acquire, for example, decorative design in a silk brocade or linen damask, it is essential to combine two or more schemes of inter-texture. Differentiations in pattern type and outline involve differentiations in principles of warp and weft interlacing. An ordinary figured texture is a combination of as many distinct "weave" effects as there are distinct textural features in the surface decoration. Figuring in such fabrics is a product of "weave" units. Thus, in the brocade, the figured elements may be the result of using, in different sections of the ornament, twill, sateen, cord, and mat weaves, in addition to the use of special crossings devised for developing various features in the design in particular varieties of textural detail. On the other hand, figuring, in all descriptions of pile carpet, is a product of colour location.

In Brussels, Wilton and velvet-pile carpets and rugs, made in harness and shaft mountings, the range of colours available, as now understood, for this purpose, unless frame planting is practised, is restricted to the employment of five or six shades of pile yarn. These colours can be distributed, according to a pre-arranged plan of design, over the carpet surface. The only limitation which applies, in the order of colour grouping in the delineation of the ornate forms, is that existing in the needle capacity of the Jacquard machine. For the ordinary widths of carpets this capacity is as follows :—

Carpet width and Frame.	Needle capacity of Jacquard.	Uprights controlled or harness cords used in figuring.	Number of units in design.
3/4 Five-frame . . .	1056	1280	256
3/4 Six-frame . . .	1320	1536	256
4/4 Five-frame . . .	1408	1700	340
4/4 Six-frame . . .	1760	2040	340
6/4 Five-frame . . .	2112	2560	512 or 256
6/4 Six-frame . . .	2640	3072	512 or 256

In weaving 16/4 Wilton and Brussels square (pitch, 256 per 27 inches) in one piece, and in five- and six-frame colouring, machines of 5632 and 7040 needles are employed, which provide for each pile thread in the width of the carpet being separately actuated. Further, with respect to the length dimensions of the decorative style, these may be diversified with the number of cards applied, that is, with the number of rows of pile yarn in a repeat of the pattern, which is variable as required.

Inasmuch as the pattern elements are produced in colour

machine-made pile carpets resemble, in this particular, the original form of Eastern carpet weaving. The carpet build is a fixed factor in both grades of manufacture. Colour insertion, whether consisting of pile loops or pile tufts, and whether bound into the carpet by shots of weft crossing over them in the manner described and illustrated, or by knotting each tuft by hand to the warp threads, gives the decorative structure. This suggests the possibility of effecting colour insertion, after a prepared design, by other mechanical means than that of the harness loom; and it is this possibility which has led to the origination of the chenille and royal Axminster systems of carpet construction. In the chenille, as previously indicated, the colour insertion after a prescribed ornate scheme is done in the making of a particular class of weft or fur yarn. This yarn is composed of coloured shots of weft which coincide, in shade assortment and grouping, with the transverse lines of colour units in the design to be woven in the pile carpet. In the royal or tufted Axminster it is a question of colour insertion, also in rows corresponding to the colour units in the transverse lines of the design, by grouping the colours in yarn lengths, correctly classified as to shade, and of feeding these into special sheds in the warp during the weaving of the carpet. Each system of manufacture requires to be separately analysed and dealt with.

Chenille Axminster

In 1839, J. Templeton of Glasgow invented the mechanism, and devised and perfected the practice, by which a velvet-pile carpet is producible, of a decorative structure and quality, by the use of chenille weft yarns. He conceived the master idea that each row of coloured tufts in either the Oriental or Western (*e. g.*, Wilton) carpet may be woven in strip form, rendering the ends of the weft, in severing strip from strip, convertible into a "fur" or "pile" yarn. Taking, for example, the order of tufts in a particular row of pile, in either the hand-tufted or harness woven carpet, as consisting of 84 tufts of red, 64 tufts of green, 48 tufts of blue, 48 tufts of red, and 12 tufts of fawn, or any other series of tufts in different colours, then, to obtain a "fur" yarn of equivalent formation and effect when inserted into the carpet, it becomes necessary to follow the prescribed grouping of the tufts in the weaving or shuttling of the "fur" yarn. Such chenille yarn is made in an ordinary loom, and is preferably

