsted, and wefting 2 picks of 2/40's worsted and 40's mercerized cotton twist, 1 pick of 15 to 20 skeins woollen, and 2 picks of worsted and cotton twist ; and setting in a 16's reed 6's, with 96 picks per inch. By using fine mercerized cotton in place of silk in the twist, piece dyeing is practicable without colouring the effects due to this yarn.

(154) RIBBED WORSTED-FACE AND WOOLLEN-BACKED
FABRICS (Fig. 131, Plate VII).

Certain weft-cord weaves, when backed, give fabrics which closely resemble in texture the stockingette cloth, but they are less firm in structure and less serviceable in wear. More satisfactory textures are acquired by combining, as in Fig. 131, small lines of warp and weft effects. The character of the pattern resulting, from using in the same weaving plan, both types of cord, is illustrated in Fig. 132, a checked vesting style produced in 4/4 warp and 4/4 weft cords, combined 16 and 16, and woven in 2-fold 30's warp and weft yarns with 64

threads and picks per inch. It illustrates the style of pattern details which develop in worsted fabrics consisting, in the plan, of the two types of this weave. For worsted overcoatings, and other medium cloths, compactly set and consisting on the face of small counts of worsted yarns, the simplest weave contrasts in line stripes are woven. They form a neat style of worsted face and woollen piece-dye backed structures. Fig. 131 is a typical plan and yields a 20 to 21 oz. cloth when produced thus:—

Warp : 6 threads of 2-fold 60's worsted.
 1 thread of 2-fold 30's ,,
 6 threads of 2-fold 60's ,,
 1 thread of 2-fold 30's ,,
 2 threads of 2-fold 60's ,,
 24's reed 4's, 66 in. in the loom.
Weft : 1 pick of single 30's worsted.
 1 ,, ,, 12 skeins woollen (backing).
 2 picks of single 30's worsted.
 96 picks per inch.

Analysed, the weave is a compound of 3/3 warp cord, marked in grey, weft effect in 's, warp prunelle in  on the face, and weft twill in 's on the back. The yarn counts are adjusted to agree with the weave formation, the face effects being woven in the 2/60's yarns, the cutting or indentation threads, , interlacing plain, in 2-fold 30's; and the 12 skeins woollen weft, making the back of the cloth, interweaving with the stronger thick counts of warp yarn.

Compound cloths of this nature are illustrative of weaving technique. Accuracy of construction is attained in the arrangement of the weaves, and in the application of yarn diameters to the sections they each form of the fabric. To combine satisfactorily three weaves, so dissimilar in effect and structure, as warp cord, small weft cord, and 2/1 twill, necessitates the development of each plan in correct counts of yarns and setting, and also their adjustment in relation to each other, on such a principle that the binding points will not detract from but accentuate their different characteristics. A special feature of this example consists in the use of the plain interlacing

threads, \square 's. These are not distinguishable in the fabric, but functionally connect the three weave elements together and prevent irregularities in the junction of one weave with another. A further technicality observed, is the effective combination of the face and backing textures, and the production, with the cheaper and thicker backing yarn, of 60 per cent of the weight of the whole fabric, and this without detriment to the fineness and evenness of the compound weave pattern utilized in the face structure.

(155) WORSTED LAMBSKIN TEXTURES (Fig. 133, Plate VII).

“Lambskins” are not a heavy variety of fabric being usually made in weights of 20 to 24 oz. per yard. The knitted texture—woven on the stockingette loom—is softer and loftier in the handle than the ordinary warp and weft production, but both textures possess a fleecy fibrous surface and a neatly interlaced backing. Worsted yarns are chiefly employed. The weft, in the woven or loom structure, is a loosely spun and doubled four-fold yarn, made of fine stapled wool, clean or snow white in colour—the fabrics being manufactured in the white as well as in bright, pure shades. The cloth is suitable for cloakings, wraps, mantles, and loose-fitting coatings. The weave (Fig. 133) is designed to float the folded weft yarn freely on the face of texture, and to intersect plain with several threads in succession. Each pick, for example, in the illustration, weaves plain with five threads, and then covers a group of eleven threads. The arrangement of the plain intersections follows the scheme of the sateen base; hence, after shrinkage, and prior to raising, the fabric appears to be sateen woven on the upper and plain woven on the under surface. A typical scheme of manufacture consists in using 2-fold 48's worsted warp, set in a 13's reed 4's, 80 in. wide in the loom, and 4-fold 14's Botany worsted with 20 to 24 picks per inch. Setting is loose or open to induce and accelerate free shrinkage of the yarns. Prolonged felting would yield some solidity and firmness of fabric, and is not practised in this class of cloth in which a soft, supple quality is essential.

(156) CROSSBRED QUALITIES OF HEAVY TWEEDS.

Friezes, Shetlands, fleeces, curled serges and "naps," form the principal varieties of these textures. Range of manufacture, weight per yard, finish and quality, are diversified in actual practice.

First, as to the materials employed: Wools are selected varying from coarse to fine Crossbred—British and Colonial grown, and from 3 in. to 7 in. in length of staple. In the production of certain of the qualities of "fleecy" overcoatings, demi-lustre wools are also combined to obtain a pile of similar brightness of tone to that developed in the lustre rugs described in Paragraph 40. Moreover, in the generality of these fabrics a bright-stapled wool is valuable in acquiring the pile surface which composes the characteristic feature of the cloth. Neither in friezes nor Shetlands is this lustrous property an essential, but rather strength and durability of structure.

Second, the yarns are thick in counts, the wools thoroughly blended and carded, developing a true, even thread in spinning. Usually both warp and weft are single, but in some manufactures, made of the higher grades of yarns, twist or two-fold warp threads are used. This practice may be applied in the production of the finer makes of "fleeces," in which classes of cloth the percentage of milling is moderate, followed by a full amount of raising to give density and fullness of pile.

For obtaining the blanket quality of handle requisite in these cloths, the pieces should not be too firmly woven nor too heavily milled. In the frieze, Shetland, and curled serge it is different. These fabrics are hard and strong in construction, durable, and of exceptional wearing property. The pile of filament, characteristic of the fleece texture, is that of the velvet-pile finished cloth, being combed, straightened or "dressed"; in the frieze the pile possesses the rough appearance and features developed in felting, the weave and colour pattern being to some degree visible; and, in the Shetland and "nap" frieze, the raised filament is formed into small neppy curls or beads, but not fully covering the surface of the fabric. Finishing work applied to the latter cloths, particularly in raising and cutting, determines

the nature of the nap characteristic. Primarily this varies with the fineness and length of the wool fibres, but it also varies in character with the degree of raising, producing a pile, of lesser or fuller composition, by the extent to which the filaments are shortened in the operation of cutting.

The particulars of manufacture in Table XXIII of these distinctive varieties of heavy tweed cloths, made of Cheviot and Crossbred wools, indicate the features of construction in which they differentiate from each other.

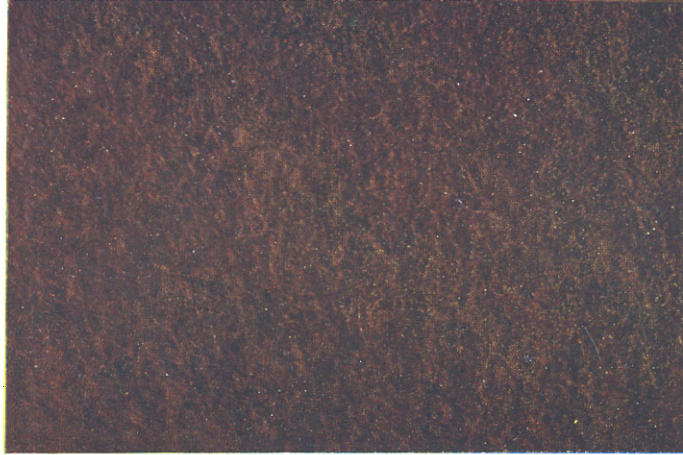
(157) TECHNICALITIES OF MANUFACTURE OF FRIEZES, SHETLANDS, FLEECES, CURLED SERGES, AND NAP CLOTHS.

TABLE XXIII.

Style of Fabric.	Counts of Warp.	Counts of Weft.	Counts of Reed.	Picks per inch.	Loom Width.	Finished Width.	Loom Length.	Finished Length.	Weight per yard.	Weave.
Irish frieze {	7 skeins	7 skeins	9½'s 3's	28	81-82 in.	55-56 in.	64 yd. from 70 yd. warps	54 yd.	38 to 40 oz.	Fig. I, Plate II
Nap frieze {	7 skeins	5 skeins	10's 2's	20	80 in.	56 to 57 in.	66 yd.	50 to 52 yd.	38 to 39 oz.	Fig. G or P, Plate II
Shetland {	7½ skeins	7½ skeins	11's 2's	22	70 in.	56 in.	58 yd.	50 to 51 yd.	26 oz.	2/2 twill
Fleece fabric {	15 skeins	15 skeins	10's 3's	31	75 in.	56 in.	60 yd.	54 yd.	20 to 21 oz.	Fig. I, Plate II
Curl serge {	2-fold 12's Crossbred	2-fold 12's Crossbred	8's 4's	28	72 in.	56½ in.	60 yd.	52 yd.	23 to 24 oz.	3/3 twill
Nap cloth {	15 skeins left-hand twine. 11 turns per inch Saxony	12 skeins left-hand twine. 10 turns per inch Cheviot	8's 4's	32	73 in.	56 in.	56 yd.	50 yd.	22 oz.	3/3 twill

The fixed factors here are the counts of yarns, ends and picks per inch, loom and finished widths. The woven and finished lengths are subject to some variation. Still, from the proportions of length shrinkage given, calculations may be formulated for the construction of cloths of a reduced or greater weight per yard. Such actual manufacturing data, as contained in the Table, establish a base on which to work. They show the relation of the loom structure to the finished cloth. Loss in scour-

A



B



PLATE VIII

Blanket finished and Napped Friezes

Pattern A—Fig. 134

Pattern B—Fig. 135

[*Standard Cloths. To face page 250*]

ing and finishing is variable, but it can be readily ascertained by testing the yarns available for manufacture. Firmness of setting is also a changeable factor, as it should be made to agree with the nature of the yarns—soft or medium-spun and composed of coarse or medium qualities of wool—and the character and nature of cloths required.

