ANALYSIS OF WOVEN FABRICS

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WITH NUMEROUS TABLES, EXAMPLES AND EIGHTY-TWO ILLUSTRATIONS

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PREFACE.

TWENTY years have elapsed since the appearance of my little work on "Pattern Analysis". It would speak badly for our Technical Institutes had they not carried both knowledge of the subject-matter and methods of research on to a much higher and more scientific plane during this period. That the field of knowledge has been most markedly extended and that newer and more satisfactory methods have been introduced into the Textile Industries, the present volume bears witness to.

I feel that I should not be doing justice to those who have followed me did I not here pay some tribute to the work that has been carried out by lecturers in that department of the Bradford Technical College over which I have the honour to preside, and especially to the research work of Mr. Midgley, without which the present treatise would have lost much of its value.

At the time when I wrote my little treatise I could but give a skeleton-sketch of the methods whereby a fabric might not only be analysed in the Finished State but from these Finished Particulars the Loom Particulars ascertained. In the present treatise so fully are the changes from the Finished State back to the Loom Particulars for the various Standard Cloths indicated that the designer may proceed without fear where previously he would not have ventured to tread. Mr. Midgley has also succeeded in bringing the Costing of Cloths up to a previously unthought of state of efficiency.

The present treatise may be regarded as a further step towards the more perfect application of scientific method, ensuring that scientific attribute "pre-vision" in the Textile Industries. The authors offer it as such, and at the same time express the hope that it may be made the basis for further excursions into yet unexplored fields, and that such explorations may result in a still further extension of the field of knowledge, in a more perfect command of the recognised methods, and in that control of results which alone can lead to lasting success.

We can hardly hope that all errors in the text or in the mass of figures involved in the Tables and Examples have been eliminated. We shall therefore feel indebted to any reader who directs our attention to such errors or to any omissions.

The thanks of the authors are also due to Dr. L. L. Lloyd for having revised certain sections of the chapter upon the Qualitative and Quantitative Analysis of Fabrics.

A. F. B.

March, 1914.

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CHAPTER I.

QUALITIES OF RAW MATERIALS.

A GREAT many varieties and qualities of materials are employed in the production of woven fabrics.

The price of the required cloth may be taken to be the chief factor in determining the quality of the raw material to be employed, and the appearance of secondary importance. The quality, handle, elasticity, strength, lustre, and appearance of a cloth, naturally depend, in a primary sense, on the nature of the material or materials employed in its manufacture. Each class of fibre possesses certain individual properties, which, of course, characterize the woven cloth in which they appear.

Raw Materials.—The varieties of fibres in general use are classified as follows:—

Table I.—Animal Fibres.
,, II.—Vegetable Fibres.
,, III.—Re-manufactured Fibres.

TABLE I.—ANIMAL FIBRES.

Material.	Producer.	Length.	Colour and Lustre.	Fineness.	Handle.	Appearance.	Uses.
Long wool .	Sheep	6 in./12 in.	Yellow and lustrous, and demi-lustrous	$\frac{1}{400}/\frac{1}{800}$	Fairly soft	Straight in fibre—lustrous and greasy	Dress goods, coatings, hosiery
Short wool .	Sheep	1 in./6 ,,	White	$\frac{1}{1800}/\frac{1}{2000}$	Very soft	Wavy in fibre—very greasy	Dress goods, coatings (good qualities)
Mohair .	Angora goat	4 in./10 ,,	White and lustrous	$\frac{1}{400}/\frac{1}{800}$	Fairly soft	Straight in fibre—fairly clean	Bright dress fabrics, plushes
Alpaca .	Alpaca goat	8 in./16 ,,	Brown, white, fawn, black, demi-lustrous	$\frac{1}{400}/\frac{1}{1000}$	Soft	Fairly straight in fibre—fairly clean	Bright dress fabrics, linings
Camel's hair (Noil)	Camel	3 in./7 ,,	Brown, yellow, and grey	$\frac{1}{200}/\frac{1}{1000}$	Soft	Ditto	Dress fabrics and coatings
Cashmere .	Tibetan goat	2 in./4 ,,	Brown, white, and grey	$\frac{1}{300}/\frac{1}{1800}$	Very soft	Ditto	Ditto
Hair . .	Cow's, horse's, dog's, rabbit's, and kangaroo's hair	Various	Colour:—various Lustre:—various	$\frac{1}{200}/\frac{1}{400}$ Rabbit's $\frac{1}{800}$	Indefinite, Rabbit's soft	Stiff, straight, and bristly	Carriage rugs, etc., upholsteries
Silk . .	Silk worm	Cultivated, indefinite; wild, and spoils, as required	White and brown, very, very lustrous	$\frac{1}{800}/\frac{1}{2000}$	Soft	In cocoon—much matted	Fine textures in dress, plush, and upholstery fabrics

TABLE II.—VEGETABLE FIBRES.

Material.	Producer.	Length.	Colour and Lustre.	Fineness.	Handle.	Appearance.	Uses.
Cotton .	Cotton plant (Gossypium)	$\frac{1}{2}$ in./$1\frac{3}{4}$ in.	White and brown	$\frac{1}{600}/\frac{1}{1600}$	Soft	Straight in fibre	All types of fabrics for domestic and ornamental purposes
Flax . .	Flax plant (Linum)	Varies from few inches to several feet	Yellowish white	$\frac{1}{400}/\frac{1}{1000}$	Fairly harsh	Ditto	Linen fabrics
Hemp . .	Hemp plant (Cannabis)	Ditto	Yellow, brown, and lustrous	$\frac{1}{300}/\frac{1}{700}$	Harsh	Ditto	Twine bagging, sail cloths, etc.
Jute . .	Jute plant	Ditto	Ditto	$\frac{1}{200}/\frac{1}{500}$	Very harsh	Ditto	Ground structure for carpets
Ramie . .	Nettle plant (Boehmeria)	Ditto	White and very lustrous	$\frac{1}{500}/\frac{1}{1000}$	Fairly soft	Ditto and lustrous	Strong fabrics, part used for dress and coating fabrics

TABLE III.—RE-MANUFACTURED FIBRES.

Material.	Sources.	Fineness.	Length.	Colour, Lustre, and Appearance.	Uses.
Noil	Combed wool	$\frac{1}{400}/\frac{1}{1500}$	$\frac{1}{2}$ in./$2\frac{1}{2}$ in.	According to the type of wool combed	Woollens, dress, and coating fabrics
Mungo	All types of milled cloths	$\frac{1}{400}/\frac{1}{1800}$	$\frac{1}{4}$ in./$\frac{3}{4}$,,	According to the type of cloth pulled	Ditto
Shoddy	All types of unmilled cloths	$\frac{1}{400}/\frac{1}{1800}$	$\frac{1}{4}$ in./2 ,,	Ditto	Ditto
Extract	Cotton and wool cloths (cotton carbon-ized)	$\frac{1}{400}/\frac{1}{1800}$	$\frac{1}{4}$ in./$1\frac{1}{2}$,,	Ditto	Ditto
Flocks	Finishing processes of wool cloths	$\frac{1}{400}/\frac{1}{1800}$	$\frac{1}{8}$ in./$\frac{3}{4}$,,	According to the type of finish-ing treatment	Blending purposes

Wool.—The wool fibre is the natural product of the sheep and is undoubtedly one of the most important fibres employed in the manufacture of woven fabrics. Wool and hair are different in structure: hair fibre is comparatively straight, smooth, and lustrous: wool fibre is wavy and covered with a scale structure. The wool fibres collect quite naturally together on the back of the sheep in what is known as staple form. Each fibre takes its origin in a tube-like depression of the skin, the physical condition of its growth being such as to account for its waviness and scaly structure. Wool varies in length, strength, colour, fineness, waviness, softness, and lustre, according to breed and to the climatic and physical conditions under which it is grown, few materials being subject to changes in such a marked degree (Fig. 1).

The characteristics of good useful wools are uniformity in length, diameter, and crimpiness. Physically the wool fibre is composed of a large number of spindle-shaped cells, with thin, irregular edges of a horny scale-like appearance on its exterior, as illustrated in Fig. 2. The walls of the wool fibre are very flexible and elastic, thus causing the fibre to respond readily to the influence of heat and moisture, and at the same time permitting free absorption into every portion of the fibre. Water, acids, or alkalies, assisted by heat, readily soften the walls of the cells, causing them to protrude, and as these are numerous and the fibre crimpy, the fibres will curl up, partly interlock, and mat

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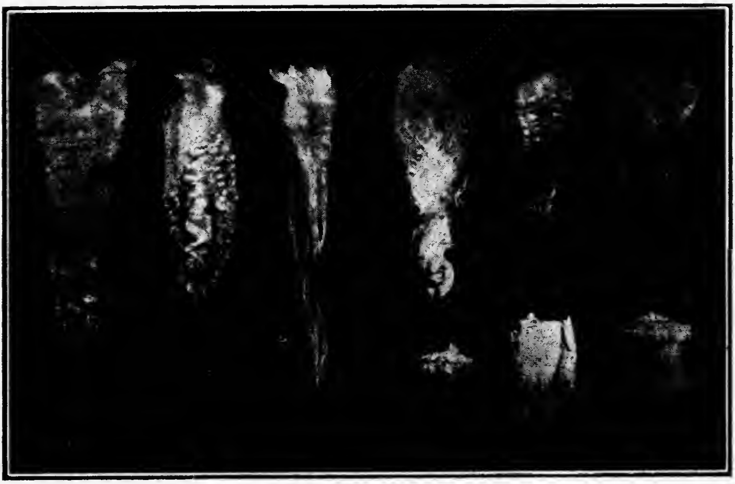

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FIG. 1.—Comparison of the various breeds of wool. (The horizontal divisions = 1 inch.)

(1) Lincoln 36's, (2) Kent 44's, (3) Scotch Blackface 28's, (4) New Zealand Crossbred 36's, (5) Australian Crossbred 46's, (6) South American Crossbred, 56's, (7) Cape Clothing wool, (8) New South Wales merino 64's, (9) Down Ewes 50's.

Note the presence and absence of grease and impurities on these natural wool staples.

together. The matting or felting becomes much more pronounced when pressure is applied. The wool fibre, like all horny substances, becomes plastic with heat and moisture, and will set in any position which may be forced upon it. This plastic nature comes into play in the scouring, crabbing, and milling processes. The various qualities of wool exhibit a diversity in their power to felt; thus there must be some inherent difference in the physical structure of the different qualities of the wool fibre. Fine Australian merino wool is very crimpy in appearance, and possesses marked tendencies to felt. Crossbred and English wool is much straighter, containing fewer scales or serrations, and does not possess the felting property of merino wool, on account of the cells and scales which form the fibre being fewer, coarser, and less flexible and elastic; consequently, the fibres have less tendency to mat or felt together.

(a) (b) (c) (d)

Fig. 2.—Micrographs of wool fibres.

(a) Merino fibre, (b) Medium Crossbred fibre, (c) English Lincoln fibre, (d) Mohair fibre.

Varieties of Wools.—The various wools employed in the worsted industry may be classified as follows :—

1. *Short Wools* (*Merino*).—Fine, wavy fibres, each possessing a large number of serrations, which give the material great felting and shrinking properties, but depreciate its lustre.

2. *Medium Wools* (*Crossbred*).—Fibres showing a medium

number of surface markings, consequently they are demi-lustrous and only fair felting wools.

3. *Long Wools* (*Mohair, Alpaca, Lincoln*).—These are very lustrous, contain few surface markings, and lack felting property.

A comparison of the particulars tabulated in Table IV will enable a fairly accurate estimation to be made of the properties of these fibres.

TABLE IV.—GENERAL CLASSIFICATION OF WOOLS EMPLOYED IN THE WORSTED TRADE.

Type of Material.	Top Makers Quality.	Length of Combed Fibre.	Average.	Diameter.	Crimps per Inch.	Scales per Inch.
Short Wool:—						
Merino	60's and upwards	From $3\frac{1}{2}$-5 in.	4 in.	$\frac{1}{1000}$-$\frac{1}{2800}$ in.	16 to 36	4800
Medium Wool:—						
Crossbred	40's-50's	From $6\frac{1}{2}$-9 ,,	$7\frac{1}{2}$,,	$\frac{1}{750}$-$\frac{1}{1000}$,,	8 to 16	2500
Long Wool:—						
(*a*) Crossbred	40's	From $7\frac{1}{2}$-$10\frac{1}{2}$,,	9 ,,	$\frac{1}{500}$-$\frac{1}{800}$,,	Straight	1000
(*b*) English Lincoln	36's	From $9\frac{1}{2}$-14 ,,	11 ,,	$\frac{1}{500}$-$\frac{1}{800}$,,	Ditto	800
(*c*) Mohair		From 5-10 ,,	8 ,,	$\frac{1}{800}$,,	Ditto	700

Mohair is the product of the Angora goat; it is fairly long, straight, smooth, and fine in appearance. The scales, which are regular and surround the fibre, are not nearly so marked as in the case of wool. On this account the mohair fibre possesses an almost unbroken circumference, and is the most lustrous of the wool or hair class of fibres. It is extensively employed in the making of lustrous dress fabrics and plushes.

Alpaca.—A fine, soft, silky hair obtained from the Alpaca goat. Its natural colours are: white, grey, brown, and black. The properties of this fibre may be stated to be similar, but on the whole inferior to those of mohair. Commercially it was originally employed as a substitute for mohair, but, possessing a certain subtleness in handle, may now be said to be used on its own merits.

Camel's Hair.—The camel yields a very yellow brown under hair, employed among other purposes for making worsted, dress, and coating fabrics, the coarser hairs being employed for making belting, carpets, etc.

Cashmere Wool.—A fine, soft, silky hair from a goat indigenous to Tibet. Like camel's hair a coarse fibre is found on the outside, and a soft, fine fibre on the inside.

Vicuna and Llama Wool.—This fibre is obtained from a camel-like goat of several species, inhabiting the mountains of Peru and Chili. These hairs or wools on account of their fineness and softness are in demand for the making of worsted and woollen goods. The fibre lends itself to the development of a nap and fibrous surface.

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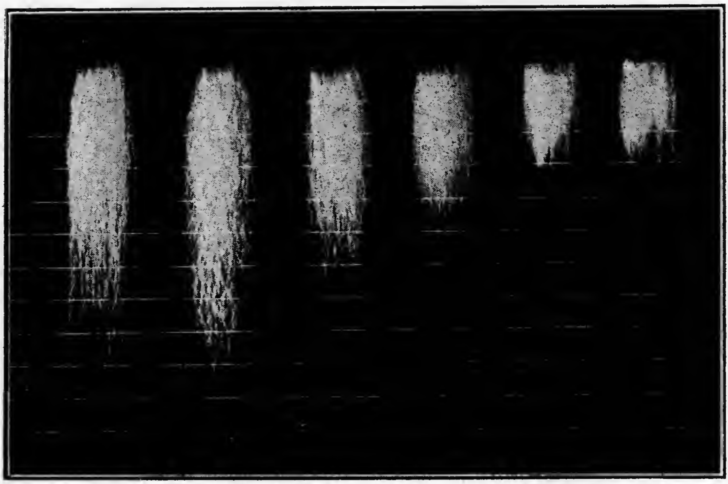

Fig. 3.—Comparison of the various length and fineness of fibres drawn from the following qualities of top. (The horizontal divisions = 1 inch.)
(1) 28's, (2) 36's, (3) 46's, (4) 56's, (5) 64's, (6) 80's.

Bradford Wool Quality Numbers.—The quality number given to combed wool fibre, although primarily based upon length and fineness, conveys some idea of the shrinking, felting, lustrous, and spinning properties it possesses, and at the same time the class to which it belongs.

A wool thick in fibre is not capable of being spun to the same count as a fine wool. When it is required to spin a worsted thread to the extent of, say, 34,000 yards to the pound of material, a fine fibre is of primary importance.

Take for example three typical worsted wools, viz. Australian Merino, Crossbred, and English. In the trade such terms as 60's, 64's, 70's, and 80's Botany or Merino; 32's low Crossbred to 58's fine Crossbred; 24's, 36's, 44's English are employed to indicate primarily the spinning capabilities, but indirectly they indicate other qualities. It is known that the fibre of the lowest number in each case is usually finer than the higher numbers of a lower class. For instance 60's Botany fibre is finer than 58's Crossbred, while 58's is finer than 44's English. The numbers are taken in a broad sense to indicate the degree of shrinking, felting, lustrous, and spinning properties possessed. To the spinner the quality number is chiefly useful as roughly indicating the count of yarn to which the material may be spun.

In the worsted industry the standard for counting yarns is based on the number of hanks per lb. the yarn is spun out to, each hank being 560 yds. in length.

Example.—If a yarn on being reeled into a hank of 560 yds. in length weighs 1 lb., the count is stated as 1's. Again, if six hanks are required to weigh 1 lb., the count will be indicated as 6's.

It may be said that all classes of worsted wools may be spun to 6's, but all such could not be spun to 60's count. A good 60's quality may possibly be spun to 60's count ($60 \times 560 = 33{,}600$ yds. per lb.), but it would be impossible to obtain the same count or length from a 50's quality. Hence, if all combed wool or "top" is up to its stated quality, its maximum spinning property will be as follows:—

Quality.		Hanks.				Yards per lb.
80's	=	80	×	560	=	44,800
70's	=	70	×	560	=	39,200
60's	=	60	×	560	=	33,600
50's	=	50	×	560	=	28,000
40's	=	40	×	560	=	22,400
30's	=	30	×	560	=	16,800

But unfortunately the "top" maker or the seller of combed wool is usually guilty of over-estimating the qualities of his products, with the result—especially in the lower numbers—that the spinner is unable to spin to the maximum stated length. For example:—

44's Crossbred top will usually spin to 40's counts
36's English „ „ „ „ 30's or 32's „

and so on. In the higher qualities such as 64's and upwards, it is usual for the spinning properties to be equal to the quality number. Details of fibres which constitute the various qualities of "tops" along with their actual count of yarn limit are given in Table V.

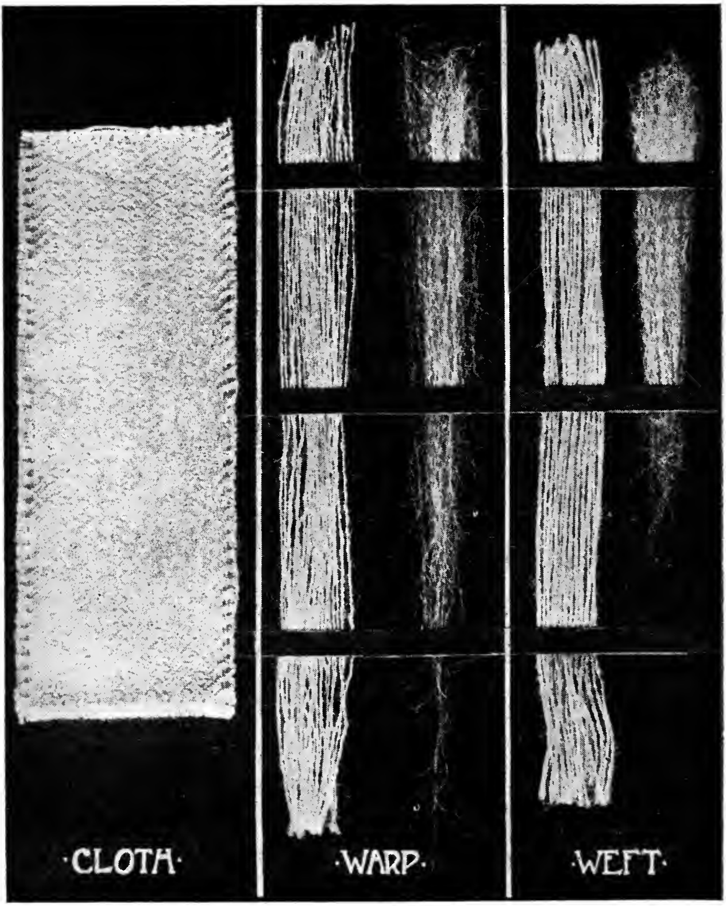

FIG. 4.—Comparison of quality of wool fibre drawn from the warp and weft yarns of a worsted cloth.

Noils.—Noils are a by-product of wool-combing. In the preliminary processes of worsted yarn production it is necessary to subject the wool fibre to a combing process in order to

TABLE V.—RANGE OF BRADFORD TOPS: DETAILS OF QUALITIES.

This table has been compiled by Mr. E. Priestley, Ex-Lecturer in preparing, combing, and spinning, Bradford Technical College, from actual experience of and experiment with a large variety of qualities of tops. It is here offered in the hope that it may prove useful to the cloth analyst in ascertaining the quality of worsted cloths.

Quality No.	Length (in inches). Extremes. Long.	Short.	Mean.	Lustre or Colour.	Handle.	Fineness (Average).	Waviness.	Uniformity.	Count of Yarn Limit.	
28's	15	5	10	Greyish Non-lustrous	Harsh	1/200 to 1/400 in.	Straight	Irregular	16's	
32's	13½	6	9	Fairly lustrous	Fairly harsh	1/400 ,,	Ditto	Ditto	24's	
36's	12½	8½	10	Ditto	Fairly soft	1/500 ,,	Ditto	Fairly uniform	28's	
40's	12	8½	10	Very lustrous	Soft	1/600 ,,	No waviness clearly defined	Uniform	36's	Standard for Comparison —40's
44's	11	8½	10½	Ditto	Ditto	1/650 ,,	No clear waviness	Very uniform	40's	
50's	7½	3½	6	Lustrous	Fairly harsh	1/750 ,,	10 Waves per in.	Fairly uniform	46's	
56's	6½	2½	5½	Yellowish in colour	Fairly soft	1/900 ,,	14 ,, ,,	Ditto	48's	
60's	5¼	2¼	3½	Fairly white in colour	Soft	1/1000 ,,	24 ,, ,,	Ditto	56's	
64's	5	2¼	3½	White in colour	Ditto	1/1200 ,,	28 ,, ,,	Uniform	64's	Standard for Comparison —60's
70's	4¾	2½	3½	Ditto	Very soft	1/1200 to 1/1400 in.	32 ,, ,,	Ditto	80's	
80's	4½	3	3½	Very white	Very, very soft	1/1400 to 1/1700 in.	36 ,, ,,	Very uniform	100's	
90's	4½	3	4	Ditto	Ditto	1/1700 to 1/2200 in.	36 ,, ,,	Very, very uniform	150's	

average up the fibre length in the "top" and to obtain as much parallelization of fibre as possible.

There is a limit to the length of fibre which may be treated on the various types of wool-combing machines, and in all cases the short fibre combed out is termed "noil".

As there are a number of wools employed in the worsted trade (List IV), each possessing its individual properties and characteristics, so there will be a corresponding number and qualities of noil as illustrated in Table VI.

TABLE VI.—QUALITIES OF NOILS.

Quality.	Average Length of Fibre.	Quality.	Average Length of Fibre.
English		Merino	
1	1¾ in.	1	1 in.
2	1½ ,,	2	¾ ,,
3	1 ,,	3	½ ,,
Crossbred		Alpaca	
1	1¼ ,,	1	2 ,,
2	1 ,,	2	1¾ ,,
3	¾ ,,	3	1 ,,
Mohair		Camel's hair	
1	2 ,,	1	2 ,,
2	1¾ ,,	2	1¾ ,,
3	1 ,,	3	1¼ ,,

Shoddy and Mungo.—These fibres are understood to be the result of "pulling" or beating to pieces soft hosiery, dress goods, and many looser types of woollen and worsted goods.

In technical terms—

Shoddy is the product of unmilled fabrics;

Mungo is the product of all types of cloths which have been subjected to the milling process.

Mungo is usually shorter and finer in fibre than shoddy, because, in the first place, milled cloths are nearly always made from the shorter kinds of wool; secondly, because the fibres of a milled cloth are very difficult to separate from one another. They are therefore always considerably broken in the process of pulling. Both shoddy and mungo are rather comprehensive terms than names for any special type of material, for both classes have an infinite number of special divisions with different names.

The rag trade which naturally forms the basis of these materials is divided into "old" and "new," and is concerned not only in home-collected but also in continental-collected rags.

Flocks. — These are the fibres cast out by the different machines employed in the finishing of wool goods. The processes of "milling," "raising," and "cropping" are responsible for the goods treated losing a certain amount of fibre. The value of these by-products may be taken in the order given. The fibre lengths obtained in "milling" are complete, from "raising" they are both complete length and broken, while the fibres which are "cropped" from wool cloths are very short and have a very limited use in the textile industry.

Extract is another comprehensive term to indicate a special class. It covers every type of "pulled" material, whether of milled or unmilled origin, but always indicates that the cloth from which it came was partly composed of cotton, this having been destroyed by the treatment which is known as carbonizing.

Cotton.—Amongst the vegetable fibres, the first place must be assigned to cotton. It is a product of the cotton, a shrub of the *Malvaceae* genus, *Gossypium* class. There are several varieties of this plant, but the growth of the raw material in each case is the same. The cotton-seed pods are divided by membraneous walls into three parts, each containing three or four seeds, covered with fibres attached by one end to the seed. The fibre during growth consists of a hollow tube gradually tapering to a fine point; the internal channel which supplies the nutriment to the growing cells narrows as it approaches the end of the fibre, leaving a solid portion. When the fibre is ripe, the supply of sap through the canal ceases, and as the residual sap is absorbed a vacuum is created in the channel, causing the walls of the fibre to collapse, and during drying and contraction the fibre twists itself into a spiral form. By means of the microscope the collapsed twisted tube appearance can be readily recognized as illustrated in Fig. 6*a*.

Wax, seed oil, and natural colouring matter are the chief impurities of the cotton fibre, and are evenly distributed over its surface. When the external impurities have been removed the chemical composition of the cotton fibre is pure cellulose.

The property of cotton to withstand severe treatment, especially during dyeing and finishing, is due to the fact that cotton cellulose is insoluble in ordinary solvents, such as water, ether, alcohol, benzine, etc. At the same time the cotton fibre when treated in certain solvents will change in its chemical and physical character.

Grades of Cotton.—Cotton is graded in different classes, depending chiefly upon its cleanliness and properties.

The chief classes are known as :—

Sea Island,
Egyptian,
American,
Brazilian,
Peruvian,
East Indian,

the first mentioned being the highest and the last the lowest quality, each class being designated into qualities as follows :—

1. Fair.
2. Middling Fair.
3. Good Middling.
4. Middling.
5. Low Middling.
6. Good Ordinary.
7. Ordinary.

The lengths of the various types of cotton fibres vary from an average of half an inch in the East Indian type to two inches in the Sea Island quality : whereas the diameter of the East Indian fibre is about three times that of the Sea Island (see Fig. 5). The twists on the cotton fibre become more irregular and decrease in number in proportion to the shortness of the fibre and increased thickness of the cell walls and diameter of the cavity. It is almost impossible to ascertain the average twists on the various types of cotton, but it is estimated that there are 300 in the Sea Island cotton fibre to 150 in the East Indian. Hence it is obvious that the spiral markings of the latter will be of a different character, and much more evident than in the former type of cotton.

Mercerized Cotton.—When the cotton fibre has been subjected to the action of caustic soda of a suitable strength by padding, immersion, or any other manner, and then freed from the alkali by washing, the fibre will be found to have acquired certain new properties. The action of the alkali causes the fibre to undergo a remarkable change. The physical alteration is a thickening and swelling of the walls of the fibre, with a tendency to become gelatinous and much more transparent. Each individual fibre loses its twisted, tube-like appearance, and assumes the form of a fibre possessing few surface markings. The action which takes place is as follows: A chemical reaction is brought about by the cellulose absorbing the alkali (forming alkali-cellulose, an unstable body) thus permitting a physical alteration in the fibre. By suitable washing the alkali is removed and the fibre becomes again a stable body. A feature observed in the washing is that the fibre contracts considerably. The shrinkage and contraction of the fibre are responsible for the twists and surface markings being

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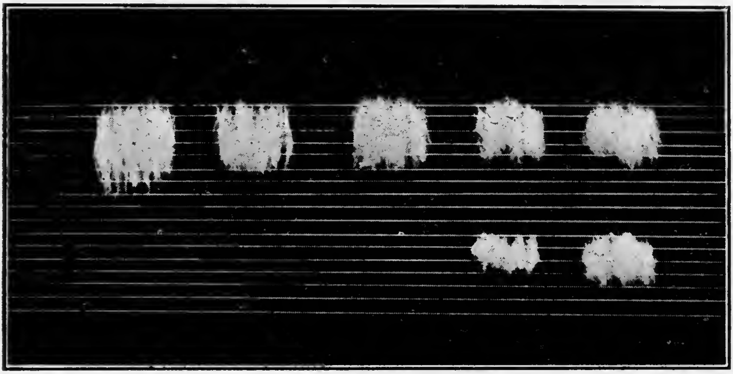

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Fig. 5.—Comparison of the various types of cotton fibre. (The horizontal divisions = ¼ inch.)

(1) Sea Island, (2) White Egyptian, (3) Brown Egyptian, (4) Peruvian, (5) Brazilian, (6) East Indian, (7) American.

recreated. This shrinking and recreating of surface markings is obviated by conducting this operation whilst the cotton is under tension: thus the smooth surface is maintained and a highly lustrous fibre developed (Fig. 6*b*).

Ramie, Rhea, China-grass.—This fibre is obtained from the stem of the various species of nettle plant grown principally in China and India. It is only of late that this fibre has attained any degree of importance. The difficulties involved in its preparation have stood in the way of its commercial success, but these difficulties are slowly being overcome. The strength and lustre of China-grass make it a valuable fibre for some classes of goods.

Silk.—This is the product of the silkworm, and in reality consists of a longitudinal body of flexible gum. This fibre possesses the least diversity of all fibres. Microscopically it has

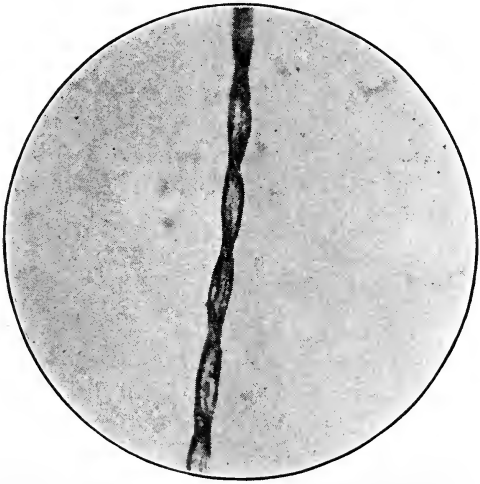

Fig. 6*a*.—Micrograph of ordinary ripe cotton fibre.

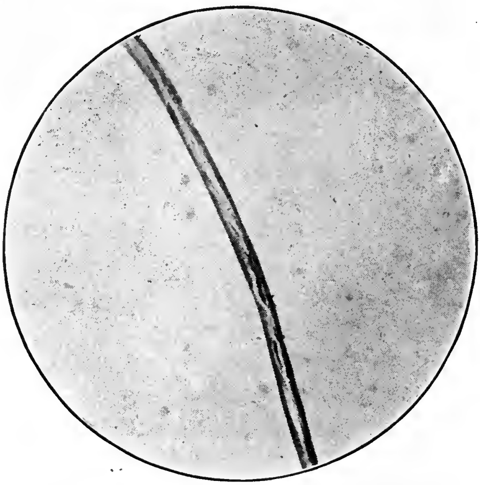

Fig. 6*b*.—Micrograph of mercerised cotton fibre.

the appearance of a transparent glass rod illustrating few surface markings, and is totally void of cellular structure (Fig. 6*c*). On examining a silk fibre longitudinally, it will frequently be seen to divide into two parts, this being due to the silk fluid coming from the two sides of the silkworm's body but always uniting to form one fibre. In certain wild silks a breaking-up of the fibres into fibrils may sometimes be noted under the microscope.

Strength and lustre are the distinguishing characteristics of the silk fibre. There is no textile fibre in proportion to its fineness comparable in elasticity and strength with that obtained from this material.

Artificial Silks: Viscose, Imitation Horse Hair, etc.—Many attempts have been made during recent years to imitate

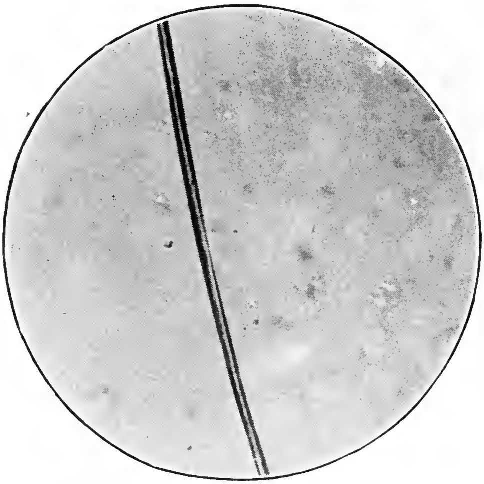

FIG. 6*c*.—Micrograph of silk fibre.

the silk produced by the silkworm. There are several methods of obtaining this artificial product and many differences in detail of manufacture, but the main outline is as follows :—

White wood pulp is first steeped in caustic soda and, in this wet state, stored so as to give the alkali a good chance of thoroughly impregnating the material. After being cut up into small pieces and exposed to the action of carbon disulphide it is placed in a strong solution of caustic soda, in which it dissolves. In this solution it is allowed to remain for a certain length of time during which a number of changes take place, the changes having an important effect upon the nature of the fibre ultimately produced (Fig. 6*d*).

When the solution has been reduced to its correct consistency it is squirted through holes in a platinum plate.

The diameter of the holes is about $\frac{1}{250}$th of an inch, and the pressure can be so arranged that it is possible to obtain filaments of various thicknesses from one and the same hole. Immediately after escaping from the holes the filaments pass quickly through solutions for the neutralization of the alkali and the consequent freeing of the gelatinous filament. A number of these filaments,

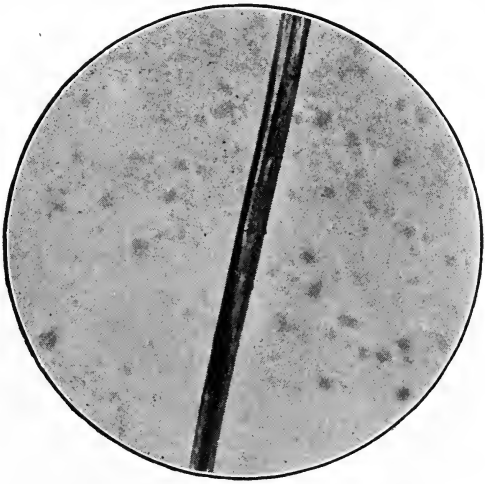

FIG. 6*d*.—Micrograph of artificial silk fibre.

according to the thickness or count of yarn required, are twisted together to form one thread.

The large number of patents which have been obtained in one or other branch of this important industry have not closed the field to other improvements for which there is ample room.

The strength of the fibre when in a moist condition still leaves much to be desired, and it is to be expected that many other improvements in detail will be brought about as the industry increases. At the present time, however, Viscose artificial silk has been found to so nearly fulfil all requirements that it is rapidly ousting most other artificial silks from the market.

CHAPTER II.

THE QUALITIES OF YARNS.

Influences which Determine Quality.—The influences, which determine or modify the quality of yarns, may be conveniently classified as follows :—

1. The nature of the raw material.
2. The method of preparing and spinning the raw material.
3. The twist put into the yarn.
4. The folding of the yarn.
5. Special treatments and preparations (Gassing, mercerizing, etc.).

1. *The Nature of the Raw Material.*—Practically the nature of the raw material determines not only the method of preparation and spinning of the yarn, but also the use the yarn may be put to, when spun.

Thus long wool such as Lincoln or other English wool is spun on the flyer frame for lustres, whereas botany may best be spun on either the cap or mule for soft goods.

2. *The Method of Preparing and Spinning.*—According to the method of preparing and spinning, vastly different results may be obtained from the same raw material, e.g. the French dry-combed mule-spun botany as compared with the cap-spun botany, worked up with oil. The former is fuller in appearance and softer in handle than the cap frame-spun yarn, this latter being an altogether "sadder" and more compact yarn.

Or to give another example, Merino wool may be prepared and spun as a woollen as well as a worsted yarn, as will be explained later. In this instance two quite different yarns are obtained. A yarn combed and gassed will give a very smooth and compact yarn, whereas a carded yarn, although the same raw material is used, is much fuller, looser, and more irregular.

3. *The Twist.*—The handle of a cloth and the appearance also may be varied greatly by altering the twist or turns of the yarn.

Almost any yarn, by the introducing of an undue amount of twist, may be made harsh in handle.

This may be desirable under special circumstances, but as a rule only the number of turns necessary to secure the firm adhesion of the fibres should be introduced.

In weft yarn (singles particularly) as little twist as possible is put in—just sufficient in most cases to enable the yarn to bear the drag of the shuttle.

In warp yarns, particularly in single counts, more twist is required than in a weft yarn of the same count, to enable the yarn to withstand the drag, friction, and strain during weaving.

Examples.—For Cheviots a very soft twist is employed, to give a full and soft handle in finishing and a rough surface; whereas for voiles a hard twist yarn is used, in order to obtain the crisp handle typical for voiles.

4. *Folding of Yarns.*—Yarns may be single, two-fold, or for special purposes many fold.

The reasons for using folded yarns instead of singles are:—

(*a*) To impart strength.
(*b*) To add weight.
(*c*) To give a special handle and appearance.
(*d*) For fancy effects (Grandrelle, etc.).

5. *Special Treatments.*—Wool or cotton yarns for special purposes are submitted to special treatments, in order to obtain novelty, e.g. the mercerizing, also the polishing and waxing of cotton yarns. In worsted the genapping or singeing may be specially noted.

Wool Yarns.—Wool is spun into two types of yarn—(*a*) worsted, and (*b*) woollen. In preparing and spinning a worsted yarn, the idea is to arrange the fibres parallel to each other. The woollen yarn, however, is spun so that the fibres are in all possible directions, with the result that the latter possesses more loose fibre than the former, and is of rougher appearance, which assists the shrinkage and felting of a fabric, as the fibres which compose the woollen yarn have a better opportunity of laying hold of each other than those which form the worsted yarn. The amount of twist or twine put into a yarn has also its influence on the contracting properties of the cloth into which it is made. The yarn in which the fibres are loosely twisted together may have a better opportunity to shrink, or contract, than the yarn where the fibres are tightly twisted together; consequently the variation during finishing of such dress fabrics as crêpons, voiles, and crêpe-de-chines (which are made from hard twisted yarns) will be different from that of dress fabrics composed of ordinary twisted yarns of the same material. There is also a difference in the shrinking property of yarns in the undyed and dyed condition, although spun from identical material. The yarn composed of coloured fibres has already been subjected to fibre shrinkage whilst being dyed in the top or yarn state; thus, it is necessary when making a piece-dyed cloth which is to be equal to a mixture cloth, or one composed of solid coloured yarns, to make a suitable allowance. For example, a fabric composed of undyed yarn would be 66 in. wide in the loom, whilst the fabric composed of coloured yarn would be set 64 in. wide in the loom, both structures to finish 56 in. wide. This point is also important in the designing of soft handling structures, also worsted coatings styles.

The amount of felting which may be developed during the milling process is largely dependent on the mechanical structure of the thread employed in the production of the fabric. This effect is illustrated in worsted and woollen goods, where, although both cloths may be made from the same class of wool, and whilst both may be identical in build and subject to the same finishing operations, they will be almost as distinct in the finished state as if they had been made from totally distinct materials and structure of fabric. This difference is entirely due to the structure of the yarns employed. Woollen and worsted yarns may be said to be as dissimilar as possible in formation.

The basis of the woollen thread is an entangled arrangement of fibres, a micro-photograph of which is illustrated in Fig. 7, whereas in constructing a worsted thread the aim is to lay the fibres in a uniform line with each other in a longitudinal direction. Fig. 8 illustrates a micro-photograph of a flyer-spun worsted yarn made from crossbred wool. The operations of spinning a woollen yarn all tend to cross and recross the fibres, whilst in preparing and spinning a worsted thread the fibres of which it is composed are mechanically arranged according to one regular order of parallelism, producing by this method a smoother and more level yarn than in the case of the woollen, where the fibres project from the main body of the thread to all points of its circumference. The cloth made from the woollen yarn will felt or mill more readily, and to a greater degree, as the fibres are crossed and recrossed, and are more easily acted upon than in the case of

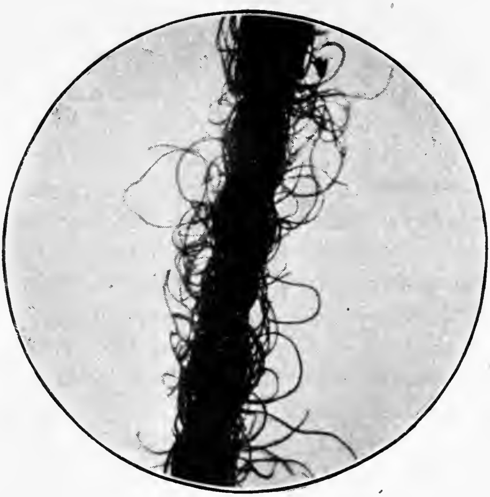

Fig. 7.—Micrograph of a woollen thread.

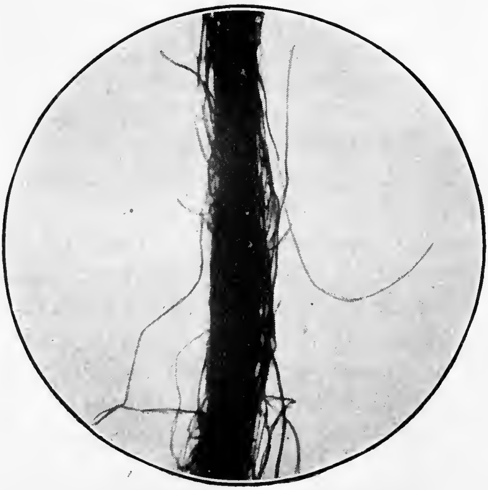

Fig. 8.—Micrograph of a flyer-spun worsted thread.

the cloth made of worsted yarns, where the fibres are bound down throughout their length by the necessary twist, and in consequence have not the opportunity to mat or felt together.

Worsted Yarns.—There are four distinct methods of spinning a worsted thread :—

Cap Spinning is the system from which a great output may be obtained, for which advantage the condition of the resultant yarn is often sacrificed. The spindles of the cap-spinning frame run at something like 5000 to 7000 revolutions per minute, and the high speed is responsible for the yarn being beardy or fibrous in appearance. In "clear" finishing goods made from that yarn, a large quantity of fibre is cut from the fabric, resulting in a certain loss of weight, nevertheless the cloth is often harsh and hard in handle.

Cap spinning is employed for short and medium length wools such as botany and fine and medium crossbred.

Ring spinning is the system employed for spinning fine and short materials. The cap and ring-spun yarns are somewhat alike in appearance, if any difference prevails it is that the ring-spun yarn is smoother, chiefly on account of the speed of the spindle being reduced, which is about 5000 revolutions per minute.

Flyer-spun Yarns are chiefly made from long wools and mohair. The speed of the flyer spindle is 2000 to 3500 revolutions per minute; the reduction in speed and method of winding the yarn, producing a cleaner, soft, and more uniform thread. The solid sound structure of this yarn readily lends itself to the production of several effects during the finishing of the fabric. The development of a "bright" finish in lustre cloths is dependent to a certain extent on the lustre yarn being smooth and the fibres parallel. A fibrous or rough yarn produces a cloth which will absorb light, whilst the yarn composed of fibres which are straight will produce a cloth presenting a greater reflecting surface.

Mule Spun.—Botany wool may be spun on the mule. In this system of spinning specially prepared worsted slivers are fed on to the machine. The twist is inserted over a distance of about 60 in. In other systems there is only a distance of about 5 to 8 in. between delivery rollers and spindle. Worsted mule spinning is in part a woollen method, therefore the fibres of a mule-spun botany yarn are not so straight and parallel as are cap-spun botany yarns. This feature of the fibre being to some extent crossed and recrossed, in addition to making a fuller, produces a stronger yarn, on which account single twist mule-spun botany yarns are in demand.

TABLE VII.—CLASSIFICATION OF WORSTED YARNS.

Type of Material.	Shrinking and Felting.	Lustre.
Short wool :—		
(*a*) Cap spun	Standard	Standard
(*b*) Mule spun	Increased	Decreased
(*c*) Ring spun	Standard	Increased
Medium wool :—		
(*a*) Cap spun	Standard	Standard
(*b*) Flyer spun	Increased	Increased
(*c*) Mule spun	,,	Decreased
Long wool :—		
(*a*) Cap spun	nil	Decreased
(*b*) Flyer spun	,,	Increased
Degrees of twist :—		
(*a*) Hard twist	Decreased	Decreased
(*b*) Medium twist	Standard	Standard
(*c*) Soft twist	Increased	Increased

Table VII indicates a comparison of the shrinking, felting, and lustrous properties of the differently spun worsted yarns.

Counts of Worsted Yarns.—Botany or merino wool is spun in counts up to 1/130's. The general counts in singles being, 1/20's, 1/30's, 1/40's, 1/50's, 1/60's, 1/64's, 1/72's, 1/80's, and in two-fold, 2/36's, 2/48's, 2/60's, 2/70's, 2/80's.

Crossbreds, generally speaking, are spun into standard 1/28's, and two-fold counts up to 2/40's.

Lincoln wool and mohair possess a spinning property about equal to that of crossbreds. Standard counts from these materials as spun for "bright" dress fabrics in such counts as 1/8's, 1/14's, 1/20's, and 1/32's.

Alpaca yarn is spun to a standard count of 1/40's.

Woollen Yarn.—This is spun as a rule from wool shorter in length than that employed for worsted yarns. Hence fibres which are too short for combing purposes are utilized in the production of woollen yarns. In construction the aim is the opposite to that of worsted, i.e. the fibres are mixed up as much as possible. The yarn on this account is fuller and more fibrous and uneven than that of a worsted construction.

On account of the method of spinning, the woollen yarn cannot be spun to the same fineness as the worsted thread. About 40 skeins woollen is a standard fine count. Yarns spun from low materials such as shoddy, mungo, extract, etc., are in most

* 256 yards to the skein.

cases spun up to their utmost. Thus the count of a low woollen yarn indicates the quality of the material employed.

Cotton Yarns are spun from combed or carded slivers and two-fold yarns may be twisted twiner, ring or flyer.

Sea Island cotton is spun up to counts of about 1/120's to 1/160's.

Egyptian Cotton is suited for counts up to about 1/120's.

The above yarns are invariably constructed on the worsted principle, and on account of the fibre being straight and parallel are most suitable yarns for being subjected to mercerizing.

American Cotton is used for counts ranging from about 1/20's to 1/80's.

Indian Cotton is employed for thick counts.

Silk Yarns.—There are two distinct classes of silk yarns, i.e. :—

(*a*) Pure or net silk.
(*b*) Spun silk.

(*a*) *Net Silk Yarns.*—These are constructed from fibres reeled straight from the cocoon, and in the case of organzine or warp yarns, three to eight fibres are lightly twisted together; subsequently two or more of these compound threads ("singles" as they are termed) are folded together to form the silk yarn employed as warp.

Weft yarns, known as tram silk, are made from two or more strands, each made from three to twelve cocoon fibres, which have undergone no preliminary twisting, so that tram silk is much straighter, softer, and more lustrous than organzine.

(*b*) *Waste and Spun-Silk Yarns.*—The fibre is obtained from entangled cocoons, through which the silkworm has eaten its way; also from wild cocoons, known as *Tussah* silk. These yarns are prepared and spun on a special principle, several qualities being produced according to the "drafts" produced on the dressing frame. The low qualities are short fibred and are only suitable for weft yarns, while the longer drafts produce higher quality yarns well suited for warp.

Union Yarns.—These are composed, as the name suggests, of two or more materials. Wool and vegetable fibre such as cotton are the materials which are usually combined. There are two distinct forms of union yarns; the two materials may be intermingled in the fibre state or a thread of each material may be twisted together. Some so-called woollen threads are composed very largely of cotton fibre. The cotton is scribbled with the wool—in some cases to add strength and in others to reduce cost.

FIG. 9*a*.—Union yarn. Micrograph of cotton and wool mixture yarn.

(*a*) (*b*)

FIG. 9*b*.—Union yarn. Micrograph of cotton (*a*) and wool (*b*) yarns twisted together.

Angola Yarns are acknowledged to be composed of cotton and wool fibres. The wool present consists of mungo or shoddy and the addition of a finer fibre such as cotton assists the spinning of the yarn for finer counts (see Fig. 9*a*).

Union Twist Yarn.—For producing special designs in union fabrics, yarns may be employed composed of one thread worsted and one cotton. The union thread is arranged in the warp according to requirements (see Fig. 9*b*). When a wool fabric composed totally or partly of such yarns is dyed, the cotton remains its original colour.

The following forms a typical example:—

Warp.

1 thread 56's botany } twisted
1 ,, 72's cotton } together.

100 threads per in.

65 in. loom width.

56 in. finished width.

Weft.

1/40's botany.

65 picks per in.

Weave.—5 end venetian or warp sateen.

Dye.—Any required colour.

Coloured Yarns.—The most important coloured woollen and worsted yarns are:—

(*a*) Mixtures.
(*b*) Melanges.
(*c*) Marls.
(*d*) Twists.

(*a*) *Mixtures.*—A mixture yarn is one composed of fibres of two or more colours which have been thoroughly blended. In woollens the wool is dyed after scouring and the mixing accomplished during the carding process. For producing worsted mixture yarns, the usual method is to slubbing dye the wool, and then to recomb it, thus producing coloured "tops". During the drawing processes the required colours of tops are placed behind the first gill box and these are run together through two or three more gill boxes producing a vari-coloured sliver, or mixture as it is termed. Thus the various-coloured tops are doubled and drafted such a number of times, that the different colours of fibre are thoroughly mixed, and the colour of the resultant yarn resembles none of the component parts; it is only by a close investigation that the separate colours may be detected.

(*b*) *Melange.*—This is a fine mixture yarn produced from a top-printed sliver. The result is obtained by printing at regular intervals the required colours on to the top (see Fig. 10). The mixing of the fibres and colours is brought about during the drawing and spinning processes. As a rule only long fibres, such as mohair, are subjected to this method of treatment. In these yarns on many fibres two or more colours may be clearly seen under the microscope.

(*c*) *Marls.*—A term sometimes applied to three-fold twist yarns but more correctly applied to a yarn which is between a twist and the mixture yarn. It is produced by combining two or

FIG. 10.—Melange printed top.

more slivers of different colour in the later drawing operations, and in consequence the colours are not so thoroughly blended as in the case of mixture yarns.

(*d*) *Twists* are produced by simply twisting or folding together two or more yarns of different colours.

Another method of making what may be termed a twist-marl yarn is to place two rovings of different colours on the spinning frame and run a thread from each through back and front or through one pair of guide rollers only and on to one spindle, and thus obtain a yarn of two colours.

Special Yarns.—These are made by folding two or more yarns together. They may be either different in quality, material, or structure, but the result of any of these is a yarn which is employed for the production of novel or fancy effects in textures; such yarns are known as: Tinsel, tinsel and cotton twist, loop, spiral, canvas, slub, flaked, knop, and cloud yarns (see Fig. 11).

Matching Coloured Yarns and Fabrics.—In matching off solid colours little difficulty will be experienced; but the colour to be matched should always, if possible, be separated from its

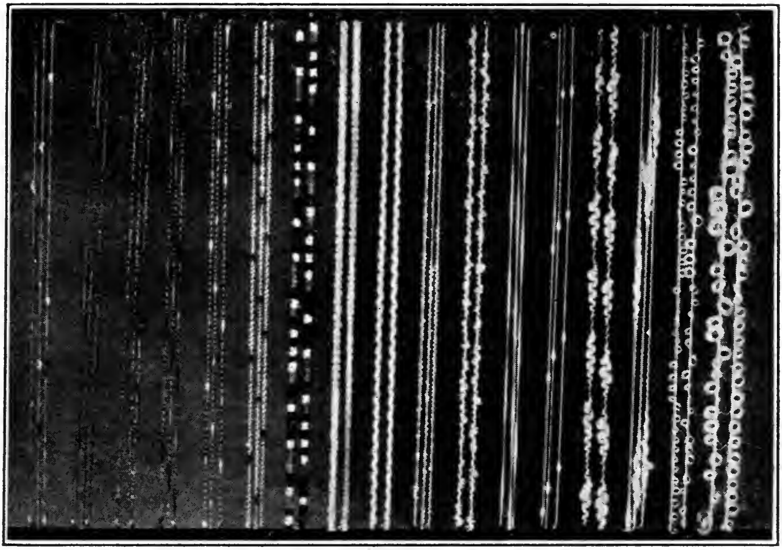

FIG. 11.—Fancy yarns.

surroundings, since its tone may be altogether different in the cloth and out of the cloth. This may be effected at times by cutting two holes in a piece of cardboard (as shown in Fig. 12) at such a distance that upon placing the cardboard upon the pattern supplied for analysis one colour appears at A and another at B. This method, however, is not so effective as might be supposed in matching colours from cloth, as the cloth to be matched should be held up to the light and judged by looking over; but at times it will prove very useful. The "tintometer" has of late been much thought of as an advance in the right direction in the matching of colours. The idea is simply to match colours by slips of coloured glass, suitably graded and numbered; but since it is a fact that the nature of the raw material in textile fabrics influences very considerably the colour employed, it is apparent that its application is very limited.

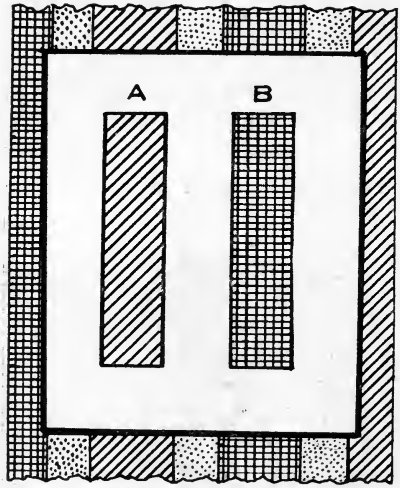

Fig. 12. – Matching coloured yarns in cloth.

Mixtures may be more difficult to deal with, especially if compounded of several shades. Microscopic examination will reveal the several colour-constituents, and matching under these conditions is difficult but possible: judgment and experience are here most essential.

In order to match practically any desired mixture, a pair of hand cards (as shown in Fig. 13) or a small gill-box should be at hand, along with a well-graded set of dyed wools (or, preferably, botany tops or drawings), so that a selection may be made of the colours supposed to be present in the combination, and the mixture effect obtained in a few minutes. This is a much handier

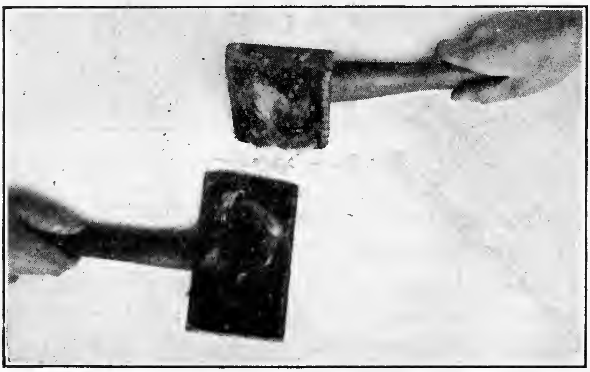

Fig. 13.—Mixing coloured fibres with hand cards.

method than running a small batch through a carder, although perhaps this latter procedure is more certain. Careful note should be made of both the colours and materials.

Of great use to the textile designer are twists composed of two, three, or even four colours. Two-fold are used most extensively; but three-fold in both plain and fancy twist may be

B A

FIG. 14.—A, openband (right twist); B, crossband (left twist).

introduced with effect at times. The attention of the analyst should always be given to this point when analysing goods where colour plays a prominent part; as, for example, in Scotch tweeds, for in such goods the most careful toning of colours is often effected by twisting coloured threads of varying thickness together, thus obtaining an effect not otherwise producible.

Fancy yarns are made in such variety that a minute analysis is usually necessary. The principle of most, however, is simply holding one thread tight and twisting the other round it, and then reversing the yarns—thus continually reversing the colours.

The Influence of Twine of Yarn on Woven Fabrics.—The direction of the twine of the yarns which constitute a woven fabric—particularly in worsteds and woollens—has an important bearing on the appearance of the design in the fabric. If two cloths were made from yarns, with the direction of the twist in one case opposite to the direction of the twist in the other case, and identical in all other respects, it would be found that the two fabrics were of different appearance.

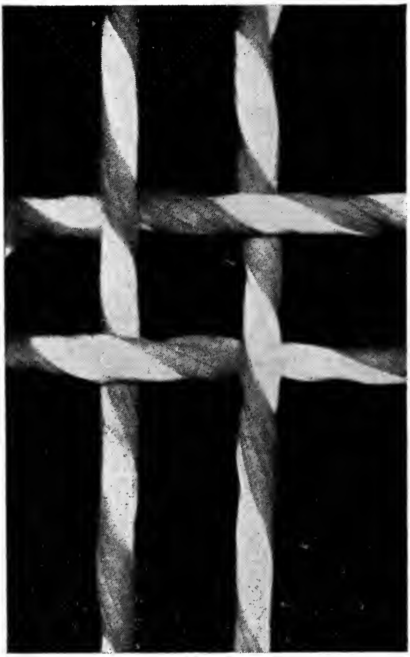

Fig. 15*a*.

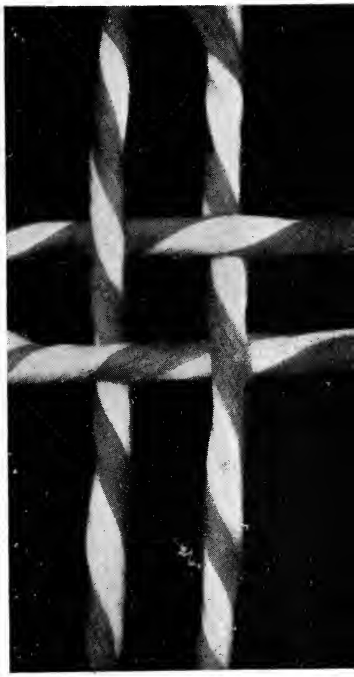

Fig. 15*b*.

Yarns may be twisted to the right (openband) or to the left (crossband) according to whether the spindle bands of the spinning frame are in an open or crossed condition, or the machine running reverse twist or not as illustrated in Fig. 14. When warp and weft yarns are twisted in opposite directions, upon being laid across at right angles (as they will be in the cloth), the twists cross one another, since the upper surface of one is in contact with the under surface of the other yarn (Fig. 15*a*): hence they tend to stand off one another, leaving the yarns distinct. This separation is further accentuated by causing the twill to oppose the surface direction of the twist of the yarns.

In woollen goods where a compact structureless texture is required, the best conditions are to have the warp and weft twisted in the same direction (Fig. 15*b*), so that in the cloth they bed into one another.

The effect of direction of twist on twills is illustrated in Fig. 16, where the direction of the twine of warp and weft are in opposite directions. It will be observed that by reversing the twill a stripe pattern is produced which is due to two factors, i.e. to the twill running to the right showing up more distinctly than that which

Fig. 16.—Illustrating the influence of direction of twist on twill.

runs to the left, and to the differently reflected light from the two angles of twill.

Right (openband) and Left (crossband) Twist Effects.—Optical effects due to different reflections of light are produced in woven fabrics by employing two yarns, as warp or weft or both, which have been twisted to the right and to the left respectively. Yarns are twisted as shown in Fig. 14. When light is thrown on to the two twists of yarn from one position, the reflection of light will be in opposite directions as indicated by the diagonal lines C in Fig. 17.

This optical effect is taken advantage of and largely employed in the production of "shadow" stripes and checks. An illustration of this effect in an "amazon" dress fabric is given in Fig. 18. The particulars of production are:—

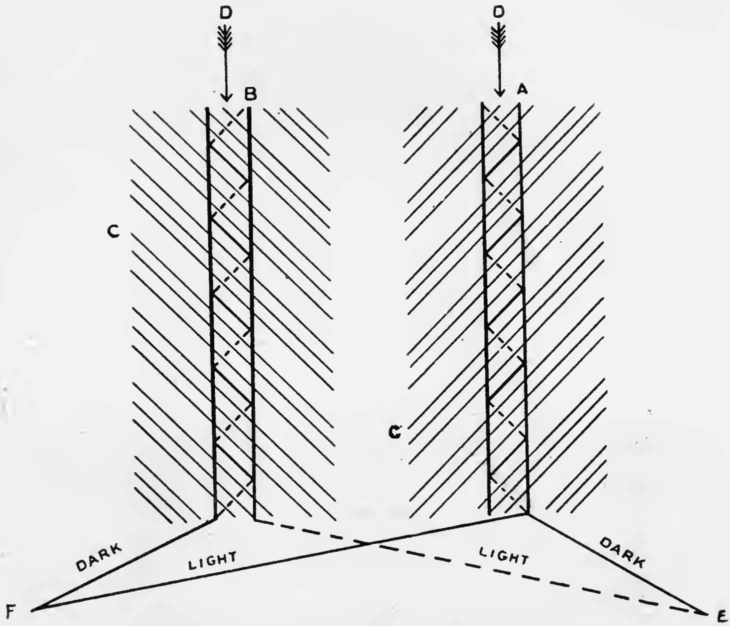

FIG. 17.—Light reflection from twills.

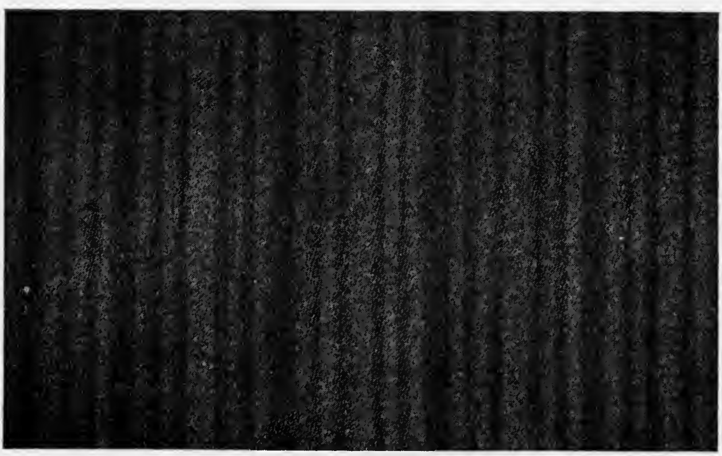

FIG. 18.—Pattern due to right and left twist yarns.

Warp.

1/32's grey botany worsted.
84 threads per in.

Weft.

40 skeins grey woollen.
38 picks per in.

The weave is 5 warp sateen, and is piece dyed to shade. The warp threads are arranged in the following order :—

	20	threads	twist	A
twice	10	,,	,,	B
	10	,,	,,	A
	20	,,	,,	B
twice	10	,,	,,	A
	10	,,	,,	B

The effect in the cloth is dark and light stripes alternately, which at the first appearance suggest that two shades of yarn or two weaves have been employed. As the cloth is piece dyed one solid colour, and the weave is the same throughout, it is evident that the dark and light stripes are entirely due to the deflection of light in opposite directions created by the warp threads being arranged in a suitable order of "right" and "left" twisted threads. Another feature in connection with these optical effects of dark and light stripes is that they counterchange when held to the light at opposite angles. This will be understood by reference to Fig. 17. In this illustration light is shown reflected on to the yarn A "right" twist and B "left" twist in the direction marked by arrows D. The action of the "right" twist is to reflect the light falling upon it to the left, whilst the "right" twist turns the light in an opposite direction. As a consequence when the yarns are viewed from the angle E the "left" twist B will reflect the light in that direction and appear in the cloth to be lighter in shade than the yarn A of opposite twist. From the opposite angle F the light and dark appearances will be vice versa.

The only difficulty in producing these goods is that, owing to the warp being all of one colour, the weaver is likely to piece up crossband broken threads with openband threads. In order to avoid this, one of the yarns, either the openband or the crossband threads, are tinted with a fugitive colour or tint.

CHAPTER III.

CALCULATIONS RELATING TO YARNS.

The Counting of Yarns.—By the terms "count," "cut," "lea," "run," "skein," etc., the ratio of length of yarn to weight is indicated. Usually 1 lb. (avoirdupois) is taken for the standard weight and the "count," etc., indicates the length to which this weight of material has been extended.

Yarn calculations are further complicated by the count of a yarn not indicating the exact length say in yards but in hanks per lb. A hank is best defined as a convenient number of yards for bundling together. Thus the "count," etc., of a yarn usually represents the number of hanks which weigh 1 lb. and thus indirectly the yards per lb.

The many methods of numbering or counting yarns are bewildering. As to the advantage and simplicity of a uniform standard and method of counting yarns, there is no doubt. Of the many systems in vogue Tables VIII*a* and VIII*b* illustrate the principal methods.

Take an example in the case of worsted, in which 1 lb. of yarn is drawn out to 560 yds. This will give 1's count and is the basis of all calculations (see Fig. 19). Similarly if 1 lb. of yarn is drawn to 5600 yds. the count will be:—

5600 (yds. per lb.) ÷ 560 (yds. per hank)
= 10 (hanks per lb.) or 10's *count*.

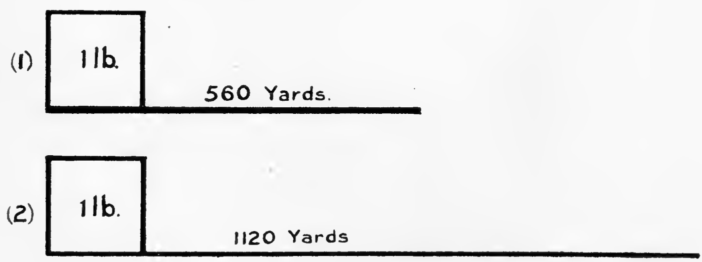

Fig. 19.—Graphic illustration of yarn counts.

The various systems of counting yarns at present in use are indicated in the following list :—

TABLE VIIIA.—VARIOUS SYSTEMS OF COUNTING YARNS (FIXED WEIGHT).

System and Material.	Fixed Weight.	Length of Hank.	Examples.
Worsted	1 lb.	560 yds.	10's = 5600 yds. per lb.
Woollen :—			
(*a*) Leeds or Yorkshire skein	1536 yds. = 6 lb.	256 „	10 skn. = 2560 „ „
(*b*) Galashiels	300 „ = 24 oz.	200 „	10's = 2000 „ „
(*c*) West of England	1 lb.	320 „	10's = 3200 „ „
Cotton	1 „	840 „	10's = 8400 „ „
Linen	1 „	300 „	10's = 3000 „ „
Silks :—			
(*a*) Spun	1 „	840 „	10's = 8400 „ „
(*b*) Organzine	1 oz.	nos. of yd.	1000's = 1000 yds. per oz.
Metric	1 kg. = 2·204 lb.	1 km.	10's = 10,000 metres per kg.
French	½ „ = 1·102 „	1 „	10's = 20,000 „ „

TABLE VIIIB.—VARIOUS SYSTEMS OF COUNTING YARNS (FIXED LENGTH).

System and Material.	Standard Weight.	Fixed Length.	Examples.
Tram or weft silks	1 dram	1000 yds.	3 dram silk indicates 1000 yds. = 3 drams
Organzine or net silks	1 gram (½ denier)	476 or 500 metres	20 denier silk indicates 500 metres = 10 grams
Artificial fibres	„	„ „	„ „

Example 1.—If 1 lb. of raw material is spun out to 33,600 yds. What is the count in the (1) worsted, (2) cotton, (3) Yorkshire skeins woollen, (4) linen, and (5) Galashiels woollen methods of counting?

(1) $33{,}600 \div 560 = 60$'s worsted.
(2) $33{,}600 \div 840 = 40$'s cotton.
(3) $33{,}600 \div 256 = 131\frac{1}{4}$'s Yorkshire skeins woollen.
(4) $33{,}600 \div 300 = 112$'s linen.
(5) $33{,}600 \div 200 = 168$'s Galashiels woollen.

Example 2.—The weight of a length of 32's worsted is 7 oz. What is its length?

1 lb. of 1's count = 560 yds.
1 lb. of 32's count = 32 × 560 yds. = 17,920 yds.
as 1 lb. (16 oz.) : 7 oz. : : 17,920 yds. : 7840 yds.

Example 3.—Find the yards per lb. of 56's count in (1) worsted, (2) West of England woollen, (3) linen.

(1) 56 × 560 = 31,360 yds. worsted.
(2) 56 × 320 = 17,920 yds. West of England.
(3) 56 × 300 = 16,800 yds. linen.

Testing a Given Count.—The simplest method of testing a given count is as follows :—

Rule.—Reel as many yards as there are hanks per lb. in the count to be tested, and weigh against 12·5 grains for worsted, 8·33 for cotton, and 27·34 for woollen (Yorkshire skein). The reason for this is as follows : There are 7000 grains in 1 lb. avoirdupois. Now, 1 yd. of 1's worsted would weigh 7000 ÷ 560 = 12½ grains, and 10 yds. of 10's worsted, 20 yds. of 20's, etc., should weigh exactly the same. A similar reasoning applies to the other systems of counting yarns.

Scales and Weights.—In the factory very crude scales will often be found, upon which the carder, comber, or spinner depends. This, however, is not as it should be, and every day sees the introduction of more perfect systems into our factories ; and the manufacturer who is alive to his own interests will provide for his workpeople all that is necessary for conducting accurate tests, for he is then justified in expecting accurate results. Scales may be purchased from most opticians at prices varying from 2s. 6d. to £10 and upwards. Neither of these extremes is necessary or perhaps desirable. A good, substantial pair may be purchased for about £1 which should be quite accurate enough for all ordinary purposes, yet not so finely adjusted but that they will stand a little rough usage. Weights may be obtained in boxes at various prices. The analyst should be provided with the following grain weights : 50, 20, 20, 10, 5, 2, 2, 1, ·5, ·2, ·2, ·1, ·05, ·02, ·02, ·01 ; and he should be careful to lift them about with the tweezers supplied, since handling is very liable to affect their accuracy.

Method of Obtaining the Counts of Yarn from a Small Sample of Cloth.—The foregoing particulars only apply to testing the count of yarn before weaving. To test yarn taken from a cloth is a more difficult matter. Let us suppose that it is required to obtain the count of yarns in a cloth of which we have a pattern cut 3 in. × 3 in. Then proceed thus :—

1. Examine the cloth carefully to ascertain if warp is all one count and if weft is all one count.

2. Obtain as great a length as convenient of each of the yarns present in the cloth.

3. Weigh these lengths carefully to the hundredth part of a grain.

4. Divide 7000 grains by the weights thus obtained and multiply by the yards of yarn weighed, and the result will be the yards per lb., from which the counts may be readily obtained.

Example 1.—(1) An examination of the 3 in. × 3 in. pattern reveals that it is a serge cloth composed of crossbred worsted yarns.

(2) From this 36 threads of warp and 36 picks of weft are taken, thus obtaining 3 yds. of each.

(3) Each is found to weigh 3·15 grains.

(4) 7000 ÷ 3·15 = 2222 × 3 = 6666 yds. per lb. ÷ 560 = nearly 12's count worsted.

Example 2.—A cotton warp and mohair weft cloth is submitted for analysis. After being cut 3 in. × 3 in. 36 threads of warp are found to weigh 1·2 grains and 36 picks of weft 3·7 grains. What are the counts of warp and weft respectively ?

Warp.

As 1·2 grains : 7000 grains : : 3 yds. : 17·500 yds. per lb.

17·500 ÷ 840 = 20's count of cotton warp.

Weft.

As 3·7 grains : 7000 grains : : 3 yds. : 5676 yds. per lb.

5,676 ÷ 560 = 10's count of mohair weft.

Gauge Points.—From the above examples it will be observed that the multiplying by 7000 grains and dividing by the number of yards per hank, according to the system of counting, is involved in each calculation. This may be obviated and the calculation made more direct and simplified by instituting a gauge point for each method of counting yarns.

7000 grn. per lb. ÷ 560 (yds. per hank) = 12·5 worsted gauge point.
,, ,, ,, ÷ 840 ,, ,, = 8·33 cotton gauge point.
,, ,, ,, ÷ 256 ,, ,, = 27·43 Yorkshire, skein, woollen gauge point.

Then—

As (weight of yarn) : (gauge point) : : (yds. weighed) : count of yarn.

Example 1*a*.—What is the count of 3 yds. of worsted warp which weighs 3·15 grains?

As 3·15 grains : 12·5 (gauge point) : : 3 yds. = 11·9 worsted counts.

Example 2*a*.—3 yd. of cotton warp weighs 1·2 grains and 2 yds. of mohair weft weighs 6·7 grains. What are the counts of both yarns?

Warp.

As 1·2 grn. : 8·33 (gauge point) : : 3 yds. : 20's count of cotton warp.

Weft.

As 3·7 grn. : 12·5 (gauge point) : : 3 yds. : 10's count of mohair weft.

The results obtained in the foregoing examples are not absolutely the count of yarn employed to make the cloth. Owing to the contraction and bending of the yarns during weaving and finishing the actual lengths of yarn weighed are more than those indicated. Further a certain loss in weight is involved during the finishing processes. Hence the two factors mentioned must be taken into account before the count of yarn as employed in the loom can be ascertained. This somewhat difficult matter will be dealt with later.

Estimating the Counts of Yarn.—A method of estimating the counts of the yarn is to compare it with known counts. By taking a number of threads of a known count and twisting them with a varying number of threads of the unknown count until the two, twisted, appear to make a thread of similar thickness, the count of the unknown yarn may be obtained. Practice enables the analyst to estimate the count with great accuracy by such comparison in the case of low and medium numbers; but in the higher numbers some more certain method is necessary.

