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Edited by ROBERTS BEAUMONT, M.Sc., M.I.Mech.E.

DRESS, BLOUSE, AND COSTUME CLOTHS

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DESIGN AND FABRIC MANUFACTURE

BY

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DRESS GOODS MANUFACTURER

WITH OVER 700 ILLUSTRATIONS, IN MONOCHROME AND IN COLOUR, OF YARNS, WOVEN SPECIMENS, AND DESIGNS

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PREFACE

THE design and manufacture of DRESS, BLOUSE AND COSTUME CLOTHS comprise phases of textile technology obtaining in the different sections of the spinning and weaving industries. Dress goods are, for instance, made of materials and yarns which constitute the staple woven products of the silk, artificial silk, cotton, linen, worsted and woollen trades, but adapted in weaving practice to the construction of light varieties of fabric. Such goods form, as a result of these conditions, a unique and distinct description of textile manufacture, one which imposes on the producer a knowledge of the technology of each of these trades, in addition to a knowledge of fabric design, tinting, and finishing applicable to dress, costume, and blouse cloths.

In view of these salient features of the subject it has been sought in this work to interpret (1) the commercial and industrial aspects of the trade; (2) the nature, structure and the qualities of the yarns employed; (3) the weaving principles involved; (4) the design and colour schemes elaborated; and (5) the systems of fabric build and manufacture practised.

As far as possible a complete dissection of these problems has been attempted. Technical and working data are supplied bearing on the manufacture of (*a*) each standard class of dress fabric in cotton—plain, twill, and specialized in weave type, e.g. voiles, zephyrs, crêpes, flannelettes and sateens; in silk—cords, repps, satins, crêpe de Chine, brocades, velvets, etc.; in woollen and worsted costume fabrics—ordinary in weave and finish and distinctive in surface features, as in curl, ripple and waved cloths; in lustres—such as Sicilians, brilliantines, poplins and plain and figured textures; in linen, canvas and soft finished goods: and (*b*) relative to the manufacture of the many varieties of "fancy" and mixed-yarn fabrics, simple or special in weave structure, piece-dyed or coloured in the loom, and elementary in pattern style or decorative in design composition.

Considering briefly the arrangement and scope of the book,

there is given in Chapter I an analysis of the industrial range and trading interests, inclusive of information on the factors which make for manufacturing efficiency and commercial stability. The influence of fashion and of changes in textural pattern and style, and also of the effects on production of standardized factory routine are explained, with reference to the phenomena entering into and determining the trend of the home and shipping trades.

The value of the Yarn Unit—the materials of which it is composed and the methods of its manufacture—in fabric construction and design is explained and illustrated in Chapter II. Silk, in one form or another, is so extensively applied in the making of dress goods that it is treated of in a separate chapter, with an exposition of the manufacture of "thrown," "spun" and "artificial" silk threads.

In treating of Weave Elements, the systems of warp and weft setting are taken fully into account, and also the various weave structures and the types of intersection plans derived from the same. Drafted patterns of a striped, checked, and all-over arrangement are systematically examined, followed by the consideration of designs built on "weave," rectangular, lozenge, rhomboidal, transposed, circular and geometric bases. Spotted and mosaic styles are, in the first place, treated of in relation to a selected number of photographic studies, including an interesting series of Japanese examples. The point-paper production of "Spottings" in different makes of light textures, in cotton, worsted, linen, silk and mixture yarns, and as formed by warp, weft, and extra warp and weft threads, is dealt with in Chapter VIII. Practice in figure designing is introduced by studies in decorative ornament as exemplified in Sicilian, Florentine, oriental and modern fabrics. These are followed by the elucidation of the technique and the structural varieties of figured effects as developed in warp or weft, and in cloths special in build or compound in type.

The subjects of the different classes of pile fabric—velveteens, corduroys, velvets, astrachans, lambskins and figured velvets are analysed in Chapter X, as also the principles of gauze and lappet weaving and designing in different kinds of textures.

Throughout the work the utility and function of colour in the several classes of dress fabrics are illustrated and defined. Finishing methods and treatment are also specified in relation to certain makes of cloth, more particularly when they are responsible for the quality and style of the fabric originated.

Technical and scientific research, as it should be increasingly encouraged in the different departments of the industry, is suggested and elucidated, but for research, as it is competent of resulting in the production of new and economic grades of dress fabrics, reference should be made to *Union Textile Fabrication*.

The subject is fully illustrated by original designs and specimens, and the authors desire, in this connection, to express their indebtedness to the publishers for the manner in which these have been prepared and published.

They also appreciate the courtesy of Messrs. J. and T. Brocklehurst & Sons, Ltd., Macclesfield; Messrs. Courtaulds, Ltd., Coventry; Messrs. Reuben Gaunt & Sons, Ltd., Farsley; Messrs. McLennan, Blair & Co., Glasgow; Messrs. W. H. Potter & Co., Bradford; and of Messrs. Sir Titus Salt, Bart., Sons & Co., Ltd., Saltaire, in supplying samples of worsted, mohair, alpaca, camelhair, silk, artificial silk, cotton, and other yarns; and that of Messrs. Greenwood & Batley, Ltd., Leeds, in providing illustrations of silk preparing and spinning machinery. Further, they wish to acknowledge the suggestive technical paper on Artificial Silk of the late Mr. Leonard Wilson, F.I.C., embodied in Chapter III; and the help of Mr. Arthur Snowden, Textile Interests, Ltd., Bradford, in the preparation of tabulated data on yarns and fabrics.

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DRESS, BLOUSE, AND COSTUME CLOTHS

CHAPTER I

INDUSTRIAL AND COMMERCIAL ASPECTS

1.—Complex Industrial Formation. 2.—Textural Basis and Manufacturing and Design Schemes. 3.—Weave Schemes—Ordinary Groups of Fabrics. 4.—Colour Practice and the Fancy Trade. 5.—Elaborated Stripings and Checkings. 6.—Distinctive Phases of Colour Technique. 7.—Materials and Textural Applications. 8.—Silk Satins. 9.—Acquiring Suitability of Fabric Structure. 10.—Double and Compound Cloths in Dress Goods. 11.—Multi-ply Weft Figuring. 12.—Art and Technique. 13.—French Silks. 14.—Loom Mounting and Figured-Velvet Production. 15.—Doupe and Cross Weaving Examples. 16.—Lappet and Woven Lace Principles of Pattern Origination. 17.—Waved Surface Cloths. 18.—Interlaced Surface Effects. 19.—The Yarn Unit and Manufacturing Technology. 20.—Frisé, Ripple and Curl Manufactures. 21.—Printing and Embossing. 22.—Embroidery as an Accessory to Loomwork. 23.—Tinctorial and Colourization Practices. 24.—Natural-Coloured and Piece-dyed Goods. 25.—Pattern development in Cloths of Admixed-Yarn Types. 26.—Factors Controlling Commercial Stability—Home Trade. 27.—Fashion. 28.—National Purchasing Power and Factory Production. 29.—Influence of Economic Evolutions. 30.—Consolidation of the Home Trade. 31.—"Style" Transitions. 32.—Standardization in the Dress Industry. 33.—Shipping or Foreign Trade—Divisible into Two Sections. 34. Prestige of French Fashions and the Goods in Demand. 35.—Phenomena Affecting Trade in the Near and Far Eastern Countries. 36.—Board of Trade Intelligence and Foreign Trading. 37.—Provisions relative to Trade Intelligence and Dress-fabric Manufacture. 38.—British Industrial Centres.

1. *Complex Industrial Formation.*—Industrially and commercially, the dress trade presents distinctive features for analysis and study. It combines, in a fuller and more intimate relation than other branches of the textile industry, the varied technicalities of the cotton, linen, silk, worsted

and woollen schemes of fabrication. In the latter, yarn and cloth construction are specific in character, and defined and restricted by the staple material employed. For example, in the worsted trade the yarn range is of a combed-wool formation, supplemented, in certain makes of cloth, by yarns of a carded-wool structure; in woollen manufacture, the yarns are chiefly carded, condensed, and selfactor spun, and consist of wool fibre or of wool substitutes; in linen production—all grades and sorts of texture from the fine cambric to the close-set and heavy damask—the warp and weft yarns are prepared from flax, or, in union linens, from flax and cotton; and, in the silk trade, the yarns are produced in pure or raw silk, "waste" silk, and artificial silk, with, however, different groups of fabrics composed of silk and cotton, silk and flax, etc.

The intermixture of yarn structures, in such industrial divisions and practices, is more or less standardized, though strictly determined by the essential qualities of the predominant material in the commercial goods. On the other hand, in the dress-fabric industry, the yarn ingredients may be as diversified in filament composition, and in routine of preparation, as in all the several forms of manufacture referred to.

2. *Textural Basis and Manufacturing Schemes.*—This technological factor provides a broad textural basis, one capable of indefinite development and elaboration. Thus such yarns—single, folded, or multi-ply, and plain or varied in tinting and in surface features—are adapted to, and employed in, the making of blouse, dress, costume, and figured cloths by the following well-defined systems of fabric building and origination—

TABLE I

SCHEMES OF DRESS-FABRIC MANUFACTURE

I.—*Weave Scheme*, as in elementary principles of intertexture, and comprising (*a*) cloths in the natural colour of the raw material and (*b*) cloths in dyed shades.

II.—*Compound Weave Scheme*, as in the combinations of weave units in striped, checked, and geometrical patterns, and produced in cloths (*a*) and (*b*).

III.—*Colour Scheme*, as in coloured fancies (*a*) in ordinary weave plans, and (*b*) in special and compound weave elements, and woven in stripes and checks of different line groupings and line demarcations.

IV.—*Figured Scheme*, as in figured patterns coloured in the loom or dyed in the piece.

V.—*Decorative Scheme*, as in silk brocades, damasks, and velvets; also in decorative styles in many descriptions of union manufactures.

VI.—*Looming Scheme*, applied in the construction of leno, gauze, lappet, lace, net, and pile-woven effects in the fabric, inclusive of design elements in which ordinary schemes of intertexture are combined with one or more of these principles of loomwork.

VII.—*Surface Differentiation Scheme*, developed in the formation of textures possessing a curled, looped, waved, cut-pile or otherwise modified surface, and producible (*a*) by the yarns selected, (*b*) the weaving practice, and (*c*) by the finishing treatment in association with the routine of manufacture.

VIII.—*Printed and Embossed Scheme*, as in cloths in which the warp, weft, or both sorts of yarn, are colour printed for giving either a blotched, spangled or regular form of pattern; and in cloths with a soft, fibrous, but plain surface, on which a pattern is acquired by a process of embossing.

IX.—*Embroidered and Woven Scheme*, obtaining in the origination of fancy and figured goods in which assorted details of the style are applied to the textures after weaving on the embroidery frame, with other details loom constructed.

X.—*Tinctorial and Manufacturing Scheme*, as in producing cloths consisting of material units differing in tinting value, and in which the admixture of the several varieties of fibre is done (*a*) in yarn preparation, (*b*) in yarn doubling and twisting, and (*c*) in weaving by combining, in the warping and wefting, threads made of different classes of material. The goods, while woven in the grey, take, in piece-dyeing, mixture tints, tones and shades.

This synopsis of the commercial and manufacturing phases of the industry, affords a general conception and view of the technical principles and practices covered, and also of the looming and design schemes involved. The yarn factor, that is the filament quality and consistency and surface conformation of the kind of yarn employed, will be dealt with in respect to the weaving of standard makes and other

descriptions of blouse and dress fabrics ; and need not, therefore, be dissected and explained in this connection. It is, however, expedient that some of the industrial differentiations, suggested in the groups of manufactures tabulated, should be reviewed. Being illustrative of the dress trade, it is essential that the special aspects and applications of the several schemes should be indicated and understood.

3. *Weave Schemes—Ordinary Groups of Fabrics.*—Examining them for this purpose and leaving the fuller analysis of each scheme for subsequent study, it has to be observed that Schemes I and II obtain in the production of ordinary fabrics in all sections of the textile industry, but, in the dress trade, Scheme I includes such staple textures as—

(1) Lustres—Sicilians, Orleans, glacés, brilliantines, poplins, serges, linings, etc.

(2) Crêpes, cords, repps, gabardines, delaines, etc.

(3) Crimps, muslins, and light or thin cottons.

(4) Plain and twilled silks, satins and sateens, and fabrics composed of silk or artificial silk and cotton, silk and linen, and silk and worsted or woollen.

(5) Worsted and woollen costume cloths ; also union costume cloths in which worsted and woollen yarns are the chief thread ingredients.

Scheme II is extensively developed in piece-dyed and natural-tinted fabrics made of silk, cotton, linen, worsted and mixed yarns. It provides for the origination of pattern style in weave elements, as in modified plain and twilled weaves, mats, cords, sateens, diaper, diamond, lozenge, and other effects, as well as designs consisting of two or more principles of intertexture, and arranged on a striped, checked, rhomboidal or geometric base. While the cloths are not standardized in pattern form, inasmuch as they are devised and produced for current consumption, they constitute important branches of manufacture in lustres, thin cottons, silks, linens, worsteds, and unions.

4. *Colour Practice and the Fancy Trade.*—Scheme III is

utilized in the construction of the various classes of coloured fabrics acquired in each division of "fancy" textile manufacturing; but it is also representative, in the dress industry,

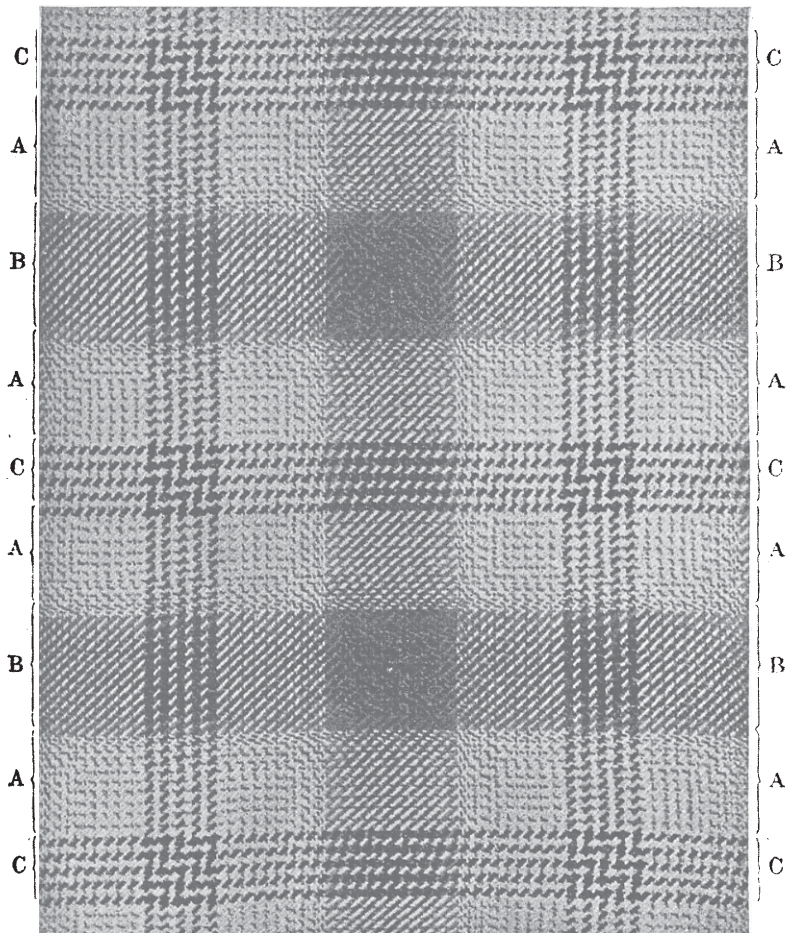


FIG. 1.—SHADED CHECK IN WORSTED YARNS.

of certain distinctive systems of looming practice. First, the textures require to be of a suitable lightness and flexibility. Firmness and super-compactness of structure are not, as a

rule, advantageous, but rather softness of surface and suppleness of handle, combined with a serviceable degree of wearing durability. Second, with the patterns of a striped, spotted, and checked order, it is obvious that many of the methods of yarn-grouping, adopted in the weaving of woollen and worsted suitings, coatings and trouserings, may be employed, but with marked variations in colour treatment. Thus the styles should be more clearly delineated though of the same structural arrangement, with the colour contrasts and tones in keeping with the garment applications of the cloths. In addition, the patterns may be broader and more elaborate in composition than those observed in the ordinary classes of woollen and worsted fabrics. To illustrate these technicalities—the shaded check compound in Fig. 1 is, in construction and design elements, a form of pattern effective in either worsted dress fabrics or woollen rugs ; or in two descriptions of cloth so dissimilar in substance, character, and applicability, as to render a different colour scheme imperative in the development of the pattern in the respective manufactures. For the former brighter and richer tinting is requisite than in the latter, but in each harmony of tone is all important.