(158) BLANKET-FINISHED AND “NAPPED” FRIEZES.

Patterns A and B (Figs. 134 and 135), Plate VIII, are specimens of the blanket-finished heather mixture frieze, and the napped-finished or Shetland Lovat mixture. Both fabrics are woven in the same weaving particulars, namely, 2-fold 20-cut Cheviot yarns for warp and weft in 9's reed 3's, and 22 picks per inch. The

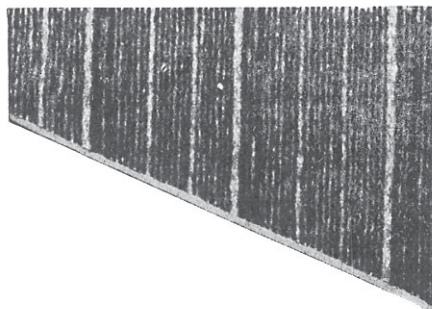


FIG. 136.—Striped beaver-finished overcoating.

weave is cassimere twill cutting two's in the threads. Sample A resembles the fleece pile texture already referred to, though the cloth is sounder and faster in construction. To facilitate felting, and the production of “balk” fibre, the pieces are set 80 in. or 84 in. wide in the loom. The “cover” of filament in the frieze may be entirely the result of tease raising, the pieces in the process being saturated with moisture. It is, however, a good practice to treat the cloths, in the first place, on the card-raising machine, which disentangles the felted fibres and also effectually draws them from the foundation of the texture. Final raising should be performed on the tease machine. Here the process is less drastic, and the combing, and spreading of the fibres, more in keeping with the straight, even character of the pile result required.

Moser or card-wire raising should also be practised in finishing the napped frieze (Pattern B). The filaments should not, in this instance, be laid or spread laterally, but have a vertical disposition, which may be effected by passing the pieces through the beating frame face down, and operating on the back or reverse side. This loosens the fibres and forces them into a suitable relation for the rubbing action of the napping machine. Cutting or cropping is only performed in each style of cloth to level and not to shorten perceptibly the pile of filament.

These specimens are suggestive of the effect of a variation in finishing methods on the character and appearance of a raised pile fabric, resulting, in the blanket frieze A, in the production of a straight vertical cover of fibres possessing fresh brightness of colour tone; and, in the napped frieze B, in the formation on the surface of the cloth of clustered or beaded neps of fibres detracting, in some degree, from the natural lustre of the wool but imparting a rough curly characteristic to the cloth.

(159) HEAVILY MILLED SAXONY TWEEDS.

No class of overcoating or heavy cloth is warmer in the wear, firmer in construction, and of better qualities of manufacture than this class of tweed. Fine spun yarns, composed of short-stapled clothing wools of high spinning, felting, and raising properties, are utilized in the production of both the single and compound fabrics. These fine qualities of wools obtain in varieties of cloths suitable for either a clear or fibrous routine of finishing. One standard structure, of the beaver-finish class, is woven swansdown on the face and plain on the back. The build of the fabric is shown in Fig. 137, Plate X, producing in a correct order of warping and wefting the pattern sketched in Fig. 136. Hairline patterns, varying in stripe formation, are developed on both sides of the texture, or fancy mixture yarns are used, giving in either scheme a soft, fibrous, heavy overcoating cloth of dense, compact composition. Simple line effects are weavable by colouring the face plan 2-and-2 and the backing plan 1-and-1. Assuming the warp yarns to be 20 or 21 skeins and the weft yarns (face and back) 16 or 18 skeins, and the

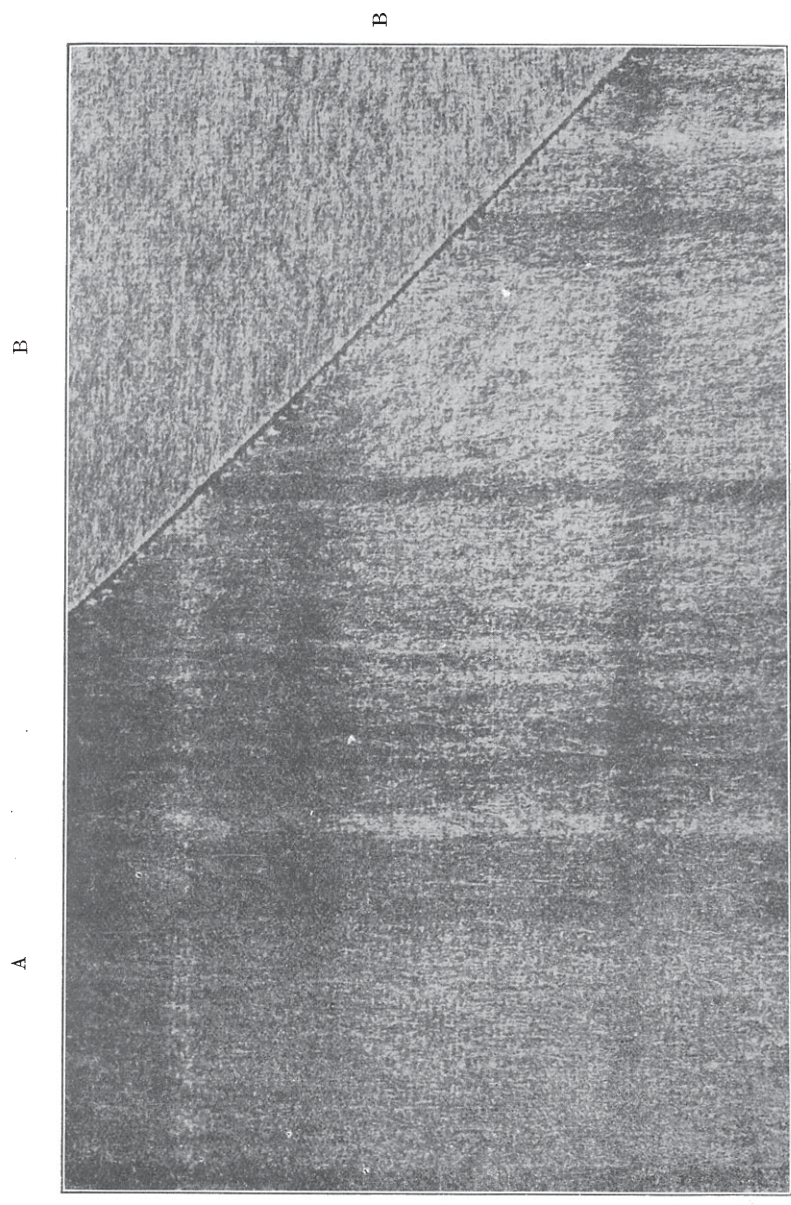


PLATE IX.—FIG. 143a.—Golf cloaking. Raised finish on the under side, A, and Clear finish on the face, B.
[*Tr. face page 252.*]

pieces 72 in. to 75 in. in the loom in a $14\frac{1}{2}$'s reed 4's, and woven with 56 or 58 picks per inch, a 28 to a 30 oz. cloth is produced. Applying this method of manufacture to clear-finished fabrics the compound weave is changed to Fig. 138, Plate X, which is strictly a 3-fold plain structure, consisting of the double-plain

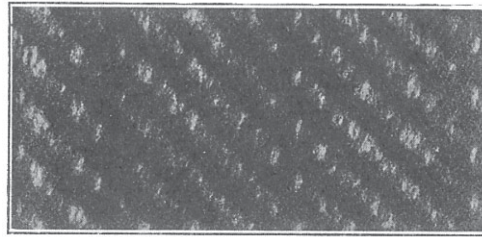


FIG. 139.—Saxony overcoating, 6/6 twill.

make, checked, on the face and of single-plain make on the back. As understood, the double weave is usable in the formation of stripe, check, and other species of pattern, by arranging the plans to agree with the orders of warp and weft colourings. Taking the example, by colouring as below, a small check in dark

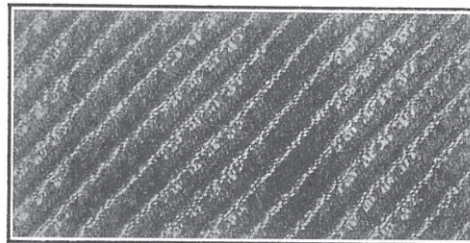


FIG. 140a.—Heavily-milled Saxony overcoating.

and light shades is developed on the face with the back in medium grey mixture yarns.

Warp: 21 skeins dark grey mixture 1 — 1 — 1 1
 21 skeins light grey ,, — 1 — 2 1 —
 21 skeins medium grey ,, 1 — 1 1 1 —

$14\frac{1}{2}$'s reed 4's, 72 in. in the loom.

Weft: As warp.

58 picks per inch.

The application of single weaves of the 4/4 or 6/6 twill group to the manufacture of pronounced twill cloths, varied in colour composition in the warp, of some 29 to 30 oz. per yard, is illustrated in Fig. 139. Diversity of pattern detail is acquired, as seen from the warping and wefting appended, by combining 2, 3, and 4-fold twist yarns, and weaving with either a mixture or 2-ply weft thread.

Yarns : A = 4-fold 40 skeins twist dark, medium, and light shades. = 9 or 10 skeins.

B = Fancy flock twist yarn.

C = 3-fold 30 skeins twist, two dark and one light shade.

D = 2-fold 20 skeins dark and light shade.

E = 9 skeins dark shade or 2-fold 18 skeins twist.

15

Warp : A — 1 — — — 1 — 2 — 2
 B 1 3 — 3 1 1 1 1 1
 C — — 1 — — — — — — — —
 D — — — — — — — 3 — — —

Weft : All shade E.

12's reed 2's, 70 in. in the loom, 24 picks per inch.