A combination of the two methods may also prove useful. Thus: judge as nearly as possible the counts of the yarn—say 20's; reel 20 yd. and weigh against 8·33 grains, if for cotton. If it weighs more (say 9·5), the counts are less in the proportion.

As 9·5 : 8·33 : : 20 : x = the true counts.

If it weighs less (say 7·5), the counts are a higher number, in the proportion.

As 7·5 : 8·33 : : 20 : x = the true counts.

Although grain weights are invariably employed for fine tests in dealing with yarns and cloths, in the works the ordinary avoirdupois weights are more frequently met with, the method of testing being this : Since there are 256 drams in 1 lb., and 560 yd. per hank of worsted, therefore 1 yd. of 1's will weigh $\frac{256}{560}$ drams, or about 3/7 dram, but this would evidently be too short a length and too small a weight to favour any degree of accuracy, therefore a convenient practical part of the hank—say 70 yds. (1/8 of the hank)—should be taken, then proceed as follows :—

$$\frac{256 \text{ drams}}{8} = \text{the weight of 70 yds. of 1's,}$$

$$\text{therefore } \frac{256 \text{ drams}}{8 \times 20\text{'s}} = \text{the weight of 70 yds. of 20's,}$$

and, consequently, putting the desired count in the place of the 20's, the drams that 70 yds. should weigh will be obtained ; and should the sample, being tested, weigh more or less, the count will be less or more in direct proportion, as explained further on.

Worsted Spinners use what is termed a "gauge point," obtained as follows :—

Taking 70 yds. as a convenient number to reel :—

$$\frac{256 \times 70}{560} = 32 \text{ drams or 2 oz. weight of 70 yds. of 1's.}$$

Consequently the count of any given yarn, divided into this, will give the drams which 70 yds. should weigh.

Example.—Find the correct weight of 70 yds. of 2/16's yarn (= 8's).

$$32 \div 8 = 4 \text{ drams.}$$

This may be readily proved, for if 70 yds. = 4 drams, 560 yds. = 32 drams, and 256 ÷ 32 = 8 hanks per lb., or 8's count.

Of course there is no need to reel 70 yds. ; 80 yds. (or 1/7 of 560), or 140 or 280 yds. will do equally well.

In the case of **Cotton and Spun-Silk Yarns** proceed in the same manner, reeling a convenient practical part of the 840 yds. —say 84 yds. = $\frac{1}{10}$th of 840 ; then

$$\frac{256 \times 84}{840} = 25\tfrac{1}{2} \text{ drams weight of 84 yds. of 1's.}$$

Consequently any count divided into $25\frac{1}{2}$ gives the weight of 84 yds.

Example.—$25\frac{1}{2} \div 20 = 1\frac{1}{4}$ drams weight of 84 yds. of 2/40's or 20's.

This may be proved thus: 84 yds. = $1\frac{1}{4}$ drams, 840 yds. = $12\frac{1}{2}$ drams, and $256 \div 12\frac{1}{2} = 20$ hanks per lb., or 20's count.

In the woollen trade the skein always equals the yards per dram; thus 20 skeins = 20 yds. per dram, 30 skeins = 30 yds. per dram.

Changing the Denomination.—From what has already been given, it will be evident that counts are used simply as a means of accurately estimating the thickness or size of yarns in relation to weight; and it will also be evident that in reality the yards to which 1 lb. of the material is drawn is used as the measure. For instance, as shown in Fig. 19 in (1) 1 lb. of material is drawn out to 560 yds. = 1's count; in (2) 1 lb. of material is drawn out to 1120 yds. = 2's count; consequently, 1 yd. of 1's is double the weight of 1 yd. of 2's, or weight is inversely to count.

Upon these lines the manufacturer bases the calculations for his cloths. But from the particulars already given it will be evident that a 20's yarn in worsted count is a very different yarn to a 20's yarn in cotton or other counts; consequently, the designer cannot estimate the relative thicknesses of any two such threads until they are in the same denomination, i.e. both stated in either worsted or cotton count (see Fig. 20). Remembering that counts are really based upon yards per lb., the rule for this will be as follows:—

To Change the Count in any Given System to Equivalent Count in any other System.

Rule.—Ascertain the yards per lb. in the count to be changed and divide by the yards per hank in the system into which the required change is to be made.

Example.—Change a 20's worsted into woollen count.

$$20 \times 560 = 11{,}200 \text{ yds. per lb.}$$
$$11{,}200 \div 256 = 43\tfrac{3}{4} \text{ woollen counts.}$$

Example.—Change a 60/2 silk into worsted counts.

$$\frac{60 \times 3}{2} = \frac{180}{2} = 90\text{'s worsted.}$$

[Note.—560 is to 840 as 2 : 3, therefore 2 and 3 are used in the above calculation instead of 560 and 840.]

From Fig. 21 any desired conversion may be read off almost at a glance.

The Counts of Two-fold Yarns.—The usual practice in two-folding yarns is to twist two or more threads of like count together, thereby obtaining a stronger, evener, and usually a heavier thread. The actual count in this case will be just half the stated count, i.e. two-fold 40's yarn (written 2/40's) equals in weight single 20's. (*Exception*—2/60's silk, usually written 60/2 = 60's.)

In twisting together yarns varying in thickness, and consequently counts, they must all first be brought to one denomi-

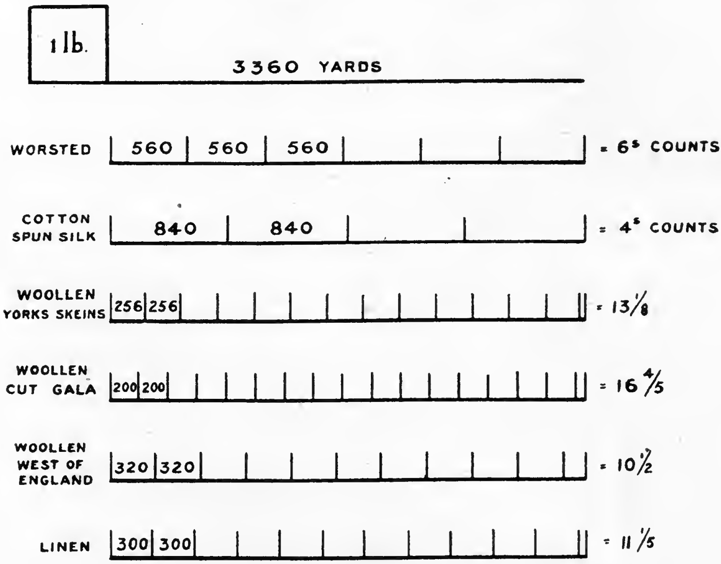

FIG. 20.—Graphic illustration of changing denominations.

nation, i.e. worsted, woollen, or cotton, as required, and then the resultant count will be obtained as follows :—

Rule.—Multiply the two counts together, add the two counts together, and divide one by the other for the answer.

Example.—What is the resultant count of 20's twisted with 40's?

$$\frac{20 \times 40}{20 + 40} = \frac{800}{60} = 13\tfrac{1}{3} \text{ count.}$$

The following is the reason for this method of procedure: 40 lb. of 20's is equal in length to 20 lb. of 40's; therefore the resultant yarn will be composed in the proportion of 20 lb. of 40's yarn to 40 lb. of 20's yarn. Now, the length of 20 lb. of 40's and 40 lb. of 20's will be the same, i.e. $20 \times 40 = 800$

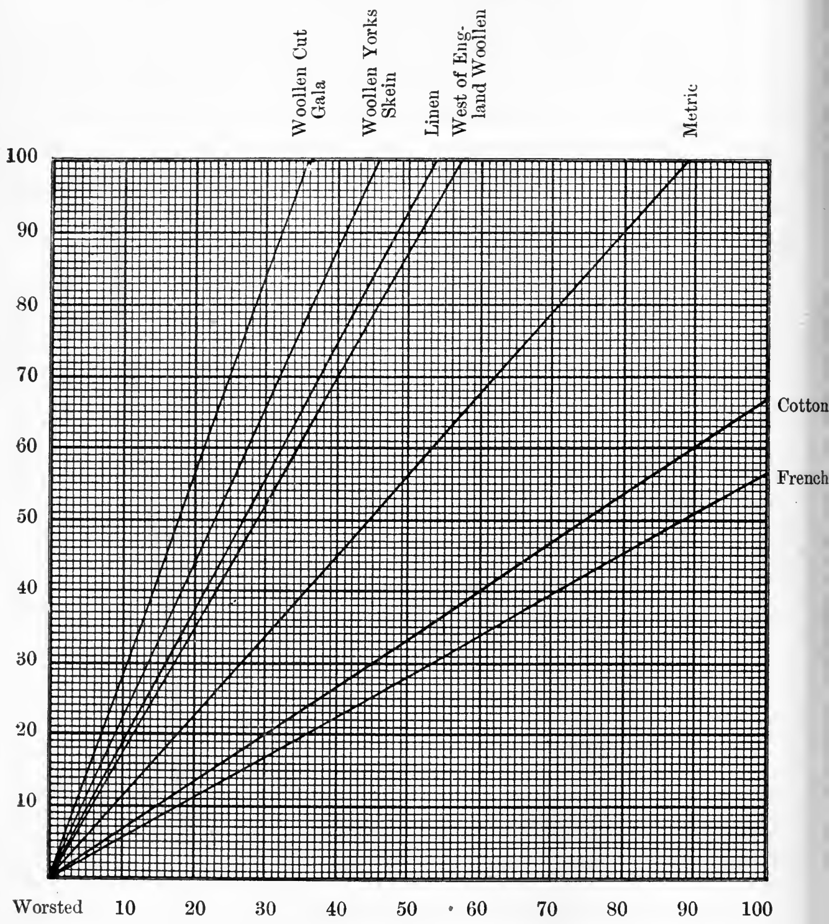

Fig. 21.—Graphic illustration of changing the denomination.

hanks; therefore the sum, simplified, is: if 800 hanks weigh 60 lb., what are the counts? and the answer is $800 \div 60 = 13\frac{1}{3}$ hanks per lb.

Another method of arriving at the same result is to divide one of the counts—preferably the highest—by itself, and by each of the others, and the result thus obtained divided into these counts will be the answer, thus :—

$$\begin{array}{l} 40 \div 40 = 1 \\ 40 \div 20 = 2 \\ \hline 40 \div \quad\;\; 3 = 13\tfrac{1}{3} \text{ count.} \end{array}$$

In this case also the reason is very apparent: the 40 hanks equal 1 lb. being taken as the length; thus, 2 lb. of 20's is requisite to give the same length, and 40 hanks weighing 3 lb. = $13\frac{1}{3}$ hanks per lb.

In the case of three or more threads twisted together, proceeding by the first rule, the resultant counts of two must be first ascertained, and then of this and the third thread and so on.

Example.—What is the resultant count of 20's, 40's, and 80's?

$$\frac{20 \times 40}{20 + 40} = 13\tfrac{1}{3} \text{ resultant count of first two threads.}$$

$$\frac{13\frac{1}{3} \times 80}{13\frac{1}{3} + 80} = 11\tfrac{3}{7} \text{ resultant count of three threads.}$$

By the second method, however, the result may be much more easily obtained—

$$\begin{array}{l} 80 \div 80 = 1 \\ 80 \div 40 = 2 \\ 80 \div 20 = 4 \\ \hline 80 \div \quad\;\; 7 = 11\tfrac{3}{7} \text{ counts.} \end{array}$$

Another case in which it may be necessary to apply the above principles is as follows :—

Example.—What thread twisted with a 40's yarn will give $13\frac{1}{3}$ count? Then,

$$\frac{40 \times 13\frac{1}{3}}{40 - 13\frac{1}{3}} = 20\text{'s count.}$$

This may be reasoned out as follows: 40 lb. of $13\frac{1}{3}$ counts (= $13\frac{1}{3}$ lb. of 40's counts) is taken for the length, i.e. $533\frac{1}{3}$ hanks, weighing 40 lb.; but of this 40 lb., $13\frac{1}{3}$ lb. represents the 40's or given count, so the remainder or component is $533\frac{1}{3}$ hanks, weighing (40 − $13\frac{1}{3}$ lb. =) $26\frac{2}{3}$ lb. = 20's count.

N.B.—Note that in the above no denomination is given—

the calculations apply equally to all denominations; but all the threads twisted together must be reduced to the same denomination before the calculation is made.

Bearing these points in mind it will be evident that this calculation may be solved on similar lines to that given above, thus:—

$40 \div 13\frac{1}{3} = 3$
$40 \div 40 = 1$
40 hanks weighing 2 lb. = 20 hanks per lb. of 20's count.

The Cost of Two and Many Fold Yarns.—If the prices of the yarns combined are given it will evidently be an easy matter to calculate the cost of the folded yarn, since the above calculation gives the relative weight of each yarn in the combination. An example will best demonstrate this.

Example.—Calculate the cost of a yarn composed of 20's yarn at 2/- and 40's yarn at 3/- :

$40 \div 40 = 1$ lb. at 3/- = 3/-
$40 \div 20 = 2$ lb. at 2/- = 4/-
3 lb., costing 7/- = 2/4 per lb.
Count of yarn = $13\frac{1}{3}$, costing 2/4 per lb.

A more difficult calculation is as follows: Required the price per lb. of a three-fold twist yarn, made as follows: one thread of 44's worsted at 3s. 8d. per lb., one thread of 36's spun silk at 17s. per lb., and one thread of 36 skeins (Yorkshire) at 2s. 6d. per lb.; allowing $17\frac{1}{2}$ per cent for twisting-up in worsted and 15 per cent for twisting-up in silk.

Evidently the first thing to be done is to bring all the counts to one denomination; so first reduce the silk and worsted to woollen counts, thus:—

$$\text{44's worsted} = \frac{44 \times 560}{256} = 96\frac{1}{4} \text{ skeins woollen counts.}$$

$$\text{36's silk} = \frac{36 \times 840}{256} = 118\frac{1}{8} \text{ woollen counts.}$$

Now the weight for any given length must be obtained: let the given length be $118\frac{1}{8}$ hanks and proceed on the principles already laid down, thus:—

		lb.	oz.	dr.	
$118\frac{1}{8} \div 96\frac{1}{4} = \dfrac{118\frac{1}{8}}{96\frac{1}{4}} + \dfrac{17\frac{1}{2}}{100}$	(for per cent)	$=1$	7	$14\frac{1}{4}$	of worsted.
$118\frac{1}{8} \div 118\frac{1}{8} = 1 + \dfrac{15}{100}$	(for per cent)	$=1$	2	$6\frac{2}{5}$	of silk.
$118\frac{1}{8} \div 36 = \dfrac{118\frac{1}{8}}{36}$		$=3$	4	8	of woollen.
$118\frac{1}{8}$ hanks		5	14	$12\frac{13}{20}$	

From this the counts may be readily obtained, for $118\frac{1}{8}$ hanks $= 118\frac{1}{8} \times 256 \div 1516$ dr. = about 20 yds. per dram, or 20 skeins.

The cost per lb. will now readily be ascertained as follows :—

lb.	oz.	dr.		d.
1	7	$14\frac{1}{4}$	at 3/8 per lb. $= \dfrac{382}{256} \times \dfrac{44}{1} =$	$65\frac{21}{32}$
1	2	$6\frac{2}{5}$	at 17/- per lb. $= \dfrac{294}{255} \times \dfrac{204}{1} =$	$234\frac{9}{32}$
3	4	8	at 2/6 per lb. $= \dfrac{840}{256} \times \dfrac{30}{1} =$	$98\frac{14}{32}$
5	14	$12\frac{13}{20}$	costing - - -	$398\frac{12}{32}$

$(398\frac{3}{8} \div 1516) \times 256 =$ 5s. 8d. per lb. for 3-fold yarn.

To test the correctness of this answer reduce all to worsted counts, and proceed as follows :—

		lb.	oz.	dr.
Silk	$= 54 \div 54 + \dfrac{15}{100}$	$=1$	2	$6\frac{2}{5}$
Woollen	$= 54 \div 16\frac{3}{7}$	$=3$	4	8
Worsted	$= 54 \div 44 + \dfrac{17\frac{1}{2}}{100}$	$=1$	7	$14\frac{1}{4}$
	54 hanks	$=5$	14	$12\frac{13}{20}$

or—

30,240 yds. ÷ 1516 dr. = 20 yds. per dram, or 20 skeins woollen ;

and $\dfrac{20 \times 256}{560} = 9\frac{1}{7}$ counts in worsted.

For the price proceed as follows :—

	lb.	oz.	dr.		d.
Silk - - -	1	2	$6\frac{2}{5}$	at 17/- =	$234\frac{9}{32}$
Woollen - - -	3	4	1	at 2/6 =	$98\frac{14}{32}$
Worsted - - -	1	7	$14\frac{1}{4}$	at 3/8 =	$65\frac{21}{32}$
	5	14	$12\frac{13}{20}$,	costs	$398\frac{12}{32}$

or about 5s. $7\frac{1}{2}$d. per lb., thus proving the previous answer.

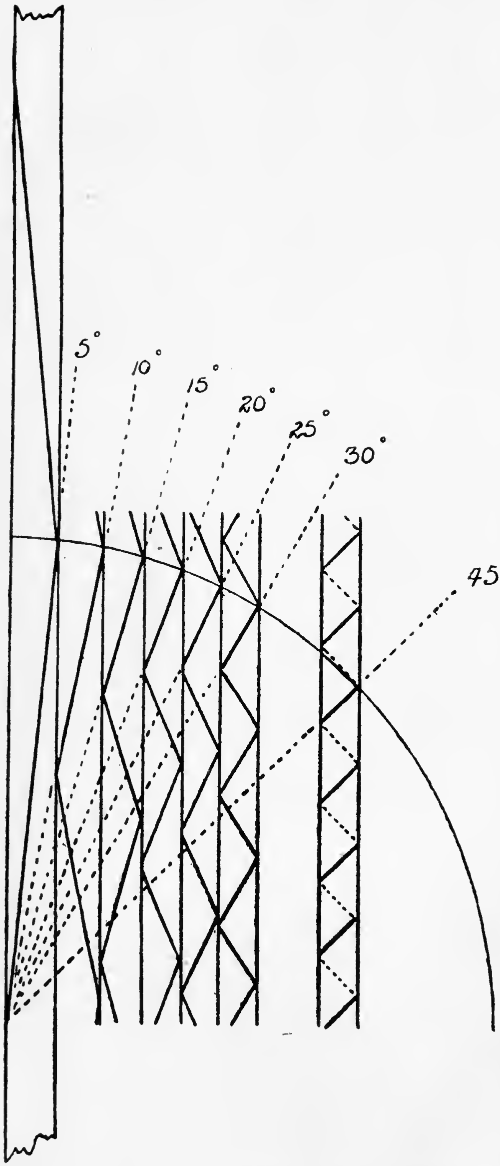

FIG. 22.—Various angles of twist in yarns.

5° Very soft twist, 10° soft twist, 15° soft medium twist, 20° medium twist, 25° hard medium twist, 30° hard twist, 45° very hard twist.

Yarn Twists,—The importance of the twist in yarns cannot well be overestimated. For example, if inadvertently, two yarns of exactly the same quality and counts but spun with a different number of turns per inch, be woven bobbin by bobbin into the same cloth a wonderful stripe effect is developed—dark on light ground when viewed from one side of the piece, light on dark ground when viewed from the other side of the piece (see Fig. 17). Probably one of the two twists gives the better fabric, so that problems of twist resolve themselves into first deciding upon the most suitable twist and secondly defining what this twist is and how it may be produced on the spinning frame.

The cloth constructor should undoubtedly look at twist from the "angle of twist" point of view. Thus, as shown in Fig. 22, angles of twist may be stated with a concomitant indication of hardness or softness.

With this diagram before him the cloth constructor can firstly decide upon the angle of twist most suitable for any fabric he may have in hand; and secondly, give the turns per inch to produce the required angle to the spinner by working upon the following formula:—

$$\frac{D}{\pi \times \text{Cot. of B.}} = T$$

in which—

D = diameter of yarn as a whole number;
π = ratio of circumference to diameter (3·1416);
Cot. of B. = cotangent of longitudinal angle, i.e. of twist angle;
T = turns per inch (whole number).

Example.—A cloth is to be constructed from 2/30's botany yarn (1/84 in. diat.) and as a hard cloth is required an angle of 30° is selected. What turns per inch to give this twist angle will be required?

$$\frac{84}{3{\cdot}1416 \times 1{\cdot}732} = 15 \text{ turns per inch.}$$

The converse is also true, thus—

$$\frac{D}{\pi \times T} = \text{Cot. of B., i.e. } \frac{84}{3{\cdot}1416 \times 15} = 1{\cdot}732 \text{ Cot. of } 30^\circ.$$

The following list of angles and cotangents will enable the cloth constructor to employ the above formulæ according to requirements:—

Angle.	Cotangent.	Suggested definition.
5°	11·43	Very soft twist (SSS).
10°	5·67	Soft twist (SS).
15°	3·73	Soft medium twist (S).
20°	2·75	Medium twist (M).
25°	2·14	Hard medium twist (MH).
30°	1·73	Hard twist (H).
35°	1·42	Hard twist (HH).
45°	1·00	Very hard twist (HHH).

The above formulæ may be usefully employed for both single and two-fold yarns, but the cloth constructor should think clearly and carefully respecting the differences between the two. In dealing with single yarns, for example, the fibre angle and the twist angle are one and the same, but in two-fold yarns there is a fibre angle and a twist angle, and both should be taken into consideration. It should also be noted that the natural or balanced twist for any two strands of single yarn will be half the number of turns in the single yarn. If for example a 1/30's yarn with 12 turns per inch be allowed to snarl or kink-up, it will be found to take naturally 6 turns per inch in the two-fold state. Thus if a balanced inert two-fold yarn is required, the two-fold twist should be half the single twist. If, for example, a 2/24's yarn with 9 turns per inch is required, the single should be spun with 18 turns reverse twist, and these conditions will yield a better balanced yarn than 12 turns reverse twist in the single and 12 turns in the two-fold, while the frame production will be approximately the same. Three-fold and many fold yarns are subject to the same laws.

The foregoing is the safest basis for the cloth constructor to design his cloths upon, but the following are particulars which may be usefully considered :—

FORMULA FOR ASCERTAINING STANDARD TURNS PER INCH.

For hosiery yarns . . .	$\sqrt{\text{counts}} \times 2{\cdot}5$
For single yarns for doubling .	$\sqrt{\text{counts}} \times 2{\cdot}75$
For medium weft yarns . .	$\sqrt{\text{counts}} \times 3{\cdot}25$
For fine weft yarns . . .	$\sqrt{\text{counts}} \times 3{\cdot}\ 8$
For medium warp yarns . .	$\sqrt{\text{counts}} \times 3{\cdot}75$
For fine warp yarns . . .	$\sqrt{\text{counts}} \times 3{\cdot}6$

These formulæ apply more particularly to cotton yarns and are only approximately correct for worsted yarns. Upon the whole the cloth constructor will do better to base his twists on his own judgment with the aid of the foregoing particulars.

Mistakes and misapprehensions are so common with reference to twists that special attention should be directed to the principles demonstrated in Fig. 23. In A a graphic illustration of a yarn with a twist-angle of 45° is given. B demonstrates that for a thread four times the thickness the same number of turns as in A will give a much greater *exterior* angle of twist, but *the same interior angle and binding of the fibres.* On the other hand C and D show that if the same exterior fibre angle is to be retained the interior angle will be very different, and that as a consequence the binding of the fibres in the centre of the thread

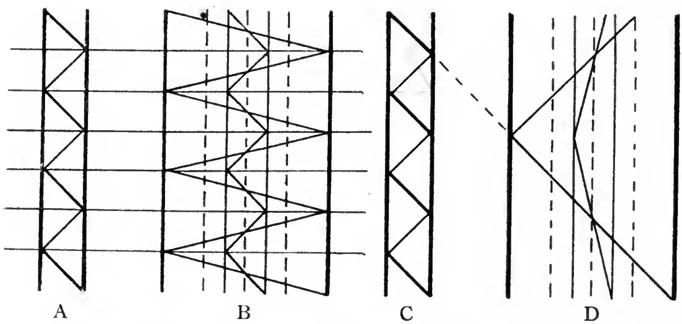

Fig. 23.—Illustration of relative twist in yarns.

will be very different. The cloth constructor must use his judgment in making twist changes in the light thrown upon this problem by these diagrams.

CHAPTER IV.

WEIGHTS OF CLOTHS.

Calculations Relating to the Weights of Cloths.—Having indicated as clearly as possible the various methods of finding the count of yarn and sett of any cloth, two very important matters have still to be fully dealt with, viz. the weight of the various yarns employed in any given cloth, and the weight of the same cloth finished. This question has been treated by other writers at some length, and we should be tempted to be very brief but for the fact that it has usually been treated under one heading instead of under the two indicated above. As those engaged in the trade are aware, the weight of cloth in the loom and the weight in the finished state vary considerably; thus, in the present chapter, calculations relating to cloths as woven are dealt with, and in the succeeding chapters the calculations dealing with the relationship of greasy and finished cloths.

Ordinary Warp and Weft Calculations.—The simplest form in which a question may occur under this heading is that in which, having a cloth made to given particulars, the weight of warp and weft is required.

Example.—A cloth is made of 2/40's worsted for warp, and 20's single worsted for weft. Sett 64 threads per inch in loom, 64 picks per inch, 34 in. wide, 50 yds. of cloth from 56 yds. of warp. Find the weight of the cloth. This question evidently involves the finding of the weight of both warp and weft, which two together give the weight of the cloth.

Rule 1.—To find the weight of warp :—

1. Ascertain yards of material in the warp, i.e. threads per inch × inches wide = threads in warp; × length of warp in yards = the yards of material in the warp.
2. The yards of material in the warp divided by the yards in 1 lb. of such material gives the total weight of warp in 1 lb.

In the above example

(1) $64 \times 34 \times 56 = 121{,}856$ yds. of material in piece.

$560 \times 20 = 11{,}200$ yds. in 1 lb. of material.

Therefore $121{,}856 \div 11{,}200 = 10$ lb. 14 oz. $\frac{17}{25}$ dr. of warp in piece.

Rule 2.—To find weight of weft :—

1. Ascertain the yards of the material in the piece by multiplying the picks per inch by the width in inches and by the length of the cloth.
2. The yards of material thus obtained, divided by the yards in 1 lb. of such material, gives the total weight of weft in lb.

In the above example

(1) $64 \times 34 \times 50 = 108{,}800$ yds. of weft in cloth.

(2) $560 \times 20 = 11{,}200$ yds. per lb.

Therefore $108{,}800 \div 11{,}200 = 9$ lb. 11 oz., diam. $6\frac{6}{7}$ of weft in piece. Then 10 lb. 14 oz. + 9 lb. 11 oz. = 20 lb. 9 oz. weight of 50 yds. of cloth, and 20 lb. 9 oz. 8 diam. $\div 50 = 6\frac{3}{5}$ oz. per yard of cloth.

It will be well for the analyst, wherever possible, to work upon the basis of a square yard, since the weights for all the various widths may be obtained by direct proportion, while at the same time it forms a useful standard for comparisons.

In the above rules prominence is given to the reason for the procedure rather than to the shortest possible statement, since we cannot impress too strongly the advantage of working by reason rather than by rule. Two points in the above, however, need further explanation. In the first place, the reason for the weft rule is not as clear as it might be, since there is an apparent mixing-up of yards and inches, which to the uninitiated is very confusing. If the sum be thought out as follows, the reason for the abbreviation will be evident :—

64 picks per inch × the width will give the inches of weft in 1 in. of cloth, and therefore the yards in 1 yd. of cloth for $64 \times 36 = 2176$ in. in the inch, and $2176 \div 36 =$ yards in the inch $= 60\frac{4}{9} \times 36 = 2176$ yds. per yard, from which it is very evident that by dividing 36 in one case and multiplying in another may be dispensed with altogether ; thus the abbreviated rule above is obtained.

The other matter to which attention was directed is the fact that, although the warp calculation is for 56 yds. the weft is only 50 yds., since 56 yds. of warp are assumed to yield only 50 yds. of cloth; therefore weft will only be required for 50 yds. Since this is fully dealt with in Chapters VIII, IX and X, there is no need to go further into the matter here.

Having indicated the principles, the simplest method of stating the calculations for both warp and weft may now be given :—

$$\text{Warp} = \frac{64 \times 34 \times 56}{560 \times 20} = 10 \text{ lb. } 14 \text{ oz. weight of warp.}$$

$$\text{Weft} = \frac{64 \times 34 \times 50}{560 \times 20} = 9 \text{ lb. } 11 \text{ oz. weight of weft.}$$

And the two together give 20 lb. 9 oz. weight of 50 yds. of cloth.

A calculation simpler in principle than the above cannot well be imagined, but the basis of all subsequent warp and weft calculations is present, and this being so, its thorough comprehension is most necessary.

Complicated Calculations.—Attention may now be directed to calculations for more complicated warps, two modifications on the above practically including all possible warp calculations.

Coloured Warp Calculation.—The first modification of the foregoing is the introduction of coloured threads or picks in either stripe or check form, under which circumstances the weight of each coloured yarn must be obtained.

Rule 3.—To find the weights of the various colours of yarn in a given warp :—

1. Find the number of ends of each colour in the warp, i.e. divide the threads in the warp by the threads in one repeat of the colouring, thus obtaining the number of repeats of the pattern across the piece, and this, multiplied by the ends of each colour in the pattern, gives the number of ends of each colour in the warp.
2. Multiply the ends of each colour by their length, i.e. the length of warp, and divide by the yards per lb. according to the counts of the yarn.

Example.—Find the weight of each colour of yarn in the following :—

Warp.

8 threads 2/40's black.
2 ,, 2/40's black and white twist.
4 ,, 2/40's black.
2 ,, 2/40's black and orange twist.
16's reeds 4's.

---

16 threads in repeat of pattern.

Weft.

All 20's black, 64 picks per inch.

Sett 34 in. wide, warp to be 56 yds. long, to yield 50 yds. of cloth.

(1) $64 \times 34 = 2176$ threads in warp.
$2176 \div 16 = 136$ repeats of colour pattern.
$136 \times 12 = 1632$ threads of black in the warp.
$136 \times 2 = 272$ threads of black and white twist in the warp.
$136 \times 2 = 272$ threads of black and orange twist in the warp.

2176 ends in warp.

(2) $\frac{1632 \times 56}{20 \times 560} = 8$ lb. $2\frac{1}{2}$ oz. weight of black yarn.

$\frac{272 \times 56}{20 \times 560} = 1$ lb. $5\frac{3}{4}$ oz. weight of black and white yarn.

$\frac{272 \times 56}{20 \times 560} = 1$ lb. $5\frac{3}{4}$ oz. weight of black and orange yarn.

---

10 lb. 14 oz. total weight of warp.

For the weft $\frac{64 \times 34 \times 50}{20 \times 56} = 9$ lb. 11 oz. of weft.

The same method of working may be adopted whatever the order of colouring may be, but it is usually advisable to work out the calculations as for a solid to compare with the total weights of the various colours. The same principles may also be readily applied to weft colourings.

Cloths with Yarns of Two or more Counts.—The second complication in warp calculation is the not unfrequent system of using yarns of two or more counts in the same warp. Two methods of finding the weight of the warp under these circumstances present themselves :—

1. The average counts of the two or more yarns may be found, and the weight calculated for the average counts on the ordinary system.
2. Should the order of warping, etc., be very complicated, the system employed for finding the weights of various colours may be adapted to these conditions.

Backed and Double Cloths.—The cloths most easily dealt with under the first conditions are backed and double cloths, in which the warping plan seldom exceeds three or four threads.

Example.—A warp is composed of alternate ends of 2/40's and 2/30's worsted, sett 120 ends per inch. Find the weight if made 60 in. wide, 60 yds. long.

Rule 4. To find the average counts. Find the resultant counts of the 2, 3, or 4 ends combined, and then multiply by 2, 3, or 4, according to the number of ends given.

In the above example

$$\frac{15 \times 20}{15 + 20} = 8\tfrac{2}{3}, \text{ and } 8\tfrac{2}{3} \times 2 = 17\tfrac{1}{3}, \text{ the average counts ; and}$$

$$\frac{120 \times 60 \times 60}{17\frac{1}{3} \times 560} = 45 \text{ lb. total weight of warp.}$$

Or, by taking each count separately :—

	lb.	oz.	dr.	
$\frac{60 \times 60 \times 60}{20 \times 560} =$	19	4	$9\frac{1}{7}$	fine warp (2/40's).
$\frac{60 \times 60 \times 60}{15 \times 560} =$	25	11	$6\frac{6}{7}$	thick warp (2/30's).
Total weight	45	0	0	

Crammed Stripes—A large number of fancy dress fabrics, usually included under the heading "crammed stripes," require distinct treatment under the second heading given above, since whether they are true crammed stripes, or only those in which two distinct materials are employed, the treatment of each material separately is much to be preferred.

The method of finding the weight of the latter class of goods —viz. those in which two distinct materials are employed—is very easy, as the following example will demonstrate :—

Warp.

12 threads	2/50's	salmon worsted.
12 ,,	2/50's	white worsted.
12 ,,	2/50's	green worsted.
12 ,,	2/50's	white worsted.
12 ,,	40/2	blue silk.
12 ,,	2/50's	white worsted.
12 ,,	2/50's	green worsted.
12 ,,	2/50's	white worsted.

96 threads in pattern.

12's reed 4's.

Weft.

Same as warp, 48 picks per inch.

Piece to be woven 48 in. wide in loom, 60 yds. long.

Then 48 threads per inch ÷ 96 threads in pattern = ½ pattern per inch, or 1 pattern = 2 in.

Therefore, 48 ÷ 2 = 24 patterns in piece, and

	lb.	oz.	dr.	
$\frac{48 \times 24 \times 60}{25 \times 560}$ =	4	15	0	white worsted.
$\frac{12 \times 24 \times 60}{25 \times 563}$ =	1	3	12	of salmon worsted.
$\frac{24 \times 24 \times 60}{25 \times 560}$ =	2	7	8	of green worsted.
$\frac{12 \times 24 \times 60}{40 \times 840}$ =	0	8	4	of blue silk.
Total	9	2	8	

The weight of the weft yarns will be exactly the same minus the take up in the weaving of the warp (p. 131).

The above is not a true "crammed stripe," since a true cram has more threads in one portion than in another, as instanced in the following:—

Warp.

40 threads of	mohair,	4 in a reed	= 10	reeds.
20 ,,	cotton,	2 ,,	= 10	,,
12 ,,	mohair,	4 ,,	= 3	,,
40 ,,	cotton,	2 ,,	= 20	,,
12 ,,	mohair,	4 ,,	= 3	,,
20 ,,	cotton,	2 ,,	= 10	,,
Reeds in pattern			56	

14 reeds per inch.

Piece to be woven 56 in. wide. Now it is very evident that here also the extent of pattern must first be found, so if the number of reeds occupied by the pattern be ascertained, this, divided into the reeds across piece, will give the required answer, i.e. :—

$56 \times 14 = 784$ reeds across the piece,

And $784 \div 56 = 14$ patterns across the piece.

Then 14×16 splits of mohair $\times$ 4 threads in a split $= 896$ ends of mohair.

14×40 splits of cotton $\times$ 2 threads in a split $= 1120$ ends of cotton.

Total number of ends in warp 2016

Having the counts of mohair and cotton with the length of warp, etc., the weight of cloth may now readily be found as previously shown.

Other necessary Calculations.—There are many other forms in which warp and weft calculations may occur, but the following formula will prove all that is necessary :—

Let C = counts, W = width in loom, L = length, N = number of ends or picks per inch, P = weight in lb.;

Then $\dfrac{N \times W \times L}{C \times 560} = P$, or $N \times W \times L = P \times C \times 560$ for worsted, 256 for woollen, 840 for cotton, or 300 for linen.

Now this is a complete equation; consequently, if one of the terms be missing, the sum worked out will give that term, i.e. the number which will complete the equation, so that all the following questions are here involved :—

1. To find the counts when ends or picks per inch, width, length, and weight are given :—

$$\frac{N \times W = L}{P \times 560} = \text{counts in worsted.}$$

2. To find the length when ends or picks per inch, width, weight, and counts are given :—

$$\frac{N \times W}{P \times C \times 840} = \text{length, if yarn is cotton or silk.}$$

3. To find the width when ends per inch, length, counts, and weight are given :—

$$\frac{N \times L}{P \times C \times 256} = \text{width for a given weight of woollen yarn.}$$

4. To find the ends per inch when width, length, counts, and weight are given :—

$$\left.\frac{W \times L}{P \times C \times 200}\right\} = \left\{\begin{array}{l}\text{ends per inch if the counts of yarn are Gala-} \\ \qquad\qquad\qquad\text{shiels system.}\end{array}\right.$$

With these formulæ not only should the analyst be able to work out any calculations which are likely to occur, but he should also be able to reason the matter out on reference to the particulars already given.

As already intimated, the above systems, although answering all requirements when dealing with cloths in the loom, require certain modifications in application to the cloth in the finished state. These modifications are considered later.

Weights of Fabrics.—The following may be taken as a guide in indicating light, medium, and heavy fabrics :—

Light fabrics up to 9 oz. for 56 in. wide.

Medium fabrics 9 oz. up to 18 oz. for 56 in. wide.

Heavy fabrics above 18 oz. for 56 in. wide.

Changing the Weights of Cloths.—The weights of cloths may usually be varied in two distinct ways :—

(*a*) They may be woven opener or closer, thereby giving less or more weight,

(*b*) They may be made thinner or thicker.

There are, however, several variations, whichever method be adopted. Thus (*a*) may be varied as follows :—

1. Putting in fewer or more picks per inch. This is a common method in producing a range of qualities as in the case of Cashmeres, Italians, etc.

2. Varying the set; i.e. putting in fewer or more threads per inch.

3. Employing a thinner or thicker weft yarn.

4. Employing a thinner or thicker warp yarn.

5. Combinations of two or more of these methods.

The practical possibilities of each and every one of the above methods should be thoroughly realized by the cloth constructor, for the full knowledge of such gives him a control over weight which is the envy of the less observant and unmethodical designer.

All these five methods, however, have very serious limitations which should be at once studied and realized if an attempt at the impossible is to be avoided. Thus with reference to (1) the argument may run: 60 picks gives a summer weight, 120 picks will give a winter weight. But can 120 picks per inch be got into the cloth with the heaviest loom built? Probably not; or if so 60 picks will have produced a very flimsy, slipping fabric! The truth is that this method—as a rule—may only be employed for comparatively slight decreases or increases in weight, and the same remarks apply to (2).

Again the employment of a thinner or thicker yarn has very similar limitations. For example, if a cloth woven with a 20's yarn equals 16 oz. per yard, a cloth woven with a 10's yarn will equal 32 oz. per yard, sett, picks, and width being the same in each case. That is to say that the weight will vary *inversely* as the count of the yarn employed. But if the 20's yarn made a presentable cloth we may be certain that the 10's cannot be made into a cloth at all—it will almost certainly be too thick for the sett and picks. Then comes in the idea of balancing up sett and picks and counts of warp and weft. Much may be done in this way but there will probably at once arise in the mind of the designer the question as to whether it is possible to balance these, say, to produce greater weight. For if the 10's count of yarn be too thick to go into the cloth then it will be necessary to employ fewer threads and picks per inch; and if fewer threads and picks per inch are employed where does the increased weight come in? *Will not the decrease in threads and picks just balance increase in the thickness of the yarn and as a result the cloth remain the original weight?*

When the cloth constructor has got thus far he is ready for the second method (*b*) of changing the weights of cloths, and should stop his reasoning sharp and turn to this for the solution of his difficulties.

It seems a simple thing to make a cloth thinner or thicker and thereby increase its weight. Possibly the simplest way is to weave two cloths together, with suitable bindings, thereby doubling the weight of the original cloth. Or a weft or a warp back may be added—1 and 1 or 2 and 1, etc.—thereby increasing the weight of the cloth—other things being equal by $\frac{1}{2}$ or by $\frac{1}{4}$. Or again resort may be made to both double-cloth and wadding threads or picks for extremely heavy structures.

But if the cloth must remain a single cloth—what then?

Simply decrease or increase its thickness directly in the required proportion.

This will be evident from Fig. 24*a*. Taking (*a*) as the original cloth, then (*b*) will be double the weight, and (*c*) will be four times the weight—simply because they are respectively double and four times the thickness.

But this increase in thickness must be expressed in terms of counts of yarn and sett and picks. This is the difficulty.

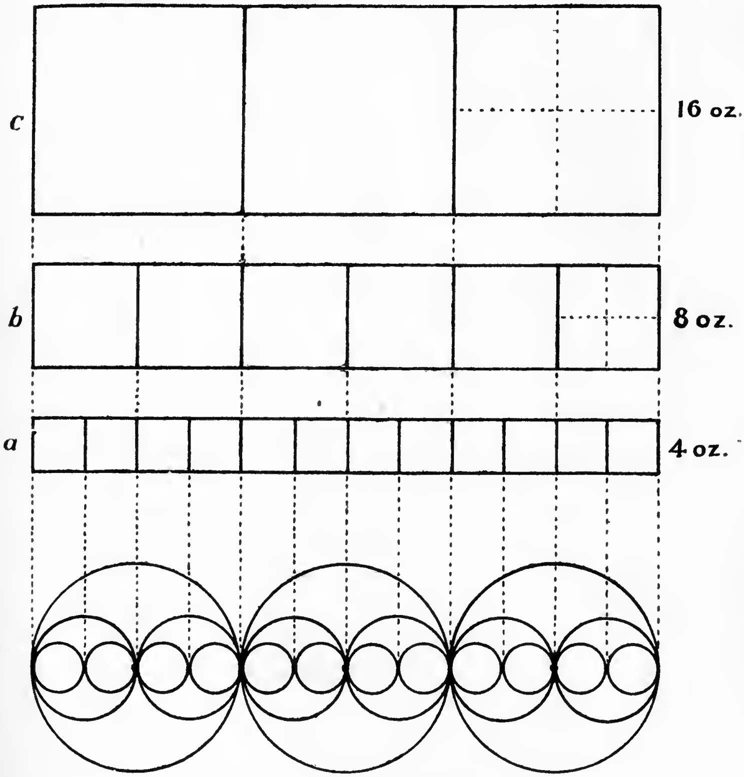

FIG. 24*a*.—Weight changes in cloth.

But after all the difficulty is not great. For (*a*), double thickness equals double the original yarn diameter, and as double the diameter equals four times the area, and as counts and area are synonymous, four times the yarn count, i.e. a yarn four times the weight of the original; (*b*) but as the yarn is double the thickness of the original, therefore half the number of threads and picks must be employed to maintain a correctly balanced structure in accordance with original cloth (see Fig. 24*b*).

Therefore it is evident that doubling the yarn diameter quadruples the weight, but the reduction in the sett and picks to half just balances half this increase leaving the cloth just double the weight.

Thus, to decrease or increase a cloth in weight maintaining the correct balance of structure :—

1. Decrease or increase the diameter of the yarn (i.e. the square root of the counts, *inversely*) directly in the required proportion; and

2. Increase or decrease the sett and picks directly in the required proportion.

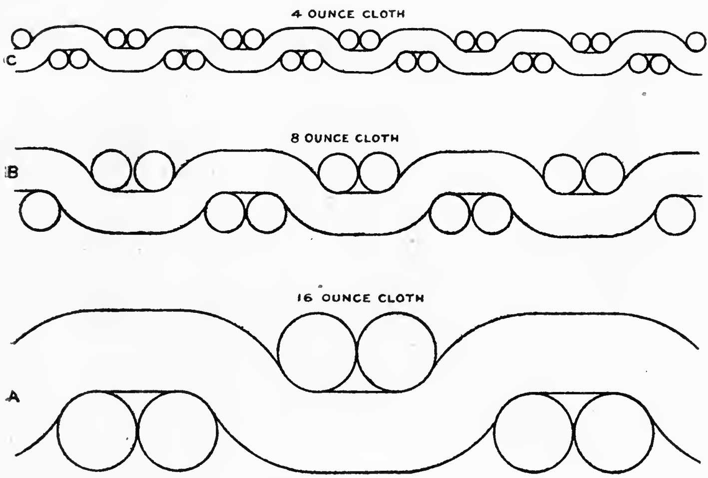

FIG. 24*b*.—Setting of fabrics.

Example.—A cloth is made to the following particulars :—

Warp and Weft.

All 1/36's botany.

64 threads and picks per inch.

A cloth $\frac{1}{6}$th heavier is required, then

As $\frac{6}{6}$ must become $\frac{7}{6}$ correct proportion is as 6 : 7.

As $7 : 6 :: \sqrt{36} : \sqrt{x} = \frac{1}{26}$ counts required for cloth $\frac{1}{6}$th heavier ; and

As $7 : 6 :: 64 : x = 55$ threads and picks per in. for cloth $\frac{1}{6}$th heavier.

It seems ridiculous for a heavier cloth to be arrived at by employing fewer threads and picks per inch and conversely for a lighter cloth to be arrived at by employing more threads and picks per inch, but a few moments study of Fig. 24*b* will clearly show why this is, and once the reason is fully realized the cloth constructor can readily control weight changes within the limits of possibilities. But just as we saw there were limits to increase in yarn, setts, and picks, so here again must it be realized that there are limitations; for example, in the cloth just given, if the weave be 2/2 twill then it will obviously be a finer twill in the original cloth with sixty-four threads and picks per inch as compared with the heavier cloth with fifty-five threads and picks per inch; and it might be just this difference to which the merchant would object.

This brings into question the method of changing both weight and weave of a fabric, still maintaining the correct balance of structure.

Example.—A cloth is woven in a 2/2 twill weave theoretically perfect, i.e. with seventy-six threads and picks per inch of 2/50's yarn, and a cloth is required in the 4/4 twill, giving an increased weight of $\frac{1}{5}$th. What counts of yarn, sett, and picks should be employed?

This problem resolves itself into three simple stages:—

1. Change the original cloth (1st cloth) to $\frac{1}{5}$th heavier on the principles already demonstrated (2nd cloth).

2. Increase the sett and picks of the 2nd cloth in accordance with the requirements of the 4/4 twill, retaining the count of the new cloth without change (3rd cloth).

3. As the 3rd cloth is too heavy just in proportion to the weave change, change the 3rd cloth to a lighter cloth in this proportion by the ordinary method (i.e. change in both counts, sett, and picks) (4th cloth and required cloth).

1. As $\frac{5}{5}$ must become $\frac{6}{5}$ correct proportion is as $5:6$.

$$\text{As } 6:5::\sqrt{25}:\sqrt{x}=17\tfrac{13}{16} \text{ counts, or}$$

$$[\text{As } 6:5::\sqrt{25}:\sqrt{x}]^2$$

$$=\text{As } 6^2:5^2::25:x=17\tfrac{13}{16} \text{ counts.}$$

Note.—This latter method is useful when the original count is an awkward number involving fractions.

$$\text{As } 6:5::76:x=63\tfrac{1}{3} \text{ threads and picks per inch.}$$

Thus 2nd cloth is—$17\frac{13}{16}$ counts,
$63\frac{1}{3}$ threads and picks per inch, and
2/2 twill weave.

2. As indicated in Fig. 25 the 2/2 twill, *for eight threads* occupies 10·928 units of space,* while the 4/4 twill, *for eight threads*, occupies only 9·464 units of space. Therefore the 4/4 twill will require a closer set in this proportion.

As $9{\cdot}464 : 10{\cdot}928 :: 63\frac{1}{3} : x = 73$ threads per inch for 4/4 twill.

Thus the 3rd cloth is—$17\frac{13}{16}$ counts,
73 threads and picks per inch,
4/4 twill weave.

3. As the 3rd cloth is too heavy just in proportion to the sett increase as compared with the 2nd cloth it must be reduced in this proportion, or what is the same thing in the weave change proportion, thus :—

Correct proportion for reduction—As $73 : 63\frac{1}{3}$, or
As $10{\cdot}928 : 9{\cdot}464$.

As $63 : 73$ or
As $9{\cdot}464 : 10{\cdot}928 :: \sqrt{17\frac{13}{16}} : \sqrt{x^2}$, or
As $63^2 : 73^2$: or
As $9{\cdot}464^2 : 10{\cdot}928^2 :: 17\frac{13}{16} : x = 23$'s or 2/46's yarn. And
As $63 : 73$ or
As $9{\cdot}464 : 10{\cdot}928 :: 73 : x = 84$ threads per inch.

Thus 4th and required cloth is—2/46's counts,
84 threads and picks per inch, and
4/4 twill.

This cloth will be found to be of a perfect structure and of the correct weight required. This may be tested as follows :—

For Structure—

Diameter of 2/46's or 2/23's $= \frac{1}{102}$ in.

$$\text{And } \frac{102 \times 8}{9{\cdot}464} = 84 \text{ to } 85 \text{ threads per inch.}$$

For Weight of One Square Yard—

$$\frac{76 \times 36 \times 1}{25 \times 560} + \frac{1}{5} = \frac{84 \times 36 \times 1}{23 \times 560}.$$

From this working the following simple rule for changing the weight and weave of fabrics is originated :—

For Counts.—Change the $\sqrt{\ }$ count of the original cloth inversely according to the required weight change and directly according to the weave change.

For Sett and Picks.—Change the sett and picks of the original cloth inversely according to the required weight change and directly according to the weave change squared.

* Note.—The weft intersection is taken as ·732 of a yarn diameter unit.

With these principles at his finger ends the cloth constructor will readily do what is possible in the matter of changing the weights of cloths. But in order that he may not get too much into one groove and be bound too much by rule the following examples of breaking away from the rule are given :—

Example.—The following 3/3 twill cloth is required $\frac{1}{4}$ less in weight *and of a similar appearance.* What counts, sett, and picks and weave should be employed ?

Warp and Weft.
All 2/32's worsted.
48 threads and picks per inch.
Weave = 3/3 twill.

As $3 : 4 :: \sqrt{16} : \sqrt{x} = 28$ or 2/56's worsted, warp, and weft (new cloth).

As $3 : 4 :: 48 : x = 64$ threads and picks per inch (new cloth).

As $3 : 4 :: 6 : x = 8$ ends in weave—say 4/4 twill (new cloth).

In this case it will be noticed that the perfect structure has been sacrificed to the weave appearance ; but as this latter is usually the dominant feature in the eyes of the merchant it may frequently be necessary to adopt some such method as this. Of course care must be taken that the new cloth is not too tightly or too flimsily built : slipping must certainly be avoided. The following example is of a similar character :—

Example.—The following 4/4 twill cloth is required double the weight *and of a similar appearance.* What counts, sett, and picks and weave should be employed ?

Warp and Weft.
All 2/50's botany.
64 threads and picks per inch.
Weave = 4/4 twill.

As $2 : 1 :: \sqrt{25} : \sqrt{x} = 6{\cdot}25$ or 2/12·5's botany, warp, and weft (new cloth).

As $2 : 1 :: 64 : x = 32$ threads and picks per inch (new cloth).

As $2 : 1 :: 8 : x = 4$ ends in weave—say 2/2 twill (new cloth).

Note.—These cloths should be drawn out diagrammatically as illustrated in Fig. 25.

The designer will also be well advised if he makes himself thoroughly acquainted with the natural weight change incident on weave change with the other factors remaining the same. The

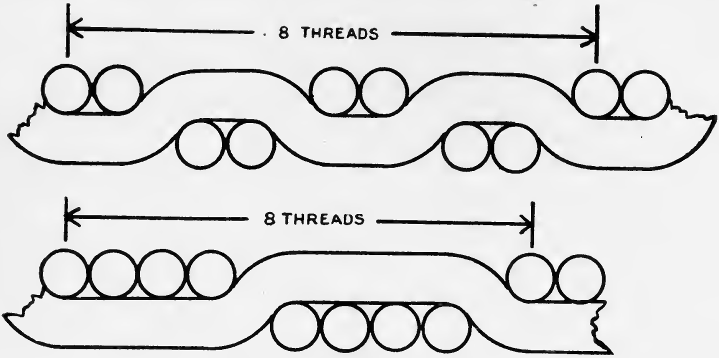

FIG. 25.—Setting of fabrics.

following lists are exceedingly interesting from this point of view and should be memorized.

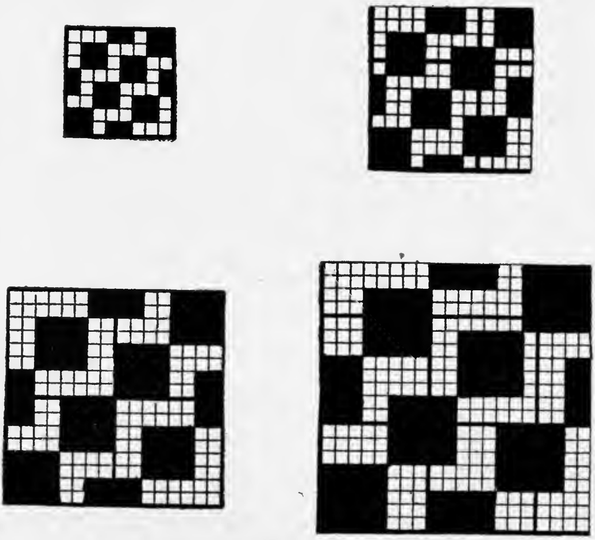

FIG. 26.—Hopsacks of various sizes.

Perfect sets for 2/36's botany (1/90 in. diameter).

			Heavier.
1/1 (Plain weave)	52	threads and picks per inch	
2/2 Twill	66	,, ,, ,,	1/4 1/11
3/3 ,,	72	,, ,, ,,	1/3
4/4 ,,	76	,, ,, ,,	1/2 1/18 1/7

			Lighter.					
1/1 (Plain weave)	52 threads and picks per inch	1/3	1/4	1/5			
2 2 Twill	66 ,, ,, ,,					1/8	1/12
3/3 ,,	72 ,, ,, ,,				1/19		
4/4 ,,	76 ,, ,, ,,						

Note.—These fractional weights are only very approximate but fully demonstrate the principles involved.

Particular note should be made of the fact that, for example, an increase in weight of $\frac{1}{11}$th will need a decrease of $\frac{1}{12}$th to arrive at the original figure, $\frac{1}{8}$th will require $\frac{1}{9}$th and so on through the range of fractions.

In problems involving changes in the weights of cloths it is also most important to remember that the various hopsacks such as 2/2, 3/3, and 4/4 may be employed in a variety of ways, thus varying the weights of hopsack cloth along with the weave appearance, and further that most weaves may be modified to give lighter or heavier structures as exampled in the range of twilled hopsacks A, B, C, and D (Fig. 26).

CHAPTER V.

SETTS AND THE SETTING OF CLOTHS.

ATTENTION must now be directed to the methods of indicating the number of ends and picks, i.e. warp and weft threads, in a piece, since these particulars, in conjunction with the count of the yarn, indicate the weight of the resultant cloth.

The ends in a piece are indicated in such a number of ways that in order to render our remarks clear the simplest method shall first be considered, and the more intricate ones explained by means of this.

Methods of Indicating the Sett.—Evidently the simplest method will be to state always the threads per inch, since the width of the piece is usually stated in inches; thus the sett multiplied by the width gives the number of ends in the warp.

The "*Stockport* system" is similar to this, only the number of dents or splits in the reed is indicated along with the number of ends through each.

Example.—A 12's reed 4's = 12 reeds per inch, with 4 threads through each = 48 threads per inch.

For the actual weaving operation, this latter method is perhaps preferable, but in all calculations for cloth the number of ends per inch forms a much more convenient standard.

The other important systems are as follows:—

The "*Bradford* system," based upon the number of beers (40 ends) in 36 in.

The "*Blackburn* system," based upon the number of beers (20 splits) in 45 in.

The "*Manchester* system," based upon the dents in 36 in.; but the ends per inch is the now universal system in Lancashire.

The "*Scotch* system," based upon the dents in 37 in.

The "*Leeds* system," based upon the number of porties (38 ends) in 9 in. ($\frac{1}{4}$ yd.).

To show clearly the different meaning of a certain sett, say 40's, in each of the above, the following list is given :—

40's sett in ends per inch	= 40	ends per inch.
40's Bradford ,,	= $44\frac{4}{9}$	,, ,,
40's Blackburn ,,	= $17\frac{7}{9}$	splits per inch.
40's Manchester ,,	= $1\frac{1}{8}$	,, ,,
40's Scotch ,,	= $1\frac{3}{37}$	,, ,,
40's Leeds ,,	= $169\frac{8}{9}$	ends per inch.

From Fig. 27 any desired conversions may be read off almost at a glance.

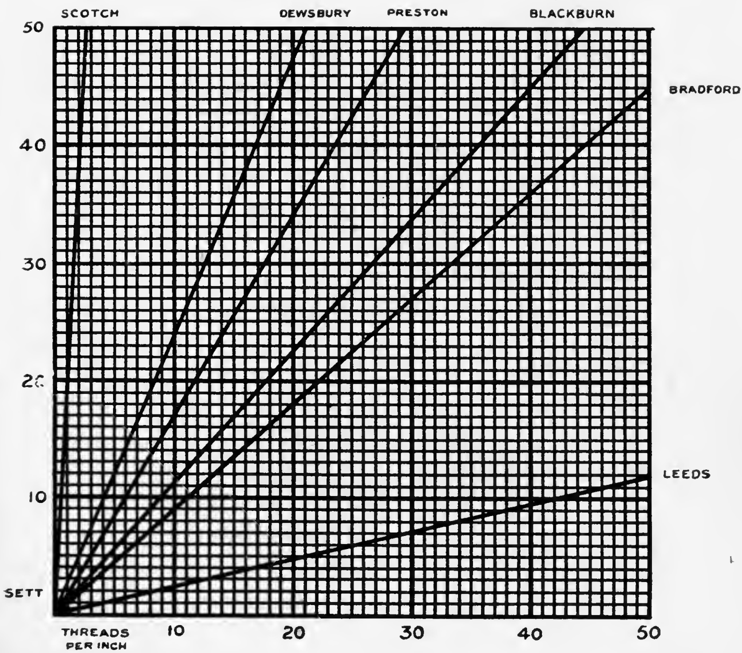

FIG. 27.—Graphic illustration. Changing from one sett system to another, or from any sett system to threads per inch.

In the following calculations, ends per inch and picks per inch will be adopted throughout, since this is simplest and most easily comprehended.

The Setting of Cloths.—Since the analyst will often be required to build cloths in various ways from the knowledge obtained in pulling them to pieces, a brief consideration of the principles of setting fabrics may be of much use in this treatise. This question is one of such wide scope that we can only touch upon the principal features, leaving the reader to carry out the ideas to their full limits.

Influences to Consider.—There are three modifying influences to consider in setting cloths. Firstly, the characteristics of the yarns to be employed; secondly, the diameter of the yarn; and thirdly, the weave or weaves.

Respecting the characteristics of the yarns employed, little further need be said after the particulars given in Chapter II., but, in the following pages the other two influences are briefly explained.

Diameters of Yarns.—These may be ascertained by finding the yards per lb. in the counts under consideration and extracting the square root. A deduction from this of 16 per cent for woollen, 14 per cent for crossbred worsted, 10 per cent for botany worsted, and 8 per cent in the case of cotton and silk yarns, will give the most approximate results.

Example.—A 40's worsted yarn gives the following result:—

$40 \times 560 = 22{,}400$ yds. per lb. and

$\sqrt{22{,}400} = 149 - 10$ per cent $= 135$ diam., i.e. $\frac{1}{135}$th part of an inch.

Another method of ascertaining the diameters of yarns is to cut a space out of a piece of cardboard, as shown in Fig. 28 exactly 1 in., and wrap the yarn round this, laying each thread close to its predecessor. The diameter of the yarn is thus obtained, and, further than this, it is possible to work as it were backwards and obtain, very approximately, the counts of the yarn.

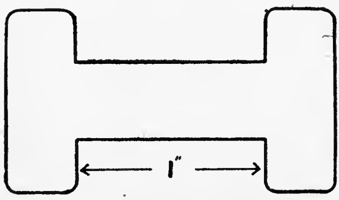

FIG. 28.—For ascertaining yarn diameters.

From the foregoing it is evident that the square root of any counts, *not the counts*, is in direct proportion to the diameter, so that should it be desired to find the diameter of one yarn from another, direct proportion may be employed, using the square root of the counts (or, what amounts to the same thing, squaring the whole equation).

TABLE IX.—COMPARISON OF YARN COUNTS WITH THEIR DIAMETERS.

Diameter.	Worsted.	Cotton.	Woollen Yorkshire skein	Diameter.	Worsted.	Cotton.	Woollen Yorkshire skein.
48	4	2·6	18¼	142	36	24	78¾
53	5	3·3	11	144	37	24·6	80¾
58	6	4	13	146	38	25·3	83
63	7	4·6	15¼	148	39	26	85¾
67	8	5·3	17½	150	40	26·6	87½
71	9	6	19¾	152	41	27·3	89
75	10	6·6	21¾	153	42	28	90½
79	11	7·3	24	155	43	28·6	93¾
82	12	8	26¼	157	44	29·3	96¼
86	13	8·6	28½	158	45	30	98½
89	14	9·3	30½	160	46	30·6	100½
92	15	10	32¾	162	47	31·3	102¾
95	16	10·6	35	164	48	32	105
98	17	11·3	37¼	165	49	32·6	107¼
101	18	12	39½	167	50	33·3	109½
103	19	12·6	41½	169	51	34	111½
106	20	13·3	43¾	171	52	34·6	113½
109	21	14	45¼	172	53	35·3	115¾
111	22	14·6	48	174	54	36	118
114	23	15·3	50¼	175	55	36·6	120½
116	24	16	52½	177	56	37·3	122½
119	25	16·6	54¾	178	57	38	124¾
121	26	17·3	56¾	180	58	38·6	126¾
123	27	18	59	181	59	39·3	129
126	28	18·6	61¼	183	60	40	131¼
128	29	19·3	63½	185	61	40·6	133½
130	30	20	65½	186	62	41·3	135½
132	31	20·6	67¾	187	63	42	137¾
134	32	21·3	70	189	64	42·6	140
136	33	22	72	191	65	43·3	142¼
138	34	22·6	74¼	192	66	44	144¼
140	35	23·3	76½	193	67	44·6	146½

Example.—If a 40's yarn has a diameter of 135, what is the diameter of a 20's yarn?

As $\sqrt{40} : \sqrt{20} :: 135 : 95$ diameter of 20's,

i.e. As $\sqrt{(40\ 560)} : \sqrt{(20 \times 560)} :: 135 : 95$ diameter of 20's, or

As $40 : 20 : 135^2 : x^2 = 95$ diameter of 20's worsted.

These rules apply to every system of counting yarns, but it should be remembered that the results obtained are only approximate: they may be affected in some degree by material or structure, and many other influences. Still, the designer need not fear making these the basis of his calculations, and introducing such slight modifications as experience and reason suggest.

The Weave.—In considering the influence of weave on the sett of a cloth two questions at once present themselves—firstly, is the diameter of yarn modified at all in weaving? and secondly, in any given weave is it possible to ascertain the precise influence of the bending of warp and weft on the sett? Respecting the diameters of yarns the only further remark called for is that common sense is a most necessary adjunct in the application of the rules respecting the diameters of yarns; particularly is this so in the case of woollen yarns.

Class of material, soft or hard twist, old or new spun yarns are a few of the most notable modifying influences, but notwithstanding this, the diameters of yarns as given may within reason be made the basis of all calculations for setts.

Classification of Weave.—The influence of weave upon the relative bending of the warp and weft and consequently upon the

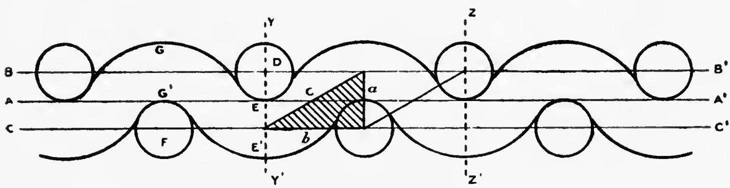

FIG. 29.—Ordinary fabric, section: plain weave.

sett, is most remarkable, and here, as in the case of the diameters, experience is most necessary, although it is now a recognized fact that this matter may be dealt with on scientific principles.

All cloths, as previously shown, may be classed under one of three heads, viz. cloths woven on the square; weft rib cloths, in which the warp lies straight and the weft does all the bending; and warp-rib cloths, in which the weft lies straight and the warp does all the bending. The influence of the weave on the sett in each of these cases must now be considered.

Cloths Woven on the Square.—In cloths woven on the square, i.e. an equal number of threads and picks—if warp and weft are approximately the same counts, as is usually the case, the threads and picks will do an equal amount of bending, as represented in Fig. 29. Now a glance at this diagram shows that the warp threads D, F are separated from each other by the picks, so that taking both warp and weft to have a diameter of, say $\frac{1}{80}$th of an inch (i.e. 80 threads can be laid side by side in 1 in.), only 40 threads can be used, since there will be 40 intersections or units of space occupied by the weft.

The following rule may be made the basis for ascertaining the approximate sett required for any weave :—

Rule.—1. Ascertain the number of units (i.e. threads and intersections) the given plan contains.

2. Divide the number of units as obtained in (1) into the diameter of the yarn to be used, thus obtaining the number of repeats of the plan in 1 in.

3. Multiply (2) by the threads in the given plan, thus obtaining the threads per inch.

Example.—Required the ends per inch to use with the 3/3 twill (Fig. 30). Counts of warp and weft :—

32's worsteds $= \frac{1}{120}$th of an inch diameter.

1. 6 threads + 2 intersections give 8 units in one repeat of 3/3 twill.

2. 120 (diameter of thread) $\div 8 = 15$ repeats of 3/3 twill in 1 in.

3. $15 \times 6 = 90$ ends per inch to use, the other 30 units of space being occupied by weft intersections.

This is a very simple method, and gives fairly approximate results, but in some classes of goods, particularly lustre dress fabrics, greater accuracy is necessary. The late Mr. T. R. Ashenhurst was the first to point out that the essential condition for the most lustrous effect is that the weft shall make with the warp an angle of 60°, and in the appendix of his work entitled "Textile Calculations and the Structure of Fabrics," shows his application of this theory. The following deductions, however, differ from his to some extent :—

Taking Fig. 29 again as our example, observe in the first place that although the threads are undoubtedly distant from one another by the full diameter of the weft yarn, yet *horizontally* they are not distant from each other the full diameter of the weft.

Construction.—*1st.* Draw A, A′ representing the base line or centre of the cloth ; then warp and weft being equal in thickness and flexibility, will be bent equally out of the straight line, i.e. above and below this line A, A′.

2nd. At a distance ½ the diameter of warp (or weft) from A, A′, rule in lines B, B′, C, C′, representing the centres of the warp threads (or weft picks) in their highest and lowest position respectively.

3rd. Take any convenient position on B and with radius $\frac{1}{2}$ diameter of yarn, describe circle D, representing the highest position of the warp threads.

4th. With radius $\frac{1}{2}$ diameter of yarn $\times$ 3, describe circle E′, representing the bending influence of thread D upon the outer edge of weft, and E for the inner edge of weft.

5th. With $\frac{1}{2}$ diameter of warp (or weft) and upon C, C′, but tangential to E, describe circle F, representing the lowest position of the warp threads.

6th. With radius $\frac{1}{2}$ diameter of yarn $\times$ 3, describe circle G, representing the bending influence of thread F, upon the outer edge of weft and G′ for the inner edge of the weft.

7th. The weft will take the direction compounded of the action of the two spheres of influence D and F and the average angle of the weft with A, A′ will be 30° (or with the known side of triangle 60°).

TO DECIDE THE "SET" OR DISTANCE APART OF THE WARP THREADS.

Construction.—Drop perpendiculars Y, Y′ and Z, Z′ through the centres of the warp threads D and F forming triangle a, b, c, of which a is the known side.

Calculation.—As $a = \frac{1}{2}$ warp $+ \frac{1}{2}$ weft $= 1$.

$\therefore c = 2$ and $a^2 + b^2 = c^2$ (Euclid, Prop. 47).

$\therefore 1^2 + b^2 = 2^2$ or $1 + b^2 = 4$,

i.e. $b^2 = 4 - 1 = 3$ and $\sqrt{3} = 1{\cdot}732$.

That is one repeat of plain weave will occupy 1·732 units of space $\times$ 2.

Example 1.—A 2/40's yarn has a diameter of $\frac{1}{95}$. Find the number of ends per inch for plain.

Then $\frac{1}{95} \times 1{\cdot}732 \times 2 = 95 \div (1{\cdot}732 \times 2) = 27\frac{1}{2}$ repeats, or 55 threads per inch in the finished cloth.

Should the previous rule be adhered to, $95 \div 2 = 47\frac{1}{2}$ ends per inch only would be employed, so that there is evidently a considerable difference in the case of the plain weave. A rough approximation is that the last method is for the finished cloth and the first for the cloth in the loom.

Another example may be taken to show the application to other weaves.

Example 2.—A 32's worsted = $\frac{1}{120}$th part of an inch in diameter. Find the number of ends per inch to use with the 3/3 twill.

As shown in Fig 30, in the 3/3 twill, there are 2 triangles + 4 diameters of the yarn in a repeat.

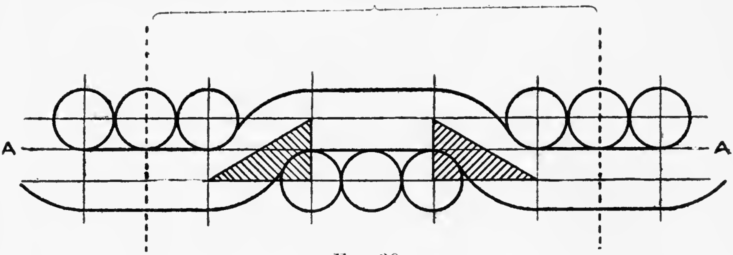

FIG. 30.

Therefore $4 + (2 \times 1{\cdot}732) = 7{\cdot}464$ units of space in the repeat of the weave, and $\frac{1}{120} \times 7{\cdot}464 = 120 \div 7{\cdot}464 = 16$ repeats of twill, and 16×6 (threads in repeat of weave) = 96 ends per inch in the finished cloth.

Here owing to the few intersections, there is not such a marked difference between this and the result previously obtained, as in the case of plain weave.

Weft-rib Cloths.—Weft-rib cloths must be treated in a different manner to the foregoing. As shown in Fig. 31 the warp

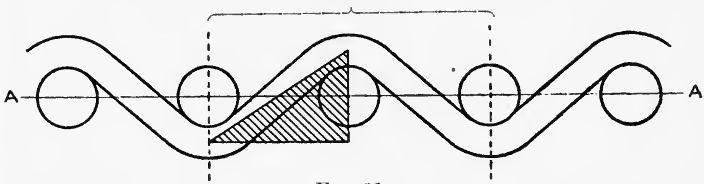

FIG. 31.

lies straight and the weft does all the bending. Therefore, the weft picks may lie close to one another, while each group of threads will be separated by at least the diameter of the weft.

Example.—In plain cloth, the picks per inch to use will be, with a 2/40's yarn with $\frac{1}{95}$th part of an inch diameter, 95, while the threads per inch will be $95 \div 2 = 47$, provided the angle of 30° is omitted from the calculation. If the angle of 30° be taken into account, then the altitude of the triangle formed, as shown in Fig. 31 = the diameter of both warp and weft, thus the threads per inch will be :—

$(\frac{1}{95} + \frac{1}{95}) \times 1{\cdot}732 = 47 \div 1{\cdot}732 = 27$ threads per inch and 95 picks per inch.

Now these are theoretical conditions, since the warp and weft would at least bend equally during weaving, being the same counts, but a thick warp and thin weft would fulfil these conditions.

Example.—In a French cashmere made as follows :—

Warp.

All 56's botany.

64 threads per inch.

Weft.

All 92's botany.

Picks according to quality.

Taking the warp threads to be quite straight, the following result is obtained. Since 56's botany has a diameter of $\frac{1}{159}$th part of an inch and 92's botany $\frac{1}{205}$th part of an inch, the altitude of the triangle will be :—

$\frac{1}{159} + \frac{1}{205} = \frac{1}{89}$ and $\frac{1}{89} \times 1{\cdot}732 = 89 \div 1{\cdot}732 = \frac{1}{52}$ of an inch for base of triangle.

Then, since the repeat of the cashmere twill contains two triangles and one thread, as shown in Fig. 32—

$(\frac{1}{52} \times \frac{1}{52}) + \frac{1}{159} = \frac{1}{26} + \frac{1}{159} = \frac{159+26}{4134} = \frac{185}{4134} = \frac{1}{22}$ of an inch.

for each repeat of twill, and since each twill contains three threads $22 \times 3 = 66$ threads per inch.

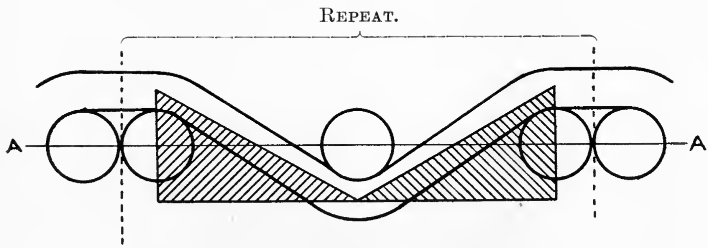

FIG. 32.

This is supposing the warp to lie quite straight, which it does not, as will be seen on referring to the micro-photograph of a thread and pick from a cashmere cloth given in Fig. 50, consequently it may be taken for granted that a few threads should be added to the above for this deflection in the warp. Now, if the warp and weft did an equal amount of bending, the following would be the result :—

$(\frac{1}{159} + \frac{1}{205}) \div 2 = \frac{1}{178}$ and $\frac{1}{178} \times 1{\cdot}732 = 178 \div 1{\cdot}732 = \frac{1}{102}$ of an inch for base of triangle, and $\frac{1}{102} + \frac{1}{102} + \frac{1}{159} = \frac{1}{51} + \frac{1}{159} = \frac{511+59}{8109} = \frac{210}{8109} =$ about $\frac{1}{39}$ and $39 \times 3 = 117$ ends per inch.