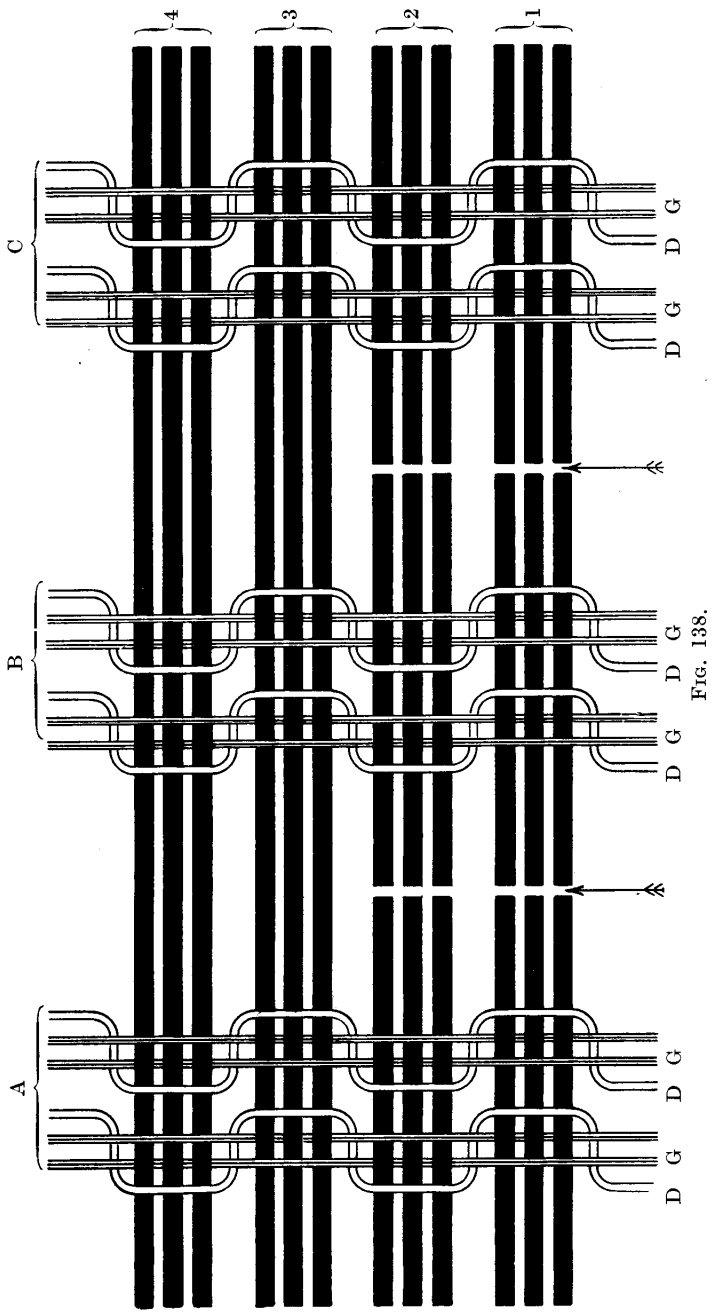


FIG. 138.

gauze or leno shedded, the crossing of the threads on this principle of intertexture resulting in the more secure binding of the shots of weft in the pile than in straight-healded weaving. For the foregoing order of tufts, the yarns would be shuttled 84 shots of red, 64 of green, 48 of blue, 48 of red and 12 of fawn. Each weft line or row of colours in the design is woven consecutively, commencing with the first and proceeding, row by row, to the last row, or, in the sectional design in Fig. 139, with shot 1 and completing the fur yarn production in shot 45.

The structure and method of making the fur yarn are indicated in Fig. 138, in which A, B and C correspond to three strips of chenille as formed in the loom. Shots 1, 2, 3 and 4 are four tufts of fur, each composed of three picks. The number of picks in each tuft depends on the fineness of the fur and the closeness of the pile acquired. In the ordinary grades of rugs and carpets two shots of weft are applied, using a suitable count of weft yarn, but in the better varieties of chenille manufactures, as in the better styles of Wilton and velvet productions, each pile tuft may be formed in two or more picks calculated as one colour unit, and yielding, with the fineness of weft yarn selected and the number of shots per inch in the chenille webbing, a fuller and richer quality of pile surface.

The advantage and utility of the gauze scheme of weaving are evident from this sketch, the doupe or crossing threads D passing round the straight-drawn threads G. Two doupe threads and four ordinary threads, made of cotton, are noticed in each strip of fur, A, B, and C, but only three threads may be employed. The strips after weaving are cut centrally as indicated by the arrows.

A portion of a chenille design for a figured fabric, as prepared on point paper and woven in eleven colours, is reproduced in Fig. 139. The different symbols in which the design is drawn represent different shades of chenille weft yarn as follows :—

Symbol ■ = Dark blue chenille.
„ ⊡ = Orange chenille.
„ I = Yellow chenille.
„ II = Tinted white chenille.
„ ▤ = Dark brown chenille.
„ S = Red brown chenille.
Symbol ▨ = Smoke grey chenille.
„ ▩ = Buff-coloured chenille.
„ ▨ = Straw-coloured chenille.
„ ⊡ = Dark olive chenille.
„ □ = Terra cotta chenille.

Section B of the illustration shows that each line of the design coincides with two shots in the chenille weft, and section C

shows the first line or row of pile in the design and the wefting sequence in weaving the chenille. For the weaving operation, the coloured picks of the design are separated one from the other as at C and consecutively numbered. The cotton warp yarns are prepared, beamed, and healded in the usual manner, with a convenient multiple of threads in each strip of fur yarn. Each set of threads—A, B, and C in Fig. 138—is entered into one split in the reed, and the distance from one strip to another is determined by the length of pile required. Three, four or more empty splits occur between the repeats of the fur yarn as shown in the drawing.

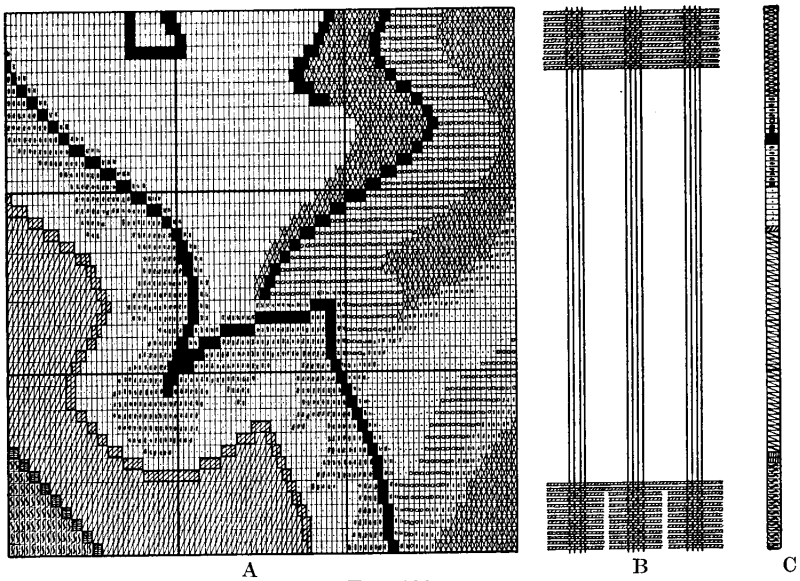


FIG. 139.