A third variety of these fine heavy Saxonies is woven in plans composed of warp and weft corkscrew twills (Fig. 140, Plate X) produced in the warping, wefting, and setting, stated below and also yielding a fabric of 28 to 30 oz. per yard.

Yarns : A = 21 skeins dark mixture shade.

B = 21 skeins medium mixture shade.

C = 2-fold 42 skeins dark mixture and light mixture twist.

D = 2-fold 42 skeins medium mixture and bright colour twist.

4 6 6 4 4

Warp : A — — — — — — — — — — 1 1 1 1 1 1 1 1 1 — 1 1 1 1
 B — 2 3 1 4 1 4 1 4 1 3 3 2 3 1 5 1 5 1 1 — 5 1 3 3 —
 C — 1 1 1 — 1 — 1 — 1 1 — — — — — — — — — — — — — —
 D 1 — — — — — — — — — — 2 — — — — — — — — — — — — — 1

Weft : 1 pick of yarn C.

1 " " " " A.

17's reed 4's 70 in. wide in the loom, 62 picks per inch.

This and the preceding example are illustrative of heavy Saxony tweeds, clear-finished to give definition to weave and

colour characteristics; but the same classes of manufactures are also finished with a fibrous surface, subduing or toning the effects in the pattern.

(160) UNION FACE CLOTHS—"PRESIDENTS" AND
"MOSCOWS" (Figs. 141 and 142, Plate X).

Heavy meltons, box cloths, doeskins, pilots, and beavers belong to the same category as certain makes of military, navy, and livery cloths, and are included in these groups of fabrics, but "union" face cloths form a special variety and may therefore be treated of separately. Two examples are given, the "President" and the "Moscow beaver". Cotton warps are used in the production of both fabrics, the weaves being 2-ply in construction in the weft. The methods of finishing practised are of a similar nature to those applied to all-wool beaver cloths. The weft yarns conceal the warp on both the face and back of the fabric. Being made of mungo, it does not, when milled and raised, give a texture of the fibrous density and softness like woollen yarns of a Saxony quality, nor that obtainable when the warp and the weft threads are equally utilized in forming the face of the cloth. Details of construction for 23 to 24 and 29 to 30 oz. fabrics, are comprised in the following looming particulars:—

MOSCOW BEAVER (Weave, Fig. 141).

Warp: Single 22's black cotton.
13's reed 4's, 84 in. wide in the loom.
Weft: 1 pick of 17½ skeins mungo.
1 ,, ,, 13 skeins mungo.
68 picks per inch.

Sixty yards of warp should yield some 54 yards of woven piece, and 50 to 52 yards of finished cloth.

PRESIDENT (Weave, Fig. 142).

Warp: 2-fold 32's or 36's cotton.
21's reed 4's. 72 in. wide in the loom.
Weft: 2 picks of 14 skeins mungo.
1 pick of 6 skeins mungo.
58 picks per inch.

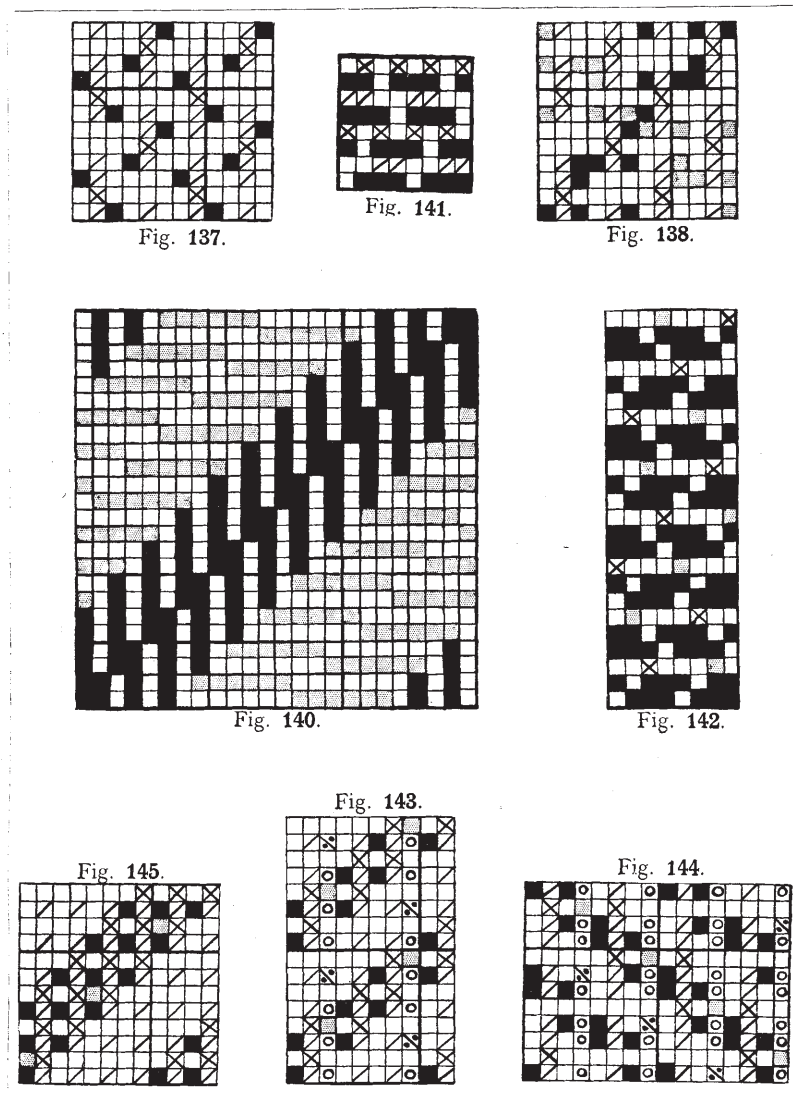


PLATE X.—Weave Structures for Heavily-milled Saxonies.

- FIG. 137.—Double weave for striped beaver-finished overcoating.
 FIG. 138.—Three-ply plain weave for heavy Saxony cloth.
 FIG. 140.—Diagonal twill for heavily-milled Saxony, clear finish.
 FIG. 141.—Moscow (union) beaver weave.
 FIG. 142.—Backed "President" (union) weave.
 FIGS. 143 and 144.—Double weave for golf coatings, centre-warp stitched.
 FIG. 145.—Double-make 4/4 twill.

The plain picks in the Moscow weave (Fig. 141) add to the firmness of the fabric structure. This weave, and also the type of plan used for the "President," may be arranged variously, in the picks, as indicated in the definitions given relative to the manufacture of two-ply weft reversibles in Chap. V. Fine "President" cloths are constructed, in which the face weave is 8-shaft weft sateen, 2 picks of face to 1 pick of backing yarn; and also in the 6-end sateen, wefted 4 picks face and 2 picks backing.

(161) HEAVY FABRICS WITH WOVEN LININGS.

Three principles of manufacture applicable to these cloths produced for golf and lined cloakings and overcoatings comprise:—

I. The application of similar yarns, Saxony or Cheviot, to the face and backing textures.

II. The application of Saxony yarns to the face, and Cheviot yarns to the back, or *vice versa*, of the cloth.

III. The application of worsted yarns, Botany or Crossbred, to the face, and Saxony or Cheviot yarns to the back of the fabric.

Reference has been made in Paragraph 47 to a class of worsted overcoating with a twilled pattern on the face and a checked pattern woven on the back as lining. This illustration (Fig. 56) is typical of the weave and textural construction of this group of heavy cloths. As a rule, they are two-fold warp and weft structures with or without centre or stitching yarns. Overcoating cloths thus constructed are more firmly woven than golf cloakings. In the latter there is considerable scope in methods of setting, schemes of colouring, and counts and qualities of yarns. Pronounced check styles, tartan plaids, and other bright colour compositions, are used in the lining texture, but the face of the cloth is ordinarily made of a solid shade of yarn (wool-dyed for a woollen texture and top-dyed for a worsted) or consists of a simple weave and colour compound.

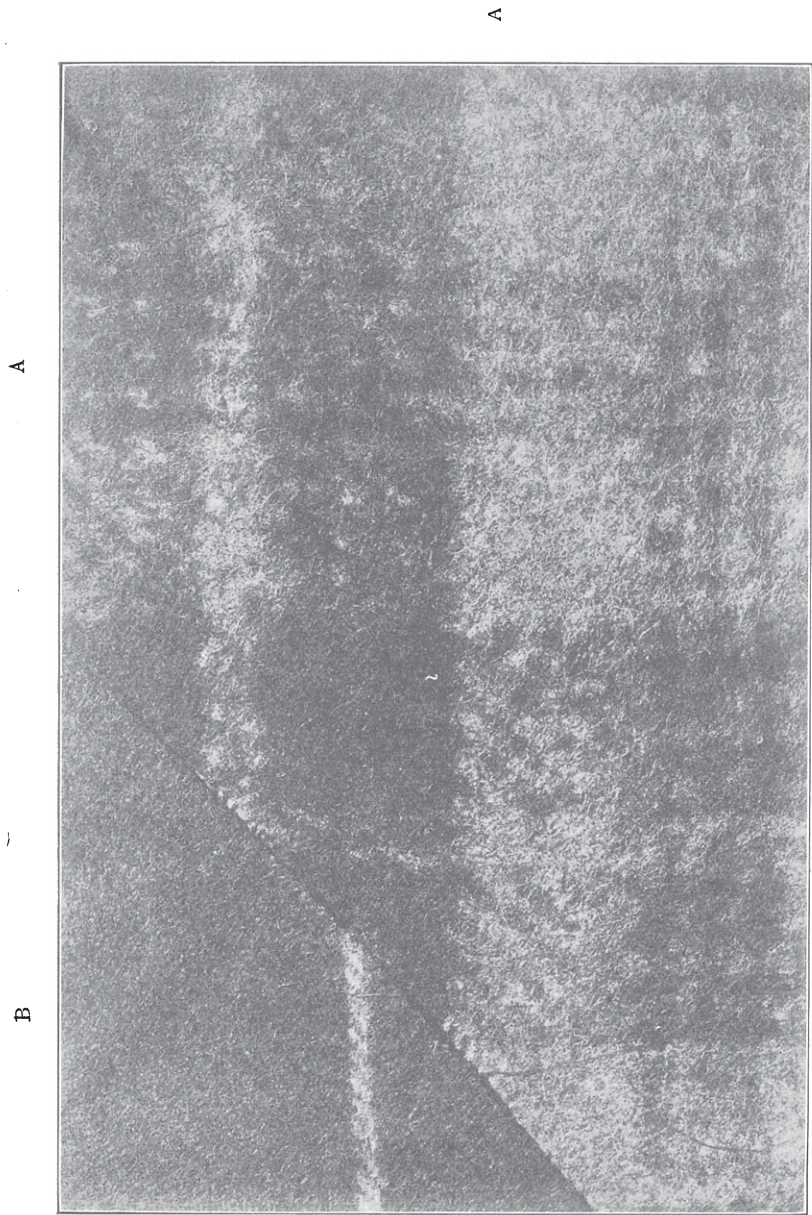


PLATE XI.—FIG. 144a.—Cheviot yarns and raised finish on the face, A; and Saxony yarns and clear finish on the under side, B.
[To face page 258.]