This latter result is very far from correct, while the former is practically correct, for the practical sett given, i.e. 64 threads per inch, is for the loom, while the 66-70 ends found by calculation is for the finished state, so that they practically coincide. The following is a clear statement of all the results for this cloth :—

Ends per inch ascertained by adding diameters together	89
Ends per inch ascertained by equal bending of warp and weft and angle of 30°	117
Ends per inch ascertained by warp straight, weft bending, and angle of 30°	66
Ends per inch used in practice in loom	64

It is evident, then, that an adherence to the principles laid down gives results of marked practical utility.

Warp-rib Cloths.—The treatment of warp-rib cloths will be exactly the reverse of weft-rib cloths, so there is practically no need to exemplify them here, since our space is somewhat limited.

Difficulties in Applying the Foregoing Principles.—A type of fabric very difficult to deal with is the Bradford plain lustre previously mentioned, this coming under none of the foregoing treatments.

These fabrics are usually woven with a fine cotton warp and comparatively thick mohair weft, which should thus give a warp rib type of structure, i.e. the finer material should bend; and in the loom it actually does, but during finishing the warp is pulled quite straight and the weft then doing all the bending produces a weft rib type of structure.

For which cloth, then, should the calculation be made, the cloth as woven or the cloth as finished? Neither calculation will give the desired result, simply because the cloth being woven approximately on the square (to keep the figures square)[1] has not sufficient warp in for a warp rib, while the threads are also much too close together to produce the structure shown in Fig. 31 should the necessary picks have been put in. A compromise therefore takes place between warp and weft. The warp becomes straight, in finishing, but in so doing flattens out the weft upon itself, bending it to the correct angle at the same time.

[1] Note.—Usually with rather more picks to compensate for the extension in finishing.

A suitable sett for plain lustre goods, from which the above deductions may be made, is as follows:—

Warp.

All 2/90's cotton.
33's reed 2's, or
66's reeds 1's.

Weft.

All 32's mohair.
70 picks per inch.

Respecting the setting of woollens, unless unshrinkable goods are required, an open sett should be employed, particularly if the yarn is woolly and thus liable to choke the shed. Under these circumstances the milling-up of the piece may be depended upon, and thus the required width obtained in the finishing. With linen and other solid yarns it is desirable to weave as close in the loom as possible, since shrinkage by bending of warp and weft *only* ensues.

It will thus be evident that although certain principles obtain in the setting of all kinds of cloths, still common sense is a most necessary adjunct.

Changes in Counts and Setts.—There are two simple yet important calculations which are likely to occur frequently, and which should be fully comprehended. They may be exemplified by the following examples:—

Example 1.—A cloth is woven with a 2/40's warp, 72 ends per inch, and yields the required structure. What counts will be required to preserve the same balance of structure with 80 threads per inch?

Example 2.—A cloth is woven with a 2/40's warp, 72 ends per inch, and yields the required structure. What number of ends per inch will be required to preserve the same balance of structure with 2/50's warp.

Example 1 may be reasoned out as follows: There are two lots of threads given, therefore the change in counts at first sight will be as 72 : 80, since with more threads a finer yarn, i.e. a higher count, is required. But since the diameter of the yarn must change in proportion to the addition or subtraction of threads, and since the $\sqrt{}$ of the counts = the diameter, the sum will be—

$$\text{As } 72 : 80 :: \sqrt{2/40\text{'s}} : \sqrt{x}, \text{ or}$$
$$(\text{As } 72 : 80 :: \sqrt{2/40\text{'s}} : \sqrt{x})^2 =$$
$$\text{As } 72^2 : 80^2 :: 2/40\text{'s} : x = 25\text{'s or } 2/50\text{'s counts required.}$$

Similarly in the second case the number of threads will be regulated by the diameters, therefore

$$\text{As } \sqrt{2/40\text{'s}} : \sqrt{2/50\text{'s}} :: 72 : x, \text{ or}$$
$$(\text{As } \sqrt{2/40\text{'s}} : \sqrt{2/50\text{'s}} :: 72 : x)^2 =$$
$$\text{As } 2/40\text{'s} : 2/50\text{'s} :: 72^2 : x^2 = 80 \text{ ends per inch.}$$

The above two calculations may then be worked by the following general rule :—

Rule.—Place the proportions as for a rule of three sums, and work by the $\sqrt{\ }$ of counts or the threads squared.

The foregoing remarks and rule are equally applicable to calculations for weft.

CHAPTER VI.

WEAVE ANALYSIS.

SINCE any further calculations than those already dealt with will relate definitely to the cloths that happen to be under consideration, the next step will be to obtain the weave, or order of interlacing of the warp and weft threads, since this, as will be shown later, besides being necessary may prove of great service in the subsequent analysis—such as in determining the threads and picks per inch.

Two Methods.—Practically there are two methods of determining the make or weave of any given cloth, viz. by analysis and by synthesis. By the former method is implied pulling a cloth to pieces, thread from thread, pick from pick; and by the latter, building a cloth up according to the principles of interlacing which experience enables the designer to detect in the cloth that it is desired to reproduce.

The second method is quite out of the reach of the uninitiated. They must fulfil the laborious task of following every end and pick throughout the cloth, whereas the experienced analyst would pull a thread or pick out to confirm his surmise respecting the make, and proceed at once to build up his cloth. More often than not the experienced judge the make of a cloth from the appearance alone: thus the fallacy of would-be analysts simply pulling cloths to pieces is fully demonstrated. Of infinitely greater service is the experience gained by experiment with the various principles of textile design.

General Consideration.—Let the reader now suppose there is before him a pattern which it is desired to reproduce, and of which nothing is known. Then the first consideration will be—is it a single, a backed, or a double cloth? This, as a rule, can readily be decided by pulling out a few threads and picks, and observing whether any of them keep to one side of the fabric or not. If one series, say of threads, form the face, and another series of threads the back, while the picks interweave both face and back, then the fabric is backed with warp, and it will be necessary to find not only the face weave but also the backing ties. Weft might be used as backing instead of warp, when there would be two series of weft threads, or picks as they are termed, and one of warp, and the interweaving of each must be obtained as in the case of warp backing. Should there be both backing warp and weft, then the fabric will usually be a double cloth, in which case three points must be decided: firstly, the face weave; secondly, the back weave; and thirdly, the system of tying the back cloth to the face. Having decided by brief examination under which heading

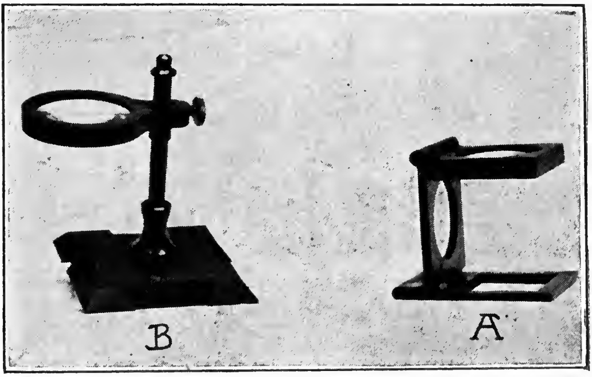

Fig. 33.—Piece glasses.

the pattern to be analysed comes, the analyst should proceed in the manner laid down in the following pages.

Instruments Required.—It would be no difficult matter to draw up a list of instruments serviceable to the analyst costing pounds; but instruments will never make a successful analyst; therefore, the following should prove all that are necessary.

The first necessity is a piece-glass, i.e. magnifying glass of the forms shown in Fig. 33*a* and 33*b*, which will cost from 1s. up to 15s., or even more. The glass should possess fair magnifying power, and in order to ensure this in purchasing, the glasses presented for examination should be compared with one of known excellence, or at least with others which the vendor shows. In the type of glass, Fig. 33*a*, to ensure a good light on the fabric during analysis the supports should be cut away as far as is compatible with strength. The measure is made in three forms as shown in A, B, and C (Fig. 34), A being the square form, either 2, 1, or $\frac{1}{2}$ an inch; and B the oblong, usually made $\frac{1}{2} \times \frac{1}{4}$ or $1 \times \frac{1}{2}$, and C the combined form. A useful form of piece glass is illustrated in Fig. 33*b*. The lens may be moved up or down to suit all ranges of vision, and at the same time moved round to any of the measurements cut into the base, as indicated at D (Fig. 34).

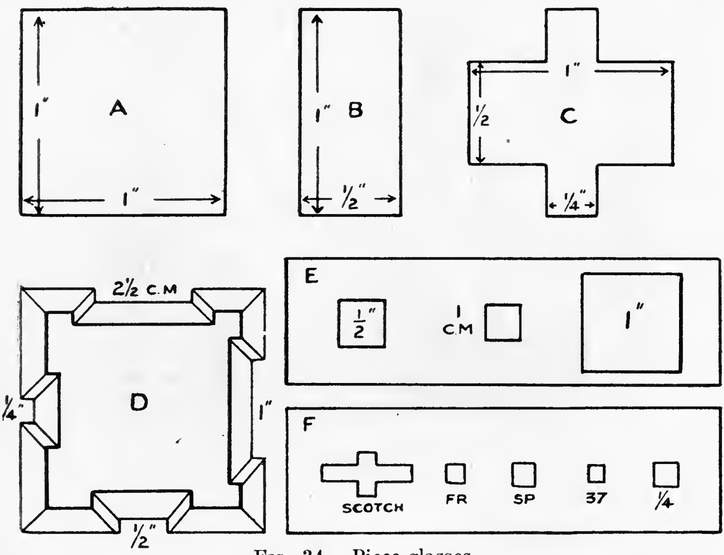

Fig. 34.—Piece glasses.

In order to examine with precision the interlacing of the threads, two needles fixed in wood handles should either be made or procured from some instrument maker, the usual charge being 2d. each. Corks should be fitted on the needles when not in work, to prevent damage to the points, and also to prevent accidents.

A pair of curved or straight scissors, a sharp knife, and a pair of tweezers to catch hold of any required thread, along with white cardboard upon which to firmly hold the pattern, design paper, drawing pins, black and white thread, pencils of two or three colours, and gum, complete the outfit.

Other apparatus such as the reflectroscope, Smith's scale, etc., is not really necessary and would only occasionally be employed.

Gill's apparatus is perhaps the most useful apparatus of this type yet put on the market. This consists of a box, on the top of which is fixed a piece of ground glass and a lens. The cloth is placed on the glass and light may be transmitted through the fabric by means of an electric light, situated inside the box. A second electric bulb throws light on to the surface of the fabric. By means of slides marked E and F (Fig. 34), the number of threads and picks may be counted in any of the given measurements.

Means of Distinguishing Warp from Weft in Woven Fabrics.—(1) *By Material.*—In such structures as twills, sateens, coverts, etc., in which one system of threads is two-fold and the other single; the two-fold is warp.

If one system of threads be softer in twist than the other, the softer material is usually weft. Often the weft is not only softer in twist than the warp but is also thicker.

When one material is found to be cotton and the other wool as in cashmere dress fabrics (cotton warp and botany weft): bright goods (lustres, mohairs, alpacas), low meltons, beavers, and tweeds, the cotton material is with few exceptions (motor cloths) the warp. The conditions of weaving are such that the yarn employed as warp must possess sufficient strength and elasticity to stand the strain imposed, whereas any material may be employed for weft which will hold together whilst the shuttle is carrying it across the open warp threads. Therefore, if one system of threads are stronger than the other, although alike in other respects, the stronger material will almost invariably be the warp.

(2) *Appearance of Fabric.*—In most cloths the warp threads appear to be straighter than the weft. During both weaving and finishing the weft is allowed to contract more than the warp on account of tension being more readily applied lengthwise to the piece.

The nap of faced finished cloths such as amazons, coverts, beavers, etc., is as a rule in the direction of the warp.

If the portion of cloth under consideration contains part of the "list," "edge," or "selvedge," the direction of this will indicate the warp.

In grey cloths it is possible to distinguish the warp on account of a handle and appearance due to sizing.

The weave and order of colouring often indicate the direction of the warp.

In almost all cloths of a twill character the direction of the twill is more towards the upright or warp direction than to the horizontal.

As coloured threads are more economically introduced into a cloth as warp than weft, if a cloth contains a coloured stripe the direction of the warp is thus indicated. In both colour and weave check fabrics the length is usually greater than the width.

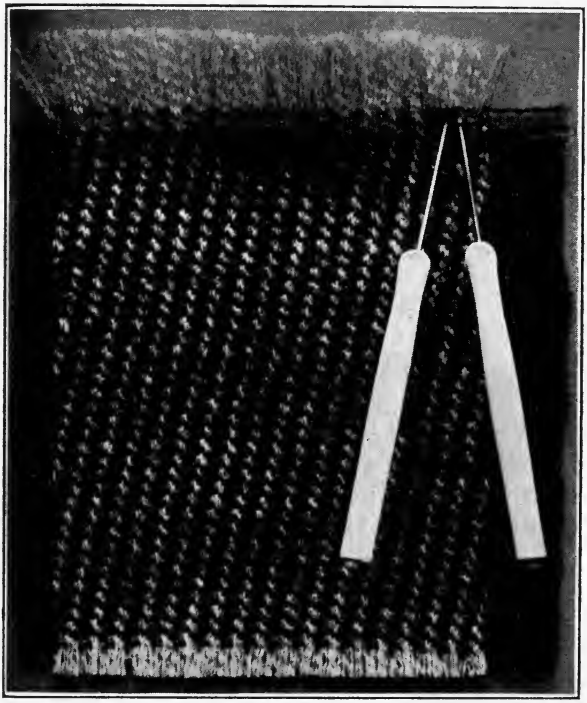

Fig. 35.—Preparing cloth for dissecting.

Method of Dissecting for Weave.—Having decided which is warp and which is weft, the analyst should proceed as follows: First, pull out a few picks, so that any thread may be pulled out at pleasure: second, pull out a few threads so that any pick may be pulled out at pleasure. Now placing the pattern upon a white ground if dark or black, or a black ground if light or white, then with the aid of the dissecting needles endeavour to separate the first thread or pick from its neighbour, but still let it remain interlacing with the warp or weft, as shown in Fig. 35, when the order of interlacings may possibly be transferred to design paper by examining with the naked eye: or a magnifying glass may be placed over and the order of interlacings read off to an assistant.

Having recorded the interlacing of thread or pick 1, liberate it

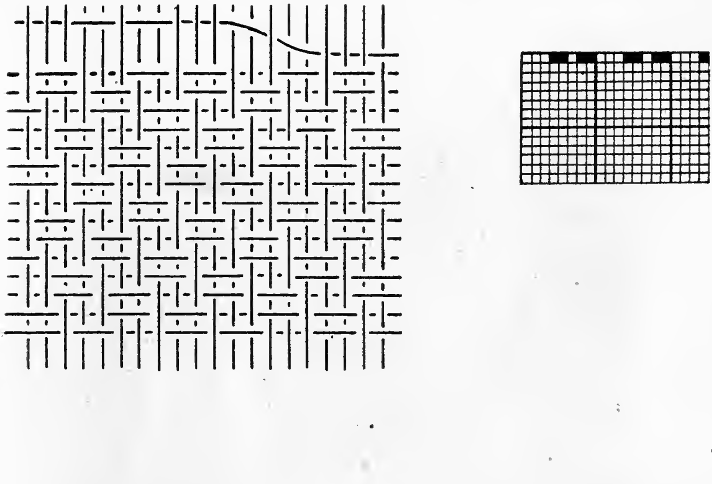

Fig. 36.—Method of dissecting cloth for weave.

from the cloth and proceed in a similar way with threads or picks 2, 3, 4, etc. Care must be taken that when once a given thread or pick has been decided upon for the commencement of the weave, each subsequent and consecutive reading must be started on this particular thread or pick.

As to which material—warp or weft—is the most convenient to take from the cloth no definite rule can be laid down. In the case of cloths containing about an equal number of threads and picks per inch with the same amount of warp and weft on the surface of the cloth, then the taking out of the weft might be established as the rule. Where the warp threads are much closer set than the picks of weft it will be found most convenient to read the interlacing by drawing the warp over weft, and where there are more picks than threads the interlacings of weft should be read off.

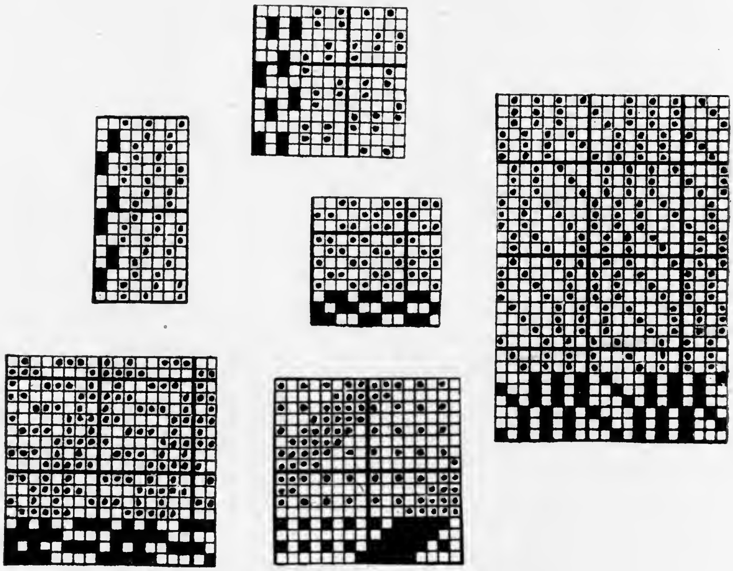

Fig. 37.—Completing weaves from sections.

Repetition of Weaves.—With many weaves, if the analyst is well grounded in the principles of design, after taking out three or four threads or picks, he will probably be able to complete the weave as illustrated in Fig. 37.

Figure Analysis.—In analysing figured textiles for precise reproduction the unit or repeat of the figure must be first ascertained. Should a full repeat, or more than a repeat, of the pattern be obtainable, several methods may be adopted. A simple plan, frequently resorted to by professional analysts, is to pin the pattern on cardboard and prick with a needle round its edge, thus obtaining a representation in outline of the figure. In some figured cloths it is not a difficult matter to obtain the outline by placing a piece of tracing paper on the pattern, the design of which can be clearly seen through and traced on to the paper, or a sheet of glass may be substituted for the tracing paper and the outline of the design painted on the glass as shown in Fig. 39 (Fig. 38 being the figured fabric). After having transferred the sketch on to ordinary paper the repeat must then be enclosed in a square or oblong, and this be divided into squares representing 8, 16, or 24 threads and picks, as required. Another method is to paste the cloth upon cardboard and divide it into spaces by wrapping threads round it,

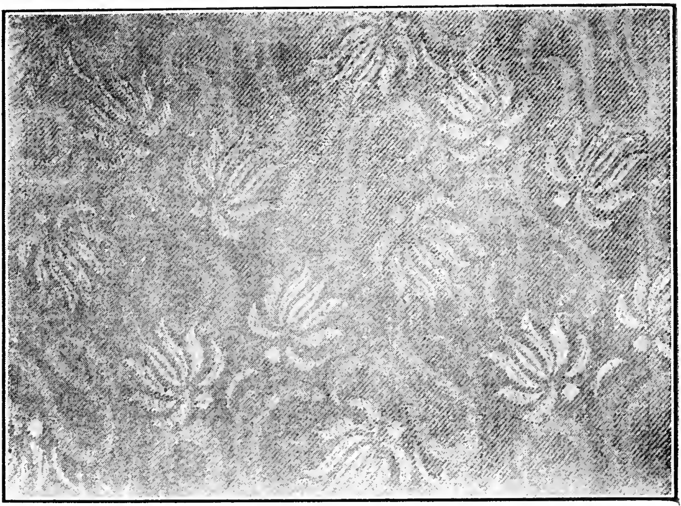

Fig. 38.—Analysis of figured fabrics.

equidistant from each other, as shown in Fig. 40. Each of these squares may then be taken to represent 8, 12, 16, or 24 threads and picks, as required. Thus, taking each square to represent 24 threads and picks, $24 \times 12 = 288$ ends and picks for the full repeat of the design. A useful means for dividing the repeat of any figure into any desired number of squares is shown in Fig. 41. By ruling a paper similar to this, and doubling until the repeat of the pattern is divided into the required number of divisions, any figure may be squared out as desired. In Fig. 41 there are 25 divisions; thus, dividing any given figure according to this, if each division is taken to mean 8 threads or picks, $25 \times 8 = 200$ threads or picks for repeat of the pattern ; if 16 threads or picks, then $25 \times 16 = 400$ ends. For a 288 jacquard, only 18 divisions should be employed ; thus, $288 \div 18 = 16$ threads or picks to each division, and so on. The lines should be ruled from the space likely to be occupied by the smallest figure to that occupied by the largest

FIG. 39.—Design painted on glass.

figure. Thus, in Fig. 41 the divisions were drawn to $\frac{1}{12}$th of an inch ; thus $\frac{25}{10} = 2\frac{1}{2}$ in. to $\frac{25}{5} = 5$ in. ; but, in drawing up a diagram for actual use, this latter space should be doubled, i.e. $\frac{50}{5} = 10$ in., when it will include all save abnormal figures.

Other modifications of the above principles are in use, according to the fancy of the particular analyst. Nevertheless, whatever system be adopted, it should be remembered that what is required is simply the division of one repeat of the figure into squares or oblongs, each representing a certain number of threads and picks on the design paper.

When only a portion of a pattern is obtainable the difficulties are greater, since no further advance can be made unless there is sufficient of the figure to decide the method of arrangement adopted, and even then the analyst can often go no further unless he possess considerable artistic insight and culture.

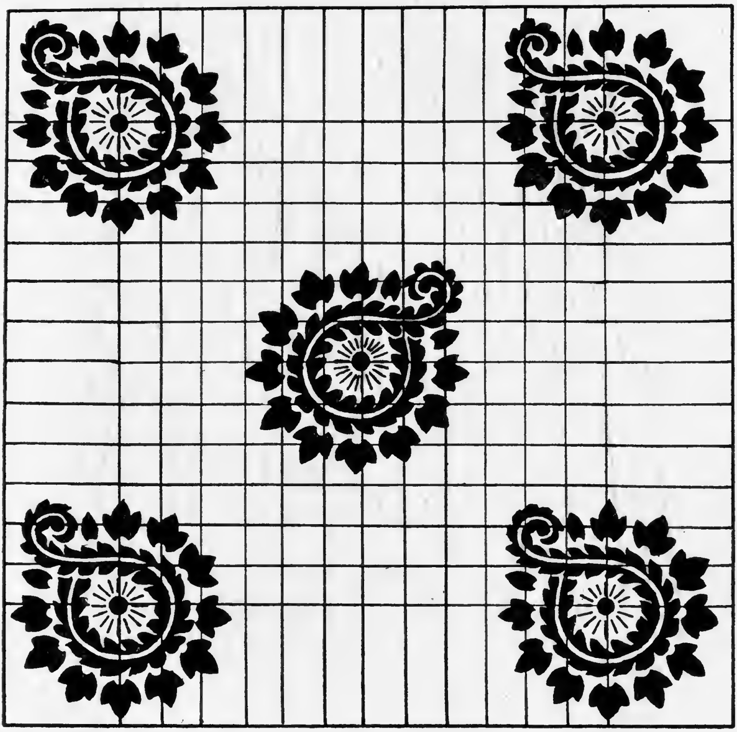

FIG. 40.—Sketch squared for point-paper.

Having obtained a satisfactory sketch of the design of the cloth and squared the same to represent the required number of threads and picks, the design may be transferred to point paper by working on the following lines, i.e. :—

1. Select a suitable size and correct ratio of point paper, according to the threads and picks per inch and in one repeat of the design.

2. Transfer the outline of the sketch on to point paper.

3. Paint in the outline of the figures with a solid yet transparent colour; shape off as well as possible and then "block in".

4. Insert the necessary weaves as systematically as possible; carefully examining the original pattern and observing all detail regarding weave development, etc.

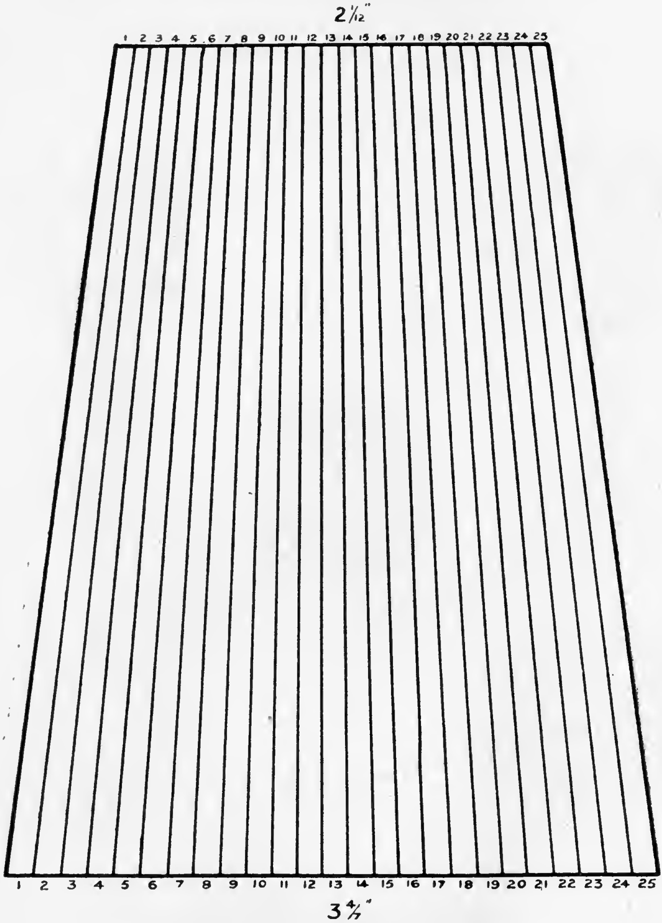

FIG. 41.—Dividing sketch into square.

As already pointed out, it may not be necessary to either pull the pattern in pieces to ascertain the weave or, in the case of simple figured styles, to first obtain a sketch of the design. In some makes of cloths, especially figured styles where the ground weave is a simple one, a very effective method is to place an ordinary piece glass on the face of the cloth, when probably individual threads and picks may be followed throughout the repeat space.

The Counting of Threads and Picks.—It is of the utmost importance that these particulars should be absolutely correct, as an error of 3 or 4 threads or picks per inch would be responsible for making the resultant and reproduced fabric a higher or lower quality than the one imitated.

In fine goods, such as cashmeres and linings in which there are 65 or more threads per inch and often over 140 picks, an error of 2 or 3 would not be of as much importance to the result, as in cloths, such as mohair sicilians or botany twilled coatings where the threads and picks per inch are comparatively low and where abnormal "slipping" may result.

There are two distinct methods of counting, viz. :—

1. By counting the individual number of threads in $\frac{1}{4}$, $\frac{1}{2}$, or 1 in. by means of a piece glass.

2. By counting the repeats of the weave or colouring within a given space.

To obtain the highest degree of accuracy the latter method is commended wherever applicable.

Example 1.—A 3/3 twill cloth counts 26 repeats of the weave across $3\frac{1}{4}$ in. of the fabric. How many threads per inch are there in the cloth?

$26 \times 6 = 156$ threads in $3\frac{1}{4}$ in.

$156 \div 3\frac{1}{4} = 48$ threads per inch.

Example 2.—(Fig. 42.)

Warping Plan.

8	threads	white
8	,,	black
8	,,	white
8	,,	black
16	,,	white
16	,,	black

64 threads per pattern.

3 repeats of pattern and 16 threads black, 16 threads white measure 3 in.

$64 \times 3 = 192 + 32 = 224$ threads in 3 in.

$224 \div 3 = 75$ threads per inch.

The piece glass is most useful for counting finer set fabrics, where it is difficult to follow the repeat of design or colouring.

It is possible to calculate the threads or picks per inch by placing the piece glass longitudinally with the twill, but as the calculation involves trigonometrical ratios it is not here given. This method, however, is very useful in making comparisons between the fineness of twill in twilled fabrics.

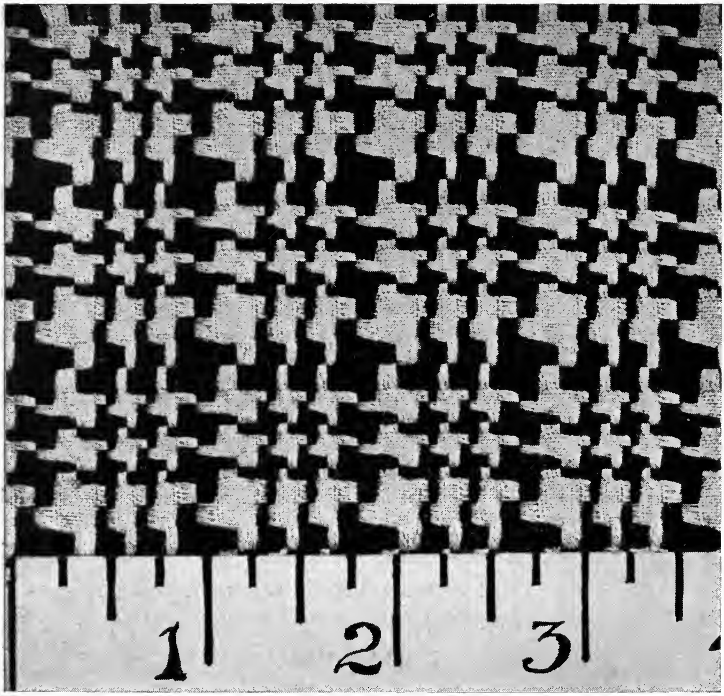

Fig. 42.—Method of counting threads and picks per inch.

Classification of Woven Structures.—In addition to the nature and quality of material and yarn employed to make a woven fabric, the contraction of warp and weft is largely controlled by the structure of the cloth. The widths and lengths of fabrics vary according to the weave, the thickness of the warp and weft, and the set of the threads and picks.

Interesting examples of the influence of weave are illustrated in Fig. 43. Here it will be noted that a similarly sett and picked cloth varies in width according to the weave applied.

The cloths contained in Fig. 43 are made to the following loom particulars :—

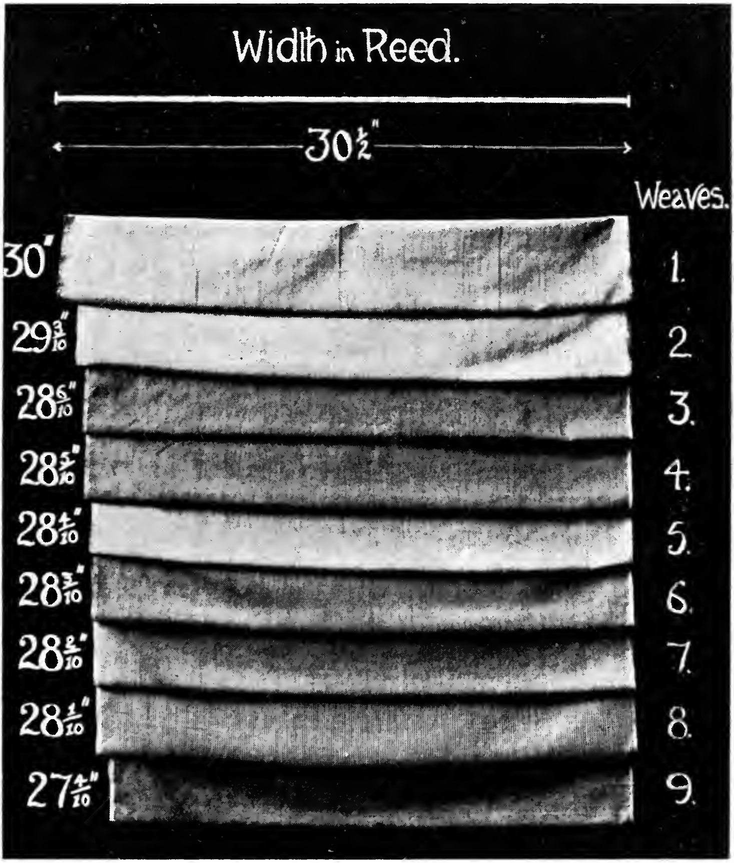

Fig. 43.—Influence of different weaves on the width of a woven fabric.

Warp.
2/56's botany worsted,
64 threads per inch.
Weft.
1/30's botany worsted,
64 picks per inch.

Fig. 44 illustrates the various weaves employed.

It is therefore obviously necessary to carefully consider the various types of interlacing as a knowledge of such may be useful in many ways.

Single Cloths.—As the name implies, single cloths are those in which only one series of warp and one series of weft are interlaced.

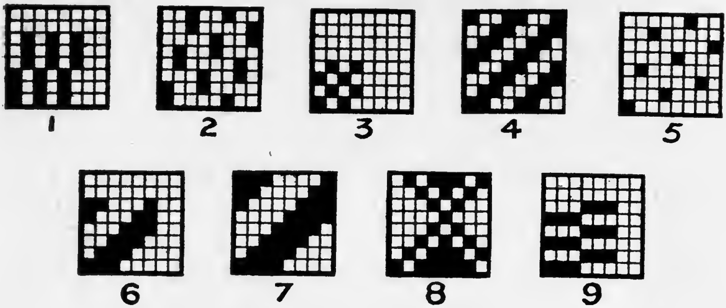

FIG. 44.—Varying widths of cloth (weaves employed).

The cloths made under this heading may be divided into two distinct classes, i.e. (*a*) ordinary structures, (*b*) ribbed structures.

Ordinary Structures are those in which the warp and weft threads are alike in thickness and number. The order of inter-

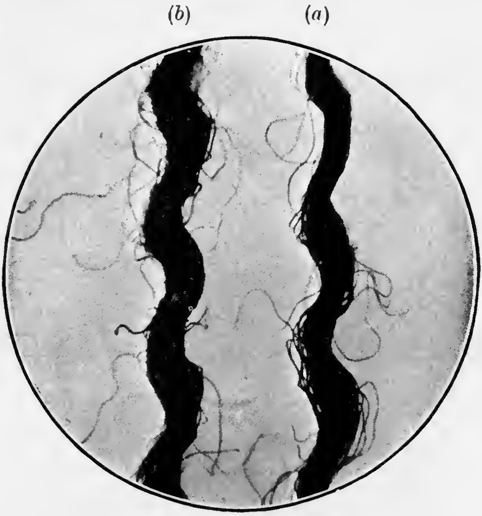

FIG. 45.—Micrograph of thread (*a*) and pick (*b*) from a 2/2 twill cloth.

lacing is also of such a character as to require about an equal amount of warp and weft on the face and back, which will cause both series of threads (warp and weft), provided they are of the same quality of material, to bend, contract, and shrink alike from being warp and weft to becoming a woven structure.

Fig. 45 is a micro-photographic reproduction of a thread and pick taken out of a 2/2 twill cloth, as shown in Fig. 45*a*. Notice first that the curves are equal, this being a necessary condition where each thread is up and down an equal number of times; and, secondly, that the deflections in warp and weft coincide, thus proving that, whatever the weave is, equal quantities of warp and weft are on the surface.

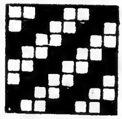

FIG. 45*a*.—2/2 twill.

The above conditions are considerably modified if one system of yarns is thicker or stronger than the other or the threads and picks per inch are not of an equal number. Although in both the above-mentioned modifications both warp and weft may show some curvature and contraction, yet the curves of warp and weft will not be equal. Such conditions will indicate varying widths and lengths. An illustration as to the extent to which the width of a cloth may be varied by modifying the number of picks or thickness of weft is indicated in Fig. 46.

Cloth.	Picks per inch.	Weft.
1	64	2/36's worsted, botany.
2	64	2/54's " "
3	40	1/30's " "
4	64	1/30's " "
5	64	2/56's " "
6	64	1/64's " "
7	84	1/64's " "
8	84	1/30's " "

Loom particulars :—

Warp.
2/56's botany worsted,
64 threads per inch.
Weave.—2/2 twill,
reed width $30\frac{1}{2}$ inches.

Rib Structures.—Ribbed structures are those in which there is a predominance of one of the two series of threads which constitute the fabric, such as corkscrews, warp and weft ribs, etc., and are produced by (1) a certain order of interlacings, such as ribbed weaves; (2) warp and weft of different thickness; (3) a different number of threads to picks, or vice versa.

Warp Ribs.—The first method of constructing a ribbed weave is illustrated in flat view warp and weft sections, in Fig. 47. It will be observed that about equal thickness of warp and weft, with an equal number of threads and picks, produces a structure in which, when woven, the weft is entirely hidden, warp predominating on both face and back of the fabric, owing to the order of interlacing causing the picks of weft to be straight, and the warp threads only to bend.

The particulars are as follows :—

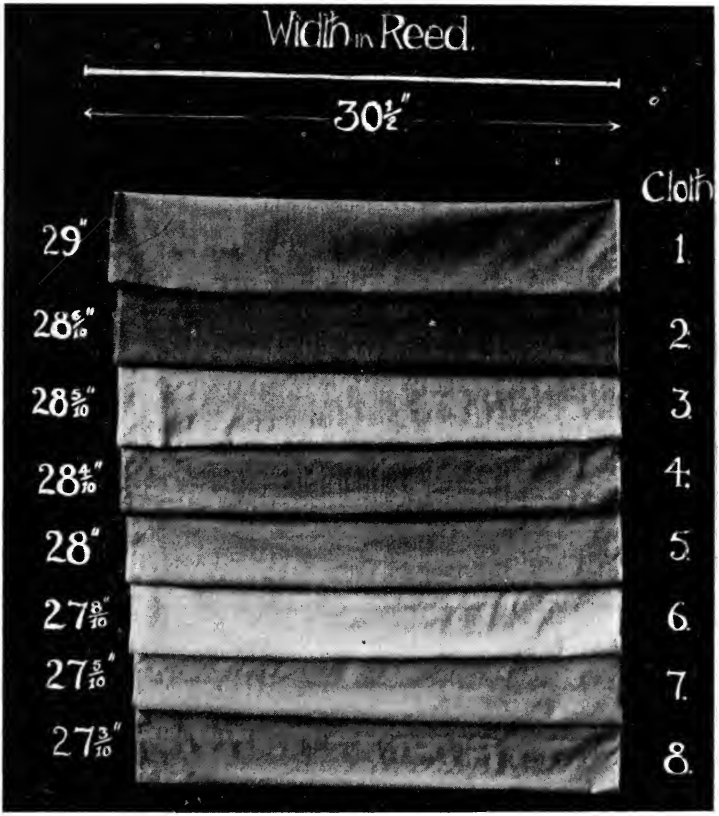

Fig. 46.—Variation in width by modifying the number of picks or counts of weft.

Warp.
2/36's botany,
76 threads per inch.

Weft.
1/20's botany,
76 picks per inch.

Weave.—3/3 warp rib.

Such conditions are responsible for little variation in width from loom to finished cloth, and great variation in length, although the warp and weft are composed of fibre of great contracting property. If a 3/3 weft rib weave be applied to the same structure, the result will be vice versa, i.e. the warp will be straight and the weft only bending.

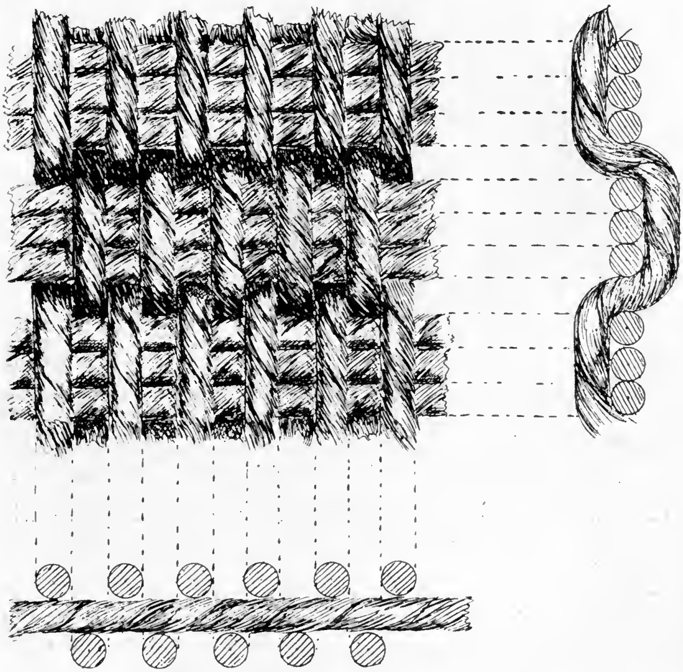

FIG. 47.

A second example of a warp rib structure is shown in Fig. 48 and Fig. 48*a*. Fig. 48 shows clearly (*a*) a warp thread, and (*b*) a pick of weft from a corkscrew cloth of which Fig. 48*a* is the weave. The warp thread (*a*) indicates the warp bending according to the floats and the pick of weft (*b*) practically in a straight condition.

Fig. 49 illustrates the flat view and warp and weft sections of a worsted poplin dress fabric made as follows :—

Warp.

2/80's botany,

135 threads per inch.

Weft.
1/12's botany,
47 picks per inch.
Weave.—Plain.

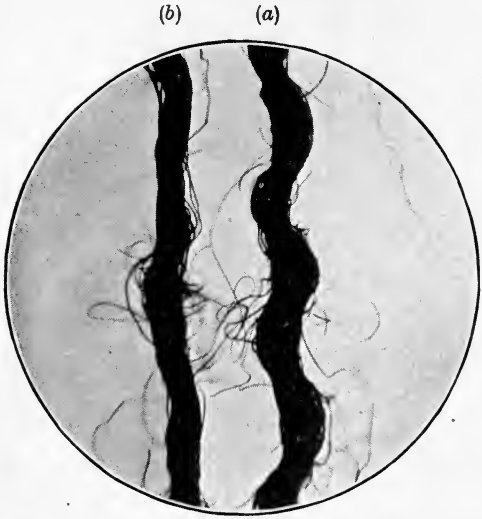

FIG. 48.—Micrograph of thread (*a*) and pick (*b*) from corkscrew cloth.

The structure (although produced from plain weave which usually results in an ordinary structure) is one of a purely warp rib character, due to the difference in the sett of the threads and picks, and the relative thickness of the warp and weft.

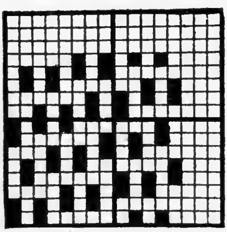

FIG. 48*a*.—13 shaft corkscrew.

Weft Ribs.—The only difference between these and warp ribs is that the weft bends and the warp lies straight. Fig. 50*a* is the 2/1 or cashmere twill of which a micrographic reproduction of actual threads is given in Fig. 50. It is noticed at once that the thick warp thread (*a*) is comparatively straight, and that the fine weft (*b*) practically does all the bending. The fact that the threads and picks are not up and down for an equal number of picks and threads is also clearly indicated by the wave of the pick here represented indicating the pick floating over two threads and where it is down for one. It is very evident, then, that if there is any doubt as to whether the ribs or twills in

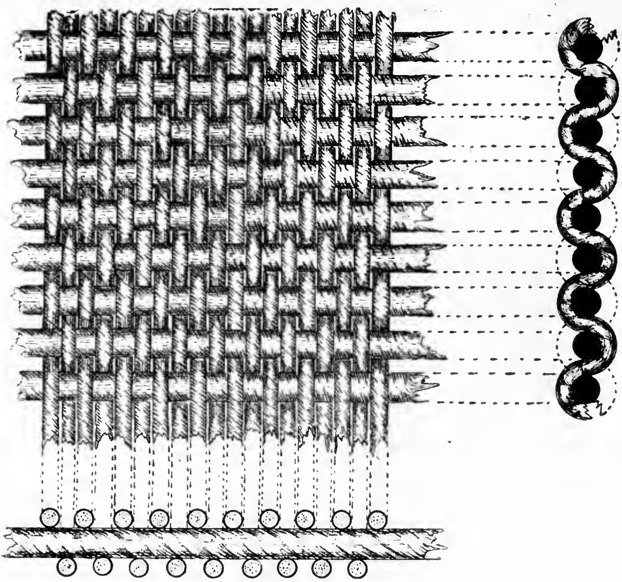

FIG. 49.—Poplin Dress Fabric.

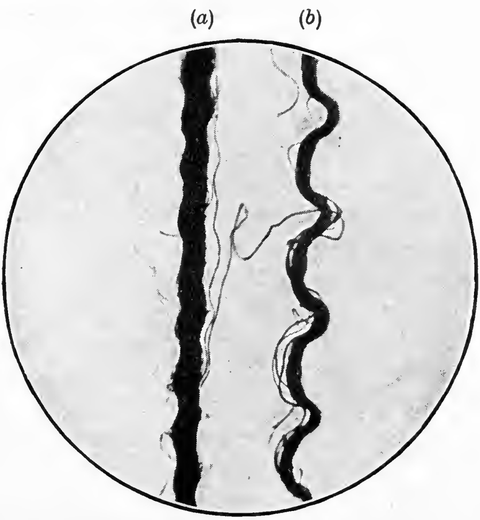

FIG. 50.—Micrograph of thread (*a*) and pick (*b*) from cashmere twill cloth.

a pattern are of the same breadth, a careful examination of the curvature of a pick will solve the question.

Backed Cloths.—Attention must now be directed to fabrics backed with warp or weft for the purpose of obtaining extra weight, warmth, and handle. In the first case we shall have two series of warp threads and one series of weft; and, in the latter case, one series of warp threads, and two series of weft threads. The following procedure should be adopted in analysing these cloths:—

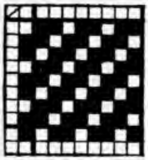

FIG. 50*a*.—Cashmere twill weave.

1. Ascertain whether backed with warp or weft.

2. Ascertain the relative proportions of face and backing threads or picks, and counts of the same.

3. Ascertain the face weave as a single cloth.

4. Ascertain the backing ties.

To decide whether a piece is backed with warp or weft may be rather a difficult matter if there is no list on the pattern submitted for analysis, and the only means of deciding will be the quality of the extra material. If it is a good quality—say a two-fold yarn—the backing has probably been warp, while if the material is single and short it has probably been weft, since it would not have the strength necessary for weaving as warp. Backing warp is nearly always finer than backing weft.

In ascertaining the relative quantities of backing yarns the safest method is to separate carefully the threads from the picks, classifying them as backing and face according to thickness, colour, material, or position in the cloth. The relative numbers will thus be ascertained with certainty.

Possibly the question may arise—Which is the most economical, warp or weft backing? With a poor material, evidently weft backing; but with a good material, warp backing, since, although there will be the trouble of beaming and fixing the backing warp independently of the face warp, yet in the case of a 1/1 backing the cloth will be woven in about half the time, and there will be little extra weaving expense.

No further reference to the third item in the above procedure is really requisite, since generally a portion of the backing may be taken off, leaving the face intact; but the fourth may profitably be considered more fully. In tying the backing to the face, of course, under any circumstances the conditions of perfect tying must, if possible, be observed, whether warp or weft be employed.

In Fig. 51 is shown an interesting fact concerning the backing of the 2/2 twill: (*a*) is a thread taken from the face, weaving as already indicated 2/2 twill, indicating two up and two down; (*b*) is the backing thread, indicating the tie. It will be observed that there are two repeats of the weave on the face thread to one on the backing. This leads us at once to decide that the backing is tied to the face in eight sateen order, since, as shown in flat view and sections Fig. 51*a* and design Fig. 51*b*, this sateen ties on every other twill.

It need scarcely be noted that it is almost impossible to analyse

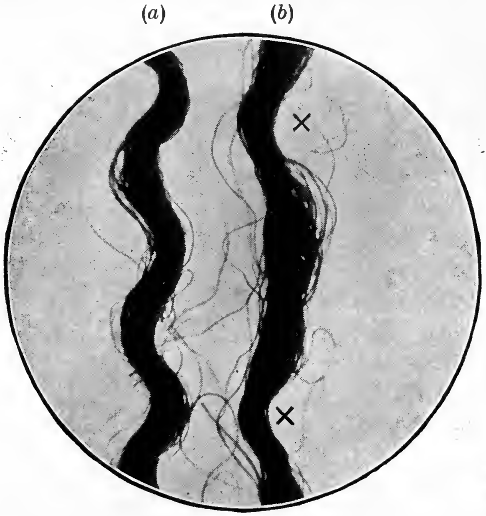

FIG. 51.—Micrograph of face (*a*) and back (*b*) warp threads from 2/2 twill cloth backed with warp.

these cloths successfully without a complete theoretical knowledge of the underlying principles, and some practical experience. For example, in addition to the foregoing difficulties, it is found in practice that, at times, such a small matter as the method of tying has quite a remarkable influence on the resultant cloth, a slight variation in the position materially influencing the result.

Double Cloths.—The principles governing the construction of these are very similar to those governing backed cloths, the only difference being that there is a distinct back cloth formed. The analyst should proceed as follows:—

1. Find the face weave or design.
2. Find the back weave or design.

3. Find the relative quantities of face warp and weft to the backing warp and weft, along with the counts of yarn, and

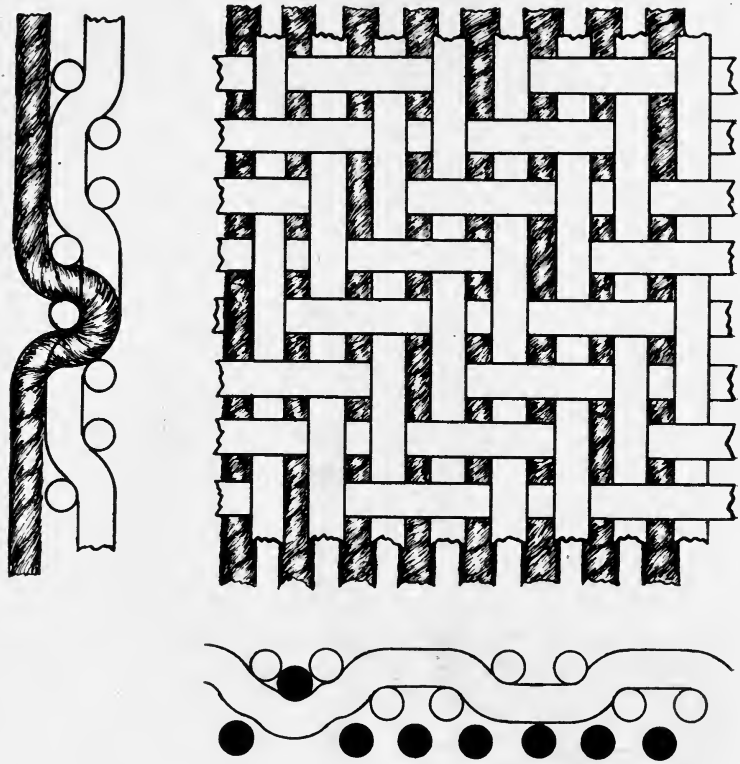

Fig. 51a.—Flat view and section of 2/2 twill cloth backed with warp.

4. Find the method of tying, whether with warp or weft, and the system of distribution.

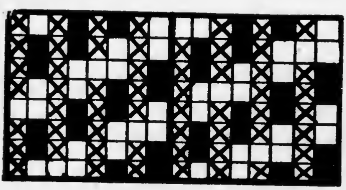

Fig. 51b.—Design for 2/2 twill, backed with warp. Marks = weft.

With reference to this latter proceeding Fig. 52 demonstrates a very useful point. Here (*a*) is a thread taken from the face of a double 2/2 twill cloth. (*b*) represents a thread taken from the back. It will at once be observed that, owing to the face being similar to the back cloth, the curves of the 2/2 twill coincide. Further, it is evident from an examination of the curve of the backing thread that the back cloth has been tied to the face by means of the backing warp, B indicating this tie,

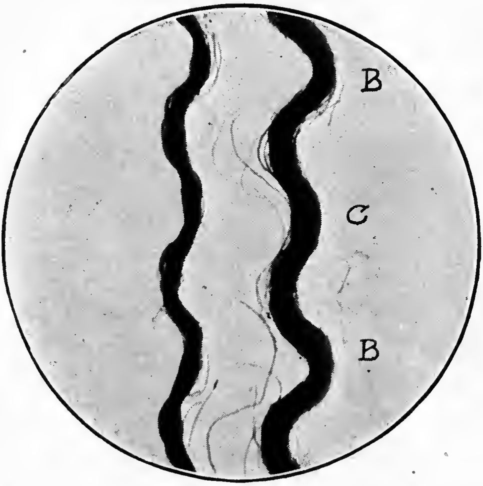

Fig. 52.—Micrograph of face (*a*) and back (*b*) threads from a double 2/2 twill cloth.

which is a much more marked curve than is C, where no such tie has taken place. In this way the system of tying may be ascertained, since if a backing thread rises over a face pick the curvature of the backing thread will show the tie; while if a backing pick rises over a face thread the curvature of the backing picks will show the tie. Fig. 52*a* is the plan employed and Fig. 52*b* illustrates the flat view and sections.

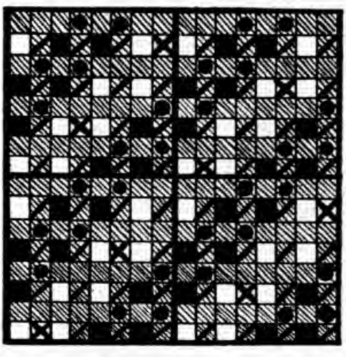

Fig. 52*a*.—Design for double 2/2 twill cloth.

Backing threads and picks.
Face weave inserted in face threads and picks.
Back weave inserted on back threads and picks.
Back threads held down when face picks enter the cloth.
Binding places, backing threads over face picks.

Marks = weft.

The Tying of Backed and Double Cloths.—The principle upon which backed cloths are tied will readily be realized by careful examination of Fig. 52*b*, in which the warp system of tying is illustrated.

The chief points to attend to are the following: First, whether warp or weft ties, all ties should be effected in such a manner that there is nothing perceptible upon the face of the

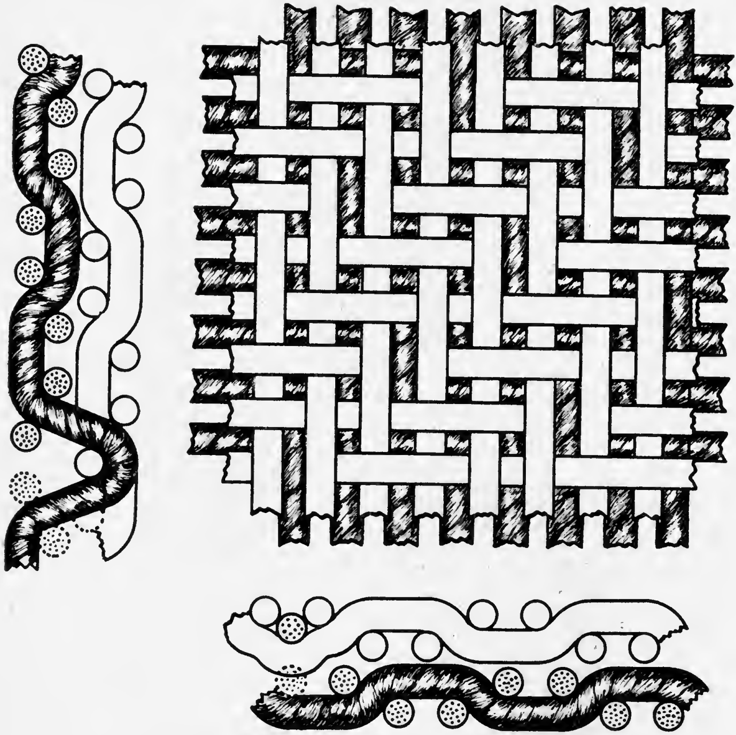

FIG. 52*b*.—Flat view and sections of double 2/2 twill cloth.

cloth; second, endeavours should be directed towards placing a tie upon every thread and every pick; third, in the case of double cloths the finer material, whether warp or weft, should as a rule be selected for tying purposes.

The first point is well demonstrated in Fig. 52*b*, a careful examination of which shows that the backing warp tie is effected between *two floating face warp threads.*

The second point will be duly attended to if the ties are arranged in sateen order. In Fig. 52*b* the eight sateen distribution is employed, since the face readily admits of this. If, however, a two of face to one of back scheme of arrangement, or any other arrangement, be adopted, the difficulties will be greater, and often cannot be entirely overcome. Note should be made that in a warp-backed cloth the backing threads should if possible rise over every face pick; while in a weft-backed cloth a backing pick should, if possible, rise over every face thread. In the case of double-cloths precisely the same principles apply, according to the system of tying adopted.

This leads up to the third point—the selection of the material to tie with. In the case of backed cloths there is no choice here, but in the case of double cloths either warp or weft tying, as just noted, may be used. Evidently if the face weave gives no advantage to either system, the finer material, usually the warp, should be employed, but if the face weave favours the weft then it may be advisable to tie by the weft. For example, in a 3/1 weft twill face cloth there is evidently no perfect tying place for a warp tie, but for a weft tie the conditions could hardly be more favourable; therefore a weft tie should undoubtedly be employed. At times it may be advisable to use both the warp and weft systems of tying, but this will be of rare occurrence. In this, as with textile designing throughout, the analyst should work upon the basis that "that which is not best is wrong".

CHAPTER VII.

DRAFTS AND PEGGING PLANS.

By means of drafting the number of heald shafts necessary to produce many designs may be considerably reduced, and thus the use of a higher capacity dobby or jacquard be avoided. Take as an example Fig. 53: this extends over 48 threads, but it is not necessary to employ 48 shafts for its production, since a brief examination will show that certain threads are always lifted together and depressed together throughout the repeat, and consequently may be drawn on to one shaft.

Method of Drafting.—Carefully examine each succeeding thread in the design; all the threads rising and falling on similar picks may be drawn on one shaft.

Example.—As shown in Fig. 53 the design may be drafted on to 8 shafts with an equal number of threads, i.e. 6 per shaft. For example, threads 1 and 6 are up and down together for the same picks, therefore one shaft will work both threads exactly as required; and similarly with the other threads.

Pegging Plan.—This, as a rule, will be the plan upon which any small number of shafts are worked to produce a large repeat in the cloth. It will consist of every kind of thread in the given pattern. For example, in Fig. 53 there are only 8 kinds of threads, which 8 shafts can conveniently work; thus each shaft must be worked *according to the requirements of the threads drawn upon it.* Examination of Fig. 53 with its draft and pegging plan will demonstrate all that is necessary respecting this matter.

Calculation for Mails per Shafts in Plain and Fancy Drafts.—Another matter the cloth analysts should thoroughly understand is the arrangement of the mails on each shaft employed in the mounting.

When the warp threads are drawn through the healds in arithmetical order and similarly repeated, or straight drafted, then the calculation is simple.

Example.—A 2/2 twill cloth is woven 64 in. wide in the reed

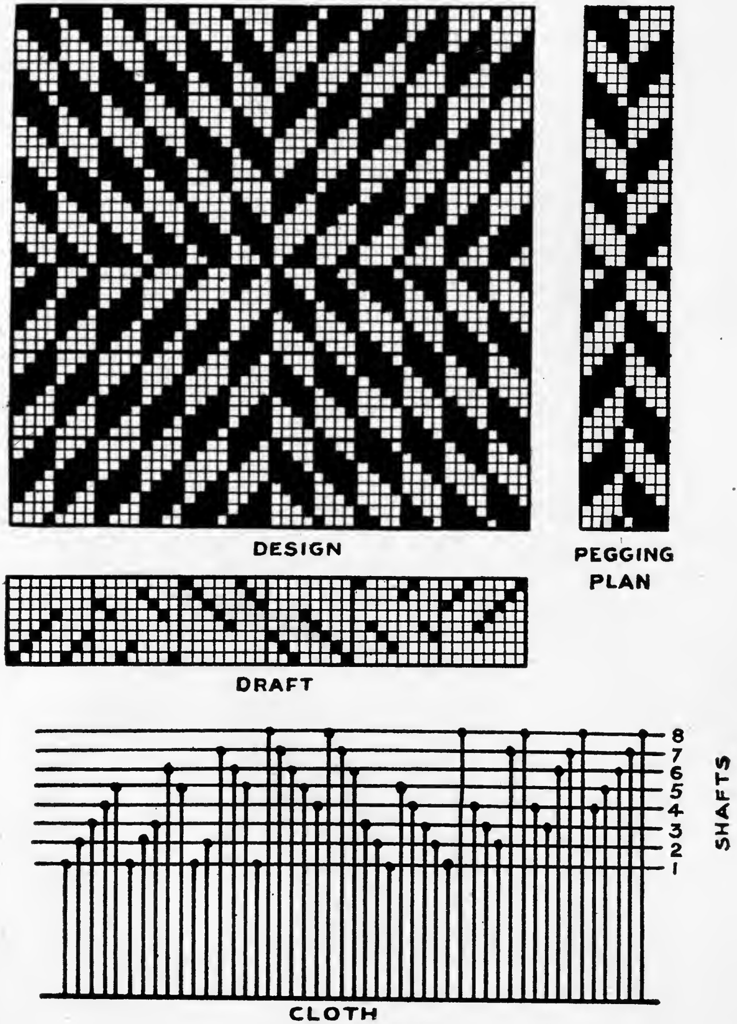

Fig. 53.—Method of drafting.

with 60 threads per inch, what number of mails upon each heald shaft is required?

Then, since 4 heald shafts are necessary to weave the 2/2 twill weave, the number of mails per heald shaft will necessarily be

$$\frac{60 \text{ (threads per inch)} \times 64 \text{ (in. wide)}}{4 \text{ (heald shafts)}} = 960 \text{ mails per shaft.}$$

In the case of fine setts it is often found expedient to employ double the number of shafts and consequently only half the number of warp threads on each shaft. In this case two shafts are usually linked together and so worked by the same tappet.

Example.—A plain weave cotton warp and mohair weft lustre cloth has to be woven with 70 threads per inch: employing 2

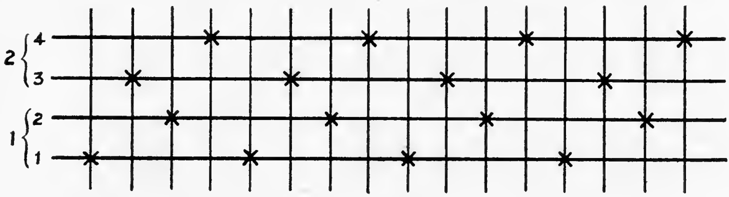

FIG. 54.

heald shafts the mails per inch upon each shaft will be :—

$$\frac{70 \text{ (threads per inch)}}{2 \text{ (heald shafts)}} = 35 \text{ mails per inch per shaft.}$$

Better conditions for weaving would be to reduce the number of mails per shaft by employing 4 shafts in place of 2, with the following result :—

$$\frac{70 \text{ (threads per inch)}}{4 \text{ (heald shafts)}} = 17\tfrac{1}{2} \text{ mails per inch per shaft.}$$

To obviate the employment of 4 tappets to actuate the shafts, the well-known "Hop-shaft" draft is employed, as illustrated in Fig. 54 : during weaving, the front two shafts and the back two shafts are linked together, the mounting thus requiring only 2 tappets. The tappet plan is for ordinary plain weave. It will be observed that the front two shafts will lift or depress the odd threads in the warp and back two shafts will actuate the even threads.

Fancy Drafts.—In the case of fancy drafts the same principle applies but there is rather more complication.

Example.—What number of mails per shaft will be required to employ the draft given at Fig. 55, in a cloth with 64 threads per inch, 60 in. wide ?

$$\frac{64 \text{ (threads per inch)} \times 60 \text{ (in. wide)}}{16 \text{ (number of threads in draft)}} = 240 \text{ repeats of the draft.}$$

240 × 2 (threads per repeat of draft) = 480 mails for shafts 1 to 4.
240 × 1 " " " = 240 " " " 5 to 12.

Casting-out is frequently resorted to as a means whereby a set of gears arranged for a given pattern may be re-adapted to another pattern, thus saving the expense of procuring a fresh set. Casting-out is accomplished in two ways, with two distinct objects :

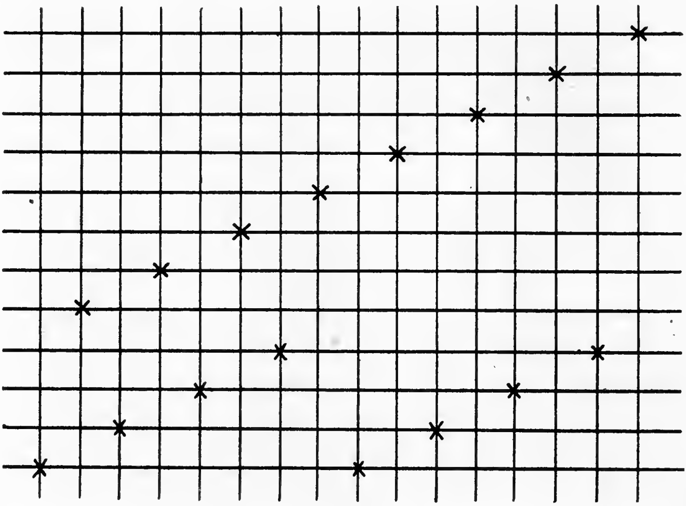

Fig. 55.

(*a*) for the reduction of the sett or ends per inch ; (*b*) for weaving a design repeating on a different number of ends.

Example.—A set of 8 shafts is arranged to give 64 threads per inch, therefore

$$64 \div 8 = 8 \text{ mails per inch per shaft.}$$

(*a*) *To Reduce the Sett.*—Cast out every other gait, i.e. draw threads upon 4 mails per inch per shaft only, leaving the others free ; thus

$$8 \text{ shafts} \times 4 = 32 \text{ threads per inch.}$$

If a less reduction is required, draw in 6 and cast out 2 gaits per inch per shaft, thus

$$8 \text{ shafts} \times 6 = 48 \text{ threads per inch,}$$

and so on.

In casting-out on the jacquard to reduce the sett it is usual to cast out uprights, since while casting-out in the harness leaves the full figuring capacity of the jacquard, yet the threads will be so extended in the reed, and the wear *caused by the empty harness working with the full* will be so great that, unless really necessary, this system should not be resorted to.

Example.—A 400 jacquard with 100 ends per inch = a 4-inch pattern.

To cast out in the harness to 50 ends per inch may then be effected as shown in Fig. 56 by drawing in 4 in. or one repeat of the mails A and missing 4 in. or one repeat B. The sley will then place the threads in their correct position in the cloth, but it will be realized that there is considerable friction on the threads,

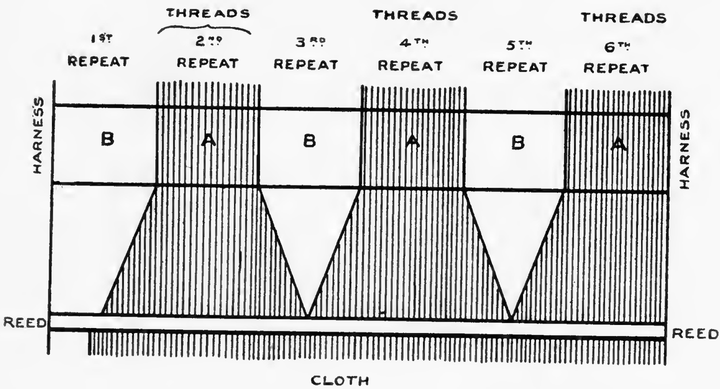

FIG. 56.—Casting out in harness.

while the wear of the harness in sections B B will be considerable, since it will work similarly to sections A A, which are forming the figure, but, since there are no threads through the mails in B B, the oscillation is liable to be very great.

(*b*) *For Weaving a Design Repeating on a Different Number of Ends.*—Take the example already given, viz. 8 shafts, 8 mails per inch = 64 threads per inch. Then to weave a 7-shaft plan one shaft may be cast off, for a 6-shaft plan two shafts may be cast off, and so on. Under these circumstances, however, the ends per inch will be reduced in direct proportion; thus, for 7 shafts the ends per inch will be :—

As 8 : 7 : : 64 : 56 ends per inch,

and for the 6 shafts—

As 8 : 6 : : 64 : 48 ends per inch, and so on.

The same principle obtains in the jacquard, uprights taking the place of shafts. Thus, to weave a 300 plan upon a 400 jacquard 100 uprights must be cast out, and so on. The set will, of course, be reduced in this proportion, for if 400 uprights give 100 ends per inch, then—

As 400 : 300 : : 100 : 75 ends per inch.

This system also may result in the threads being slightly drawn across if the uprights are all cast out together instead of say one row out of every four; but since the uprights are cast out the empty harness may remain stationary and thus obviate the wear resulting from working empty harness.

Inversely, to obtain a given set in a jacquard, uprights may be cast out in proportion as required, since, taking the foregoing as an example, to reduce from 100 ends per inch to 75 ends per inch will be

As 100 : 75 : : 400 : 300 uprights to be employed.

With these particulars the analyst should be able to overcome any difficulties arising, even should the conditions be more complicated.

Crammed Stripes.—Still more intricate calculations relate to mails per shaft for crammed stripes. Under these circumstances two or more distinct sets of healds will be employed, one set to weave the ground, and the other the figure or crammed stripe. Then—

(*a*) The number of shafts in each set will depend upon the respective weaves.

Example.—For a plain ground with an eight sateen crammed stripe, two or four shafts for the ground and eight for the stripe will be required.

(*b*) The absence of mails on the ground shafts and the presence of mails on the stripe shafts must be arranged for, according to the extent of the figure.

Example.—Fig. 57 is a sketch of a crammed stripe produced from the following loom particulars :—

Warp.

32	threads	2/56's botany	(at 64 threads per inch)
16	,,	40/2's spun silk	(at 128 ,, ,,)
24	,,	,, ,, ,,	(at 96 ,, ,,)
16	,,	,, ,, ,,	(at 128 ,, ,,)

32 dents per inch in reed.

Weft.

1/30's botany,

64 picks per inch

The Weave: Sleying plan, Drafts A and B, and Pegging plans A and B to produce this style are given in Fig. 57*a*.

In draft A it will be observed that 4 shafts are required whilst in draft B the "hop-shaft" draft is employed, requiring half the weaving capacity of draft A.

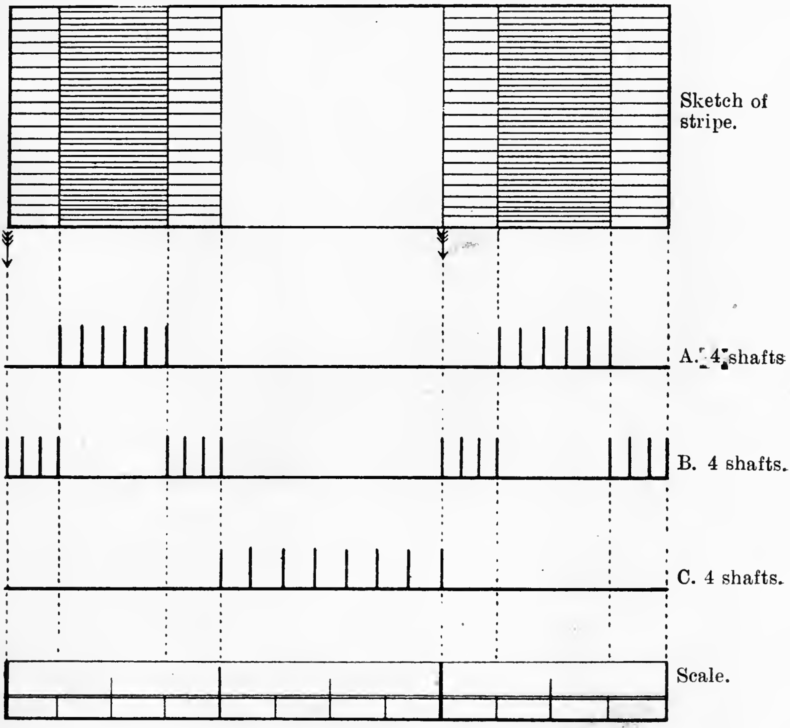

Fig. 57.

For this type of healds, where the warp threads are set finer in some parts than in others it is desirable to knit the healds according to the pattern. When this plan is adopted the finest set is taken as the pitch at which the knitting machine is made to knit the healds. All the remaining healds are then knitted to this same rate according to their relative fineness and spaced as indicated by the requisite draft pattern.

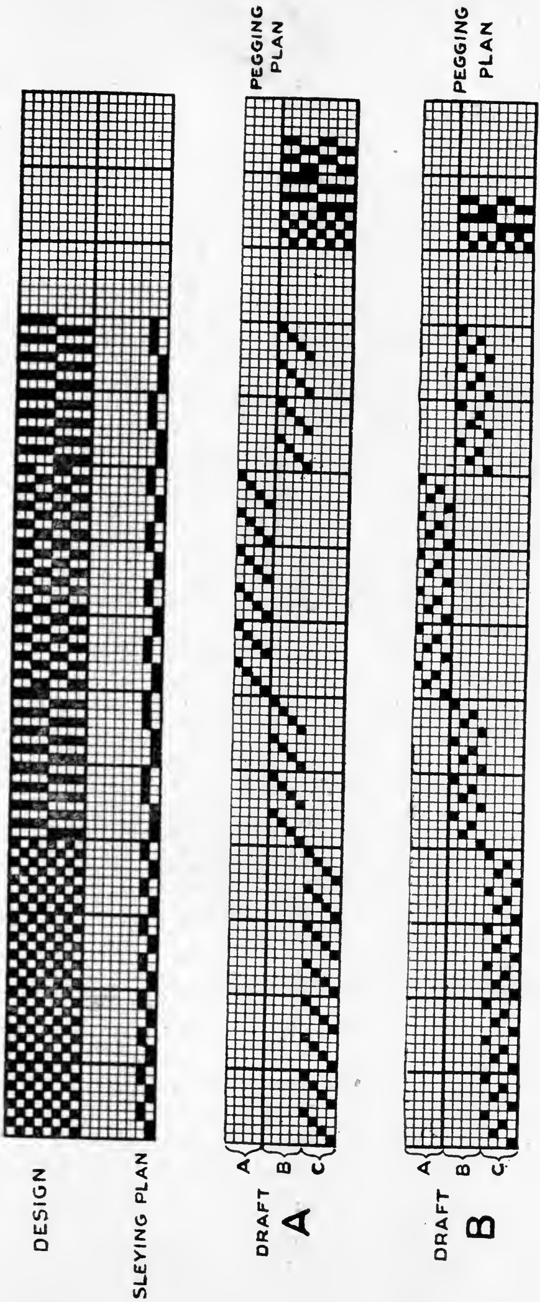

Fig. 57*a*.—Crammed stripe, design, sleying plan, drafts and pegging plans.