5. *Elaborated Checkings and Stripings.*—An examination of the order of warping and wefting for the specimen, which is shown on page 7, will enable the technical qualities of the colouring of dress goods, as distinguished from those of other textiles, to be discriminated and defined.

Substituting a tint—say lavender—for white, a tone (medium blue) for grey, and a shade (navy blue) for black, the pattern would consist of a lavender-tinted ground shaded with medium blue and overchecked with navy ; or it would be woven in analagous colourings. In the dress trade, pure colours, such, for illustration, as those distinguishing the original tartans, are also combined. Depth and strength of colour contrasts, due to the admixture of different coloured hues as well as to the admixture of colour tones and tints, are more common, and classified in larger areas of effect, than in

SPECIMEN FIG. 1. ORDER OF WARPING AND WEFTING

4 threads	of	black	32	threads.
4 „	„	white		
4 „	„	black		„
6 „	„	white	14	„
1 thread	„	grey		
5 threads	„	white	12	„
1 thread	„	grey		
4 threads	„	white	10	„
1 thread	„	grey		
3 threads	„	white	8	„
1 thread	„	grey		
2 threads	„	white	6	„
1 thread	„	grey		
1 „	„	white	6	„
1 „	„	grey		
8 threads	„	grey		
1 thread	„	black	6	„
1 „	„	grey		
2 threads	„	black	6	„
1 thread	„	grey		
3 threads	„	black	8	„
1 thread	„	grey		
8 threads	„	black		
1 thread	„	grey	8	„
3 threads	„	black		
1 thread	„	grey	6	„
2 threads	„	black		
1 thread	„	grey	6	„
1 „	„	black		
8 threads	„	grey		
1 thread	„	white	6	„
1 „	„	grey		
2 threads	„	white	6	„
1 thread	„	grey		
3 threads	„	white	8	„
1 thread	„	grey		
4 threads	„	white	10	„
1 thread	„	grey		
5 threads	„	white	12	„
1 thread	„	grey		
6 threads	„	white	14	„
1 thread	„	grey		

other branches of manufacture in which the goods are designed for clothing purposes. Hence, the colouring characteristic of the Rothsay (red, green, and white), the Barclay (blue, red, and green), the Forth-Second (indigo blue, green, and black), and other plaids, might be effectively applied to this checking. Thus, adapting the colour assortment in the Rothsay tartan, white, as in Fig. 1, is usable in the field of the specimen, shading with green and weaving the 4-and-4 lines in black; or red in the ground toned with black and overchecked with white. In the case of the Barclay, red is applicable to the ground, taking the place of the white yarns in the warping and wefting, green to the shaded details, and white to the overchecking; and in that of the Forty-Second, green in the ground, blue in the shading, and black in the overchecked features. Selecting further colour units, as heliotrope for white, sage green for grey, and ochre brown for black, or light fawn for white, tan for grey, and purplish-blue for black, light-tinted and medium-toned patterns would be formed of a colour composition and quality chiefly useful in dress cloths.

6. *Distinctive Phases of Colour Technique.*—It is clear from this example in Scheme III that, with the adaptation of a style, applicable to several varieties of woven fabrics, to dress designing, colour technology offers distinctive phases of study, as in the freshness and richness of the hues employed and in the systems of colour grouping developed—bright tinting being practised in the ground and in the details of the patterns originated. With, however, the subject of colour considered relative to the dress trade purely, it will be shown that the scope for patternwork is greatly widened as it is affected by colour gamut and assortment, by diversification in striping and checking, and by range in style composition. In a limited degree this is evident in Fig. 1, for whether examined as a checked combination or as a striped design—e.g. sections A, B, and C—it is typical of the elaborate and ingenious orders of warping and shuttling feasible. A more complete analysis

of the textural principles and colour groupings involved would emphasize the peculiar value and utility of colour as a primary design ingredient, and as a fundamental element in pattern structure, in all classes of "fancy" dress cloth manufacture.

7. *Materials and Textural Applications.*—Considering Scheme IV, it has two principal aspects—the materials usable and the textural applications. One elementary group of fabrics here comprised is that in which the warp yarn is cotton and crossed with alpaca, mohair, or lustre weft; and cotton or fine Botany worsted warp yarns woven with silk or artificial silk weft yarns. The styles range from sateen or geometric plans of simple figure distribution to styles composed of floral and leaf details of a strictly conventionalized form and method of treatment. The cloths are plain in the ground with the design features acquired by floating the weft yarn in sateen, in twilled or in other common principles of inter-texture. Other types of fabric are more diversified in the yarn units, looming practice, and in systems of colouring. Four specimens will be examined—Figs. 2, 3, 4, and 5. They are suggestive of the woollen, silk, cotton and silk, and of the cotton, worsted, and silk methods of manufacture. The tweed specimen—Fig. 2—is made of woollen yarns, namely, twist threads in the warp and mixture-shade threads in the weft. In carded-yarn cloths the weaves combined require to be of a simple twill, mat, or plain variety. The example is $\frac{3}{1}$ twill in the ground and $\frac{1}{3}$ twill in the wave lines forming the figuring. Piece-dyeing may be practised in such goods, when, by using worsted yarns in the warp and shuttling with woollen yarns, the degree of differentiation in the qualities of the woven surface, due to each kind of yarn, is sufficient to accentuate the design structure in the finished fabric.

8. *Silk Satins.*—In contrast with this comparatively coarse grade of figured but thin cloth—12 to 13 oz. per yard, 54 ins. wide—obtained in carded woollen yarns, openly set in the reed, the silk satin, in Fig. 3, may be taken as exemplifying the

finer build of figured textures, but also elementary in weave formation. Silk designing, in dress, blouse, necktie, and

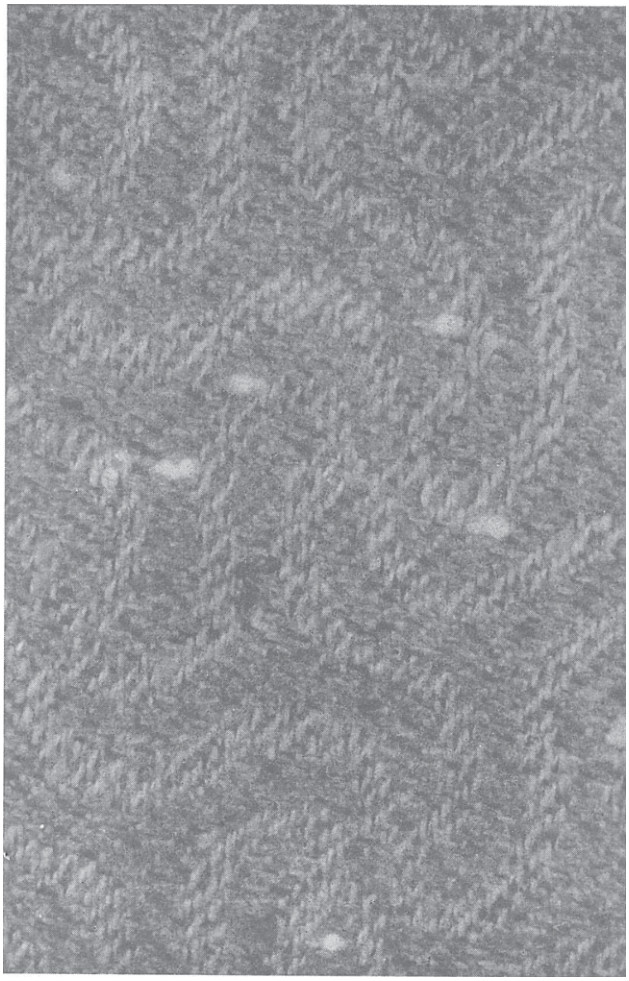


FIG. 2.—FIGURED TWEED COSTUME CLOTH.

decorative manufactures, is illustrative of the higher branches of technique and art as applied to loomwork. Here the ingenuity and skill of the technologist are associated in the fullest ratio with the imaginative force and executive faculty

of the decorative artist. There is no fibrous material which offers such freedom and facility in the delineation of woven ornament, and in the origination of richness of tinting in the tissue, as silk when prepared in the quality of *organzine* for warp, and in the softer and more diffusive quality of *trame* for weft.

9. *Acquiring Suitability of Fabric Structure.*—As in the general practice in dress-fabric weaving, it is essential, in silk goods, to produce a sound textile structure, and also to develop

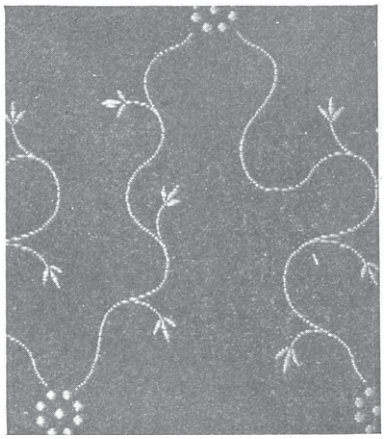


FIG. 3.—SILK SATIN TEXTURE.

distinctly the outlines and small effects of which the style consists. The minutest details need to be smartly delineated, or with a corresponding definiteness and accuracy as if painted on the woven surface, yet with that beauty of toning rendered possible by the intersection of warp and weft threads. These technicalities necessitate close setting in the loom, and the selection of weave plans, for the ground and figuring, in strong contrast with each other, such as, a warp-face sateen for the former and a weft-face sateen for the latter. This represents the weave structure of the specimen, Fig. 3, with the addition of floating the weft solid in forming the twig and stem parts of the design. Textural fineness and durability

are acquired in this and similar makes of fabric, by (1) full setting in the loom—in the example 340 threads and 120 picks per inch ; (2) by the employment of two wefts—ground and figuring ; and (3) by the scheme of fabric construction or by the weave units selected.

10. *Double and Compound Cloths in Dress Goods.*—That double and compound builds of cloth should be applied in

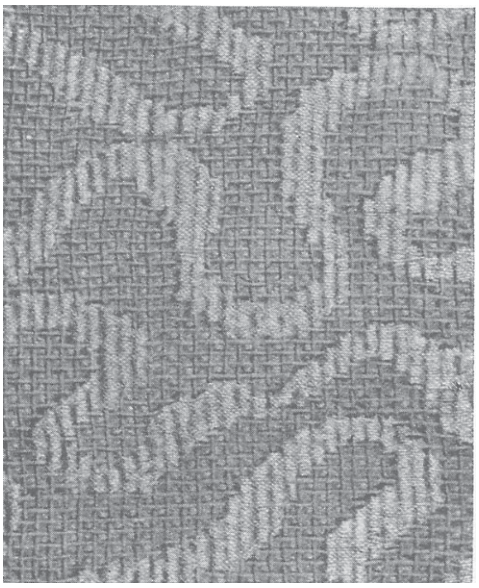


FIG. 4.—COTTON AND SILK COMPOUND FABRIC STRUCTURE.

the formation of light textures is due to the various systems of setting possible in looming, and to the sorts and counts of yarn combinable in weaving. An explicit method of work is shown in Fig. 4. This double-plain make of dress goods consists of thick, folded cotton and of fine silk yarns, arranged, in the warp and weft, 7 threads of silk to 1 thread of cotton. Both sets of threads interlace in plain order, but each group of yarns yields a separate texture, that in the cotton being open and loose, and that in the silk fast and dense, in thread

composition. For the development of the pattern, the silk-woven texture is brought on to the face in the figuring, and the cotton-woven texture on to the face in the ground. This

FIG. 5.—EXTRA WEFT FIGURED CLOTH.

relation of the two textures obtains throughout the weaving of the piece. It follows that the underside of the compound cloth is the opposite in effect and in appearance to the upper side, making it "reversible" and actually usable on either surface.

11. *Multi-ply Weft Figuring.*—With the assortment of worsted, cotton, and silk yarns, employing cotton in the warp,

the fabrics may be multi-ply in the weft, yet thin and light in construction as seen in the example given in Fig. 5. The specimen typifies the weft principle of figured cloth construction, being produced in three wefts, blue and straw-tinted silk, and light fawn worsted, interlacing with the greenish-grey cotton warp yarn. Similar descriptions of texture and design are also feasible in the warp principle of figured weaving, in which instance several chain beams are used, as for the silk and worsted threads respectively. The relative merits of the two principles of intertexture will be discussed in their proper place. It may, however, be observed that the multi-ply shuttling arrangement, as here illustrated, affords certain advantages in acquiring fineness, compactness, and quality of fabric build. But the leading technicality it is now the object to punctuate is the diversity of weaving practice exercised in this grade of fabrication, particularly as exhibited in the yarn units, the structure of the cloth, and in the whole system of manufacture.

This specimen, and the specimens in Figs. 2, 3, and 4, suggest the field of application of Scheme IV, but by no means represent the designing and productive technology in figured dress textiles. Still they serve to demonstrate the range of textural work implied in acquiring makes and varieties of cloth of a definite commercial value and serviceability.

12. *Art and Technique.*—Decorative fabrics for court robes and like purposes (Scheme V) do not literally come within the scope of this treatise, but as they result from the selection, combination, and practice of the weaving principles utilized in the manufacture of the different kinds of dress goods, their distinctive characteristics demand some explanation. For affording this, reference will be made to the French examples in Figs. 6, 7, and 8. The two former are illustrative of silk brocades, and the latter of decorative velvets with a satin ground.