(162) GOLF CLOAKING, WOOLLEN YARN STRUCTURE.

Fig. 143a, Plate IX (Weave, Fig. 143), is an example woven 2/2 twill on both the face and back with centre warp stitching; the counts of the yarns being 24 skeins Saxony throughout and 2-fold 40's cotton for the binding threads. The fabric has a raised or "fleece" finish having, however, the twill slightly visible on the face side. The setting applied makes, approximately, a 19 to a 20 oz. cloth. Actual weaving particulars for this compound structure are as follows:—

Face Warp and Weft.

24 skeins drab. Warp yarn = 13·5 turns per inch right-hand twine.
 Weft yarn = 10 " " " " "

Backing Warp.

Light brown	12	8	4	8	4	6	—	6
White	4	—	—	2	2	—	—	—
Medium brown	—	2	2	—	—	—	4	4
Drab or fawn	—	—	—	—	—	20	40	—

Backing Weft.

Similar to the Pattern of Warp but yarns looser spun.
 13's reed 5's, 66 in. or 68 in. wide in the loom, 46 picks per inch.

(163) GOLF CLOAKING—CHEVIOT AND SAXONY YARN COMPOUND (Fig. 144a, Plate XI, Weave, Fig. 144, Plate X).

The second scheme of manufacture is illustrated in Fig. 144a, Saxony and Cheviot yarns being used for the back and face of the cloth respectively.

The weave (Fig. 144) in this example is arranged 2-and-1 in both warp and weft. The Saxony-yarn surface has a fibrous finish, and the Cheviot-yarn surface a rough appearance. Produced in the following data the cloth is 23 to 24 oz. per yard:—

Saxony Warp.

20 skeins blue	4	24	24	4	4	2	2	—	4	} 168 threads.
20 ,, black	2	—	2	2	20	—	—	20	2	
20 ,, white	—	6	—	—	—	—	—	—	—	
20 ,, green	—	—	—	—	20	—	20	—	—	
2-fold 40 skeins black and yellow twist	—	—	—	—	—	6	—	—	—	

B A

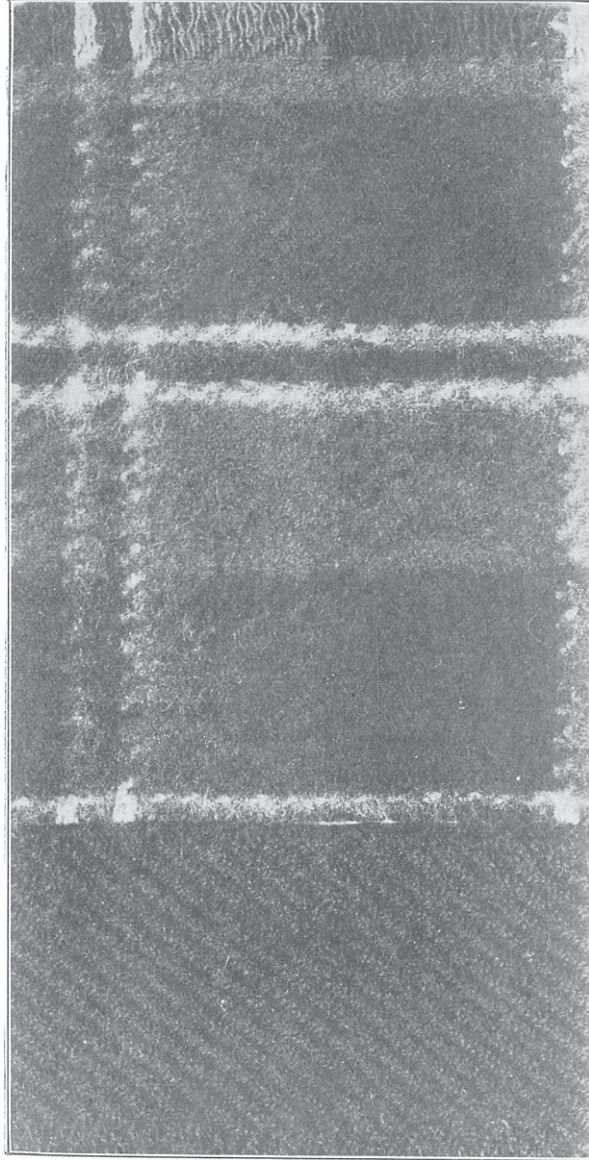


PLATE XII.—Fig. 145a.—Lined cloaking. Saxony yarns, fibrous finish for the under side, A; and serge worsted yarns, clear finish, for the face, B.

[To face page 260.]

Saxony Weft.

20 skeins green	20	—	20	—	} 168 picks.
20 „ blue	2	2	58	58	
2-fold 40 skeins black and red twist	4	—	—	—	
20 skeins white	—	—	4	—	

Cheviot Warp.

10 skeins grey	16	2	2	16	2	2	2	} 84 threads.
10 „ black	16	—	16	—	—	—	—	
Black and yellow fancy twist	—	2	—	—	—	—	—	
2-fold 20 skeins black and red twist	—	—	—	2	2	2	2	

Cheviot Weft.

10 skeins grey	—	2	2	16	2	2	2	16	} 84 picks.
10 „ black	16	—	16	—	—	—	—	—	
2-fold 20 skeins black and yellow twist	—	2	—	—	—	—	—	—	
„ „ „ „ „ red twist	—	—	—	2	2	2	2	—	

Centre warp : 2-fold 40's brown cotton.

13's reed 4's, 70 in. or 72 in. wide in the loom, 35 picks per inch.

Fig. 145a illustrates the principle of constructing the face side of the cloth in worsted yarns, and lining in woollen yarns. A three-fold contrast of effects is obtained in this grade of manufacture formed first in the qualities of the materials combined, second in the yarn structures, and third in the textural features.

(164) LINED CLOAKING, WOOLLEN AND WORSTED YARN STRUCTURE (Fig. 145a, Plate XII, Weave, Fig. 145, Plate X).

Face Warp and Weft : 2-fold 16's Crossbred black worsted.

Backing Warp.

10 skeins black	46	8	} 98 threads.
12 skeins grey	36	—	
2-fold 16's white worsted for over checking	4	4	

Backing Weft.

10 skeins black	40	6	} 86 picks.
10 skeins grey	32	—	
2-fold 16's white worsted	4	4	

14's reed 4's, 68 in. in the loom, 48 or 50 picks per inch.

This cloth—about 29 oz. per yard—is equally balanced as to compactness of face and backing yarns. It is three and three

twill woven on both sides, and stitched by depressing face warp threads on backing picks.

When this group of fabrics is compared with other compound structures they manifest distinctive features. Stitching is done by the use of special yarns (marked in \square 's in Figs. 143 and 144). Such yarns have no effect either on the face or backing texture, their only function being to bind them to each other. Small cotton or worsted threads are used for this purpose. Should these centre yarns not be employed, the double-cloth may be stitched by the ordinary method, as in Fig. 145, which is practicable when, as in this instance, the warp and weft shades in the two textures are alike in tone.

Structurally the cloths are loosely formed, but in all varieties of these manufactures the distinct fabrics—face and back—should be as perfect in colour and weave characteristics as a single-make texture, and each so compactly woven that neither construction modifies in the smallest degree the effects developed in the other.

CHAPTER X.

ARMY AND NAVY CLOTHS : FIBROUS-FACED FABRICS.

(165) Groups of Army Clothing Fabrics ; (166) Manufacturing Methods : Woollen and Worsted ; (167) Army Clothing Nomenclature ; (168) "Tartan" Cloth ; (169) "Serges," "Tartans," "Tweeds" and "Khaki" ; (170) "Serge" and "Tartan" Cloths ; (171) "Tweed" Cloths ; (172) "Khaki" ; (173) Khaki Mixtures ; (174) Blends for Khaki and French Grey Mixtures ; (175) The "Barathea" ; (176) Highland Plaids ; (177) Data of Manufacture for "Staff," "Sergeant," and "Rank and File" Highland Tartans ; (178) Tartan or Plaid Technicalities ; (179) Face-finished Fabrics ; (180) Analysis and Weaving Particulars for Heavy Box and Melton Cloths ; (181) Constructive Particulars for Doeskin and Beaver Cloths.

(165) GROUPS OF ARMY CLOTHING CLOTHS.

CONTRACT cloths for the Royal Army and Navy Clothing Department comprise various grades of woollen, worsted, and woollen and worsted union fabrics, such as textures light in construction and weight, and of medium substance and firmness of manufacture ; heavily-felted cloths for overcoatings ; and blankets and rugs. These several classes of woven production are composed of different materials, and made in fine, intermediate, and coarse qualities, according to the uses and purposes to which they are applicable. Pure wools are given, in the official statement, as the staple fibre, though mungo and shoddy are also employed. Standard samples are submitted and accompany the specifications. A similar system, as stated in Chap. IV, is in force in contract work offered by city corporations, railway companies, and other official boards. This practice enables manufacturers to determine accurately the nature and class of raw material to utilize, and also the quality, structure, and finish of the cloth. A verbal description of a fabric is not in such transactions adequate. It is liable to unsatisfactory interpretation and ought not to be accepted in lieu of the approved or authorized

standard sample. This system might be extended with advantage to other branches of manufacturing, as an effective means of correcting misunderstandings if not of obviating controversial litigation.