Note.—In B the shafts are linked together in pairs (see Fig. 54, p. 108).

Without entering into the details of the construction of the heald knitting machine, suffice it to say that it is usually constructed to automatically knit or miss, at will, any cord or number of cords in succession on each shaft.

Example.—In Figs. 57 and 57*a*, three sets of heald shafts are required to be spaced according to pattern and knitted as follows :—

Shafts	A at 128	per inch	÷ 4	shafts	= at 32	per shaft per inch.
„	B at 96	„	÷ 4	„	= at 24	„ „
„	C at 64	„	÷ 4	„	= at 16	„ „

With the heald knitting machine arranged to knit 32 mails

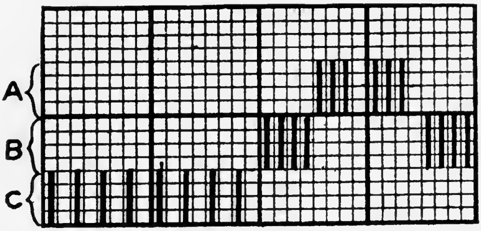

FIG. 57*b*.—Crammed stripe, heald knitting plan.

cords per inch, the order of knitting will be as shown in Fig. 57*b* which corresponds to the following :—

4 heald shafts A	miss 20	
	knit 3	x times
	miss 1	
	knit 3	
	miss 5	
	miss 20	
4 heald shafts B	miss 16	
	knit 4	x times
	miss 8	
	knit 4	
	miss 16	
4 heald shafts C	knit 1	8 times, x times
	miss 1	
	miss 16	
	knit 1	8 times
	miss 1	

Another method of illustrating the heald order is by graphically indicating the position of the mails per shaft as illustrated in Fig. 57 according to the pattern.

In the case of ascertaining the total number of mails per shaft, the following calculation is involved.

Example.—What will be the total number of mails per shaft in producing the crammed strip (Fig. 57) 40 in. wide in the reed?

32 (dents per inch) × 40 (inches wide) = 1280 dents.

1280 (dents) ÷ 32 (dents per pattern) = 40 repeats of pattern.

Shafts	A	6 (mails per shaft)	× 40 (repeats)	= 240	mails per shaft.
,,	B	8 (,, ,,)	× 40 (,,)	= 320	,, ,,
,,	C	8 (,, ,,)	× 40 (,,)	= 320	,, ,,

Note.—It will be well to balance this by finishing on the right hand list with an extra repeat of 8 mails per shaft on C; thus C will be 328 mails per shaft.

CHAPTER VIII.

EFFECTS OF DYEING AND FINISHING ON WOOL CLOTHS.

General Conditions.—It may be laid down as a general rule that all classes of woven fabrics alter in appearance, handle, weight, dimensions, strength, and elasticity in the processes of dyeing and finishing. The degree of alteration is entirely dependent on the following factors:—

(*a*) Type and quality of material or materials employed.

(*b*) Type and structure of the yarns employed.

(*c*) Build or structure of the fabric.

(*d*) Treatments and degrees of treatments imparted to the cloth during dyeing and finishing.

Fabrics made from materials with the greatest shrinking and felting properties vary most from the loom to becoming finished cloth. Since wool is the fibre possessing most of the above-mentioned properties, and also as the shrinking and felting properties of wools vary according to their quality, wool fabrics are influenced to a greater degree, and also vary differently, by the finishing processes as compared with fabrics made from other materials.

When a cloth made from all-wool yarns is subjected to the milling and raising processes, the thready appearance so characteristic of the fabric as it leaves the loom totally disappears and it may purely resemble a felt structure, with a pile or nap of fibre drawn from the body of the cloth. Consequently wool cloths which have been submitted to a "face" finish, such as amazons, vicunas, beavers, meltons, etc., have few features common to the fabric as it left the loom.

In a finished worsted coating there is not that distinctive alteration noticeable in other types of all-wool cloths. Here the character of the weave or effect is not only maintained, but smartly developed. In the case of a coloured worsted, where the finished cloth may appear very similar to the same fabric as in the loom, it is still not difficult to distinguish the unfinished and finished fabrics. The latter has a very much improved handle and smarter appearance generally, this latter being brought about by all the loose and straggling fibre having been removed from the texture by the cropping or cutting operation.

Wool is spun into two types of yarn, (*a*) worsted and (*b*) woollen. In preparing and spinning a worsted yarn the usual aim is to arrange the fibres parallel to each other. The woollen yarn, however, is spun so that the fibres are in all possible directions, with the result that this yarn presents more loose fibre than the former and appears rougher. This fibre assists the shrinking and felting of the fabric, as these fibres are more subject to any desired treatment than those which compose the worsted thread. Thus the contraction of a woollen cloth is usually markedly greater than in the cloth made of worsted yarns, although both may be made from the same raw material.

The amount of twist or twine put into a yarn has also its influence on the contracting properties of the cloth into which it is made. The fibres of a yarn which are loosely twisted together, are more subjected to any shrinking influence, than the fibres of the yarn, which are tightly twisted. Consequently the variation during finishing such dress cloths as crépons, voiles, crêpe-de-chines (which are made from hard twisted yarns) will be different from that of dress fabrics composed of ordinary twisted yarns of the same material.

There is also a difference in the shrinking property of yarns in the undyed and scoured or dyed condition, although spun from identical material. The yarn composed of coloured fibres has already been subjected to some fibre shrinkage whilst being dyed in the top or yarn state: thus it is necessary when making a piece dyed cloth, which is to be equal to a mixture cloth, or one composed of solid coloured yarns, to make a suitable allowance. For example a fabric composed of undyed yarns would be 66 in. wide in the loom, whilst the cloth composed of coloured yarns would be set 64 in. wide in the loom, both structures to finish 56 in. wide.

In cotton, linen, and ramie fabrics the above influences are almost *nil*, consequently there is but slight variation from the fabric in the loom to becoming finished. Variation is likely to occur in silks, according to the state of the fibre of the yarn when woven: if the gum has been "boiled off" the fibre before weaving, little variation is likely to occur: but if the fibre of the yarn is in its gummed condition, loss of weight may be expected, as the finishing operations will extract the gum.

Finishing All-wool Cloths.—In the first instance it should be pointed out that different firms will employ different methods of finishing the same type of structure: it is also important to remember that each type of cloth requires that kind of treatment which will yield the best result.

No. 1. *Vicuna Coating.*

Loom particulars:—

Warp.

2/56's grey botany.
60's quality.
104 threads per inch.
7254 ends in warp.
70 yds. of warp per cut.

Weft.

40 skeins woollen.
100 picks per inch.
69¾ in. wide.

Weave.—Double 2/2 twill.

The grey cloth is delivered to the dyer and finisher 66 in. wide, 62½ yds. long, and weighing 78 lb.: the instructions being:—

Vicuna finish,
Indigo blue dye,

deliver the finished fabric 58 in. wide.

The finisher having been instructed to impart a "Vicuna" type of finish indicates that the treatment must be of such a character as to give the fabric a fibrous appearance and a soft full handle.

Routine of Finishing Processes.—Knotting and mending, crabbing or blowing with steam to set the fabric, scouring, milling, dyeing, washing off, tentering, raising (wet), cutting, brushing, steaming or dewing, shrinking and pressing (rotary machine).

An alternative routine is to raise the cloth prior to milling, as the raising process facilitates the latter. Generally it may be said that the order of operations is varied and repeated according to particular requirements.

To illustrate in what way and to what degree the above-mentioned finishing processes affect the structure in question, investigations made after each process reveal the variations indicated in Table X.

No. 2. Clear Finished.

Loom particulars :—

As No. 1.

The grey cloth is delivered to the dyer and finisher, the same dimensions and weight as No. 1, with the following instructions :—

Clear finish,
Indigo blue dye

deliver the finished fabric 58 in. wide.

The routine of the finishing processes and the influence of each are indicated in Table XI.

On comparing the variation of these dimensions and weights, it will be observed that the dimensions are about identical, but there is a difference in the weights of the two cloths. The clear finished cloth weighs $72\frac{1}{4}$ lb., whilst the vicuna finished cloth weighs $71\frac{3}{4}$ lb. The difference in weight is equal to the amount of fibre which has been drawn from the body of the vicuna cloth during raising and cut away during cutting.

No. 3. Dyeing and Finishing a Worsted Coating.—The following example illustrates the effects of the various dyeing and finishing processes on a cloth composed of worsted yarns.

Loom particulars :—

Warp.

1 thread 2/36's grey botany 60's quality (face cloth).
1 ,, 2/40's ,, ,, ,, ,, (back cloth).

20's reed 6's.

Weft.

1/20's grey botany.
60 picks per inch.
$65\frac{1}{4}$ in. wide in loom.
3920 ends (face warp).
3920 ,, (back ,,).
70 yds. of warp per cut.

Weave.—2/2 twill backed with warp.

TABLE X.—VARIATION OF AN "ALL WOOL" FABRIC AFTER THE VARIOUS FINISHING OPERATIONS. DYED, INDIGO BLUE. VICUNA FINISH.

	Counts of Warp.	Threads per Inch.	Length of Warp.	Width.	Counts of Weft	Picks per Inch.	Weight of Warp and Weft.	Total Weight.
Loom particulars	2/56's botany	104	70 yds.	$69\frac{3}{4}$ in.	40 sk. woollen	91	—	—
As received by the finisher . . .	2/50	111	$62\frac{1}{2}$,, of cloth	66 ,,	36 sk.	102	$32\frac{1}{2}$ lb. warp $45\frac{1}{2}$,, weft	78 lb.
After crabbing and scouring . . .	2/52	122	60 yds.	60 ,,	35 ,,	107	30 ,, warp 43 ,, weft	73 ,,
,, milling	2/54	124	60 ,,	59 ,,	35 ,,	107	29 ,, warp $42\frac{1}{2}$,, weft	$71\frac{1}{2}$,,
,, raising (wet) and cutting . .	2/54	124	$60\frac{1}{2}$,,	59 ,,	36 ,,	106	29 ,, warp 41 ,, weft	70 ,,
,, dyeing and tentering . . .	2/51	126	60 ,,	58 ,,	35 ,,	107	$30\frac{1}{2}$,, warp 42 ,, weft	$72\frac{1}{2}$,,
,, cutting	2/51	126	60 ,,	58 ,,	35·5 ,,	107	$30\frac{1}{2}$,, warp $41\frac{1}{4}$,, weft	$71\frac{3}{4}$,,
,, pressing	2/53	126	$61\frac{1}{2}$,,	58 ,,	35 ,,	104	$30\frac{1}{2}$,, warp $41\frac{1}{4}$,, weft	$71\frac{3}{4}$,,

Observations :—

Total loss in weight = 8 per cent { 6 per cent loss of worsted / 10 ,, ,, woollen } Shrinkage in width = 17 per cent
,, length = 12 ,,

TABLE XI.—VARIATION OF AN "ALL WOOL" FABRIC AFTER THE VARIOUS FINISHING OPERATIONS. DYED, INDIGO BLUE. CLEAR FINISH.

	Counts of Warp.	Threads per Inch.	Length of Warp.	Width.	Counts of Weft.	Picks per Inch.	Weight of Warp and Weft.	Total Weight.
Loom particulars	2/56's botany	104	70 yds.	69¾ in.	40 sk. woollen	91	—	—
As received by the finisher . . .	2/50	111	62½ yds. of cloth	66 ,,	36 sk.	102	32½ lb. warp 45½ ,, weft	78 lb.
After crabbing and scouring . . .	2/52	122	60 yds.	60 ,,	35 ,,	107	30 ,, warp 43 ,, weft	73 ,,
,, milling	2/54	124	60 ,,	59 ,,	35 ,,	107	29 ,, warp 42½ ,, weft	71½ ,,
,, dyeing and tentering . . .	2/51	126	60 ,,	58 ,,	34 ,,	107	30½ ,, warp 43½ ,, weft	74 ,,
,, raising (dry) and cutting . .	2/52	126	60½ ,,	58 ,,	34·5 ,,	106	30½ ,, warp 42½ ,, weft	73 ,,
,, pressing	2/53	126	61¾ ,,	58 ,,	35 ,,	104	30½ ,, warp 41¾ ,, weft	72¼ ,,

Observations :—

Total loss in weight = 7 per cent { 5 per cent loss in worsted
9 ,, ,, woollen Shrinkage in width = 17 per cent
,, length = 12 ,, The cloth is delivered to the dyer and finisher, 61 in. wide, 65 yds. long, weighing 76½ lb. The instructions being:—

Dye Black,
Clear finish

deliver fabric after finishing 56 in. wide.

The following are the treatments to which the cloth has been subjected and may be taken to be typical of those applied to cloths made from worsted yarns and intended to have a clear appearance.

Knotting and mending, scouring, dyeing, tentering, raising (dry), cutting, brushing, steaming, and pressing. In the above processes it will be observed that the operation of crabbing or fixing is omitted. This omission is justifiable as the quality of the material employed in the cloth is 60's quality of botany wool, the fibres of this material being of an average length and diameter, their shrinking properties will be regular. When warp and weft are composed of such fibre there is little risk of irregular shrinkage taking place during finishing. What little irregular shrinkage may have been developed during finishing, owing to irregular soaping or scouring, is eliminated in the blowing or steaming process prior to pressing. Such treatments as milling and raising (wet), both of which have a tendency to obliterate the weave, are also noticeable omissions from the above treatments.

Table XII indicates the influences of the processes on the fabric.

Grey and Finished Cloths.—To the analyst it is not difficult to ascertain the particulars of most cloths in a finished condition, but to state the loom particulars for reproducing the same is another matter. The amount of variation in the particulars of cloths finished and in the loom is dependent entirely on two factors, i.e. (1) loss in weight incurred during finishing, (2) contraction and shrinkage of the yarns from being in the loom to becoming a finished cloth.

Loss in Weight (Worsteds).—Worsted cloths which are submitted to a "clear" finish lose very little in weight. This loss occurs chiefly during the scouring, milling, raising, and shearing processes. The amount of loss varies slightly according to the severity of the processes and the structure and quality of the yarns. The "clear" finished cloth is not subjected to

TABLE XII.—VARIATION OF A WORSTED COATING AFTER THE VARIOUS FINISHING OPERATIONS. DYED BLACK. CLEAR FINISH.

	Counts of Warp.	Threads per Inch.	Length of Warp.	Width.	Counts of Weft.	Picks per Inch.	Total Weight.
Loom particulars	{2/36's 2/40's} botany	120	70 yds.	65½ in.	1/20's botany	58	—
As received by the finisher	{2/33 2/36}	130	65 yds. of cloth	61 ,,	1/18	62	76½ lb.
After scouring	{2/32 2/34}	134	62½ yds.	58 ,,	1/18	63	74½ ,,
,, dyeing and tentering	{2/30 2/33}	138	60 ,,	56½ ,,	1/17·5	67	76½ ,,
,, raising (dry)	{2/31 2/33}	140	60 ,,	56 ,,	1/17·5	67	76 ,,
,, cutting and brushing	{2/31 2/34}	140	60 ,,	56 ,,	1 18	67	75 ,,
,, steaming or blowing	{2/32 2/34}	140	60 ,,	56 ,,	1/18·5	67	73½ ,,
,, pressing	{2/32 2/35}	140	61 ,,	56 ,,	1/18·5	66	73 ,,

Observations :—

Total loss in weight = 6 per cent

Shrinkage in width = 14 per cent
,, length = 13 ,,

milling, raising (wet) as in producing a "face" finish such as a melton or a vicuna. As the operations named produce an appreciable loss of fibre, the loss in weight, during finishing a clear worsted, is not so great as when compared with the same type of cloth subjected to a face finish.

In worsteds submitted to a "clear" finish the chief loss in weight occurs during the process of scouring, in which treatment the impurities are expelled. The impurities consist of the oil —usually about 3 per cent—which is applied to the fibre to facilitate the preparing, combing, and spinning processes, and the sizing agent which is often applied to the warp to improve its weaving properties; also the filth which has been contracted during manufacture.

After scouring there is very little further loss in weight. The small amount of fibre which is taken from the cloth during cutting and brushing has practically no influence on the weight of the fabric.

Fabrics made from dyed yarns and "dry" spun yarns are free from oil; in the former the oil applied for spinning purposes having been extracted when the yarn was being dyed whilst "dry" spun yarns are spun without the assistance of a lubricant although they always hold a fractional percentage. Consequently there is not the loss of weight during the finishing of this type of fabric which occurs in finishing cloths composed of grey or undyed yarns.

Table XIII indicates the grey and finished weights of a number of standard worsted cloths which have been submitted to a "clear" finish. As all worsted cloths contain about the same amount of impurities and are subjected to about the same treatments during finishing, the amount of weight lost during finishing can be standarized.

Table XIII states an average loss in weight of 5·7 per cent, which for all practical and cloth analysis purposes may be taken at 6 per cent. Hence the conclusion arrived at, is that all worsted cloths which are "clear" finished and *not subjected to any weighting, adulteration, or loading*, will sustain a loss in weight of 6 per cent.

Woollens.—The weight of grey and finished cloths composed of woollen yarns vary more than in any other type of woven textures.

TABLE XIII.—LOSS OF WEIGHT IN WORSTEDS SUBMITTED TO A CLEAR FINISH.

Style of Fabric.	Material.	Grey Weight.	Finished Weight.	Loss per cent in Weight.
Grey cloth to be dyed	Botany	80 lb.	74·8 lb.	6·5
Mixture fabric	,,	80 ,,	75·5 ,,	5·6
Grey cloth scoured only	,,	80 ,,	75·9 ,,	5·2
,, ,, to be dyed	Crossbred	44½ ,,	42 ,,	5·6
Fancy coating, coloured yarns	Botany	56 ,,	53 ,,	5·4
Voile dress fabric	,,	19¾ ,,	18½ ,,	6
Covert cloth (coloured yarns)	,,	68 ,,	64½ ,,	5
Dress cloth, grey cloth to be dyed	,,	24 ,,	22 ,,	6·6
				8)45·9
		Average loss per cent		5·7

Conclusion : Loss in weight = 6 per cent.

To facilitate the preparing and spinning of a woollen thread from 5 to 15 per cent of oil is required to lubricate the fibre. This large variation is primarily due to the quality of the material, and to a certain extent to the indiscriminate manner in which oil is applied. As a rule the best quality of woollen yarns contain the least amount of oil and the lowest qualities—such as mungoes, etc.—the largest amount.

The treatment imparted to a woollen cloth during finishing is much more severe than that given to the average worsted cloth. Further it must be borne in mind that the structure of a woollen thread is different from that of a worsted, this being responsible for the finishing processes producing different effects upon woollen and worsted cloths. For example during the process of milling, the fibres of the woollen cloth are much more readily felted than the fibres of the worsted fabric : also during the same operation much more fibre, and consequently weight, is taken from the woollen structure. The fibres, which constitute a woollen yarn, are much more readily separated from the body of the yarn or cloth than in the case of worsteds. On this account the loss of fibre during finishing a woollen is in excess of the fibre lost in finishing a worsted, although both may be subjected to identical treatments.

The total amount of weight lost in finishing a woollen will depend upon the amount of impurities present and the degree of finishing treatment applied. As already stated, the amount of impurities varies almost directly with the quality of the material; thus the fabric composed of low quality of woollen material will lose more weight during scouring than the cloth which is composed of better quality of material. Owing to the varying constituents of woollen cloths and to the many treatments and degrees of treatment to which they are subjected to obtain different types of finish it is impossible to standardize the amount of loss in weight involved during finishing.

A perusal of the makes of cloths and respective losses during finishing tabulated in Table XIV provides a suitable illustration. Fabrics Nos. 1 and 7 lose 24 and 27 per cent respectively in weight. This apparent enormous decrease is due to the low woollen yarn, containing about 15 per cent of oil which is extracted during scouring; also to the severe treatment imparted to the cloth to obtain the vicuna and melton appearance. The cloths numbered two and three are typical Colne Valley structures. In considering the structures and type of finish, i.e. worsted and cotton twist warp and low woollen weft and "clear" finish—it is obvious that most of the loss is due to the impurities of the woollen weft, as the treatments to obtain a clear finish are comparatively light. The losses in weight of cloths Nos. 4, 5, 6 are stated to be equal to 10 per cent of weight. This amount is a minimum when compared with the other results. As the cloths are composed of mixture and coloured yarns of good quality, it is reasonable to estimate the amount of oil at about 5 per cent. In all the three examples the treatment during finishing is of a light character and, as the loss of fibre is according to the degree of treatment, the comparative slight loss in weight will be understood.

The lack of any previously published particulars relating to the loss in weight during the finishing of woollens, also the lack in uniformity of the results, makes Table XIV useful for reference in the analysis of woollen patterns.

Contraction and Shrinkage of Yarns.—There are two distinct stages of contraction and shrinkage of yarns from being in the loom to becoming finished cloths. The first being from loom to grey cloth and the other from grey to finished cloth. In both cases the influences are:—

(*a*) *Nature of Material and Structure of Yarns.*—A worsted

TABLE XIV.—TABLE ILLUSTRATING THE LOSS OF WEIGHT INCURRED DURING FINISHING "WOOLLENS".

Type of Cloth.	Finish.	Warp.	Weft.	Weight.	Loss in Weight.
Vicuna	Heavily milled	Woollen yarn, low quality	As warp	$21\frac{1}{2}$ oz.	24 per cent
Trousering	Clean finish	Coloured worsted and cotton twist	Black woollen, low quality	16 ,,	17 ,,
,, ...	Ditto	Ditto	Ditto	16 ,,	$16\frac{1}{2}$,,
Mixture coating	Tweed finish	24 cut Gala (mixture), 44 threads per inch	As warp	17 ,,	10 ,,
,, ,, ...	Ditto	2/24 cut Gala (mixture), 30 threads per inch	Ditto	18 ,,	10 ,,
Trousering	Slightly milled	30 skein coloured woollen, good quality, 68 threads per inch	As warp, 64 picks per inch	17 ,,	10 ,,
Low melton	Heavily milled	2/40 cotton, 40 threads per inch	6 skein low quality, 60 picks per inch	18 ,,	27 ,,
Carriage rug	Velvet finish	2/20 cotton, 18 threads per inch	Coloured 5 skein woollen, medium quality	$3\frac{1}{2}$ lb.	20 ,,
,, ,, ...	Ditto	Coloured woollen yarn, low quality	As warp	4 ,,	22 ,,
Amazon dress fabric . . .	Milled and raised	1/36 mule spun worsted, 72 threads per inch	40 skein woollen, fair quality, 36 picks per inch	—	13 ,,

yarn composed of fine botany wool possesses more natural shrinking property than any other type of worsted yarn. A case in point is as follows :—

A cotton warp leno piece, very open in set, was woven with mohair and botany weft of the same counts. The widths of the two materials in the same structure of fabric are :—

	Mohair Weft.	Botany Weft.
Loom width . .	27 in.	27 in.
Grey cloth width .	25 ,,	20 ,,
Finished cloth width .	20 ,,	17 ,,

Thus a difference of 5 in. in the grey and 3 in. in the finished cloth is due to difference in the quality of worsted weft employed.

(*b*) *Structure of Cloth.*—(Counts of yarn, weave, threads, and picks per inch.) The fibres and yarns of an open set cloth have much more opportunity to shrink than those of a tightly woven texture, as the development of shrinkage is largely controlled by the freedom of the fibres. For example the fibres of an open set cloth are much more subjected to the shrinking action of scouring and milling than the fibres of a close set texture : also a tightly twisted yarn will tend to diminish the amount of shrinkage which might be otherwise developed.

A thick weft will bend or contract the warp, during weaving, more than a fine weft and vice versa.

The order of interlacings of warp and weft are largely responsible for the amount of shrinkage developed during finishing and entirely responsible for the amount of take up or contraction during weaving. As previously stated in ordinary structures, twills, hopsacks, etc., the warp and weft bend about alike and any modification in weave, thickness of warp and weft, number of threads and picks per inch, will cause warp and weft to take up differently.

Warp-faced cloths such as ribs, corkscrews, etc., have a greater take up in length during weaving than in width, whereas weft-faced cloths take up less in length than in width. The conditions of weaving are such, that cloths, which are identical in structure, may vary in dimensions to some degree ; the amount of tension applied to the warp beam and to the weft by means of the shuttle and by templing will account for the lengths and widths of pieces, which are expected to be alike, varying to some extent.

(c) *Finishing Treatments.*—The amount of shrinkage or contraction is primarily due to the factors already mentioned, but wet finishing processes although carried out with other objects invariably develop the natural shrinking property of the raw material, so far as the structure of yarn, fabric, etc., will allow.

Scouring for example, although intended to be a cleansing process, is responsible for more fibre shrinkage than any other process in manufacture. The cloth finisher may vary the shrinkage of identical fabrics. Differences in length of time, degree of temperature, type of soap employed during scouring and milling may be responsible for enormous variations in the shrinkage of the length and width and also of the weight of cloths composed of good quality of wool and identical in structure.

Comparison of Dimensions of Grey and Finished Cloths.—Interesting studies in cloth structure and the influence of materials, structure, and type of finish on the varying dimensions of a number of worsted fabrics are given in Tables XV, XVI, and XVII, a perusal of the various shrinkages, at once indicating that standardization is impossible. In the absence of recorded particulars of cloths actually woven, the particulars stated in this table will be found useful to the cloth analyst, especially when estimating the lengths and widths of grey cloths from certain loom dimensions. Such estimation without the aid of recorded results entails the application of an extensive practical experience in addition to an application of knowledge of materials, structure, and effects of finishing.

Table XV indicates : (*a*) Contraction from loom to grey cloth, (*b*) shrinkage from grey to finished cloth, of a number of standard worsted fabrics of different structure submitted to a clear finish.

In Table XVI the loom particulars and amount of shrinkage are given of the same cloth in four different weights. These may be taken as an example of the extreme amount of shrinkage which may be developed in a worsted cloth submitted to a clear finish. To obtain this enormous variation from loom to finished cloth the following factors are essential : First, the employment of raw material possessing great shrinking properties ; second, a loosely built grey cloth to facilitate shrinkage during finishing ;

TABLE XV.—VARIATIONS IN THE DIMENSIONS OF WORSTED CLOTHS, DYED AND SUBMITTED TO A CLEAR FINISH.

Style of Fabric.	Quality of Material.	Weight per Yard.	Widths.			Lengths.		
			Loom.	Grey.	Finished.	Warp.	Grey.	Finished.
11-shaft whipcord . . .	Botany	18 oz.	70¼ in.	66 in.	56 in.	70 yds.	60 yds.	54 yds.
2/2 twill coating . . .	,,	21 ,,	65 ,,	62 ,,	56 ,,	,,	63 ,,	58 ,,
,, ,, ,, . . .	,,	13 ,,	65 ,,	62 ,,	56 ,,	,,	65 ,,	60 ,,
,, ,, ,, . . .	Crossbred	12 ,,	62 ,,	59 ,,	56 ,,	,,	65 ,,	62 ,,
,, ,, ,, . . .	Botany	21 ,,	76½ ,,	70 ,,	58 ,,	,,	61½ ,,	57 ,,
Voile light dress cloth . .	,,	—	47 ,,	45 ,,	41 ,,	,,	64 ,,	64 ,,
Poplin dress cloth . . .	,,	—	46 ,,	45¾ ,,	44 ,,	,,	60 ,,	58 ,,
3/3 warp rib	,,	14 oz.	58½ ,,	57½ ,,	56 ,,	,,	62 ,,	60 ,,
Covert cloth	,,	Light weight	65 ,,	62½ ,,	56 ,,	,,	60 ,,	58 ,,
13-shaft corkscrew . . .	,,	17 oz.	64 ,,	62 ,,	56 ,,	,,	61 ,,	58 ,,

TABLE XVI.—WORSTED 2/2 TWILLS, CLEAR FINISH, DYED BLACK.

Weight. per Yard Finished.	Loom Particulars.					Widths.			Lengths.		
	Counts of Warp.	Threads per Inch.	Ends in Warp.	Counts of Weft.	Picks per Inch.	Loom.	Grey Cloth.	Finished Cloth.	Warp.	Grey Cloth.	Finished Cloth.
13 oz.	2/42's botany	52	3930	As warp	60	75½ in.	70 in.	58 in.	70 yds.	63 yds.	60 yds.
21 ,,	2/26's ,,	52	3980	,,	58	76½ ,,	70 ,,	58 ,,	70 ,,	61½ ,,	57 ,,
19 ,,	2/30's ,,	52	4030	,,	60	77½ ,,	70 ,,	58 ,,	70 ,,	61½ ,,	58 ,,
22 ,,	2/16's ,,	39	2850	,,	39	73 ,,	68 ,,	57 ,,	70 ,,	62 ,,	57 ,,

third, treatment during finishing, particularly scouring, to develop the amount of shrinkage required.

In perusing the makes of these cloths it is noticeable that there are usually a greater number of picks per inch than threads per inch. The different amount of shrinkage allotted to warp and weft is such as to counteract this feature, the finished cloth containing about an equal number of threads and picks per inch.

Table XVII gives particulars of three makes of union covert cloths, with the varying dimensions of warp and weft. A noticeable feature is the influence of the various thicknesses of weft on the take-up of the warp during weaving. Cloth No. 1 gives the least length owing to the fact that the thickest weft is employed.

TABLE XVII.—WORSTED COVERT FABRICS, CLEAR FINISH, DYED COLOURS.

Loom Particulars.					Widths.			Lengths.		
Counts of Warp.	Threads per Inch.	Ends in Warp.	Counts of Weft.	Picks per Inch.	Loom.	Grey Cloth.	Finished Cloth.	Warp.	Grey Cloth.	Finished Cloth.
2/48's	78	5070	1/18	64	65 in.	62-63 in.	56-57 in.	70 yd.	60 yd.	58 yd.
2/66's	92	6040	1/30	64	65½ „	62-63 „	56-57 „	70 „	61 „	59 „
2/60's	100	6520	1/40	64	65¼ „	62-63 „	56-57 „	70 „	62 „	60 „

Union cloth (Warp, cotton, and worstedtwist, Weft all botany worsted); Weave, 5-end covert.

Effects of Shrinkage.—The influence of shrinkage on the length and width of a cloth is to increase :—

1. Weight per yard.
2. Counts of warp and weft.
3. The number of threads and picks per inch, and decrease :—
4. The width and length of cloth.

Before any allowance or deduction can be made on finished cloth particulars to obtain the loom particulars, each of the above features must be dealt with in detail, and then, to render thorough comprehension easy, a typical example must be fully considered.

1. *Weight per Yard.*—As cloths are sold by the weight per

yard almost any and every width, it is evident that contraction in width has no influence on the desired weight whatever. Certain standard widths, however, being recognized in the various branches of the trade, this uniformity must be exactly obtained by tentering.

Contraction in length, however, has a direct influence on the weight per yard of a cloth. For example, if a grey cloth 40 yds. long weighs 1 lb. per yard, the whole cloth will weigh 40 lb. If this is shrunk during scouring and milling up to 20 yds., supposing there is no loss in weight, the piece will still weigh 40 lb., i.e. 2 lb. to the yard, or

As 20 yds. : 40 yds. : : 1 lb. : 2 lb. per yard.

From this, however, a deduction must be made for the loss in weight involved during finishing. The best examples of this are given in the cloths dealt with in Tables X, XI, and XII.

Example 1.—(Table X) a cloth composed of worsted warp and woollen weft is dyed indigo blue and submitted to a vicuna finish.

Weight of cloth, grey 78 lb.; finished $71\frac{3}{4}$ lb.
Length of cloth, grey $62\frac{1}{2}$ yds.; finished $61\frac{1}{2}$ yds.
78 lb. ÷ $62\frac{1}{2}$ yds. = 20 oz. per yard grey.
$71\frac{3}{4}$,, ÷ $61\frac{1}{2}$,, = 18·6 ,, ,, finished.

Example 2.—(Table XI). The same cloth as in example 1: dyed indigo blue and submitted to a clear finish.

Weight of cloth, grey 78 lb.; finished $72\frac{1}{4}$ lb.
Length of cloth, grey $62\frac{1}{2}$ yds.; finished $61\frac{3}{4}$ yds.
78 lb. ÷ $62\frac{1}{2}$ yds. = 20 oz. per yard grey.
$72\frac{1}{4}$,, ÷ $61\frac{3}{4}$,, = 18·72 ,, ,, finished.

Example 3.—(Table XII). A worsted coating cloth, dyed black and submitted to a clear finish.

Weight of cloth, grey $76\frac{1}{2}$ lb.; finished 73 lb.
Length of cloth, grey 65 yds.; finished 61 yds.
$76\frac{1}{2}$ lb. ÷ 65 yds. = 18·8 oz. per yard grey.
73 ,, ÷ 61 ,, = 19 ,, ,, finished.

Hence it is evident that the weights per yard of cloths grey and finished increase according to the shrinkage in length, and decrease according to the weight lost during finishing.

2. *Counts of Warp and Weft.*—As the shrinkage of a cloth and the loss in weight involved during finishing is responsible for

the variation in the weight per yard of a cloth, so the same two factors create a similar and relative variation in the counts of the yarns which constitute the cloth. The loss in weight will in consequence cause the yarn to become lighter or thinner, and the shrinkage will be responsible for a thicker count of yarn, a balancing up of the two taking place.

An illustration of this is given in Tables X, XI, XII, where the counts of warp and weft in the loom and in the finished cloth are as follows :—

No.	Warp.		Weft.	
	Loom.	Finished.	Loom.	Finished.
Table X	2/56	2/53	40 skeins	35 skeins
,, XI	2/56	2/53	40 ,,	35 ,,
,, XII	{2/36 2/40	2/32 2/35	1/20	1/18·5

Figs. 58 and 59 graphically illustrate the conditions of warp and weft of the cloth given in Tables X and XII from being in the loom to becoming a finished cloth, from which it is evident, that as the warp and weft, which is perfectly straight during weaving, begins to contract or shrink, so the counts of the yarns become thicker.

Example.—A worsted cloth is made from : 2/60's botany warp and 1/30's botany weft. The dimensions from loom to finished cloth are :—

70 yds. warp. 66 in. wide in loom.
65 ,, grey cloth. 63 ,, width of grey cloth.
61 ,, finished cloth. 56 ,, ,, finished cloth.

Assuming there has been no loss in weight during finishing : what is the count of warp and weft in the grey and finished cloths ?

Warp.

$70 : 65 :: 2/60 : x = 2/55{\cdot}7$ grey cloth.
$70 : 61 :: 2/60 : x = 2/52{\cdot}3$ finished cloth.

Weft.

$66 : 63 :: 1/30 : x = 1/28{\cdot}6$ grey cloth.
$66 : 56 :: 1/30 : x = 1/25{\cdot}5$ finished cloth.

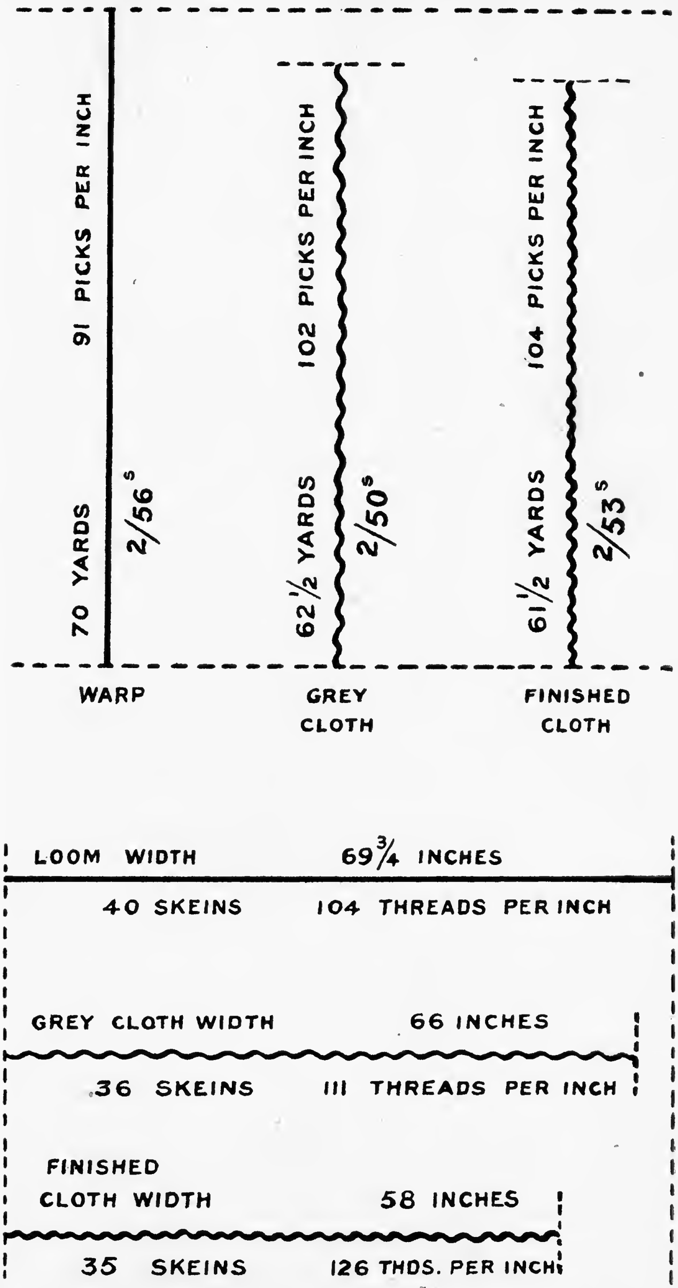

Fig. 58.—Variation from Loom to Finished Cloth (Vicuna).

3. *Threads and Picks per Inch.*—For the same reason that the count of warp and weft becomes thicker as the contraction and shrinkage is being developed, so the number of threads and picks per inch will increase.

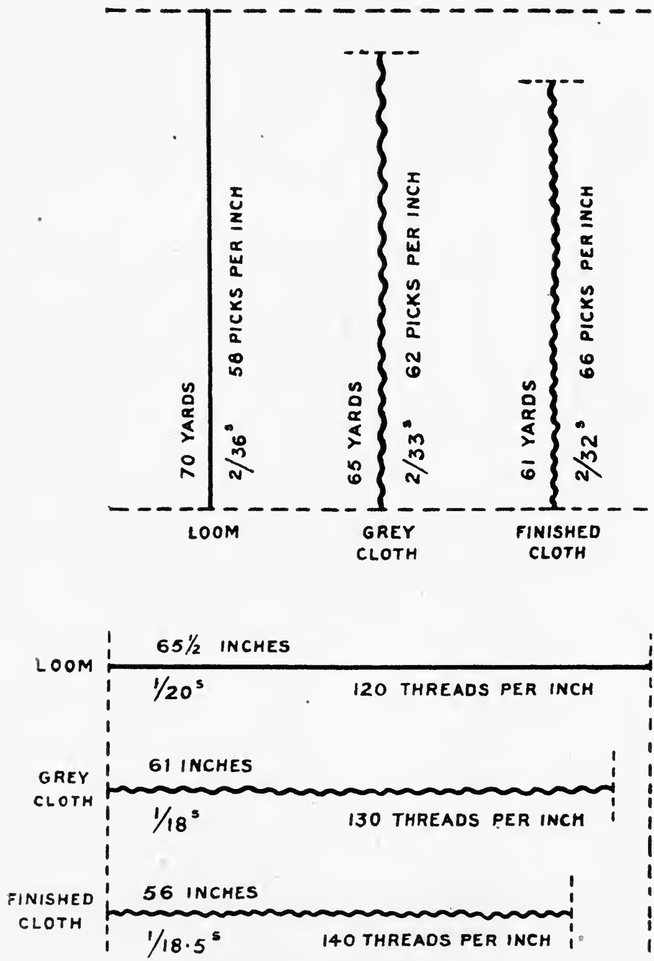

FIG. 59.—Variation from Loom to Finished Cloth (Worsted Coating).

Figs. 58 and 59, indicate that the picks per inch will increase in direct proportion to the shrinkage of the warp, and the threads per inch in proportion to the weft.

Example.—Taking the same cloth as given in the previous example: what will be the number of threads and picks per inch if in the loom there are sixty threads per inch in the reed and sixty picks per inch of warp.

Threads per Inch.

63 : 66 : : 60 : 63 grey cloth.
56 : 66 : : 60 : 71 finished cloth.

Picks per Inch.

65 : 70 : : 60 : 64 grey cloth.
61 : 70 : : 60 : 69 finished cloth.

CHAPTER IX.

EFFECTS OF DYEING AND FINISHING ON UNION DRESS AND LINING AND COTTON CLOTHS.

General Conditions.—Union or mixed cloths are of a most varied character, wool and cotton fibre may be intermingled to form the warp or the weft of a fabric or, as is usually the case, each fibre may be confined to separate threads, forming part or whole of the warp or weft.

A large class of dress goods comprising cashmeres, sicilians, brilliantines, glacés, alpacas, italians, etc., and low woollens such as presidents, meltons, beavers, etc., come under the heading of union cloths and are usually compounded of cotton warp and worsted or woollen weft.

To the dyer and finisher cloths composed of two or more materials require special consideration and treatment as compared with fabrics which are composed of only one material. The combination of materials such as cotton and wool forms a compound structure of different hygroscopic, chemical, and physical properties. The chemical properties of wool and cotton are so different that the agents which are satisfactorily employed in the dyeing and finishing of an all-wool fabric are totally unsuitable for the same purpose in the case of fabrics containing cotton.

For example, all-wool cloths and even raw wool, very often contain a certain amount of vegetable matter, such as burrs, the chemical composition of which is similar to that of cotton, and it is very desirable to extract this vegetable matter. For this purpose the cloth or fibre is subjected to a process known as carbonizing. The material is passed into a bath containing sulphuric acid of a suitable strength and temperature. Upon drying the acid concentrates upon the vegetable matter converting it into hydrocellulose, which, being in the form of powder, is easily removed, while the wool, not being acted upon by the acid to any considerable extent, remains intact.

For the same reason some agents which are successfully employed in the finishing of all-wool cloths must be avoided in the treatment of cloths containing cotton.

Cotton warp and wool wefted goods are woven under the following conditions :—

1. The cotton warp may be dyed the requisite colour and be interlaced with weft which is in a grey or undyed condition. In this case only the weft is subsequently dyed. This method is known as "cross dyeing".

2. When light shades are required in the fabric, the cotton warp and wool weft are woven in a grey or undyed condition and then both are dyed in the fabric. This method is styled, dyeing in the grey. In some cases the wool and cotton are treated separately; in other cases union dyes are employed.

Cross dyeing is preferred as it is then possible to dye both the cotton warp and the weft with a greater choice of colouring matters and processes, and at the same time the most suitable treatment for each fibre may be employed. For example the cotton warp may be dyed with such colours as will withstand the action of acid colours which may be used in the dyeing of the wool weft.

When the cloth is dyed for both cotton and wool, the mordanting and dyeing necessary for the cotton often interferes with the brightness of the colour dyed on the wool. Further, it is considered that cross dyed fabrics possess a better handle than those which are dyed for both wool and cotton. When fabrics are dyed for both materials much judgment and practice are called for on the part of the dyer to make the colour of the cotton and of the wool as identical as possible in tone and intensity, should solid shades, as is usually the case, be required.

Finishing a Plain Lustre Dress Fabric.—A plain weave lustre cloth is made to the following loom particulars :—

Warp.

2/80's fast black cotton.
40's reed 1's.
$49\frac{3}{4}$ in. reed width.

Weft.

1/14's mohair (worsted).
51 picks per inch (grey cloth).
70 yds. of warp per cut.

The cloth is delivered to the dyer and finisher 49 in. wide and 61 yds. long; the instructions being: dye black, bright finish, and deliver the cloth 44 in. wide finished.

As in all cloths the particular finishing treatments are determined by the finisher after considering the following factors: (*a*) The quality and type of the raw materials employed; (*b*) the structure and colour of the yarns employed; (*c*) the build of the fabric; (*d*) the particular appearance and handle required in the finished cloth.

A consideration of the above factors reveals to the finisher the following features:—

(*a*) *The Raw Materials Employed.*—As warp and weft are composed of different fibres possessing distinctive chemical properties and physical features, the dye-taking, shrinking, lustrous, felting, and elastic properties of warp and weft will be different. The warp is non-lustrous and the weft is highly lustrous. These features have an important bearing on the particular treatments and methods employed to obtain the requested "bright" finish.

(*b*) *The Structure and Colour of the Yarns.*—As the cotton is already dyed a fast black, and the mohair weft is the only material in an undyed condition, it is only necessary—to obtain the requisite colour of cloth—to submit the structure to a wool-dyeing process, this being usually of an acid character. The mohair weft yarn has been spun so as to contain as few turns or twists as possible, and the fibres may be said to be in a straight and parallel position. This parallelism of the fibres enhances the lustrous appearance of the yarn, as the fibres present a comparatively flat surface, and so reflect large quantities of light.

(*c*) *The Structure of the Cloth.*—The order of interlacing, in conjunction with the fine cotton warp and thick mohair weft, has resulted in a grey cloth of a warp rib structure, the weft being so much thicker than the warp, that in the cloth as it leaves the loom the weft is practically straight and the warp is made to do all the bending. These conditions account for the slight variation in loom width to grey width and the excessive take-up of warp during weaving. A grey cloth of 61 yds. long and 49 in. wide is produced from 70 yds. of warp set $49\frac{3}{4}$ in. wide in the loom.

(*d*) *The Type of Finish and Appearance Required.*—The instructions given are to produce a "bright" or lustrous appearance, and in consequence the treatments during finishing must be of such a character as to develop the natural lustrous properties contained in the fabric.

Alteration of Structure.—The grey cloth in its grey condition possesses a visible appearance of non-lustrous cotton. If the maximum amount of lustre is to be produced, the appearance of cotton must be eliminated as much as possible. With this idea

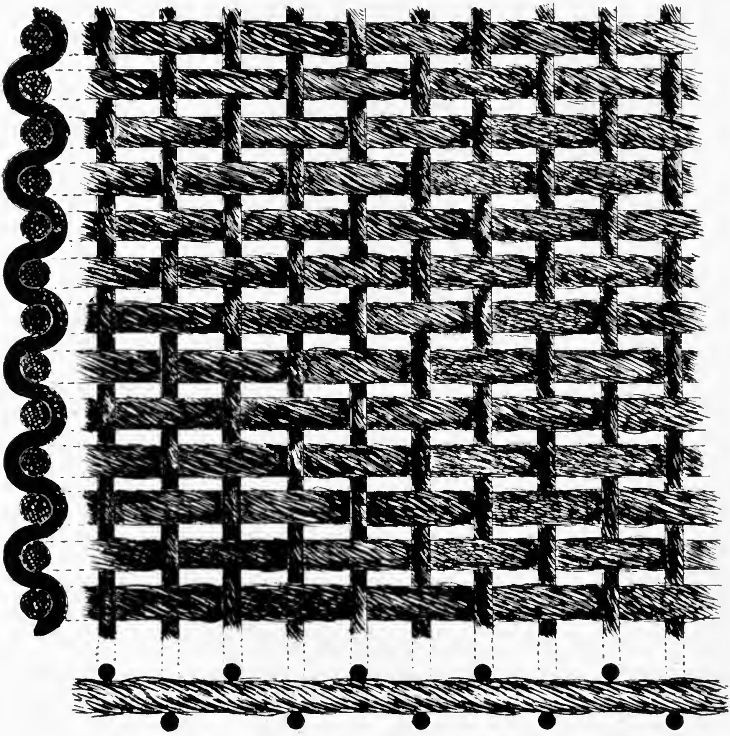

FIG. 60*a*.—Lustre Cloth (before crabbing).

in mind the primary treatment in finishing union cloths is to take away the appearance of cotton from the cloth by developing the mohair or wool. To attain this the fabric is drawn out in the direction of the cotton material during the process known as crabbing, the aim being to make the cotton warp as straight as the conditions will allow and so enable it to become embedded in the cloth: such action throws the lustrous weft on to the surface of the cloth and greatly aids in the attainment of the desired finished appearance.

This process of pulling out the cloth in length totally alters its build: what was originally a warp rib structure is converted during the crabbing process into a weft rib structure. The influence of the pulling-out treatment is illustrated in Figs. 60*a* and 60*b*. Fig. 60*a* illustrates the flat view, warp and weft sections of the grey cloth, and is of the following set and dimensions:—

Warp.
2/80 cotton.
40 threads per inch.
49 in. wide.
Weft.
1/14 mohair.
51 picks per inch.
61 yds. long.

Fig. 60*b* illustrates the same after the crabbing process, the set and dimensions being:—

Warp.
45 threads per inch.
44 in. wide.
Weft.
46 picks per inch.
67 yds. long.

Crabbing Union Cloths.—As the crabbing process alters in structure the build of union cloths, it is not out of place at this stage to deal with the process and its effect on fabrics.

There are two distinct objects in crabbing, i.e. drawing out the cloth in length and fixing warp and weft at right angles. The stretching and fixing of a union cloth forms one of the most important processes that the cloth is subjected to during manufacture. A cloth may be made or marred during this treatment; excessive or insufficient pulling out and fixing of the fabric will cause it to be unmarketable. When over-tensioned during treatment there is a great risk of the warp threads being broken and creating what are known as "cracked ends". On the other hand, insufficient tension or pulling out will result in the cotton remaining to some degree on the surface of the cloth, this being detrimental to the lustrous appearance required. The amount of tension that may be applied is dependent upon the quality and thickness of warp and weft and the number of threads and picks per inch. The care and foresight required will be realized from the fact that a cloth composed of single twist cotton warp may be stretched to a greater length than an identical build of cloth composed of two-fold warp.

Contraction in Width and Elongation in Length.—A study of the variation of the dimensions of union cloths (cotton warp and wool weft) from the loom to the finished cloth forms a most interesting subject. All fabrics vary in this respect according to

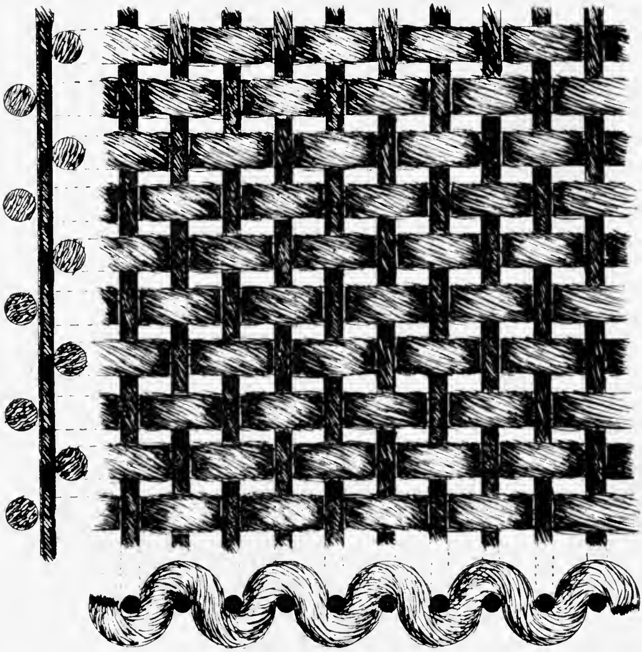

FIG. 60*b*.—Lustre Cloth (after crabbing).

the contracting or shrinking properties of the materials and yarns employed, the structure of the fabric, and the treatments applied during finishing. In the case of all-wool cloths each of the above-mentioned factors comprises many features which influence the shrinkage of the fabric, and these are so numerous that the variation of length and width from loom to finished cloth varies considerably. On the other hand, the various types of union cloths when classified will be found to be somewhat similar in construction, and subjected to about the same finishing processes; in consequence there will be a more uniform variation in dimensions.

Union dress fabrics may be classified under three distinct headings, as tabulated in Table XVIII. In each of the three classes the same conditions prevail regarding materials, yarns, and weave of fabric, so far as their shrinking properties are concerned; and in the case of this class of goods it is the features mentioned which control the variation in dimensions from loom to finished cloth. Therefore, when standard materials, yarns, weaves, and finishing treatments are employed in the production of cloths, it is within the realms of possibility to create standard loom widths and lengths resulting in certain dimensions of finished fabrics.

TABLE XVIII.—CLASSIFICATION OF UNION DRESS FABRICS.

Class.	Style.	Warp.	Weft.	Weave.
1	Brilliantines	Cotton	Mohair	Plain
	Glacés	,,	,,	,,
	Sicilians	,,	,,	,,
	Alpacas	,,	Alpaca	Plain or twill
	Lustres	,,	Lustre or demi-lustre	,, ,,
2	Italians or linings	,,	Fine botany	5-shaft weft sateen
3	Cashmeres	,,	,,	2/1 weft twill

Tables XIX and XX illustrate the dimensions and weights of two lustre cloths after each stage of finishing. A striking feature in both examples is that the dimensions remain practically stationary after the crabbing process. As this treatment is a combined one of pulling out and fixing of the warp and weft, it is obvious that the length of the cloth will be increased, and (assuming the weft possesses no natural shrinking property) the width will contract a corresponding amount. Further, it is apparent that the fixing has been thorough, as the dimensions obtained remain stationary.

TABLE XIX.—VARIATION OF A CROSS-DYED LUSTRE CLOTH AFTER THE VARIOUS FINISHING OPERATIONS.

In loom: 70 yds. warp, 49¾ in. wide.

As received by finisher	61 yd. cloth	49 in. wide	24 lb.
After crabbing	67 ,,	44 ,,	22 ,,
,, dyeing and tentering	67 ,,	44 ,,	22·6 ,,
,, singeing	67 ,,	44 ,,	22 ,,
,, pressing	67 ,,	44 ,,	22 ,,

Loom particulars :—

Warp.
2/80's black cotton.
40's reed 1's.

Weft.
1/14's mohair.
50 picks per inch.
(Grey cloth in loom.)
Dye.—Black.
Finish.—Bright.
Weave.—Plain.

TABLE XX.—VARIATION OF A BLEACHED LUSTRE CLOTH AFTER THE VARIOUS FINISHING OPERATIONS.

In loom : 70 yds. warp, 49¾ in. wide.

As received by finisher	58 yd. cloth	49 in. wide	26¼ lb.
After crabbing	68 ,,	45 ,,	25¼ ,,
,, singeing	68 ,,	45 ,,	25 ,,
,, scouring and stoving	68 ,,	44 ,,	24½ ,,
,, tentering	68 ,,	45 ,,	24½ ,,
,, pressing	68 ,,	44 ,,	24 ,,

Loom particulars :—

Warp.
2/80's bleached cotton.
40's reed 1's.

Weft.
1/12's mohair.
48 picks per inch.
(Grey cloth in loom.)
Colour.—Stoved white.
Finish.—Bright.
Weave.—Plain.

Standardization of Dimensions.—By means of the particulars tabulated in Table XXI an effort is made to standarize the dimensions of the cloths under consideration. In this list twenty cloths of different make have been taken, and their respective widths and lengths indicated. For utility each is based on a length of 70 yds. of warp per cut and a finished width of 44 in.

TABLE XXI.—VARIATION OF THE DIMENSIONS IN UNION CLOTHS (COTTON WARP AND LUSTRE WEFT) SUBMITTED TO A "BRIGHT" FINISH.

Style of Fabric.	Widths.			Lengths.		
	Loom.	Grey.	Finished.	Warp.	Grey.	Finished.
Demi-lustre lining	50½ in.	49½ in.	44 in.	70 yd.	60½ yd.	66 yd.
	50 "	48 "	44 "	70 "	62 "	67 "
" "	52½ "	49 "	44 "	70 "	60½ "	66½ "
Mohair sicilian	50 "	48 "	44 "	70 "	59 "	66¾ "
" brilliantine	50 "	49 "	44 "	70 "	60 "	68 "
" glacé	50 "	48 "	44 "	70 "	61 "	68½ "
" lustre	48 "	47 "	44 "	70 "	61 "	67 "
Alpaca lining	49 "	48 "	44 "	70 "	62½ "	67 "
Fancy mohair	49½ "	48½ "	44 "	70 "	57 "	67¾ "
Fancy English lustre	51 "	49 "	44 "	70 "	58 "	66 "
Mohair sicilian	48 "	47 "	44 "	70 "	58 "	68 "
Lustre "	49¾ "	48 "	44 "	70 "	61 "	67 "
" "	49 "	47¼ "	44 "	70 "	60 "	70* "
Melange	48 "	47½ "	44 "	70 "	60½ "	68½ "
Demi-lustre lining	50 "	49½ "	44 "	70 "	62 "	69* "
Mohair brilliantine	50 "	49 "	44 "	70 "	61 "	69½* "
" sicilian	50 "	49 "	44 "	70 "	60 "	67½ "
" "	50 "	48¾ "	44 "	70 "	60 "	67½ "
" brilliantine	50½ "	49½ "	44 "	70 "	59 "	67 "
" sicilian	53 "	52½ "	44 "	70 "	59 "	67 "
Average	50 "	48½ "	44 "	70 "	60¼ "	67½ "

RESULT: (1) A contraction from loom to finished width of 12 per cent.
(2) An elongation from grey to finished length of 12 per cent.

The particulars of the three cloths marked with an asterisk in Table XXI were not obtained without broken threads. The damage on being investigated was declared to be due to excessive tensioning during the finishing processes; consequently these lengths must not be considered for standard purposes.

As the extreme length to which these cloths can be pulled without risk of broken or cracked ends is the best condition for developing the utmost degree of lustre, then the standard length of finished cloth from 70 yds. of warp must be taken at 67 to 68 yds.

The conclusion arrived at from these results is that the elongation from grey to finished cloth is 12 per cent, and a corresponding contraction is developed from the width in the loom to that of the finished cloth. Fig. 61 illustrates the standard variation in dimensions of a lustre cloth from being in the loom to becoming a finished cloth; also the influence of the various dimensions on

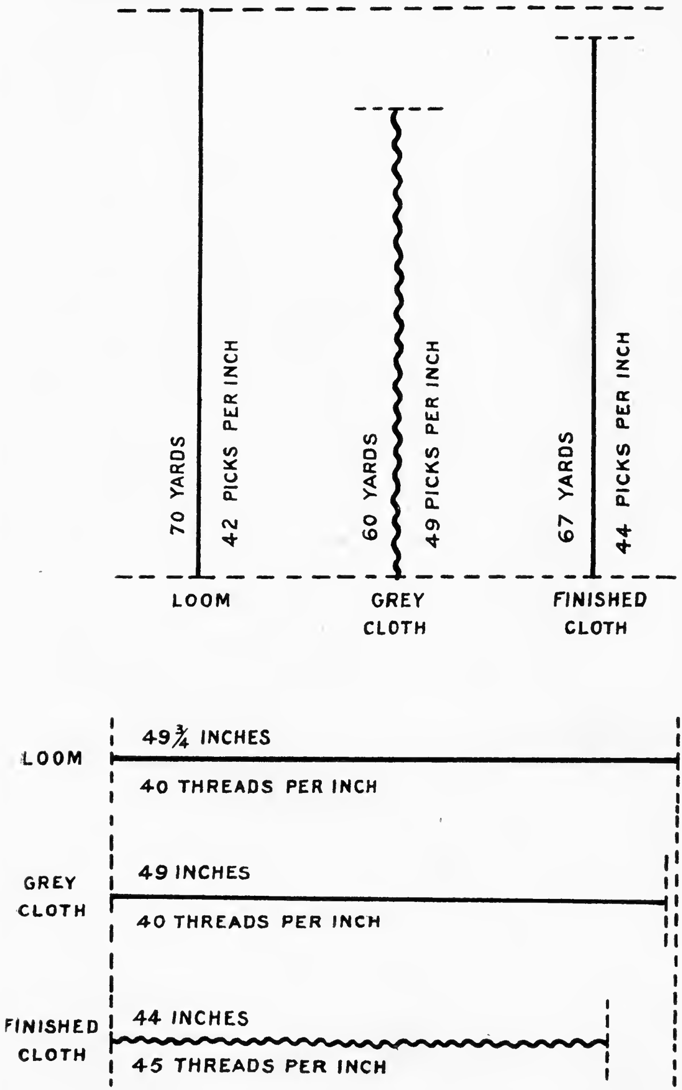

Fig. 61.—Variation from Loom to Finished Cloth (Mohair Lustre).

the number of threads and picks per inch. Fig. 61 shows the widths in the loom, the grey cloth and the finished cloth respectively, the number of threads per inch being given in each case, also the length of the warp in the loom, and in the grey and finished cloth. The number of picks per inch is indicated under each condition.

Variation in Threads and Picks per Inch.—During the weaving and finishing of most woven fabrics there is a contraction in length and width which is responsible for a corresponding increase in the number of picks and threads per inch.

Example.—An all-wool grey (unfinished) cloth is 64 yds. long and 66 in. wide, containing 104 threads and 100 picks per inch. After finishing, the dimensions of the cloth are 60 yds. and 58 in. What are the number of threads and picks per inch in the finished cloth?

60 yds. (finished) : 64 yds. (grey) : : 100 picks (grey) : 107 picks per inch finished cloth.

58 in. (finished) : 66 in. (grey) : : 104 threads (grey) : 118 threads per inch finished cloth.

There is an exception, however, in the case of union dress fabrics. As illustrated in Fig. 61 there is actually an elongation in length and a corresponding contraction in width. Consequently, during the finishing of these goods the picks per inch will be decreased and the threads per inch increased in direct proportion to the elongation and the contraction.

To the cloth analyst whose experience has been limited to all-wool goods, these conditions present a difficulty. However, when the conditions are realized, and the amount of elongation in length and contraction in width is standardized, the difficulty is eliminated. An application of the results given in Table XXI and Fig. 60 will be found of great assistance in ascertaining, from the finished cloth, the number of threads and picks per inch in the grey cloth.

Example.—A finished lustre cloth contains 100 threads and picks per inch. How many of each will there be in the grey cloth? As the amount of elongation is equal to 12 per cent, then :—

As 100 yds. grey cloth : 112 yds. finished cloth : : 100 picks finished cloth : 112 picks per inch grey cloth.

As the contraction in width is 12 per cent, then :—

As 100 in. grey cloth : 88 in. finished cloth : : 100 threads finished cloth : 88 threads per inch grey cloth.

Loss in Weight.—The loss in weight that occurs during the finishing of a union lustre dress fabric is chiefly during the crabbing and scouring processes, which expel the impurities contained in the cloth. The chief impurities contained in this class of fabric are oil—usually about 3 per cent—which is added to the mohair fibre to assist the spinning of the weft yarns, the sizing agent which is applied to single twist cotton warps to improve the weaving properties, and the filth which has been contracted during manufacture. As indicated in Tables XIX and XX, there is little loss incurred after the crabbing and scouring processes. The amount of fibre which is burnt away during singeing has no appreciable influence on the weight of the fabric.

TABLE XXII.—LOSS OF WEIGHT IN UNION CLOTHS (COTTON WARP AND LUSTRE WEFT) SUBMITTED TO A "BRIGHT" FINISH.

Style of Fabric.	Use.	Warp.	Weft.	Grey Weight.	Finished Weight.	Loss per cent in Weight.
Beatrice twill .	Lining	Cotton	Demi-lustre	25 lb.	23¼ lb.	6·6
Mable or Hilda twill . .	,,	,,	,,	25½ ,,	24 ,,	6
Beatrice twill .	,,	,,	English	15 ,,	14½ ,,	6·2
Plain lustre .	Dress goods	,,	Mohair	24 ,,	22 ,,	8
,, .	,,	,,	,,	26¼ ,,	25 ,,	6
Glacé . .	,,	,,	,,	14½ ,,	13½ ,,	7
Brilliantine .	,,	,,	,,	19½ ,,	18 ,,	7·7
Sicilian . .	,,	,,	,,	33 ,,	31 ,,	7·5
Brilliantine .	,,	,,	,,	16¼ ,,	15 ,,	7·7
,, . .	,,	,,	,,	15 ,,	14 ,,	6·8
			Average loss per cent .	.	.	6·9

Lustre cloths composed of dyed yarns, such as melanges, are practically free from oil, this having been extracted when the sliver or yarn has been printed or dyed. Consequently, there is not the loss in weight during the finishing of this class of fabric which occurs in finishing cloths composed of undyed yarns. As lustre cloths are composed of the same material, and the method of finishing is about the same for the several classes, the loss of weight involved may be standarized. In Table XXII a number of these goods are tabulated, with their respective weights, before and after finishing. On perusing the results indicated it will be found that the amount of variation is from 6 to 8 per cent. With such a slight variation there is no difficulty in arriving at the conclusion that this class of fabric, submitted to a "bright" finish and *not subjected to any weight adulteration*, will sustain a loss in weight equal to 7 per cent.

Italian Linings.—As the manufacture of Italian linings forms an important part of the union dress goods trade, the influence of the various dyeing and finishing processes on these structures will provide useful information. The cloth to be taken as an example is made to the following loom particulars:—

Warp.

2/66's fast black cotton.
100 threads per inch.
3800 threads in warp.
70 yds. of warp per cut.

Weft.

1/66's botany worsted.
161 picks per inch (grey cloth).
38 in., reed width.

Weave.—Five end weft sateen.

Dye.—Black.

In the general finishing treatments of this type of cloth, the principles laid down regarding the finishing of other types of union cloths are observed. For example during the process of crabbing or fixing the length of the cloth is increased and remains practically stationary during the subsequent treatments.

Table XXIII indicates the various processes and the action of

TABLE XXIII.—VARIATION OF A LINING CLOTH AFTER THE VARIOUS FINISHING PROCESSES.

	Widths.	Threads per Inch.	Picks per Inch.	Counts.		Weight.	Length.
				Warp.	Weft.		
Grey cloth . . .	35 in.	108	161	2/60	1/62	21·5 lb.	64 yd.
After crabbing . .	32 ,,	120	154	2 70	1/54	20·7 ,,	67 ,,
,, singeing . . .	32 ,,	120	154	2/70	1/56	20·24 ,,	67 ,,
,, dyeing, blue black	31 ,,	122	154	2/68	1/54	21 ,,	67 ,,
,, singeing, tentering, and pressing	32 ,,	120	154	2/68	1/56	20·3 ,,	67 ,,
After dyeing full black	31¼ ,,	122	154	2/68	1/53	20·7 ,,	67 ,,
,, singeing, tentering, and pressing	32 ,,	120	154	2/66	1/52	20·4 ,,	67 ,,

finishing on the dimensions, weight, counts of warp and weft, etc., of the cloth.

As Italian lining cloths are made from standard materials, i.e. cotton warp and botany weft, identical in structure and subjected to about the same finishing treatments, there is a possibility of establishing a definite length of finished cloth from a given length of warp. In Table XXIV the warp and the grey and finished cloth lengths of five makes of cloth are given, the average of which indicates a drawing out in length during finishing of under three yards.

TABLE XXIV.—LENGTHS OF ITALIAN LINING CLOTHS.

	Warp.	Grey Cloth.	Finished Cloth.
1	70 yd.	64 yd.	66 yd.
2	70 ,,	$64\frac{1}{2}$,,	$66\frac{1}{2}$,,
3	70 ,,	64 ,,	67 ,,
4	70 ,,	63 ,,	$65\frac{1}{2}$,,
5	70 ,,	63 ,,	65 ,,
Average	70 ,,	$63\frac{3}{4}$,,	66 ,,

Fig. 62 illustrates the variation in the dimensions of the type of cloth under consideration from the loom to the finished fabric; also the influence of the varying dimensions on the number of threads and picks per inch. It also shows the widths in the loom, grey cloth and the finished cloth respectively along with the number of threads per inch for each dimension. Fig. 62 also illustrates the length of warp per cut, and length of grey and finished cloth, with the number of picks per inch under each condition.

Loss in Weight incurred during Dyeing and Finishing Cotton Yarns and Fabrics.—Where cotton yarns or cloths are not subjected to any loading or filling during the processes involved in dyeing and finishing, slight variation is to be observed in grey and finished weights.

It is recognized that in grey or untreated cotton fibres and yarns, there are about 3 per cent of impurities or substances other than cotton cellulose. Of this amount about ·6 per cent is wax and the remainder is composed of natural oil and colouring matter.

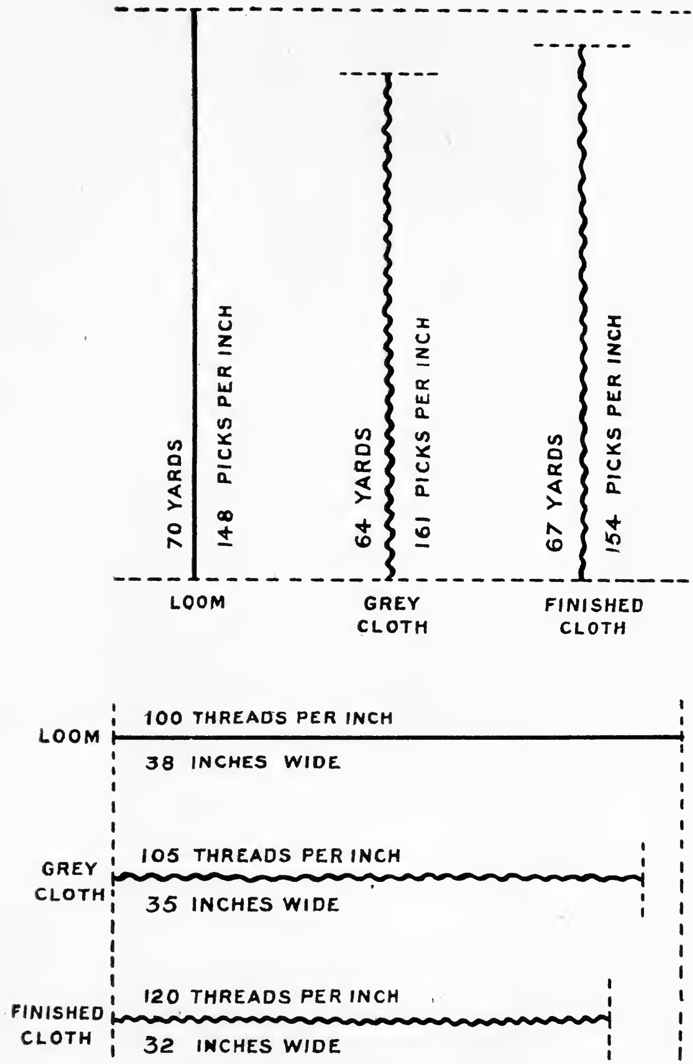

Fig. 62.—Variation from Loom to Finished Cloth (Italian Lining).

To give some idea of the variation which does occur various tests have been carried out with the results as tabulated in Table XXV.

TABLE XXV.—DETERMINATION OF VARIATION IN WEIGHT OF COTTON YARNS AFTER UNDERGOING VARIOUS TREATMENTS.

Treatment.	Original Weight.	After Treatment.						
		2/40 American.	2/120 Sea Island.	1/50 Egyptian.	2/40 Egyptian.	2/60 Egyptian.	1/40 Egyptian.	Mean.
Boiling water . .	100	96	95	95	97	97	97	96
Bleached . . .	100	95	93	93	93	95	95	94
Mercerised . . .	100	98	96	96	98	98	97	97
Aniline black . .	100	105	103	103	104	104	104	104
Logwood black . .	100	105	105	107	105	106	107	106

CHAPTER X.

OBTAINING THE LOOM PARTICULARS FROM A SMALL SAMPLE OF FINISHED CLOTH.

When the analyst has decided upon the quality of the material or materials, and the structure of yarn or yarns, of the sample submitted for analysis; when he has also determined the order of interlacing and counted the number of threads and picks per inch the following operations must be successively carried out:—

1. Cut the pattern a suitable size.
2. Weigh the sample and calculate the weight per yard.
3. Obtain as great a length as convenient of each of the yarns; weigh and calculate the count of each yarn.

1. Cutting the Pattern a Suitable Size.—After having determined successfully the warp and weft ways of the fabric, and marked the cloth in the direction of the warp to prevent further doubt, it is then necessary to cut a sample of the cloth some suitable size. If the sample is large enough a square of cloth which is exactly 3 in. on each side will be found to be most convenient. This size may be obtained with the aid of a pair of scissors and a clearly marked measure taking care that the cutting is exactly to the thread in both directions. A better method, however, is to employ a steel cutter, such cutters being obtainable in almost all sizes. A very useful shape of cutter, especially for very small patterns, is that shaped as shown in Fig. 63.

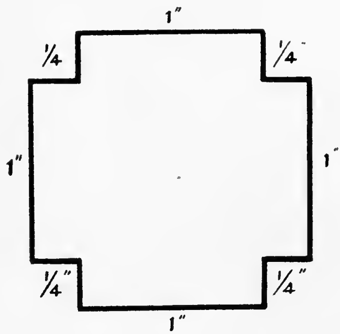

Fig. 63.—Cross-shaped Cutter.

This cutter gives an area which is exactly 2 sq. in. and the length and breadth of the middle section is $1\frac{1}{2}$ in. As the sides are 1 in. each way, the cloth so cut will contain an inch of threads and picks which will facilitate the counting of the number of threads and picks per inch, especially in the case of fine set structures.