By one looming practice the design is cut into strips or shots (= rows of pile) and the weaver produces them in the chenille yarn one by one, fastening one end of the strip, in the process of weaving, to the fabric and passing the other end through a space in the sley and weighting it, enabling him to follow the order of colouring readily. Thus, for producing the chenille yarn for the tufted row No. 1 in the design in Fig. 139 or shot C, the shuttling, according to the signs in which it is marked and their colour equivalents, would be—16 picks of red brown, 2 of dark brown, 40 of smoke grey, 1 of straw colour, 7 of orange, 8 of yellow, 2 of dark blue, 2 of tinted white, 1 of dark olive, 4 of yellow, and 18 of buff. Having completed this strip of the pattern in as many

repeats thereof as there are webbing widths in the loom, the weaver passes across the web a few blind picks and then weaves the second strip, inserts the requisite number of divisional picks, and so on with each strip or line of colouring in the design.

A second and simpler practice is that of indicating the order of wefting on the paper band of a pulley which turns automatically with the insertion of the picks into the chenille webbing. This band is sectionally divided across into picks and forms a shuttling chart. Each division in the band corresponds to a shot of weft. All the shuttles are numbered according to the coloured bobbins of yarn they carry and the positions such yarns are required to take in the fur or woven strips of pile. Assuming part of the first pile row of a pattern to consist of 20 shots of brown (= shuttle 1), 10 shots of grey (= shuttle 2), 14 shots of green (= shuttle 3), and 8 shots of orange (= shuttle 4), then the chart would be divided and numbered thus :—

Division 1 = No. 1. Divisions 2–20 = Blank spaces.	= 20 shots of shuttle 1 or brown.
Division 21 = No. 21. Divisions 22–30 = Blank spaces.	= 10 shots of shuttle 2 or grey.
Division 31 = No. 31. Divisions 32–44 = Blank spaces.	= 14 shots of shuttle 3 or green.
Division 45 = No. 45. Divisions 46–52 = Blank spaces.	= 8 shots of shuttle 4 or orange.

The weaver is required to follow the numbers and change the shuttles as they occur in the chart, and with the latter turning in unison, from the first to the last shot on the section of the pattern being woven, the exact sequence of colour insertion is effected. The work, however, involves close attention as the introduction of the wrong shade of weft, or of the improper number of shots of any particular colour into the chenille webbing, necessarily results in a faulty reproduction of the pattern type.

The scale of the point-paper design in the tapestry fabric chenille in Fig. 139 denotes the ratio of pile tufts per inch in the texture to the ground threads. Each set of coloured ends across shot C agrees with a like area of colour in a transverse line of the fabric. It follows that when the chenille fur is turned round or into the position it occupies in weaving the pattern, each series of colour elements, marked in different signs in the illustration, makes a sectional part of the design of the dimensions drafted on the ruled paper.

These technicalities are further exemplified in Figs. 140, 141, 142 and 143. Fig. 140 is a small chenille mat specially constructed for demonstrating the principles of producing this class of carpet

manufacture. It is woven in three colours and comprises 29 units of warp threads and 39 shots of chenille weft or rows of pile in a repeat. The point-paper section is drawn to the actual fabric scale, each unit of colour being equal to two shots of weft

FIG. 140.

in the chenille yarn, and to a fixed number of ground, stuffing and float warp yarns and also binding picks in the carpet. The method of constructing the fur yarns and of preparing them for insertion into the fabric is illustrated in Figs. 142 and 143, specimens of the yarn as woven, and as "closed" or formed into a pile structure. Each coincides in colour composition with the