Artistic and technical faculty is evident in the style origination of these designs as also in the draughtsmanship exercised

FIG. 6. FRENCH BROCADE, MODERN STYLE.

in the planning, drawing and distribution of the figuring, and particularly in the conventional treatment of plant form. But the real excellence of the decorative composition is revealed and emphasized in the textural schemes combined

FIG. 7.—FRENCH BROCADE.

in the origination of the design elements. Other methods, for example, of expressing the latter in warp and weft interlacings might have been applied in Fig. 6, but those selected are strictly in harmony with the decorative qualities of the style. Looming technology is illustrated as adding richness, novelty and unity of tone, first, to the integral parts of the pattern, and, second, to the complete plan of ornamentation.

Weaving technique, in this instance, assumes its legitimate

province, that of producing a fabric of the correct build and fineness, with suitable variations in surface treatment for the effective development of the component sections of the design. It is seen in the weave details, the groundwork being a 16-end sateen, and the figured elements—stem, leaves and petals—in special types of intertexture ; while the choice scheme of colouring applied conforms with the clear delineation of the leaf figuring developed in fancy and original weaves. Dissecting the textural plans combined, the stem work results from employing solid floats of weft, edged with warp cord. The petals of the flowers are woven in flushes of weft—varying in length according to the emphasis it is desired to give to each detail—and in mat and repp weaves. The shading of the leaf figuring is mainly on the twilled principle, with floats of warp for defining the veins, and with a fast rib ground for importing flatness of tone.

13. *French Silks.*—French decorative silks are invariably illustrative of (1) correctness of manufacture ; (2) structural adaptability ; (3) design freshness and merit due to " weave " details and " weave " composition ; (4) originality in pattern attributes and style ; (5) harmony of colour tinting and tone ; and (6) richness of quality in finish or commercial get-up.

Fig. 7 is suggestive of these several characteristics. It is a decorative style with a fine repp ground in a silver-grey tone of colour, and with the interior sections of the figuring in a light tint of warp, and woven in sateen. The pronounced contrast between the compact floats of weft—forming the edging of the pattern features, and also the line details—and the effects in warp sateen, bring out every section of the design. While the decorative forms of the pattern are skilfully executed, the beauty of style expression is a derivation of weave structures, counts and qualities of warp and weft yarn, and of accuracy in fabric setting.

14. *Loom Mounting and Figured-Velvet Production.*—Another form of technique predominates in the origination and manufacture of the decorative grade of velvet texture illustrated in

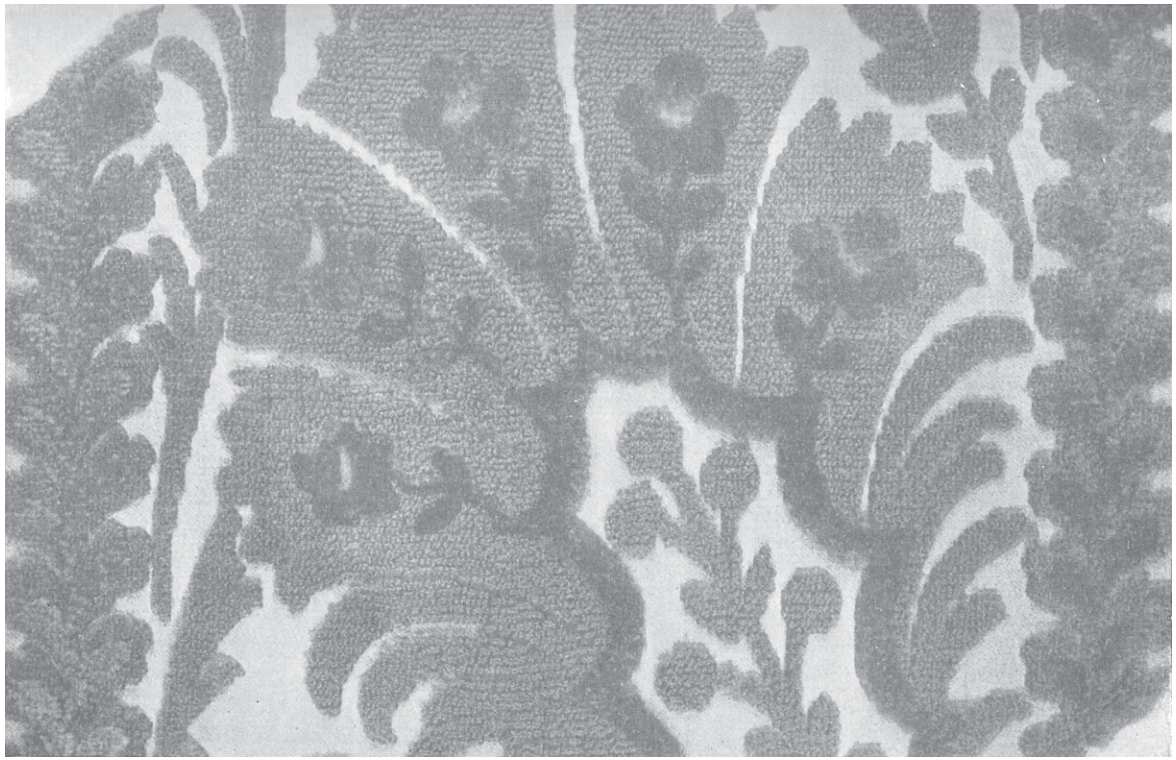


FIG. 8.—VELVET AND TERRY PILE FIGURING ON A SATIN GROUND.

Fig. 8. Fabric build, rather than fabric diversification by weave assortment, is the salient branch of textile study here typified. Loom-mounting, as exercised in the making of this kind of woven product, involves (*a*) the utilization of the full harness capacity in the development of the figured design; (*b*) the use of a set of heddles in front of the harness for weaving the ground of the cloth; and (*c*) the control, by means of special wires in the Jacquard machine, of a series of metal or wooden staves, inserted into the harness below the comber-board, for enabling the mails of the harness to be operated in serial groups in any determined order, or to correspond, in warp shedding, to a set of heddles, with, however, the staves remaining inactive during the process of lifting the warp for the origination of the pile figuring.

In the second place, this scheme of loom-mounting involves the individual tensioning of the pile warp yarns by winding each thread on to a separate reel or double-headed bobbin, made equal, in the resistance it offers to the delivery of the yarn, to a small chain beam frictionally governed; and also the tensioning of the satin and foundation warps by the use of ordinary beams independently actuated; and thus providing for the regulation of the let-off of each kind of yarn as necessitated in the weaving routine. Work of this nature, as that concerning compound harness and shaft gearing, is purely technical in character, but requires to be devised and planned to coincide with the fabric data and structure, with which the design draughting must, moreover, be in perfect agreement.

There are obvious distinctions between this form of technology and practice and that relating to Scheme VI. "Looming" covers the system of healding or of entering the threads of warp into the healds of the shafts or the mails of the harness; and the mechanical motions and devices employed in obtaining, as in the lappet, gauze, and net effects, the decoration on the face of the cloth with yarns additional to those ordinarily used in the warp and weft; and also the means employed in the production of textures with a waved, watered

or sinuous surface, and caused by the displacement of the warp threads, in weaving, from the normal or straight line.

15. *Doupe and Cross Weaving Examples.*—By the first of these means—the employment of doupe healds—fabrics are producible of a more or less perforated formation. The

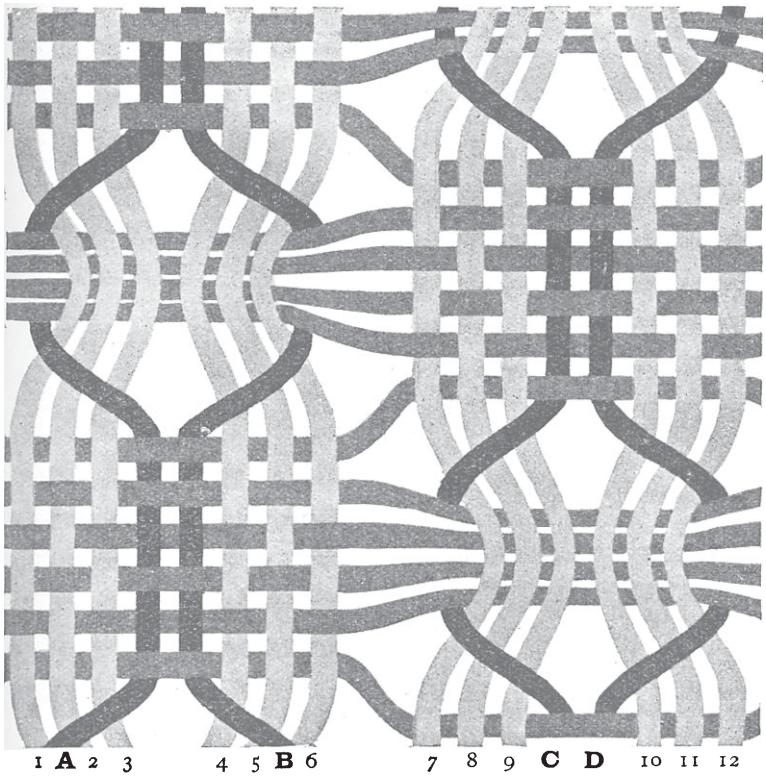


FIG. 9.—GAUZE STRUCTURE.

douping yarns—which may be of a like or dissimilar counts, and quality of fibre, to the yarns making the texture proper—successively intersect with the shots of weft on the right and left side of selected warp threads, interlacing plain or in some simple order. Thus, in Fig. 9, threads A and B and C and D "whip" or "twist" alternately from one side to the other of ends 1, 2, and 3, and 4, 5, and 6; and 7, 8, and 9, and 10, 11,

and 12, giving a gauze cloth of a definite open and varied structure. Or the doupe yarns may be actuated in series as in Fig. 10, when three ends, *a*, *b*, and *c*, intertwine with three adjacent threads, *d*, *e*, and *f*, with the shots of weft interlacing 3-and 3 and in regular sequence in Parts A; and with the thick pick 2 binding the crossing of four groups of whip threads in part B.

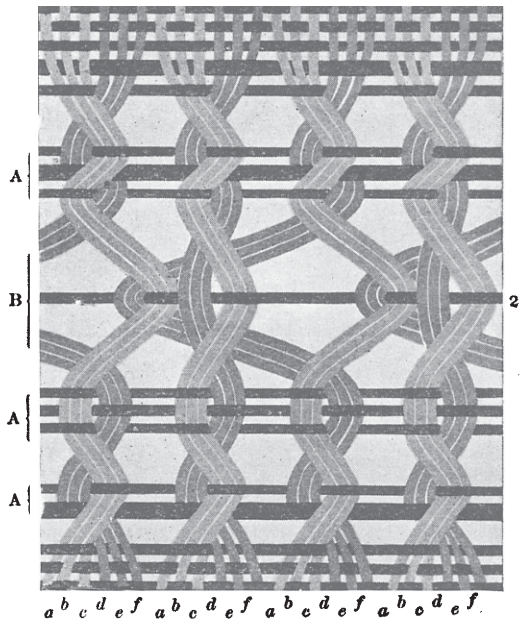


FIG. 10.—MULTI-YARN CROSSING IN GAUZE FABRIC.

When it is considered, first, that the practice in working the doupe threads may be diversified indefinitely; second, that the textural effects acquired may be united with plain and other woven types in the weaving of striped, checked, and figured goods; and third, that compound gauze and ordinary makes of cloth may be produced—such as fabrics having a gauze surface and a plain or twilled texture underneath—the extended usefulness of the gauze principles of weaving will be understood.

16. *Lappet and Woven Lace Principles of Pattern Origination.*—Gauze weaving, as a scheme of intertexture differs greatly from that of lappet weaving, in that the cloth structure is entirely a resultant of shedding with shafts, or harness, comprising doupe or half healds, which allow of the whip threads being transferred, according to the manner of

FIG. 11.—LAPPET FABRIC.

healding and sleying, from side to side of certain ground warp yarns; whereas, in the lappet arrangement, frames or needle bars, through the eyes of the pins or needles of which the threads pass, are placed in front of the sley, and on the lateral movement imparted to the frames depends the features seen in the fabric. In other words it is the function of the frames to spread the lappet yarns on the face of the cloth, lifting and depressing them concurrently with the shedding of the warp. The amount and sequence of the

traverse of the threads is determined by the extent and manner in which the frames are operated by the cam or other automatic mechanism of the loom. In Fig. 11 the frames have been worked to yield a lozenge-shaped style in parts A which, it should be observed, is a distinct product of the lappet motion. It has the appearance and structural character of a pattern acquired by floating the weft yarn. This arises from the side-to-side displacement of the frames laying the lappet yarns in a line with the shots of weft, and not in a line with the threads of warp. Many varieties of cotton, linen, silk, and mixed goods are adapted for this class of pattern treatment as will be subsequently demonstrated.

17. *Waved Surface Cloths.*—To produce the waved-surface class of fabrics—also included in Scheme VI—the ondulé reeds of the sley (Fig. 12) are of a special shape or design, and the sley is automatically moved up and down or in a vertical plane. The threads of warp are thereby made to change their position in the line of the fabric. The plan of inter-texture is not varied, but this movement of the threads develops sinuous or waved characteristics in the piece. Usually the cloths are made of fine yarns and moderately well set, so that, however slightly the warp yarns are affected by the form and movement of the reeds, the fabric tone and appearance are modified.

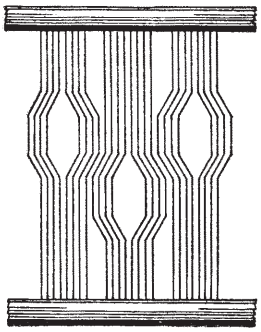


FIG. 12.

18. *Interlaced Surface Effects.*—Without having recourse to the doupe mounting, lace and net effects may be woven by combining threads and picks of a suitable thickness and sort of yarn with the threads used in constructing the several sections of the fabric. These yarns are floated more loosely on the upper side of the texture than those of which the warp and weft are chiefly composed. They may be knit together in

a variety of plans of interlacing to form different net structures, such as oval, circular, and irregularly-shaped. The network is weavable in sectional parts, or it may be distributed over the entire surface, of the fabric. It is developed in silk yarns on cotton, in mercerized cotton on worsted, and in mohair yarns on woollen textures.

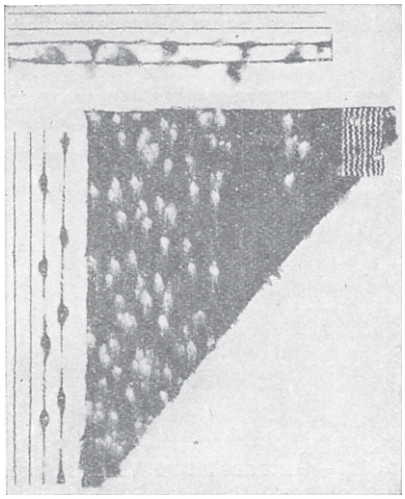


FIG. 13.—RAISED KNOPPED YARN COSTUME CLOTH.

19. *The Yarn Unit and Manufacturing Technology.*—Other manufacturing and designing principles and technicalities come into prominence in Scheme VII, than those paramount in the schemes of textural construction and patternwork examined. These principles are combined with the systems of yarn making and of yarn structure and composition; with the practice in cloth production as caused and fashioned by the fibrous materials used and admixed; and with the qualities and features obtainable in the woven or knitted fabrics as the consequence of finishing treatment. It is not intended, in this place, to more than briefly describe the branches of technology comprised, and the classes of goods to which Scheme VII is applicable.