2. Weight per Yard.—A useful method of arriving at the weight per yard of a sample of cloth submitted for analysis, is to weigh a given number of square inches, and from this to ascertain the weight by direct proportion of 1 yd. of cloth the required width.

Example.—

1. By carefully weighing 3 × 3 in. (i.e. 9 sq. in.) of worsted cloth = 33·6 grains.

2. 36 × 56 = 2016 sq. in. in 1 yd. of cloth 56 in. wide.

3. As 9 : 2016 : : 33·6 : x = 7526·4 grains or 17·2 oz. per yard (36 × 56 in.)

Or perhaps a better statement is :—

$$\text{As } 3 \times 3 \text{ in.} : 36 \times 56 \text{ in.} :: 33{\cdot}6 \text{ grains} : \frac{x \times 16 \text{ (oz. per lb.)}}{7000 \text{ grains (per lb.)}}$$

$$= 17{\cdot}2 \text{ oz. per yd. } (36 \times 56 \text{ in}).$$

In order to test the accuracy of this calculation, from the counts of warp and weft, and threads and picks per inch, contained in the sample of cloth, the weight per yard of material may be calculated as follows :—

(For method of ascertaining counts of yarn from a small piece of cloth see Chap. III, p. 38).

1. 36 threads of warp, 3 in. long (36 × 3 = 108 in. or 3 yds.), weighs 2·64 grains.

As 2·64 : 12·5 : : 3 : x = 14·2 worsted counts.

2. 36 picks of weft 3 in. long (36 × 3 = 108 in. or 3 yds.) weighs 3·1 grains.

As 3·1 : 12·5 : : 3 : x = 12 worsted counts.

3. 78 threads per inch.
63 picks per inch.

Weight of Warp.—

$$\frac{78 \times 56 \times 16}{14{\cdot}2 \times 560} = 8{\cdot}78 \text{ oz.}$$

Weight of Weft.—

$$\frac{63 \times 56 \times 16}{12 \times 560} = 8{\cdot}4 \text{ oz.}$$

Total weight = 17·18 oz. per yard.

In Fig. 64 a graph is given which enables the designer at a glance to get the total weight of material in a piece, weight per yard and length being given.

Having ascertained the counts of warp and weft the particulars of the finished cloth are now decided, from which it is

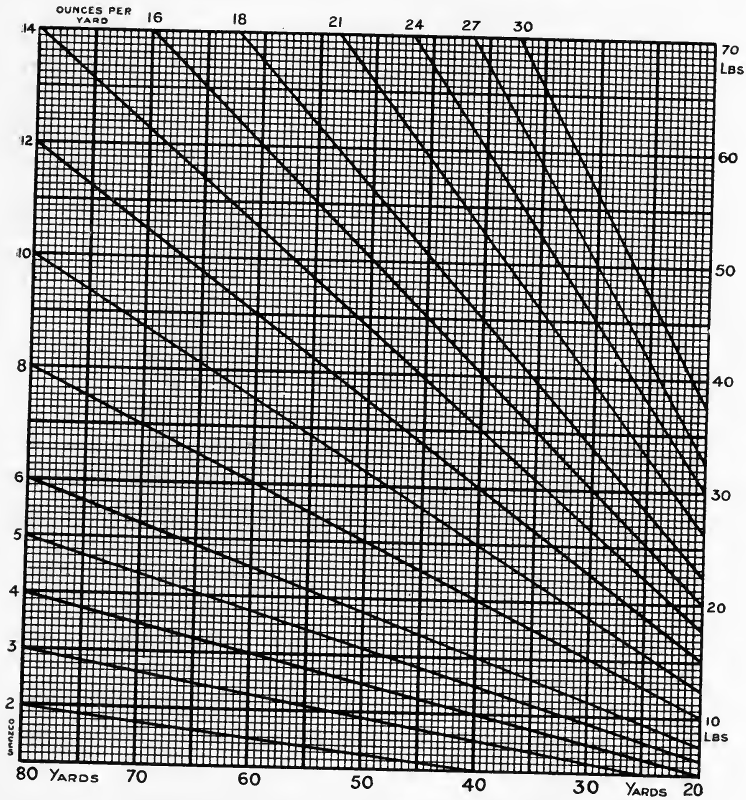

FIG. 64.—Graphic Illustration for finding Weight per piece from Length and ounces per yards.

necessary to make suitable allowances and deductions before the loom particulars can be ascertained.

As previously stated the variation from loom to finished cloth is entirely dependent upon the two factors, i.e. loss in weight and contraction of warp and weft.

Loss in Weight.—In Chaps. VIII and IX (Influence of dyeing and finishing on all-wool, union dress and lining cloths) an attempt has been made to standardize the loss of weight involved during the dyeing and finishing of a number of styles of standard cloths, with the following results:—

1. Worsteds submitted to a "clear" finish (Table XIII, p. 125) = 6 per cent loss.

2. Cloth containing woollen yarns (Table XIV, p. 127) = from 10 to 30 per cent loss.

3. Union cloths (cotton warp, worsted weft) (Table XXII, p. 149) = 6·9 per cent loss.

4. Cotton yarns and fabrics submitted to bleaching or mercerizing or both (Table XXV, p. 153) = 5 per cent loss.

Ascertaining the Contraction of Warp and Weft.—As it is impossible to standardize this factor in most woven fabrics it will be necessary by some means to obtain the amount of shrinkage from the sample of cloth submitted for analysis. This can be done very accurately, with some practice and experience, by taking a number of threads and picks, and measuring the length, to the $\frac{1}{32}$ part of an inch when these are stretched to their extreme length on a flat measure.

This part of the analysis is the most important and must be carried out with all the influencing conditions in mind. During weaving the warp and the weft is in a perfectly straight condition, but whilst being made into cloth, and the cloth finished, the yarns have developed some curvature which indicates the amount of contraction of yarn developed. Thus, when the threads and picks taken from a finished sample of cloth are drawn straight and measured, the result will indicate the warp length and reed width to produce that particular size of finished cloth and by proportion the relative warp length and width in loom can be obtained for any required dimensions of finished cloth.

In measuring the drawn out length of yarn taken from any cloth the distance should always be taken on the full side, as shown in Fig. 65. At (A) in this illustration the yarn is shown, containing a certain amount of curvature, taken from a cloth cut 3 in. × 3 in. This same yarn when drawn straight is shown at (B) to measure about $3\frac{15}{32}$ in. When it is pointed out that it is nearly impossible to draw out such threads to their original length, when once they have been woven into a cloth and subjected to the various finishing processes it will be understood that $3\frac{1}{2}$ in. will indicate more accurate loom dimensions than $3\frac{15}{32}$ in. Further it should be noted, that in the case of wool yarns, there are two forms of contraction. The first is due to the warp and weft curving or bending during weaving and a development of the same during dyeing and finishing, and the second is due to the

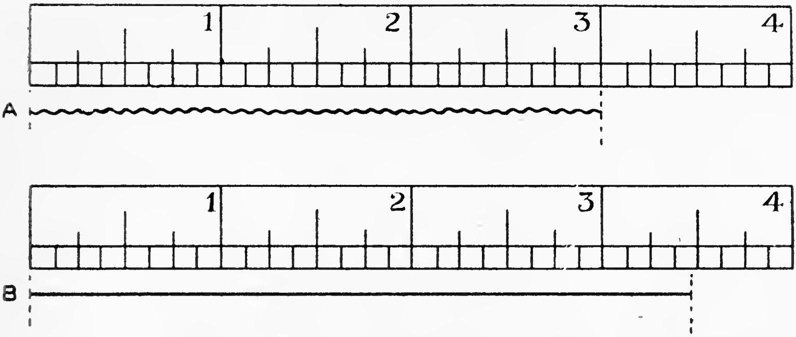

Fig. 65.—Measuring the Contraction of Yarns.

shrinkage and interlocking of the individual wool fibres contained in the yarn. Hence in ascertaining the loom dimensions of cloths which have been severely milled and subjected to excessive shrinkage an allowance for fibre shrinkage must be made

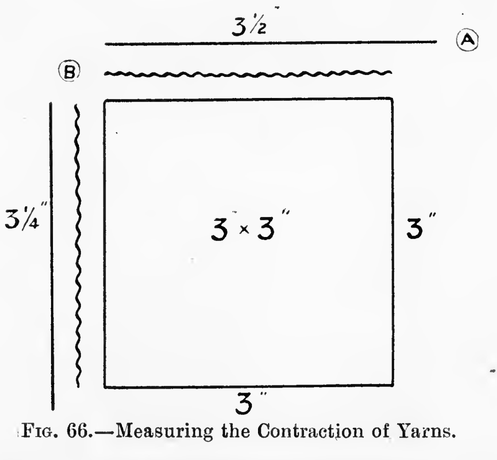

Fig. 66.—Measuring the Contraction of Yarns.

over and above the actual contraction indicated by measuring the thread in a straight condition.

Fig. 66 represents a sample of cloth cut 3 × 3 in. A pick of weft (A) when drawn straight is found to measure $3\frac{1}{2}$ in. whilst the warp thread (B) measures $3\frac{1}{4}$ in. These figures representing the loom and finished cloth dimensions of a worsted texture. To reproduce this cloth which is 3 in. long and wide a warp will be required $3\frac{1}{4}$ in. long and a loom width of $3\frac{1}{2}$ in.

Example.—It is desirable to reproduce the cloth illustrated in Fig. 66. What length of warp and width in loom will be required in order that the finished cloth will be 60 yds. long and 56 in. wide?

Warp Length.

As 3 in. (length of pattern) : $3\frac{1}{4}$ in. (length of warp) : : 60 yds. (length of cloth) : $x = 65$ yds. of warp.

Width in Loom.

As 3 in. (width of pattern) : $3\frac{1}{2}$ in. (loom width) : : 56 in. (width of cloth) : $x = 65\frac{1}{3}$ in. loom width.

When the analyst has obtained the particulars of the finished cloth and decided the amount of shrinkage of warp and weft, the following loom particulars must be successively decided :—

1. Counts of warp and weft.
2. Threads and picks per inch.
3. Width in loom.
4. Selection of reed.
5. Length of warp.

1. **Counts of Warp and Weft.**—The counts of yarn in any given cloth, as already shown, may readily be obtained by weighing as long a length as may conveniently be obtained, i.e. at least to the tenth part of a grain, and preferably to the hundredth part of a grain. From the result, allowances must be made according to loss in weight and shrinkage before the counts of yarn in the loom can be obtained.

Example 1.—A worsted cloth is submitted for analysis, after being cut 3 × 3 in. the particulars of warp and weft are found to be as follows :—

24 threads of warp (2 yards) weigh = 1·8 grains.
24 ,, weft ,, ,, = 1·5 grains.
3 in. of warp stretches to $3\frac{1}{4}$ in.
3 ,, weft ,, $3\frac{1}{2}$ in.

What are the counts of warp and weft in the loom?

Warp.

As 1·8 : 2 yds. : : 12·5 : $x = 13{\cdot}9$ count of warp (finished).
Allowance for gain in weight owing to contraction.

$$3 \text{ in.} : 3\tfrac{1}{4} : : 13{\cdot}9 : x = 15.$$

Loss in weight during finishing = 6 per cent.
Allowance for loss in weight during finishing.

$$100 : 94 :: 15 : x = 14 \text{ count of warp in loom.}$$

or the whole calculation may be worked out as a compound proportion.

$$\begin{array}{rcl} 1{\cdot}8 : 12{\cdot}5 & :: & 2 : \\ 3 : 3\tfrac{1}{4} & :: & : x = 14 \text{ count of warp in the loom.} \\ 100 : 94 & :: & : \end{array}$$

Weft.

As $1{\cdot}5 : 12{\cdot}5 :: 2 : x = 16{\cdot}7$ count of weft (finished).
Allowance for gain in weight owing to contraction:—

$$3 : 3\tfrac{1}{2} :: 16{\cdot}7 : x = 19{\cdot}4.$$

Allowance for loss in weight during finishing:—

$$100 : 94 :: 19{\cdot}4 : x = 18{\cdot}2 \text{ count of warp in the loom.}$$

or

$$\begin{array}{rcl} 1{\cdot}5 : 12{\cdot}5 & :: & : \\ 3 : 3\tfrac{1}{2} & :: & 2 : x = 18{\cdot}2 \text{ count of warp in the loom.} \\ 100 : 94 & :: & : \end{array}$$

$$= \frac{12{\cdot}5 \times 3\tfrac{1}{2} \times 94 \times 2}{1{\cdot}5 \times 3 \times 100} = 18{\cdot}2.$$

After some experience in analysing worsted cloths it will be noted, that in many instances the gain due to the contraction about counterbalances the loss in weight involved during finishing. An instance of this is shown in the warp of the foregoing example. The contraction of the warp is from $3\frac{1}{4}$ in. to 3, and the finished count is 13·9 to 14 in the loom. In the case of the weft—owing to increased contraction—the count finished is 16·7 and 18·2 in the loom. Hence it is only an application of experience which will indicate any simplification of the above calculation.

Example 2.—The particulars of warp and weft from a 3 × 3 in. pattern of sicilian cloth (cotton warp and mohair weft) are as follows:—

3 yds. of warp weigh = ·56 grains.
3 ,, weft ,, = 1·21 grains.
3 in. of warp stretches to $3\frac{1}{8}$ in.
3 ,, weft ,, $3\frac{5}{16}$ in.

What are the counts in the loom?

Warp.

$$\left.\begin{array}{r} \cdot 56 : 8\cdot 3 \\ 3 : 3\frac{1}{8} \\ 100 : 95 \end{array}\right\} : : 3 : x = 44\text{'s counts cotton.}$$

Weft.

$$\left.\begin{array}{r} 1\cdot 21 : 12\cdot 5 \\ 3 : 3\frac{5}{16} \\ 100 : 94 \end{array}\right\} : : 3 : x = 32 \text{ counts worsted.}$$

Example 3.—Three yards of warp and weft from a woollen cloth each weigh 5 grains. The contraction of both being from $3\frac{1}{2}$ to 3 in. What will be the count in the loom, when the cloth has lost 20 per cent of weight during finishing?

$$\left.\begin{array}{r} 5 : 27\cdot 34 \\ 3 : 3\frac{1}{2} \\ 100 : 80 \end{array}\right\} : : 3 : x = 11\cdot 3 \text{ Yorkshire skein woollen.}$$

2. **Threads and Picks per Inch.**—The number of threads and picks per inch, vary from being in the loom to becoming a finished cloth, according to the shrinkage of warp and weft. On referring to Fig. 58 (p. 135) it will be observed that there are three distinct conditions of dimensions, consequently a corresponding variation in the number of threads and picks per inch, from loom to finished cloth. This illustration graphically shows the amount of variation as follows:—

Warp	70 yds. . . .	= 91 picks per inch.
	$69\frac{3}{4}$ in. reed width .	= 104 threads per inch.
Grey cloth	$62\frac{1}{2}$ yds. . . .	= 102 picks per inch.
	66 in. grey cloth width	= 111 threads per inch.
Finished cloth	$61\frac{1}{4}$ yds. . . .	= 104 picks per inch.
	56 in. finished width	= 126 threads per inch.

With such variations it is necessary to bear in mind the conditions which prevail when analysing a small pattern of cloth. For example:—

A finished all-wool cloth cut 3×3 in. counts 84 threads and 80 picks per inch. The warp when drawn straight measures $3\frac{1}{4}$ in. and the weft $3\frac{1}{2}$ in. What are the number of threads and picks per inch in the reed and the warp?

As $3\frac{1}{2}$ in. : 3 in. : : 84 : x = 72 threads per inch in reed.

As $3\frac{3}{8}$ in. : 3 in. : : 80 : x = 71 picks per inch of warp.

To obtain the corresponding threads and picks in the grey cloth the take up in weaving must be taken into account, assuming that the warp threads were arranged 65 in. wide in the reed and resulted in 63 in. wide of grey cloth, then

As 63 in. : 65 in. : : 72 : $x = 74$ threads per inch in grey cloth.

The warp, which is 70 yds. long, has resulted in 65 yds. of grey, in which case the picks per inch in grey cloth would be :—

As 65 : 70 : : 71 : $x = 76$ picks per inch in grey cloth.

Width in Loom.—As the loom width of the cloth being subjected to analysis is revealed by the weft being drawn perfectly straight, by direct proportion the loom width for any given finished width can readily be obtained.

Example.—The weft from a pattern cut 4 in. × 4 in. stretches to $4\frac{5}{8}$ in.

Find the loom or reed width which must be employed to result in 56 in. wide of finished cloth.

As 4 in. : $4\frac{5}{8}$ in. : : 56 in. : $x = 64\frac{3}{4}$ in. in loom.

Experience will prove that the best result and the most convenient method of working will be obtained by considering the threads per inch and the width in conjunction as illustrated in the following example :—

A finished cloth cut 3 in. × 3 in. counts 87 threads per inch. The weft when drawn perfectly straight measures $3\frac{3}{8}$ in. What will be the number of threads per inch in the reed, also the width of the warp in the reed to produce a finished cloth 56 in. wide?

As $3\frac{3}{8}$: 3 : : 87 : $x = 77\frac{1}{3}$ threads per inch. in reed

As 3 : $3\frac{3}{8}$: : 56 : $x = 63$ in. wide in reed.

Modifications of calculated results have often to be made owing to limitations imposed by practical conditions. In this particular case the only reed available might be one with 19 dents per inch, and in this to give anything like $77\frac{1}{3}$ threads per inch the warp threads must be sleyed or reeded four threads in each dent. Thus the conditions are that only $19 \times 4 = 76$ threads per inch can be obtained. As the above-stated loom or reed width is in direct ratio to the calculated threads per inch, an alteration of the number of threads per inch necessitates a corresponding alteration in the width. To ensure consistency the following method is recommended :—

87 (threads per inch) × 56 (finished width) = 4872 ends in warp.
4872 ÷ 76 (threads per inch in loom) = 64 in. loom width.

In making any modifications in the calculated number of threads per inch it should be borne in mind that as previously remarked, in woollens and worsteds, there is a tendency to under measure the shrinkage of the yarns. Realizing this, any alteration should be made by decreasing the threads per inch calculated result.

Selection of Reed.—Having found the ends per inch the question occurs—what reed shall be used and what number of ends per dent will prove most efficient? Experience only can decide this, since, although a coarse reed might be selected which *would weave* the piece, still a much better result will usually be obtained by the use of a fine reed, for, within reason, the finer the reed the better. This is particularly so in the case of cotton warps, but designers are warned against applying the experience gained with cotton warps to wool warps, a large deduction owing to the increased bulk and nature of the threads, and the finish imparted being usually necessary. For example, a botany worsted cloth, woven as follows:—

Warp.
All 2/36's grey.
12's reed 6's.

Weft.
All single 18's grey.
72 picks per inch.

will when finished show no reediness, still less will a woollen.

On the other hand a cotton warp lustre dress fabric made as follows:—

Warp.
2/90's cotton.
12's reed 6's.

Weft.
1/26 mohair.
70 picks per inch.

will prove very unsatisfactory. Whatever is done in the loom or in the subsequent finishing to counteract the reediness, the threads will not take their correct or best position, and altogether an unsightly piece results.

If the warp is now sleyed 36's reed 2's or better still 72's reed 1's, quite a different cloth results: the reed marks go, the fine warp ground asserts itself, and the piece is, compared with the previous one, beautifully covered.

The Length of Warp.—This is a most important matter and one to which, so far, little attention has been directed. In its simplest form the question may be put as follows :—

Example.—A warp 100 yards long is put into the loom. What length of grey and finished cloth will be obtained?

Length of Grey Cloth.—There are two matters here involved—firstly, what allowance is necessary for twisting-in and felling the piece, a portion of the warp being usually left in the healds, by which the succeeding warp is twisted to? Secondly, what will the warp take up during weaving?

The first matter will be influenced by the loomer or twister-in and the loom-tuner or starter of the loom, and can only be estimated, but an allowance of $1\frac{1}{2}$ yards per warp is considered ample under ordinary circumstances.

The second matter is one of much importance, since it affects not only the calculations which are being considered, but also calculations relating to allowances for backing and figuring warps. As already demonstrated, the take-up of warp during weaving is dependent upon the structure of the cloth which involves type of material, thickness of yarns, number of threads and picks per inch, and the weave employed. It has been stated that ordinary structures take up about an equal amount of warp and weft, whereas in warp-rib cloths the weft is straight, and in consequence more warp is taken up. In the case of weft-rib structures the warp being almost straight, the yield of cloth will be almost the warp length.

In addition to the above factors, it should be observed, that, during the process of weaving, the dimensions of cloths, identical in make or structure, may vary to some extent, owing to the fact that the tensioning of the warp beam will influence the take up in some slight degree.

The length of grey cloth obtainable from a given length of warp, can only be estimated owing to the innumerable variations which obtain in the making of woven fabrics. To make fairly accurate estimates the application of an extensive knowledge of weaving cloths is essential; or it is possible to some extent to estimate this result by resorting to records of lengths of similarly constructed cloths. For this purpose the warp and grey cloth lengths of different structures of cloths have been tabulated in Tables XV, XXI, and XXIV.

Length of Finished Cloth.—From the pattern submitted for analysis, the analyst calculates the length of finished cloth obtained from a given warp length.

Example.—The warp of a pattern cut 3×3 in. when drawn straight measures $3\frac{3}{8}$ in. What length of finished cloth will be produced from 70 yds. of warp?

As the length $3\frac{3}{8}$ in. is the warp length of the finished cloth which is 3 in. long, the length produced from 70 yds. of warp will be in direct proportion.

As $3\frac{3}{8}$ in. : 3 in. : : 70 yds. : $x = 62\frac{1}{4}$ yds. finished cloth.

Grey and Finished Weights of Cloths Compared.—When the analysis of a pattern has been completed a useful method of checking the result is to compare the total weights of grey and finished cloths. For example :—

A costume cloth has been subjected to analysis with the following result :—

12·75 oz. per yard Finished cloth (56 in. × 36 in.).

Loom Particulars :—

Warp.

2/24's worsted.

46 threads per inch.

2856 threads.

70 yds. warp.

66 yds. finished cloth.

Weft.

2/24's worsted.

40 picks per inch of warp.

62 in. reed width.

56 in. finished width.

Weight of Grey Cloth :—

$$\textit{Warp.}\text{—}\frac{2856 \times 70}{12 \times 560} = 29{\cdot}75 \text{ lb.}$$

$$\textit{Weft.}\text{—}\frac{40 \times 62 \times 70}{12 \times 560} = 25{\cdot}83 \text{ ,,}$$

$$\text{Total} \quad 55{\cdot}58 \text{ lb.}$$

Weight of Finished Cloth :—

$$12{\cdot}75 \text{ oz. per yard.}$$

$$\frac{12{\cdot}75 \times 66 \text{ yd.}}{16 \text{ oz.}} = 52{\cdot}59 \text{ lb.}$$

In this case the difference between grey and finished weight is 3 lb. which is equal to about 6 per cent. Previously it has been shown that worsted cloths, on an average, lose this amount during finishing; hence this result indicates to some extent the accuracy of the analysis.

Edges or Lists.—In reproducing any woven fabric it is necessary to give special consideration to the edges or lists. The body of a cloth may be perfect in structure and design but if the edges are not even, level and regular, the cloth may be banned as unsaleable.

The appearance and smartness of the list in all cases gives improved character to the piece. In addition to appearance the warp threads which form a list must be strong enough to bear the special tension which is required during finishing, as should the edge break, it is impossible to develop the best type of finish. For this reason 2-fold and 3-fold yarns are often employed as against single yarns for the body warp. Tight or slack lists will result in the edges curling, which will prove an inconvenience to the finisher.

In structures such as Venetians, Amazons, Cashmeres, lining and sateens, where warp or weft predominate the edges have a tendency to curl, and on this account the lists of such styles are composed of plain weave or a modification. Figured structures also require an edge of ordinary weave, as the floats of warp and weft at the edge of the cloth would result in unevenness.

Hence to obtain a level list it might be laid down as a rule that all weaves away from twills, hopsacs, etc., require an edge of some plain weave.

As to what is a suitable list for any particular type of fabric, depends on: 1st, the set; 2nd, the weave; 3rd, the yarns employed. No general rule can be laid down and it is only after experimenting in the loom that a suitable list can be determined.

The following are a few lists which are employed for different structures of standard cloths :—

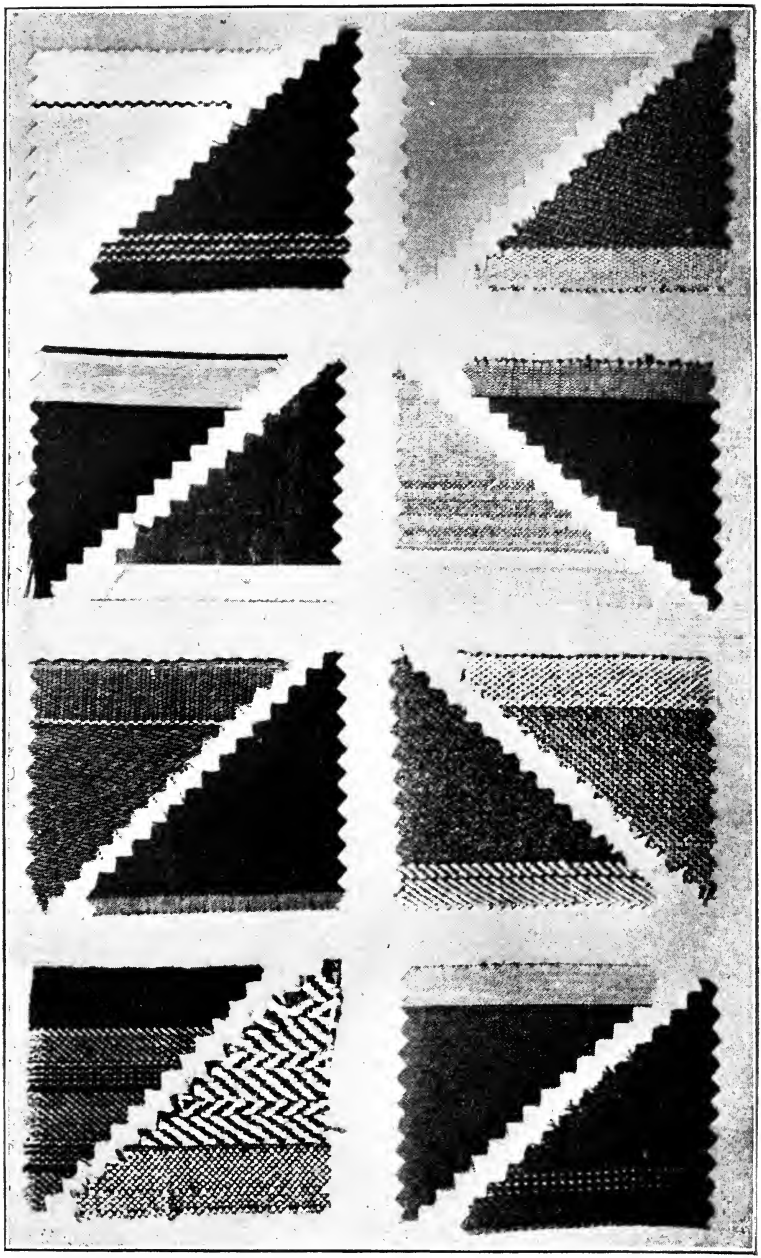

FIG. 67.—Various types of "Edges" or "Lists"

Worsted Twills.—(1) Edges weaving as body of cloth with coloured threads introduced about half an inch from edge.

(2) Edges weaving as body of cloth, but hopsac or reverse weave, with coloured threads introduced.

(3) As 1 or 2 with the warp threads in edges being composed of different colour.

Lustre Sicilians.—Warp arranged 40's reed 1's (plain weave) of 1/50 black cotton, with 24 threads of 2/40 bleached cotton at each edge sleyed 1 in a reed weaving plain.

Cashmeres.—Warp arranged 52 threads per inch of 2/60 black cotton, sleyed 3 in a reed, weaving 2/1 weft twill and a suitable number of 2/30 black cotton threads at each edge, sleyed 2 in a reed weaving plain weave or a modification.

Italian Linings.—Similar to Cashmeres, with the body of warp weaving 5 weft sateen.

Worsted Voile dress cloth.—Body warp of 1/30 voile yarn, arranged 40's reed 1's weaving plain weave and at least half an inch at each edge a number of threads of warp sleyed 2 in a reed weaving plain or the warp threads weaving two as one.

Amazon dress fabric.—Body warp of 1/36's botany weaving 2 end warp sateen, sleyed 24's reed 3's with a suitable number of warp threads, working double, sleyed 2 double threads in a reed weaving a hopsac.

Figured dress fabric.—Warp of 2/60 botany sleyed 32's reed 2's with a suitable number of double warp threads weaving alternately up and down for two picks, sleyed two in a reed.

In Fig. 67 various typical edges or "lists" for fabrics are illustrated.

CHAPTER XI.

EXAMPLES IN THE ANALYSIS OF WOVEN FABRICS.

Example 1.—Worsted Costume Cloth (Fig. 68).

Finished Cloth Particulars :—

1. Weight of pattern cut 3 × 3 in. = 23·4 grains.
2. 3 yds. of warp (worsted, two-fold) = 2·16 ,,
3. ,, weft ,, ,, = 2·3 ,,
4. Threads per inch = 66.
5. Picks ,, ,, = 62.

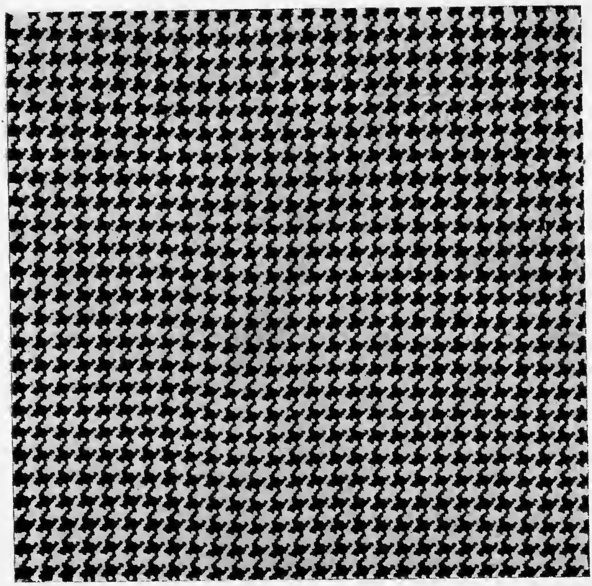

Fig. 68.—Worsted Costume Cloth.

Contraction from Loom to Finished Cloth :—

Warp.—3 in. measures $3\frac{1}{4}$ in.
Weft.—3 in. ,, $3\frac{1}{2}$ in.

The cloth to be reproduced from 70 yds. of warp per cut and the width of finished cloth to be 56 in.

Ounces per Yard (finished cloth).

$$\text{As } 3 \times 3 \text{ in.} : 56 \times 36 \text{ in.} :: 23{\cdot}4 \text{ grains} : \frac{x \times 16}{7000} =$$

$$\frac{23{\cdot}4 \times 56 \times 36 \times 16}{3 \times 3 \times 7000} = 11{\cdot}5 \text{ oz. per yard } (56 \times 36 \text{ in.}).$$

Loom Particulars :—

1. *Count of Warp :—*

$$\begin{array}{rl} 2{\cdot}16 : 12{\cdot}5 :: & : \\ 3 : 3\tfrac{1}{4} :: & 3 : x = \\ 100 : 94 :: & : \end{array}$$

$$\frac{12{\cdot}5 \times 3{\cdot}25 \times 94 \times 3}{2{\cdot}16 \times 3 \times 100} = 17{\cdot}7 = 2/36 \text{ worsted.}$$

2. *Count of Weft :—*

$$\begin{array}{rl} 2{\cdot}3 : 12{\cdot}5 :: & : \\ 3 : 3\tfrac{1}{2} :: & 3 : x = \\ 100 : 94 :: & : \end{array}$$

$$\frac{12{\cdot}5 \times 3{\cdot}5 \times 94 \times 3}{2{\cdot}3 \times 3 \times 100} = 17{\cdot}8 = 2/36 \text{ worsted.}$$

3. *Picks per Inch of Warp :—*

$$\text{As } 3\tfrac{1}{4} : 3 \text{ in.} :: 62 : x = 54 \text{ picks.}$$

4. *Threads per Inch in Reed :—*

$$\text{As } 3\tfrac{1}{2} : 3 \text{ in.} :: 66 : x = 56 \text{ threads.}$$

5. *Threads in Warp :—*

$$56 \times 66 = 3696 \text{ threads.}$$

6. *Width in Reed :—*

$$3696 \div 56 = 66 \text{ in.}$$

7. *Length of Finished Cloth :—*

$$3\tfrac{1}{4} : 3 \text{ in.} :: 70 : x = 64\tfrac{3}{4} \text{ yds.}$$

Quantities of Material.—

1. *Weight of Warp in Grey Cloth :—*

$$\frac{3696 \times 70}{18 \times 560} = 25\tfrac{2}{3} \text{ lb.}$$

2. *Weight of Weft in Grey Cloth :—*

$$\frac{54 \times 66 \times 70}{18 \times 560} = 23\tfrac{3}{8} \text{ lb.}$$

3. *Total Weight of Grey Cloth* :—

lb.
$25\frac{2}{3}$ warp
$23\frac{3}{8}$ weft
49 lb.

4. *Total Weight of Finished Cloth* :—

(11·5 oz. per yard.)

$$\frac{11 \cdot 5 \times 64\frac{3}{4}}{16} = 46\frac{1}{2} \text{ lb.}$$

Example 1.—(Fig. 68).—Style of cloth, worsted costume cl oth 11·5 oz. per yard (finished cloth), 56 × 36 in.

	Counts.	Material.	Reed.	Lengths.			Total Weight.
Warp				Warp.	Grey Cloth.	Finished Cloth.	Grey Cloth.
	2/36's	Botany worsted 56's quality	14/4's	70 yd.	(66 yd.)	$64\frac{3}{4}$ yd.	49 lb.
	Counts.	Material.	Picks per Inch.	Widths.			Total Weight.
Weft				Loom.	Grey Cloth.	Finished Cloth.	Finished Cloth.
	2/36's	Botany worsted 56's quality	54 warp 57 {grey cloth	66 in.	(63 in.)	56 in.	$46\frac{1}{2}$ lb.

Threads in Warp.

Warped.—4 threads black = 1820 = 1820
4 ,, white = 1820 + 56 for edges = 1876
Total 3696

Weight of Warp = $25\frac{2}{3}$ lb.
Wefted.—4 picks black
4 ,, white.
Weight of Weft.—$23\frac{3}{8}$ lb.

Lists.—28 white botany threads at each edge.
Weave.—Figs. 68*a* and 68*b*.

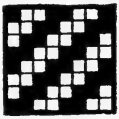

Fig. 68*a*.

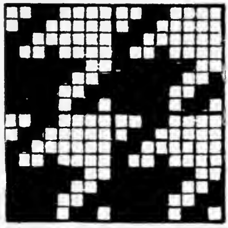

Fig. 68*b*.

Example 2.—Figured Mohair, Lustre Dress Fabric (Fig. 69).

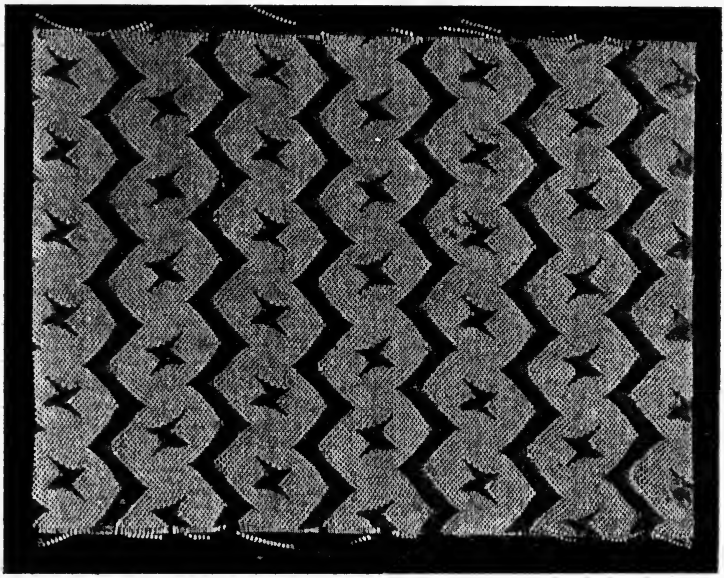

Fig. 69.—Figured Lustre Mohair Fabric.

Finished Cloth Particulars:—

1. Weight of pattern cut 3 × 3 in. = 9·6 grains.
2. 3 yds. of warp (cotton two-fold) = ·4 ,,
3. ,, ,, ,, weft (mohair single) = 1·34 ,,
4. Threads per inch = 71.
5. Picks ,, ,, = 65.

Contraction from Loom to Finished Cloth :—

Warp.—3 in. measures $3\frac{1}{8}$ in.
Weft.—3 in. „ $3\frac{3}{8}$ „

The cloth to be reproduced from 70 yds. of warp per cut and the width of finished cloth to be 44 in.

Ounces per Yard (finished cloth) :—

$$\text{As } 3 \times 3 \text{ in.} : 44 \times 36 \text{ in.} : : 9{\cdot}6 \text{ grains} : \frac{x \times 16}{7000} =$$

$$\frac{44 \times 36 \times 9{\cdot}6 \times 16}{3 \times 3 \times 7000} = 3{\cdot}8 \text{ oz. } (44 \times 36 \text{ in.}).$$

Loom Particulars :—

1. *Count of Warp :—*

$$\begin{array}{rcl} {\cdot}4 : 8{\cdot}3 & : : & \quad : \\ 3 : 3\frac{1}{8} & : : & 3 : x = \\ 100 : 94 & : : & \quad : \end{array}$$

$$\frac{8{\cdot}3 \times 25 \times 94 \times 3}{8 \times {\cdot}4 \times 3 \times 100} = 60 \text{ or } 2/120 \text{ cotton.}$$

2. *Count of Weft :—*

$$\begin{array}{rcl} 1{\cdot}34 : 12{\cdot}5 & : : & \quad : \\ 3 : 3\frac{3}{8} & : : & 3 : x = \\ 100 : 94 & : : & \quad : \end{array}$$

$$\frac{12{\cdot}5 \times 27 \times 94 \times 3}{8 \times 1{\cdot}34 \times 3 \times 100} = 30\text{'s mohair.}$$

3. *Threads per Inch in Reed :—*

As $3\frac{3}{8} : 3 : : 71 : x = 63$ or 64 threads
$= 64$'s reed 1's or 32's reed 2's.

4. *Threads in Warp :—*

$71 \times 44 = 3124$ threads.

5. *Width in Reed :—*

$3124 \div 64 = 50$ in.

6. *Lengths of Grey and Finished Cloths :—*

As $3\frac{1}{8} : 3 : : 70 : x = 67$ yds. (finished cloth).

The following Table indicates that the average grey length of these structures is 61 yds. which during finishing are pulled to an average length of 67 yds. Hence the picks per inch in grey and finished cloth will vary according to lengths.

7. *Picks per Inch of Warp and Grey Cloth :—*

There are 65 picks per inch in the finished cloth, consequently the number per inch of warp and grey cloth will be :—

As 61 yds. (grey cloth) : 67 yds. (finished cloth) : : 65 : x = 71 picks per inch (grey cloth).

As 70 yds. (warp) : 67 yds. (finished cloth) : : 65 : x = 62 picks per inch (warp).

Quantities of Material :—

1. *Weight of Warp in Grey Cloth :—*

$$\frac{3124 \times 70}{60 \times 840} = 4{\cdot}3 \text{ lb.}$$

2. *Weight of Weft in Grey Cloth :—*

$$\frac{62 \times 50 \times 70}{30 \times 560} = 13 \text{ lb.}$$

3. *Total Weight of Grey Cloth :—*

lb.	
4·3	warp
13	weft
17·3 lb.	

4. *Total Weight of Finished Cloth :—*

(3·8 oz. per yard)

$$\frac{3{\cdot}8 \times 67}{16} = 16 \text{ lb.}$$

Example 2.—(Fig. 69).—Style of cloth, figured mohair, 3·8 oz. per yard (finished cloth), 44 × 36 in.

	Counts.	Material.	Reed.	Lengths.			Total Weight.
				Warp.	Grey Cloth.	Finished Cloth.	Grey Cloth.
Warp	2/120's	Cotton	32/2's or 64/1's	70 yd.	(61 yd.)	67 yd.	17·3 lb.

	Counts.	Material.	Picks per Inch.	Widths.			Total Weight.
				Loom.	Grey Cloth.	Finished Cloth.	Finished Cloth.
Weft	1/30's	Mohair	62 warp 71 grey cloth	50 in.	(49 in.)	44 in.	16 lb.

Threads in Warp.—3124.
Weight of Warp.—4·3 lb.
Weight of Weft.—13 lb.
Lists.—20 double threads at each edge weaving plain.
Weave.—Jacquard.

Example 3.—Extra Warp Striped Cotton (Fig. 70).

Finished Cloth Particulars.—By employing Gaunt's standard weights, the counts of the warp and the weft are found to be :—

1. Various colours of warps = 2/60 cotton.
2. Weft = 2/60 cotton.
3. Ground threads per inch = $74\frac{1}{2}$.
4. Picks per inch = 52.

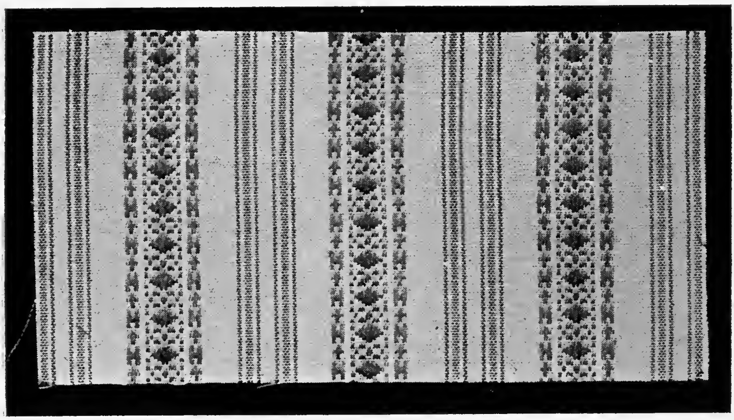

FIG. 70.—Extra Warp Striped Cotton.

Contractions from Loom to Finished Cloth :—

1. Ground warp = 3 in. measures $3\frac{3}{10}$ in.
2. Figure stripe warp = 3 ,, ,, $3\frac{2}{10}$,,
3. Weft = 3 ,, ,, $3\frac{3}{16}$,,

The cloth to be reproduced from 70 yds. of ground warp and the width of the finished cloth to be 44 in.

Loom Particulars :—

1. *Counts of Warp* :—

$$\left.\begin{array}{l} 3 : 3\tfrac{3}{10} :: 2/60 : \\ 100 : 95 \ \ :: \qquad : \end{array}\right. x = 2/60 \text{ cotton.}$$

The difference in the contraction of the ground and extra warp has no appreciable influence on the count.

2. *Counts of Weft*:—

$$\left.\begin{array}{l} 3 : 3\tfrac{3}{16} :: 2/60 : \\ 100 : 95 \;\; :: \quad\;\; : \end{array}\right. x = 2/60 \text{ cotton.}$$

3. *Threads per Inch in Reed.*—An examination of this cloth has revealed that the extra threads, which are double, are sleyed in the reed, one thread extra to each ground thread. As these styles involved some fairly complex calculations and as such are based on the reed employed, in the first place it must be determined what reed has been employed, also what number of threads have been placed through each.

The ground threads count $74\frac{1}{2}$ to the inch, therefore :—

$$\text{As } 3\tfrac{3}{16} : 3 :: 74\tfrac{1}{2} : x =$$

70 ground threads or 35/2's reed for ground weave.

4. *Threads in Warp, and Warp Dressers Particulars.*—The warp threads are arranged in the cloth as follows :—

20 threads		white	sleyed in	10	dents.
*2	,,	shade A	,,	1	,,
2	,,	white	,,	1	,,
4	,,	shade B	,,	2	,,
2	,,	white	,,	1	,,
2	,,	shade A	,,	1	,,
8	,,	white	,,	4	,,
2	,,	shade A	,,	1	,,
2	,,	white	,,	1	,,
4	,,	shade B	,,	2	,,
2	,,	white	,,	1	,,
⊙2	,,	shade A	,,	1	,,
20	,,	white	,,	10	,,
6 { 1 / 1	,, / ,,	(double) shade C / white	,,	3	,,
4	,,	white	,,	2	,,
20 { 1 / 1	,, / ,,	(double) shade D / white	,,	10	,,
4	,,	white	,,	2	,,
6 { 1 / 1	,, / ,,	(double) shade C / white	,,	3	,,
				56	dents per pattern.

The finished width of this cloth is 44 in., therefore as the finished cloth contains $74\frac{1}{2}$ ground threads per inch or $\frac{74\frac{1}{2}}{2}$ dents per inch the total number of dents to be occupied by warp threads will be :—

$$\frac{74\frac{1}{2}}{2} \times 44 = 1639 \text{ dents.}$$

1639 (dents) ÷ 56 (dents per pattern) =
29 repeats of pattern and 16 dents over.

An important point to decide at this stage is the exact beginning and finishing place in making the warp. In deciding this it must be borne in mind that such warp dresser's instructions be given as will result in there being in the woven fabric an equal amount of ground at both edges of the cloth.

There being 16 dents over a definite number of repeats of pattern, which must be taken into account, allows the following warp dresser's instructions :—

Twenty-nine repeats of pattern, starting at the mark * and finishing at the mark ⊙, such particulars will result in the woven cloth appearing as shown in Fig. 70*a*.

Having decided the warp dresser's particulars it is not a difficult matter to ascertain the number of threads of each colour to make the warp, i.e. :—

Colours of Yarn.	Threads per Pattern.	For 16 Dents over 29 Repeats.	Total number of Threads in Warp.
Shade A	8 × 29 repeats =	232 + 8 =	240
„ B	8 × „ „ =	232 + 8 =	240
„ C (double)	12 × „ „ =	348 + 0 =	(double) 348
„ D (double)	20 × „ „ =	580 + 0 =	„ 580
White	96 × „ „ =	2784 + 16 =	2800
Total	144	Total	4208

5. *Width in Reed.*—As there are 1639 dents in reed required to reproduce this structure and it is decided that the reed must contain 35 dents per inch, the width in reed of this warp will be :—

$$1639 \div 35 = 46{\cdot}8 \text{ in. width in reed.}$$

6. *Length of Grey and Finished Cloths.*—It has been noted that 3 in. of ground warp has contracted from $3\frac{3}{10}$ in., con-

sequently if 70 yds. of warp per cut be employed the length of finished cloth will be :—

As $3\frac{3}{10}$ in. : 3 in. : : 70 yds. : $x = 63\frac{2}{3}$ yds. finished cloth.

It has also been noted that 3 in. of figure or extra warp has contracted from $3\frac{2}{10}$ in., which indicates that during weaving this material has been let off less than the ground warp. These weaving conditions necessitate the employment of two warp beams, one for plain ground material and a second for figure material. As the ground warp is 70 yds. long for a definite length

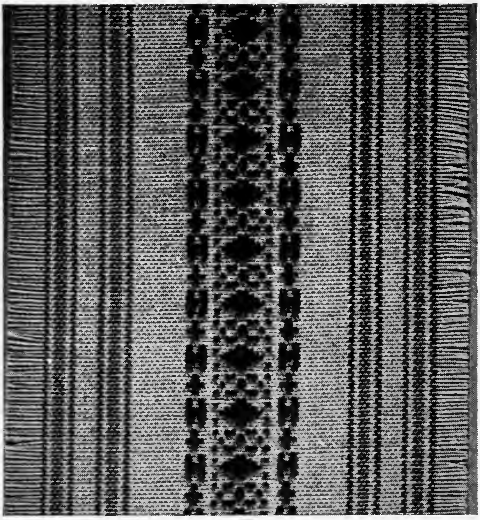

FIG. 70*a*.—Suitable Beginning and Finishing Places for Warp Dresser.

of cloth the question now arises as to the length required of figure warp.

As $3\frac{3}{10}$ in. : $3\frac{2}{10}$ in. : : 70 yd. : $x = 67{\cdot}8$ yds. of figure warp to 70 yds. of ground warp.

In this type of structure the grey length of cloth may be estimated at 63 yds., the finished cloth usually being slightly longer than the grey cloth.

7. *Picks per Inch.*—The picks per inch in the finished cloth are counted to be 52: the number to the inch of grey cloth and warp will be as follows:—

As 64 yds. : $64\frac{2}{3}$ yds. : : 52 : x = 52 picks per inch of grey cloth.
As 70 yds. : $64\frac{2}{3}$ yds. : : 52 : x = 48 picks per inch of warp.

Quantities of Material.—1. *Weight of Warp* :—

$$\frac{5136 \times 70}{30 \times 840} = 16 \text{ lb.}$$

2. *Weight of Weft* :—

$$\frac{48 \times 46{\cdot}8 \times 70}{30 \times 840} = 9{\cdot}36 \text{ lb.}$$

3. *Total Weight, Grey Cloth.* 25·36 lb.

4. *Finished Cloth Weight.*—The finished cloth weight may be considered 5 per cent less than the grey cloth weight, i.e. $24\frac{1}{4}$ lb. finished cloth.

Example 3 (Fig. 70).—Style of cloth, extra warp striped cotton.

	Counts.	Material.	Reed.	Lengths.			Total Weight.
				Warp.	Grey Cloth.	Finished Cloth.	Grey Cloth.
Warp	2/60	Cotton various colours	35/2's	Ground 70 yd. Figure 68 yd.	(63 yd.)	$63\frac{2}{3}$ yd.	25·36 lb.
	Counts.	Material.	Picks per inch.	Widths.			Total Weight.
				Loom.	Grey Cloth.	Finished Cloth.	Finished Cloth.
Weft	2/60	Cotton white	48 Warp 52 grey cloth	46·8 in.	45 in.	44 in.	$24\frac{1}{4}$ lb.

Order of Warp :—

Colour.														Threads per Pattern.		Threads in Warp.
White	20	2	2	8	2	2	20	1	5	1	5	1	=	96	=	2800
A	*2	—	2	2	—	$\odot$2	—	—	—	—	—	—	=	8	=	240
B	—	4	—	—	4	—	—	—	—	—	—	—	=	8	=	240
C	—	—	—	—	—	—	1	1	—	—	1	1	=	12	=	348 (double)
D	—	—	—	—	—	—	—	—	1	1	—	—	=	20	=	580 (,,)
								5		19		5		144		4208

29 repeats of pattern.
start * and finish $\odot$.

Weight of Warp = 16 lb.
Weight of Weft = 9·36 lb.
Lists.—As warp.
Design, Draft and Sleying Plan.—See Fig. 70*b*.
Pegging Plan.—See Fig. 70*c*.

Example 4.—Striped Moirette (Fig. 71)

Finished Cloth Particulars.—By employing Gaunt's standard weights the counts of the warps and the weft are found to be :—

1. Ground warp = 2/44 black mercerized cotton.
2. Stripe ,, = 40/2 white spun silk.
3. Weft ,, = 1/20 polished black cotton.
4. Ground threads per inch = 81.
5. Picks per inch = 68.

Contractions from Loom to Finished Cloth :—

1. Ground warp = 3 in. measures $3\frac{5}{8}$ in.
2. Stripe ,, = 3 ,, ,, $3\frac{1}{8}$,,
3. Weft ,, = 3 ,, ,, $3\frac{1}{16}$,,

The cloth to be reproduced from 70 yds. of ground warp and the width of the finished cloth to be 30 in.

Loom Particulars.—1. *Count of Ground Warp :—*

$$\left.\begin{array}{r} 3 : 3\frac{5}{8} :: \\ 100 : 95 :: \end{array}\right. 2/44 : x = 2/50 \text{ cotton.}$$

2. *Count of Stripe Warp :—*

$$\left.\begin{array}{r} 3 : 3\frac{1}{8} :: \\ 100 : 95 :: \end{array}\right. 40/2 : x = 40/2 \text{ silk.}$$

3. *Count of Weft :—*

$$\left.\begin{array}{r} 3 : 3\frac{1}{16} :: \\ 100 : 95 :: \end{array}\right. 1/20 : x = 1/20 \text{ cotton.}$$

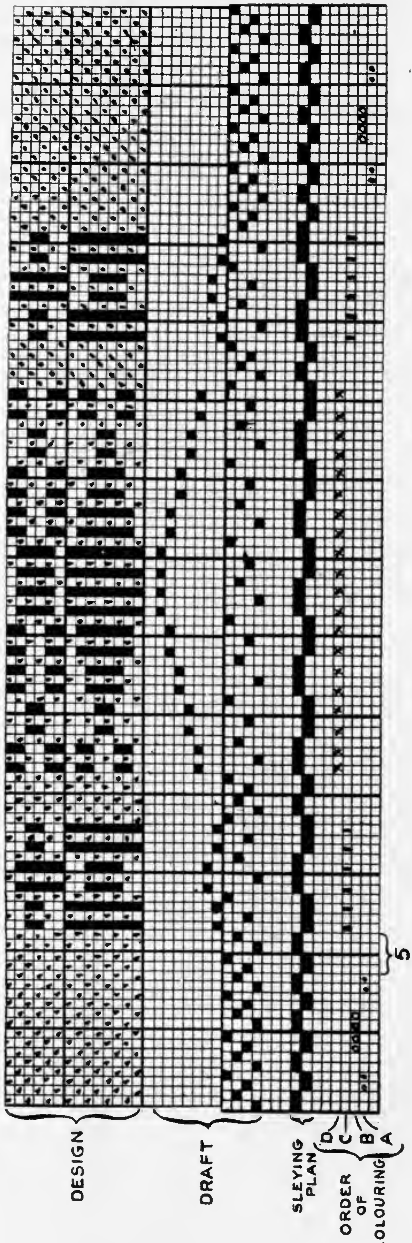

FIG. 70b.—Design, draft, sleying plan, and order of warping.

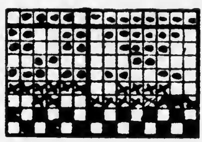

FIG. 70c.—Pegging Plan.

4. *Threads per Inch in Reed.*—The white silk threads are weaving two as one and are sleyed one double thread extra to

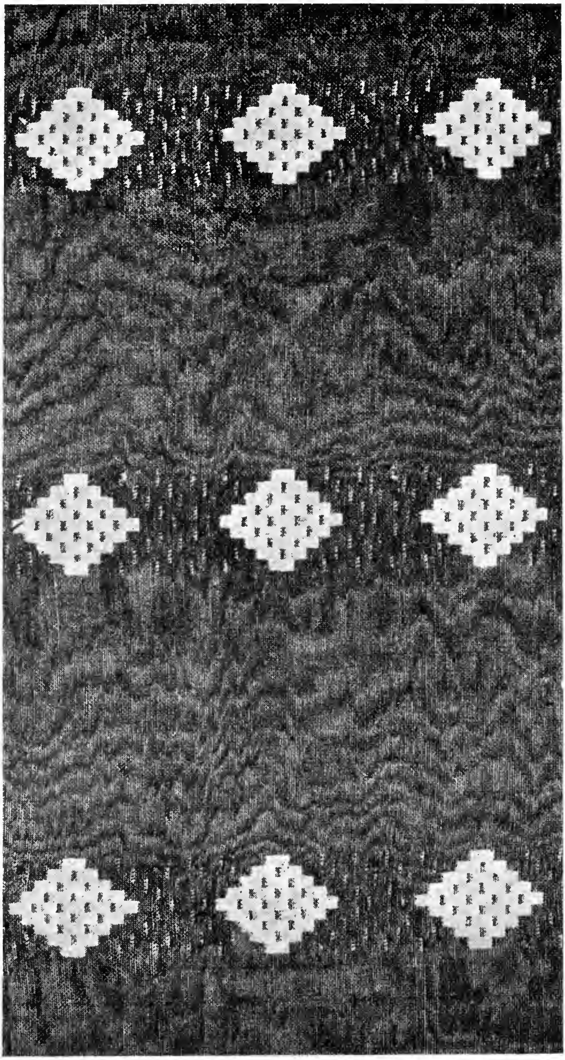

Fig. 71.—Striped Moirette.

each ground thread. The ground threads count 82 per inch, therefore :—

As $3\frac{1}{16}$ in. : 3 in. : : 81 : $x = 80$ ground threads or 40/2's reed for ground weave.

5. *Threads in Warp.*—The warp threads are arranged in the cloth as follows:—

$$54 \begin{cases} 1 \text{ double thread white silk} \\ 1 \text{ thread mercerized black cotton} \end{cases} \text{in 27 dents.}$$

158 ,, ,, ,, ,,	,, 79	,,
Dents per pattern	106	

The finished width of the cloth is 30 in., therefore as it contains 81 threads or $40\frac{1}{2}$ dents per inch, the total number of dents to be occupied by warp threads will be: $40\frac{1}{2} \times 30 = 1215$ dents.

1215 (dents) ÷ 106 (dents per pattern) = 11 repeats of pattern and 49 dents over.

There being 49 dents over a definite number of repeats of pattern, which must be taken into account, will cause the warp dresser's instructions to be: 11 repeats of pattern, starting and finishing with 128 threads of black mercerized cotton.

The number of threads required to make the warp will be:—

	Threads per Pattern.		For 49 Dents over.	Total Number of Threads.
Silk	54 × 11 repeats =	594 +	0 = (double)	594
Cotton	212 × ,, ,, =	2332 +	98 =	2430
Total	266		Total	3024

6. *Width in Reed.*—As there are 1215 dents in the reed required to reproduce this cloth, and it is decided that the reed must contain 40 dents per inch, the space occupied by the warp will be:—

$$1215 \div 40 = 30\tfrac{1}{2} \text{ in. width in reed.}$$

7. *Length of Grey and Finished Cloths.*—It has been ascertained that 3 in. of ground warp has contracted from $3\frac{5}{8}$ in., therefore if 70 yds. of warp per cut be employed, the length of the finished cloth will be:—

As $3\frac{5}{8}$ in. : 3 in. : : 70 yds. : $x = 58$ yds. finished cloth.

The extra silk warp has contracted from $3\frac{1}{8}$ in. to 3 in., the length of silk warp will be much less than the ground warp.

As $3\frac{5}{8}$ in. : $3\frac{1}{8}$ in. : : 70 yds. : $x = 60\frac{1}{2}$ yds. of silk warp to 70 yds. of cotton warp.

During the finishing of these goods the length is pressed out to the extent of about half a yard in sixty, consequently the grey length of cloth can be estimated at $57\frac{1}{2}$ yds.

8. *Picks per Inch.*—The picks in the finished cloth are counted to be 68 per inch, the number to the inch of grey cloth and warp will be :—

$$\text{As } 57\tfrac{1}{2} : 58 :: 68 : x = 68 \text{ picks per inch in grey cloth.}$$
$$\text{As } 70 : 58 :: 68 : x = 56 \text{ picks per inch of warp.}$$

Quantities of Material.—1. *Weight of Warps* :—

$$\text{Silk } \frac{594 \times 2 \times 60}{40 \times 840} = 2{\cdot}1 \text{ lb.}$$

$$\text{Cotton } \frac{2430 \times 70}{25 \times 840} = 8{\cdot}07 \text{ ,,}$$

2. *Weight of Weft* $\frac{56 \times 30{\cdot}25 \times 70}{20 \times 840} = 7$,,

3. *Total Weight, Grey Cloth.* 17·17 lb.

4. *Finished Cloth Weight.*—The finished cloth weight can be considered 5 per cent less than grey cloth weight, i.e. $16\frac{1}{4}$ lb. finished cloth.

Example 4.—(Fig. 71).—Style of cloth, striped moirette.

	Counts.	Material.	Reed.	Lengths.			Total Weight.
				Warp.	Grey Cloth.	Finished Cloth.	Grey Cloth.
Warp	2/50's	Black mercerized cotton.	40/2's	70 yd.	$57\frac{1}{2}$ yd.	58 yd.	17·17 lb.
	40/2	White spun silk		60 yd.			

	Counts.	Material.	Picks per Inch.	Widths.			Total Weight.
				Loom.	Grey Cloth.	Finished Cloth.	Finished Cloth.
Weft	1/20	Black polished cotton	56 warp 68 {grey cloth	$30\frac{1}{2}$ in.	30 in.	30 in.	$16\frac{1}{4}$ lb.

Order of Warp :—

		Thread.
54	{ 1 double thread, silk = (double) 1 thread black cotton = }	594
*158	,, ,, ,,	2430
11 repeats of pattern		Total 3024

* Start and finish 128 threads black cotton on two warp beams.

Weight of Warps :—

Silk = 2·1 lb.
Black cotton = 8·07 ,,
10·17 lb.

Weight of Weft.—7 lb.

Lists.—As warp.

Draft and Sleying Plan.—According to warping plan: ground threads on 4 shafts (hopshaft draft) sleyed 2 in a dent and silk threads on 5 shafts (according to pattern) and sleyed extra, Fig. 71*a*.

Pegging Plan.—Fig 71*b*.

Example 5.—Cotton and Artificial Silk Dress Fabric (Fig. 72).

Finished Cloth Particulars.—By employing Gaunt's standard weights the count of the warp and wefts are found to be:—

1. Warp = 2/80's black cotton.
2. Cotton weft = 2/80's black cotton.
3. Artificial silk weft = 1/30's (cotton count).
4. Threads per inch = 51.
5. Picks per inch = 47.

Contraction from Loom to Finished Cloth :—

1. Warp = 3 in. measures $3\frac{1}{8}$ in.
2. Weft = 3 in. measures $3\frac{1}{4}$ in.

The cloth to be reproduced from 70 yds. of warp and the width of finished cloth to be 44 in.

Loom Particulars.—1. *Counts of Warp and Weft.*—The contraction of yarns are so slight also the loss in weight during the finishing of this type of fabric that the finished count of warp and wefts may be taken to be the same in the loom.

Warp = 2/80's cotton.

Wefts = 2/80 cotton and 1/30 (cotton counts) artificial silk.

2. *Threads per Inch in Reed* :—

As $3\frac{1}{4}$ in. : 3 in. : : 51 : x = 47 threads or 47 reed 1's.

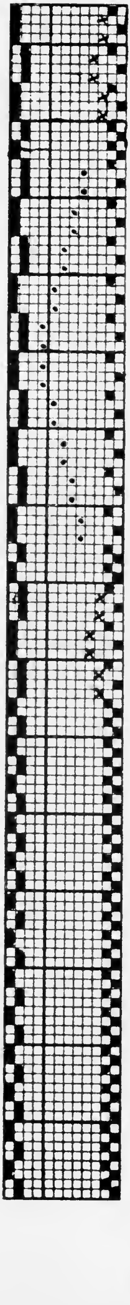

Fig. 71*a*.

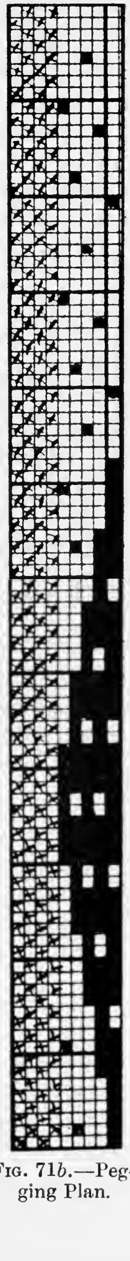

Fig. 71*b*.—Pegging Plan.

3. *Threads in Warp* :—

$$51 \times 44 = 2244 \text{ threads.}$$

4. *Width in Reed* :—

$$2244 \div 47 = 48 \text{ in.}$$

5. *Lengths of Grey and Finished Cloths* :—

As $3\frac{1}{8}$ in. : 3 in. : : 70 yds. : $x = 67$ yds. (finished cloth).

Taking into consideration the weave, difference in material of warp and weft, and the present contraction shown on warp

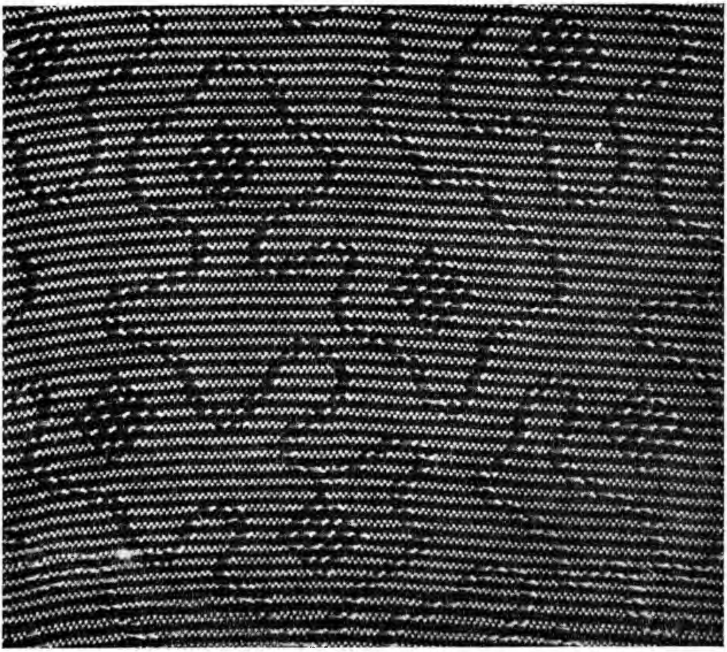

Fig. 72.—Figured Cotton and Artificial Silk Dress Cloth.

and weft, it is evident that this fabric, during the finishing processes, has been drawn out in length.

A reasonable estimate of grey cloth length is 65 yds.

6. *Picks per Inch of Warp and Grey Cloth*.—Picks per inch in finished cloth 67 yds. long = 47. What are the number of picks where the cloth is 65 yds. (grey cloth) and 70 yds. (warp length)?

70 : 67 : : 47 : $x = 45$ picks per inch of warp.

65 : 67 : : 47 : $x = 48$ picks per inch of grey cloth.

Quantities of Material.—1. *Weight of Warp in Grey Cloth.*—

$$\frac{2244 \times 70}{40 \times 840} = 4{\cdot}67 \text{ lb.}$$

2. *Weight of Weft in Grey Cloth* :—

$$\frac{45 \times 48 \times 70 \times 2}{40 \times 840 \times 4} = 2\tfrac{1}{4} \text{ lb. cotton.}$$

$$\frac{45 \times 48 \times 70 \times 2}{30 \times 840 \times 4} = 3 \text{ lb. art. silk.}$$

3. *Total Weight of Grey Cloth* :—

4·67 lb. warp.
2·25 ,, cotton weft.
3 ,, art. silk weft.
9·92 lb.

4. *Total Weight of Finished Cloth* :—

($2\frac{1}{4}$ oz. per yard.)
$2\frac{1}{4} \times 67 = 9{\cdot}42$ lb.

Example 5.—(Fig. 72). Style of cloth, cotton and artificial silk, $2\frac{1}{4}$ oz. per yard (finished cloth), 44 in. × 36 in.

	Counts.	Material.	Reed.	Lengths.			Total Weight.
				Warp.	Grey Cloth.	Finished Cloth.	Grey Cloth.
Warp	2/80	Black cotton	47/1's	70 yd.	(65 yd.)	67 yd.	9·92 lb.

	Counts.	Material.	Picks per Inch.	Widths.			Total Weight.
				Loom.	Grey Cloth.	Finished Cloth.	Finished Cloth.
Weft	2/80 1/30 cotton	Black cotton. Art. silk	45 warp 48 grey cloth	48 in.	(47 in.)	44 in.	9·42 lb.

Threads in Warp.—2244.
Picking.—2 picks black cotton.
2 ,, art. silk.

Weight of Warp.—4·67 lb.

Weight of Weft :—

Black cotton = $2\frac{1}{4}$ lb.
Art. silk = 3 ,,

Lists.—20 threads 2/40 white cotton at each edge weaving plain.

Weave.—Jacquard.

Example 6.—Corduroy Woollen (Fig. 73).

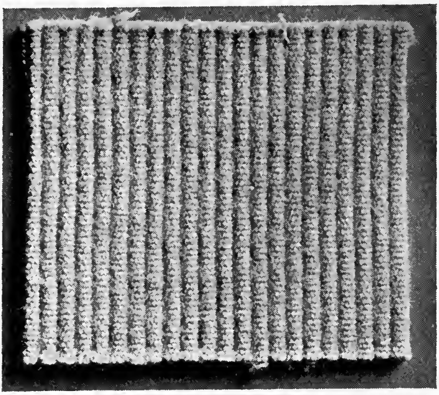

Fig. 73.—Corduroy Woollen.

Finished Cloth Particulars.—By employing Gaunt's standard weights, the ounces per yard, counts of warps and weft, are found to be :—

1. 32·8 oz. per yard (56 in. × 36 in.).
2. Cotton warp = 2/28. Woollen warp = 23 skeins.
3. Woollen weft = 16 skeins.
4. Threads per inch = 92.
5. Picks per inch = 88.

Contractions from Loom to Finished Cloth :—

1. Cotton warp = 3 in. measures $3\frac{3}{4}$ in.
2. Woollen warp = 3 in. ,, $3\frac{3}{4}$,,
3. Woollen weft = 3 in. ,, $4\frac{1}{4}$,,

The cloth to be reproduced from 70 yds. of warp and the width of the finished cloth to be 56 in.

Loom Particulars.—1. *Count of Cotton Warp* :—

$$\left.\begin{array}{l} 3 : 3\frac{3}{4} :: \\ 100 : 95 :: \end{array}\right. 2/28 : x = 2/34 \text{ cotton.}$$

2. *Count of Woollen Warp.*—15 per cent loss in weight.

$$\begin{matrix} 3 : 3\frac{3}{4} :: \\ 100 : 85 :: \end{matrix} \; 23 : x = 24 \text{ skeins woollen.}$$

3. *Count of Woollen Weft* :—

$$\begin{matrix} 3 : 4\frac{1}{4} :: \\ 100 : 85 :: \end{matrix} \; 16 \text{ skeins} : x = 20 \text{ skeins woollen.}$$

4. *Threads per Inch in Reed* :—

$4\frac{1}{4}$ in. : 3 in. : : 92 : $x = 65$ threads.

5. *Threads in Warp* :—

$92 \times 56 = 5160$ threads.

Arranged :—2 threads cotton = 1032 threads
8 ,, woollen = 4128 ,,

516 repeats 5160 threads

6. *Width in Reed* :—

Threads in warp $5160 \div 65$ threads per inch $= 79\frac{1}{2}$ in.

7. *Length of Grey and Finished Cloths* :—

As $3\frac{3}{4}$ in. : 3 in. : : 70 yd. : $x = 56$ yd. finished cloth.

The length of grey cloth may be estimated at 58 yd.

8. *Picks per Inch.*—There are 88 picks per inch in the finished cloth. What will be the number per inch of warp and grey cloth?

70 yd. warp = picks per inch.
58 ,, grey cloth = ,, ,,
56 ,, finished cloth = 88 ,, ,,

As 70 : 56 : : 88 : $x = 70$ picks per inch of warp.

As 58 : 56 : : 88 : $x = 85$ picks per inch of grey cloth.

Quantities of Material.—1. *Weight of Warps* :—

$$\text{Cotton } \frac{1032 \times 70}{17 \times 840} = 5 \text{ lb.}$$

$$\text{Woollen } \frac{4128 \times 70}{24 \times 256} = 47 \text{ ,,}$$

2. *Weft* :—

$$\frac{70 \times 70 \times 79{\cdot}5}{20 \times 256} = 76 \text{ ,,}$$

3. *Total Weight* (*Grey Cloth*). 128 lb.

4. *Finished Cloth Weight* :—

32·8 oz. per yard $\times$ 56 yd. = 108 lb.

Example 6. (Fig. 73).—Style of cloth, corduroy woollen, 32·8 oz. per yard (finished cloth), 56 in. × 36 in.

	Counts.	Material.	Reed.	Lengths.			Total Weight.
				Warp.	Grey Cloth.	Finished Cloth.	Grey Cloth.
Warp	2/34's 24 skeins	Cotton Woollen	65 threads per inch	70 yd.	(58 yd.)	56 yd.	128 lb.
	Counts.	Material.	Picks per Inch.	Widths.			Total Weight.
				Loom.	Grey Cloth.	Finished Cloth.	Finished Cloth.
Weft	20 skeins	Woollen	70 warp 85 grey cloth	79½ in.	68 in.	56 in.	108 lb.

Order of Warping :—

2 threads cotton = 1032 threads
8 ,, woollen = 4128 ,,

516 repeats on one warp beam 5160 threads

Weight of Warp :—

Cotton = 5 lb.
Woollen = 47 ,,

52 lb.

Weight of Weft = 76 lb.

Lists.—As warp.

Weave.—(Fig. 73*a*.) The cotton threads are indicated in crosses.

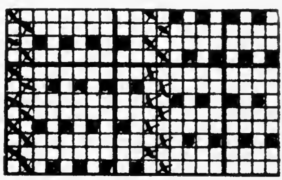

Fig. 73*a*.

Example 7.—Double Cloth Woollen (Fig. 74*a*, face cloth ; Fig. 47*b*, back cloth).

Finished Cloth Particulars :—

1. Weight per yard = 32 oz. (56 × 36 in.).
2. Woollen warp = 10½ skeins (woollen).

3. Bending cotton warp $= 2/60$ (cotton).
4. Woollen weft $= 9\frac{1}{2}$ skeins (woollen).
5. Threads per inch of woollen $= 47$.
6. Picks per inch $= 40$.

Contraction from Loom to Finished Cloth :—

1. Cotton and woollen warp $= 3$ in. measures $3\frac{5}{16}$ in.
2. Woollen weft $= 3$ in. measures $3\frac{1}{2}$ in.

The cloth to be reproduced from 70 yds. of warp, and the width of the finished cloth to be 56 in.