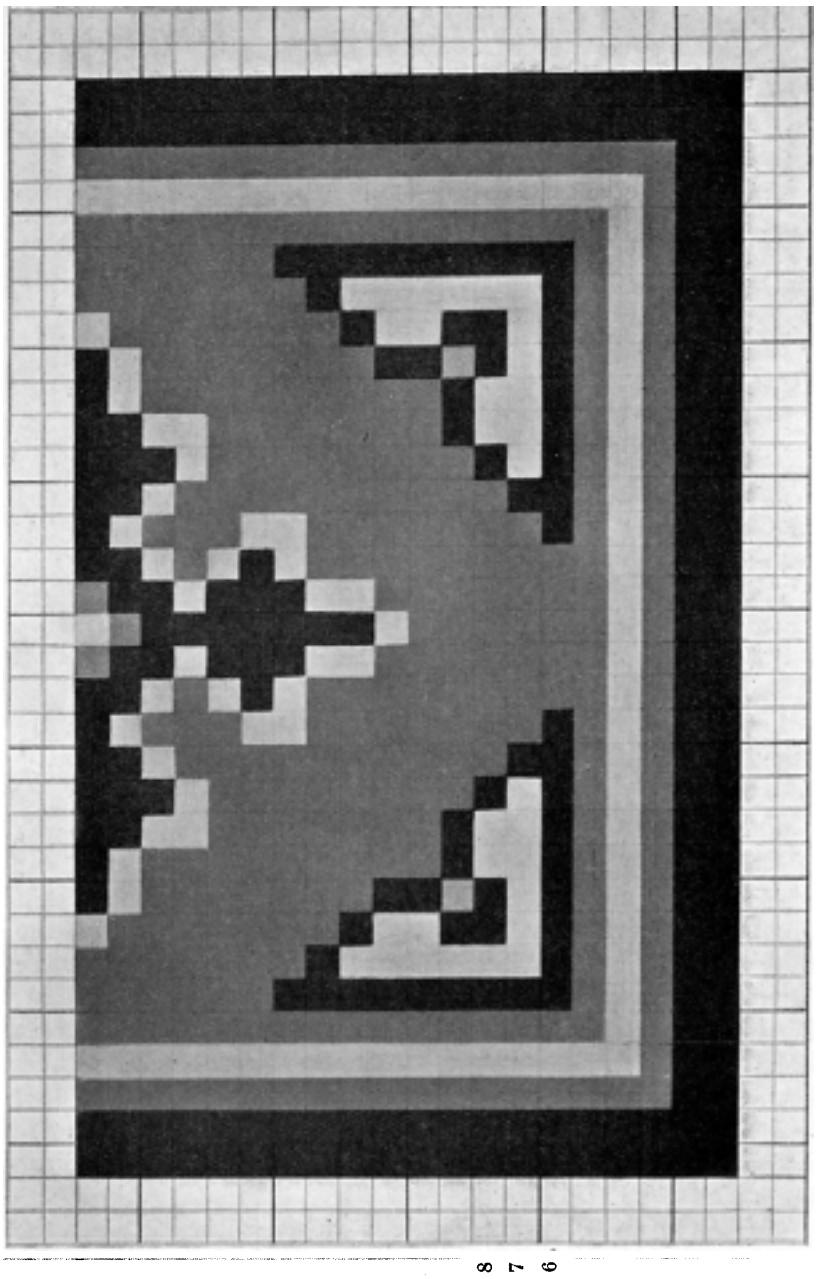


FIG. 141.

transverse lines 6 and 7 in the sectional plan and in the mat. Comparing these lines of colour in the respective figures brings out their exact relation to each other. Thus, as each single transverse line of coloured effects in Fig. 141 represents two shots of yarn in the chenille, the order of colour grouping in Figs. 142 and 143 for the tufted lines 6 and 7 in the mat is as follows :—

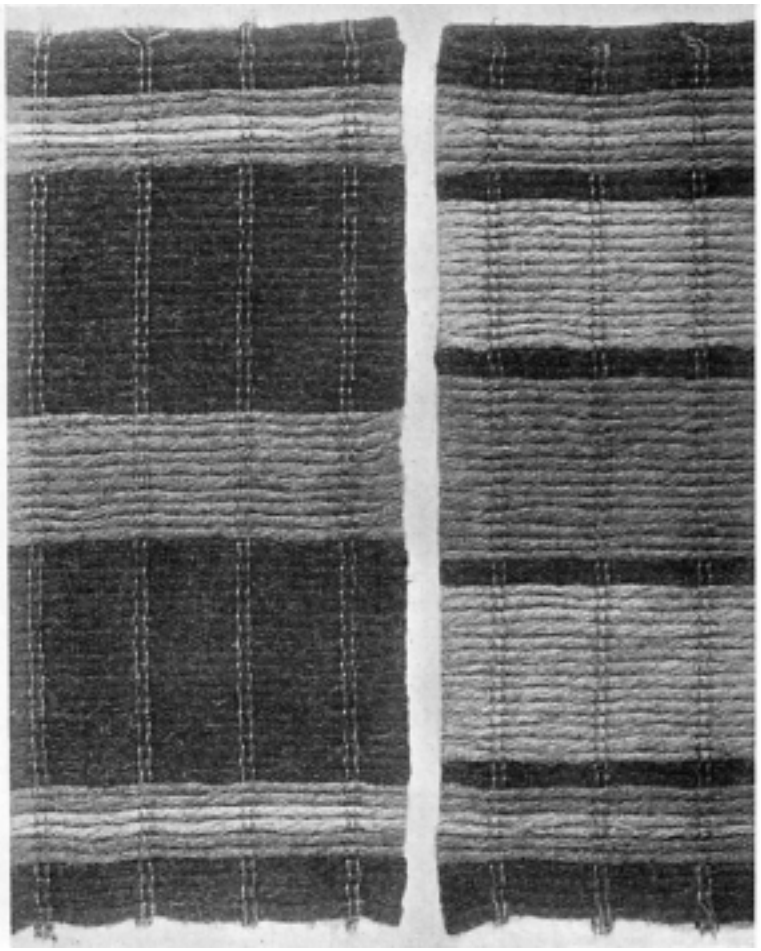
CHENILLE MAT, FIG. 140.

SECTIONAL DESIGN, FIG. 141.	FUR YARN, FIG. 142.
Shot 6.	*Pile row* 6.
2 colour units in dark blue green.	4 shots in dark blue green.
1 ,, unit in red.	2 ,, red.
1 ,, ,, ochre.	2 ,, ochre.
1 ,, ,, red.	2 ,, red.
9 ,, units in dark blue green.	18 ,, dark blue green.
5 ,, ,, red.	10 ,, red.
9 ,, ,, dark blue green.	18 ,, dark blue green.
1 ,, unit in red.	2 ,, red.
1 ,, ,, ochre.	2 ,, ochre.
1 ,, ,, red.	2 ,, red.
2 ,, units in dark blue green.	4 ,, dark blue green.
Shot 7.	*Pile row* 7.
2 colour units in dark blue green.	4 shots in dark blue green.
1 ,, unit in red.	2 ,, red.
1 ,, ,, ochre.	2 ,, ochre.
1 ,, ,, red.	2 ,, red.
1 ,, ,, dark blue green.	2 ,, dark blue green.
6 ,, units in ochre.	12 ,, ochre.
1 ,, unit in dark blue green.	2 ,, dark blue green.
7 ,, units in red.	14 ,, red.
1 ,, unit in dark blue green.	2 ,, dark blue green.
6 ,, units in ochre.	12 ,, ochre.
1 ,, unit in dark blue green.	2 ,, dark blue green.
1 ,, ,, red.	2 ,, red.
1 ,, ,, ochre.	2 ,, ochre.
1 ,, ,, red.	2 ,, red.
2 ,, units in dark blue green.	4 ,, dark blue green.