The cloths requisitioned for both Army and Navy clothing are divisible into these principal groups: woollens (Cheviot and Saxony qualities); worsteds (Crossbreds and Botanies); and unions composed of woollen and worsted yarns. Each group comprises the following varieties of manufactures:—

(a) Unmilled but “shrunk” fabrics, chiefly of light weight from 4 to 6 oz. per yard, 27 to 31 or 32 in. wide.

(b) Milled fabrics, with a clear surface and from which the extraneous filament, developed in scouring and milling, is removed in the operations of finishing.

(c) Milled fabrics, with a rough fibrous surface of the melton and serge class.

(d) Heavily felted fabrics, with a smooth and even fibrous surface, or dress-face finish, such as doeskin, beaver, pilot and box cloths.

Types (b), (c) and (d) include fabrics ranging from 16 to 40 oz. per yard of 36 in. × 56 in. or 57 in. within the selvages or lists.

Large proportions of these cloths are made of woollen-spun yarns. The worsted cloths selected are principally of a medium and fine Crossbred quality, but some of the better grades, the Barathea for example, are made of Botany wools. The weave in most instances is single in construction and of a simple or elementary type—plain and the prunelle and cassimere twills predominating, and, in the manufacture of fine face cloths, sateens, on five and seven shafts, may be admissible. Pattern or design, as understood in the fancy section of the industry, is not applied if exception is made of the Highland plaids or tartans. The introduction of khaki during the South African war, as a standard shade, has afforded some facility for the blending, in varying percentages, of dyed materials in the production of both woollen and worsted yarns for Army Clothing fabrics.

Accuracy of shade reproduction is defined in the specifications as an absolute essential, whether acquired by a simple or compound process of dyeing, or the result in the cloth of using

solid or mixture shades of yarns. The latter possess a subtle, fresh tone of colouring, being obtained in the routine of manufacturing work by intermingling two or more lots of dyed wools, of the same or dissimilar qualities. The scheme of colouring offers advantages and should have fuller recognition by the Government Army Clothing authorities. Khaki is practically the only cloth to which it has been applied, yet the system is feasible in the production of other standardized shades; and is commendable as the practice to be adopted in the manufacture of new varieties of cloths applicable to military clothing. It must, however, be recognized that, whatever the nature of the method of colour acquirement approved, no relaxation should be made in the stringency of the tests imposed for evenness and uniformity of shade, and fastness to scouring, milling, and light.

(166) MANUFACTURING METHODS: WOOLLEN AND WORSTED.

The groups of cloths enumerated provide a copious range for diversity in manufacturing routine, in the raw materials available, and in the number of qualities and standards feasible and required in corresponding makes of cloth. Technically, the elements in which the woollen and worsted industries differentiate in practice are clearly emphasized in the production of these fabrics. As a rule, worsted manufacturers are not actually concerned in the manipulation of the material up to the yarn, nor yet in the finishing of the pieces, though, in tendering for Government and Official contracts, it is an adjunct to successful work to control directly the finishing operations in addition to the setting out and weaving of the fabric. The amount and method of shrinkage in the width and length of the piece, and the nature of the finish applied, not infrequently influence the success or otherwise of the scheme of manufacture. But the worsted industry is essentially departmental. Yarn construction is effected on a standardized base, and specialization obtains in dyeing and finishing. These conditions, while favourable to the ordinary branches of the piece-dye and fancy trades, are not so well adapted to the manufacture of cloths to a definite standard in which modifications in methods and practice are desiderata; and which,

moreover, are an integral and natural part of the system of woollen manufacturing in attaining specific technical results. Where the worsted producer is restricted by industrial exigencies, the woollen producer may apply technical knowledge and experience in initiative and performance.

In the woollen industry, the producer is responsible for the selection and grouping or classification of the raw materials, the manufacture of the yarns, the looming and weaving, and also for the routine of finishing. He is therefore in a different and freer position from the average maker of worsted fabrics. Within the compass of the same mill every process of work is conducted. Similar departmental phases prevail in yarn and fabric construction, and in dyeing and finishing, as in worsted cloth manufacture, with the inherent difference that the woollen manufacturer determines and organizes the precise nature of the work from the sorting and blending of the raw materials to the finished product, whereas the worsted manufacturer may be limited in the field of correlative operations to the conversion of the spun yarn into a woven piece. Woollen cloth production, when thus viewed, affords more complex elements under one scheme of control than are involved in the purchase of yarns of the accurate counts, shade and quality, and in weaving them into cloth of a prescribed structure, strength and substance.

On these grounds it is a *sine quâ non* that the woollen manufacturer have an expert and experimental knowledge of the physical and clothing properties, and spinning qualities, of the various grades and classes of wools. It is imperative that he should be acquainted with the behaviour of different wools in the combination of chemical and mechanical processes of manufacture, and also be competent to initiate, group, and co-ordinate methods calculated to ensure economic and accurate results. The nature and scope of the varied work comprised is more fully apprehended when viewed in relation to the range and characteristics of cloths to be produced. At the outset, the construction, adaptability, and running efficiency of the machinery accessible has to be taken into account. Serges and the rougher classes of fabrics, for example, being made of the coarser-grown wools, are producible economically in factories

equipped for the Cheviot grades of manufacturing; and, for a like reason, the finer makes of cloths, composed of yarns small in diameter and spun from short-stapled Merino wools, necessitate the use of carding, spinning, and finishing machinery employed in the production of Saxony cloths. Economy and efficiency in manufacture are only attainable on these lines. Neither issue is practicable by the utilization of machinery not specially designed and adapted for the treatment of the classes of wools applicable to the makes and qualities of cloth to be manufactured.

The setting out of the machinery plant and running of the mill are all-important. Each department should be subjective to separate supervision, and be equipped proportionably in productive power with correlative departments. The maximum output of each section, on the systems of work for which it is usable, should be tested and recorded. This facilitates initial and general control, and acts as a correction or preventative of leakage in individual groups of operations. These factors may not be more fully investigated here but they lie at the basis of successful production.

The scope of the worsted manufacturer, whose concern is the making of the pieces from yarns obtained from the spinner, relates chiefly to accuracy and economy in woven results. The grouping of the looms in types, and speeding them according to the class of fabric on which they are utilized, are essentials. Looms on which the speed is alterable by the use of change wheels, are the more satisfactory for maintaining a maximum efficiency of output, when changing from one grade of cloth to another. On elementary fabrics, especially simple in weave structure and shuttling arrangement, a higher speed is attainable than in weaving some classes of double-make textures in which the order of wefting, as to yarn counts and shades, is more or less complex.

(167) ARMY CLOTHING NOMENCLATURE.

References with analyses have been made in Chapter IV to flannels (Group *(a)* Page 265); serges clear finished (Group *(b)*); kerseys, khaki, and tartan drab mixtures (Group *(c)*).

Taking the official nomenclature the cloths for Army and Navy clothing are designated flannels (white and scarlet): serges, thin and thick (white, red, blue, and black): tweeds (blue): tartans (blue, black and khaki): "fearnoughts" and Kerseys (white, red and green): and cloths (red, green, blue and black). Each term defines some characteristic feature of the fabric. The differences in texture and other qualities of flannels, and light or thin serges, as suggested by this terminology have already been indicated. Fabrics of the serge group vary in yarn structure, material and finish, as will be explained. They are harder in texture than the tweeds, which are made of either single or two-fold woollen yarns, yet both makes of fabrics consist of Crossbred wools of a fine or medium but not of a coarse quality. Tartans are intermediate in grade and fineness of texture between the tweed and the cloth. This latter is a well-milled, face-finished fabric. "Fearnoughts" and Kerseys are made of thick strong-haired wools, and to the particulars stated in Paragraph 66.

"Kersey"—French *cariset*—is descriptive of a coarse woollen cloth, hand-loom woven, and said to have been formerly made in Devonshire and Kent. "Serge,"—French *serge croisée* (twilled), *serge drapée* (milled) and *serge fine* (fine, unmilled)—is applied to a woollen or worsted fabric with an undressed fibrous surface produced in the natural colour of the wool, and in one shade of yarns, or piece dyed. "Tartan," as employed in the above designations, is somewhat misleading. The term is variously interpreted, but if of Gaelic origin, it would appear, according to Logan, to be suggestive of the intermingling and crossing of colours characteristic of the Highland plaid. Certainly the term was understood to have this significance in the fourteenth century in such records as the purchase of "half an elle of doble tartane to lyne the collars to our good Lady Quene," 1471; and later—1538—a "Heland tartane to hose to the King's grace; as also in a banner of yellow tartane," and in "ane elle and ane halve to lyne the gown of gold" of James III. Other terms were also used by the Highlanders to describe their national fabric, namely, "Cath-dath," which Logan renders

as "the strife of colours," and Planche as "War colour"; and "Breacón-feile," literally checked striped colouring. Buchanan, however, writing in 1582 on the customs of the Highlanders, chiefly particularizes the material and colour, stating "they delight in marled clothes, especially that have any long stripes of sundry colours," and adds "their predecessors wore short plaids of divers colours"; and here he is followed by a later historian who observes "Every isle differs from each other in their fancy of making plaids as to stripes in breadths and colours". "Plaid" and not "tartan" is the term used by both these authors and is suggestive of its early employment and application.

(168) "TARTAN" CLOTH.

That "tartan" is a corruption of the French word *tire-taine*, meaning linsey-woolsey, a coarse hand-woven fabric of linen warp and woollen weft is not probable. Whatever the origin and true rendering of the term, which is applied in French and English to checked plaid fabrics, in Army Clothing "tartan" is descriptive of the material and texture and not of the composite colouring peculiar to the Highland plaids.