Primarily, it should be observed that it is not generally sought, in such manufactures, to obtain effects in the textures by different plans of interlacing warp and weft, or by pattern as understood in the combination of ornamental forms, but to make a cloth of such a consistency and structure that, in the processes of finishing, diversity of surface will be developable. Fancy or plain yarns may be employed; but, in filament property and density, they must be subservient to the nature

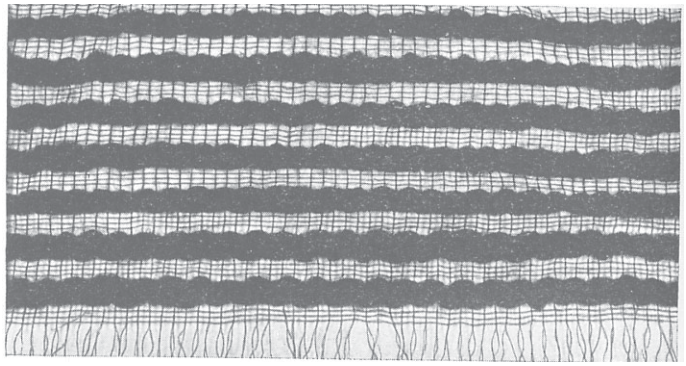


FIG. 14.—GIMPED-WEFT VEIL TISSUE.

and sort of fabric surface it is intended to produce in the processes of finishing. Thus knop, curl, flake, and other irregular threads are used for emphasizing the textural features as in Fig. 13, where knop yarns have been interspersed in the warp. By selecting mohair for the "knop" characteristic, the long, lustrous fibres of this material are drawn or trailed on the face of the cloth in the operation of raising. Of the different kinds of folded-yarn patterns, applied to this and similar makes of texture, and also to other light fabrics not changed in appearance after weaving, such as that in Fig. 14 (a gauze specimen lined across with a thick gimp weft yarn), analyses will be given; but it is now more especially to the manufacture of the "ripple," "wave," and the "curl" grades of cloth that come into consideration. From the ordinary soft

fibrous face type of cloth in Fig. 15, to the types illustrated in Figs. 16 and 17, it is a problem of fabric structure in the right sort of yarn for the method of finishing to be adopted.

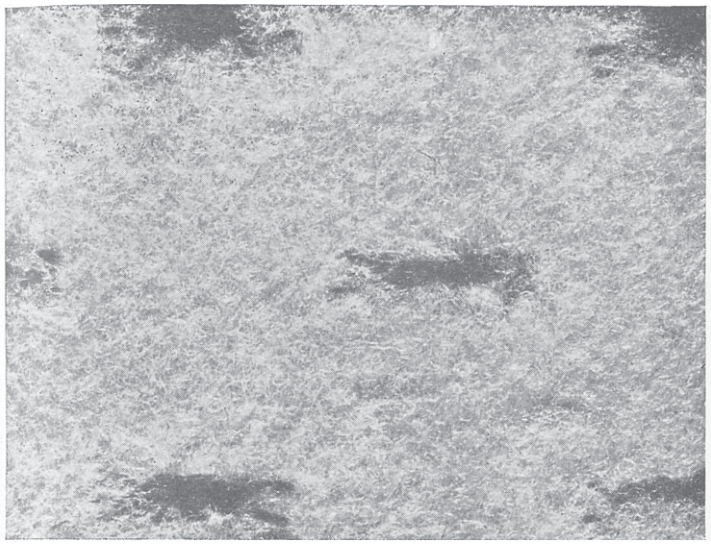


FIG. 15.—FIBROUS-FINISHED CLOTH.

20. *Frisé, Ripple, and Curl Manufactures.*—For producing a full nap of fibre the yarns, forming the face of the texture,

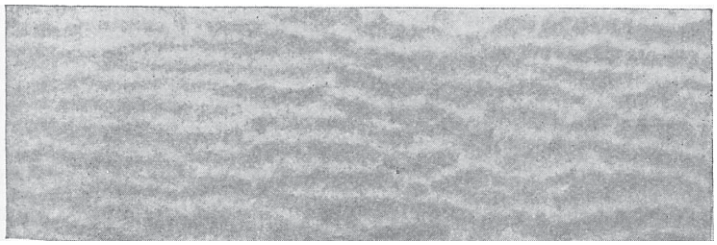


FIG. 16.—RIPPLE CLOTH.

not only need to be of the correct counts but made of a suitable fineness and length of material. To make these points clear the style in Fig. 15 may be first examined. It is woven in the 4-end broken $\frac{2}{2}$ twill, and shuttled with a soft-spun

woollen yarn, with the indented spottings in picks of mercerized cotton, a yarn less suitable for raising action. With a small degree of felting, a cloth is acquired on which the nap or pile may be readily and uniformly developed as seen in the specimen. For producing a " ripple " surface (Fig. 16) the cloth is similarly constructed, but raising is done with the pieces in a moist condition ; and, after the pile has been formed, the pieces are treated on the napping machine to give the wavy surface. Yet different practices in cloth

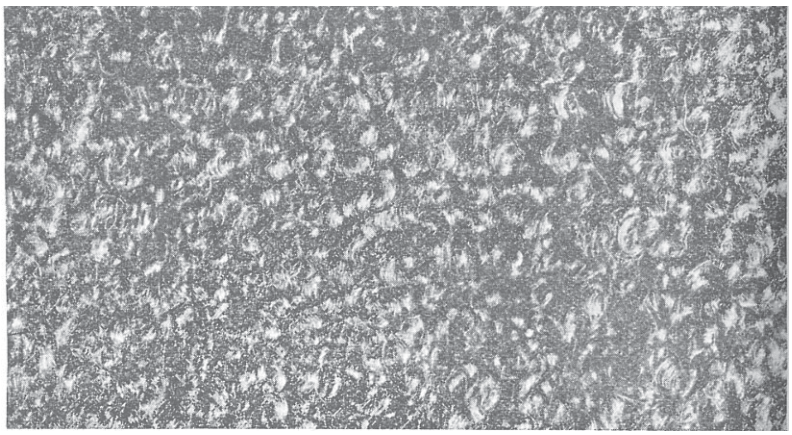


FIG. 17.—CURL-SURFACED TEXTURE.

making, and in yarn assortment, obtain in fabrics having a looped or curled face characteristic—Fig. 17. This structure is made in cotton warp and mohair weft yarn. Each shot interlaces with, and floats over, a number of warp ends in succession, so that, in the shrinkage of the piece, the floating picks buckle or loop on the surface, when the form, dimensions, and frequency of the " curls " produced depend on the plan of intertexture and the nature of the weft yarn used.

21. *Printing and Embossing.*—Printing and embossing (Scheme VIII) are practised for attaining two distinctive objects in the manufacture of dress and costume cloths. The finest and thinnest—voiles and silks—as well as many classes

of dress and blouse textures, are printed either in the yarn, or in the piece, for the purpose of tinting, or of producing, the pattern style. But only the pile-finished costume cloth is adapted for the embossing operation ; and it yields a blocked-out pattern in the same shade as the dyed piece, though of a different tone. This change in toning is caused by the suppression of the pile of fibres by the embossing rollers,

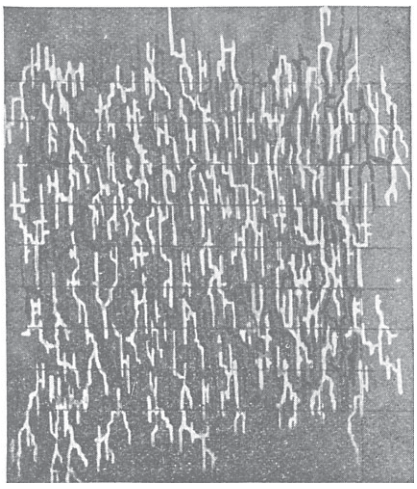


FIG. 18.—PRINTED TYPE OF DESIGN.

resulting in the lateral sides of the fibres being, in such positions in the texture, exposed to the light ; whereas, in the groundwork or unembossed parts of the fabric, the ends of the fibres appear in dense formation. Embossing does not, therefore, enhance the colour tinting of the piece in the same way as the printing process. Its function is to give a pattern impression, fairly permanent, on an otherwise plain but raised nap surface ; while the function of printing is either to yield a part or the whole of the colour composition of the design style.

Such types of effect as that observed in Fig. 18 may be the sequence of printing the warp yarns prior to weaving, or of printing the goods after cleansing. Taking the former

as the method, the yarns require to be grouped, in the loom, in the order in which they are intended to develop the pattern details in the fabric. For the latter method, the cloths are plain woven or made in the white or grey. The printed-yarn practice provides for variations in textural colouring in the looming, but does not offer the same advantages as the printed-piece practice, for determining the colour ingredients of the manufactures as the commercial requirements may impose.

22. *Embroidery as an Accessory to Loomwork.*—Embroidery (Scheme IX) constitutes a special branch of textile art, which is, from time to time, in vogue in both the plain and figured dress trade. It need only be briefly noted here. On the finished fabric, of a suitable material and make, the decorative plan—usually consisting of detached figures—may be freely executed in selected colourings. As an adjunct to loomwork, embroidery is an effective and economical method of obtaining on a prepared texture, which may be expeditiously manufactured, simple or elaborate styles of pattern.

Any variety of fabric with a plain, twill, or fancy weave surface may be thus treated. The specimen (Fig. 19) is of the voile description. One utility of the practice obtains in the readiness with which the added ornamentation is producible; and in the development of the effects which it contains, with a minimum length of the silk or other special yarn applied. In this it differs from weaving, where the shuttle—unless a swivel batten is employed—charged with the weft thread, for constructing the sectional parts of the design, travels from selvedge to selvedge of the piece, though it may only distribute, on the face of the texture, a fraction of the length of the yarn utilized, that not appearing in the pattern being concealed from view. Moreover, should the figuring yarns be inserted in the warp they necessarily extend the whole length of the cloth, so that either of these methods of weaving spotted and figured designs, entails an excessive consumption of the supplementary and costly yarns. On

the other hand, the embroidery frame only involves the stitching with the extra coloured threads over such parts of the fabric as are actually covered by the pattern; and it enables the decorative elements to be planned in fixed line

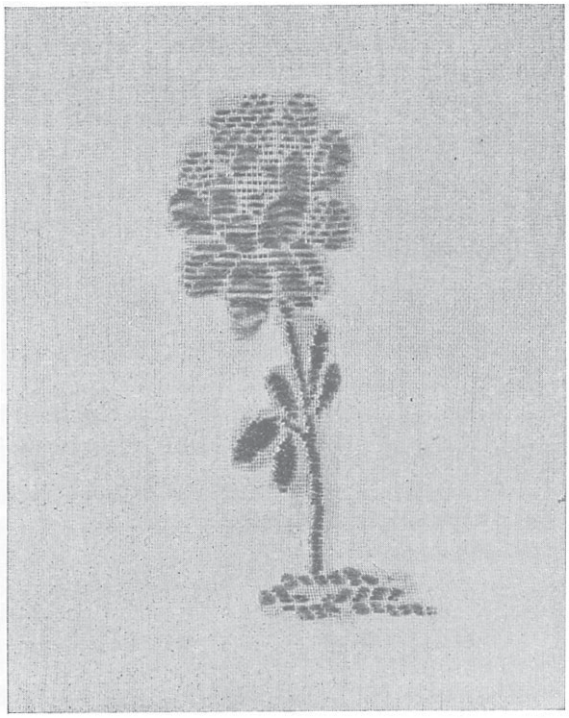


FIG. 19.—EMBROIDERED VOILE.

order, on a drop basis, or in particular sections of the width and length of the piece.

23. *Tinctorial and Colourization Practices.*—The progress made in recent years in dyeing, and in the application of chemical science to tinctorial methods and processes, has been followed by the systematization and expansion of the technological units of work comprised in Scheme X. The forms of practice therein implied, penetrate the whole field and organic plan of textile manufacture from the selection

of the raw material to the finished goods, including the systems of blending fibres of dissimilar colouring affinities, and of yarn construction and combination; also the principles of fabric weaving as they apply to modern industrialism, for the express object of acquiring an amplified tinted range in the commercial goods. From these technical means and resources—only restricted in variety of textural result by the classes and grades of fibres spinnable and by their colourization value—the trading in costume, dress, and other woven manufactures, has been greatly extended. More especially has this been marked in the manufacture of the following varieties of light fabrics of a plain and figured character—

TABLE II

TEXTURAL VARIETIES—PIECE-TINTED

I.—SINGLE-MAKE FABRICS

(*a*) Textures in mixture-shades, light, medium, and dark in tone.
(*b*) Textures composed of warp and weft yarns contrasting in shade or colour tone.
(*c*) Textures consisting of one shade of warp and two shades of weft.
(*d*) Textures composed of two shades in the warp and crossed with a third shade of weft.

II.—WARP OR WEFT COMPOUND FABRICS

(*a*) Textures formed of two shades of warp and of one shade of weft.
(*b*) Textures formed of three shades of warp and of one shade of weft.
(*c*) Textures formed of two shades of weft and one shade of warp.
(*d*) Textures formed of three shades of weft and of one shade of warp.

III.—COMPOUND WARP AND WEFT FABRICS.

(*a*) Two-ply textures in two shades.
(*b*) Three-ply textures in three shades.

24. *Natural-Coloured and Piece-Dyed Goods.**—It is understood that these several styles of woven textures are, as stated in Scheme X, produced in the natural colour of the materials used in yarn making. Their diversity of shade tone is the consequence of the assortment or percentages of

* See *Union Textile Fabrication*, by the same Author and Publishers.

the filament ingredients of which the warp and weft threads consist, and of the system of dyeing practised. Here it will

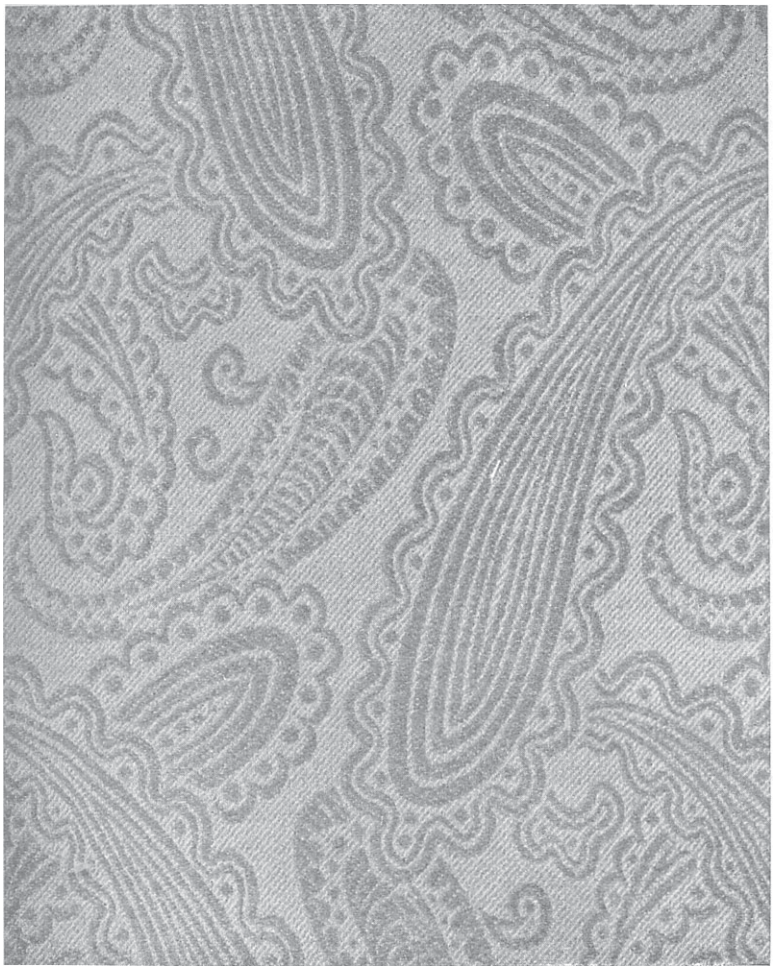


FIG. 20.—BI-FIBRED DRESSING-GOWN PATTERN.

be sufficient to indicate the manufacturing basis and procedure comprised, by alluding to the figured specimens, in Figs. 20 and 21. The former is made of bi-fibred worsted

yarns and the latter of cotton and silk, both fabrics being weavable in the white or grey with the colour composition developed in the routine of piece dyeing.