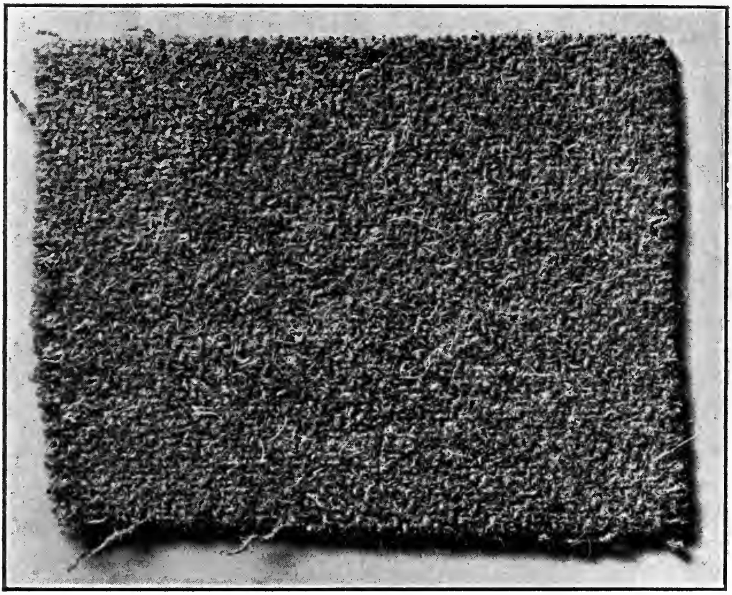

Fig. 74*a*.—Woollen Double Cloth (face).

Loom Particulars.—1. *Count of Warp* (woollen) (25 per cent loss in weight) :—

$$\left.\begin{array}{r} 3 : 3\frac{5}{16} :: \\ 100 : 75 \;\; :: \end{array}\right\} 10\frac{1}{2} \text{ skeins} : x = 8 \text{ skeins.}$$

2. *Count of Binding Warp* (cotton) :—

As finished counts 2/60 cotton.

3. *Count of Weft*.—(25 per cent loss in weight) :—

$$\left.\begin{array}{r} 3 : 3\frac{1}{2} :: \\ 100 : 75 :: \end{array}\right\} 9\frac{1}{2} \text{ skeins} : x = 8 \text{ skeins (woollen).}$$

4. *Threads in Warp* :—

$47 \times 56 = 2640$ woollen threads.

The warp is arranged :—

1 cotton thread for binding (extra).
4 woollen threads.
$2640 \div 4 = 660$ cotton threads (extra).

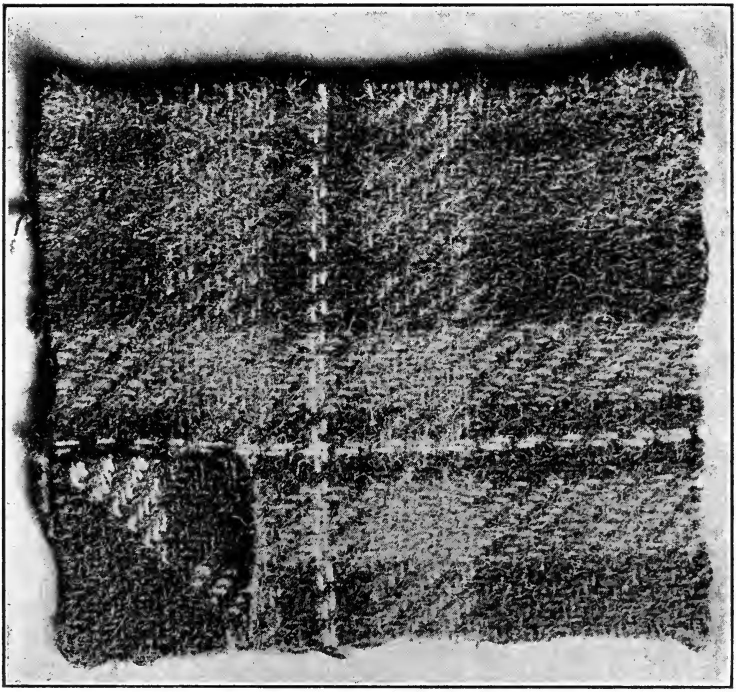

FIG. 74*b*.—Woollen Double Cloth (back).

5. *Threads per Inch in Reed* :—

$3\frac{1}{2}$ in. : 3 in. : : 47 : $x = 40$ woollen threads per inch.

6. *Width in Reed* :—

$2640 \div 40 = 66$ in.

7. *Length of Grey and Finished Cloths* :—

$3\frac{5}{16}$: 3 : : 70 : $x = 63\frac{1}{2}$ yds. (finished cloth).

The grey cloth length may be estimated at 65 yds.

8. *Picks per Inch.*—There are 40 picks per inch in the finished cloth. The picks per inch of warp will be :—

As $70 : 63\frac{1}{2} :: 40 : x = 36$ picks per inch of warp.

The picks per inch in grey cloth :—

As $65 : 63\frac{1}{2} :: 40 : x = 39$ picks per inch in grey cloth.

Quantities of Material.—1. *Weight of Warp* (woollen) :—

$$\frac{2640 \times 70}{8 \times 256} = 90 \text{ lb.}$$

2. *Weight of Extra Warp* (cotton) :—

$$\frac{660 \times 70}{30 \times 840} = 1\tfrac{5}{6} \text{ lb.}$$

3. *Weight of Weft* :—

$$\frac{36 \times 66 \times 70}{8 \times 256} = 81 \text{ lb.}$$

4. *Weight of Grey Cloth* $= 172\frac{5}{6}$ lb.

5. *Weight of Finished Cloth* :—

32 oz. (56 in. × 36 in.) × $63\frac{1}{2}$ yds. = 128 lb.

Example 7 (Fig. 74).—Style of cloth, double cloth woollen, 32 oz. per yard (finished cloth), 56 in. × 36 in.

	Counts.	Material.	Reed.	Lengths.			Total Weight.
				Warp.	Grey Cloth.	Finished Cloth.	Grey Cloth.
Warp	8 skeins 2/60	Woollen coloured cotton	10/4's	70 yd.	(65 yd.)	$63\frac{1}{2}$ yd.	$172\frac{5}{6}$ lb.

	Counts.	Material.	Picks per Inch.	Widths.			Total Weight.
				Loom.	Grey Cloth.	Finished Cloth.	Finished Cloth.
Weft	8 skeins	Woollen coloured	36 warp 39 {grey cloth	66 in.	(62 in.)	56 in.	128 lb.

Order of Warping :—

$2 \begin{cases} 1 \text{ thread woollen face cloth} = 1320 \text{ threads on 1 beam.} \\ 1 \quad ,, \quad\quad ,, \quad \text{back} \;\; ,, \; = 1320 \quad ,, \quad ,, \quad ,, \end{cases}$

1 ,, cotton for binding = 660 ,, ,, ,,

660 repeats.

Weight of Warp:—Woollen = 90 lb.
Cotton = $1\frac{5}{6}$ lb.
Weight of Weft = 81 lb.
Lists.—As warp.
Weave and Draft.—Fig. 74*c*.

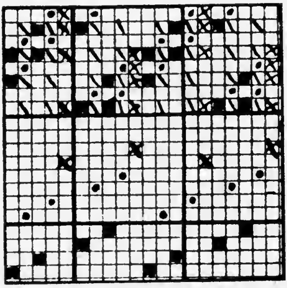

Fig. 74*c*.—Design and Draft.

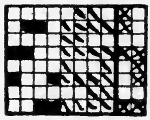

Fig. 74*d*.—Pegging Plan.

Pegging Plan.—Fig. 74*d*.

Example 8.—Weft Cut Pile Corduroy Woollen (Fig. 75).

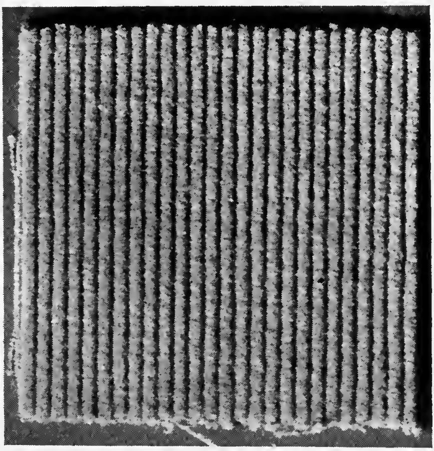

Fig. 75.—Weft Cut Pile Corduroy Woollen.

Finished Cloth Particulars :—

1. Weight per yard = 16·4 oz. (13in. × 36 in.).
2. Warp = 2/16 cotton.
3. Weft = 32 skeins woollen.

4. Threads per inch = 66.
5. Picks per inch = 210.

Contraction from Loom to Finished Cloth :—

1. Warp = 3 in. measures $3\frac{1}{4}$ in.
2. Weft = 3 in. ,, $3\frac{13}{16}$ in.

The cloth to be reproduced from 70 yds of warp, and the width of the finished cloth to be 30 in.

Loom Particulars.—1. *Count of Warp* :—

$$\left.\begin{array}{r} 3 : 3\frac{1}{4} :: \\ 100 : 95 :: \end{array}\right. 2/16 : x = 2/16 \text{ cotton.}$$

2. *Count of Weft* (15 per cent loss in weight) :—

$$\left.\begin{array}{r} 3 : 3\frac{13}{16} :: \\ 100 : 85 \;\; :: \end{array}\right. 32 \text{ skeins} : x = 34 \text{ skeins woollen.}$$

3. *Threads per Inch in Reed* :—

$$3\tfrac{13}{16} \text{ in.} : 3 \text{ in} :: 66 : x = 52 \text{ threads.}$$

4. *Threads in Warp* ; -

$$66 \times 30 = 1980 \text{ threads.}$$

5. *Width in Reed* :—

$$1980 \text{ threads} \div 52 = 38 \text{ in.}$$

6. *Length of Grey and Finished Cloths* :—

$$3\tfrac{1}{4} : 3 :: 70 \text{ yds.} : x = 64\tfrac{1}{2} \text{ yds. (finished cloth).}$$

In this type of structure the grey cloth length may be estimated as finished cloth length say 65 yds.

7. *Picks per Inch.*—There are 210 picks per inch in the finished cloth. What will be the number per inch of warp and grey cloth?

70 yds. warp = per inch.
65 ,, grey cloth = per inch.
$64\frac{1}{2}$,, finished cloth = 210 per inch.

As $70 : 64\frac{1}{2} :: 210 : x = 194$ per inch of warp.
As $65 : 64\frac{1}{2} :: 210 : x = 208$ per inch of grey cloth.

Quantities of Material :—

1. *Weight of Warp* :—

$$\frac{1980 \times 70}{8 \times 840} = 20\tfrac{5}{8} \text{ lb.}$$

2. *Weight of Weft* :—

$$\frac{194 \times 38 \times 70}{34 \times 256} = 59\tfrac{1}{4} \text{ ,,}$$

3. *Total Weight of Grey Cloth.* $79\frac{7}{8}$ lb.

4. *Finished Cloth Weight* :—

16·4 oz. (30 in. × 36 in.) × 64½ yds. = 66 lb.

Example 8 (Fig. 75).—Style of cloth, weft cut pile, corduroy woollen, 16·4 oz. per yard (finished cloth) 30 in. × 36 in.

	Counts.	Material.	Reed.	Lengths.			Total Weight.
				Warp.	Grey Cloth.	Finished Cloth.	Grey Cloth.
Warp	2/16's	Cotton	52 threads per inch	70 yd.	(65 yd.)	64½ yd.	79⅞ lb.

	Counts.	Material.	Picks per Inch.	Widths.			Total Weight.
				Loom.	Grey Cloth.	Finished Cloth.	Finished Cloth.
Weft	34 skeins	Woollen	194 Warp 208 {grey cloth	38 in.	(32 in.)	30 in.	66 lb.

Threads in Warp.—1890 threads.

Weight of Warp.—20⅝ lb.

Weight of Weft.—59¼ lb.

Lists.—As warp.

Weave.—Fig. 75*a*.

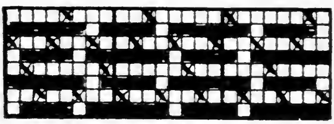

Fig. 75*a*.—Design.

Example 9.—Colour and Weave Worsted Costume Cloth (Fig. 76).

Finished Cloth Particulars :—

1. Weight per yard = 8·04 oz. (56 in. × 36 in.).
2. Warp = 2/50 worsted.
3. Weft = 2/49 ,,
4. Threads per inch = 62.
5. Picks per inch = 61.

Contraction from Loom to Finished Cloth :—

Warp.—3 in. measures $3\frac{1}{4}$ in.

Weft.—3 in. ,, $3\frac{5}{16}$ in.

The cloth to be reproduced from 70 yds. of warp per cut, and the width of the finished cloth to be 56 in.

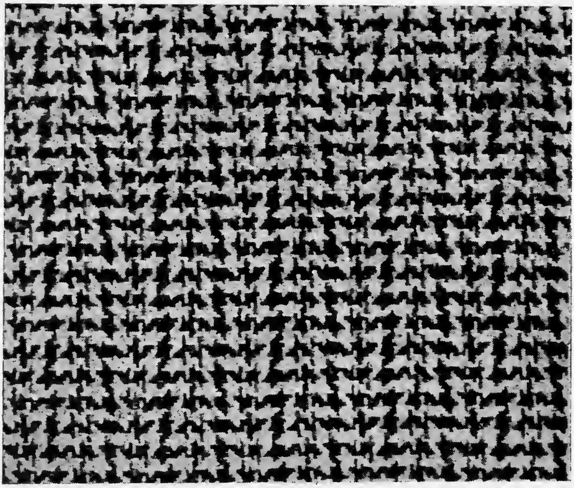

Fig. 76.—Colour and Weave Worsted Cloth.

Loom Particulars.—1. *Count of Warp* :—

$$\begin{matrix} 3 : 3\frac{1}{4} : : \\ 100 : 95 : : \end{matrix} 2/50 : x = 2/50 \text{ worsted.}$$

2. *Count of Weft* :—

$$\begin{matrix} 3 : 3\frac{5}{16} : : \\ 100 : 94\ : : \end{matrix} 2/49 : x = 2/50 \text{ worsted.}$$

3. *Threads per Inch in Reed* :—

$$3\frac{5}{16} \text{ in.} : 3 \text{ in.} : : 62 : x = 56 \text{ threads.}$$

4. *Threads in Warp* :—

$$62 \times 56 = 3472 + 2 = 3474 \text{ threads.}$$

5. *Width in Reed* :—

$$3474 \div 56 = 62 \text{ in.}$$

6. *Length of Grey and Finished Cloths* :—

$$3\frac{1}{4} \text{ in.} : 3 \text{ in.} : : 70 \text{ yds.} : x = 64\frac{1}{2} \text{ yds. (finished cloth).}$$

In this structure it may be estimated that the grey length of cloth is $65\frac{1}{2}$ yds.

7. *Picks per Inch* :—

70 yds. warp = picks per inch.
$65\frac{1}{2}$,, grey cloth = picks per inch.
$65\frac{1}{2}$,, finished cloth = 61 picks per inch.
$70 : 64\frac{1}{2} :: 61 : x = 56$ picks per inch of warp.
$65\frac{1}{2} : 64\frac{1}{2} :: 61 : x = 60$,, ,, ,, of grey cloth.

Quantities of Material :—

1. *Warp* :—

$$\frac{3474 \times 70}{25 \times 560} = 17{\cdot}25 \text{ lb.}$$

2. *Weft* :—

$$\frac{56 \times 62 \times 70}{25 \times 560} = 17{\cdot}25 \text{ ,,}$$

3. *Total Weight of Grey Cloth.* 34·5 lb.
4. *Finished Cloth Weight* :—

$$8{\cdot}04 \text{ oz.} \times 64\tfrac{1}{2} \text{ yds.} = 32{\cdot}4 \text{ lb.}$$

Example 9 (Fig. 76).—Style of cloth, worsted costume cloth 8·04 oz. per yard (finished cloth) 56 × 36 in.

	Counts.	Material.	Reed.	Lengths.			Total Weight.
				Warp.	Grey Cloth.	Finished Cloth.	Grey Cloth.
Warp	2/50's	Botany worsted. 56's quality	14/4's	70 yd.	($65\frac{1}{2}$ yd.)	$64\frac{1}{2}$ yd.	$34\frac{1}{2}$ lb.

	Counts.	Material.	Picks per Inch.	Widths.			Total Weight.
				Loom.	Grey Cloth.	Finished Cloth.	Finished Cloth.
Weft	2/50's	Botany worsted. 56's quality	56 Warp 60 grey cloth	62 in.	(60 in.)	56 in.	32·4 lb.

Order of Warping :—

Black	1	2	1	4	= 1544 black threads.
White	1	1	4	4	= 1930 white ,,
	193 repeats				3474

Order of Picking :—

4 picks black.
4 ,, white.

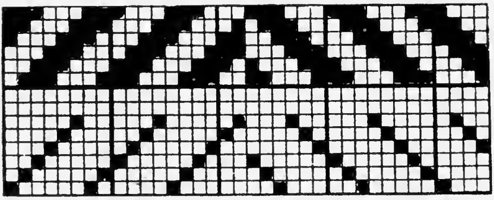

FIG. 76*a*.—Design and Draft.

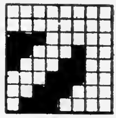

FIG. 76*b*.—Pegging Plan.

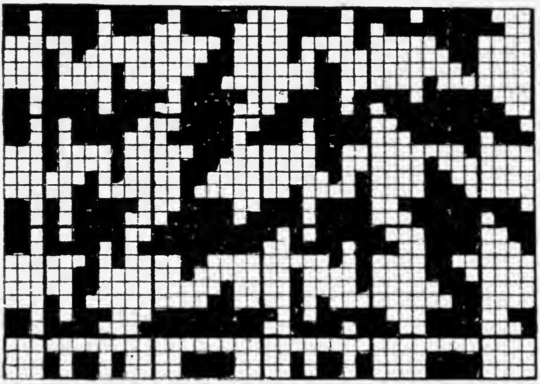

FIG. 76*c*.—Colour and Weave Effect.

Weight of Warp = 17·25 lb.
Weight of Weft = 17·25 lb.
Lists.—As warp.
Weave and Draft.—Fig. 76*a*.
Pegging Plan.—Fig. 76*b*.
Colour and Weave Effect.—Fig. 76*c*.

CHAPTER XII.

QUICK METHODS OF ANALYSIS, STANDARD WEIGHTS AND GAUGES.

Previous chapters have indicated that, to obtain the weight per yard, and counts of warp and weft, a certain amount of calculation is involved. This to some extent may be obviated by employing standard weights.

Standard Weights.—By means of these weights—without resort to calculation—the following results may be obtained:—

(*a*) The weight per yard in ounces (54×36 in.) and the corresponding grammes per square metre.

(*b*) The count in woollen (Y. Sk.) of warp or weft threads.

" " " worsted " " " " "

" " " cotton or spun silk " " " " "

To obtain these results the pattern must be cut, either of two sizes. No. 1 cutter gives a pattern 3×3 in. or 9 sq. in. No. 2 cutter gives a cross-shaped pattern (Fig. 63) the area of which is 2 sq. in.

Ounces per Yard (54 *in. wide*) *and Grammes per Square Metre.*—As the patterns may be cut into two sizes, there are, in consequence, two sets of weights to obtain this result. However, in both cases the method is simple and the same. In each case there are a number of aluminium weights, which range, in the ratio of from $\frac{1}{8}$th of an oz. to 20 oz. and stamped on each is the equivalent in grammes per square metre.

The method of procedure is to place the pattern cut in one pan of the scales, and the weights required to balance the pattern at once indicate the result.

To Obtain the Count of Yarn.—There are three aluminium weights marked, woollen, worsted, and cotton respectively (Fig. 77), and the number of threads 3 in. long which balance either of these weights, indicates the count of yarn in that particular denomination.

Example 1.—24 threads from a worsted pattern cut 3×3 in. balance the weight marked worsted, the counts of the yarn will be 24's or $24 \times 560 = 1$ lb. of yarn.

Example 2.—20 threads from a woollen cloth, each 3 in. long, balance the woollen weight: thus the counts will be 20 Yorkshire skeins woollen or $20 \times 256 = 1$ lb. of yarn.

Example 3.—40 threads 3 in. long are equal to the cotton weight. The hanks per lb. of counts will be 40's or $40 \times 840 =$ yards per lb.

When No. 2 cutter is employed it will be found that the threads of warp and weft across the centre are $1\frac{1}{2}$ in. in length. Hence 40 threads $1\frac{1}{2}$ in. long will be equal to 20 threads 3 in. long.

Note that:—

(1) Patterns tested in a grey condition. Grey weight and counts are given.

(2) Patterns tested in a finished condition. Finished weight and counts are given.

Basis of Calculation for Standard Weights.—*Weight per Yard.*—In 1 yd. of cloth there are 36×54 in. $= 1944$ sq. in.; therefore the pattern cut 3×3 in. or 9 sq. in. will be $\frac{9}{1944} = \frac{1}{216}$ part of the weight per yard; and where No. 2 cutter is employed, giving 2 sq. in. of cloth, the pattern cut will be $\frac{2}{1944} = \frac{1}{972}$ part of the weight per yard. Thus as there are 7000 grains per lb. the weight in grains of the standard weights will be as follows:—

No. 1 cutter (3×3 in. or 9 sq. in.).

$\frac{1}{216}$ part	of	20	oz.	= 40·5	grains	or	20	oz.	aluminium	weight.
,,	,,	10	,,	= 20·25	,,	,,	10	,,	,,	,,
,,	,,	5	,,	= 10·125	,,	,,	5	,,	,,	,,
,,	,,	4	,,	= 8·1	,,	,,	4	,,	,,	,,
,,	,,	2	,,	= 4·05	,,	,,	2	,,	,,	,,
,,	,,	1	,,	= 2·025	,,	,,	1	,,	,,	,,
,,	,,	$\frac{1}{2}$	,,	= 1·017	,,	,,	$\frac{1}{2}$	,,	,,	,,
,,	,,	$\frac{1}{4}$	,,	= ·508	,,	,,	$\frac{1}{4}$	,,	,,	,,
,,	,,	$\frac{1}{8}$	,,	= ·259	,,	,,	$\frac{1}{8}$	,,	,,	,,

No. 2 cutter (2 sq. in.).

$\frac{1}{972}$ part	of	20	oz.	= 9	grains	or	20	oz.	aluminium	weight.
,,	,,	10	,,	= 4·5	,,	,,	10	,,	,,	,,
,,	,,	5	,,	= 2·25	,,	,,	5	,,	,,	,,
,,	,,	4	,,	= 1·8	,,	,,	4	,,	,,	,,
,,	,,	2	,,	= ·9	,,	,,	2	,,	,,	,,
,,	,,	1	,,	= ·45	,,	,,	1	,,	,,	,,
,,	,,	$\frac{1}{2}$	,,	= ·227	,,	,,	$\frac{1}{2}$	,,	,,	,,
,,	,,	$\frac{1}{4}$	,,	= ·113	,,	,,	$\frac{1}{4}$	,,	,,	,,
,,	,,	$\frac{1}{8}$	,,	= ·056	,,	,,	$\frac{1}{8}$	,,	,,	,,

Standard weights may be made to give the ounces per yard for any dimension of cloth. In most instances, as for example in the worsted coating trade, a set of weights, based on the cloth

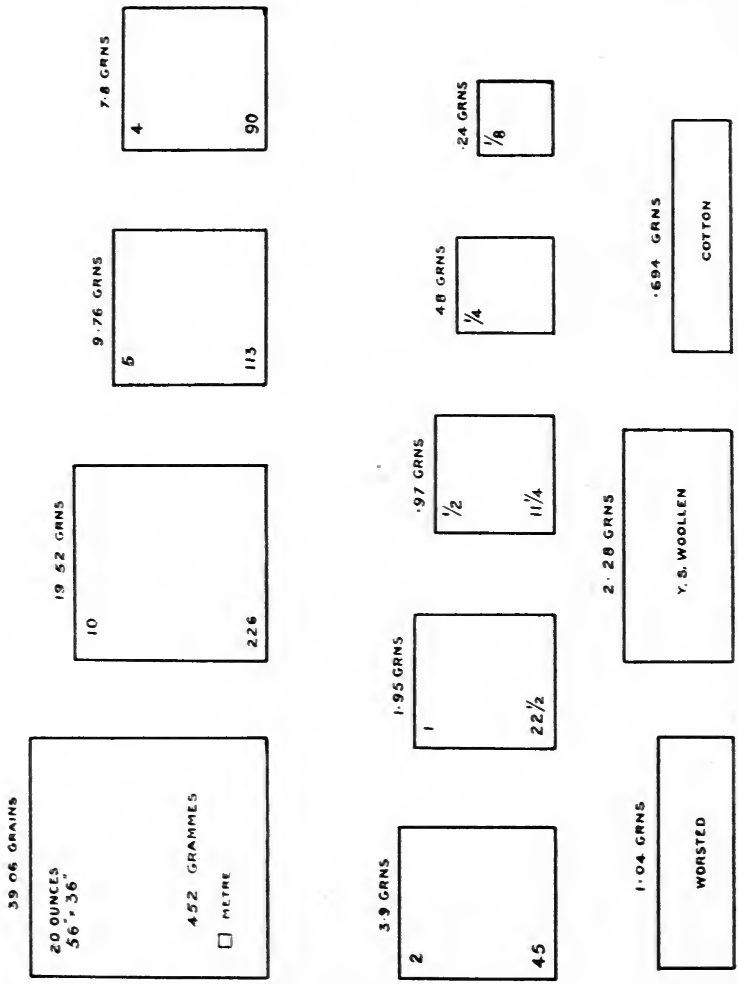

FIG. 77.—Standard Weights for 3 × 3 in. Cutter.

being 56 in. wide and 36 in. to the yard, would be most useful. The weight in grains of the standard weights would be for a pattern cut 3 × 3 in. as stated in Fig. 77.

Counts of Yarn :—

(*a*) 560 yds. of 1's count worsted weighs 1 lb. (7000 grains).

$\therefore$ 3 in. " " " " $\frac{7000 \times 3}{560 \times 36} =$

1·04 grains, weight of worsted weight.

(*b*) 256 yds. of 1's count woollen weighs 1 lb. (7000 grains).

$\therefore$ 3 in. " " " " $\frac{7000 \times 3}{256 \times 36} =$

2·28 grains, weight of woollen weight.

(*c*) 840 yds. of 1's count cotton and spun silk weighs 1 lb. (7000 grains).

$\therefore$ 3 in. of 1's count cotton and spun silk weighs $\frac{7000 \times 3}{840 \times 36} =$

·694 grains, weight of cotton and spun silk weight.

Yarn Gauge.—To ascertain the count of yarn from any fabric without resort to calculation.

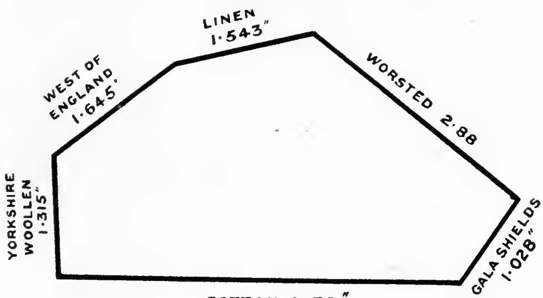

FIG. 78.—Yarn Gauge.

Fig. 78 illustrates a gauge made of aluminium by which the count of yarn may quickly be obtained in any of the denominations stated.

The instructions are to place the required side of the gauge to the pattern and cut the fabric exactly the same length and width. Then place as many threads of warp or picks of weft in a pan of a balance as will weigh one grain. The count of yarn in the finished cloth is equal to the number of threads which weigh one grain.

Example.—If 20 threads taken from a worsted cloth, each as long as the worsted side of the gauge, weigh one grain, the result is 20's worsted count.

In the case of a cotton fabric, if 40 threads each as long as the cotton side of the gauge weigh one grain, the result is 40's cotton count.

The method is the same in all other systems of counting.

Basis of Calculation for Yarn Gauge.—The gauge is based on the length in inches of 1's count in the various denominations.

Worsted Counts.—In 1's worsted there is one hank of 560 yds. weighing 1 lb. (7000 grains): therefore the length of 1's yarn which weighs one grain will be :—

$$\frac{560 \times 36}{7000} = 2{\cdot}88 \text{ in. for worsted count.}$$

As in 20's worsted there are 20 hanks per lb., there will be 20 threads 2·88 in. long to weigh one grain.

Cotton Counts, 840 yds. per hank :—

$$\frac{840 \times 36}{7000} = 4{\cdot}32 \text{ in. for cotton count.}$$

Yorkshire Skeins Woollen, 256 yds. per hank :—

$$\frac{256 \times 36}{7000} = 1{\cdot}315 \text{ in. for Yorkshire skeins woollen count.}$$

Galashiels Count, 200 yds. per hank :—

$$\frac{200 \times 36}{7000} = 1{\cdot}028 \text{ in. for Galashiels count.}$$

West of England Count, 320 yds. per hank :—

$$\frac{320 \times 36}{7000} = 1{\cdot}645 \text{ in. for West of England count.}$$

Linen Count, 300 yds. per hank :—

$$\frac{300 \times 36}{7000} = 1{\cdot}543 \text{ in. for linen count.}$$

Analysis by Comparison.—The method of analysing a fabric by comparison is one of the quickest and most reliable employed for obtaining the loom particulars of an unknown cloth. On account of these advantages it is the one chiefly in use in the industry. The principle underlying the method is that of comparing the constituents of an unknown cloth with those of a known cloth.

Conditions.—It is already realized that all woven fabrics vary from being in the loom to becoming finished cloths according to: (1) the quality of the raw material, (2) structure of yarn, (3) build of cloth, and (4) type of finish and degree of treatment during finishing. Therefore when a known cloth is being chosen for this purpose, the utmost care must be taken, *because if any of the above* *four factors, in the known and unknown cloths, are distinctly different, the variation from loom to finished cloth will have varied according, and the comparison will not be a fair one and in consequence the results will be incorrect.*

The application of this method will have some limitation as the analyst is not likely to possess a sample and loom particulars of every type of woven fabric which may be submitted to him for analysis.

Example 1.—To a maker of worsted dress cloths an unknown cloth is submitted for reproduction. Having ascertained the quality, structure, weave, etc., of the structure submitted, the maker selects a cloth of his own make which he considers nearest in the details mentioned. The maker's known cloth is of the following particulars :—

"Known" Cloth :—

Example 1.—Style of cloth, worsted dress, 9·9 oz. per yard (finished cloth), 56 × 36 in.

	Counts.	Material.	Reed.	Lengths.			Total Weight.
				Warp.	Grey Cloth.	Finished Cloth.	Grey Cloth.
Warp	2/48's	Grey botany	15/4's	70 yd.	65 yd.	63 yd.	41·8 lb.

	Counts.	Material.	Picks per Inch.	Widths.			Total Weight.
				Loom.	Grey Cloth.	Finished Cloth.	Finished Cloth.
Weft	1/24	Grey botany	60 warp 64 grey cloth	67 in.	64 in.	56 in.	39 lb.

Comparison of "Known" and "Unknown" Cloths :—

1. *Weight per Yard* (finished cloth).—Cut both patterns 3 × 3 in. and test for weight per yard (for convenience employing Gaunt's standard weights).

"Known" cloth = 9·9 oz. (56 × 36 in.).

"Unknown" ,, = 7·74 ,, ,, ,,

2. *Counts of Warp in Loom.*—Take a suitable number of warp threads, 3 in. long, from "known" cloth of 2/48's (say 48 threads) and place them in one pan of a pair of scales: in the other pan place as many threads, the same length, from "unknown" cloth as will balance the threads from known cloth.

In this case it is found that 60 threads from "unknown" cloth, balance and are equal in weight to 48 threads of 2/48 ∴ if 48 threads (known) are equal to 2/48 in the loom, 60 threads (unknown) will be:—

$$48 : 60 :: 2/48 : x = 2/60 \text{ warp counts of unknown cloth.}$$

3. *Counts of Weft in Loom* (as in the case of warp).—From "known" cloth 24 picks of 1/24's are found to balance 30 picks from "unknown".

∴ if 24 picks are equal to 1/24's counts in the loom 30 picks will be:—

$$\text{As } 24 : 30 :: 1/24 : x = 1/30 \text{ weft counts of unknown cloth.}$$

4. *Threads per Inch in Loom.*—On examination it is found that in both "known" and "unknown" cloths, there are 72 threads per inch.

∴ if 72 threads (finished) are obtained from 60 in th loom (known cloth), then in the "unknown" cloth 72 threads (finished) will be obtained from 60 threads per inch in the loom, or

$$\text{As } 72 : 72 :: 60 : x = 60 \text{ threads per inch in loom of "unknown".}$$

5. *Picks per Inch in Loom.*—On the two cloths being compared for picks per inch, it is found that the "known" cloth contains 68 to 64 in the "unknown" cloth.

∴ If 67 gives 60 in the loom, what in the loom will the "unknown" cloth be, which counts 64 picks?

$$\text{As } 68 : 64 :: 60 : x =$$

57 picks per inch in loom of "unknown" cloth.

6. *Widths and Lengths of "Unknown" Cloth.*—As the two cloths are alike in all which affects the contraction or shrinkage and the above results of the unknown cloth, being obtained by comparison with a cloth of a certain variation from loom to finished dimensions, it is obvious that the various widths and length of the two cloths must be identical, if the particulars obtained are to be correct.

Particulars of "Unknown" Cloth :—

Example 1.—Style of cloth, worsted dress, 7·74 oz. per yard (finished cloth), 56 × 36 in.

	Counts.	Material.	Reed.	Lengths.			Total Weight.
				Warp.	Grey Cloth.	Finished Cloth.	Grey Cloth.
Warp	2/60	Grey botany	15/4's	70 yd.	65 yd.	61 yd.	32·65 lb.
	Counts.	Material.	Picks per Inch.	Widths.			Total Weight.
				Loom.	Grey Cloth.	Finished Cloth.	Finished Cloth.
Weft	1/30	Grey botany	57 warp 61 grey cloth	67 in.	64 in.	56 in.	30·5 lb.

Total Grey and Finished Weights of "Known" and "Unknown" Cloths :—

1. "*Known*" (*Grey Cloth*) :—

$$\text{Warp } \frac{4020 \times 70}{24 \times 560} = 20{\cdot}9 \text{ lb.}$$

$$\text{Weft } \frac{60 \times 67 \times 70}{24 \times 560} = 20{\cdot}9 \text{ ,,}$$

$$41{\cdot}8 \text{ lb.}$$

2. "*Known*" (*Finished Cloth*) :—

9·9 oz. (56 × 36 in.) × 63 yds. = 39 lb.

3. "*Unknown*" (*Grey Cloth*) :—

$$\textit{Warp } \frac{4020 \times 70}{30 \times 560} = 16{\cdot}75 \text{ lb.}$$

$$\textit{Weft } \frac{57 \times 70 \times 67}{30 \times 560} = 15{\cdot}9 \text{ ,,}$$

$$32{\cdot}65 \text{ lb.}$$

4. "*Unknown*" (*Finished Cloth*) :—

7·74 oz. (56 × 36 in.) × 63 yds. = 30·5 lb.

Example 2.—To a maker of worsted coatings a small piece of cloth, Fig. 80, is submitted for reproduction. Having ascertained the quality, structure, weave, etc., of the pattern submitted, the maker selects a cloth of his own make, Fig. 79, which he considers nearest in the above details. The maker's known cloth is of the following particulars :—

"Known" Cloth :—

Example 2 (Fig. 79).—Style of cloth, worsted coating, 11 oz. per yard (finished cloth), 56 × 36 in.

	Counts.	Material.	Reed.	Lengths.			Total Weight.
				Warp.	Grey Cloth.	Finished Cloth.	Grey Cloth.
Warp	2/36's	Botany, various colours	14/4's	70 yd.	66 yd.	64 yd.	46¼ lb.
	Counts.	Material.	Picks per Inch.	Widths.			Total Weight.
				Loom.	Grey Cloth.	Finished Cloth.	Finished Cloth.
Weft	2/36's	Botany, solid colour.	53 warp 56 {grey cloth	61 in.	59 in.	56 in.	44 lb.

Comparison of "Known" and "Unknown" Cloths :—

1. *Weight per Yard* (finished cloth).—Both cloths are cut 3 × 3 in. and when tested for weight per yard are found to be as follows :—

"Known" cloth = 11 oz. (56 × 36 in.).
"Unknown" cloth = 8·8 oz. ,, ,,

2. *Count of Warp.*—18 warp threads 3 in. long from "known" cloth (2/36's) are equal in weight to 20 warp threads 3 in. long from "unknown" cloth, therefore :—

As 18 : 20 : : 2/36 : x = 2/40 *count of Warp in "Unknown" cloth.*

3. *Count of Weft.*—18 picks of weft (2/36's) 3 in. long from

"known" cloth are equal in weight to 25 picks, each 3 in. long from "unknown" cloth, therefore :—

As 18 : 25 : : 2/36's : $x = 2/50$'s "*count of weft*" in "*unknown*" *cloth.*

4. *Threads per Inch in Loom.*—On examination it is found

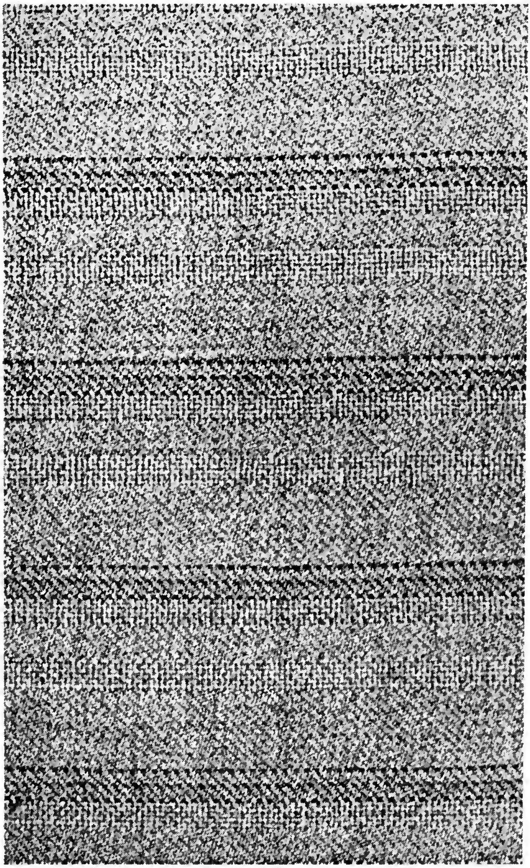

FIG. 79.—"Known" Cloth.

that in both structures there are 60 threads per inch. In the "known" cloth the 60 threads per inch are obtained from 56 in the loom, thus the threads per inch in "unknown" cloth will be :—
As 60 : 60 : : 56 : $x = 56$ threads per inch in "unknown" cloth.

5. *Picks per Inch in Loom.*—On the two cloths being compared for picks per inch, it is found that there are 60 in both cases. In

the "known" cloth 60 picks finished are obtained from 56 in the loom, therefore the picks per inch in "unknown" cloth will be :—

As $60 : 60 :: 56 : x = 56$ picks per inch in "unknown" cloth.

Total Grey and Finished Weights of "Known" and "Unknown" Cloths :—

1. "*Known*" (*Grey Cloth*) :—

$$\text{Warp } \frac{3420 \times 70}{18 \times 560} = 23\tfrac{3}{4} \text{ lb.}$$

$$\text{Weft } \frac{56 \times 61 \times 66}{18 \times 560} = 22\tfrac{1}{4} \text{ ,,}$$

$$\overline{46 \text{ lb.}}$$

2. "*Known*" (*Finished Cloth*) :—

11 oz. (56 × 36 in.) × 64 yds. = 44 lb.

3. "*Unknown*" (*Grey Cloth*) :—

$$\text{Warp } \frac{3420 \times 70}{20 \times 560} = 21\tfrac{1}{2} \text{ lb.}$$

$$\text{Weft } \frac{56 \times 61 \times 66}{25 \times 560} = 16 \text{ ,,}$$

$$\overline{37\tfrac{1}{2} \text{ lb.}}$$

4. "*Unknown*" (*Finished Cloth*) :—

8·8 oz. (56 × 36 in.) × 64 yds. = 35·2 lb.

Particulars of "Unknown" Cloth :—

Example 2 (Fig. 80).—Style of cloth, worsted coating, 8·8 oz. per yard (finished cloth), 56 × 36 in.

	Counts.	Material.	Reed.	Lengths.			Total Weight.
				Warp.	Grey Cloth.	Finished Cloth.	Grey Cloth.
Warp	2 40's	Botany, various colours	14/4's	70 yd.	66 yd.	64 yd.	37½ lb.
	Counts.	**Material.**	**Picks per Inch.**	**Widths.**			**Total Weight.**
				Loom.	**Grey Cloth.**	**Finished Cloth.**	**Finished Cloth.**
Weft	2/50's	Botany, solid colour	53 warp, 56 grey cloth	61 in.	59 in.	56 in.	35·2 lb.

Analysis of Standard Cloths without Resort to Calculations.—In the analysis of some standard cloths, the loom particulars may be obtained from the finished cloth without resort to calculations.

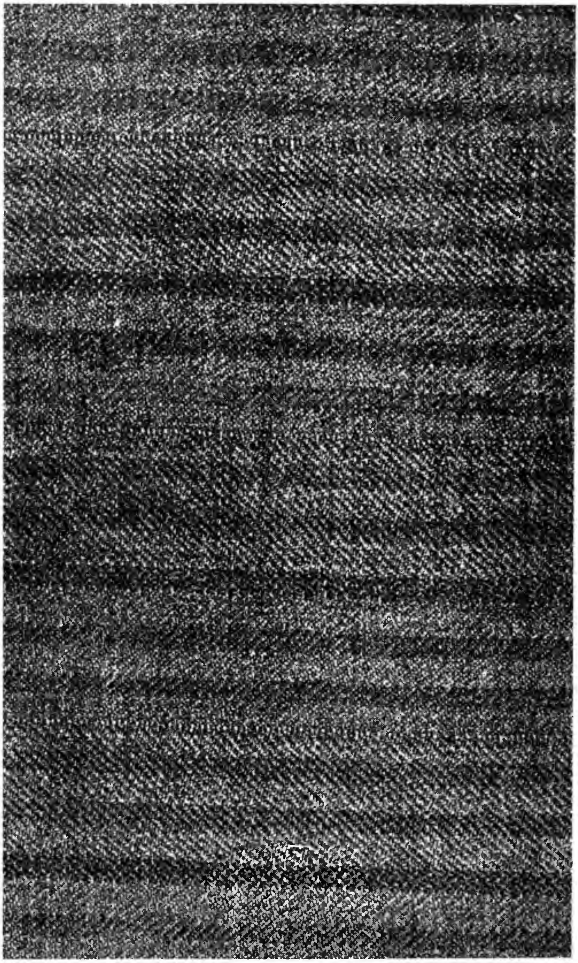

FIG. 80.—"Unknown" Cloth.

The maker of certain classes of goods composed of identical constituents and subjected to similar finishing treatments, recognizes that the variation of cloth dimensions from being in the loom to being finished is identical. A certain standard cloth may be produced in many qualities, but in each quality the factors which control the shrinkage from loom to finished cloth dimensions are approximately alike. Consequently, by the application of experience or reference to tabulated particulars, the maker of a standard type of cloth may readily ascertain the particulars for reproducing an unknown cloth which is somewhat similar in its constituents.

A typical example is provided in the well-known union lustre dress fabric. In all cases this type of structure is composed of cotton warp, mohair, or lustre weft. The ground weave is usually of a plain ground character and in all instances these structures are submitted to a "bright" finish. Such a cloth (Fig. 81) is submitted to a maker of these goods for reproduction.

Method of Analysis.—1. *Count of Warp and Weft.*—These goods being produced from standard counts and qualities of warp and weft, and the maker being familiar with these, from examination is able to accurately estimate the count of warp and weft as follows :—

Warp = 2/100's cotton.
Weft = 1/26's mohair.

2. *Loom and Finished Cloth Dimensions.*—Table XXI (p. 146) indicates the loom, grey and finished cloth dimensions of twenty makes similar to this under consideration. These results indicate little variation and the averages are stated to be :—

50 in. loom width.	70	yds.	warp.
49 ,, grey cloth width.	$60\frac{1}{4}$	,,	grey cloth.
44 ,, finished cloth width.	$67\frac{1}{2}$	,,	finished cloth.

There is a contraction in width from loom to finished cloth width of 12 per cent. The elongation from grey cloth to finished cloth length is also 12 per cent.

(*a*) *Width in Loom.*—If the finished cloth width is 44 in. the width in loom will be :—

As $88 : 100 :: 44 : x = 50$ in. wide.

(*b*) *Length of Finished Cloth.*—When 70 yds. of warp per cut is employed, the grey length of cloth will be about $60\frac{1}{4}$ yds., consequently the finished length :—

As $100 : 112 :: 60\frac{1}{4}$ yds. : $x = 67\frac{1}{4}$ yds.

3. *Threads per Inch in Reed.*—The contraction from loom to finished cloth width is 12 per cent, consequently, as the threads

per inch in the finished cloth count 73, the same in the reed will be :—

As 100 : 88 : : 73 : $x = 64$ threads.

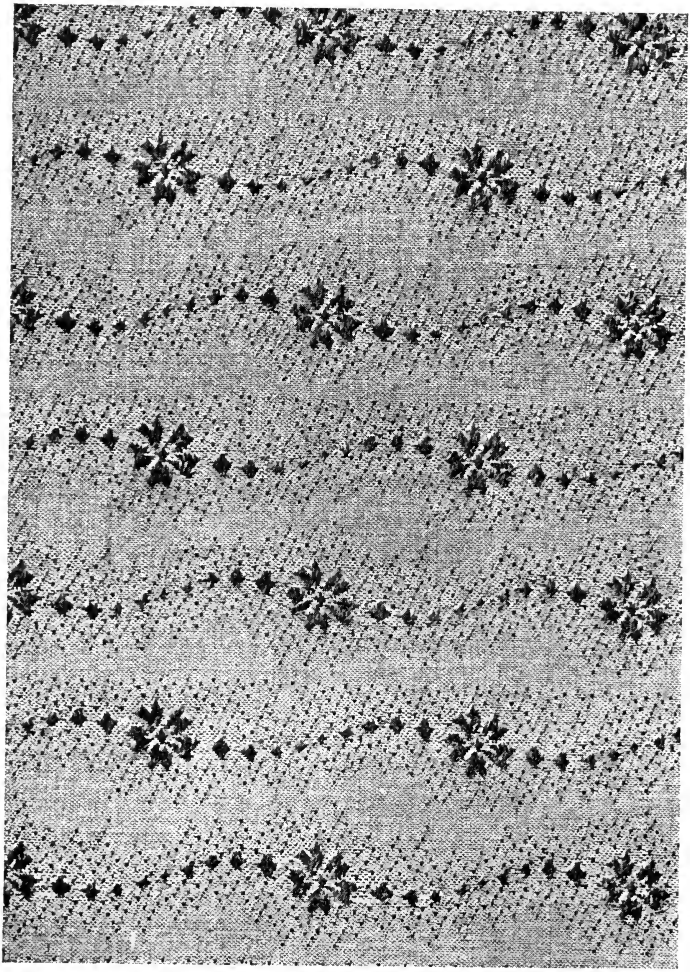

FIG. 81.—Figured Lustre.

or, as 50 in. in loom results in 44 in. wide of finished cloth, the threads per inch in reed will be :—

As 50 in. : 44 in. : : 73 in. : $x = 64$ threads.

4. *Picks per Inch of Warp and Grey Cloth.*—The finished cloth

counts 68 picks per inch, the picks per inch in grey cloth will be :—

As 100 : 112 : : 68 : x = 76 picks per inch grey cloth,

or these results may be obtained by taking into consideration the various lengths :—

70 yds. warp = 67 picks per inch.
$60\frac{1}{4}$,, grey cloth = 76 picks per inch.
$67\frac{1}{2}$,, finished cloth = 68 picks per inch.

(*a*) *Picks per Inch in Grey Cloth* :—

$60\frac{1}{4} : 67\frac{1}{2} :: 68 : x = 76$ picks per inch.

(*b*) *Picks per Inch of Warp* :—

As $70 : 67\frac{1}{2} :: 68 : x = 67$ picks per inch.

Weights of Grey and Finished Cloths :—

Grey Cloth :—

$$\text{Warp } \frac{3200 \times 70}{50 \times 840} = 5\tfrac{1}{3} \text{ lb.}$$

$$\text{Weft } \frac{67 \times 50 \times 70}{26 \times 560} = 16 \text{ ,,}$$

$$21\tfrac{1}{3} \text{ lb.}$$

Finished Cloth.—By standard weights the weight per yard is ascertained to be $4\frac{3}{4}$ oz. 44 × 36 in. $4\frac{3}{4}$ oz. × $67\frac{1}{2}$ yds. = 20 lb.

Example 1 (Fig. 81).—Style of cloth, mohair lustre, $4\frac{3}{4}$ oz. per yard (finished cloth), 44 × 36 in.

	Counts.	Material.	Reed.	Lengths.			Total Weight.
				Warp.	Grey Cloth.	Finished Cloth.	Grey Cloth.
Warp	2/100	Cotton	32/2's	70 yd.	$60\frac{1}{4}$ yd.	$67\frac{1}{2}$ yd.	$21\frac{1}{3}$ lb.
	Counts.	**Material.**	**Picks per Inch.**	**Widths.**			**Total Weight.**
				Loom.	Grey Cloth.	Finished Cloth.	Finished Cloth.
Weft	1/26	Mohair	67 warp 76 grey cloth	50 in.	49 in.	44 in.	20 lb.

CHAPTER XIII.

QUALITATIVE AND QUANTITATIVE ANALYSIS OF FIBRES IN WOVEN FABRICS.

Method of Determining the Nature and Quality of Fibres.—The chief object of most cloth analysis is to determine the loom particulars for reproducing the sample of cloth submitted. In addition it is necessary to define the nature and quality of the fibre or fibres which constitute the threads of the fabric. There are four methods by which the nature and quality of fibres may be determined:—

1. Ordinary Observations.
2. Burning Tests.
3. Microscopic Examination.
4. Chemical Reaction.

General Observations.—From observations and the application of some experience and by the exercise of a reasonable amount of care and judgment, very reliable tests may be made in ascertaining the particular quality and type of fibre employed to produce woven fabrics. The method is to take from the cloth, threads of warp and weft, and unravel or untwist a number of each between the fingers and thumbs, in order that an examination of the fibres might be made. With the naked eye or assisted by means of a magnifying glass a bunch of fibres are examined—possibly by being drawn upon a black velvet board—and recognized to be one or another of the various textile fibres.

One experienced in wool yarns and cloths can readily estimate what particular quality of wool has been employed by noting the length, waviness, and fineness of the fibres, bearing in mind the same features of known qualities of wool.

Burning Tests.—A very simple method of discriminating between fibres of vegetable and animal origin is by the manner in which they burn.

Vegetable Fibres.—Cotton, linen, ramie, etc., ignite and burn readily, with a bright smokeless and odourless flame, and will leave only a small amount of ash.

Animal Fibres.—Wool, hair, and silk are more difficult to ignite than vegetable fibres. From ignited wool the flame is more or less lifeless, and burns slowly, with the emission of a disagreeable odour, the residue forming itself into a black bead-like form or knob.

This result applies to silks which are practically free from adulteration or weighting material. For example, when a heavily weighted silk is ignited, instead of forming itself into small black beads or knobs, it burns, leaving a distinct ash which retains somewhat the shape of the original material.

It is evident, however, that the burning test can only be employed for material in bulk, and is of little value in determining the fibre constituents of a blend.

Microscopic Examination.—Testing materials by microscopic examination is a most valuable and reliable method, especially when the mechanical structure of the fibre has not been altered, during the processes of manufacture, as is usually the case in woven fabrics.

When fibres are placed under the microscope and examined, especially with transmitted light, and with powers varying from 20 up to 200 diameters, their appearance and distinctions will be clearly visible and may be compared with the well-known structures of :—

(*a*) *Wool.*—This fibre is easily distinguished, being practically always of a more or less cylindrical form. It is covered with rings or scales, with fine, smooth, or imbricated edges, which point from root to tip of the fibre. These scales differ much in form, regularity, and in size. There are also indications of a curl or curvature in the fibre. These peculiarities are always distinctive and enable wool to be at once differentiated from silk and other fibres.

(*b*) *Hair* differs in appearance from wool inasmuch as though it is usually covered with similar scales on the surface of the fibre, these scales are always more closely adherent to the shaft of the fibre and the edges are not turned outwards. Mohair, alpaca, vicuna, llama, cashmere, and other hairs all closely resemble each other in this respect.

(*c*) *Silk.*—The cultivated silk fibre derived from mulberry silkworm has the appearance of a double stand of a clear, semi-transparent, lustrous, continuous fibre. Wild silks always exhibit a fibre which is much flatter and irregular, and is usually more striated on the surface in the direction of length. It is also larger in diameter than cultivated silks.

(*d*) *Artificial Silks.*—Viscose, imitation horse hair, etc. The artificial silk fibre under the microscope is very similar to silk. Chemically silk and artificial silk are very different, which is better disclosed by a burning or chemical test than by microscopic means.

(*e*) *Cotton: Ordinary*, microscopically presents the appearance of twisted collapsed ribbons, with more or less thickened edges, and exhibiting a wrinkled surface. The cross section reveals a central cavity with cloudy deposits.

Mercerized Cotton.—Mercerized cotton appears like silk to the naked eye, yet microscopic examination of the fibres determines the matter in case of doubt. When the yarn or cloth has been fully mercerized, the cotton fibre is fuller and almost void of the surface markings or twists which characterize ordinary cotton.

(*f*) *Flax, Hemp, and Jute.*—These fibres have a general similar appearance, consisting of a series of cells united together longitudinally and in the case of flax and hemp usually thickened at the point of juncture with a node or ring, which adds strength and rigidity to the fibre. In the case of jute, the nodes are generally absent, although the point of juncture of the multiple cells is very apparent.

Chemical Reactions.—By microscopic examination the nature of the material or materials can be ascertained, but not the quantity and proportions in which two materials might be present. Chemical reaction not only indicates the type of material but may also be employed to ascertain the proportion in which the materials are present.

From time to time many chemical tests have been given to the public for the purpose of discriminating between the various textile fibres, especially those of vegetable origin. As all vegetable fibres are of practically the same chemical composition—cellulose—it is very difficult to obtain, by means of a chemical agent, a distinguishing colour or feature in one fibre which the same agent does not impart in some degree to the other. Therefore before any reliable results can be obtained the application of some knowledge and experience of chemistry is essential.

Practically all the fibres employed in the manufacture of woven fabrics are of vegetable or animal origin, hence it will not be difficult to realize that the chemical reagents used as solvents for the fibres can be divided into two distinct classes :—

(*a*) Those employed as solvents for vegetable fibres.

(*b*) Those employed as solvents for animal fibres.

Chemical Reaction on Textile Fibres.—Table XXVI indicates the characteristic chemical reactions on the principal fibres, and by suitably employing these tests the various fibres may be easily distinguished from each other.

The reagents employed for the tests may be prepared as follows :—

1. *Madder Tincture.*—Extract 1 grm. of ground madder with 50 c.c. of alcohol and filter from undissolved matter.

2. *Fuchsine Solution.*—Dissolved 1 grm. of fuchsine (magenta) in 100 c.c. of water, then add caustic soda solution drop by drop until the fuchsine solution is decolorized : filter and preserve in a well-stoppered bottle. In applying the test with this reagent the mixed fibres are treated with the hot solution, then well rinsed, when the animal fibres will be dyed red and the vegetable fibres remain colourless.

3. *Zinc Chloride Solution.*—Dissolve 1000 grm. of zinc chloride in 850 c.c. of water, and add 40 grm. of zinc oxide, heating until complete solution is effected.

4. *Sodium Plumbate* (solution of lead in caustic soda).—Dissolve 5 grm. of caustic soda in 100 c.c. of water and add 5 grm. of litharge (PbO) and boil until dissolved.

5. *Caustic Soda.*—Dissolve 10 grm. of caustic alkali in 100 c.c. of water and filter.

6 and 7. *Sulphuric and Nitric Acid.*—The commercial concentrated acids are employed.

8. *Iodine Solution.*—Dissolve 3 grm. of potassium iodide to 60 c.c. of water and add 1 grm. of iodine. Dilute this solution before using with 10 parts of water. When the reaction is employed in connection with sulphuric acid, the latter consists of 3 parts of concentrated sulphuric acid, 1 part water and 3 parts of glycerine. The glycerine has the effect of preventing injury to the fibre.

Note.—In Nos. 1, 2, 3, 4 and 5 the material is firstly gently warmed and finally boiled for a short time. Nos. 6 and 7 must be used cold.

TABLE XXVI.

CHEMICAL REACTION ON TEXTILE FIBRES.

	Wool.	Silk	Cotton.	Linen.
Madder tincture	*Nil*	*Nil*	Colours yellow	Colours orange
Fuchsine solution magenta	Colours red	Colours red	*Nil*	*Nil*
Zinc chloride solution	Partially dissolves	Dissolves	Undissolved	Undissolved
Sodium plumbate	Black precipitate	No precipitate	*Nil*	*Nil*
Caustic soda	Dissolves slowly	Dissolves gradually	Colours faintly	Colours faintly
Sulphuric acid	Dissolves when heated	Dissolves quickly when heated	Quickly dissolves	Quickly dissolves
Nitric acid	Colours yellow dissolves slowly	Colours yellow and rapidly dissolves	*Nil*	Dissolves
Iodine solution	—	—	Colours yellow	Colours yellow

The fibres are moistened first with the iodine solution and then with the sulphuric acid solution.

Distinguishing Test for Flax and Jute.—Moisten the two samples with an acidulated alcoholic solution of phloroglucine. Jute will stain an intense reddish-brown and flax will remain practically unchanged (a slight yellowing may be noticed).

Note.—The stain is not permanent—therefore a lighter colour will result in the course of time.

Loading Worsteds and Woollens.—It frequently happens that the cloth finisher is instructed to deliver a cloth after finishing the same weight as prior to finishing. As previously pointed out, fabrics composed of wool fibre lose a certain amount of weight during the finishing processes. It is obvious that this loss in weight can only be made up by adulteration or artificial means. A suitable example is provided in following botany worsted twill cloth submitted to a "clear" finish:—

Average of 20 pieces :—

$58\frac{3}{7}$ lb. Weight of grey cloth.
$59\frac{5}{7}$,, ,, Finished cloth.

The finished fabric shows an increase in weight of over one pound. This difference, however, does not signify the actual amount of loading. As "clear" finished worsted goods lose about 6 per cent in weight, the finished weight of these goods—if unadultered—should be: $58\frac{3}{7}$ lb. − 6 per cent = 55 lb. Hence the amount of loading is from 55 lb. to $59\frac{5}{7}$ lb., which is equal to about a 10 per cent adulteration.

Wool fabrics by reason of their great hygroscopic properties are usually weighted by being impregnated with hygroscopic substances such as magnesium chloride. Other agents employed for filling worsted and woollen goods are: Zinc chloride, magnesium chloride, magnesium sulphate, glue, gelatin, dextrin, starch, and water glass (alkali silicate).

Zinc chloride is a most useful loading agent on account of it possessing great hygroscopic properties. When a wool fabric has passed through solutions containing this agent the chloride is absorbed and permanently retained in form of liquid or moisture, and a slippery handle imparted.

Distinguishing Tests for Loaded Wool Cloths.—(*a*) A rough test for a weighted cloth is to wet the fabric with a sponge on one side. If a deliquescent material has been employed to retain moisture, the water will sink in at once: whereas with unadulterated cloth the moisture will remain on the surface in the form of beads and will take a considerable time to penetrate the interior.

Although this test may be used as a guide, a more reliable one may be carried out on the following lines:—

(*b*) A suitable size of the suspected material should be boiled for half an hour in water made slightly acid with hydrochloric acid, which will extract the filling. The water should now be squeezed off, decanted and placed on one side. After a second extraction in fresh water, the two liquors should be carefully evaporated down to perfect dryness, when whatever substance has been employed, will be left behind as a solid residue.

If possible distilled water should be employed for extracting.

Tests for the Weighting and Dressing of Cotton, etc., Goods.—Weighting and dressing of cotton goods is often carried out with addition of starches, soaps, softening, and antiseptic agents.

One of the most common filling agents is magnesium chloride, and during finishing this compound is converted into a basic salt which is no longer soluble in water.

I. A weighed quantity of cloth is extracted in a Soxhlet apparatus with ether—this removes fats, waxes, and zinc chloride. The ether extract is transferred to a separating funnel, and washed twice with dilute hydrochloric acid to remove the zinc chloride.

The ethereal solution is transferred to a small weighed flask, the ether distilled off, and the residue dried at 105° C. for about two hours. The gain in weight of the flask represents fat or wax.

II. The zinc chloride is obtained by ashing about 5 grams of the cloth in a small weighed crucible; the ash is washed well with distilled water, and the zinc oxide collected on a filter paper; the filter paper and contents are transferred to a weighed crucible, ashed, and the gain in weight multiplied by 1·7 to obtain the weight of zinc chloride.

III. Magnesium chloride is estimated similarly to zinc chloride; after ashing, the ash is treated, when cold, with two or three drops of nitric acid, the crucible covered with a lid and heated in a fume chamber to expel acid fumes. The residue is then filtered and treated as in II. The weight of the ash multiplied by 2·37 gives the weight of magnesium chloride.

IV. A weighed quantity of the sample after extraction with ether in a Soxhlet is steeped for a few minutes in cold 1 per cent caustic soda, well washed, boiled with 2 per cent hydrochloric acid until no further change takes place; wash well with distilled water, dry, and weigh. Loss = size, organic and inorganic weighting. If the weight of the cotton is required in the conditioned state, 8 per cent of its weight must be added.

Cotton and wool in union in presence of magnesium chloride requires treating with boiling 2 per cent hydrochloric acid to remove the magnesium salt. A weighed quantity, about 5 grams, is boiled with alcohol to remove soap; the cloth is then boiled twice with 200 c.c. of 2 per cent hydrochloric acid, and after each treatment well washed with distilled water, boiled with alcohol; it is then dried at 105° C. and weighed. Loss in weight = moisture + filling.

The piece is now boiled with 10 per cent caustic soda, well diluted with water and filtered; the cotton which remains on the filter is well washed with water, then with a little dilute acetic acid, dried at 100° C. and weighed.

For cotton in the conditioned state add 10 per cent; about 2 per cent of the cotton is lost during boiling with caustic soda.

The weight of the dried cotton subtracted from the weight of the dried cotton plus wool gives dry wool; to this add 15 per cent for conditioned wool.

Cotton and silk unions. On account of high weighting in silk the percentage is best obtained by separating the separate fibres of cotton and silk from a weighed quantity of the material. The fibres are weighed, and in the case of the silk, the real weight of silk is found by burning the silk in a weighed crucible and subtracting the weight of the ash from it. In the case of tin and iron fixed on silk as tannate, the weight of tin tannate is found by multiplying the weight of the ash by 3·33, and in the case of iron as tannate by 7·2.

If the union cannot be separated into separate fibres, the silk is dissolved from the union, after removing as much filling as possible by alternate boiling with 1 per cent caustic soda and 2 per cent hydrochloric acid, by steeping in a cold ammoniacal nickel solution for two to three minutes, washing with water, boiling with 2 per cent hydrochloric acid, washing with water, drying and weighing.

The ammoniacal nickel solution is prepared from 25 grams of nickel sulphate dissolved in 100 c.c. of water; to this solution caustic soda is added, in small quantities at a time, until a drop of the solution gives a pink colour with phenol phthalein. The solution is diluted to 125 c.c. and mixed with an equal bulk of concentrated ammonia.

Loading and Filling in Silk Fabrics.—The practice of adding to the weight of silk goods in the dyeing and finishing operations has become so common, that it is necessary, in silk cloth analysis, to ascertain the amount of fibre present and the amount and character of the loading material.

Determination of Adulteration and Filling. Physical Examination.—Whether a fabric loaded or filled on one side or impregnated will be detectable at once. Goods containing such loading agents as starch will be recognized, as such fabrics, if rubbed between the fingers, will lose their stiffness. By the aid of a magnifying glass it can be ascertained whether the covering of filling is merely superficial or penetrates the cloth.

Determination of Moisture.—1. Weigh a suitable size of cloth in grains.

2. (*a*) Place the sample for about half an hour in drying oven.

(*b*) Place the sample in a desiccator to cool down.

(*c*) Weigh the sample in grains.

The difference between the first and final weighings indicates the amount of moisture. When the difference is more than the standard regain of moisture, a degree of loading may be suspected, since loading agents possess great hygroscopic properties.

Determination of Extraneous Substances.—Test 1.—1 and 2 as in determination for moisture. 3. Expel the extraneous substances and ascertain the absolute dry weight of the pattern by :—

(*a*) Treating the sample at boiling heat with malt extract.
(*b*) Rinse thoroughly in several changes of water.
(*c*) Dry in oven and cool in desiccator.
(*d*) Weigh in grains.

The difference between the weights of 2 and 3 indicate the amount of extraneous matter. As a few insolubles may remain, the sample is boiled for a short time in dilute acid and reweighed after drying.

Test 2.—As in Test 1 employing a 5 per cent solution of ammonia in place of malt extract and boiling for half an hour.

Ether Test for Insolubles.—The material to be tested is washed three times in ether (enough ether to saturate the material). Pour the ether containing the insolubles in a separate flask. Although washing three times in ether is the regular thing, more or less washes may be employed according to the amount of insolubles. The flask containing the ether plus the insolubles is then shaken up with an equal quantity of water. The water being allowed to settle brings down with it the insolubles. This process should be repeated until the ether is clear, and when completed the water and insolubles are placed into a paper filter (which has previously been weighed) and allowed to drain, leaving the insolubles on the paper. The additional weight on the paper is employed to obtain the percentage of insolubles.

Net Fatty Matters by the Ether Process.—With a syphon arrangement ether is allowed to soak the material to be tested for one and a half hours. At the end of this time the flask containing the ether and net fatty matters is distilled and the residue is the fatty matter contained in the material. As a precaution the flask is placed in a hot oven to evaporate any ether remaining. The net fatty matter is calculated on the additional weight of the flask.

To Ascertain the Amount of Cotton and Wool in Mixed or Union Cloths :—

Method 1.—When the whole or part of the warp is composed of cotton threads and the weft of wool or vice versa.

(1) Weigh a suitable size of pattern in grains.
(2) Ether wash.

(3) Extract all impurities such as dirt, grease, and free dyeware, by boiling.

(4) Ascertain the absolute dry weight of the sample by :—

(*a*) Placing the sample for half an hour in a drying oven.

(*b*) Place the sample in a desiccator to cool down.

(*c*) Weigh the sample in grains.

(5) Separate the cotton threads from the wool and weigh each material separately.

Example.—A sample is composed of cotton warp and wool weft.

	Grains.
Weight of sample before extracting impurities and drying	= 12·6
,, ,, after ,, ,, ,, ,,	= 10·8
Amount of moisture and impurities	= 1·8

∴ 12·6 : 1·8 : : 100 : 14·3 per cent of moisture and impurities.

Weight of cotton warp threads (dry)	= 4·0	grains.
,, wool weft ,, ,,	= 6·8	,,
	10·8	grains.

∴ 10·8 : 4 : : 100 : 37 per cent of cotton.

∴ 10·8 : 6·8 : : 100 : 63 per cent of wool.

To Ascertain the Amount of Silk and Cotton in Mixed or Union Cloths. Separation of Cotton from Silk :—

Method.—(1), (2), (3) as in Method 2 (separating cotton from wool).

(4) Dissolve the silk and ascertain the absolute dry weight of the residue by :—

(*a*) Boiling the sample in a solution containing 10 per cent of caustic soda until the silk dissolves.

(*b*) Rinse thoroughly in several changes of cold water.

(*c*) Neutralize the caustic soda and wash thoroughly in hot water.

(*d*) Dry in oven and cool in desiccator.

(*e*) Weigh in grains.

(5) In calculating the percentage, add 2 per cent to the weight of cotton on account of loss which occurs in the soda bath.

Example.—A sample of cloth is composed of a warp, part of which is cotton and silk twist the remainder of the cloth being cotton.

	Grains.
Weight of sample before extracting impurities and drying	= 10·6
,, ,, after ,, ,, ,, ,,	= 9·2
Amount of moisture and impurities	= 1·4

∴ 10·6 : 1·4 : : 100 : 13·2 per cent of moisture and impurities.

Weight of residue (cotton) after treating with caustic soda and drying } = 8 grains.

∴ 9·2 : 8 : : 100 : 87 per cent of residue (cotton).
2 per cent loss incurred in soda bath.

89 per cent of cotton.
11 ,, ,, ,, silk.

Method 2.—When the yarns of the fabric are a mixture of cotton and wool fibre.

(1), (2), and (3) as in the first method.

(4) Dissolve the wool and ascertain the absolute dry weight of the residue by :—

(*a*) Boiling the sample in a solution containing 10 per cent of caustic soda, until the wool dissolves.

(*b*) Wash thoroughly in several changes of cold water.

(*c*) Neutralize the caustic soda and repeat (*b*).

(*d*) Dry in oven and cool in desiccator.

(*e*) Weigh in grains.

5. In calculating the percentage, add 2 per cent to the weight of cotton, on account of loss which occurs in the soda bath.

Example.—A sample of cloth is composed of cotton and wool mixed yarn.

	Grains.
Weight of sample before extracting impurities and drying	= 13·3
,, ,, after ,, ,, ,, ,,	= 11·5
	1·8

∴ 13·3 : 1·8 : : 100 : 13·5 per cent of moisture and impurities.

Weight of residue (cotton) after treating with caustic soda and drying } = 5 grains.

∴ 11·5 : 5 : : 100 : 43·5 per cent of residue (cotton).
2 ,, loss incurred in soda bath.

45·5 per cent of cotton.
54·5 ,, of wool.

Separation of Silk and Wool.—These fibres may be separated by boiling in hydrochloric acid, in which the silk is readily soluble, whilst the wool merely swells up.

Removing Rubber from Rubbered Waterproof Cloth.—Steep the sample for about fifteen minutes in benzine, which causes the rubber to slightly swell and become soft. The rubber may then be scraped off with a knife.

Note.—The above result does not give an absolutely clean cloth, owing to the rubber penetrating into the interstices of the cloth and also that vulcanized rubber will not dissolve. The cloth, however, may be so cleaned that it can be easily analysed.

Fastness of Colour.—Cut two patterns and have ready boiling solutions of 10 per cent ammonia and 10 per cent sulphuric acid. Place the patterns into these solutions for one minute. Wash thoroughly in cold water and dry. Should the colour be altered to any great extent the colour of the cloths may be stated as "not fast".

Nitric Acid Test for Indigo.—A test applied to cloths of navy blue shades, to detect whether they have been dyed with indigo, is to drop on the fabric some fairly strong nitric acid, allowing the acid to soak in. After washing and drying the characteristic spot for pure dyed indigo is of a yellow colour with a distinct green rim. This kind of spot, considering also the tone of the colour of blue, is taken by many cloth merchants as a sufficient guarantee that the cloth is indigo dyed; by practice and experience, the bloomy appearance of the colour, together with the nitric acid spot, the cloth under inspection can be judged fairly accurately as to whether it has been dyed with indigo or not.

This test is by no means an absolutely accurate one, because many low qualities of indigo when dyed upon the cloth, result in the nitric acid producing a reddish-brown spot, in which the green rim in many cases is entirely absent. Further, indigo vat dyeing is such that it is impossible to dye to certain shades of blue by indigo alone. In these cases the goods have to be what is termed "topped" with another colour to bring them up to the requisite shade. When such cloths be spotted with nitric acid, the result will not be the yellow spot of indigo, but the spot will be the result of the action of the nitric acid on the "topping" colour. There have been many cases where goods have been refused by the merchant, because the characteristic spot for indigo has not been the result of the nitric acid test, the merchant taking it for granted that the fabrics were not indigo dyed, whilst, as a matter of fact, they possessed a good bottom of indigo and are simply "topped" with other colouring matter to bring them up to shade. In the dyeing of these goods, however, the dyer can evade this test by a little skilful manipulation, and cause the dye on the cloth to produce with nitric acid the requisite spot.

As a matter of fact, if a merchant orders some goods to be indigo dyed, and relies solely for a test on the nitric acid spot, it is quite possible for the dyer to dye the goods with other materials which will give a most typical indigo spot, while the goods have no trace of indigo on them. The only reliable method of testing indigo dyed cloth, is to place it in the hands of a colour chemist who, by a few simple tests and an application of his own experience, will quickly detect whether the sample of cloth is indigo dyed or not and to what extent.

Tests for Indigo Dye.—*Test* 1. (1) Cut a few samples into half inch squares and place into test tube.

(2) Barely cover the samples with glacial acetic acid, and boil for two minutes and then allow to cool.

(3) Add water until the test tube is three quarter full and then add some methylated spirit ether SP 720 and shake up.

When this mixture is allowed to settle, it will be found that the water and acid are in the bottom of the tube and the ether floating on the top with the indigo (if any) situated between the two, possessing a flaky appearance.

Test 2.—Boil a small quantity up in a test tube containing chloroform; should indigo be present a light blue colour will be formed.

Test for Mercerized Cotton.—A solution of iodine in saturated potassium iodide solution, colours both ordinary and mercerized cotton a deep brown.

On washing with water mercerized cotton changes to a blue black, which fades very slowly on long washing, whereas ordinary cotton rapidly becomes white on washing.

Note.—For further details of indigo testing consult the recently published research of Green, Gardner, Lloyd & Frank in the "Journal of the Textile Institute".

CHAPTER XIV.

THE COSTING OF WOVEN FABRICS.