(169) "SERGES," "TARTANS," "TWEEDS" AND "KHAKI".

In Tables XXIV to XXVI the specification particulars and looming technicalities, based on analytical data, are supplied of the official standard patterns of "Serges," "Tartans," "Tweeds," "Cloths," and "Khaki" fabrics. Several of the Navy Clothing materials, including "Flannels," "Blue Cloths," "Tartans," "Kerseys," and "Fearnoughts," have been treated of in some detail in the analysis of the principles and theory of fabric structure and production in the Chapter on the "Standard Grades of Woven Manufactures".

It will be understood that, in the following Tables of Army and Navy Clothing Fabrics, the looming data given are variable, in some degree, in such particulars as the Counts of Yarns, the Threads per inch in the Loom, and the Measure of Shrinkage.

TABLE XXIV. ARMY CLOTHING FABRICS: "SERGES".

SPECIFICATION.										LOOMING DATA.									
Description.	Dye and Finish.	Width.	Weight per yard 36 in.	Threads per 1/2 inch.		Strength in lb.		Elasticity in inches.		Width in Loom.	Counts of Yarns.		Threads per inch.		Weave.				
				Warp.	Weft.	Warp.	Weft.	Warp.	Weft.		Warp.	Weft.	Warp.	Weft.					
A { Serge blue, No. 1	Dye, indigo. To be equal to sample both in quality of dye and shade of colour. Finish, as per pattern, London shrunk.	58 in.	17 to 18 oz.	28	26	210 lb.	150 lb.	2 in.	2 1/2 in.	72 in.	28 skeins woollen	25 skeins woollen	46	46	Prunelle				
B { Serge blue, No. 2, thin				23	21	370 lb.	370 lb.	2 in.	2 1/2 in.		69 to 70 in.	2-fold 24's Crossbred worsted	17 to 18 skeins woollen	38 to 40		40 to 42	2 1/2 twill		
C { Serge blue, No. 2, thick	As sample B.	56 in.	22 1/2 to 23 oz.	24 to 25	24 to 25	350 lb.	310 lb.	2 in.	2 in.	70 in.	2-fold 24's Crossbred worsted	13 1/2 to 14 skeins woollen	41	42 to 44	2 1/2 twill				
D { Scarlet serge, No. 1				22	34	250 lb.	430 lb.	2 in.	3 1/2 in.		63 in.	2-fold 32's Crossbred worsted	14's Crossbred worsted	40		63	2 1/2 twill		
E { Scarlet serge, No. 2	As sample D.	56 in.	19 3/4 to 20 1/2 oz.	27	20	385 lb.	310 lb.	2 in.	2 1/2 in.	68 in.	2-fold 24's Crossbred worsted	13 skeins woollen	45 to 46	40	2 1/2 twill				

TABLE XXV. ARMY CLOTHING FABRICS: "TARTANS".

SPECIFICATION.										LOOMING DATA.					
Description.	Dye and Finish.	Width.	Weight per yard 36 in.	Threads per 1/2 inch.		Strength in lb.		Elasticity in inches.		Width in Loom.	Counts of Yarns.		Threads per inch.		Weave.
				Warp.	Weft.	Warp.	Weft.	Warp.	Weft.		Warp.	Weft.	Warp.	Weft.	
F { Tartan blue, No. 1	Dye, indigo. To be equal to sample pattern, both in quality of dye, and shade of colour. Finish, as per pattern, London shrunken.	56 in.	23 to 24 oz.	22 to 23	20 to 21	275 lb.	205 lb.	2 1/2 in.	2 1/2 in.	72 in.	2/28 skeins woolen	2/26's to 2/28 skeins woolen	35	36	2/2 twill
G { Tartan blue, No. 2	1 Dye, indigo, etc.	5 1/2 in.	23 to 24 oz.	20	20	280 lb.	250 lb.	2 in.	2 1/2 in.	70 in.	2/28 skeins woolen	2/26's to 2/28 skeins woolen	30 to 32	37	2/2 twill
H { Tartan black, No. 1	1 Dye, woaded, etc.	56 in.	23 to 24 oz.	21	20	290 lb.	210 lb.	1 1/2 in.	2 1/2 in.	72 in.	2/28 skeins woolen	2/26's to 2/28 skeins woolen	36	39	2/2 twill
I { Tartan black, No. 2	1 Dye, woaded, etc.	56 in.	23 to 24 oz.	20	20	280 lb.	250 lb.	2 in.	2 1/2 in.	70 in.	2/27 skeins woolen	2/27 skeins woolen	32 to 34	37	2/2 twill

1 Follow with description given of the Tartan blue, No. 1.

TABLE XXVI. ARMY CLOTHING FABRICS: "TWEEDS".

SPECIFICATION.		LOOMING DATA.													
Description.	Dye and Finish.	Width.	Weight per yard 36 in.	Threads per inch.		Strength in lb.		Elasticity in inches.		Width in Loom.	Counts of Yarns.		Threads per inch.		Weave.
				Warp.	Weft.	Warp.	Weft.	Warp.	Weft.		Warp.	Weft.	Warp.	Weft.	
Tweed blue, No. 1	Indigo, wool dyed. To be equal to pattern both in quality of dye and in shade of colour. Finish, as pattern, London shrunken.	56 in. within lists	31 to 32 oz.	21	21	360 lb.	310 lb.	2½ in.	2½ in.	90 in.	2-fold 24 skeins woollen	26	36	2/2 twill	
				19	19	350 lb.	30 lb.	2½ in.	3 in.	76 to 78 in.	2-fold 18 skeins woollen	28	34	2/2 twill	
Tweed blue, No. 2	Dye, indigo, etc.	56 in.	32½ to 33 oz.												

(170) "SERGE" AND "TARTAN" CLOTHS.
(Tables XXIV. and XXV.)

Analysing these technical data, as they relate primarily to "Serges," and "Tartans," it should be noted that elasticity, or fabric stretch, under breaking strain, is a property dependent upon the quality of the fibre used, the diameter of the yarns, and the turns per inch. These points are apparent on comparing Patterns B and C, both similar makes of serge, though specified as "thin" and "thick" respectively. The term "thick," as applied here, may be taken as synonymous with fibrous cover, Pattern C being more clothly in the handle than Pattern B; a characteristic due to the use of a $13\frac{1}{2}$ skeins woollen yarn for weft as contrasted with the 18 skeins used in the weaving of Pattern B. That is to say, the approximate relative diameters of the warp and weft threads in B are as 17:11, and in C as 17:19. Theoretically this would indicate a similar test for breaking strain and elasticity for both cloths; but, as specified, the fabric woven with the smaller spun weft thread tests $2\frac{1}{2}$ in. against 2 in. of the fabric woven with the thicker spun weft. Yarn dissection shows the same warp yarn structure in each cloth, and 9.4 turns per inch in the $13\frac{1}{2}$ skeins and 10.4 turns in the 18 skeins, which points to the disparity seen in the tests of the two cloths being caused by a difference in the quality of the wools used, and in the favour of Cloth B as to fineness of fibre, strength of staple, and felting property.

Blue serge No. 1 is a distinct make of fabric from Types B and C being woven prunelle twill, and consisting of single woollen yarns spun to 28 skeins in the warp (16.6 turns per inch) and 25 skeins in the weft (14.2 turns per inch). The methods of manufacture, and finishing result, in a fabric of soft, fibrous handle on the face, but firm and clear on the under surface, due to the well-spun weft thread. The degree of milling contraction, from 46 threads and picks in the loom to 56 threads and 52 picks per inch in the finished cloth, accounts, partially, for the elasticity test of 2 in. in the warp and $2\frac{1}{2}$ in. in the weft.

Scarlet serges Nos. 1 and 2—Patterns D and E—have been described and contrasted in manufacturing technicalities in Chapter IV.

The differences, in the structure and character of the "Serge" and the "Tartan" cloths, are readily understood when the qualities of the yarns employed in the production of each class of fabric is analysed. The "Tartan" is a woollen cloth—two-fold yarns in both warp and weft—made of fine Saxony or "clothing" wools, spun to 28 skeins; whereas, the serge is a "Union"—(worsted warp and woollen weft, Patterns B and C)—a pure Crossbred worsted—(Pattern D)—or a fine Saxony woollen composed of single yarns—Pattern A.

The "Tartan" fabric is fibrous finished, but not faced or dressed. The strength test necessitates, in this grade of cloth, the use of 2-ply yarns. Single 14 skeins warp and weft would, in the looming particulars stated in Table XXV, give the requisite weight per yard, but the cloths thus obtained would be unsatisfactory in fineness and quality if not in strength and elasticity; and would, moreover, be liable to suffer in durability or wearing property.

(171) "TWEED" CLOTHS.

The "Tweeds"—Blue Fabrics 1 and 2—are of a Saxony class, medium-fibred wools of the Merino variety being utilized in their manufacture. Both patterns are characterized by softness of texture and suppleness of handle. To acquire standards agreeing with the tests specified, two-fold warp yarns are employed. Assuming "quality" to be an essential in the purpose to which these cloths are applicable, it is correct, theoretically and practically, to spin the yarns to a moderately small counts—blending true-grown "clothing" wools—and doubling for weaving, a practice which yields yarn strength, and a cloth dense in fibre and firm in construction. Felting is also fairly high to produce some firmness of texture and add to the wearing character. Similar grades of fabrics might be more economically manufactured by reducing the fineness of the wool and the yarn counts. Such cloths would be of improved soundness and strength, but have a tendency to be deficient in flexibility and softness.

TABLE XXVII. ARMY CLOTHING FABRICS: "KHAKI".