As a rule in such textures, the principles of design and of fabric weaving adopted are analagous with those obtaining in the manufacture of similar types of cloth in which coloured yarns are admixed in the looming operations. In the first of these examples—illustrative of tone differentiation due to fibre blending—the shades resultant are invariably " mixtures " and not pure or solid colours. One quality of hue necessarily distinguishes each group of shades observed in the dyed piece, so that the changes in shade depth, in any particular style, are strictly gradations in colour tone. They are not the product of diversification in hue or tint. This feature in the mixture tones acquired, in the dyeing of the goods, has to be taken into account in planning and originating the design scheme ; for unless cotton yarns, or yarns which may be differently treated in the piece tinting from the union filament yarns combined in the weaving of the texture, form part of the cloth structure, it is not feasible to separately emphasize any individual sections or details in the pattern. Examining the specimen (Fig. 20), it is producible in two sorts of bi-fibred worsted yarns, namely, a *warp* yarn composed of 60 per cent. of wool and 40 per cent. of cotton, and a *weft* yarn composed of 85 per cent. of wool and 15 per cent. of cotton, and by piece-dyeing the wool fibre a dark colour. The figured parts in the cloth result from the weft, and the ground, or lighter parts, from the warp threads. It is typical of the distinctiveness of line and detail practicable in the production of pattern by this system of colour treatment, and by selecting and applying suitable weave elements. In all instances the figuring, woven in compact floats of weft yarn, is in pronounced contrast with the warp-face twill in the foundation of the texture.

25. *Pattern Development in Cloths of Admixed Yarn Types.*—Combining yarns spun from two or three varieties of fibre as

cotton and silk, cotton, silk and wool, etc., each yarn unit in the cloth may be differently coloured in the piece-dyeing process. This is observed in Fig. 21, a silk and cotton union texture. In the specimen the repp and waved twill features, and the leaf and floral forms, are woven in silk, the dark elements in cotton, and the dulled grey spaces in the two kinds

FIG. 21.—COTTON AND SILK STYLE—PIECE-TINTED.

of yarn worked into a plain rib. With the weave plans of this interesting structure, the design is clearly delineated in the untinted loom fabric, but dyeing the silk one colour and the cotton a second colour, whether in contrasting or complementary hues, adds to the richness and commercial value of this style of manufacture.

The practices in fabric construction, and in coloured-pattern development, exhibited in these examples (Figs. 20 and 21)

are analytically treated of in *Union Textile Fabrication.* The specimens are, therefore, to be viewed here as denoting the systems of manufacturing fancy goods in the natural or untinted material, and of combining the sorts of fibres selected in such proportions, either in yarn formation or in the grouping of warp and weft threads consisting of different kinds of filament, to yield, in piece-dyeing, definite shades or pure coloured results. In the " mixtures," the cloths, as indicated in Scheme X, may be elementary in weave type, or they may be, as shown in reference to Fig. 20, of a figured order ; while the employment of yarns, made of special sorts of fibre, either plain or pattern-decorated textiles are also obtainable with each yarn, in the finished texture (woven in the grey), distinct in tone, tint, or hue, that is, as identical in colour freshness and property as if the yarns applied were hank, top, slubbing, or material dyed and prior to weaving.

26. *Factors Controlling Commercial Stability—Home Trade.*— In reviewing the industrial phenomena and aspects of the dress trade it has been regarded as vital to outline, as far as possible, the textural range covered, the basic and constructive principles in fabric orgination, and the design and colour schemes practised and elaborated.

The commercial aspects of the trade will be noted as they concern the varied conditions and factors which induce and control productive performance and stability. These claim and exact constant thought and investigation on the part of the manufacturer, the designer, and the industrial expert. All trading achievement in textiles is contingent on the nature of supply and demand. Particularly is this a governing principle in dress manufactures, inasmuch as the marketable goods are subjective to insistent and capricious changes in material and style. Textile commerce may, in certain abnormal instances, be created and enforced on exclusive lines. Originative, inventive, and economic work in fabrication is competent of discovering and establishing a new textural basis which may fructuate in this issue. But, in general, business in the dress

industry is measured and determined by conforming with the trend of fashion, especially as this stimulates and sustains the buying interests centred in the markets of Western Europe, the United States of America, and in the Overseas Dominions of Canada, Australia, New Zealand, and South Africa.

27. *Fashion.*—Fashion—prevailing taste in cut and make of garment—forms the pregnant and dominating cause of the quality, shade, material and variety of the textures merchantable. The producer must perforce organize and regulate the mill operations and manufactured output in accordance with its code of teaching. In doing this he finds latitude for the exercise of initiative faculty and ingenuity in cloth type, value, and diversification, providing the resultant manufactures are in consonance with the make-up of the style of garment in vogue. The study of the problem, as it affects progressive industrialism, is facilitated in recognizing that fashion is inspired and substantially formulated by social and economic conditions, and by historic events and conjecture. For example, the modern disposition for tailor-made costumes is largely the consequence of the professional life and career now pursued by women, and in contrast with the domestic sphere favoured by women of a former generation. To wear clothing of unnecessary length and width dimensions is not compatible with the convenient following of the duties in the office, the works laboratory, and the many different métiers in which women have acquired a legitimate place in the professional world. This social transition and advance has left its impress on the trading avenues in textiles for women's wear. Hence the manufacturing proclivities of the last few decades, during which woman's services in the capacities named have been increasingly requisitioned, have gravitated in the direction of the origination of fabrics of the plain and twilled variety. Alpaca and figured textures have been superseded in the home trade by worsted (Botany and Crossbred), tweed (Cheviot and Saxony), and union cloths, similarly

constructed in each case, though lighter in weight per yard, as goods ordinarily adapted for men's consumption.

28. *National Purchasing Power and Factory Production.*—That the purchasing power of the community has a perceptible bearing on the nature and character of the goods fashionable will be evident. How this, in turn, is reflected in manufacturing practice and trading ideals may be traced in the re-organization of the industry, owing to the advance in the labour market, and the betterment of the financial status of the working classes. A decline in the workers' earning capacity is followed by competitive strain in the production of inexpensive manufactures, as the augmentation of this capacity is signalized by the transference of the competitive effort to the making of cloths of a superior material, structure, and quality.

29. *Influence of Economic Evolutions.*—Economic evolutions of this nature impose befitting thought and inquiry. On their judicious interpretation and sound analysis the factory provisions have to be made, and the scheme of trading devised. Their exigencies must be fully met and dealt with. For some years prior to 1914, the market conditions rendered "cheapness," in the manufactured product, a potential factor in maintaining trading constancy, and an absolute requisite to trading aggressiveness and prosperity. In the instance of the workers' wages reaching an unprecedented high standard—as in the present crisis, 1919–20—the trade instincts and activities are levelled as to the classes of goods requisitioned. Pronounced demarcations in the sorts and grades of fabric for the respective sections of society are largely eliminated. The workers are clothed in a similar quality and variety of texture as the middle and upper classes ; and, as a consequence, trading, in the bulk, is comparatively of a uniform description, both as to texture and as to the fibrous materials employed.

The problem of what to produce is, therefore, intrinsically suggested in the economic position of the country. This moulds the whole basis and structure of the manufacturing

organization. For this reason it becomes imperative that the dress goods manufacturer should be *au fait* with the purchasing flexibility of the community whose interests he seeks to command. Mutations engendered in this respect, of whatever tendency, should be foreseen and calculated, and the productive operations adapted thereto.

30. *Consolidation of the Home Trade.*—Apart from these considerations, the home trade is capable of being further consolidated by technical research relative to (1) the sources and means of acquiring textural newness; (2) style in the manufactured goods, including design and colour schemes as illustrated and exemplified in historic and modern woven specimens; (3) textile analysis; (4) economic methods of production as distinct from adulterative practices; and (5) in yarn and cloth standardization. The subjects come within the scope of this work, and will be elucidated in their respective connections.

31. "*Style*" *Transitions.*—Regarding "style" it has to be observed that, to the student of modern industrial practice, it is evident that transitions and developments, whether in small or in substantive elements, are incessantly being effected in manufacturing procedure which modify the types of textural production. These may be in the nature of revised and amplified phases of well-known systems of work, or they may consist of styles emanating from experiment and investigation. Trading success and growth are recognized as being closely allied with, and dependent upon, the amount of technical ingenuity thus directed and exerted. This factor vitalizes mill productiveness, and determines the successive degrees of progress in the textile arts as associated with dress-fabric manufacture.

A study and an analytical survey of the styles and classes of fabrication, season by season, may not palpably reveal the process of reconstruction taking place. Extending the period of comparison to ten or twenty years discovers, however, its active efficiency. Important and radical changes are now

observed as a direct result of sustained and successful effort in the origination of fresh varieties of loomwork. All advance in textile constructiveness is relative. It is not a spontaneous but an evolutionary growth. Distinctive achievement in the dress as in other branches of trade is rooted in historic venture and performance. Experimental speculation in manufacture and design is, therefore, strengthened in compass by embodying what has been accomplished, as it is enriched in issue by expanding and supplementing the work already wrought. The technical co-efficients of commercial aptitude obtain, in a pre-eminent degree, in a comprehensive knowledge of " style " as defining the texture, design, and colour composition of the manufactures in vogue at different periods of the trade.

32. *Standardization in the Dress Industry.*—Hitherto the principle of production to " standard " has not been appreciated to its full value, as a cause of business success, in the spinning and weaving branches of the dress industry. Standardization in yarn and fabric, and also in dyeing and finishing, in the bulk groups of dress and costume cloths, should be instituted as a means of increased industrial efficiency, and as an auxiliary to trading practice and conservation.

Experience and precedent have been largely the accepted rule and guide in the acquirement of a requisite quality of yarn and texture. But it must be obvious that accuracy in, and uniformity of, manufactured result, are to be more satisfactorily attained when an organized system of testing the process products is adopted. The features and properties of the finished fabric are contingent on the correctness of each series of operations through which the material passes. They are not solely the organic derivatives of specified counts of yarn made of cotton, wool, silk, etc., woven into cloths of a prearranged thread compactness or density. Other and more subtle elements enter into the scheme of work, and assist in determining and fixing the actual grade of texture produced. Material preparation in carding and combing, in drawing or condensing, the degree of twine inserted in spinning, and the

filament grouping and admixture in the spun yarn, all exert controlling effects on the fineness, softness, elasticity, wearing durability, and tensile strength of the woven product.

The inference is that something more is needed than the checking and passing of the departmental output of goods, as at present done. Technical testing, comparative analysis, or laboratory investigations of the products should be undertaken and carried out in the factory. The equipment and province of the laboratory would be ordered and adapted to the class and variety of the materials used, the assortment of yarns spun, and the styles of fabrics made. In the case of a spinning mill, the apparatus would be such as to enable qualitative and quantitative chemical analyses to be prosecuted in the raw and manufactured ingredients employed; microscopic examination of the process results; and the testing of the yarns for fibre composition, twine, breaking strain, and elasticity. But each factory would find it convenient to add to the organization, adjusting the system of investigation to its special productions and trading requirements. Naturally, in the case of factories, including the whole scheme of manufacture, equipment would be provided for covering the mechanical, chemical, comparative and identification tests of the fabric as well as of the yarn and the fibrous material; and also of the degree of permanence and tone purity of the dyed colour, and the textural conditions and qualities due to the finishing routine. Standardization on this basis, in the dress trade, presupposes an important extension of mill procedure and methods, but it aims at a measure of industrial efficiency culminating in definite and consistent forms of textile commerce.

33. *Shipping or Foreign Trade—Divisible into Two Sections.*- The Shipping or Foreign trade in dress goods is divisible, in regard to styles and descriptions of manufacture, into two principal sections. First, trade with the countries of Western Europe (France, Italy, Belgium, Germany, Spain, Portugal, and the Netherlands), the United States of America, and the

Overseas Dominions of the British Empire, exclusive of India. Second, trade with the countries of the Near and Far East (Russia, Persia, Turkey, India, China, and Japan) and of South America, more especially the Argentine Republic, Brazil, Peru and Chili.

34. *Prestige of the French Fashions and the Goods in Demand.*—For the former section, the goods are mainly of a similar order and classification to those produced for the Home Trade, and which are saleable in the markets of the United Kingdom. Distinctions in colouring and in texture are, however, introduced in the instance of manufactures intended for Italian and Spanish consumption. Generally, in communities in which the French fashions in dress are observed or followed, the goods purchased are of a like material consistency and fabric variety; but, in exploiting continental markets, the social and economic aspects and conditions, explained as influencing trading returns, have to be taken into account.

35. *Phenomena Affecting Trade in the Near and Far Eastern Countries.*—Further, in the second category of the shipping trade, attention has to be given, by the home producer, to the following characteristic features and phenomena in the countries concerned: (1) Climatic conditions; (2) National customs in dress; (3) Native predilections as manifest in the demand for textures of materials, designs, and colourings possessing a symbolical or emblematical significance; (4) Religious, caste, and social prejudices; and (5) Economic cost of the manufactures, especially in rivalry with goods made by competitive communities, e.g. France, Germany or America; and as consistent with the purchasing power of the people.

36. *Board of Trade Intelligence and Foreign Trading.*—The subject of this branch of the foreign dress trade is linked up with intelligence bearing on these heads. Under informed and primed conditions technical power may be exerted in achieving the prescribed industrial and commercial task. If the maker should be imperfectly apprised of the specific requirements of a trading centre, he labours at a disadvantage, and his

productions are as likely as not to be unsuitable in material, quality, style and price. Exact and trustworthy commercial intelligence is the security of successful modern dress manufacture.