The length measurement of a shot of fur yarn is the same in length measurement as a line of colour elements across the design; with, in this example, two picks in the chenille filling the same space in the yarn as one colour element in the pattern. Fig. 142 contains three repeats of each yarn, a number of repeats being woven together, varying with the width of the chenille loom and with the distance between the strips or sections 1, 2 and 3 in the specimen. With the strips $\frac{1}{2}$ an inch apart the pile length in the rug or carpet is from $\frac{1}{8}$ to $\frac{3}{16}$ of an inch, as in the sample mat in Fig. 140.

After the chenille yarn has been woven as in Fig. 142, the strips (each completed strip being a repeat of the design, so that with 30 webbings in the loom width this number of design repeats would be produced at one time) are separated from each other,

and the pile ends " closed " or made to assume the form shown in Fig. 143, the three fur yarns in which represent the rows of pile numbered 6, 7 and 8 in the mat, or correspond with these rows of colour in the sectional design, Fig. 141.



Pile Row 6. Pile Row 7.

Fig 142.

The entire length of fur yarn, made up as shown of chenille shots or lengths divided from each other by dummy picks, forms one repeat of the carpet design whatever its size and colour composition. It has to be secured to the carpet structure in the order in which it has been woven, and without the stitching

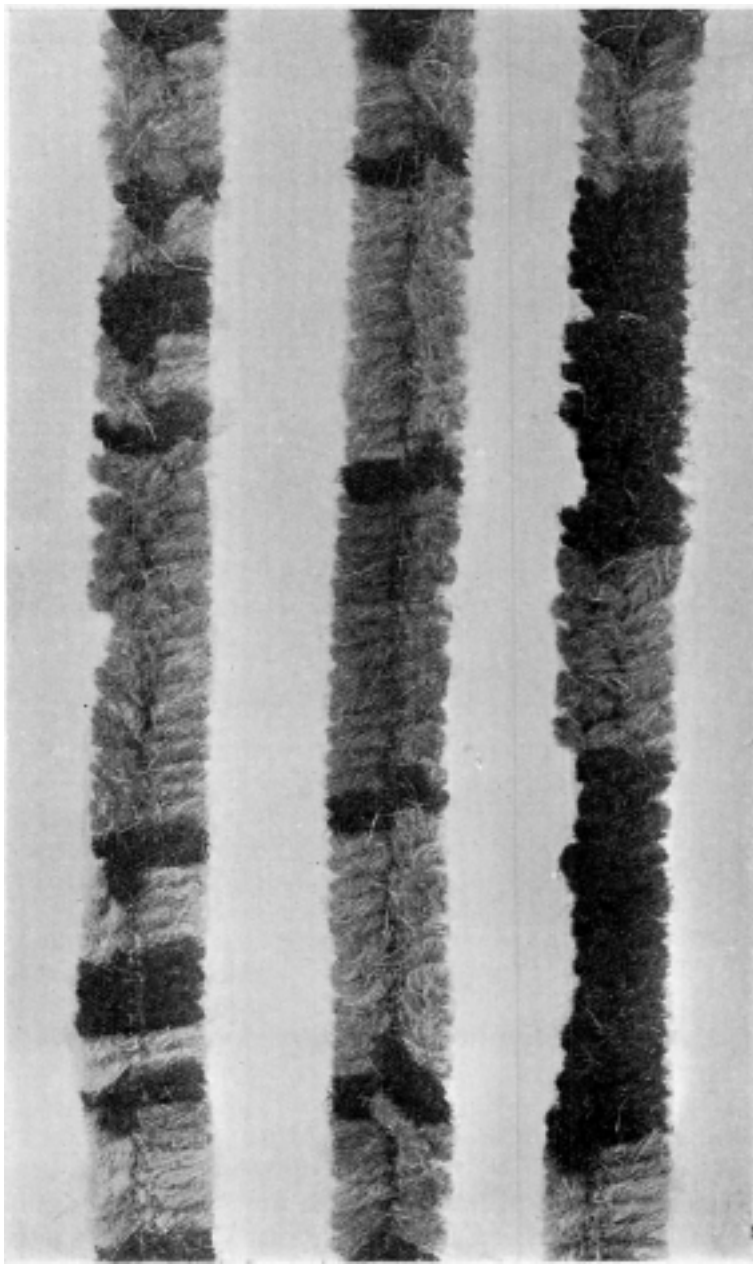


FIG. 143.

ends employed for this purpose showing in the pile surface. The system of stitching applied will be explained in dealing with the construction of the carpet. The insertion of the fur yarn, length by length or shot by shot, into special sheds in the warp, is done in two ways. First, the " closed " pile yarn for one or more repeats of the design is wound loosely on to a large spool and placed for convenience behind the warp beams of the loom, and conveyed therefrom by a " carrier " on to the carpet surface but

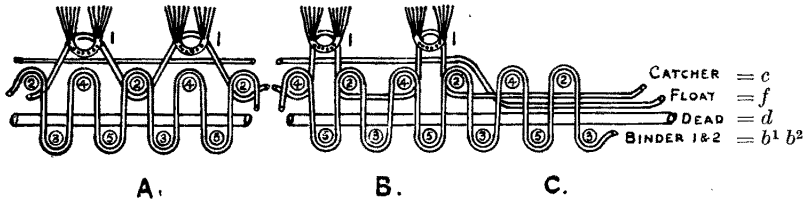


FIG. 144.

underneath the " catching " or stitching threads. Secondly, it is wound on to shuttle bobbins with double ends and each capable of receiving about 30 yards of chenille, or it is placed in a metal box or taut linen bag which fits within the shuttle, and in one of these forms shuttled across the loom in the usual way. In either instance the pile yarn has to be trimmed after being placed in the weaving position and forced by the reed of the going-part into a correct relation with the preceding rows of pile.