SPECIFICATION.										LOOMING DATA.					
Description.	Colour and Finish.	Width.	Weight per yard 36 in.	Threads per 1/2 inch.		Strength in lb.		Elasticity in inches.		Width in Loom.	Counts of Yarns.		Threads per inch.		Weave.
				Warp.	Weft.	Warp.	Weft.	Warp.	Weft.		Warp.	Weft.	Warp.	Weft.	
L { Serge drab mixture (thin)	Dye as pattern. Supplies to be equal to pattern in quality of dye and in shade of colour. Finish as sample London shrunk.	56 in. within lists	16 to 16 1/2 oz.	26	22	400 lb.	270 lb.	3 in.	2 3/4 in.	63 in. or 64 in.	2/28's Crossbred worsted	16 1/2 or 17 skeins woollen.	47 or 48	42 or 43	2/2 twill
M { Serge drab mixture	As above	56 in.	20 to 21 oz.	27	23	430 lb.	400 lb.	2 1/2 in.	3 in.	70 to 72 in.	2-fold 24's Crossbred	12 or 13 skeins	42	44	2/2 twill
N { Tartan drab mixture	As above	56 in.	23 to 24 oz.	22 or 23	21	350 lb.	350 lb.	3 1/2 in.	3 1/2 in.	68 in.	2-fold 14's or 2-fold 15's Crossbred worsted	2-fold 14's or 2-fold 15's Crossbred worsted	36	40	2/2 twill
O { Cloth drab Melton (thin)	As above	56 in. within lists	15 to 15 1/2 oz.	21	21	180 lb.	180 lb.	2 in.	2 1/2 in.	71 in.	20 to 21 skeins woollen	22 to 23 skeins woollen	32	36	Plain
P { Cloth drab Melton (thick)	As above	56 in. within lists	21 to 21 1/2 oz.	28	30	200 lb.	190 lb.	3 1/2 in.	4 in.	80 to 82 in.	22 to 22 1/2 skeins woollen	22 to 22 1/2 skeins woollen	40	54 or 56	Plain
Q { Cloth drab mixture ¹	As above	58 in. within lists	33 to 33 1/2 oz.	19	23	280 lb.	240 lb.	3 in.	4 in.	80 in. to 84 in.	10 1/2 to 12 skeins woollen	10 to 12 skeins woollen	26 to 28	38 to 40	Prunelle

¹ This heavy overcoating cloth is, in practice, manufactured variously. Another standard method, for example, consists in using about 9 skeins warp and 12 skeins weft yarns, setting 90 inches in the loom, and weaving with 24 threads and 35 picks per inch. The cassimere and 3-and-1 twills have also been applied.

(172) KHAKI.

The "Khaki" fabric is a special manufacture for Army clothing produced in "Serge," "Tartan," "Cloth" and "Melton" qualities. Detailed analyses have been compared and explained in Paragraphs 69, 70, and 71 so that the present exposition of these groups of fabrics will mainly relate to colour characteristics and composition. Some features of the cloths tabulated under this heading may, however, be noted, as they are typical and illustrative of specific principles and systems of manufacture.

Referring to the data given in Table XXVII the tartan drab mixture—Pattern N—is a solid Crossbred worsted of ordinary construction, in the finishing of which some degree of milling is practised to improve the elasticity test. The 16-17 oz. and the 20-21 oz. fabrics of this class—L and M—are composed of worsted warp yarns,—fine Crossbred—two-fold 28's and two-fold 24's respectively, woven with $16\frac{1}{2}$ and 12 skeins weft. The woollen yarn develops milling property and fibrous density. These two serges are rendered more serviceable for clothing purposes by the woollen structure of the weft yarn, and are closer in the make, and more satisfactorily resist atmospheric conditions for being milled. Melton cloths O and P are plain woven, heavily milled, with the weave concealed or covered by the surface or "balk" fibre produced in felting. In construction they are of the usual Melton type of cloth treated of in Paragraph 126. Sample Q—cloth drab mixture—is the most interesting fabric of the series in manufacturing data. It is prunelle twill woven, compactly set in the reed, and, for the counts of the yarns employed, maximum wefted. Eighty inches is an approximate loom width, but the pieces may be, with advantage, set wider, adjusting the threads per inch and counts of the yarns to agree with the alteration. Felting on the length, or warp, is essential to the production of the strength test indicated. Warp felting is successfully effected by compound milling, the action of the automatic stocks accelerating and supplementing the action on the pieces between the flanged and the upper pressure rollers and in the cutting box or trough of the machine.

(173) KHAKE MIXTURES.

“Khaki” is a Persian term signifying “like the earth”. It is a well-known mineral dye extensively used in India; but the “khaki” made for army clothing is not a simple but a compound shade or blend of several colour units.

Blending, for mixture shades, may be performed on two distinct bases: first, by employing a minimum number of simple colours to adequately match the standard shade; and, second, by combining a number of colour ingredients which, in addition to yielding a correct match, produce colour strength and value. The latter method may appear the less economical, but it has features in its favour. The mixture or compound shade resultant, is enhanced in tone and freshness of tinting. The first base simply attains the necessary shade with the smallest diversity of colour units and is correspondingly of weaker colour value.

A practical advantage obtains in the second system, in the facility it affords for grading or toning mixture shades. Obviously, for example, more colours are given on Plate XIII than absolutely necessary to produce the khaki shade in the woven texture (Specimen G). The brown could be eliminated, and a shade intermediate between the buff and the drab could be dyed to take the place of both, thus reducing the colour units to five instead of seven. Theoretically this is sound. An advantage, however, in practice, in using the larger number, is the base it provides for keeping the resultant blend to standard. If the blend shows too yellow less drab and more buff may be added; if not red enough, more brown; if too red an increase of sage green; and if deficient in “body” a higher percentage of brown.¹ Moreover, the khaki mixtures vary in tone, but the “serge,” “tartan,” “melton” or “overcoating” are all producible from this series of colours. The composition of these mixtures is stated in Table XXVIII.

¹ An alternative method would be to employ four colours, namely, the brown, the lavender, and two intermediate shades obtained, (a) betwixt the drab and the fawn, and (b) betwixt the bronze and the green. This would form an economic scheme of dyeings.

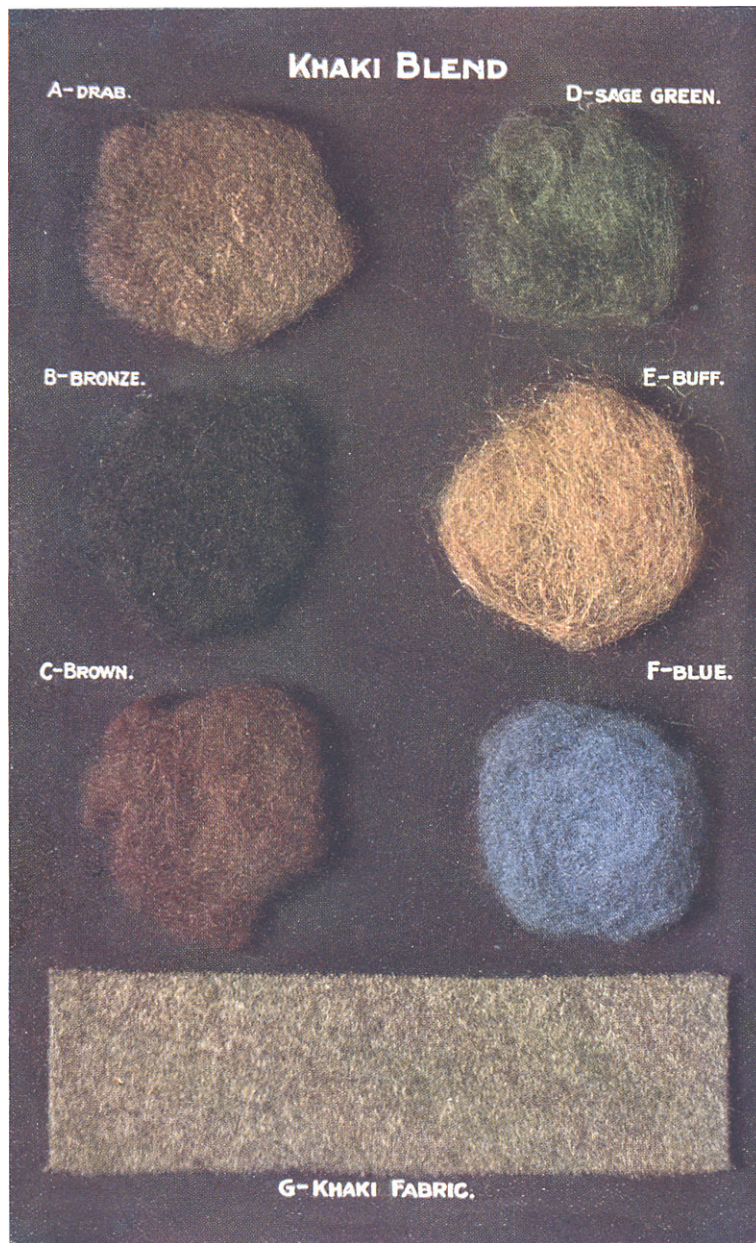


PLATE XIII

Specimens of Khaki Blend and Fabric

[Standard Cloths. To face page 278

fine-fibred wools possessing the property of scouring a pure white.

(175) THE BARATHEA.

It will be observed in the descriptions given of the cloths supplied for Army and Navy clothing that they are fabrics chiefly made of woollen yarns. With the exception of some makes of scarlet and blue serge, woollen yarns are used in all cases for weft, and in many of the cloths for both warp and weft. As ordinarily manufactured, a woollen fabric is close and compact in structure. The relative qualities of woollen and worsted textures doubtless form the base on which a preference has been established in favour of woollen materials for military and navy clothing. The "Barathea" is one of the few cloths (double weave in formation) used for this purpose composed throughout of worsted yarns. It is a vat indigo dyed fabric of fine quality, correct in principle of looming, counting 68 threads and 53 picks per half inch finished. The weight per yard is 28 oz., the specified tests being—*Strength*: Warp, 590 lb.; weft, 480 lb.; and *Elasticity*: 4 in. in warp and weft. As regards breaking strain and elasticity tests, the fabric is equal in standard to that of the milled varieties of woollen cloths; but these are features in which worsted fabrics as a rule compare favourably with woollen fabrics of the same weight per yard, and composed of materials of similar qualities. Two-fold yarns manufactured on the worsted system indicate a high breaking test. Counts for counts they are in this property superior to woollen yarns. One cause of this is the removal of the "neppy" fibre in the process of combing, and a second cause in the successive leveling, drawing out, and doubling of the slivers of combed wool, performed in the production of this type of thread structure. Fabrics made of worsted yarns should therefore test satisfactorily both in regard to strength and elasticity. Such makes of cloth as the "Barathea" are also closely constructed or woven, and characterized by suppleness and softness of handle. This compound structure is woven twilled mat on the face and plain weave on the back, and arranged 2 threads of face to 1 thread



PLATE XIV

French Grey Blend and Fabric; Blue Grey Army Cloth ;
and Wool Samples for Khaki

[Standard Cloths To face page 280

Scheme of Colouring.