Markets may be nurtured and exploited by gleaning and assorting data and information on different spheres of foreign commerce. A more complete intelligence system, authoritatively planned and operated, is fundamental to the commercial and manufacturing interests of the dress goods industry. To know the nature and scope of a trading requisition is, in business warfare, more than half the battle to a resourceful producing community. Hitherto the fertility of the British industrial supply has exacted recognition and ensured progressive development. If the precise form of product were absent, a passable substitute was possible. Between the two lies the realism in manufactured adaptability and fitness, and this provides the true or preferential marketable value. Faculty in constructiveness is not to be lessened but augmented by the advantages in manufacturing practice accruing from penetrative and inclusive commercial information. The maker, possessing a solid basis on which to establish inventive work, is enabled to originate mercantile goods diversified in structure, design, and application, and in close agreement with the special needs and technicalities of the markets for which they are intended.

It should be reiterated that in cultivating Eastern and South American trading in dress materials, with a view to its constituting the staple business of the factory, the producer should have recourse to both private and official sources of intelligence. To rely upon the former is not an adequate procedure. Isolated and spasmodic effort such as it embodies is not to be pitted against systematized inquiry and administrative action. In the latter, the objects and functions of the Commercial Intelligence Department of the Board of Trade grip the industrial problem. They embrace the collecting, co-ordination and presentation of informative records on the trade, industries,

and shipping of the countries affected. The plan formulated has the intention, firstly, " to enable the Government to form a correct appreciation of the commercial relations between the British Empire and the several foreign countries from the point of view of British commercial interests " ; secondly, " to facilitate the efforts of the British traders to get into touch with the mercantile and industrial communities in foreign countries, as well as with the national or local authorities where necessary " ; thirdly, " to enable the Government to promote, and if necessary assist in negotiating through its agents abroad, commercial or industrial concessions to British subjects, where such concessions are of sufficient importance to call for Government intervention " ; and, fourthly, "to afford, within the limits of diplomatic or consular action, assistance in composing or smoothing over any difficulties that may arise beteeen British subjects in the exercise of their trade or legitimate commercial activity, and foreign Government and local authorities." Under the first category there is also the important issue of the British Government being in a position " to afford advice on matters arising in connection with the negotiation of commercial treaties, based on a comprehensive knowledge of the commercial geography, legislation, and actual conditions of the foregin countries concerned " ; and " to furnish to the British traders reliable information as to (*a*) local laws, rules, regulations, and trade customs; (*b*) existing or potential markets for British exports ; (*c*) supplies needed by, or useful to, British industries which are or may be produced in the countries concerned ; (*d*) openings for British capital in developing the natural resources and general prosperity of such countries ; and (*e*) suitable agents for British firms in foreign countries.

This informative force should be serviceable in conserving, directing, and advancing British textile industry and commerce. It opens up trading facilities and avenues of great potentiality to the English manufacturer. Prepared instead of unprepared trading ground is to be available for industrial

developments. In the commercial exploration of a foreign country, accumulative intelligence, useful to the home producer, may either precede or be carried on side by side with trading activity, evolving conditions influential in enforcing and sustaining industrial continuity and progression.

37. *Provisions Relative to Trade Intelligence and Dress-Fabric Manufacture.*—Specifying the provisions of direct import and significance to the dress-fabric manufacturer interested in the shipping trade, they should also comprise—

1. Intelligence affecting commerce in manufactured goods, as it may be rendered instrumental in the successful exploitation of foreign markets, that is, suggestive to the producer as to the materials, textures, and styles of design adapted to national usages, dress, manners, and customs.

2. General intelligence concerning the textile industrial status of a country as included in and determined by (*a*) the indigenous and imported supplies of the raw materials of manufacture; (*b*) the existing and prospective character of the local industries; (*c*) labour efficiency and the educational and official organization employed for its betterment; (*d*) the branches of industry and commerce on which the activities of the country are mainly concentrated; and (*e*) the initiative and enterprise shown in native manufacture, and the facilities existing accessory to their realization.

The more complete and the more searching the study and dissection of these problems, connected with foreign trading in all classes of fabrics for women's wear and apparel, the fuller the enlightenment of the British producer on the exact needs of the shipping markets, and the stronger the state of preparedness of British industrialism for assuming the province of furnishing the requisite manufactured supplies.

38. *British Industrial Centres.*—The dress goods trade of the United Kingdom is chiefly located in the Bradford and Keighley districts of the West Riding of Yorkshire, the South-Eastern towns of Lancashire, and in Glasgow and the vicinity. The

woollen branches, as represented in tweeds and costume cloths, made of all-wool yarns, are practised in the Border towns of Scotland, in the north, west, and south of Ireland, in Huddersfield and the neighbourhood, with fine-faced goods of the habit cloth quality in the West of England, and textures of a flannel character in Rochdale. Raw silk and artificial silk manufactures are extensively produced in Macclesfield, Coventry, and Spitalfields. Union silk textures are a staple section of the industry in Bradford, Keighley and Glasgow, but the raw silk goods are largely from the looms of Macclesfield, and the more decorative varieties from the looms of Spitalfields. Linen cloths form a comparatively smaller section of the trade. They are chiefly of Irish manufacture and from the factories of Belfast and Lurgan, with limited contributions from the mills of Dundee and Dunfermline. Knitted or hosiery woollen and worsted textures are made in Leicester, Hawick, and Edinburgh, and knitted artificial silks in Macclesfield and Leek. Embroidered fabrics, of different yarn ingredients and looming structures, are pattern decorated on the embroidery frames of Nottingham, smaller design effects being hand-sprigged or machine-worked by the cottagers in certain Irish localities.

Bradford is the historic centre of the trade in lustre stuff goods, and includes Shipley, Saltaire, and Bingley. Keighley, with Silsden, Cowling, Skipton, etc., also occupies a prominent place in the same classes of manufacturing. Both the Bradford and Keighley centres specialize on, first, the lighter makes of fabric—Sicilians, brilliantines, linings, figured lustres, gabardines, and the several sorts of alpaca, mohair, and camel-hair textures—and, second, on the medium weights of plain and fancy worsted and union costume cloths. Velvet, pile, and plush goods are also an important class of the productions of the Bradford mills.

Glasgow is the principal centre of the dress fabric industry in Scotland. While its trade output does not include "lustres" it combines a large assortment of thin and light fancies, such

as skirting, blouse, gauze, and lappet textures as producible in heddle-mounted and Jacquard looms.

The Lancashire districts naturally concentrate on cloths made of cotton yarns—the plainer and lighter varieties (voiles, muslins, and zephyrs) being made in Burnley, Heywood, Nelson, etc., lappet and gauze fabrics in Preston and Bolton; striped and checked goods in Blackburn; velveteens, corduroys, and velours in Hebden Bridge, Todmorden, and Sowerby Bridge (Yorkshire); and general and diversified sorts of manufacture in Manchester, Pemberton, Chorley, Bury, etc. The cotton trade is complex in organization, hence in the same mill voiles on 2-fold 100's or 2-fold 150's warp and weft, and heavy flannelettes and creton cloths composed of 32's twist warp and 8's twist weft may be produced.

The outstanding features of the trade, as here delineated, are the large and progressive industrial areas covered, the varied systems of manufacture fostered and practised, the technological interests involved, and the diversity of textural product acquired for both home and foreign consumption.

CHAPTER II

THE YARN UNIT

39.—Yarn a Controlling Factor in Fabric Design. 40.—Yarn Features relative to Textural Utility. 41.—Cotton Yarns and Cloth Qualities. 42.—Linen Yarns and Textural Features. 43.—The Silk Yarn Unit. 44.—Yarns made of Animal Fibre. 45.—Worsted and Woollen Groups of Yarn. 46.—Wool Fibre and Thread Formation. 47.—Yarn Specimens Compared. 48.—English and French Worsted Yarns. 49.—Value of Filament Length. 50.—Staple Measurement and Yarn Structure and Density. 51.—Lustre Quality in Cashmere, Alpaca, Mohair, and Camelhair. 52.—Yarn Differentiations. 53.—Circumferential Area of Yarns. 54.—Woollen-Yarn Structure. 55.—Metallic Threads. 56.—Modern Practice and Threads made of Mineral Substances. 57.—The Twine Factor in Spun Yarns. 58.—Folded Yarns and Twine Insertion. 59.—Compound Yarns and the Dress Trade. 60.—Types of Folded Yarns. 61.—Basic Principles in Folded-Yarn Construction—Fancy Twists. 62.—Folded and Multi-ply Twist Threads. 63.—Fancy Yarns in Dress and Costume Textures.

39. *Yarn a Controlling Factor in Fabric Design.*—It has been indicated that the Yarn Unit is a primary and constant source of textural diversification in the manufacture of dress goods. The importance of a full and accurate knowledge of the different kinds of yarn, with a technical appreciation of their structural qualities and characteristics, needs to be strongly emphasized. Modern practice recognizes the significance of the yarn product in a number of ways, and the competent designer proceeds on the basic understanding that to obtain an adequate measure of commercial success the scheme of fabric building starts with the fibre, takes cognizance of thread construction, enters into the loom-made texture, and covers the processes of cloth finishing.

In fabric structure and in design planning, the yarn employed is regarded as a controlling factor. On its apt selection, as to its material ingredients, counts or fineness and mechanical formation, the fitness of the texture for the purpose intended,

and the effective development of the pattern details, are mainly dependent.

40. *Yarn Features relative to Textural Utility.*—Yarn in this relation presents four distinctive features, each of which modifies its textural functions and applications, namely, (*a*) Filament composition; (*b*) Diameter measurement or thickness; (*c*) Structure as determined by the method of manufacture; and (*d*) Weavable form, that is, whether a single spun thread or consisting of two or several spun threads folded into one yarn unit. In the dress trade, as pointed out in the early sections of Chapter I, every variety and description of textile fibre may be utilized. The goods may result from cotton, flax, silk, wool, hair, or wool substitutes; or they may be admixtures of two or more classes of fibre. From this it is to be understood that whichever sort of material is applied, it is designed to impart its properties—whether natural or artificially developed—to the manufactured cloth. As this is a fundamental principle in all branches of textile production, it will be explained in reference to dress textures by considering the yarn groups obtainable from each variety of staple, and the qualities and grades of woven fabric acquired in each kind of yarn.

41. *Cotton Yarns and Cloth Qualities.*—The textures resulting from the use of cotton yarns are normally clear in surface features, with the threads distinct, and the weave and pattern satisfactorily delineated. Compared with woollen and worsted fabrics they are somewhat deficient in softness of feel, but possess firmness and durability of structure.

Under certain conditions the yarn properties, as derived from the raw material, are subjective to modification in the manufactured goods. Thus, by the process of mercerizing, the natural flat tone of the cotton fibre is changed to a bright tone, causing the yarns so treated to give to the fabric a degree of the lustre seen in silks. Second, cotton-yarn cloths of the sateen type may be lustred in the work of dressing and finishing; and, third, the thicker or heavier builds of cotton fabrics, composed

of loosely-spun yarns, may be raised and covered with a nap of filament, imparting some of the fullness of handle which is known to distinguish woollen cloths. But, ordinarily, the cotton yarns, being compact and dense in fibre, and the fibre being small in diameter, are applied to textures firm in construction, smart and clean on the surface, and well defined in warp and weft intersections. This is equally characteristic of the plain as of the fancy woven fabrics. It also distinguishes figured cotton goods, and cottons of the gauze and lappet structure. In velveteens, corduroys, and ribbed-velvet cotton manufactures, as in cloths of the velour (raised pile) description a specific aspect of the pile, as contrasted with that in similar styles of fabrics obtained in silk, mohair, or worsted yarns, is dullness of colour tone. The even, smooth, and symmetrical formation of cotton yarns, and the range of counts in which the yarns are spun, render them applicable, as warp, weft, or as both warp and weft, to an extensive assortment of dress and blouse fabrics in light and medium weights.

42. *Linen Yarns and Textural Features.*—With linen yarns, somewhat brighter and better delineated textural features are producible than in cotton yarns. The linen fabric has, however, a peculiar hardness of feel, which, in comparison with a cotton cloth of the same yarn setting, is suggestive of a deficiency in thread flexibility and pliancy. Clearness and smartness of woven surface, with the interlacing details forcibly developed, are readily acquired in the use of such yarns. Yet linen yarns are not so generally well adapted for dress manufactures as yarns made of cotton. In the finer counts, they are employed in the construction of thin, light textures, either plain, leno or gauze woven ; and, in the medium and thicker counts, of the looser spun grade, in the weaving of goods of the canvas cloth variety. Further, in admixture with cotton, linen threads yield a special class of union fabrics, in which cotton forms the material of the warp yarn, and flax the material of the weft yarn. Linen textures are of great

durability, and recover their original freshness of tone in cleansing and pressing. The relative higher cost of flax than cotton, plus the increased attention required in loom production in the use of linen as compared with cotton warp yarn, detracts in a measure from the wider applicability of linen yarns in the making of dress goods. Linen, however, is preferably used in the surgical and medical profession on account of its clean, smooth quality, and also on account of the firm, compact thread it produces, and the readiness with which the fabric absorbs moisture.

43. *The Silk Yarn Units.*—Silk and artificial silk are so largely used in dress fabrication, and have such a special technical interest and value, that they are separately dealt with in Chapter III. Here it may be observed that neither material is prepared and formed into a thread by the systems applied in the treatment of cotton, flax, ramie, jute, wool, and hair. The first is in a matured thread-like state in the cocoon and is converted into a yarn of weavable consistency by " throwing," " reeling," and " doubling " ; and the second is manufactured chemically from wood pulp. " Spun " silk is the waste fibre derived from the reeling of damaged cocoons. By reducing such " waste " to a flossy material it is rendered suitable for a similar mechanical treatment—opening, drawing, and twisting —akin to spinning routine as commonly understood. Both Silk—raw and spun—and the artificial or chemically-produced silk substitute, are employed in fabrics composed of cotton warp to a large degree, and of worsted warp to a lesser degree, for imparting richness of textural tone and colour brilliancy. Silk is, moreover, used in the origination of numerous varieties of dress and blouse cloths, as well as important styles of figured goods, which will come under analysis. Added to these intrinsic textural values, silk yarns are obtainable in a fineness of diameter and of tensile property not practicable in other sorts of fibre ; while the pure silk fabric is remarkable for its durability in the made-up garment.

44. *Yarns Made of Animal Fibre.*—These yarns, as

they concern the dress industry, are divisible into yarns made of wool (worsted and woollen), alpaca, mohair, cashmere, camel-hair and vicuna fibre. Of the yarns acquired from wool, and from wool admixed with vegetable fibre (cotton, ramie and flax, but mainly cotton), there are two principal varieties, namely, yarns prepared and spun on the worsted, or combed-and-drawn, system ; and yarns prepared on the woollen, or carded, and condensed system. The worsted and woollen practices of preparation include the yarn process and yarn types described in Table III.

TABLE III

WORSTED YARNS MANUFACTURED OF ANIMAL FIBRE

I.—Yarns manufactured on the English system and comprising—

(*a*) Botany and Crossbred Yarns—carded, combed, drawn, and *frame* spun.

(*b*) Lustre-wool Yarns—Gilled, combed, drawn, and *frame* spun.