To give a clear idea of the unit cost of producing worsted and woollen fabrics is a very difficult matter. In the case of producing cotton goods, the material, machines, and processes are so standardized, and uniform wage lists compiled by organizations representing the manufacturers and the workers, that the costing of cloths is very much simplified. In the manufacture of wool fabrics, there is not only a great difference between the two branches, i.e. woollen and worsted, but in each case there is a wide variation in methods and prices paid for commission work and to the workers.

There is a great variety of materials employed in the production of wool fabrics, and great variation in qualities and proportions of mixture of these materials, with consequent variation of cost. As neither the employers nor employees are strongly organized, there is an absence of any universal wage lists. Certain sections of the trade are able to make certain classes of goods more profitable than others, and in consequence a weaver earns more money in one class of trade than another. There is a difference in the prices paid in mills of different localities manufacturing the same class of goods, hence the weaver in one town earns more money than the weaver of a neighbouring town. Frequently there is a considerable difference in the prices paid in mills of the same town manufacturing the same cloths.

Conditions of and Costing in the Bradford Textile Trade.—The textile trade of Bradford has divided itself up into sections, each making a speciality of its own particular stage of manufacture. There is (1) the wool merchant, (2) the comber or top-maker, (3) the spinner, (4) the weaver or manufacturer, (5) the dyer and finisher, (6) the merchant. Of these the manufacturer or the merchant must be considered the chief agent in the cloth manufacture. Each of these sections has a separate staff for administration and selling, and makes its own charges for profit and financing.

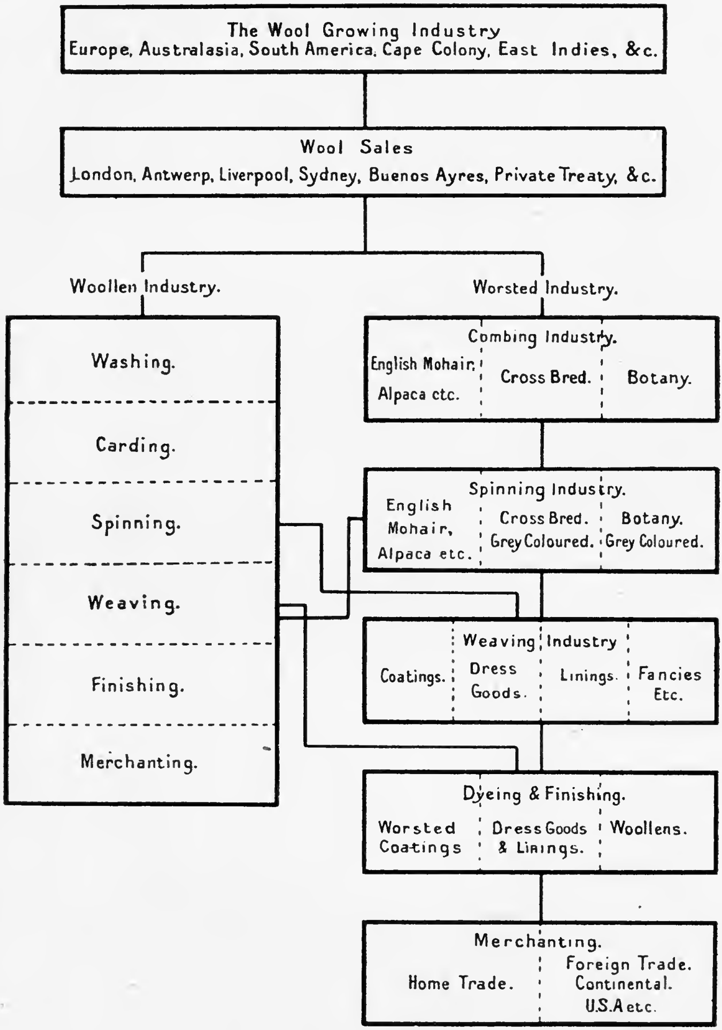

FIG. 82.—Organization of the woollen and worsted trades.[1]

Thus the items which enter in the costing of cloths are :—

[1] From "Textiles," published by Messrs. Constable & Co., London.

1. Cost of yarns (Lists 1*a*, *b*, *c*).
2. ,, ,, warp dressing (List 2).
3. ,, ,, looming, sleying, and twisting in (List 3).
4. ,, ,, weaving (List 4).
5. ,, ,, burling and mending (Lists 5*a* and *b*).
6. Other expenses involving:—
   (*a*) Interest and sinking fund.
   (*b*) Repairs.
   (*c*) Gas and insurance.
   (*d*) Wages for loom tuning, taking in, weft and grey room expenses.
   (*e*) Depreciation.
   (*f*) Miscellaneous expenses.
   } (Lists 7*a* and *b*).
   (*g*) Cost of room and power (List 6).
7. Cost of dyeing and finishing (Lists 8*a*, *b*, *c*, *d*).

Note.—As previously stated there is a variation in the prices paid for the different classes of work. The tabulated prices given can be considered the average paid for the various types of work.

For price lists employed in other localities for the same and other types of work, see appendix.

Cost of Material. (Yarns).—The prices of yarn are so liable to variation, and the price up to date can be so readily obtained, that there is no advantage to be gained by inserting here lengthy lists, but the following particulars will at least be useful in ascertaining the cost of worsted yarns when only the price of combed top is available.

List 1a. To Estimate the Price of Yarn Spun from a Botany Top:—

Standard.—1/40's grey; price of top per lb. + 7d. = price per lb. of yarn.

Variations:—

$\frac{1}{2}$d. per lb. less for every four counts from 40's to 32's.
$\frac{1}{4}$d. ,, ,, ,, ,, ,, ,, 32's to 20's.
Other lower counts the same as 20's.

$\frac{1}{2}$d. per lb. more for every four counts from 40's to (say) 52's.
For other higher counts there are special prices.

1/40's colours and mixtures = price of top per lb. + 1s. = price per lb. of yarn.

1/40's black = price of top per lb. + 11d. = price per lb. of yarn.

Two-fold Yarns.—Price per lb. for single yarn + $\frac{3}{4}$d. for doubling.

Coloured Twists.—1d. per lb. more than solid colours.

Marl Yarns.—2d. per lb. more than solid colours.

Contracts.—Over 350 lb., 1d. per lb. less. Over 600 lb., 2d. per lb. less.

List 1b. To Estimate the Price of Yarns Spun from Cross-bred, Lustre, and Mohair Tops.

(*a*) *Cap-Spun Yarns.*—Standard 1/16's : price per lb. of top + $2\frac{1}{2}$d. = price per lb. of yarn.

For higher counts than 1/16's add $\frac{1}{8}$d. per count up to 1/40's.

(*b*) *Flyer-Spun Yarns.*—Standard 1/16's : price per lb. of "top" + 3d. = price per lb. of yarn.

For higher counts than 1/16's add $\frac{1}{8}$d. per count up to 1/24's and $\frac{1}{4}$d. per count from 1/24's to 1/40's.

(*c*) *Ring-Spun Yarns.*—In crossbreds, ring-spun yarns are being substituted for flyer-spun yarns at a price midway between the above "flyer" and "cap" spun yarn prices—say $2\frac{3}{4}$d. added to price of top for 1/16's counts ring spun.

Two-fold Yarns.—$\frac{3}{4}$d. per lb. more than singles.

Melange Yarns.—Add 1s. to price per lb. of "top" for 1/30's counts.

Note.—The well-known 1/30's demi-lustre flyer-spun yarn is often spun at 1s. 3d. per gross hanks, i.e. $3\frac{1}{8}$d. per lb. This indicates the divergence from above prices (1/30's would be $5\frac{1}{2}$d.) brought about by big weight orders, contracts, etc.

Woollen Yarns.—Owing to the fact that almost every producer of woollen cloths spins his own yarns, costing is most varied and complicated. There is little exaggeration in saying that woollen yarns may be bought at any price from 6d. to 3s. or even more per lb. according to the materials combined and the counts spun to. Perhaps the best method of indicating the method of costing a woollen yarn is to give an example :—

List 1c. The Cost of 12 Skein (Two-fold 24 Skein) Woollen Warp :—

(*a*) *Price of Materials :—*

		s.	d.	
6 lb. wool, at 1s. 3d. (scoured) .	=	7	6	
6 ,, mungo, at 8d.	=	4	0	
8 ,, cotton, at 6d.	=	4	0	
20 lb. – 5 per cent for waste = 19 lb.	=	15	6 =	10d., price of the blend per lb.

(*b*) *Cost of Production* :—

2s. per wartern (6 lb.)		= 4d.	per lb.	for	carding	(condensing to 12 skein).
1s. 2d.	,, ,,	= $2\frac{1}{2}$d.	,,	,,	spinning (to 24 skein).	
6d.	,, ,,	= 1d.	,,	,,	twisting.	
		$7\frac{1}{2}$d. = $7\frac{1}{2}$d. per lb., cost of production.				

Thus, 12 skein (two-fold 24 skein) woollen warp costs 1s. $5\frac{1}{2}$d. per lb.

The Cost of 12 Skein (Single) Woollen Weft:—

(*a*) *Price of Materials* :—

		s.	d.	
4 lb. of botany noil, at 1s. 2d.	=	4	8	
12 ,, mungo, at 4d.	=	4	0	
4 ,, cotton, at 6d.	=	2	0	
20 lb. – 10 per cent. = 18 lb. at		10	8	= 7d. per lb.

(*b*) *Cost of Production* :—

9d. per wartern (6 lb.)	= $1\frac{1}{2}$d.	per lb.	for	carding (condensing to 6 sk.).
9d. ,, ,, ,,	= $1\frac{1}{2}$d.	,,	,,	spinning
	3d. per lb., cost of production.			

Thus, 12 skein (single) woollen weft costs $10\frac{1}{2}$d. per lb.

The chief points to note in the above are : (1) the predominance of wool and cotton in the warp yarn calculation to spin to the 24 skein, as against a large proportion of mungo in the weft calculation to spin only to 12 skein; (2) owing to the poorer material in the weft there is more waste; (3) the extra prices for condensing and spinning in the case of the warp yarn.

Note should be made that the wool is calculated upon the cost scoured: thus, the wool here given might be taken at $7\frac{1}{2}$d. greasy, and, losing 8 lb. in 16 lb. in yolk, etc., thus costs just double.

Preparation for the Loom.

Evidently the first additional expense to the actual cost of the materials will be incurred in preparing a warp for the loom, i.e. in winding, warping, sizing, dressing, twisting-in, looming, and sleying.

Winding.—This is necessitated by the anxiety of the manufacturer to deal with pure yarn alone; the difficulty of estimating the tare, should the yarn be purchased upon cops or paper tubes, and the difficulty of estimating and returning the tare if spun upon bobbins, resulting in most manufacturers buying in the hank and winding for themselves, the extra cost being reckoned at ½d. to 1d. per lb. There has been a tendency of late to spin or twist upon bobbins of a stable weight, thus rendering the estimation of yarn more stable; but there is still the difficulty in returning the tare.

Yarns may usually be obtained in the form required, from the spinner; but the foregoing considerations tend to render every manufacturer his own winder for weft yarns. In both the ordinary cotton and worsted trades the warp yarns are purchased in the warp form at no additional expense, while in some cases they may also be obtained warped, sized, and beamed on to the manufacturer's own beam, at a slightly increased expense.

Warping.—This is effected in so many different ways that it is practically impossible to estimate the cost save to given particulars. The various methods may be summed up as follows :—

(1) Warping of solid colours, usually effected by the spinner.

(2) Two or more warps made by the spinner, but dressed by the manufacturer to pattern.

(3) Warps made by the manufacturer to pattern upon one of the many machines used in the trade.

Sizing or Slashing varies considerably in the wool and cotton trades. In the former trade animal or vegetable size is put on according to the roughness or tenderness of the warp to make the yarn weave well, being extracted in the finishing process : in the latter case size is put on not only to facilitate weaving, but also to weight the cloth. Thus the percentage of size to cloth may be taken as follows :—

For a light size	10 per cent.
For a medium size	50 ,, ,,
For a heavy size	200 ,, ,,

According to the price and weight of the various ingredients used in the composition of the size, and the percentage, will the cost, then, be estimated.

Warp Dressing.—The object of dressing is to ensure that the threads of warp all weave at equal tensions; to clear tangled places; and, generally, to put the threads in the best possible condition for weaving. Possibly no other operation in manufacturing is subjected to so much variation as this one, according to the various classes of materials dealt with, and also according to the particular ideas of the manufacturer.

Dressing is often effected along with warping and sizing, on machines specially constructed for the work. With warps received in the "ball form," however, dressing and beaming imply extra labour.

For assistance in costing, the following warp dresser's price list is given. This list is worked to by a commission warp dresser, and compiled so as to be applicable to almost all types of warps which are dressed in connection with the trade of Bradford.

Price List 2. Warp Dressing (Double Twist Coloured Warps).

No. of Colours.	Number of Threads.											
	10 / 600	601 / 1200	1201 / 1800	1801 / 2400	2401 / 3000	3001 / 3600	3601 / 4200	4201 / 4800	4801 / 5400	5401 / 6000	6001 / 6600	From to
1	1½d.	1½d.	3d.	4½d.	7¼d.	10d.	12¾d.	17d.	19¾d.	22½d.	25¼d.	per cut
2	1½d.	3d.	4½d.	6d.	8¾d.	11½d.	14d.	18¼d.	21d.	24d.	26¾d.	,, ,,
3	3d.	4½d.	6d.	7½d.	10¼d.	13d.	15½d.	19¾d.	22½d.	25¼d.	28d.	,, ,,
4	4d.	5½d	7d.	8½d.	11¼d.	14d.	17d.	21d.	24d.	26¾d.	29½d.	,, ,,
5	5½d.	7d.	8½d.	10d.	12¾d.	15½d.	18¼d.	22½d.	25¼d.	28d.	31d.	,, ,,
6	7d.	8½d.	10d.	11½d.	14¼d.	17d.	19¾d.	24d.	26¾d.	29½d.	32½d.	,, ,,
7	8½d.	10d.	11½d.	13d.	16¾d.	18¼d.	21d.	25¼d.	28d.	31d.	33¾d.	,, ,,

Starting per Warp:—

From	10 to 1800	threads	1s. 6d.
,,	1801 ,, 3000	,,	2s.
,,	3001 ,, 4800	,,	2s. 6d.
,,	4801 ,, 6600	,,	3s.

Extras:—

1. 1d. per cut for single twist warps.
2. 1s. per warp above 42 in. wide.
3. Cutting warp in two (in dressing frame) 4d. per 1000 ends.
4. 2d. per cut. Running back.
5. For mercerized cotton 25 per cent on above prices.
6. 1s. per warp for odd end patterns.

Deductions.—For grey warps, 1d. per cut off above prices.

Warp Dressers' Cut.—55 yds. – 28 yds. above a number of cuts is an additional cut.

Time Work—7½d. per hour.

Twisting-in, Looming, and Sleying.—Having sized, dressed, and beamed the warp, it must now be drawn through the mails in the shaft or harness.

There are two methods of effecting this—firstly, by twisting or tying in the fresh warp to the threads of a previous warp, left in the mails with this idea; secondly, by drawing the threads separately through the mails of the shafts or harness.

Sleying is carried out after twisting-in or looming by passing the warp threads through the reed according to requirements.

It is, perhaps, needless to point out that the twisting-in, looming, and sleying wage covers a number of pieces according to the cuts in the warp, and should be divided by that number.

List 3. Price List for Twisting-in, Looming and Sleying.

(*a*) *Twisting* (*In Twisting Frame*) :—

1. Plain, double twist, cotton, worsted and silk	5½d. per 1000 threads.
2. Single twist, stripes, artificial silk, fancy worsted, mercerized cotton, finer counts than 2/70's for poplins and venetians	6d. ,, ,, ,,
3. Under 2/20's to 2/11's plain .	7½d. ,, ,, ,,
4. Under 2/20's to 2/11's stripes .	8d. ,, ,, ,,
5. Polished cotton and glissades .	9d. ,, ,, ,,
6. 2/10's and under. To be loomed.	

Twisting-in *at the loom*, 1d. per 1000 threads extra on above.

(*b*) *Sleying* :—

1. Over two in a dent . . .	4d. per 1000 threads.
2. One in a dent (all dents to count)	9d. ,, ,, ,,

(*c*) *Looming* (*Drawing-in and Sleying*) :—

1. *Ordinary healds* :—

Straight draft up to 8 shafts	1s. per 1000 threads
,, ,, 9 ,, 12 ,,	1s. 1d. ,, ,, ,,
,, ,, 13 ,, 16 ,,	1s. 2d. ,, ,, ,,
Drafted up to 8 shafts .	1s. 2d. ,, ,, ,,
,, 9 ,, 12 ,, .	1s. 3d. ,, ,, ,,
,, 13 ,, 16 ,, .	1s. 4d. ,, ,, ,,

Extras :—

Above 16 shafts . ½d. per shaft per 1000 threads.
Varnished healds . . . 2d. ,, ,, ,,
Wire healds . . . . 4d. ,, ,, ,,

All stripes to be paid, the same rate as drafted. If sleyed one in a dent, 4d. per 1000 threads on above.

2. *Jacquards* :—

Ordinary mails, 8 in a row 1s. 2d. per 1000 threads.
,, ,, 12 or 16 in a row . . . . 1s. 5d. ,, ,, ,,
Wire mails, 8 in a row . 1s. 5d. ,, ,, ,,
,, ,, 12 or 16 in a row 1s. 8d. ,, ,, ,,

If sleyed one in a dent, 4d. per 1000 threads extra.

3. *Side Threads* (*Edges*) :—

Ordinary healds . . . 2d. per 100 threads.
Varnished healds . . . 2½d. ,, ,, ,,
Wire healds and jacquards . 3d. ,, ,, ,,

If sleyed one in a dent ½d. per 100 extra.

4. *Extras* :—

Rollers up to 400 threads . 4d.
Rollers over 400 threads . 8d.
Two beams . . . . 1s.
Broken lease . . . . 1d. per 1000 threads in warp. 3d. as minimum.
Casting out up to 10 setts . 2d.
,, ,, above 10 up to 30 setts . . . . . 4d.
Casting out above 30 setts . 6d.
Two pairs of rods in the warp with pattern to make . . 1s.
Heald dressing to be time work.

(*d*) *Douping* :—

1. Up to $\frac{1}{10}$ of threads in warp . . . 3d. per 1000 threads extra on total.
2. Over $\frac{1}{10}$ and up to $\frac{1}{6}$ of threads in warp . 4½d. ,, ,, ,, ,,
3. Over $\frac{1}{6}$ and up to $\frac{1}{3}$ of threads in warp . 6d. ,, ,, ,, ,,

4. Over $\frac{1}{3}$ of threads in warp . . . 1s. per 1000 threads extra on total.

Re-douping as above, with sleying extra.

(e) *Ordinary Time Rate*, 7d. per hour.

(f) *Day men*, 8d. per hour.

Cost of Weaving.—If there is variation in the foregoing items, still more will there be cause for variation in the cost of weaving. The following are the principal modifying influences :—

1. Breadth of loom, or reed space.
2. Number of looms, attended to by one weaver.
3. Speed of looms.
4. Type of loom, whether plain or box, and also whether tappet, dobby, or jacquard loom.
5. Type of work.
6. District in which cloth is to be woven.

Of course all these depend more or less upon one another, but some idea of the complexity of the question may be gained from the perusal of the above.

Payment is made in the several great centres of the weaving industry in many ways: thus, while the worsted trade follows the Lancashire system, based upon the price per pick per $\frac{1}{4}$ in. to the standard given in the following lists, the woollen trade has a system of its own, based upon the price per string of 10 feet. Again, when dealing with fancies, it is well-nigh impossible to fix any definite price; and particularly is this so in the case of fancy woollens and worsteds.

The following particulars will give an idea of the cost of weaving in the Bradford District.

List 4.—Standard Wage List for Weavers.

(As suggested by committees appointed by the Bradford Chamber of Commerce and the Bradford Trades and Labour Council.)

Dress Goods, Linings, etc.

70 yds. Warp.

		Price per pick per $\frac{1}{4}$ in.
All weaves up to and including 8 shafts, woven with any one colour of warp with white weft.	Up to and including 38 in. reed space . .	2d.
	Above 38 in. but not exceeding 47 in. reed space	$2\frac{1}{8}$d.
	,, 47 ,, ,, 57 ,,	$2\frac{1}{2}$d.
	,, 57 ,, ,, 66 ,,	$2\frac{7}{8}$d.
	,, 66 ,, ,, 76 ,,	$3\frac{1}{4}$d.

Extras.	Up to and Including 57 in. Reed Space.	Above 57 in. Reed Space.	Price.
1. White mohair and mixture or coloured weft other than alpaca	$\frac{1}{4}$d.	$\frac{1}{2}$d.	per pick per $\frac{1}{4}$ in.
2. (*a*) Alpaca, grey; plain weave (1 × 1)	$\frac{5}{8}$d.	$1\frac{1}{8}$d.	,, ,,
(*b*) Alpaca, grey; twills	$\frac{1}{2}$d.	1d.	,, ,,
3. (*a*) Single twist botany warps, over 72 sett, and with more than 18 picks per $\frac{1}{4}$ in.	$\frac{3}{4}$d.	1d.	,, ,,
(*b*) All other single twist worsted warps	$\frac{1}{4}$d.	$\frac{1}{2}$d.	,, ,,
4. Stripes in warp, up to 8 shafts inclusive:—			
(*a*) Up to 4 colours inclusive	$\frac{1}{8}$d.	$\frac{1}{4}$d.	,, ,,
(*b*) 5 colours or more	$\frac{1}{4}$d.	$\frac{1}{2}$d.	,, ,,
5. Drafted stripes, with or without extra shafts	$\frac{1}{4}$d.	$\frac{1}{2}$d.	,, ,,
6. Shafts above 8, whether dobbies or tappets	1d.	2d.	per shaft.
7. (*a*) Boxes up to and including 3 shuttles	$\frac{1}{2}$d.	$\frac{3}{4}$d.	per pick per $\frac{1}{4}$ in.
(*b*) Boxes, above 3 shuttles	$\frac{5}{8}$d.	1d.	,, ,,
(*c*) Skip or drop boxes	$\frac{3}{4}$d.	$1\frac{1}{4}$d.	,, ,,
8. Pick and pick looms	$\frac{3}{4}$d.	$1\frac{1}{4}$d.	,, ,,
9. (*a*) Jacquards	$\frac{1}{3}$d.	$\frac{7}{8}$d.	,, ,,
(*b*) ,, with alpaca weft	$1\frac{1}{2}$d.	2d.	,, ,,
10. Cop weft	$\frac{1}{4}$d.	$\frac{1}{2}$d.	,, ,,
11. Weft of 16s. count and thicker	$\frac{1}{4}$d.	$\frac{1}{2}$d.	,, ,,
12. One weaver to one loom (for special weaves)	—	$1\frac{1}{4}$d.	,, ,,
13. Rollers or extra beams	4d.	8d.	per piece.
14. Below 9 picks	2d.	4d.	,,
15. Warps of 140 yds. or shorter	6d.	6d.	for the whole warp.
16. One end of warp in one reed	3d.	6d.	per piece of 70 yds.
17. Extra for finding pick, excepting all plain (1 × 1) weaves and goods made from alpaca	3d.	6d.	,, ,,

Coatings.

Up to 84 in. reed space. Speed 120/130 picks minute. 70 yds. warp.

	One weaver to 1 loom.	One weaver to 2 looms.	Price.
All weaves up to 8 shafts	—	$3\frac{3}{4}$d.	per pick per $\frac{1}{4}$ in.
,, ,, 12 ,,	$5\frac{1}{2}$d.	—	,, ,,

Extras.			Price.
1. Plain drafted stripes up to 3 cols.	$\frac{1}{4}$d.	$\frac{1}{4}$d.	per pick per $\frac{1}{4}$ in.
2. ,, ,, 4 cols. or more*	$\frac{3}{4}$d.	$\frac{3}{4}$d.	,, ,,
3. Cross-drafted stripes up to 3 cols.*	$\frac{3}{4}$d.	$\frac{3}{4}$d.	,, ,,
4. ,, ,, 4 cols. or more*	1d.	1d.	,, ,,
5. Coloured weft, except where colour is paid for in the warp, as in extras 1 to 4	$\frac{1}{4}$d.	$\frac{1}{4}$d.	,, ,,
6. Revolving boxes	1d.	1d.	,, ,,
7. Skip or drop boxes	$1\frac{1}{4}$d.	$1\frac{1}{4}$d.	,, ,,
8. Jacquards	$\frac{3}{4}$d.	$\frac{3}{4}$d.	,, ,,
9. Looms running 110/119 picks per minute	1d.	1d.	,, ,,
	Per piece.		
10. Above 8 shafts	—	$1\frac{1}{2}$d.	per shaft.
11. ,, 12 ,,	$1\frac{1}{2}$d.	—	,,
12. ,, 80 sett	1d.	1d.	each 5 setts.
13. ,, 2 shuttles	9d.	9d.	per shuttle.
14. A second beam	1s.	9d.	per piece.
15. Below 9 picks	9d.	9d.	,,
16. Warps shorter than 140 yds.	1s. 6d.	1s.	for the whole warp.

* There was a difference of opinion as to these three items; the Chamber's representatives contended that they should be a $\frac{1}{4}$d. lower in each case.

Perching, Picking, Burling, and Mending.—When a woven texture leaves the loom, and before it is subjected to any dyeing and finishing processes, it is carefully examined, looked over, or perched, and any imperfection that may be observed is, if at all possible, eliminated in the department of burling and mending. Especially is this the case in the manufacture of worsted goods, as the grey cloth defects are developed during the finishing treatment, and if not remedied will result in a damaged fabric. The clear type of finish imparted to worsteds, necessitates evenly spun yarns and regularly woven fabrics.

In cloths, such as woollens, which are severely milled and raised during finishing, the high standard of perfection is not so essential, as the above treatments develop a "face" on to the cloth which minimizes to a great extent any defects there might be; hence the process of burling and mending is not so important in the making of cloths which are subjected to a "face" finish as those which are "clear" finished.

The defects to be found in wool cloths may be classified under two headings:—

1. Those arislng in the preparing, combing, and spinning processes which are responsible for the presence in the woven fabric of burrs, straws, kemps, hairs, knots, thick and thin yarn, and slubs.

2. Such irregularities as missing threads of warp and weft, known as "broken warp threads" and "broken picks" or "picks out," and oil stains, may be considered due to defective weaving.

The amount and type of treatment involved during burling and mending is dependent on the nature of the defects, the type of fabric, and subsequent finished appearance, some textures will be "picked" only, others "picked" and "burled," whilst other makes of cloth necessitate "picking," "burling," and "mending". A definition of the three treatments mentioned, of eliminating imperfections in woven fabrics, is as follows:—

Picking.—Taking out from the face of the cloth all hairs, slubs, kemps, straws, etc.

Burling.—First, from the back of the cloth, taking out all slubs, straws, etc., drawing out and replacing thick warp threads and picks of weft and opening the knots. Afterwards carefully looking over the face of the cloth, and pushing such irregularities as remain (loose ends and curls) on to the back, in order that the face of the fabric is as clear of irregularities and imperfections as possible.

Mending represents the inserting of yarn, where, in the woven cloth, there are any warp threads or weft picks missing.

When goods are delivered into the burling department, it is clearly indicated, whether they are to be "picked," "burled," or "burled and mended". Where the instructions are "to be burled" the operative or burler considers the cloth is not to be "mended": but when the instructions are "to be burled and mended" the burler understands that everything has to be done to eliminate all imperfections.

Cost of Burling and Mending.—The price paid for burling and mending varies considerably and is dependent on the particular type and quality of the woven fabric and the amount of imperfections to be repaired. The list on next page contains the particulars of a number of standard cloths, with the treatment given to them and the price paid to a commission burler and mender. (See Price Lists 5a and 5b.)

A number of dress fabrics do not require mending.

Silks (plain and fancy) 45 to 50 yds.

This class of goods are not often burled and mended, but are usually "picked" of straws, hairs, slubs, etc., and the oil stains washed out.

The price varies from 6d. to 1s. 9d. per piece.

"Other Expenses."

General Expenses (Wages and Salaries).—This item should consist of all wages paid except to loomer or twister, warp dresser, weaver, and burler and mender as stated under list prices. The wages of over-lookers; staff of piece-room, weft room, designing room, and office, and of all foremen, mechanics, and assistants should come under this heading.

Working Expenses. Depreciation.—No costing can be complete unless ample allowance is made for the wear and tear of machinery and depreciation in value of plant generally.

This item is as much a current expenditure as is wages or any other working expenses, the only difference being that it is not annually expended, but nevertheless it ultimately falls due in some shape or form. In some instances the amount for depreciation will be taken into account with the capital expenditure and in other instances a fund is created from which renewals and repairs of buildings and machinery are paid.

Rates, Insurance, Fuel, Lighting, Water, Carriage of Yarn and Cloth.—This might be defined to include the cost of everything received, with the exception of those items in the yarn account such as those above enumerated with the addition of taxes and rates if any.

Price List 5a.—Burling and Mending.

Grey Worsted Coatings (Burling and Mending). *About 65 yds., over 60 in. wide.*

	Type.	Weight.	Price per Piece.	Extras. per yard Warp Threads.	Extras. for Sewing-in per Pick above 2.
1	2/2 twill	16½ oz. per yd.	1s. 9d. to 2s. 9d.	1d. to 2½d.	1½d. to 3d.
2	,, ,,	18½ to 20 ,, ,, ,,	2s. 9d. ,, 3s. 6d.	1d. ,, 2½d.	2d. ,, 3d.
3	,, fine	,, ,, ,, ,, ,, ,,	3s. ,, 3s. 9d.	1d. ,, 2½d.	2d. ,, 3d.
4	,, imperial cloth		2s. 9d. ,, 4s. 6d.	1d. ,, 2½d.	2d. ,, 4d.
5	3/3 twill	18 oz. per yd.	2s. 9d. ,, 4s.	1d. ,, 2½d.	2d. ,, 4d.
6	Corkscrews	16½ ,, ,, ,,	3s. ,, 5s. 9d.	2d. ,, 4d.	4d. ,, 6d.
7	,,	Heavy	5s. ,, 7s.	2d. ,, 4d.	4d. ,, 6d.
8	Venetians	16 oz. per yd.	2s. 6d. ,, 6s. 6d.	2d. ,, 4d.	2d. ,, 6d.
9	,,	Heavy	3s. 6d. ,, 7s. 6d.	2d. ,, 4d.	2d. ,, 6d.
10	Fancy fine	Light	3s. ,, 5s.	2d. ,, 4d.	2d. ,, 6d.
11	,, ,,	Heavy	5s. ,, 7s.	2d. ,, 4d.	2d. ,, 6d.
12	Union cloths	Light	2s. 3d. ,, 3s. 6d.	1d. ,, 4d.	1d. ,, 6d.
13	,, ,,	Heavy	3s. 6d. ,, 7s.	1d. ,, 4d.	1d. ,, 6d.
	Coloured and Mixture Coatings (Burling and Mending).				
	The price for Coloured Coatings is from 3d. to 1s. 6d. per piece more than Grey Coatings.				
14	2/2 twill	16½ oz. per yd.	2s. 9d. to 3s. 6d.	1d. to 4d.	2d. to 4d.
15	3/3 and 4/4 ,,	Light	3s. ,, 4s. 6d.	2d. ,, 4d.	3d. ,, 4d.
16	,, ,, ,, ,,	Heavy	4s. ,, 5s. 6d.	2d. ,, 4d.	3d. ,, 4d.
17	Fancies 3d. to 1s. 6d. per piece more than 14, 15, 16.				
	Grey Worsted Coatings (Burling Only).				
18	Corkscrews		1s. to 2s.		
19	Venetians		1s. ,, 2s.		
20	For cutting loose picks from edges where 2 or more wefts have been employed 4d. to 6d. per piece.				

Price List 5b.—Burling and Mending.

Grey Dress Fabrics about 60 yds. over 40 in. wide.

Type.	Price per Piece.
1 Plain twills	1s. 6d. to 1s. 9d.
2 ,, mohairs	10d. ,, 2s.
3 Figured ,,	9d. ,, 1s. 9d.
4 Plain lustres	1s. 3d. ,, 1s. 9d.
5 ,, voiles	1s. ,, 1s. 6d.
6 Striped ,,	1s. 3d. ,, 3s. 1d.
7 Poplins	1s. 6d. ,, 2s. 3d.
8 Panamas	1s. 6d. ,, 2s. 3d.
9 Orleans	1s. 6d. ,, 2s. 6d.
10 Sateens	1s. ,, 1s. 9d.

Coloured Dress Fabrics.

11 Plain	2s. to 3s. 6d.
12 Fancy	2s. ,, 4s. 6d.

Grey Dress Fabrics (Burled only).

13 Plain twills	1s.	Burled back and face.
14 ,, ,,	9d.	,, on face only.

15 For "picking" only (hairs, straws, and washing out grease spots) from 3d. to 1s. 6d. per piece.

Interest on Capital.—In the costing of cloths the item of interest on the capital invested must be considered and taken into account. When money is invested in an industrial or manufacturing concern, the investor takes a certain risk for which he is entitled to the ordinary rate of interest and in addition a "profit".

An investor might place his money, say, in mortgages and obtain, say, 4 per cent with absolute safety; therefore when money is placed at a risk, the investor is entitled to look for something over and above the 4 per cent interest. Thus in making out the working expenses involved in cloth production a certain percentage—say 4—must be allowed as interest on the capital laid down in plant, buildings, etc. In addition, the interest on any banker's or other loan should of course be included. However, it must be remembered in costing cloths, that "interest" and "profits" are two separate items and in no way should one item include the other.

List 6. Price Paid in Bradford for Room and Power:—

3/4 looms	14d. to 15d. per week	Dress goods.
4/4 ,,	15d. ,, 16d. ,, ,,	Dress goods.
5/4 ,,	16d. ,, 18d. ,, ,,	Dress goods.
6/4 ,,	18d. ,, 20d. ,, ,,	Dress goods.
7/4 ,,	20d. ,, 24d. ,, ,,	Dress goods.
8/4 ,,	30d. ,, ,,	coatings.

Including room for warehousing. The prices vary slightly according to the warehouse room provided.

List 7a. "Other Expenses" involved in the Manufacture of Worsted Coatings.—In a weaving plant of 100, 9/4 box looms, the following details have been worked out, covering the "other expenses" in weaving a worsted coating, made to the following particulars:—

Loom Particulars:—

Warp.
2/44/60 botany.
78 threads per inch.
70 in. reed width.
60 in. finished cloth.

Weft.
1/20/60 botany.
72 picks per inch.
70 yds. warp.
61 yds. finished cloth.

Warped.	*Wefted.*
4 threads dark	4 picks dark
4 ,, light	4 ,, light

Weaving Plant:—

100 9/4 looms.
Speed 110 to 120 picks per minute.
54 hours per week.
30 per cent stoppages.

with 72 picks per inch and 66 yds. of cloth woven, will result in the following number of pieces per (fifty weeks) year:—

$$\frac{120 \times 60 \times 54 \times 50 \times 70 \times 100}{100 \times 72 \times 36 \times 66} = 7955,$$

say 7960.

Capital Expenditure.	£	s.	d.
100 9/4 looms at £38 each	3800	0	0
,, straps, shuttles, temples, etc., at 18s. 6d.	92	10	0
,, pulleys and belts at 16s.	80	0	0
Extra fittings	30	0	0
Healds, reeds, etc.	300	0	0
Miscellaneous expenses	300	0	0
Total	£4602	10	0

Annual Cost.	£	s.	d.
[1] Interest and sinking fund (10 years) on £4600 at 5 per cent .	586	10	0
Repairs, including new healds, reeds, etc.	180	0	0
Rent for room and power, 100 looms at 30d. per week (52 weeks) including rates	650	0	0
Gas £20, insurance (plant £103, materials £150).	273	0	0
Wages :—			
(*a*) Loom tuner at 40s.: 2 loom tuners at 37s. 6d. per week (52 weeks)	299	0	0
(*b*) Weft room: man at 30s., 2 boys at 10s. 6d. (52 weeks) .	132	12	0
(*c*) Piece room: taker in at 36s., youth at 16s., boy at 11s. (52 weeks)	163	16	0
(*d*) Clerk and assistant (52 weeks)	180	0	0
Designer manager's salary	250	0	0
Office material, postage, etc.	100	0	0
Cartage of pieces, etc.	80	0	0
Miscellaneous expenses	50	0	0
Depreciation of machinery, etc., 10 per cent.	460	0	0
Total	£3404	18	0

£3404 18s. ÷ 7960 pieces = 8s. 6½d. per piece "other expenses".

List 7b. "Other Expenses" involved in the Manufacture of Dress Goods.—In a weaving plant of 100 6/4 tappet looms, the following details have been worked out, covering the "other expenses" in weaving a mohair lustre dress cloth made to the following particulars :—

Loom Particulars :—

Warp.

2/100 cotton.

64 threads per inch.

49¾ in. reed width.

49 in. grey cloth.

44 in. finished cloth.

Weft.

1/32 mohair.

70 picks per inch (grey cloth).

70 yds. warp.

61 yds. grey cloth.

67 yds. finished cloth.

[1] This item applies to loan capital ; being repaid in 10 years, the item then becomes £4600 at 5 per cent = £230.

Weaving Plant :—

100 6/4 tappet looms.
Speed 160 picks per minute.
54 hours per week.
30 per cent stoppages.

with 70 picks per inch and 61 yds. of grey cloth woven, will result in the following number of pieces per (fifty weeks) year :—

$$\frac{160 \times 60 \times 54 \times 50 \times 70 \times 100}{100 \times 70 \times 36 \times 61} =$$

11,147 say 11,150.

Capital Expenditure.	£	s.	d.
100 6/4 tappet looms at £13 each	1300	0	0
,, straps, shuttles, temples, etc., at 18s. 6d.	92	10	0
,, pulleys and belts at 16s.	80	0	0
Extra fittings	30	0	0
Healds and reeds, etc.	200	0	0
Miscellaneous expenses	150	0	0
Total	£1852	10	0

Annual Cost.	£	s.	d.
[1] Interest and sinking fund (10 years) on £1860 at 5 per cent.	237	0	0
Repairs, including new healds, reeds, etc.	180	0	0
Rent for room and power (100 looms at 19d. per week (52 weeks).	411	13	0
Gas £14, insurance (plant £45, material £90)	149	0	0
Wages :—			
(*a*) 2 loom tuners (40 looms each) at 36s., an improver at 24s. per week (52 weeks)	249	12	0
(*b*) Weft room man at 30s., 2 boys at 10s. 6d. per week (52 weeks)	132	12	0
(*c*) Piece room, taker in at 36s., youth at 16s., boy at 11s.	163	16	0
(*d*) Clerk and assistant	180	0	0
Designer manager's salary	250	0	0
Office material, postage, etc.	100	0	0
Cartage of pieces	80	0	0
Depreciation of machinery at 10 per cent	185	0	0
Miscellaneous expenses	50	0	0
Total	£2368	13	0

£2368 13s. ÷ 11,150 pieces = 4s. 3d. per piece " other expenses ".

The cost of weaving the worsted coating indicated in List 7*a* is 8s. 8d. per piece, and for the same type of work in producing the dress fabric in List 7*b* the cost is 4s. 3d. On these being compared with the amount per piece for " other expenses " it will be found, in each case, that cost of weaving is about identical with the item " other expenses ".

	Other Expenses.	Cost of Weaving.
Worsted coating	8s. 6½d.	8s. 8d.
Lustre dress fabric	4s. 3d.	4s. 3d.

[1] When capital is repaid, this item becomes £1860 at 5 per cent = £93.

This result is supported by practical experience. Consequently in costing a woven fabric, the amount stated as "other expenses" may safely be taken to be *equal to the cost of weaving*.

Dyeing and Finishing Woven Fabrics.—The following lists indicate the costs of dyeing and finishing the various classes of goods produced in the locality of Bradford.

List 8a. Dyeing and Finishing :—

Finishing only. Dress Goods, etc. :—

(*a*) All wool (plain finish) 1½d. per lb. (grey).

(*b*) "Milled" or "vicuna" finish 2s. 6d. per piece (extra).

(*c*) "Pirle" finish 1d. per yard (extra).

(*d*) "Permanent" finish 5s. 6d. (average) per piece (extra).

(*e*) "Proofing" 1½d. per yard (extra).

(*f*) "Stove white" 3s. per piece over colour price.

(*g*) "Permo" finish 3d. per yard.

(*h*) Fancy coloured lustres and mohairs, melanges, etc., 7/4 width, 3s. 6d. per piece (60 yds. warp).

Dyeing and Finishing. Dress Goods, etc. :—

1. Ordinary low crossbred serges. (Mattings and similar fabrics.) Blacks 2½d. per lb. Colours 3¼d. per lb.

2. Estamenes. Blacks 2½d. per lb. Colours 3½d. per lb.

3. Panamas, armures, and similar fabrics, usually finer in make and qualities than No. 1. Blacks 3d. per lb. Colours 4d. per lb.

4. Wool sateens (venetians, etc.). Blacks 3d. per lb. Colours 4d. per lb.

5. Cheviots (milled). Blacks 4d. per lb. Colours 5d. per lb. (Some dyers charge more.)

6. Amazons. Blacks 4½d. to 5d. per lb. Colours 5½d. to 6d. per lb. (Some dyers include a non-spot finish for these prices.)

7. Worsted italian linings. 56 yds. warp, 54 in. finished width.

22/26 lb.	Blacks	9s. 6d.	Colours	11s.
26/30 ,,	,,	11s.	,,	12s. 6d.

8. Cotton warp serges and dress goods.

Grey warp { Blacks 3d. per lb. / Colours 4d. ,, ,, } average.

9. Lustre linings (cotton warp and lustre weft).

70 yds. warp, 32 in. finished width.

12/16 lb. Blacks 2s. 9d. Colours 3s. 6d.

10. Cashmeres (black cotton warp and grey botany weft).

Blacks—16/22 lb. 4s. 3d.
22/26 ,, 4s. 9d.
26/30 ,, 5s. 3d.

Colours 1s. 6d. to 2s. advance on above prices.

11. Brilliantines, sicilians, etc. (cotton warp, mohair, alpaca and lustre weft).

18 lb. 40/45 in. Finished width, 56 yds. warp.
50 ,, grey cloth.

(*a*) *Mohair and Alpaca Wefts*—

White warps—9s. per piece for white and colours.
Coloured ,, 7s. 3d. ,, ,, crossdyed colours and navy blue.
Black ,, 4s. 6d. ,, ,, crossdyed blacks.

(*b*) *For Lustre and Demi-lustre Wefts*—

1s. per piece less on white and coloured warps.
9d. ,, ,, black warps.

(*c*) *Above* 18 *lb.*

White warps—6d. per lb. for white and colours.
Coloured ,, 5d. ,, ,, crossdyed colours and navy blue.
Black ,, 3d. ,, ,, crossdyed blacks.

(*d*) Base heavier and lighter fabric on the same footing.

List 8b. Woollens and Worsteds:—

Finishing only:—

(*a*) Scour, mill, and finish woollens. 1 hour's milling, 8s. 9d. per piece.

(*b*) Scour and finish worsteds. (Plain finish.) 18 oz. per yard. 9s. per piece.

(*c*) Soap scouring woollens. 1s. 6d. per piece extra.

(*d*) Soap scouring worsteds. 1s. 9d. per piece extra.

Dyeing and Finishing:—

1. Woollens (23 oz. per yard) vicuna finish. Black 20s. per piece. Colour 22s. per piece.

2. Worsteds (18 oz. per yard) plain finish. Black 18s. per piece. Colour 22s. per piece.

3. Worsteds (22 oz. per yard) plain finish. Pure alizarine 45s. per piece.

4. Woollens not dyed alizarine. Indigos from 34s. per piece to 8d. per lb. and 10s. for finish.

5. Beavers and meltons. 1d. per yard extra on the above dyed and finished prices.

List 8c. Silks :—

1. Finishing and degumming plain silks. 27 in. wide, $1\frac{1}{4}$d. per yard. 26 to 36 in. wide, $1\frac{1}{2}$d. per yard.

2. Finishing and degumming brocades. 27 in. wide, $\frac{3}{4}$d. per yard. 28 to 36 in. wide, 1d. per yard.

3. Spun-silk handkerchiefs. About 6d. per doz.

Price List 8d. For Dyeing and Finishing Moreens and Venetians (Cottons) :—

(*a*) *Moreens.*—All widths from 27 to 42 in., average will be 38 in.

1. The price for 38 in. in ordinary finish, dyed and finished, 1d. per yard.

2. If mercerized and callendered, $1\frac{5}{8}$d. per yard.

3. Mercerized and specially watered, $2\frac{7}{8}$d. per yard.

(*b*) *Venetians :—*

1. Up to 35 in. wide, 2d. per yard for both blacks and colours.
2. 36 to 39 in., $2\frac{1}{4}$d. ,, ,, ,, ,,
3. 40 to 45 in., $2\frac{3}{4}$d. ,, ,, ,, ,,
4. 46 to 49 in., 3d. ,, ,, ,, ,,

   50 to 60 in.—*the prices depend upon the weight.*

5. 28 lb. for 80 yd., $3\frac{1}{8}$d. per yard for both blacks and colours
6. (Say) 42 lb., $3\frac{5}{8}$d. ,, ,, ,, ,,
7. (Say) 50 lb., $4\frac{1}{4}$d. ,, ,, ,, ,,

Examples in Costing :—

Example 1.—Mixture worsted coating.

Warp.

2/36 mixture botany.
9 threads shade A.
9 ,, ,, B.
9 ,, ,, C.
9 ,, ,, D.
68 threads per inch.
4480 threads in warp.
66 in. width in loom.
56 in. finished cloth width.

Weft.
2/36 mixture botany.
64 picks per inch (grey cloth).
Picked as warped.
70 yds. warp.
65 yds. grey cloth.
62 yds. finished cloth.

Weave.—3/3 twill, reversed (18 threads to the right and 18 to the left).

Finish.—Slightly milled and raised.

Weight of Material :—

Warp $\frac{4480 \times 70}{18 \times 560} = 31\frac{1}{4}$ lb. $= 31\frac{1}{4}$ lb.

Weft $\frac{64 \times 66 \times 65}{18 \times 560} = 27\frac{1}{4}$,, + 5 p.c. waste in weaving $= 28\frac{1}{2}$,,

$58\frac{1}{2}$ lb. grey cloth. $59\frac{3}{4}$ lb. material required.

Cost of Material (Yarn).—See List 1a.

Price of 60's quality of botany top $= 27\frac{3}{4}$d. per lb.

$27\frac{3}{4}$d. + 12d. $= 39\frac{3}{4}$d.	per lb.	price of 1/40's	mixture yarn.
$39\frac{3}{4}$d. − $\frac{1}{2}$d. $= 39\frac{1}{4}$d.	,,	,, 1/36's	,, ,,
$39\frac{1}{4}$d. + $\frac{3}{4}$d. $= 40$d.	,,	,, 2/36's	,, ,,

	£	s.	d.
$31\frac{1}{4}$ lb. warp at 3s. 4d. per lb. =	5	4	2
$28\frac{1}{2}$,, weft ,, ,, =	4	15	0
Total cost of yarn	9	19	2

Cost of Warp-dressing.—See List 2.

Calculated on a 10 cut warp (70 × 10 = 700 yds.).

700 ÷ 55 = 12 warp dresser's cuts.

4480 threads; 4 colours; 21d. per cut × 12 cuts	= 252d.
Add 2s. 6d. for starting	= 30d.
,, 1s. for over 42 in. wide	= 12d.
Total cost of 10 cut warp	= 294d.

294 ÷ 10 = $29\frac{1}{2}$d. average cost per cut (70 yds.)

Cost of Looming (Drawing-in and Sleying).—See List 3.

4480 threads drafted on to 6 shafts =
4480 at 1s. 6d. per 1000 threads =
6s. 9d. cost of looming.
6s. 9d. ÷ 10 (cuts) = 8d. average cost per cut.

Cost of Weaving.—See List 4.

One weaver to 2 looms.

All weaves up to 8 shafts = $3\frac{3}{4}$d. per pick per $\frac{1}{4}$ in.

Add for drafted styles and up to 4 colours = 1d. per pick per $\frac{1}{4}$ in.

Add for drop box = $1\frac{1}{4}$d. per pick per $\frac{1}{4}$ in.

64 picks per inch at 6d. per pick per $\frac{1}{4}$ in.

$$= \frac{64}{4} \times \frac{6}{1} = 8\text{s. per piece.}$$

Burling and Mending.—See List 5a.

Coloured 3/3 twill coating = 4s. 6d. per piece.

Other Expenses.—See List 7a.

Equal to price of weaving = 8s. per piece.

Finishing.—See List 8a.

Plain finish, $1\frac{1}{2}$d. per lb., $58\frac{1}{2}$ lb. at $1\frac{1}{2}$d.	= 7s. 4d.
Milled or vicuna finish extra	= 2s. 6d.
Permanent finish	= 5s. 6d.
	15s. 4d. per piece.

EXAMPLE I.—DESCRIPTION OF CLOTH—MIXTURE WORSTED COATING.

	Per Piece of 70 yd. Warp.					
Cost of material, viz. :—	£	s.	d.	£	s.	d.
$31\frac{1}{4}$ lb. warp at 3s. 4d.	5	4	2			
$28\frac{1}{2}$ lb. weft at 3s. 4d.	4	15	0	9	19	2
Prices paid for processes, viz. :—						
Warping . . . (10 cut warp) at 24s. 6d.	0	2	$5\frac{1}{2}$			
Looming and sleying " " at 6s. 9d.	0		8			
Weaving	0	8	0			
Burling and mending	0	4	6			
"Other expenses"	0	8	0			
Finishing	0	15	4	1	18	$11\frac{1}{2}$
Total cost				11	18	$1\frac{1}{2}$

Yards finished, 62 yds.
Cost per yard (finished), 3s. 10d.

Example 2.—Mohair, lustre dress fabric.

Warp.

2/80's bleached cotton.

64 threads per inch.

3200 threads in warp.

50 in. reed width.
$49\frac{1}{2}$ in. grey cloth width.
44 in. finished cloth width.

Weft.

1/32's mohair.
70 picks per inch (grey cloth).
70 yds. warp.
61 yds. grey cloth.
67 yds. finished cloth.

Weave.—Plain.

Dye to light shade and lustre finish.

Weight of Material :—

$$\text{Warp} \quad \frac{3200 \times 70}{40 \times 840} = 6{\cdot}6 \text{ lb.} \qquad\qquad = 6{\cdot}6 \text{ lb.}$$

$$\text{Weft} \quad \frac{70 \times 50 \times 61}{32 \times 560} = 12 \quad \text{,,} \quad + 5 \text{ per cent waste} \quad = 12{\cdot}6$$

Grey cloth 18·6 lb. material required 19·2 lb.

Cost of Material (Yarn) :—

	£	s.	d.
6·6 lb. warp at 2s. 2d. per lb. =	0	14	4
12·6 ,, weft at 3s. 6d. ,, =	2	4	1
Total cost of yarn	£2	18	5

Cost of Warp Dressing.—See List 2.

Calculated on a 10 cut warp (70 × 10 = 700 yds.).

700 ÷ 55 = 12 warp dresser's cuts.

3200 threads; 1 colour; 10d. per cut × 12 cuts.	= 120d.
Add 2s. 6d. for starting	= 30d.
,, 1s. for over 42 in. wide	= 12d.
Total cost of 10 cut warp	= 162d.

$162 \div 10 = 16\frac{1}{2}$d. average cost per cut.

Cost of Looming (Drawing-in and Sleying).—See List 3.

4 shafts (straight hop shaft draft).

3200 threads at 1s. per 1000 = 3s. $2\frac{1}{2}$d. cost of looming.

3s. $2\frac{1}{2}$d. ÷ 10 (cuts) = 4d. average cost per cut.

Cost of Weaving.—See List 4.

Tappet loom. One weaver to 2 looms.

Over 47 in. reed space	= $2\frac{1}{2}$d.	per pick	per $\frac{1}{4}$	inch.
Add for white mohair weft	= $\frac{1}{4}$d.	,,	,,	,,
,, for cop weft . .	= $\frac{1}{4}$d.	,,	,,	,,
70 picks per inch at .	= 3d.	,,	,,	,,

$$\frac{70}{4} \times \frac{3}{1} = 4\text{s. } 4\tfrac{1}{2}\text{d. per piece.}$$

Burling and Mending.—See List 5b.
Plain mohairs = 1s. 6d per piece.
"*Other Expenses.*"—See List 7b.
Equal to price of weaving = 4s. 4½d. per piece.
Dyeing and Finishing.—See List 8a.

For 50 yds. grey cloth, made from white warps and dyeing into light colours .	=	9s. per piece.
For 61 yds. of grey cloth add	=	2s. „ „
Total cost	=	11s. „ „

EXAMPLE II.—DESCRIPTION OF CLOTH—MOHAIR LUSTRE DRESS FABRIC.

	Per piece of 70 yd. warp.					
Cost of material, viz. :—	£	s.	d.	£	s.	d.
6·6 lb. warp at 2s. 2d.	0	14	4			
12·6 lb. weft at 3s. 6d.	2	4	1	2	18	5
Prices paid for processes, viz. :—						
Warping . . . (10 cut warp) at 13s. 6d.	0	1	4½			
Looming and sleying . („ „) at 3s. 2½d.	0	0	4			
Weaving	0	4	4½			
Burling and mending	0	1	6			
"Other expenses"	0	4	4½			
Dyeing and finishing	0	11	0	1	2	11½
Total cost				4	1	4½

Yards finished, 67 yds.
Cost per yard (finished), 1s. 2½d.

CHAPTER XV.

DEFINITIONS.

Glossary of Terms Applied to Woven Fabrics.

Abb (Weaving Term).—The weft or filling which is inserted between the warp threads to form a cloth.

Alaska.—A yarn composed of combed wool and cotton carded and drawn together to form a mixture.

Alizarine.—A dye of coal-tar origin largely employed in the place of indigo for the production of navy blues and blacks.

Alpaca (Cloth).—A fabric in which the weft (which predominates) is spun from alpaca.

Alpaca (Wool Term).—Material of a long, fine, and silky nature, possessing characteristics of both wool and hair. It is obtained from the Peruvian sheep of the Llama species.

Amazon.—An all-wool fabric made from a B.A. mule-spun warp and a thicker soft spun woollen weft, the mule-spun warp being thrown on to the surface. The finish is more or less of a dress face character.

Aniline.—One of the substances produced from the fractional distillation of coal-tar.

Angola Yarn.—A yarn composed of wool and cotton scribbled together. The proportions may be varied according to requirements.

Angora Goat.—A species of goat originally bred in Asia Minor, but later introduced into Cape Colony, producing the mohair fibre, known under the three headings of Turkey, Van, and Cape mohair.

Armure.—A small weave effect usually of a fancy warp-rib character, employed in fabrics as a rule made wholly of wool.

Art Serge.—Any fabric of a serge character in æsthetic colours.

Asbestos.—A fibrous mineral of a long, fine, and flexible nature, and usually of a white colour, which is not affected by fire, acids, gases, etc. It may be spun into yarn and woven into cloth.

Astrachan (Astrakan).—A wool of a curly character, coming from the town of Astrakhan, in Russia.

Astrakan (Weaving Term).—The name given to a pile fabric of a coarse texture presenting a curious curly surface. These fabrics are produced in two ways :—

1. On the weft principle, a shrinkage of the ground texture throwing the pile weft up as a loop.

2. As a warp texture, in which a thick curly warp yarn is brought over wires to form the necessary loops.

Axminster.—A carpet originally made at Axminster in Devonshire, but since the introduction of the Axminster power loom now produced in all the great carpet weaving centres. It is of the knotted pile structure, and no doubt took its origin in what is now termed the "Turkey" carpet.

Backed Cloth.—A single texture with extra threads (warp) or picks (weft) stitched on the back of the texture, thus adding weight but not interfering with the face texture.

Baffetas.—White or blue calico.

Bandanna.—A calico cloth in which white or brightly coloured spots are produced upon a red or dark ground.

Barathea.—A fine texture of broken weft-rib character, made in the best qualities from silk warp and fine botany weft.

Basket Effect.—An order of intersection, giving an enlarged hopsack or mat appearance, hence the special name.

Bead Yarn.—A yarn upon which is fastened either an actual bead or a lump of hardened gelatine of a bead-like form.

Beating.—A group of extra threads usually left with each warp from which the threads broken during weaving may be replaced.

Beaver.—A heavy texture made from woollen yarns, the fabric being milled, raised, and finally given a dress face finish, no doubt with the idea of matching the natural beaver skin.

Bedford Cord.—A texture in which the interlacing is so arranged that a warp surface fabric is produced with a rounded cord effect, running warp way, the indented effect being produced by two threads working plain.

Beege.—A fabric of a twill character, somewhat loose in texture.

Beetling.—A finishing process consisting of subjecting the fabric to an even hammering by means of a series of fallers.

Bengaline.—A bold warp-rib silk fabric.

Billiard Cloth.—A fine milled woollen texture of melton finish, usually dyed green.

Binding Threads.—Threads employed to unite two or more textures into one firm structure.

Bird's Eye Pattern.—A term originally applied to a peculiar small pattern produced on four shafts, but now applied to any similar fabric.

Bleaching.—The whitening of textile materials in the raw, semi-manufactured, or fully-manufactured state by "grassing," or by chemical means.

Bleeding.—A term applied to cloth or yarn from which, when subjected to the scouring or milling operation, the colour runs, which colour usually stains the whites or light shades there present.

Blister Cloth.—A fabric—usually a double texture—designed to produce a blistered or raised effect.

Boardy.—A term applied to fabrics which handle hard and cakey.

Boiling-off.—The operation of removing, by means of a hot liquid, the gum which covers the raw silk fibre.

Botany Twill.—A twilled texture the warp and weft of which are made from botany wool.

Botany Wool.—Originally merino wool grown near Botany Bay, Australia; at the present time a term applied to all classes of merino or fine wools.

Box Cloth.—An all-wool fabric made from yarn spun on the woollen principle with a milled finish giving a felt appearance.

Box Loom.—A loom by which different colours of weft may be thrown into the fabric by lifting or lowering the required shuttle into the picking plane.

Braid-Effect.—A weave developed style made so far as possible to imitate the appearance of braid.

Brilliantine.—A plain texture of medium weight composed of a cotton warp and a lustrous weft, the lustre weft predominating.

Broad Cloth.—A fine woollen cloth, usually woven plain, finely dyed, dressed, and finished. The original style was undoubtedly set very wide in the loom to allow for a considerable shrinkage in finishing—hence the name.

Brocade (Silk Fabric).—A rich texture of an elaborately figured description.

Broken-Ends.—Ends in the warp which have broken owing to weakness or being too heavily tensioned. The breaking may have taken place during weaving or during finishing.

Broken-Picks.—A defect in weaving caused by the weft breaking as it passes from edge to edge of the piece.

Broken Crow Twill.—The 4-sateen weave.

Broken Twill.—A design or plan in which the effect is that of an ordinary twill arranged in a broken or non-continuous order.

Buckskin Cloth.—A cloth of a fine warp surface, sateen twill texture; originally made of fine woollen yarns.

Buckskin Weave.—A point-paper plan usually based upon the 8-warp sateen to which a dot is added, thus producing an upright warp twill effect.

Buenos Ayres Wool.—Wool from Buenos Ayres, South America, which is composed of crossbreds and botanies. The quality is usually not quite equal in Australian wools.

Burl Dyeing.—The dyeing or inking of spots of vegetable matter which otherwise would give a grey appearance to the finished piece.

Burler.—A person who dresses cloth prior to finishing.

Burling.—The looking over of a piece of cloth and the taking out of all burrs, slubs, knots, etc., thus improving its appearance.

Calendering.—A heavy continuous pressing under heat.

Calico.—A plain cloth made from cotton.

Cambric.—A finely set weave linen cloth, originally made at Cambrai, in Belgium.

Campbell Twill.—An 8-thread weave of the irregular sateen derivative class.

Canvas Cloth.—An open plain texture, usually produced from hard-twisted yarns.

Cape Wool.—Wool, mostly merino, very fine and often very white, but slightly defective in soundness of staple, largely used for blending purposes with Australian wools.

Cashmere.—The pure under wool from the Cashmere goat.

Cashmere Cloth.—A fine, light texture; warp of cotton or wool, weft always of a fine botany yarn; weave 2/1 weft twill. The warp is set fairly close, but a great number of picks per $\frac{1}{4}$ in. are inserted, thus giving what is known as the "cashmere twill" or "plain-back".

Cashmere Twill.—The 2/1 weft twill.

Cassimere Twill.—The 2/2 twill.

Cellulose.—The substance forming the cellular tissue of plants now largely employed in the production of imitation silk yarns.

Celtic.—What is known as a 2/2 hopsack.

Celtic Twill.—A weave with a sateen base, otherwise spoken of as twilled hopsack.

Centre Stitching Warp.—An extra warp, usually of thin cotton, employed in double cloth structures for binding the two cloths together.

Chaine or Chain.—A word usually used in the market for "warp".

Chain Twill.—A twilled fabric of a chain character or appearance obtained by a combination of weave and material.

Chappe Silk Yarn.—A term given to silk yarn made from special wastes.

Chardonnet Silk.—An artificial silk prepared by nitrating cellulose and dissolving in ether and alcohol.

Check.—The term given to the square appearance produced on a fabric by employing a special weave of two or more colours of warp and weft specially arranged to give this appearance.

Chenille.—A section or group of threads of a fabric woven on the gauze principle and cut up into stripes and subsequently twisted, frequently introduced as weft into what are termed chenille or Victorian Axminster carpets.

Cheviot (Cloth).—A texture, usually of a roughish character, made from wool of the Cheviot type.

Chiffon.—The name given to a light, flimsy texture of plain weave, the warp and weft usually being of a very fine silk material.

China Grass.—A vegetable fibre produced by two members of the nettle family, otherwise spoken of as Ramie or Rhea.

Chiné.—A name given to fabrics usually woven plain in which a figure has been printed on to the warp prior to weaving.

Cloakings.—A term given to textures suitable for making up into cloakings.

Cloth Finish.—A term usually applied to a fabric which has been finished to be "full" in the handle, the weave being more or less obliterated.

Clothing Wool.—A wool usually short and fine in fibre, specially suited in structure of fibre for the woollen trade.

Cloudy.—A term usually applied to a fabric which has been either unevenly dyed or unevenly steamed.

Cobblers.—A term applied to pieces returned as being of unsatisfactory build.

Cobourg.—A cloth made from cotton warp and botany weft, with a warp interlacing of the 2/1 or cashmere weave.

Cockled (Cockliness).—A curliness or crimpiness most marked in fine goods, but always appearing in fabrics when different runs of yarn or tensions on sections of the warp have been accidentally introduced.

Cockled Fabric.—A defective fabric, with an uneven surface appearance, usually due to irregular shrinkage during finishing. The cause of such irregularity must, however, be usually looked for much earlier on in the cycle of operations.

Combination Twill.—A twill produced by combining two simple twills together, thread and thread, or two threads and one thread, etc., or pick and pick, or two picks and one pick, etc.

Combing (Commission).—A branch of the wool trade. The commission comber is equipped with the plant, but receives his material from either the wool merchant or the spinner, and delivers it in the form of top and noil, simply receiving a commission for his work.

Compound Twill.—A twill composed or more weaves which weave well together, each weave, however, maintaining its individuality in its particular section of the design.

Conditioning.—The ascertaining of or the fixing of the amount of moisture present in textile materials. Thus to ascertain the true weight of a bulk lot of wool for instance, representative samples must be drawn from the exterior and interior of the bale or bales. These samples must then be absolutely dried, weighed, and their true or "conditioned" weight obtained by adding to the dry weight the standard "regain" moisture. The fixed Bradford standards of "regain" are, for tops—oil combed, 19 per cent; dry combed, 18¼ per cent; for noil, 14 per cent; for yarn worsted, 18¼ per cent; cotton, 8½ per cent; silk, 11 per cent.

Coping.—A heavy cloth made of either worsted or woollen yarns for gentlemen's wear; with various weaves and colourings applied.

Cord-de-Chin.—A light fabric made from botany warp and silk weft in which two threads are combined as one to form a lightly defined cord lengthways in the piece.

Corduroy.—A weft pile structure in which the floats of pile weft are bound into the ground texture in one continuous line warp way, so that upon being cut they project from this line and hence form a dense pile cord.

Corkscrew Cloth.—A closely set fabric usually made from fine worsted yarns and presenting the appearance of a warp rib running almost in the weft direction.

Corkscrew Weave.—A weave or plan based upon the 13-sateen which presents a peculiar appearance, best described as that of a warp rib running at a low angle.

Counts.—A term employed in the silk trade for indicating the number of threads and picks per inch.

Counts of Yarn.—The number given to a yarn of any material, usually indicating the number of hanks per lb. of that yarn.

Covert Coating.—A light or medium style of fabric constructed of a solid mixture or twist yarn presenting a smart upright twill appearance and usually shower proofed.

Covert Weave.—A smart upright warp twill, usually obtained by employing a warp sateen weave, or a modification of the same.

Crabbing.—A preliminary finishing operation which consists in running the fabric under tension on to a roller usually, but not always, running in a hot liquor and then steamed. This is sometimes termed "setting" the fabric.

Cracked Ends.—Broken ends in a lustre piece—the breaking having taken place in either (*a*) weaving, or (*b*) finishing—creating a defective bright spot at each position where an end has been cracked.

Crammed Stripe Fabric.—A fabric of a striped character produced by cramming a great number of threads into one section of the stripe, as compared with the other section or sections of the stripe. A special order of looming and sleying is obviously necessary, particularly when the jacquard is employed.

Cramping (Finishers' Term).—The operation of pressing a fabric between "cramps" after it has been cuttled.

Crash.—A coarse linen fabric mostly used for towels.

Cravenette.—A finishing process which causes the fabric submitted to it to be water-proof and spot-proof.

Crêpe de Chêne.—A fabric produced from a fine silk warp and a right and left (open band and cross laid) tightly twisted worsted weft, this latter during the finishing operation disturbing the straightness of both itself and the warp, and thus creating a crêpe effect.

Crêpe Weave.—An interlacing of threads and picks in a more or less mixed or indiscriminate order to produce an appearance of a finely broken character, usually associated with crêpe cloths.

Crepoline.—A fabric of a warp-rib character, in which the regular order of the weave is so broken as to give a "rib-crape" effect.

Crêpon.—A structure, as the name implies, of a crape-like character, this character being obtainable in at least five ways (a) by combination of materials, (b) by combination of weaves, (c) by combination of a and b, (d) by mechanical arrangements during weaving, (e) by subjecting fabrics specially constructed to a special chemical process during finishing.

Crimp.—A term synonymous with crêpon, but less frequently employed.

Crimpiness or Curliness.—The curls or crimps in the wool fibre, which in the case of merinos largely assist the felting of the fabric, which felting takes place during the finishing operation.

Crossband Twine.—The direction of the twist in yarns produced by cross spindle bands, as distinct from that produced by open spindle bands.

Cross band or warp twist is from right to left looking up the yarn; open band or weft twist is from left to right looking up the yarn.

Cross-dyed.—The dyeing of a fabric usually composed of two materials—say cotton and wool, one of these materials—usually the warp—having been yarn or warp dyed prior to weaving, so that there only remains the second material to be dyed.

Cross-over Style.—A style of fabric of a striped character, in which the stripe takes the direction of the weft.

Crow Foot.—A defective appearance in fabrics usually due to defectively-spun yarns.

Crow Foot Weave.—The 4-sateen or 3/1 broken twill.

Crow Twill.—The 3/1 twill.

Cut.—A standard length of warp. In the worsted district 70 yds., but in other districts sometimes 50 and sometimes 100 yds.

Cut or Lea.—A length of 300 yds. employed in the linen trade for measuring yarns. Thus the cuts or leas per lb. indicate the count. In the Galashiels trade the cuts or leas of 300 yds. per 24 oz. indicate the count.

Cut Pile.—A pile formed by looping the threads over wires, which carry at their ends knives, so that as each wire is withdrawn its knife severs the pile loop, thus producing cut pile.

Cutting.—The finishing operation, which consists in passing the fabric close to the blades of the cutting machine, so that all the surface fibres raised from the piece during the operation of raising, are cut off, leaving a clean and level piece.

Cutting Machine.—A machine employed in the finishing for shearing or cutting the fibre from the face of fabrics. The knives are usually arranged spirally in a circular box, as in the ordinary lawn-mower.

Cuttling (Finishers' term).—The folding of a fabric after finishing in a suitable manner for handling.

Damask.—A figured fabric formerly made of silk, taking its name from Damascus in Syria. Cotton, linen, and worsted are now used in the manufacture of the fabric.

Decatizing.—The process of fixing a cloth by steam.

Degumming.—The boiling-off of silk in soap and hot water, in order to dissolve and wash away the natural gum or sericin which surrounds the fibre.

Delaine.—A light all-wool cloth of plain weave. It is usually printed in various designs and colours. The term, no doubt, arose from "mousseline delaine," which signifies "wool muslin".

Demi-Lustre.—Not pure lustre. A term applied to long and fairly fine wools and yarns usually from 36's to 46's in quality and counts.

Denier System.—A method of counting silk yarns. The hank is 400 French ells, that is, 520 English yards; the weight is the denier, of which $533\frac{1}{3}$ weigh one English ounce. The number of deniers that one hank weighs is the count of the yarn.

Dhooty.—A plain fabric ornamented by the use of extra warp or weft in border form, and usually woven in a type of swivel loom.

Diagonal.—A term applied generally to bold twills.

Diamond or Diaper.—Terms applied to patterns of a twilled check character, such usually being produced by weave development. The original diaper fabric was based upon the sateen weave, and was usually made of linen.

Dice Pattern.—A type of pattern consisting of squares of various dimensions emphasized in various weaves.

Dimity.—A stout cotton cloth similar to a fustian, but not usually so thick in texture, being usually figured with raised stripes. Dimity was originally imported from India, but is now largely produced in Lancashire.

Discharging.—Another term for degumming.

Doeskin.—A fine woollen cloth made from the best botany wool, finely spun and finely set in the loom, with the 5-sateen warp interlacing being employed. A soft dress face finish is given to the fabric.

Dolly.—A machine consisting of rollers and vats for scouring pieces which are stitched together to form an endless band.

Double Ends.—Two ends weaving as one in a cloth. This may be due either to a fault, or it may be that the cloth is specially arranged with either double ends or double picks.

Double Plain.—A combination of two plain makes produced at one and the same time but quite distinct from one another, although they may change places to form stripes, checks, or figures.

Doubling.—The twisting together of two or more threads, in order to make a stronger and firmer thread.

Doup.—An ordinary heald with the addition of a loose half-heald which is passed through the eye of the ordinary heald, and then in its turn receives the warp thread. It is made in several forms, tied or free, or entirely of string or partly of metal.

Doup Harness.—A term applied to either an ordinary harness with a doup mounted in front or to a specially-built gauze harness.

Draft (Weaving Term).—Exactly the same as drawing-in.

Drape.—A medium-weight, heavily milled worsted cloth.

Drawing-in.—A term employed to indicate the drawing-in of the warp threads, already dressed upon the loom beam, through the mails of the healds in the order indicated by the draft supplied by the designer.

Dresser (Warp).—The operator, usually a man, employed in dressing the warps delivered in ball form on to the loom beams.

Dressing (Weaving Term).—The process of preparing the warp previous to its being placed in the loom and really consisting in the even distribution of the threads over a given space, and the placing of a similar tension on each thread.

Drill.—A twilled linen or cotton fabric used for sheeting.

Dry Finish.—One of the finishing processes applied to certain types of yarn dyed cloths, with the idea of obviating bleeding of colours, at the same time obtaining the required handle.

Dyed Slubbing.—A term applied to worsted tops which have been dyed in the top form. These dyed slubbings (or more properly speaking, dyed tops) are then recombed prior to drawing and spinning.

Dyeing.—The colouring of materials in the piece to enhance the value and appearance. There are five methods of producing colour in the fabric: (1) Raw material dyeing, (2) Yarn dyeing, (3) Cross dyeing, (4) Mixed dyeing, (5) Piece dyeing.

East India Wool.—Wool of a short, coarse and hairy nature coming from sheep in India, which from lack of cultivation grow material very near the original type of hairy wool. Largely used in the carpet trade.

End and End Warp.—A warp that is dressed from two balls of warp, taking one end from each ball alternately.

Ended Hank.—A term applied to yarn which being irregularly dyed in the hank, shows a regularly repeated unevenness corresponding with the hank length.

Ends.—A term applied to the threads in a warp.

Eolienne.—A very open texture, composed of silk warp and wool weft.

Estamene.—A cloth made from crossbred yarn usually employing the 2/2 or 3/3 twill. It is given a milled rough finish.

Estrella.—A plain woven fabric consisting of silk warp and botany weft, picked 2 right-twist yarn and 2 left-twist yarn. The weft yarn is very hard twist in order to produce the required crimped appearance.

Etamine.—A light cloth made of wool, silk, linen, etc., and of an openwork structure originally used as a filter cloth.

Extract.—A fibrous material of wool derived from waste cotton and wool mixed materials, the cotton being destroyed by the sulphuric acid or other process, leaving the wool intact to be ground or carded up into extract.

Extra Warp.—The term given to warp threads which are added to a single cloth with the object of:—

(*a*) Increasing the weight of the cloth.
(*b*) Figuring the cloth, or
(*c*) Both increasing the weight and figuring at one and the same time.

Extra Weft.—A term given to extra weft threads or picks with the object of :—

(*a*) Increasing the weight of the cloth.
(*b*) Figuring the cloth, or
(*c*) Both increasing the weight and figuring at one and the same time.