<i>Warp:</i>	Blue	—	—	—	66	62	22	22	62	66	—	—	}	570 threads.
	Green	22	6	64	—	—	—	—	—	64	6	22		
	Red	6	14	—	6	14	—	14	6	14	6	—		
	Yellow	—	—	—	—	—	—	6	—	—	—	—		
<i>Weft:</i>	Blue	—	—	—	54	52	20	20	52	54	—	—	}	488 picks.
	Green	38	6	54	—	—	—	—	—	54	6			
	Red	6	12	—	6	12	—	12	6	12	6			
	Yellow	—	—	—	—	—	—	6	—	—	—			

Weave: 2/2 twill.

II. TARTAN HIGHLAND, "SERGEANT PIPER," "SCOTS GUARDS" AND "ROYAL HIGHLANDERS".

Warp and Weft: 16 skeins fine Cheviot.
 32 threads and 32 picks per inch, 70 to 72 in. wide in the loom.
Finished width: 56 in. with 40 threads and 40 picks per inch.
Weight per yard: 16 to 17 oz.
Tests.—Strength—Warp: 195 lb. *Elasticity—*Not specified.
Weft: 175 lb.

Scheme of Colouring.

<i>Warp:</i>	Red	—	75	—	—	—	22	6	6	22	—	—	—	}	374 threads.
	Black	—	—	22	4	4	4	—	4	—	4	4	22		
	Green	—	—	—	—	—	24	—	—	—	24	—	—		
	Blue	—	14	—	—	—	—	—	—	—	—	—	14		
	White	—	—	—	6	—	—	4	—	—	6	—	—		
	Yellow	—	—	4	—	—	—	—	—	—	—	4	—		
<i>Weft:</i>	Red	—	81	—	—	—	24	7	7	24	—	—	—	}	404 picks.
	Black	—	—	26	5	5	4	—	4	—	5	5	26		
	Green	—	—	—	—	—	24	—	—	—	24	—	—		
	Blue	—	14	—	—	—	—	—	—	—	—	—	14		
	White	—	—	—	6	—	—	4	—	—	6	—	—		
	Yellow	—	—	4	—	—	—	—	—	—	—	4	—		

Weave: 2/2 twill.

III. TARTAN HIGHLAND, No. 2, "RANK AND FILE" (Plate XV.).

Warp: 2-fold 22 skeins Cheviot.
Weft: 12 or 12½ skeins Cheviot.
 30 threads and 32 picks per inch, 68 in. in the loom.
Finished width: 56 in. with 36 threads and picks per inch.
Weight per yard: 19¾ to 20¾ oz.
Tests.—Strength—Warp: 330 lb. *Elasticity—Warp:* 2 in.
Weft: 250 lb. *Weft:* 2 in.



PLATE XV

Tartan Highland: No. 2, "Rank and File"

[Standard Cloths. To face page 282

Scheme of Colouring.

<i>Warp :</i>	Black	—	—	6	6	28	4	4	28	4	4	28	4	4	28	6	6	}	400 threads.	
	Green	—	—	—	—	26	—	—	—	—	—	26	—	—	—	—	—			
	Blue	—	13	6	6	—	—	—	—	28	—	—	—	—	—	6	6			13
	White	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	—			—
	Red	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—			—
<i>Weft :</i>	Black	—	—	6	6	26	4	4	26	4	4	26	4	4	26	6	6	}	376 picks.	
	Green	—	—	—	—	24	—	—	—	—	—	24	—	—	—	—	—			
	Blue	—	11	6	6	—	—	—	—	26	—	—	—	—	—	6	6			11
	White	—	—	—	—	—	—	—	—	—	—	—	—	—	—	10	—			—
	Red	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—			—

Weave : 2/2 twill.

The three styles of these textures will be understood from the distinct materials used and schemes of production practised.

(178) TARTAN OR PLAID TECHNICALITIES.

Plaids or tartans form a grade of woollen manufacture necessitating technical accuracy in every detail. In the first place, purity and fastness of colour are essentials. Definition of line and beauty of pattern are accentuated by distinctiveness of colouring. In no process of finishing—scouring, shrinking, and steaming—must there be the slightest indication of the colour being modified in hue or of running one into the other. For the black, blue, and green shades, woaded vat indigo dyeing is practised; for the reds, cochineal; and for the yellows, weld.

Secondly, the setting out of the textures in the loom, to produce the exact width of fabric, developing each plaid in the correct dimensions in the finished cloth, is another essential. The tartans must be “woven to pattern with which the size of the check must be in exact conformity”. This, in such compound colourings, is only attainable by the motions of the loom,—tensioning of the warp and weft, shuttling, and take up of the fabric—being absolutely uniform throughout the weaving of the pieces. Finishing is a routine of cleansing, shrinkage, tentering, dressing of the surface of the cloth in cutting, levelling and straightening in pressing, and of improving the quality of handle in the final process of steaming.

(179) FACE-FINISHED FABRICS.

Several varieties of these cloths have been analysed but chiefly of a light or medium substance ; the principles, however, underlying their construction are also applicable to cloths of a thicker and heavier character. Army clothing fabrics of this description range from 23 to 30 oz. per yard. They are wool-dyed manufactures varying in strength on the *warp* from 240 to 300 lb., and on the *weft* from 180 lb. in the 23 oz. cloth, to 300 lb. in the 30 oz. cloth. Elasticity tests show on the *warp* a stretch of $1\frac{3}{4}$ to 3 in. and on the *weft* from $2\frac{1}{4}$ to 3 in. All the fabrics are plain woven, securing firmness of structure. Yarn counts, in the warp, vary from 13 to 22 yards per dram ; and, in the weft, from $10\frac{1}{2}$ to 20 yards per dram. Loom setting, with the exception of scarlet cloth No. 1, is in agreement with the normal standards. This fabric (Pattern V, Table XXX), consisting of 18 skeins yarns and plain in the weave, is woven with the maximum number of picks. One useful element, in this method of looming, is that a weft surface is developed, in a plain woven texture, composed of the same counts of warp and weft yarn ; and if soft-spun, as in this manufacture (the dissection of the warp threads in the standard shows the yarn to be right-hand twine with 16.3 turns per inch, and the weft yarn left-hand twine with 5 turns per inch), it yields a full amount of felting and raising properties.

Faced cloths, produced for ordinary commercial purposes, have technical points in common with these fabrics, but sateen twill, broken twill, and double-warp and double-weft doeskin weaves, are employed in addition to the plain weave. They comprise medium and heavy meltons, box cloths, doeskins, pilots and beavers.

Melton and box cloths are similarly manufactured but differ in surface or fibrous characteristics, the box cloth having a dress-face finish, and the melton a fibrous finish without laying or drawing the fibres in a line in the process of raising. Methods of manufacture for each of these fabrics are outlined in the following Table.

TABLE XXX.—ARMY CLOTHING FABRICS. "CLOTHS."

SPECIFICATION.		LOOMING DATA.														
		Description.	Dye and Finish.	Width. in.	Weight per yard 36 in.	Threads per $\frac{1}{2}$ inch.		Strength in lb.		Elasticity in inches.		Width in Loom.	Counts of Yarns.		Threads per inch.	
Warp.	Weft.					Warp.	Weft.	Warp.	Weft.	Warp.	Weft.		Warp.	Weft.	Warp.	Weft.
R	Cloth blue, No. 1	Indigo wool dyed to be equal to sample both in quality of dye and shade of colour. <i>Finish</i> , as pattern, London shrunk.	58 in.	23½ oz.	23	26	210 lb.	180 lb.	2 in.	2½ in.	90 in.	22 skeins woollen	20 skeins woollen	30	45	Plain
S	Cloth blue, No. 2	As above	56 in. within lists	27 to 28 oz.	21	21	275 lb.	200 lb.	1¾ in.	2½ in.	90 in.	13 skeins woollen	16 or 17 skeins woollen	25 or 26	36	Plain
T	Cloth blue, No. 3	As above	56 in. within lists	29½ to 30½ oz.	20	18	285 lb.	215 lb.	2½ in.	2½ in.	90 in.	13½ skeins woollen	10 or 10½ skeins woollen	24 or 25	31	Plain
U	Cloth green, Rifles	Woaded supplies to be equal to pattern in quality of dye and shade of colour. <i>Finish</i> , as pattern, London shrunk.	56 in. within lists	26 to 27 oz.	21	21	270 lb.	200 lb.	2 in.	2½ in.	90 in.	13 or 13½ skeins woollen	17½ or 18 skeins woollen.	26 or 27	37	Plain
V	Cloth scarlet, No. 1	<i>Dye</i> , cochineal to be equal, etc.	58 in. within lists	28 to 29 oz.	24	30	240 lb.	300 lb.	2 in.	3½ in.	90 in.	18 skeins woollen	16 to 18 skeins woollen	29	54	Plain
W	Cloth scarlet, No. 2	As above	56 in. within lists	29 to 30 oz.	23	25	300 lb.	300 lb.	3 in.	3¼ in.	86 in.	17½ skeins woollen	14 or 14½ skeins woollen	30	44	Plain
X	Cloth scarlet, No. 3	As above	56 in. within lists	27½ to 28 oz.	23	25	260 lb.	230 lb.	2½ in.	3½ in.	86 or 88 in.	17 skeins woollen	16 to 16½ skeins woollen	29	39	Plain