(*c*) Alpaca, Mohair, Cashmere, and Camelhair Yarns—Gilled, combed, drawn and *frame* spun.

II.—Yarns manufactured on the French System and comprising—

(*a*) Botany and Crossbred Yarns—Carded, combed, drawn, and *self-actor* spun.

(*b*) Bi-fibred or Union Worsted Yarns—Carded, combed, drawn, and *self-actor* spun.

WOOLLEN YARNS MANUFACTURED OF ANIMAL FIBRE

(*a*) Saxony Yarns, spun from fine and short-stapled wools.

(*b*) Cheviot Yarns, spun from medium-stapled wools.

(*c*) Vigogne or Union Yarns, made of wool and cotton.

(*d*) Inferior grades of Saxony, composed of wool and wool substitutes.

(*e*) Inferior grades of Cheviot, composed of strong wools and shoddy, or of the longer-stapled materials reclaimed from cast-off garments and fabrics which have been in use, whether consisting solely or partially of animal fibre.*

45. *Worsted and Woollen Groups of Yarn.*—Both the worsted and the woollen groups of yarn vary considerably in the counts or thicknesses in which they are applicable to the dress industry, such as, in the former, from 2-fold 20's (= 10 hanks per lb., i.e. 2 fold 60's = 60 hanks of 560 yards each per lb.);

* See *Wool Substitutes.*

and, in the latter, from 16 to 24 yards per dram. Worsted threads of the smaller and medium diameters are used in the thinner and lighter classes of goods either made of pure wool or animal fibre, in both the warp and weft yarns, or with the warp yarn made of cotton or flax and crossed with a yarn of the worsted structure. Worsted threads of the heavier counts enter largely into the manufacture of solid worsted costume cloths. Woollen threads of the finer counts are adapted to the production of all-wool fabrics having a fibrous or face finish as in the "habit" cloth type; those of the medium counts to union textures of a flannel character; and the thicker woollen yarns to fancy tweeds of a costume weight.

46. *Wool Fibre and Thread Formation.*—From wool the fullest range of yarn counts is derived. The fibre is wavy, flexible, and soft, with the external scales more or less lustrous. The staple, or natural length of filament, in the "short" wools, averages from a fraction to over 2 inches in length; in the "medium" wools from 3 to 5 or 6 inches, and in the "long" wools from under 7 to 16 or more inches. Chemically, the analysis of the fibre is identical in each class of staple, but the variations in filament fineness, elasticity, and measurement, provide an extensible spinning compass. The two systems of work indicated form the two ideals in thread preparation and construction. The worsted system develops the lustrous character of the wool in combination with the acquirement of a smooth, level thread; and the woollen system develops the flexible property of the wool in combination with the production of a yarn having a comparatively non-lustrous surface, and one in which the fibres are freely commingled and intercrossed.

Whenever, in dress manufacture, it is sought to emphasize the lustre value of the material in the commercial fabric, the yarns selected are spun on the worsted practice. To acquire this value with yarns of the woollen nature involves raising the surface of the cloth, or the bringing of the fibres into a coincident relation as obtains in worsted thread construction.

Parallelism of filament in the texture, right or under side, lends brightness of tone to the woven manufacture, in so far as it is producible from the class of wool used. On the other hand, fullness and depth of tinted tone coincide with the tips of the fibres being exposed to the light, as in the instance of the crossed and intertwined grouping of the fibres in the woollen thread; and also in a milled and raised cloths in which the ends of the fibres rather than their lateral sides are presented to view

Softness, warmth of feel, and comfort in the wear, are the characteristic features derivable from the employment of yarns made of wool in whatever structural form they are applied in the weaving process. Whether the staple is short, medium, or long, the fibre coarse or small in diameter, or the wool spun into a combed or carded thread, the textural product should possess these qualities in a pronounced degree.

It is not, however, to be understood that the yarn, and the texture manufactured, do not differentiate in value and in technical and trading applications with the sort and grade of wool selected. With wool, and also with other varieties of textile fibre, the yarn features and yarn utility are modified with the nature and fineness of the filament, and with the length and elasticity of the staple. Thus the shorter-grown wools yield the Botany and Saxony kinds of yarn, the medium-grown wools the Crossbreed and the Cheviot, and the long-grown wools the Lustre kind of worsted yarn. Into the uses of the different categories and qualities of wool it is not necessary to enter here.* But the structural form and special weaving properties of each description of yarn require to be taken into full consideration. Each type of thread is a unit in fabric production, so that its standardized applications in manufacturing practice need to be explained. The industrial designations of the respective classes of yarn, and the approximate range of counts in which they are used commercially are given in Table IV.

* See Chapter I. *Woollen and Worsted.*

TABLE IV

COMMERCIAL YARN COUNTS—WOOL AND HAIR

(*See Specimens in Fig.* 22)

	Description.	*Range of Counts in 2-fold Yarns.*
A	Botany Worsted (English prepared and spun)	2/16's to 2/180's
A^2	,, ,, (French prepared and spun)	,, ,,
B	Crossbred Worsted (English prepared and spun)	2/8's to 2/32's
B^2	,, ,, (French prepared and spun)	,, ,,
C	Lustre Worsted	2/12's to 2/40's
D	Cashmere	2/12's to 2/32's
E	Alpaca	2/12's to 2/50's
F	Mohair	2/12's to 2/50's or 2/60's
G	Camelhair	2/8's to 2/40's
H	Saxony Woollen	2/10 skeins to 2/44 skeins
I	Cheviot	2/8 ,, 2/28 ,,
		Range of Counts in Single Yarns.
A^1	Botany Worsted (English prepared and spun)	10's to 80's
A^3	,, ,, (French prepared and spun)	,, ,,
B^1	Crossbred Worsted (English prepared and spun)	8's to 32's
B^3	,, ,, (French prepared and spun)	,, ,,
C^1	Lustre Worsted	12's to 40's
D^1	Cashmere	12's to 32's
E^1	Alpaca	12's to 50's
F^1	Mohair	12's to 50's
G^1	Camelhair	8's to 40's
H^1	Saxony Woollen	5 skeins to 40 skeins
I^1	Cheviot ,,	3 ,, 24 ,,

47. *Yarn Specimens Compared.*—All these yarns differ in character and in textural application; yet the yarns A to G, in both the 2-fold and single counts, are of the worsted structure, with the fibres similarly straightened, levelled, and lined with each other in the making of the thread. The structural distinctions are principally due to the varieties of material used in their manufacture; and, in a secondary sense, to the necessary differentiations in the mechanical treatment incident upon the working of materials of dissimilar staple measurement into a yarn-like form and condition. In the instance of A and A^2, B and B^2, A^1 and A^3, and B^1 and B^3, the distinctions are also caused by the practice of two systems of drawing and spinning. First, it should be noted that threads A, A^1, A^2,

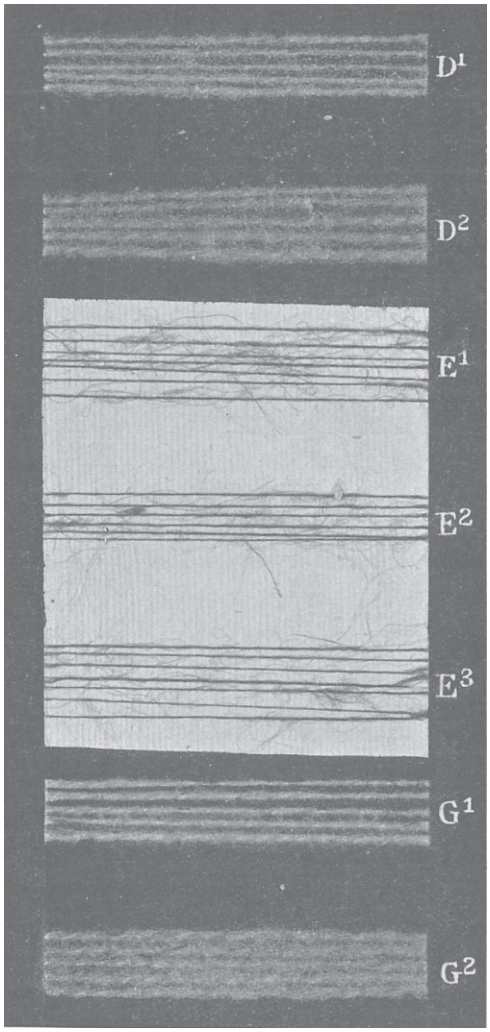


FIG. 22.

D^1 = 2/16's Cashmere.
D^2 = 2/16's Cashmere and Wool.
E^1 = 28's Alpaca.
E^2 = 32's Alpaca.
E^3 = 36's Alpaca.
G^1 = 2/16's Camelhair.
G^2 = 2/16's Camelhair and Wool.

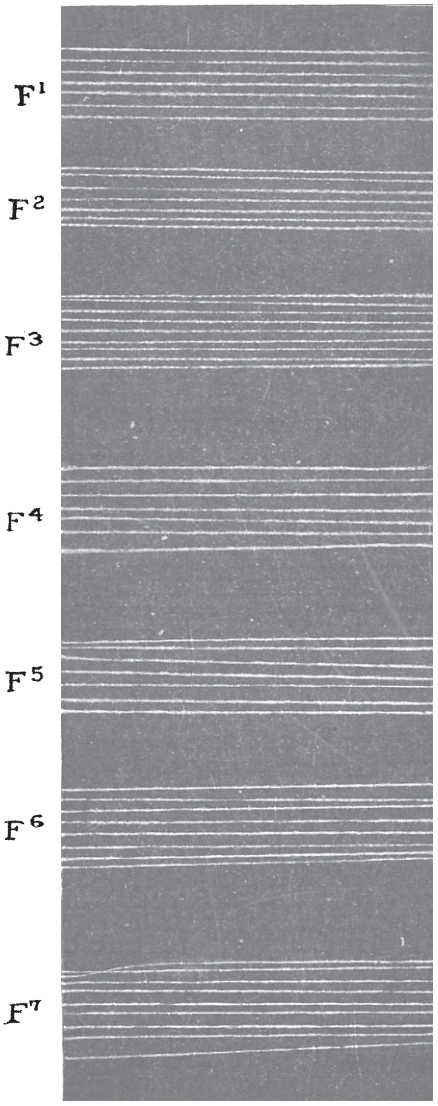


FIG. 22.

F^1 = 2/32's super Mohair.
F^2 = 2/40's " "
F^3 = 2/50's " "
F^4 = 1/16's Super Mohair.
F^5 = 1/24's " "
F^6 = 1/30's " "
F^7 = 1/36's Super Mohair.

and A^3 are denser and more compact in fibre than threads B, B^1, B^2, and B^3. This fundamental distinction between the two typical worsted threads arises from the finer and shorter wools employed in spinning Botany as compared with Crossbred yarns. The latter thread is of the opener and stronger character and results in fabrics of a brighter tone than the former. Botany cloths are, however, the softer, the more supple and the more pliable, while the Crossbred-yarn cloths possess the greater crispness or sharpness of handle. It follows that textural quality, as determined by fineness of fibre, is obtainable to a superior degree in the Botany yarn, and textural quality, as determined by brightness of surface and keen firmness of feel, is the more effectively developed in yarns of the Crossbred variety.

48. *English and French Worsted Yarns.*—Apart from these features—the results of the kinds of wool selected for the manufacture of the respective yarns—the types of thread specified at A and A^1 or A^2 and A^3 differ in structural formation. The English-made worsted, Botany or Crossbred, is the clearer in tone and presents the more level and smoother surface, while the French-made worsted, from the same class of wool and spun to identical counts, possesses the greater suppleness and flexibility of structure—that is a thread of a more yielding filament consistency. One yarn may be designated a comparatively "lean," and the other yarn a comparatively "foody" worsted thread as regards fibre composition and fibre grouping and arrangement. These distinctive characteristics originate in the methods of drawing and spinning. The combed slubbings, on the English practice, receive, at each operation in the drawing sequence, a quota of false twist, and a percentage of oil, and the yarn is *frame* spun; whereas, in the French practice, the combed slubbings pass down the drawing in a perfectly open and dry state, and the yarn is finally spun on the *self-actor*, but "roller" and not "spindle" drafted as in the making of woollen yarn. These structural distinctions, in the two grades of worsted thread,

will be shown to have a bearing on the purposes to which the respective yarns are applied in dress fabrication.

49. *Value of Filament Length.*—When the yarns defined as lustre worsted, cashmere, alpaca, mohair, and camelhair—C to G in Table IV and specimens D^1, to G^2 in Fig. 22—are examined, it is found that staple length and filament structure have a dominant effect on the quality of all classes of "lustre" yarns.

Each fibrous material here represented is of the long-stapled variety. In preparing fibres of a pronounced length into yarn, however small the yarn may be in circumference, the fibres freely overlap each other in a lineal direction, and for a fractional length of the thread corresponding with their average measurement. Therefore, the longer the individual fibres in the staple, when such are mechanically levelled and attenuated to their normal stretch, the smaller the number of filament units in a given counts of yarn, but the more extended the side by side relation of fibre with fibre in the thread. Taking, for example, two materials of the same net filament fineness, say, merino combing wool and cashmere, the first of 2 in. to $2\frac{1}{2}$ in. and the second of 5 in. to 6 in. in staple, and spinning each to 30's counts (diameter $\frac{1}{116}$ of an inch) the percentage of fibre in the worsted yarn, length for length, would be much higher than in the cashmere. A dissection, however, of cross sections of the different yarns would show the aggregate number of the fibres in each to be in approximate agreement. Comparative shortness of staple, in the wool, accounts for the relative increased quantity of filament in the Botany as contrasted with the cashmere yarn when examined inch by inch; and identical filament fineness, in the wool as in the cashmere staple, accounts for the ratio of fibres being in conformity, one thread with the other under a cross section analysis. Hence fineness, and not length, of filament determines the number of fibres in a specified yarn diameter; while length, rather than fineness, results in the yarn being filament marked and characterized.

50. *Staple Measurement and Yarn Structure.*—Staple measurement as a co-efficient in yarn structure may be graphically illustrated. To refer to Fig. 23, section A is suggestive of the fibre classification and grouping in yarns consisting of short-stapled, and section B of long-stapled, material. The more extended overlapping of fibre with fibre is at once observed in A as compared with B. The larger number of individual fibres required in A to form one or several inches of yarn—increasing with the amount of disparity between the average lengths of the two classes of filament represented—is also clearly brought out. Another feature is suggested, that of

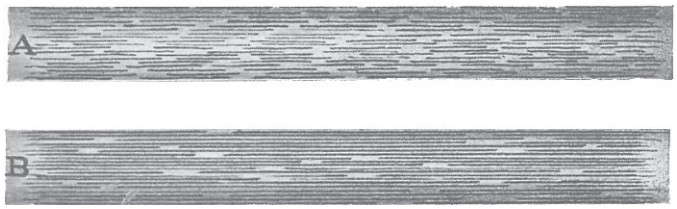


FIG. 23.

the influence of fibre length in imparting character, as indicated above, to the spun thread. In the shorter stapled material, the fibres in the aggregate, rather than as separate units, modify and fashion the yarn quality and structure. Thus, in threads made of fine merino wool the fibres in the mass yield the structural yarn value, each filament being less distinctive in the thread formation than in yarns made of lustre wool or long-stapled material. In the latter, the extent to which each fibre runs through the thread induces conditions which accentuate the physical properties and structure of the filament, so that the fibrous factor is rendered increasingly assertive in giving definition to the tone and constructive type of the yarn.