Fabric.—A term applied to structures which may be composed of either

(*a*) Fibres milled together.
(*b*) Threads interlaced at right angles, or
(*c*) One thread interlaced with itself to produce a knitted structure.

Fancy Draft.—An entering or order of drawing threads into a set of gears in any regular or fancy manner.

Fast Colour.—A term applied to the colour on yarn or cloth which will withstand light and milling, etc.

Felling Marks.—Marks woven into fabrics at certain distances indicating that one piece has been finished and another piece started.

Felt.—A type of fabric which may be defined as "fibre" fabric as distinct from ordinary cloths which are "thread" fabrics. It is usually made from a wool having a strong tendency to felt. Films of wool, say 80 in. wide, are laid on the top of one another —number according to the thickness of felt required—by means of an apparatus added to the end of the ordinary carder. Upon due thickness being obtained, the films are milled into one compact mass or fabric.

Felting Property.—The property possessed by most wools which results in the interlocking of the fibres and consequently in the production of a firm cloth. This property may be said to be due to the fibre structure, to the natural curliness of the fibre, and to the nature of the fibre, which causes it to contract and curl under the action of alkalies and heat.

Fents.—Short damaged lengths of cloths or short lengths cut from piece ends.

Fibre.—The name given to the individual constituents of a thread. Thus fibrils may be said to constitute fibres, fibres may be said to constitute threads, and threads may be said to constitute cloths.

Filling.—Weighting such as starch, size, etc., put into goods during or after the dyeing and finishing operations for the purpose of adding weight to the cloth and making it firmer.

Finishing.—The processes through which goods are put after leaving the loom, to improve them in appearance and give them the required characteristics. Dyeing may be considered a finishing operation, but it is perhaps better considered as a process distinct from the finishing.

Flake Yarn.—A yarn spotted with a round or elongated lump at varying distances, usually of a different material and colour.

Flannel.—An all-wool fabric usually of a plain or twilled make, of a soft, and, if possible, non-shrinking character, making it specially suitable for being worn next the skin.

Flannelette.—A structure made of cotton from soft mule spun yarns, the fabric being subsequently raised to give an imitation of the true wool flannel. It is necessarily very inflammable.

Flax.—The fibrous material of a long and strong nature, this being part of the stem of the flax plant (Linum family).

Flecked.—A spotted appearance on either yarns or fabrics due to some distinctive colour or material thrown in some way or other on to the ground texture or colour.

Flipes.—The folds into which a piece is thrown so that it may be looked over easily. The length varies from half to one yard.

Flocks.—The refuse or waste from wool (and sometimes cotton) produced in the milling, raising, and cropping machines.

Florantine Twill.—A weave suitable for lustre fabrics on eight threads and eight picks.

Florette Silk.—The external covering of the double fibre or filament exuded by the silkworm, this being known as waste silk. Some years ago it was practically useless, but now is spun into very satisfactory yarn and cloth.

Flyer Spinning.—Spinning on the flyer principle. This system is employed in spinning yarns such as mohair, etc., in which smoothness of thread is the most essential feature. The output is only about 50 per cent of that of the other systems of spinning.

Folded Yarn.—Yarn composed to two or more single threads, these being twisted together to produce a stronger yarn more suitable for weaving or for special twist effect.

Foulard.—A fairly fine silk cloth with a pattern printed on after weaving.

Foulie.—An all botany wool cloth which receives a severely milled finish, thus hiding the weave structure.

Foundation Cloth Embroidery (Term).—A fine gauze cloth made from exceedingly strong but fine silk yarns, used as a foundation for embroidering upon, for the production of the laces of St. Gaul, being subsequently destroyed by chemical treatment.

Fulling.—An operation through which wool cloth is passed to increase it in thickness, density, and solidity, and also to improve it in handle.

Gait or Gate.—A full repeat of the draft in healds, or, in the case of a jacquard, one complete row—usually of either eight or sixteen—in the harness.

Gala (Yarn Count).—The method of counting yarns employed in the Galashiels district of Scotland. The fixed weight is 24 oz., and the hank 300 yds. As usual, the number of hanks for the fixed weight gives the count number.

Gassed Yarn.—Yarn which has been subjected to the process of gassing.

Gassing.—A process which certain classes of yarns—especially certain silk, cotton, and braid yarns—are put through to take away all superfluous fibres, and thus make a very clean and smooth thread. A gas flame is usually employed, but occasionally a surface heated to white heat takes the place of the flame.

Gauge Point.—A fixed number—obtained by simplifying a compound number—employed as a quick means of working out certain calculations with reference to both machinery and materials.

Gauze.—A type of fabric in which certain of the threads, although keeping approximately in the same plane, are deflected from the straight line in order to produce spider's web and other well-recognized gauze styles.

Gaws.—A Scotch term for thin places in cloth.

Genapping.—A process through which certain classes of yarns—more particularly worsteds—are put with the idea of leaving them perfectly clean and smooth. Practically the same as gassing.

Gig.—A finishing machine practically consisting of a large cylinder clothed with teasels, with suitable apparatus for bearing the cloth to be treated continuously upon these teasels.

Gigging.—The process of producing a nap or raised surface on cloths by passing them through the gig.

Gimp Yarns.—A term usually applied to twist yarns of a more or less ask nature. They are usually of a fancy character. Usually two or more coloured threads are twisted round a centre core thread, completely hiding it.

Gingham.—A plaided or checked cotton fabric of a somewhat stiff character suitable for dress goods.

Glacé.—A term applied to fine lustre fabrics usually of a figured character, made from a fine cotton warp with a comparatively thick mohair weft which is made to do all the bending.

Glass Fibre.—A fibre made from specially prepared glass, used in a very limited degree in textiles.

Glazed Cotton.—Cotton yarn specially prepared and coated giving a result in appearance somewhat similar to horse hair.

Gordon Cord.—The name applied to a weave of a twilled cord character.

Grandrella.—A term applied to solidly coloured cotton twists of an irregular character. These yarns are usually introduced in stripe or check form.

Grandrelle.—A type of twist yarn produced by twisting together of two threads usually very differently coloured.

Granite.—A type of weave effect giving a broken, irregular appearance of a granite-like character.

Grenada.—The name of a fabric woven from a three down two up 5-sateen weft twill, the warp usually being black cotton and the weft alpaca or mohair.

Grenadine.—An open-work, gauze-like fabric of silk or wool, or a combination of the two, extremely thin and transparent.

Grey.—A term given to yarn as it leaves the spinning frame, or to a piece upon leaving the loom.

Gross.—Twelve dozen, or 144 hanks, worsted wefts being sold by the gross.

Gross Grain.—A fine silk warp and cotton weft, producing a warp ribbed fabric.

Habutai.—A term applied to a soft, washable Japanese silk fabric.

Hair.—A smooth, almost straight, fibre, of varying length, fineness, and lustre, grown by various animals—the goat, the horse, the cow, etc. Its structure is cellular, the exterior surface of each hair being of a scaly character, although not apparent under the microscope owing to the fact that the scales are imbedded for two-thirds or more of their length close into the trunk of the fibre.

Hair (Camel's).—From the camel, which grows a long and bristly hair, at the root of which is a fine fibre usually of a fawn colour, and somewhat short. With this material the comber reverses the ordinary combing operation, rather extracting the short fibre—which forms the camel's hair of commerce—from the long, as against the ordinary operation of combing, which consists in extracting the long fibres from the short.

Hairline.—A term indiscriminately applied to fine, solid-coloured striped fabrics. Strictly speaking, these stripes should be formed on the true hairline principle, which is, that for the stripe in the warp direction each colour of warp must be covered by its own colour of weft, and for the weft direction that each colour of weft should be covered by its own colour of warp.

Hank (Yarn Term).—A term applied to a bundle of material of a suitable length for calculating from handling commercially. Its length in the worsted trade is due to the employment of a 1 yd. circumference reel, in the cotton trade to the employment of a $1\frac{1}{2}$ yd. circumference reel. In other trades it is impossible to say how the hank length has been decided upon. The following are the most important :—

The worsted hank = 560 yds. (that is 7 smaller, of 80 yds. each).
The cotton hank = 840 yds.
The woollen hank = 256 yds.

The hanks per lb. usually indicate the "count" of a yarn. It should be noted, however, that the basis of the woollen hank is 1520 yds. to a 6 lb. unit of weight.

Hank Tester.—A machine for testing the strength and elasticity of a hank of yarn. It consists of two hooks upon which the yarn is suitably hanked, an arrangement for receding one of these hooks from the other, thereby putting strain upon the yarn, and a mechanism for recording the amount of such strain and also of the elasticity. The best form is on the dead-weight principle.

Hard Twist.—A yarn which contains more than the usual number of turns per inch, and is consequently employed only in special cases. Any twist more than the square root of the count multiplied by four should be ranked as a hard twist.

Harlequin Check.—A plaid effect of a somewhat striking character in three or more distinct colours.

Head-end.—The commencement of a piece (in the loom).

Head-lease.—A term applied to the arrangement of the threads at the commencement of a warp, usually end-and-end.

Heald or Heddle.—An apparatus composed of two wooden shafts, the necessary cords, and the mail in the centre; a series of which control the warp in weaving.

Hemp.—The term hemp is often used in a generic sense, and is applied to fibres derived from entirely different plants. Sunn hemp is yielded by a species of Crotalaria, Manila hemp by a wild plantain, sisal hemp by an aloe (Agave), while "Chinese hemp" is applied indiscriminately to the fibre of an Abutilon pineapple.

Henrietta.—A cloth usually made from silk warp and from fine botany weft with a 2/1 weft twill heavily wefted.

Herring-bone.—A striped design, in which, by means of special drafting or a special weave, a certain number of threads are twilled first to the right and then to the left, thus opposing each other and giving the appearance of a herring-bone.

Honeycomb.—A type of interlacing which causes marked depressions and elevations of warp and weft, thus giving to a fabric more or less the appearance of being honeycombed.

Hopsack, Matt or Basket Weave.—A weave which is produced by dividing the warp into two sheds only, a 2/2 hopsack being produced by two threads and two picks working together; the 3/3 hopsack by three threads and three picks working together.

Hot-Pressed Finish.—A finish which is given to pieces to obtain the desired handle, and also to prevent the colour from bleeding.

Indigo.—A vegetable colouring matter obtained from a leguminous plant found in India, Africa, and America, of the genus *Indigofera*.

Ingrain.—A term particularly applied to certain carpets indicating that the wool employed has been coloured prior to the manufacturing of the carpet.

Irregular Sateen.—A weave based on the sateen, but including certain irregular indications.

Italian Cloth.—A cloth made of cotton warp and fine botany or cotton weft, the weave being 5 sateen weft face, and the balance of the cloth a great number of picks to comparatively few threads. These fabrics are usually woven from black warp and grey weft, being piece dyed.

Jacconettes.—Tangibs, mulls, cambrics, and nainsooks are all varieties of plain cloth differing in width, length, counts of yarn, reed, and picks. These goods are all woven in the grey.

Jean.—A cotton term for a three-shaft twill 2/1 made with weft predominating.

Jeanette.—A similar fabric to the jean in which the warp predominates.

Jute.—The fibre from the *Corchorus Capsulasis* and other species. It is grown in India, China, America, and West Africa, and may be considered essentially a tropical plant.

Kaai Finish.—A type of finish imparted to crepon fabrics which have been manufactured from cotton and mohair. The cotton is caused to shrink, thus giving to the mohair the crinkled appearance associated with crepons.

Kersey.—A coarse worsted or woollen fabric of a serge-like character.

Keymo Finish.—A finish—said to consist in running the fabrics through a sulphuric acid solution—given to all-wool goods such a flannels, shirtings, etc., to render them unshrinkable.

Kink.—A snarl or curl produced by a hard-twisted thread receding upon itself.

Kirtle.—A mantle or upper garment.

Knickerbocker Goods.—A fabric in part or entirely made from knickerbocker yarns.

Knickerbocker Yarns.—Yarns which are spotted or striped often in several colours. They may be produced in several ways, but the true knickerbocker yarn is produced by flecking the spotting material on to the carder.

Knitted Fabric.—A fabric composed of a yarn interlacing with itself as distinct from a woven fabric in which two series of threads cross one another at right angles.

Knop Yarn.—A yarn upon which knops or lumps of yarn of one or more colours appear at intervals.

Knubs.—Waste silk produced during the operation of winding off from the cocoon.

Kurkee.—A coarse kind of blanket.

Lasting.—A fine, durable fabric made from strong wool or cotton, of a somewhat hard handle, but smooth in appearance.

Lawn.—A type of fine linen cloth usually employed as a dress fabric, the name being derived from the French "linon".

Lea (linen term).—The hank of 300 yds. in length employed in the linen trade. The number of leas per pound indicates the count.

Leaf.—A term sometimes used for a heald shaft.

Lease.—The division of the threads in a warp—either 1 and 1, 2 and 2, 8 and 8, 16 and 16, etc.

Linen.—A yarn or cloth made from fibres obtained by the process of retting, scutching, etc., the flax plant.

Lining.—A cloth usually made from cotton warp and cotton, alpaca or botany weft according to the type of cloth required, a sateen weave being usually employed. The Italian is a particular example.

List.—The edge or selvedge of a piece.

Listed.—A defect which occurs on the list or edge of a piece, such as the edge being torn away, stained or otherwise damaged.

Loading.—A method of adding weight to either yarn or cloth by loading with various substances.

Log-wood.—A wood extensively employed in the dyeing trade mostly for dyeing blacks.

Looker-over.—A person who looks over or passes pieces after they leave the loom and after the dyeing or finishing off operations. It is the duty of the looker-over to report damages, etc.

Looming.—The act of drawing the warp into gears which will ultimately be placed in the loom in a devised order. The term is very occasionally applied to putting the gears into the loom.

Loop Yarn.—A yarn which is made with loops at various distances apart as desired, usually made at two operations. It is largely employed in the production of astrakhan fabrics.

Lump.—A length of cloth which is woven double the ordinary piece length, this particular length varying from 100 to 140 yds. of warp.

Lustre.—The glossy or shiny appearance which mohair, alpaca, and some English wools possess, and which causes materials made from them to look bright.

Lustre (Piece Term).—A piece made from a fine cotton warp and mohair or lustre weft with the plain weave. In the grey state, the fine cotton warp bends and the comparatively thick lustre yarn is straight, but in finishing, the cotton warp is pulled straight and the weft bent, and it is this bending of the weft which gives the lustre to the piece.

Lustre-wool.—Long wool from the Lincoln, Leicester, Wensleydale and other long wool sheep.

Make.—A term indicating the interlacing or weave structure of a fabric, sometimes employed even in a more general way.

Making-up.—A process which finished goods are put through, such as rolling, ticketing, papering, etc., in preparation for the market; different markets require goods to be made up in special ways.

Mantle Cloth.—A cloth suitable for making into cloaks or loose outer garments.

Mantua.—A lady's gown.

Marceline.—A thin silk tissue.

Marl.—A term sometimes applied to three-fold twists, but more correctly applied to a yarn coming between the wool mixture and the ordinary two-fold twist. It is produced by twisting the colours required together prior to the spinning, that is, in the roving form.

Marquise Finish.—A very lustrous finish applied to very fine set cotton venetians, etc.

Matelasse.—A type of fabric usually produced from a cotton warp interwoven with flush weaves of mohair weft; or it may be produced from mohair or silk warp or cotton or low quality weft. The true matelasse should have wadding material introduced to give a more or less raised appearance.

Mat-Weave.—Weaves of the hopsack type which give to fabrics an appearance similar to closely interwoven mats.

Maud.—A greyish striped wool plaid originally worn by shepherds in Scotland.

Mayo or Campbell Twill.—An irregular 8-sateen derivative weave no doubt in the first instance employed for Scotch tartans but now largely employed in all types of fabrics.

Mazambeque.—A thin gauze fabric generally produced with a cotton warp and mohair weft, but distinguishable from an ordinary mohair fabric by its flimsy gauzy texture.

Melange.—A yarn produced from printed tops being distinguishable from a mixture yarn in that many fibres have more than one colour upon them whilst in a mixture yarn each fibre is the same colour.

Melton.—A heavily milled fabric in which the fibres have been caused to stand straight up and then the piece cut bare to obtain the typical melton. Careful selection of the material, spinning of the yarn, the correct twist for warp and weft, together with careful weaving and finishing is necessary. Both light and heavy meltons are now made with cotton warp and woollen weft.

Mending.—The repairing of a fabric, such as stitching in threads and picks which have been allowed to run down during weaving.

Mercerizing.—A process applied to yarns or fabrics to either shrink the same, or if the shrinkage is resisted by mechanical means to give permanent lustre to the same. Both yarns and fabrics after mercerizing under tension are so lustrous that they may be used as silk substitutes.

Milled Cloth.—A cloth which has been heavily milled and consequently presents a close compact surface.

Millerain.—A finishing process which causes the fabric subjected to it to be water and spot proof.

Milling.—The operation whereby fibres and threads composed of wool are caused to interlock more closely one with another.

Mixture Cloth.—A cloth produced from any type of mixture yarn.

Mixture Yarn.—A yarn in which two or more distinct colours are apparent. These colours are usually on distinct fibres, and the fibres are mixed together to produce the required mixture tone whether in the wool state or in the top or sliver state. Melanged types are also gilled to produce what is known as the "melange mixture," in which colours are supposed to be more evenly blended than in the case of the ordinary fibre mixture.

Mock-gauze.—A type of fabric which, although woven in ordinary healds, has the appearance of a gauze or leno.

Moire.—A term applied to the watered or clouded appearance usually given to textiles by pressure in conjunction with a special set and count in warp and weft.

Moire-antique.—A type of figured silks from which waistcoats are made.

Moirette.—A fabric similar to the moreen but of lighter make.

Moquette.—A carpet of superior quality originally made by hand, but now mechanically. The pile consists of knotted tufts, and is not as a continuous warp thread.

Moreen.—A plain weave fabric composed of fine warp and thick polished cotton weft, so constructed that upon the fabric being pressed with itself it develops an excellent or moire effect. Sometimes these fabrics are figured with extra warp.

Mungo.—The waste produced by grinding up the harder cloths such as worsteds, woollens, etc. It is usually of a fine fibre nature though very short, and is used in the woollen trade as a blending material for purposes of cheapness.

Muslin.—A very fine, thin, open, plain cotton cloth.

Muslin-de-laine.—A muslin, originally a muslin texture, constructed of wool yarns, but now frequently made of cotton and wool.

Muslinet.—A sort of coarse muslin.

Nankeen.—A species of cloth originally from China made of a sort of yellowish cotton.

Nap.—A somewhat heavy woollen cloth severely raised in the finishing operations to give it the nap from which it derives its name.

Napery.—Linen for domestic use especially at table.

Nead-end.—The show end of woollen pieces.

"Neat" Silk.—Another term or "net" silk.

"Net" Silk.—Silk yarns produced from the cocoons by winding or throwing the single fibres as threads, as distinct from spun silk obtained by tearing the material into a fibrous mass and preparing and spinning as in the case of wool.

Noil.—The short fibre extracted from the long during the combing process in worsted, cotton and silk yarn preparation. It is used for blending purposes in worsted, and alone, or as a blend in woollen for purposes of cheapness.

Oatmeal Effect.—A style of mixed interlacing which gives a mixed "crape" appearance to the fabric, of an appearance something like oatmeal.

Open Band Twine.—The direction of the twist in yarns produced by open spindle bands as distinct from that produced by crossed spindle bands. Open band or weft twist is from left to right, looking up the thread. Cross band or warp twist is from right to left, looking up the yarn.

Organzine.—A term applied to reeled or net silks in which several twisted strands are again combined (with maximum twist) into yarn suitable for warp.

Orlean.—A term applied to fabrics made from a fine-spun cotton warp and a worsted weft, the interlacing being plain weave.

Overcheck.—A check introduced over and above a ground or more subdued check. This type of design is mostly employed in worsted coatings and in some few dress fabrics.

Overspun.—Yarn which is very uneven owing to its having been drafted to too high a count for the material of which it is composed, the result being that it is twitty and in the thin places there is a preponderance of twist while in the thick places there is an absence of twist.

Oxford Shirtings.—Coloured cotton shirtings in which the ground weave is usually plain. There has been a tendency of late, however, to figure these goods as desired by means of dobby weaves.

Paisley Shawl.—An elaborately extra weft figured shawl; style imitated by the Paisley weavers from the cashmere shawls originally imported from India.

Pantograph.—An instrument for copying on a reduced or enlarged scale, designs or plans.

Paramatta.—A thin fabric composed of a cotton warp and a botany weft interlaced 2 × 1 weft twill.

Pattern.—A specimen or sample of a particular style of yarn or fabric.

Pattern Weaver.—A power or hand loom weaver whose time is occupied in producing "blankets" of new styles.

P. C. (Cotton Cop Term).—A term implying pin cop, that is, a small or weft size of cop.

Pea-jacket.—A thick woollen jacket worn by seamen.

Pegging Plan.—A plan reduced from a large design which is required to be pegged on the loom lags, and which being so pegged, results, in conjunction with the draft, in the original design being produced.

Perch.—(*a*) A measure of $5\frac{1}{2}$ yards.

(*b*) Two rollers so fixed that fabrics may be rapidly passed over and examined in a good light.

Persian Cord.—A cloth made from worsted or cotton warp and worsted weft employing the plain weave, but with the warp threads working in twos, thus giving a rib effect.

Pick.—A single strand of weft reaching once across the piece. This term is also used to express the action of throwing or picking a shuttle in a loom.

Pick and Pick.—This implies the throwing of single picks of different colours into a fabric.

Piece.—A length of cloth woven from various warp lengths. As a rule the warp length is fixed, and under varying conditions will yield varying lengths of fabrics. The following are the principal warp lengths: Bradford, 70 yards; Huddersfield and Halifax, 60 yards; Lancashire, 100 yards.

Piece Glass.—A small magnifying glass of suitable size employed for the examining and counting of the threads and picks per inch or one-quarter inch in cloths. The most suitable sizes are 1 in. × 1 in. and $\frac{1}{2}$ in. × $\frac{1}{4}$ in.

Pile.—A nap of fibre on the surface of the fabric.

Pile Fabric.—A fabric in which either special threads or picks are caused to stand up from the surface. If left looped as more frequently is the case in warp piles the fabric is spoken of as "terry". If cut, as is sometimes the case with warp piles, and usually the case with weft piles, the fabric is spoken of as "cut".

Pilot Cloth.—A stout woollen cloth with a nap surface used for great overcoats, such as are worn by pilots.

Pina Cloth.—A fabric made in Manilla from the fibres of the leaf of the pine-apple plant.

Pirle Finish.—A finish which is given to all-wool dress goods with the idea of rendering them shower and spot proof and unshrinkable.

Plaid.—A woollen garment usually of a check style, still worn in the Highlands of Scotland. The term no doubt originated from the plaiting of straws or other materials of which the garments were in the first place made.

Plain Cloth.—The simplest form of a woven texture, both warp and weft being over one and under one. By changes in materials, sizes of yarn and balance of structure, many of the best recognized styles of fabrics are produced with this interlacing.

Poncho.—A woollen cloth worn in South America with a slit in the middle for the head to pass through.

Poplin.—A plain weave fabric originally made with a fine silk warp and a comparatively thick gassed worsted weft, thus having the appearance of a warp ribbed fabric. It is now made in other materials such as worsted and cotton.

Proofing.—A process through which goods pass whereby they are rendered impervious to rain and are also supposed as a rule to be unspottable and unshrinkable.

Prunelle Twill.—The 2 and 1 warp twill taking its name from the possibilities of producing by this weave a bird's eye effect.

Prunello.—A light smooth fabric made from woollen yarns.

Quality.—The extent to which material in its various forms—wool, top or yarn—possess the features or characteristics essential to its successful utilization. In wool, quality chiefly refers to fineness in fibre, this being closely related to the fineness in yarn counts, the wool will spin to, but other features such as length, lustre or colour, soundness, elasticity, and felting property, are also involved.

Quality Number.—The count number by which wools, tops, noils, and yarns are known, this being based on the count of yarn the material will spin to. Thus, 60's tops are supposed to spin approximately to 60's yarn and should consequently be made from a 60's quality of wool. 60's noils are the noils taken from 60's quality of wool during combing.

Quilt.—A fabric composed of two fabrics stitched together, usually having wool, cotton, or some soft fibre as a kind of wadding, between.

Raising.—A process applied to heavy woollen goods and some few lighter weight goods, whereby fibres are raised out of the body of the cloth on to the surface.

Ramie.—A bast fibre obtained from the stems of one or other of the plants *Boehmeria nivea* or *Boehmeria tenacissima.*

Raw Silk.—A term applied to the fibre produced by the silkworm in the form of cocoons, and the term also applies to the thread produced by reeling a given number of cocoons together, thus each thread being composed of a number of filaments.

Reed Marks.—Marks or lines running up the warp way of the cloth, usually due to the warp threads being arranged too many in a dent or to faulty setting of the loom.

Reedy.—A term applied to cloth which shows reed marks.

Rep.—A term usually applied to fabrics of the warp ribbed class in which the rib or rep runs weft way. It is sometimes, however, applied to the weft rib also.

Rhea (See "Ramie").—Sometimes this term is limited to *Boehmeria tenacissima.*

Rib Weave.—A weave in which, either owing to the interlacing or to the yarns used, warp or weft is the stronger and remains comparatively straight while the weaker material does all the bending. Thus in warp ribs the weft is the stronger, causing the warp to bend and form a warp surface rib running from list to list of a piece, while in weft ribs the warp is the stronger, forming a weft surface rib running lengthways up the piece. The ordinary corkscrew may be regarded as a (running or) twilled warp rib.

Rigged.—The term applied to a piece folded selvedge to selvedge.

Rigging.—The folding of a piece down the centre (after placing selvedge to selvedge) so that it may be handled with greater facility.

Rolling.—The rolling of a piece on to a board in preparation for the market. The pieces are sometimes measured at the same time for some market. Pieces are also rolled on to a steel plate which is afterwards pulled out.

Run.—A term applied to the same batch of wool which is run through the same set of machinery at one and the same time.

Russell Cord.—A cloth made from cotton warp and worsted weft employing plain weave, but with the warp woven double ends instead of single to give a rib or cord effect.

Samite.—A silk fabric.

Sarcanet.—A fine, thin, woven silk fabric.

Sateen.—The term applied to weaves which produce the satin (warp or weft) effect.

Satin.—A warp or weft surface cloth in which the intersection of warp and weft are so arranged as to be imperceptible, the fabric thus possessing the smoothness for which satins are noticeable.

Satinet.—An imitation of the true satin in mercerized cotton or other yarns.

Schappe.—A term referring to the yarn spun from silk waste which has not been fully discharged or degummed.

Selvedge.—The edge of a piece, this term being synonymous with the term "list". Different yarns and different interlacings are often applied to give both strength and appearance to the selvedges of fabrics.

Serge.—A term applied to fabrics of a twill character and of a rough make as distinct from the finer make of worsteds; the weave is usually 2/2 twill and the yarns woollen or crossbred.

Set.—The term implying the number of threads of which a cloth is composed within a given width. The simplest application of the term is to say that a cloth is "set" so many threads per inch. In Bradford and other districts, however, the "set" implies the number of times a convenient number of threads repeat in a given distance: thus the Bradford "set" implies the number of times that 40 threads (that is a beer) repeats in 36 in.

Setting of Yarns and Pieces.—In the case of yarn, this is effected by storing the yarn in a damp place until the curl is taken out of it: sometimes the yarn is set by being steamed.

Shading Effects.—Effects produced by different colours or qualities of materials or by weave, the result being a gradual change of appearance from one colour or structure to another.

Shag.—A fabric with a long coarse nap.

Shearing (Finishing Term).—The cropping or cutting of the loose fibres from the surface of the fabric by means of the circular shearing or cropping machine.

Shed.—The opening made across the warp by raising some threads and depressing others; through this opening or shed the shuttle passes leaving the weft behind.

Shedding.—The dividing of the warp threads into two parts to form a passage for the shuttle.

Shirting.—A term applied to the fabrics made of pure wool; pure cotton or a mixture of the two; the colourings and structure are usually of a particular style.

Shoddy.—The worked-up waste of woollen or worsted goods in which the initial material has been of the long fibred class, as against the short fibred class which is worked up into mungo.

Shot Silk.—Silk usually woven with contrasting colours in warp and weft so that under certain conditions the warp colour predominates and under other conditions the weft colour predominates.

Shower Proofing.—Various finishes such as cravenette, pirle, etc., to which cloths are subjected, rendering them shower proof.

Shrinkage.—The amount of contraction which most cloths are subjected to from the loom to the finished state. It is interesting to know that the shrinkage of cloth is dependent upon three factors, namely, structural shrinkage, shrinkage due to twist in the yarn, and shrinkage due to absolute contraction of the fibres of which the yarn is composed.

Sicilian.—A cloth made from a fine cotton warp and a thick mohair weft employing the plain weave.

Silesia.—A species of linen cloth originally made in Silesia.

Singeing.—An operation in finishing to clear the yarn or cloth from all superfluous fibres. There are two forms, gas and plate singeing.

Single Yarn.—Yarn composed of only one strand or thread.

Singles.—A term referring to "thrown" silk threads which consist of minimum strands sufficient for manipulation. These are doubled if necessary in various numbers to give the requisite strength, appearance, and handle to the fabrics into which they are manufactured.

Sizing.—The process of dipping the warp into a suitable size in order that the threads may be strengthened and rendered more compact.

Spun Silk.—A yarn composed of fibres of silk which have not been reeled from the natural cocoon length, but have been dressed in lengths varying from five to twelve inches, to be later made into a cheaper type of yarn.

Stained (Cloth Term).—Marks or stains or a different colour of dye, etc., these getting on to the cloth while it is passing through the various operations, making it more or less defective.

Stoving.—The submitting of wool, yarn, or cloth in a damp state to an agent, such as sulphur fumes, with the object of bleaching it.

Straight Gate.—This is equivalent to straight draft.

String.—A length equivalent to 10 ft. English warps are frequently calculated by the string.

Stripe.—A term applied to patterns running longitudinally with the warp in textile fabrics, produced by employing a special weave or two or more colours of warp specially arranged.

Stud Ewe.—A pure-bred ewe kept for breeding stud stock.

Stuffs.—Dress and lining cloths produced from cotton warp and worsted weft.

Tabby.—A term largely employed in the plush districts for plain cloth.

Tabs.—The bits of cloth cut from piece ends.

Taffeta.—A fine cloth made from silk warp and botany weft employing the plain weave.

Tail-end.—The end of a piece. The reverse to head-end.

Taker-in.—A person engaged in the taking-in or passing of pieces as they come from the loom.

Tartan.—A check cloth usually of an elaborate design and colour scheme, probably originated in the Highlands of Scotland, where each clan has its special tartan.

Tender.—A top, yarn, or cloth which has been abnormally weakened during any of the operations through which it has passed.

Tennis Cloth.—A cloth usually of a lightish texture and colour, soft to the handle, and usually made from wool.

Tentering.—A finishing process in which goods are widened out or tentered by being hooked on to chains, which expand to the width required, then carry the cloth through a heated chamber or over gas jets so that the cloth is dried in this position.

Terry.—Uncut or loop pile.

Thrown Silk.—The silk produced on the throwster's mill. This is usually made from cultivated silk and from unbroken cocoons, the singles having previously been reeled. It is finer, stronger, and more lustrous than the spun type which is made from waste silks. There are various types, viz. singles (which may be considered as a thrown silk) tram, organzine, no-throw, and sewing silks.

Tinting.—A process of covering yarn with a fugitive colour so that it may be readily distinguished when in contact with other yarns. For example, for weaving right and left twist yarns, one of them is tinted so as to prevent them becoming mixed.

Tram.—Weft silk of the thrown type, arranged in the form of two, three, or more threads sufficiently twisted for strength but with a minimum of twist in, so that lustre may be preserved.

Trap.—A weaver's term for a smash or breaking down of ends caused by something going wrong in the loom, especially the shuttle being caught in the shed.

Tube.—A piece of rolled paper or cardboard shaped as a tube on which material in yarn form is wound. Its advantage lies in its weight and in the small cost at which it can be produced.

Tulle.—A very flimsy texture made from fine silk yarns.

Tussah Silk.—The wild silk of India and China. These cocoons are generally pierced, that is, open at one end or more or less damaged, and must thus form spun silk as distinct from thrown silk. In fibre it is usually less lustrous and coarser than cultivated silk, but its low price makes it very acceptable. Special types are exceedingly valuable for plushes as the fibres appear to split at the end.

Tweed.—A fancy coloured woollen cloth originally made from Cheviot wool, and said to have taken its name from an attempt being made to imitate the coloured stones on the bottom of the river Tweed.

Tweel.—The Scotch name for "Twill".

Twill.—An interlacing effect running in a diagonal direction across the piece, as distinct from non-twill effects which will follow the direction of either warp or weft, or may have no definite direction whatever.

Twist.—The turns inserted into a yarn to bind its fibres together and thereby to add more strength for manipulation and weaving. The amount of twist applied varies according to the material, process, means employed for its application, and ultimate requirements.

Twisting.—The binding of the fibres into a yarn to add to its strength. This is definitely accomplished by running the spindle at a decided number of revolutions according to the number of inches delivered by the front rollers of the spinning frame.

Twitty.—A term applied to yarn which is irregular, that is, thick and thin, the thin places being below the count required, and the thick places above. The defect is caused by the material being drafted to too high a count, or to either defective or badly running rollers.

Union Fabric.—Fabrics composed of mixed materials, usually a cotton warp and worsted or wool weft. The term, however, may also be applied to silk and cotton or silk and wool mixtures.

Union Yarn.—Yarns spun from a mixture of cotton and wool, silk and cotton, or silk and wool. This term is oftener applied to twist yarns of these materials rather than to carded or gilled mixtures.

Valentia.—A fabric composed of woollen, worsted, cotton, and silk yarns specially designed for waistcoats.

Variegated Yarn.—A yarn composed of a number of colours usually obtained by printing.

Veiled Wool.—The wool partly disorganized in staple in which fibres from one staple have become attached and mixed to fibres from another staple.

Velvet.—A fabric covered with a close, short pile of silk formed on the warp pile basis.

Velveteen.—A fabric covered with a close, short, fine pile of cotton introduced on the weft pile basis.

Velvet Finish.—A finish in which a fairly dense pile of a velvet description is produced upon a woollen fabric by wet raising in various directions, and then cropping just to level the pile, but not to leave the fabric bare.

Venetian.—A fabric of an upright warp twill character produced by a sateen warp weave with a dot added. The term was originally applied to a dress face woollen cloth, but later worsted dress venetians have been made, and later still cotton venetians.

Vesting Fabric.—A fabric intended to be made up as a waistcoat.

Vicuna Wool.—The wool from an animal of the camel family which runs wild in Peru. Of this there is only a limited supply. The material is fine, long, and lustrous, and has a remarkably soft handle.

Viyella.—A light cloth largely made from cotton and wool scribbled together, principally used for underclothing.

Voile.—An open cloth of a canvas type made with plain weave interlacing, and hard twist cotton or worsted yarn.

Wadding Pick.—A thick pick usually of low quality which is inserted often without interlacing between the two fabrics in double cloths and between the two warps in a warp-backed structure, thus giving weight to the fabric and a certain amount of solidity without being seen or without being detrimental to the fabric in other respects.

Warp.—The series of threads placed longitudinally in the loom and spread over any desired width. Each thread in the warp passes from the back rest, usually through lease rods, and then through a mail of one of the several heald shafts and forward through the reed to the front rest, over which the cloth woven passes. It is by means of the heald shafts that warp threads are lifted or depressed to enable the weft yarn thrown in by the shuttle to be interlaced according to requirements with the warp threads. Warp yarns as a rule are stronger than weft yarns, as they have to bear a more severe strain during the operation of weaving.

Warp Dresser.—One who sleys and dresses warps from the ball form or from warper's beams on to the true loom beam ready for the threads being passed through the healds or twisted to the warp already in the loom.

Warper.—One who makes warps by hand. The attendant of a warping mill.

Warp Rib.—A warp surface weave in which the weft picks being thicker or grouped together in greater numbers, lie straight, causing the warp threads to bend round them and thus produce a ribbed appearance across the piece, but with a warp surface. Hence the term warp rib.

Warp Wool.—Wool of a sound type, full, bold, compact, and free in its growth; in fact, of a character specially suiting it for warp yarns.

Watering.—A finishing process by which watered patterns are produced on plain woven fabrics. The principle of this operation is that two fabrics of precisely similar build when pressed together naturally water one another by the coincidence or non-coincidence of the threads or picks causing flatness or ribbedness of a sufficiently marked character under conditions of heat and pressure.

Waterproof.—A fabric which is made waterproof by one of three methods:—

(1) By some physical action on the material of which the fabric is composed.

(2) By impregnating the material with some water-resisting agent.

(3) By coating the material with a film of rubber or other water-resisting agent.

Weave.—The interlacing of warp and weft with one another to form a suitable cloth.

Weaving.—The process of producing a cloth by the insertion of weft between the warp threads in such a way as to form the desired interlacing.

Weft.—The series of threads—technically termed picks or shoots—thrown into a cloth at right angles to the warp by means of the shuttle. Weft yarns, as a rule, are softer spun and consequently weaker than warp yarns, some in fact only just standing the strain of weaving.

Weft Bars.—Broad bars or stripes running across fabrics usually caused by spools of different counts of yarn, different runs of yarn or different twists of yarn being woven in alongside one another. Such bars may also be caused by defective letting-off and irregular taking up, resulting in a variation in the picks per inch.

Whip Thread.—The crossing thread in a gauze fabric.

Winsey.—A cloth composed of a cotton warp and a woollen weft of a fairly heavy type.

Wool-dyed.—A term applied to coloured fabrics in which the colour was originally dyed on the wool in either the loose or top form as distinct from fabrics in which the colour has been placed on the wool by either yarn dyeing or piece dyeing.

Woollen Fabric.—The typical woollen is a full handling fabric in which structure and colouring cannot readily be defined, on account of the threads and picks and even the fibres having become thoroughly intermingled in passing through the operations of finishing. To insure a typical woollen fabric, the material selected, the method of preparation of spinning and weaving and of finishing, must all be applied with the woollen type of fabric in view. Strictly speaking, a woollen fabric should be made of fine wool (possibly noils included), but in the Law Courts a definition of woollen fabrics as being composed of mungo, shoddy, cotton, etc., has been accepted.

Woollen Yarn.—Yarns spun from wool in which anything but a parallel position of the fibres is noticeable as distinct from worsted yarn in which the wool fibres are markedly parallelized.

Worsted Coating.—Cloths for men's wear made from fine crossbred or botany yarns.

Worsted Fabric.—The typical worsted is a clear, smooth handling fabric in which structure and colour are clearly defined owing to the smoothness and clearness of both the yarns and the interlacing, finishing in this case often developing clearness rather than otherwise. Of course there is every conceivable variety of fabric between the woollen and the worsted.

Worsted Yarn.—Yarns spun from wool in which the wool fibres are markedly parallelized as distinct from woollen yarns in which anything but a parallel position of the fibres is noticeable. Almost without exception, worsted yarns are combed yarns, but it is quite conceivable that wool fibres might be so parallelized by careful drawing and spinning that practically a yarn of worsted characteristics might be produced without combing. The old definition based upon length of fibre is to-day absolutely untenable, as in many cases shorter wools are spun into worsted yarn than into woollen yarn.

Xerga.—The Spanish name for a peculiar woollen blanket. Our common market term "serge" is derived from this word.

Yarn.—A filament of twisted fibres or any thread structure which has been spun.

Yarn-dyed.—A term applied to fabrics in which the colour has been introduced by dyeing the material in hank or cop form.

Zephyr.—A very light cotton cloth made in plain, stripe, or check form.

Zibeline.—A dress fabric made in cross-bred yarns, strongly coloured, usually in stripe form, and in finishing hardly raised with fibre laid in one direction.

Zig-Zag.—A term sometimes applied to herring-bone textures and designs.

APPENDIX.

1. Huddersfield weavers' standard wage list.
2. Leeds fine worsted, weavers' standard wage list.
3. Fancy dress goods manufacturers' warp-dressers' wage list.
4. Fancy dress goods manufacturers' twisters' price list.
5. Drawing-in and twisting cotton-warps price list.
6. Winding and beaming cotton yarns price list.
7. Bradford commission weaving price list.
8. Standard wage list at a Batley shoddy mill.
9. Uniform list of prices for weaving cotton goods.

List 9. The Huddersfield Weavers' Standard Wage List.

(For men weavers on wide looms—62 to 90 in. reed space). (One man to one loom.) Price in pence per 18 strings of 10 ft. each (60 yd. cloth). Looms running at 80 picks per minute :—

(*a*) *For Mixture or Solid Coloured Worsteds and Woollens :—*

	A. One Shuttle.	*B. Two Shuttles.*	*C. Three Shuttles.*	*D. Four Shuttles.*
(1) One beam.	3d. per pick per in., plus 1s.	5 per cent on 1A.	10 per cent on 1A.	17½ per cent on 1A.

(2) Two beams. 17½ per cent on the above.

(*b*) *Fancy Coloured Worsteds and Woollens :—*

(3) One beam. 5 per cent on those indicated at 1, A, B, C, D.

(4) Two beams. 32½ per cent on those indicated at 1, A, B, C, D.

(*c*) *Looms running at from* 100 *to* 120 *Picks per Minute :—*

(5) Deduct 5 per cent from the above prices.

(*d*) *Add 9d. per Cut for every two Heald Shafts above* 16.

(*e*) *For Men Attending to two Looms, These will be Paid* 35 *per cent less than Above Scale.*

(*f*) *Women's Wage List :—*

(1) Deduct 12½ per cent from above men's scale.

(2) For white worsteds (botany) 1 beam, 1 shuttle = 2·6d. per pick per in.

(3) For serges (crossbred) 1 beam, 1 shuttle = 2·12d. per pick per in.

List 10. Leeds Fine Worsted Weavers' Standard Wage List.

A large worsted manufacturer near Leeds submits the following as his rate of wages to weavers :—

Plain Looms.—1½d. per pick per in. for 60 yd. of warp per cut.

Extras per Piece :—

1. 1d. per shaft above 12.
2. For colours and mixtures, 6d.
3. For woollen weft, 6d.
4. For 2 beams, 1s.
5. For every 10 sets above 100, 6d.
6. For looms with boxes at one end, 1s.

Dobcross Looms.—2d. per pick per in. for 60 yd. of warp per cut.

Extras per Piece :—

1. Each shuttle above one, 1s.
2. For two beams, 1s.
3. For colours and mixtures, 6d.
4. For woollen weft, 6d.
5. 1d. for each shaft above 18.

Hattersley Four-box Looms.—1⅚d. per pick per in. for 60 yd. of warp per cut.

Extras.—As Dobcross Looms.

List 11. Fancy Dress Goods Manufacturers' Warp-dressers' Wage List.

Silk and Cotton Warps (1 colour).

Up to 1000 ends,	3½d.	per	100 yd.
1001 ,, 1500 ,,	5d.	,,	,,
1501 ,, 1750 ,,	6d.	,,	,,
1751 ,, 2000 ,,	6½d.	,,	,,
2001 ,, 2250 ,,	7d.	,,	,,
2251 ,, 2500 ,,	7½d.	,,	,,
2501 ,, 2750 ,,	8½d.	,,	,,
2751 ,, 3000 ,,	9d.	,,	,,
3001 ,, 3250 ,,	10d.	,,	,,
3251 ,, 3500 ,,	10½d.	,,	,,
3501 ,, 3750 ,,	11d.	,,	,,
3751 ,, 4000 ,,	12d.	,,	,
Fast dyed warps extra.	2d.	,,	,,
Fast shirting warps extra.	4d.	,,	,,

Undyed or unbleached warps 1d. per 100 yd. less.

Worsted Warps, Serges, 2 Balls.

Up to 1000 ends,	3½d.	per	100 yd.
1001 ,, 1500 ,,	4d.	,,	,,
1501 ,, 2000 ,,	5d.	,,	,,
2001 ,, 2500 ,,	6d.	,,	,,
2501 ,, 3000 ,,	7d.	,,	,,
3001 ,, 3500 ,,	8d.	,,	,,
3501 ,, 4000 ,,	9d.	,,	,,
4001 ,, 4500 ,,	10d.	,,	,,
4501 ,, 5000 ,,	11d.	,,	,,

Fast Dyed Worsted Warps.—Less than half-dyed, double grey price.

More than half-dyed, 3 times grey price, and 1d. extra for every 250 ends over 4000.

Warps of more than 1 colour :—

2 cols.	3 cols.	4 cols.	5 cols.	6 cols.
1d.	2d.	3d.	4d.	5d. per 100 yd. extra.

Warps of above 3000 ends :—

2 cols.	3 cols.	4 cols.	5 cols.	6 cols.
2d.	3d.	4d.	5d.	6d. per 100 yd. extra.

Warps on 7/4 beams, 1d. per 100 yd. extra. Running warps back, half price. Cutting warps in two, 3d. per 1000 ends. Tying ends 4d. per 100 ends.

Sleying plain warps	1 and 1	1 and 1 and 1	1 and 1 and 1 and 1
4d.	6d.	8d.	10d. per 100 ends.

Sleying distinct colours :—

2 cols.	3 cols.	4 cols.	5 cols.	6 or more cols.
8d.	12d.	16d.	20d.	22d. per 1000 ends.

Sleying one in reed, double price.

All single twists cotton warps to be paid 1½d. per 100 yd. more for dressing than twofold. 10 per cent to add.

List 12. Fancy Dress Goods Manufacturers' Twisters' Price List.

Twisting 10d. per 1000 ends for thick genappe warp, and serges up to and including 20's sett and woollens.

Twisting 5d. per 1000 ends plain warps. Stripes 5½d. and ½d. per 1000 ends extra for single twists, and 1d. per 1000 ends extra for twisting in loom.

Sleying 4½d. per 1000 ends 4 or 2 or 3 in reed, one in reed 9d.
,, 6d. per 1000 ends Pekin stripe, 2 in dent grounds.
,, 12d. per 1000 ends Pekin stripe, 1 in dent and missing dents.

Side ends or cast out ends filling up 2d. per 100 ends.

Looming 4 to 8 shafts plain warp, 10d. per 1000 ends } Sleyed 4
,, 9 to 16 ,, ,, ,, 12d. ,, ,, ,, } in dent.
,, stripes 2d. per 1000 ends more than plain.
,, 2 in mail 1½ times price (per 1000 mails) 1 end in mail.

Sleyed 2 and 3 in reed, 2d. per 1000 ends more than 4 in reed.
,, 1 ,, ,, 6d. ,, ,, ,, ,, ,, ,, ,,

Harness looming 1s. 3d. per 1000 ends.
,, stripe 1s. 5d. per 1000 ends.
6d. extra for roller.

Time 6½d. per hour or as agreed to.

Broken leases, ½ hour's time for shirting-warps, 1 hour for dress warps.

2d. per 1000 ends extra for all casting out in frame-warps.

2 ends in mail twisting $1\frac{1}{2}$ times ordinary price per 1000 mails.
3 ends in mail twisting twice ,, ,, ,, ,, ,,
2 ends in mail sleying $5\frac{1}{2}$d. per 1000 mails.
3 ends in mail sleying $6\frac{1}{2}$d. per 1000 mails.
Healds dressing $\frac{1}{2}$d. each.
Looming wire healds 1s. extra.
Organzine warps 4000 ends and over 1s. extra.
Organzine warps under 4000 ends 6d. extra.

List 13. Drawing-in and Twisting Cotton Warps Price List.

Drawing-in Grey Warps :—

	Per 1000 ends.
1. Plain 4 shafts, up to 80 threads per inch . .	$5\frac{1}{4}$d.
$\frac{1}{4}$d. extra per 1000 for every 10 threads over 80 per inch.	
2. Twills or sateens, 3, 5, 6 or 7 shafts, 2 in a dent	7d.
,, ,, ,, 3 in a dent, $\frac{1}{4}$d. per 1000 extra.	
3. Shaft work :—	
5 to 7 shafts . . .	7d.
8 ,, 13 ,, . . .	8d.
Above 13 shafts, $\frac{1}{4}$d. per 1000 ends per shaft extra.	
Drawing-in Coloured Warps :—	
1. Plain, one colour	$6\frac{1}{4}$d.
2. Shaft work :—	
5 to 7 shafts . . .	8d.
8 ,, 13 ,, ...	9d.
Above 13 shafts, $\frac{1}{4}$d. per 1000 ends per shaft extra.	
Twisting Grey Warps :—	
1. Plain 4 shafts, 26's to 80's twist . . .	4d.
,, ,, ,, coarser that 26's and over 80's to 90's	$4\frac{1}{4}$d.
,, ,, ,, over 90's to 100's . . .	$4\frac{1}{2}$d.
,, ,, ,, over 100's	5d.
2. All shaft work other than 4 shafts . . .	$5\frac{1}{2}$d.
Twisting Coloured Warps :—	
1. Plain, one colour	$4\frac{1}{2}$d.
Jacquards :—	
1. Ordinary one beam—leased and loom front taken out for drawer	1s. 0d.
2. Unleased—loom front taken out for drawer .	1s. 6d.
3. Re-douping and re-sleying combined (leno healds in front of harness)	1s. 0d.
4. Twisting only—ordinary one beam	6d.

	Per 1000 ends.
5. Twisting, and drawing the twisting through the harness and reed	6½d.

Sleying. The same price as twisting.

Extras :—

1. For each beam over one, 3d.
2. Over 80's to 100's twist, ¼d. per 1000 ends.
3. Over 100's twist, ½d. per 1000 ends.

Gauze Jacquards. Time work.

Dobby Gauzes :—

1. One or two doup cloths and one beam . . .	11d.
1d. per 1000 ends extra for each additional doup.	
2. Twisting :—	
In room	7d.
In shed	8d.

Time Work. Minimum price per hour.

1. Drawing-in :—

In room not less than 8d.
In shed ,, ,, ,, 8½d.

2. Twisting :—

In room not less than 6d.
In shed ,, ,, ,, 6½d.

List 14. Winding and Beaming Cotton Yarns Price List.

Winding.

16's to 18's Twist	1s. 4½d.
20's ,, 22's ,,	1s. 6¼d.
24's ,, 26's ,,	1s. 7¼d.
28's ,, 30's ,,	1s. 8¼d.
32's ,, 34's ,,	1s. 9½d.
36's ,, 40's ,,	1s. 11d.
40's ,, 44's ,,	2s. 0½d.
44's ,, 48's ,,	2s. 2d.
48's ,, 52's ,,	2s. 3½d.
52's ,, 56's ,,	2s. 5d.
60's ,, 62's ,,	2s. 6½d.

Beaming.

For beaming 400 threads, 17,500 yd., 5 wraps, the payment to be as follows :—

4½d. per beam for creeling, and 4¼d. for each wrap irrespective of counts of twist.

For every 10 threads or fraction thereof, one half penny up or down, but no deduction below 370 threads thus :—

For 400 ends, 5 wraps, 17,500 yd., the price will be 2s. 1¾d. per beam including creeling.

For 441 to 450 threads, the price will be 2s. 4¼d. per beam, including creeling.

For 379 threads and below the price will be 2s. 0¼d. per beam, including creeling.

List 15. Bradford Commission Weaving Prices.

1. *Cashmeres.*—Grey warp on beam : 3½d. per pick per ¼ in. up to 50 in.

2. *Cashmeres.*—Warp in ball : 4d. per pick per ¼ in. up to 50 in.

3. *Serges.*—Warp on beam :—

3½d.	per pick	per ¼ in.	up to	44 in.
3¾d.	,,	,,	,,	46 ,,
4d.	,,	,,	,,	50 ,,
4½d.	,,	,,	,,	54 ,,
5d.	,,	,,	,,	58 ,,

With extra roller 1d. per pick per ¼ in. on above.

,, ,, ,, and boxes 2d. per pick per ¼ in. on above.

4. *Amures.*—Warp on beam : 6½d. to 7d. per pick per ¼ in. up to 48 in.

5. *Harness Work.*—Worsted warps on beam :—

6d.	per pick	per ¼ in.	up to	44 in.
6½d.	,,	,,	,,	48 ,,
7d.	,,	,,	,,	52 ,,

For Dobby work ½d. per pick per ¼ in. less.

6. *Cotton Warp Harness Work.*—Warp in ball :—

5d.	per pick	per ¼ in.	up to	42 in.
5½d.	,,	,,	,,	46 ,,
6d.	,,	,,	,,	50 ,,

7. *Lustre and Mohairs.*—Pieces delivered mended.—Warp in ball :—

5½d.-6d.	per pick	per ¼ in.	up to	46 in.
6d. -6½d.	,,	,,	,,	50 ,,
7d.	,,	,,	,,	56 ,,

For harness work 1d. per pick per ¼ in. extra.

8. *Cheviots and Low Picked Tweeds.*—Warp to dress :—

8d.	per pick	per ¼ in.	up to	44 in.
9d.	,,	,,	,,	48 ,,

Stripes (extra roller) 1d. extra, boxes 2d. extra, single picks 4d. extra.

9. *Panamas.*—Fine hopsacks, etc. Warp on beam :—

5½d.	per pick	per ¼ in.	up to	48 in.
6d.	,,	,,	,,	54 ,,

Very high picked goods ½d. per pick per ¼ in. less.

10. 8/4 *Worsted Italian Linings* : 5d. per pick per ¼ in.

Heavy Woollen Looms from 60 *in. to* 96 *in. Reed Space. Various Types Warps with Low Woollen Weft.* 100 *Picks per Minute.*

Cotton Warps.

Picks per Inch.	Yd. per Cut.	Beams.	Shuttles.	Price per Cut.
36	90	1	2	10/2
40	,,	,,	,,	11/2
44	,,	,,	,,	12/2
48	,,	,,	,,	13/2
52	,,	,,	,,	14/2
56	,,	,,	,,	15/2
60	,,	,,	,,	16/2

Worsted Warps.

Picks per Inch.	Yd. per Cut.	Beams.	Shuttles.	Price per Cut.
36	100	2	2	13/2
40	,,	,,	,,	14/2
44	,,	,,	,,	15/2
48	,,	,,	,,	16/2
52	,,	,,	,,	17/2
56	,,	,,	,,	18/2
60	,,	,,	,,	19/2

Extras: (1) Drop boxes, 6d. per 2 picks.
(2) Extra shuttle, 1s.
(3) Extra beam, 1s.

Woollen Warp.

Picks per Inch.	Yd. per Cut.	Beams.	Shuttles.	Price per Cut.
Plain.				
17	106	1	1	5/10
17	120	1	1	6/7
Checks.				
17	106	1	2	6/7

Extras: Drop boxes, 3d. per pick.
Plain: Extra shuttle, 6d.

Worsted or Cotton Warps.

Picks per Inch.	Yd. per Cut.	Beams.	Shuttles.	Price per Cut.
Cotton Warps.				
36	90	1	1	9/4
40	,,	,,	,,	10/4
44	,,	,,	,,	11/4
48	,,	,,	,,	12/4
Worsted Warps.				
28	100	1	1	8/2

Drop boxes, 6d. per 2 picks.

80 *Picks per Minute.*

Cotton Warps.

Picks per Inch.	Yd. per Cut.	Beams.	Shuttles.	Price per Cut.
36	90	1	2	12/8
40	,,	,,	,,	13/9
44	,,	,,	,,	14/10
48	,,	,,	,,	15/11
52	,,	,,	,,	17/-

(1) Drop boxes, 7d. per 2 picks.
(2) Extra beam, 1/6.
(3) Extra shuttle, 1/-.

Worsted Warps.

Picks per Inch.	Yd. per Cut.	Beams.	Shuttles.	Price per Cut.
36	100	1	2	14/8
40	,,	,,	,,	16/-
44	,,	,,	,,	17/4
48	,,	,,	,,	18/8
52	,,	,,	,,	20/-

(1) Drop boxes, 8d. per 2 picks.
(2) Extra beam, 1/6.
(3) Extra shuttle, 1/-.

Woollen Warp.

Picks per Inch.	Yd. per Cut.	Beams.	Shuttles.	Price per Cut.
Plain.				
17	106	1	1	6/7
17	120	1	1	7/7
Checks.				
17	106	1	2	7/7

(1) Drop boxes, 3d. per pick.
(2) Plain: Extra shuttle, 6d.

Worsted or Cotton Warps.

Picks per Inch.	Yd. per Cut.	Beams.	Shuttles.	Price per Cut.
Cotton Warps.				
36	90	1	1	11/2
40	,,	,,	,,	12/2
44	,,	,,	,,	13/2
48	,,	,,	,,	14/2
Worsted Warps.				
28	100	1	1	10/2

Drop boxes, 6d. per 2 picks.

17. Uniform List of Prices for Weaving Cotton Goods[1] :—

(1) *The Standard.*—The standard upon which this list is based is an ordinary made loom, 45 in. in the reed space.

Reed.—60 reed, 2 threads in a dent or 60 threads per inch.

Picks.—15 picks per quarter inch, with $1\frac{1}{2}$ per cent added for contraction.

Length.—100 yd. of 36 in. measured on counter.

Count of Warp.—28's or any finer number.

Warp. In.	72 in. Loom. Per Cent.	Warp. In.	68 in. Loom. Per Cent.	Warp. In.	64 in. Loom. Per Cent.	Warp. In.	60 in. Loom. Per Cent.
65	1·38	61	1·49	57	1·35	53	1·45
64	2·76	60	2·98	56	2·7	52	2·91
63	4·14	59	4·47	55	4·05	51	4·36
62	5·52	58	5·96	54	5·4	50	5·81
61	6·9	57	7·2	53	6·74	49	6·98
60	8·28	56	8·44	52	8·09	48	8·14
59	9·66	55	9·69	51	9·44	47	9·3
58	11·04	54	10·93	50	10·79	46	10·47
57	12·19	53	12·17	49	11·87	45	11·63
Warp. In.	**56 in. Loom. Per Cent.**	**Warp. In.**	**52 in. Loom. Per Cent.**	**Warp. In.**	**48 in. Loom. Per Cent.**	**Warp. In.**	**44 in. Loom. Per Cent.**
49	1·26	45	1·35	41	1·08	37	·95
48	2·52	44	2·36	40	2·15	36	1·9
47	3·78	43	3·38	39	3·23	35	2·85
46	5·04	42	4·39	38	4·13	34	3·80
45	6·3	41	5·41	37	5·02	33	4·75
44	7·25	40	6·42	36	5·92	32	5·70
43	8·19	39	7·43	35	6·82	31	6·65
42	9·14	38	8·28	34	7·72	30	7·41
41	10·08	37	9·12	33	8·61	29	8·16
Warp. In.	**40 in. Loom. Per Cent.**	**Warp. In.**	**36 in. Loom. Per Cent.**	**Warp. In.**	**32 in. Loom. Per Cent.**	**Warp. In.**	**28 in. Loom. Per Cent.**
33	1	29	·84	25	·88	21	·93
32	2	28	1·69	24	1·76	20	1·85
31	3	27	2·53	23	2·65	19	2·78
30	3·8	26	3·37	22	3·53	18	3·7
29	4·6	25	4·21	21	4·41		
28	5·4	24	5·06	20	5·29		
27	6·2	23	5·9	19	6·18		
26	7	22	6·74	18	7·06		
25	7·8	21	7·58				

[1] From "Uniform List of Prices for Weaving," by T. Birtwistle, Esq., J.P., of Accrington.

Count of Weft.—31's to 100's both inclusive.

Price.—30d. or 2d. per pick per quarter inch.

(2) *Width of Looms.*—A 45 in. reed space loom being taken as the standard, the following allowances and deductions to be made for varying widths of looms :—

Allowances :—

(*a*) $1\frac{1}{2}$ per cent up to and including 51 in.
(*b*) 2 ,, from 51 to 56 in.
(*c*) $2\frac{1}{2}$,, ,, 56 ,, 64 ,,
(*d*) 3 ,, ,, 64 ,, 72 ,,

Deductions :—

(*a*) $1\frac{1}{4}$ per cent from 45 to 37 in. inclusive.
(*b*) 1 ,, ,, 37 ,, 24 ,, ,,

Below 24 in. no further deduction is made.

(3) *Width of Warp in Reed.*—All looms shall be allowed to weave a warp to within 4 in. of the reed space, but whenever the difference between the width of warp and the reed space is less than 4 in., it shall be paid as if the loom were 1 in. broader and if less than 3 in. as if it were $2\frac{1}{2}$ in. broader.

(4) *Allowances for Warp being Narrower than Reed Space.*—When the warp is from 7 to 15 in. inclusive narrower than the reed space of the loom in which it is woven a deduction shall be made. No further deduction shall be made when the warp is more than 15 in. narrower than the reed space, or when the warp is narrower than 18 in.

The amount of deductions vary according to the tables on page 294.

(5) *Reeds.*—A 60 reed being taken as the standard, $\frac{3}{4}$ per cent shall be deducted for every two threads or count of reed from 60 to 50, but no deduction shall be made below 50. $\frac{3}{4}$ per cent shall be added for every two threads or count of reed from 60 to 68 : 1 per cent from 68 to 100 : $1\frac{1}{2}$ per cent from 100 to 110 : and 2 per cent from 110 to 132. All additions or deductions under this clause to be added to or taken from the price of the standard 60 reed.

(6) *Cloths Woven with One Thread in a Dent.*—Cloths woven with one thread in a dent to be paid three quarters of the reed—thus an 80 reed one end in a dent would be paid for a 60 reed two ends in a dent.

(7) *Picks.*—*Low.*—An addition of 1 per cent shall be made for each pick or fraction of a pick below 11, thus :—

Below	11	down to and including	10·1	per cent.
,,	10	,, ,,	9·2	,,
,,	9	,, ,,	8·3	,,
,,	8	,, ,,	7·4	,,

and so on adding 1 per cent for each pick or fraction thereof.

Deducted from Standard.		Added to Standard.			
Count of Reed.	Percentage.	Count of Reed.	Percentage.	Count of Reed.	Percentage.
50	$3\frac{3}{4}$	62	$\frac{3}{4}$	98	18
52	3	64	$1\frac{1}{2}$	100	19
54	$2\frac{1}{4}$	66	$2\frac{1}{4}$	102	$20\frac{1}{2}$
56	$1\frac{1}{2}$	68	3	104	22
58	$\frac{3}{4}$	70	4	106	$23\frac{1}{2}$
60	standard	72	5	108	25
		74	6	110	$26\frac{1}{2}$
		76	7	112	$28\frac{1}{2}$
		78	8	114	$30\frac{1}{2}$
		80	9	116	$32\frac{1}{2}$
		82	10	118	$34\frac{1}{2}$
		84	11	120	$36\frac{1}{2}$
		86	12	122	$38\frac{1}{2}$
		88	13	124	$40\frac{1}{2}$
		90	14	126	$42\frac{1}{2}$
		92	15	128	$44\frac{1}{2}$
		94	16	130	$46\frac{1}{2}$
		96	17	132	$48\frac{1}{2}$

High.—An addition of 1 per cent per pick shall be made whenever they exceed the following, if using

Weft below 26's	when picks exceed	16.
,, 26's to 39's inclusive	,,	18.
,, 40's and above	,,	20.

In making additions for high picks any fraction of a pick less than the half shall not have any allowance; exactly the half shall have $\frac{1}{2}$ per cent added: any fraction over the half shall have the full 1 per cent added.

(8) *Twist or Counts of Warp.*—The standard being 28's or finer, the following additions shall be made, when coarser twist is woven in the following reeds:—

Below 28's to 20's in	64 to 67	reed inclusive	1 per cent.
,, ,, ,,	68 ,, 71	,,	2 ,,
,, ,, ,,	72 ,, 75	,,	3 ,,
Below 20's to 14's in	56 to 59	,,	1 ,,
,, ,, ,,	60 ,, 63	,,	2 ,,
,, ,, ,,	64 ,, 67	,,	3 ,,
Below 14's to 10's in	48 to 51	,,	1 ,,
,, ,, ,,	52 ,, 55	,,	2 ,,
,, ,, ,,	56 ,, 59	,,	3 ,,
,, ,, ,,	60 ,, 63	,,	4 ,,

and so on at the same rate. When twist is woven in coarser reeds no additions shall be made. The above prices are for single and two-fold yarns. When three-fold yarns are woven one end in a dent, one half of the above percentages to be added.

(9) *Counts of Weft.—Ordinary Pin Cops.*—The standard being 31's to 100's both inclusive, shall be reckoned equal. Above 100's 1 per cent shall be added for every 10 hanks or fraction thereof. In lower numbers than 31's the following additions shall be made :—

For 30's,	add 1	per cent.	For 13	add 18	per cent.
,, 29's, 28's	,, 2	,,	,, 12's	,, 21	,,
,, 27's, 26's	,, 3	,,	,, 11's	,, 25	,,
,, 25's, 24's	,, 4½	,,	,, 10's	,, 30	,,
,, 23's, 22's	,, 6½	,,	,, 9's	,, 38	,,
,, 21's, 20's	,, 8	,,	,, 8's	,, 48	,,
,, 19's, 18's	,, 10½	,,	,, 7's	,, 61	,,
,, 17's, 16's	,, 13	,,	,, 6's	,, 76	,,
,, 15's, 14's	,, 16	,,	,, 5's	,, 94	,,

Large Cops.—When weft of the following counts is spun into large cops, so that there are not more than 22 in one pound, the following additions shall be made in place of the allowance provided for pin cops in preceding table :—

For 29's, 28's,	add 1	per cent.	For 12's	add 15	per cent.
,, 27's, 26's,	,, 2	,,	,, 11's	,, 19	,,
,, 25's, 24's, 23's	,, 3	,,	,, 10's	,, 24	,,
,, 22's, 21's, 20's	,, 4½	,,	,, 9's	,, 30	,,
,, 19's, 18's,	,, 6	,,	,, 8's	,, 38	,,
,, 17's, 16's,	,, 8	,,	,, 7's	,, 48	,,
,, 15's, 14's,	,, 10	,,	,, 6's	,, 61	,,
,, 13's,	,, 12	,,	,, 5's	,, 76	,,
			,, 4's	,, 94	,,

(10) *Four Shaft Twills.—Low Picks.*—In four shaft twills an addition of 1 per cent for each pick or fraction thereof below the picks mentioned in the following table shall be made when using weft as follows :—

Below 26's the addition shall begin at				13
,, 26's to 39's	,,	,,	,,	14
,, 40's and above	,,	,,	,,	15

High Picks.—When using weft.

Below 26's the addition for high picks shall begin at						21
,, 26's to 39's	,,	,,	,,	,,	,,	22
,, 40's and above	,,	,,	,,	,,	,,	23

In making additions for high picks, any fraction of a pick less than the half shall not have any allowance, exactly the half shall have ½ per cent added, any fraction over the half pick shall have the full 1 per cent added.

(11) *Herring-bone Twills.*—For weaving cloths known as

herring-bone twills, 4 shafts, 5 per cent extra on twill cloth prices shall be paid.

(12) *Coloured Edges or Borders.*—Coloured edges or borders with one or more coloured ends at the side shall be paid 5 per cent on plain cloth prices.

(13) *Splits.*—The following additions shall be made for splits :—

One split uncut add 5 per cent.
Two splits ,, ,, 7½ ,,

Empty dents only shall not be considered splits.

(14) *Sateens, Jeans, Jeanettes, Drills, Drillettes, and Florentines* :—

Basis.—Plain Cloth as per Uniform List with the following modifications.

Reeds.—When cloths are woven with three or more threads to one dent, the allowance for every two threads or counts of reed above 68 shall be ¾ per cent only, the same as from 60 to 68. When the reed exceeds the pick ⅜ per cent shall be added for every additional count of reed above the number of picks per ¼ in.

Picks.—Cloths up to and including 25 picks to be paid 5 per cent extra, and for every additional pick or fraction beyond the half, up to and including 32 picks to have ½ per cent per pick added, from 32 upwards to have an additional ¼ per cent per pick or fraction beyond the half added.

Pick Finding.—Where the employer requires the loom to be turned in order to find the broken picks the following percentages to be paid :—

5	per cent when using	26's or finer weft.
7½	,, ,, ,,	25's to 16's ,,
10	,, ,, ,,	15's ,, 12's ,,
12½	,, ,, ,,	11's and under.

Coarse Twist in Fine Reeds.—Clause 8 of the Uniform List to apply, and when there are more than two threads in one dent, the reed and number of threads per inch to be added together and divided by two. Thus a 52 reed three ends in one dent, below 28's to 20's twist would be paid for as a 65 reed, and when using twist below 20's to 14's in a 45 reed, three threads in one dent would be paid for as a 56 reed for twist purposes only.

(15) *Sateens, etc., made with More than Five Shafts.*—Sateens made with more than 5 shafts to be paid by the Sateen List, with the following additions for shafts :—

6 shafts, 12 per cent.
7 and 8 ,, 16 ,, and so on.

Paragraph 6 of the Heald Shaft List not to apply to the above.

(16) *Heald Shaft Work.*—Cloth with dobby and tappet motions, one shuttle loom (lenos, sateens, jeans, drills, and similar goods excepted).

(*a*) *Basis.*—Plain cloth as per Uniform List.

(*b*) Cloth woven with the number of shafts as follows :—

4	shafts	12	per cent	added.	13	shafts	20	per cent	added.
5	,,	12	,,	,,	14	,,	22	,,	,,
6	,,	12	,,	,,	15	,,	23	,,	,,
7	,,	16	,,	,,	16	,,	24	,,	,,
8	,,	16	,,	,,	17	,,	25	,,	,,
9	,,	16	,,	,,	18	,,	26	,,	,,
10	,,	18	,,	,,	19	,,	27	,,	,,
11	,,	18	,,	,,	20	,,	28	,,	,,
12	,,	19	,,	,,					

(*c*) Single-lift dobbies to be paid 10 per cent extra.

(*d*) Stripes and other cloths with more than 2 threads in one dent to be paid for by the number of ends per inch.

(*e*) Skeleton shafts for edges not to be counted.

(*f*) Where the employer does not require the cards or lags to be turned in order to find the pattern 3 per cent less to be paid.

(*g*) Where the employer requires the loom to be turned in order to find the broken pick 10 per cent more to be paid.

(*h*) Single shuttle cord checks with more than two picks in one shed to be paid $2\frac{1}{2}$ per cent less.

(*i*) In single shuttle checks and all other special classes of goods in which more than one pick is put in one shed, such extra picks shall be counted.

(*j*) For cloths woven in tappet or dobby looms from more than one beam, 5 per cent extra shall be paid per beam. Lenos, crimps excepted.

(17) *Additions on Plain Cloth Prices for Jacquard Weaving :—*

Basis.—Uniform List with the following modifications :—

Plain and satin grounds	25	per cent.
Single lift machines	35	,,

When cloths, satin ground, are woven with three or more threads in one dent, the allowance for every two ends or counts of reed above 68 shall be $\frac{3}{4}$ per cent only, the same as from 60 to 68.

Picks.—Uniform List up to and including 30 picks from 30 to 40, $\frac{3}{4}$ per cent per pick, all above 40, $\frac{1}{2}$ per cent per pick.

Mock lenos and lace brocades to be paid 5 per cent extra.

Pick Finding.—Where the employer requires the loom to be turned in order to find the broken picks the following percentages to be paid :—

$7\frac{1}{2}$	per cent	when	using	18's or finer weft.
10	,,	,,	,,	17's to 12's ,,
$12\frac{1}{2}$	,,	,,	,,	11's or under.

For each warp beam above one, 5 per cent per beam extra. Lenos, crimps, etc. excepted.

(18) *Cotton Crimps :—*

Basis.—Plain cloth as per Uniform List. Cloth woven with the number of shafts as follows :—

4 shafts	20 per cent added.	12 shafts	28 per cent added.
5 ,,	21 ,, ,,	13 ,,	30 ,, ,,
6 ,,	22 ,, ,,	14 ,,	32 ,, ,,
7 ,,	23 ,, ,,	15 ,,	34 ,, ,,
8 ,,	24 ,, ,,	16 ,,	37 ,, ,,
9 ,,	25 ,, ,,	17 ,,	40 ,, ,,
10 ,,	26 ,, ,,	18 ,,	44 ,, ,,
11 ,,	27 ,, ,,	19 ,,	48 ,, ,,

When coloured yarn is used to form a stripe 5 per cent extra is paid.

When all the warp is coloured, the price to be paid shall be by arrangement.

(19) *Lenos* :—

One doup 70 per cent on Plain List.
Two doups 80 ,, ,, ,,

Leno and crimp cloth combined to be paid leno price plus 10 per cent for crimp: the addition for crimp + leno to be put together.

(20) *All Classes of Grey Crammed Stripes.*—All classes of grey crammed stripes in which the ground warp is two end in a dent and made from one beam and one count of yarn, to be paid 4 per cent and reedage, and if made from two beams, 7½ per cent and reedage; and if made from three beams, 12½ per cent and reedage.

If the cloth is part one end in a dent then the percentage shall be 7½ per cent, 11 per cent, and 16 per cent, and the reed to be found by the number of threads in the warp.

All classes of grey crammed stripes made from two or counts of yarn and made on one or two beams, to be paid 7½ per cent and reedage. If the cloth is part one end in a dent, the reedage shall be found by dividing the difference between the actual reed employed and the number of ends in the cloth.

For each additional beam 5 per cent to be added.

(21) *Coloured Crammed Stripes*—When employing up to 15 per cent of coloured yarn in the warp, 5 per cent extra to be paid. Over 15 per cent to 25 per cent of coloured yarn in the warp 7½ per cent extra to be paid.

Over 25 per cent of coloured yarn in the warp the payment to be by the Colne Coloured List. Bleached warp and weft to be called a colour. If all the warp is grey yarn, and employing coloured or bleached weft, 5 per cent extra to be paid.

(22) *Grey Checks.*—Circular-box grey checks to be paid by the Colne Coloured Goods List, check basis, less 15 per cent for there being no colour.

This basis is equivalent to the Uniform List 7½ per cent.

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