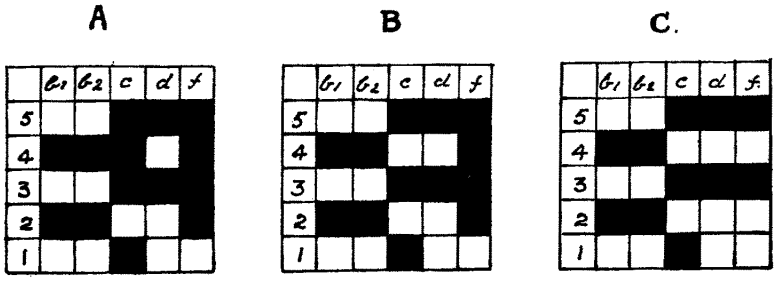


FIG. 145.

The various practices in chenille rug and carpet production are illustrated in the sectional drawings in Figs. 144, 149, 151 and 153, and also in the weave plans A, B and C in Figs. 145 and 150, and in Figs. 152 and 154. In Fig. 144 the foundation of the fabric is made up of the binder threads b^1, b^2, the catcher yarns c, the stuffer or dead yarns, d, the float threads f, and the filling shots 2, 3, 4 and 5. Section A of the sketch shows a part of the structure with the catcher yarn weaving four up and one

down or as in plan A, Fig. 145; section B with the catcher yarn weaving three up and two down, or as in plan B; and section C when " filling " or shuttling with the catcher yarn either four up and one down, or three up and two down (see plan C), and the float yarn out of action. The healding draft and reeding system is sketched in Fig. 146, and the shedding gear in Fig. 147, in which the binder, stuffer and float healds are shown depressed, and the catcher heald lifted on the shed for the insertion of the chenille yarn *v*. The driving and tappet gearing of the loom is shown in Fig. 148, S being the stop, B the shuttle-box, C the heddle tappets, and D the driving mechanism.

According to the healding draft (Fig. 146) the drawing-in of the warps and of reeding is done for Figs. 145 and 150 as below :—

1	thread of	binder,	b^1,	through heald	1	of shaft	1	Split 1 of the reed.
1	,,	stuffer,	*d*,	,, ,,	1	,,	4	
1	,,	catcher,	*c*,	,, ,,	1	,,	3	Split 2 of the reed.
1	,,	binder	b^2,	,, ,,	1	,,	2	
1	,,	stuffer,	*d*,	,, ,,	2	,,	4	
1	,,	float,	*f*,	,, ,,	1	,,	5	
1	,,	binder,	b^1,	,, ,,	2	,,	1	Split 3 of the reed.
1	,,	stuffer,	*d*,	,, ,,	3	,,	4	
1	,,	binder,	b^2,	,, ,,	2	,,	2	Split 4 of the reed.
1	,,	stuffer,	*d*,	,, ,,	4	,,	4	
1	,,	catcher,	*c*,	,, ,,	2	,,	3	
1	,,	binder,	b^1,	,, ,,	3	,,	1	Split 5 of the reed.
1	,,	stuffer,	*d*,	,, ,,	5	,,	4	
1	,,	float,	*f*,	,, ,,	2	,,	5	
1	,,	binder,	b^2,	,, ,,	3	,,	2	Split 6 of the reed.
1	,,	stuffer,	*d*,	,, ,,	6	,,	4	

Sixteen threads make a healding and reeding cycle in this standard practice of loom mounting. It is repeated throughout the drawing-in operation. The binder or ground yarn commonly consists of jute, but coarse woollen is also used. Other yarns are of jute or hemp and cotton, such as 2-fold 8 lb. jute for ground, 6–9 lb. jute or hemp for stuffer, 4-fold 24's cotton for catcher, and 2-fold 7 to 8 lb. jute for float, with the filling yarn in thick jute, or, in the better makes of rugs, thick woollen (Figs. 144 and 149) arranged four shots of ground yarn and one shot of fur yarn.

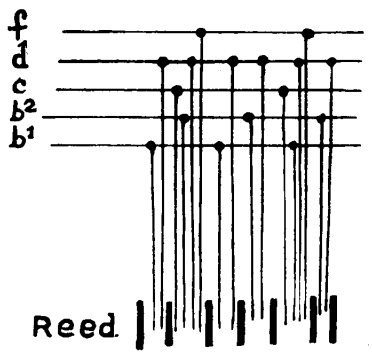


FIG. 146.

From the sketches A, B and C in Fig. 144 it will be observed that the chenille yarn (shots 1) in A is bound above the float

yarn into the carpet structure by the catcher *c* passing over it and under shots 2 but over shots 3, 4 and 5; while in sketch B the chenille yarn is bound by the catcher *c* in a similar manner, but by interlacing over shots 1, 3 and 5 and under shots 2 and 4,

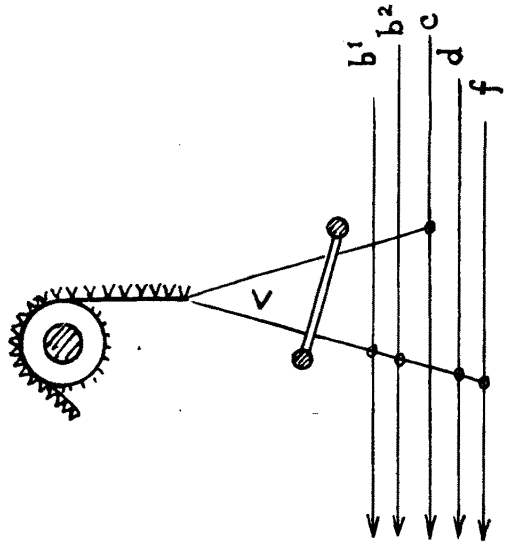


FIG. 147.