51. *Lustre Quality in Cashmere, Alpaca, Mohair, and Camel-hair.*—When these data are associated with the distinctive surface elements of the longer varieties of animal fibre, they

augment in value as they affect the nature and quality of the spun thread. In alpaca, cashmere, mohair, and camelhair (*see* specimens in Fig. 22), and also in the lustre wool, the outer scales are of the larger dimensions, but symmetrical in order of grouping from the root to the tip of the fibre. The scales in the wool filament—merino, crossbred, and lustre—tend to protrude slightly from the core outwards, but in other animal fibres they lay flatter or closer to the surface, which adds to the smoothness of the hair or filament. In other words, the serrations forming the external portion of alpaca, cashmere, and mohair are of that evenness of disposition as to reflect the light freely, or to develop the natural brightness of the staple. The true, straight formation of such fibres also contributes to the development of this quality. The staple of the materials may be wavy, or it may be composed of spiral locks, but the individual fibres are less undulated, or crimpy in appearance, than the fibres in the staple of merino or crossbred wools.

52. *Yarn Differentiations.*—The manufacture of yarns in the long-stapled materials on the worsted principle, with the filaments correctly aligned, has the effect of exhibiting the lustrous tone of the materials, and also of utilizing their maximum staple length in producing a smooth, even thread structure. Further, considering the several classes of yarn tabulated, and in the light of these deductions, it will now be understood how yarns spun to the same counts, and by similar mechanical routine, actually vary in technical features and in manufacturing attributes. First, the more open structure of Crossbred as contrasted with Botany yarns, is obviously caused by the relatively stronger and thicker fibres of which the Crossbred yarn is composed. Second, in regard to the cashmere and alpaca yarns (D^1, D^2, E^1 and E^2 in Fig. 22) they might be formed of fibres of an average fineness as the Botany worsted but of a greater staple length, resulting in the comparatively "thinner" and "leaner" quality of these threads. Smallness of fibre diameter, in both the cashmere and the alpaca, is the origin

of the softness and suppleness of such yarns, which, in the better qualities, are also distinguished by silkiness of feel. Third, the lustre worsted and mohair are both bright in tone but of a less flexible filament composition than cashmere or alpaca; with the mohair, if spun from selected sorts, of an exceptional lustre and colour purity.

53. *Circumferential Area of Yarns.*—It should be observed that the disparity in the circumferential area of the different varieties of yarn, when spun to identical counts, is more apparent than actual. Lustre threads of the same counts as Botany yarns appear to differ in thickness or diameter. This technicality requires explanation. Lustre yarns are particularly suggestive of the influence of filament qualities—fineness, tensility, and length—in the working or weavable circumference of the thread produced. Yarns may be firm, hard, or loose and pliable, or even spongy in fibre composition. As the yarn structure leans to one or the other of these extremes, it assumes, or relapses from, its true mathematical proportions.

The fullest measure of filament consistency and cohesion is observed in the English and French Botany yarns. Compactness of structure in these yarns is not a consequence of excessive twisting. This is absent from all Botany yarns which are normal spun, or from yarns in which the turns per inch are consistent with the staple length and the yarn thickness. Yet, as pointed out, there are discrepancies in structural details which modify the perceptible diameter of the different kinds of yarn made of animal fibre. It has to be taken into account that, as the staple length increases, the average filament stretch in the thread becomes greater, and this is followed by a proportionate diminution in the aggregate number of fibres in a transverse section of a known counts of yarn. This implies that the greater the length of the fibres combined in making the yarn, the less, as a common rule, the twine insertion in the process of spinning to form a weavable thread, and the more favourable the yarn structure acquired to the dispersive,

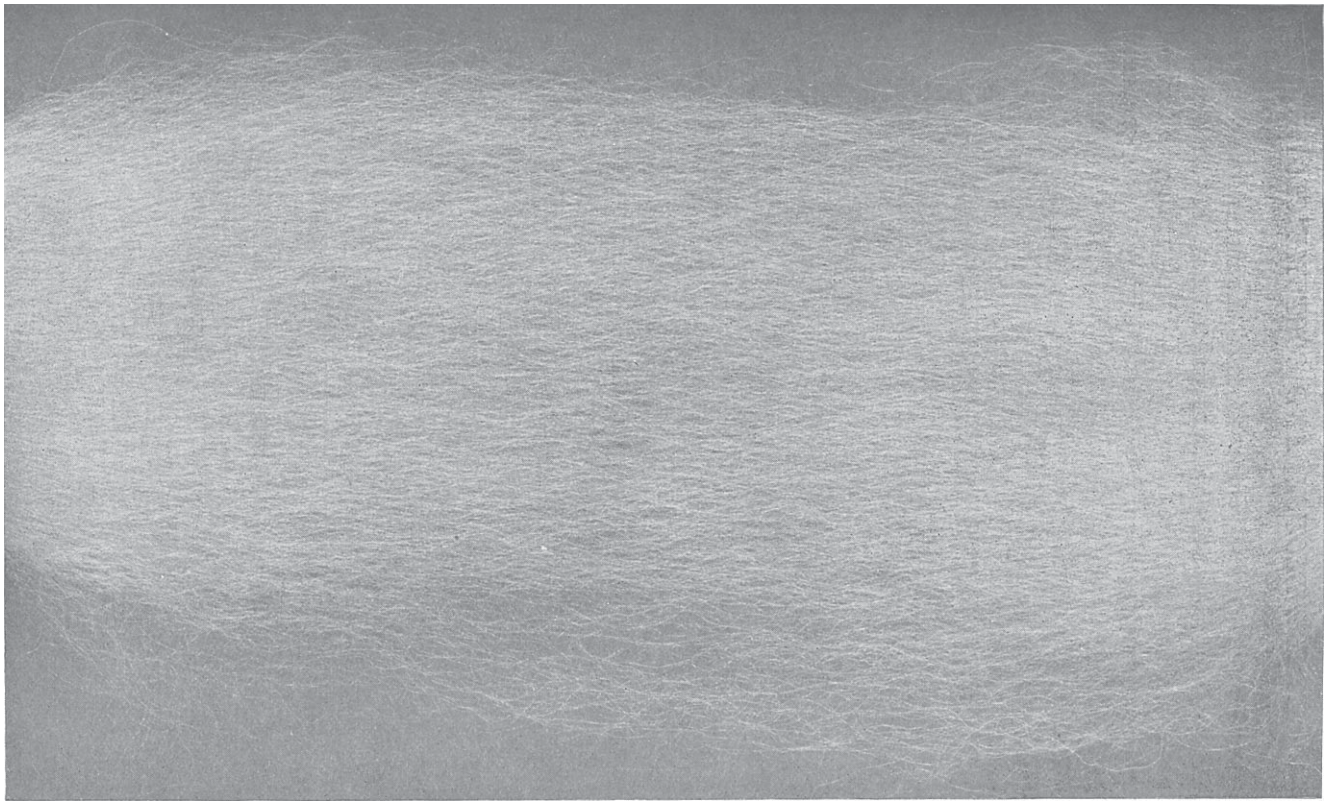


FIG. 24.—SAMPLE OF COMBED TOP.

spreading, and diffusive properties of the materials used. By such filament conditions the superficial area of the thread is visibly enlarged, and this exaggerates its working or textural setting diameter, and also affects the properties it originates in the fabric.

54. *Woollen-Yarn Structure.*—Woollen yarns are typical of the spun thread structure in which the maximum filament

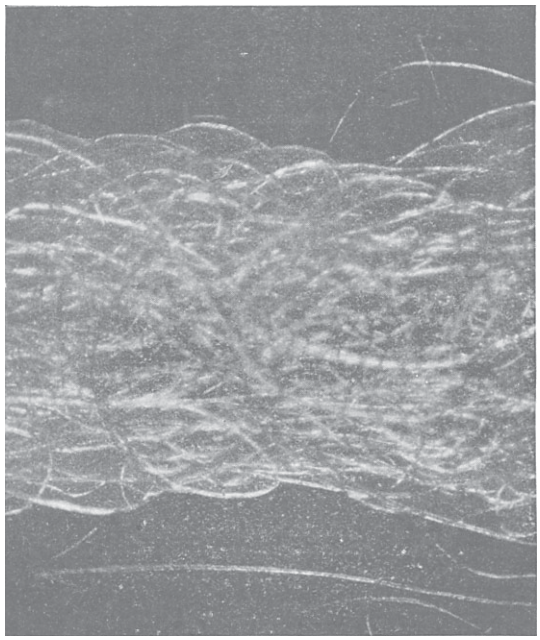


FIG. 25.—SAMPLE OF CONDENSED WOOLLEN SLIVER.

density, and the maximum amount of filament crossing, obtain. How markedly the woollen differentiates from the worsted structure, will be evident on comparing the fibre grouping and relation in the combed top (Fig. 24) and in the condensed sliver (Fig. 25). The lateral uniformity, the direct-line order, and the parallel co-extension of the fibrous ingredients, are the striking features of the former; as the involved cohesion, and sinuous, hooked and twirled formation

of the fibrous ingredients, are the striking features of the latter. The combed slubbing and the carded sliver are the basic material forms of all descriptions of worsted and woollen threads. With the fibre preparation for spinning thus widely differing, the yarns produced necessarily vary in constructive details and in structural arrangement even in the use, as in the specimens in Figs 24 and 25, of a similar quality of wool. It will be shown in treating of the application of the " Yarn Unit " how the manufacturing practice is extensible by the selection of one yarn or the other. For the present the points to be noted relative to each sort of yarn spun on the woollen principle are (1) the filament density of the thread, which consists of all kinds of fibre, however diversified in measurement, existing in the material selected; (2) its firm central coil with its rough, sinuous exterior as compared with worsted, cotton or linen yarn; (3) its disposition to develop a fibrous cover on both sides of the cloth; and (4) its structural character provides for textural diversification as obtained in the processes of cloth finishing.

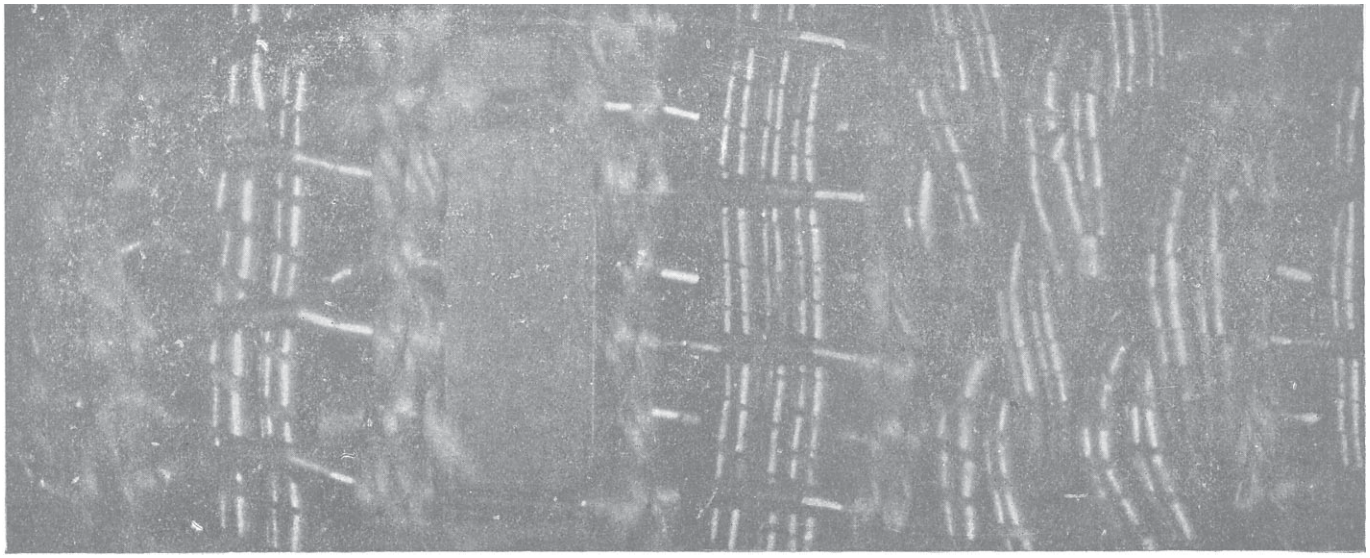
55. *Metallic Threads.*—In addition to what may be termed the standardized materials employed in yarn construction, and to which reference has been made, the range and character of the dress trade admit of the use of all substances, natural or manufactured, which may be reduced to a weavable form. For acquiring specific features in the design or fabric style, threads of a mineral origin are applicable. Cloths composed partially or wholly of metallic threads have from time to time been woven. In China the art of weaving threads made of the precious metals was understood at an early date. Moreover, on the exploration of India in the Middle Ages by Portuguese, Venetian, and English merchants, textures made of gold were found to be a native production.

Artistic specimens of Florentine craftsmen of the thirteenth to the seventeenth century, in which gold and silver threads are used, are still extant, and an example of this class, woven in the fifteenth century, is photo-micrographically illustrated

in Fig. 26. As magnified, the constructive scheme followed, and the distinguishing details of each kind of thread combined, are rendered visible, namely (1) the varieties of warp and weft yarns, including linen in sections *a*, gold and silk strands folded into compound threads in parts *b*, the flat ribbon-like bands at *c*, and the multi-fold gold threads in section *d*; (2) the minute textural characteristics arising out of these distinctive thread structures; (3) the full plan of intertexture, so that the warp and weft interlacings are clearly translatable; (4) the relative value of each species of thread, first as a textural unit, and, second, as an effect producer; and (5) the degree of yarn compactness, suggestive of the loom setting and of the frictional strain each class of thread sustains in the making and in the application of the fabric.

The Indian art weaver has carried this extravagance, in the admixture of priceless with ordinary classes of materials, to a point of lavishness undreamt of in the Western school of design, as instanced in the Baroda tapestry or carpet. This production resembles in the ground sections a woven pile structure, but literally it is a loom-formed and embroidered piece of jewellery—a tissue of pearls, rubies, sapphires, and diamonds.

56. *Modern Practice and Threads made of Mineral Substances.*—Modern practice discounts the use of gold and silver threads, but resorts, in a limited way, to the insertion, into either the warp or weft of the texture, of metallic strands assorted with yarns of a suitable diameter and grade of fibre. Figs. 27 and 27A are examples of this order. The utility of the metallic threads consists in the scintillating lustre acquired, which is distinctive in effect from the lustre characteristic of thrown silk threads. The contrast, as developed in the actual fabrics, is not, however, clearly distinguishable in the photographic reproductions. Fig. 27 presents, in the cloth, three species of textural contrast due to the cotton warp and weft, composing the sections in plain interlacing, the spun silk weft details, and the spottings in gilt shots of weft which are floated without stitching on the face of



a b a c a b a d d a

FIG. 26.—FLORENTINE FABRIC WITH FOLD-THREAD INTERLACINGS.