effecting a firmer binding and fastening of the catcher yarn into the fabric foundation. In sketch C, in which no chenille yarn appears, the catcher and float yarns pass between the pairs of ground picks 2 and 4 and 3 and 5, with the stuffer or stationary

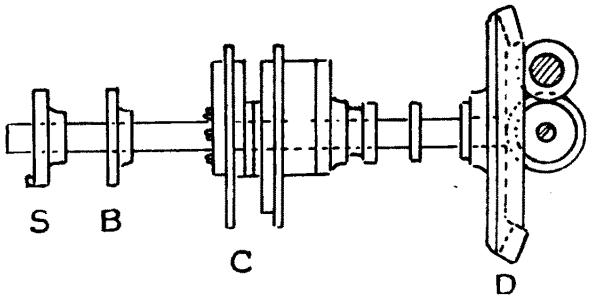


FIG. 148.

threads also between the upper and lower series of picks as in Brussels and Wilton carpets.

In the weave plans A, B and C, Fig. 145, shot 1 is the fur yarn, and shots 2, 3, 4 and 5 the jute weft or filling. The marks in the plan represent threads lifted, the latter being lettered as in the sectional drawings A, B and C, of the fabric. Similar

letters have a like significance in the healding draft, Fig. 146, and in the loom mounting, Fig. 147, in both of which f is the heald-shaft carrying the float chain threads, d the heald-shaft for the stuffing yarns, c the heald-shaft for the catcher threads, and b^1 and b^2 the heald-shafts for the yarns of the binding warp.

This system of setting the chenille in the carpet and of weaving is known as plain with four shots of ground weft to one shot of pile yarn. That shewn in sketches A, B and C in Fig. 149 is also woven

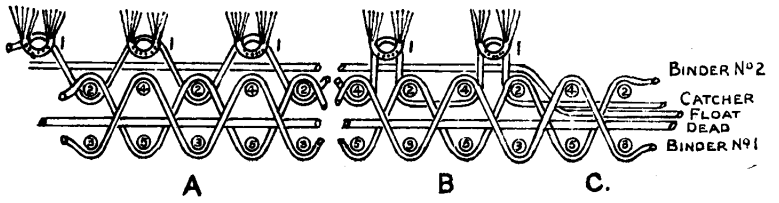


FIG. 149.

four shots of jute—see plans A, B and C, Fig. 150—to one shot of fur yarn, but is of the diamond-weave formation, the order of interlacing of the catcher thread in A being over the chenille weft pick 1, under pick 2 and over picks 3, 4 and 5, and for binder b^1 under picks 1, 2 and 3 and over picks 4 and 5, and for binder b^2 under pick 1, over 2 and 3 and under 4 and 5, with the float and stuffer yarns in the position described in reference

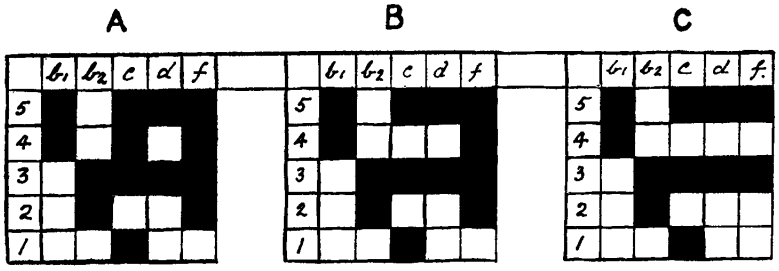


FIG. 150.

to Fig. 144. In this arrangement the catcher threads work four up and one down in plan A, but in sketch B such threads are lifted for three and depressed for two picks, or, as shown in the sectional drawing, they pass over pick 5, under 4, over 3, under 2 and over pick 1, securing such threads firmly in the build of the carpet and binding the fur yarn a degree faster to the carpet surface than in the first practice. The actual make of the carpet without the pile yarn is shown in sketch C—plan C, Fig. 150—in which the binder threads b^1 and b^2 pass over and under two

shots in alternate order, with the catcher threads equivalent to one down and one up.

In both these examples a foundation cloth is constructed by combining ground and stuffer yarns, and interweaving these together on similar principles as in other and standard builds of pile carpets. To this foundation fabric the chenille weft is loosely

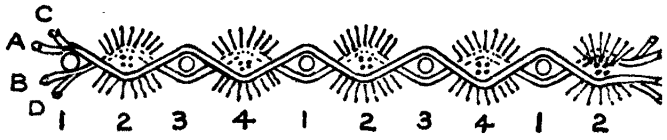


FIG. 151.

tacked with the float yarn between such weft and the carpet groundwork.

Chenille rugs are, however, made without any such foundation structure, and in the plain weave, shuttled one pick of jute and one pick of fur yarn, or in the four-shaft weft twill, chenille-yarn wefted. Sections of these light and cheaper varieties of manufacture are given in Figs. 151 and 153. In weaving the chenille

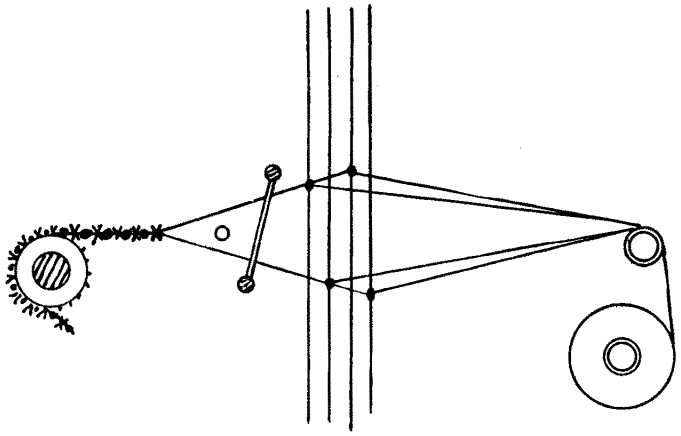


FIG. 152.

yarn it is double-shotted to produce, after cutting, a circular type of pile yarn of the character illustrated in Fig. 157.

Considering the plain-weave rug of which Fig. 151 is a section of the fabric, threads A, B, C and D are the cotton warp and picks 1 and 3 the jute weft, and picks 2 and 4 the fur yarn, with the pile ends projecting from the core of the yarn, and causing it to have a tufted circumference. The loom mounting for weaving this class of manufacture is that shown in section in Fig. 152,

the warp being healded straight and sleyed two threads in a dent of the reed. Only one warp beam is necessary and either two or four heddles may be employed. The structure of the rug as woven is indicated in the sketch as it passes over the pinned breast or take-up roller.

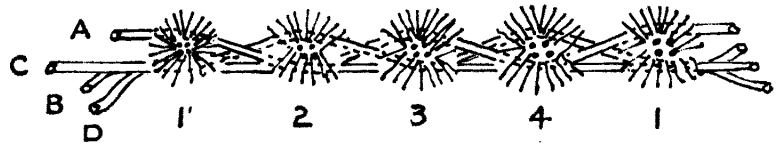


FIG. 153.

It will be observed that the interlacings of the ground threads and picks are evident in the fabric structure—Fig. 151—but these become invisible in the finished rug. The tufted yarn is full and yielding in formation, and the ends of the pile spread over the ground texture and effectively conceal it from view.

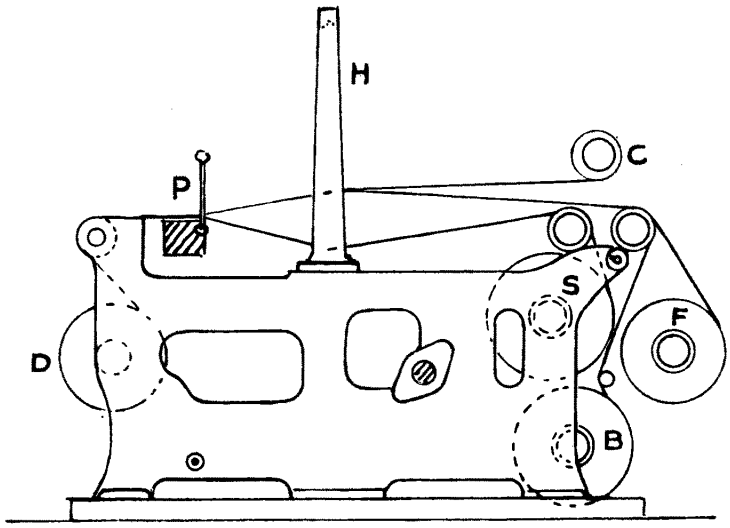


FIG. 154.

Whereas in this single-weave build of chenille Axminster only one chain beam is required, in the compound structures in Figs. 145 and 149 three chain beams are necessary. The plan of arranging these is illustrated in the end elevation of the loom in Fig. 154, in which B is the beam for the binder warp, F for the float warp, S for the stuffer and C for the catcher chains, while H is the heddle stand, P the going-part and reed, and D the piece roll.

Fig. 153 is a sectional illustration of the single-make twilled chenille rug, which may be closer set in the warp than the preceding variety of production, the weave being either a straight or broken four-shaft weft twill, preferably the latter. This style of rug is woven entirely in fur yarn, the only ground threads in the fabric being in the warp, cotton, linen or jute. As this is small in size as compared with the bulky circumference of the fur yarn, it readily becomes, in the process of weaving, embedded and hidden in the pile tufts. The section of the fabric structure (Fig. 153) shows such warp threads as lining the surface of the pile, but this does not actually take place. They interweave with the pile weft in the manner sketched for making the rug and holding the chenille shots together, but in doing so they pass between the pile ends to the core of the chenille, by which means they are rendered invisible.

These single-weave principles of construction are so simple in type as to admit of the manufacture of inexpensive rugs, in which the chenille weft yarns may be made of cotton, coarse wool, noils, and other wool substitutes. They yield a style of fabric deficient in strength and durability, but with a soft surface, not infrequently excellent in design and colouring. On the other hand, in the compound build of chenille Axminster, rugs and carpets firm and compact in the velvet pile and serviceable in the wear are produced in an extensive assortment of qualities, and in elaborate styles of decoration.

Specimens in the single-make " reversible," the woollen-yarn foundation, and in the close, fine pile varieties of chenille rugs will be examined. Fig. 155 is illustrative of the " reversible " style of production. It is made of circular or round fur yarn of which specimens are shown in Fig. 157, obtained from the chenille webbing in Fig. 156. Such webbing is leno woven, each strip consisting of four cotton threads. The first pick is inserted in the open shed, the second pick in the leno shed with the leno yarn crossed to the right, the third pick in the second open shed, and the fourth pick in the second leno shed with the leno yarn crossed to the left. The webbing contains fourteen shots of 2-ply 7 skeins woollen (Fig. 158) per inch, with the strips $\frac{3}{8}$ of an inch apart, a spacing which produces a pile of about $\frac{3}{16}$ of an inch in depth in the rug. Cutting the floating yarns centrally between the cotton interlacing threads gives a round fur yarn of the form seen in Fig. 157, in which all the pile ends are of the same length. The sample web is woven in tan, maroon, blue

lavender, tinted white, light olive, green, and rose-pink yarns, and is an actual part of the webbing used in the production of the fur yarn for the decorative rug in Fig. 155.

FIG. 155.

The character of the fur yarn determines the quality of the pile surface in the finished manufacture. It is affected by the counts or size of the yarns applied in the weft in making the

chenille webbing, and also by the number of shots in a given length of the fur yarn. In this instance the weft yarn in the

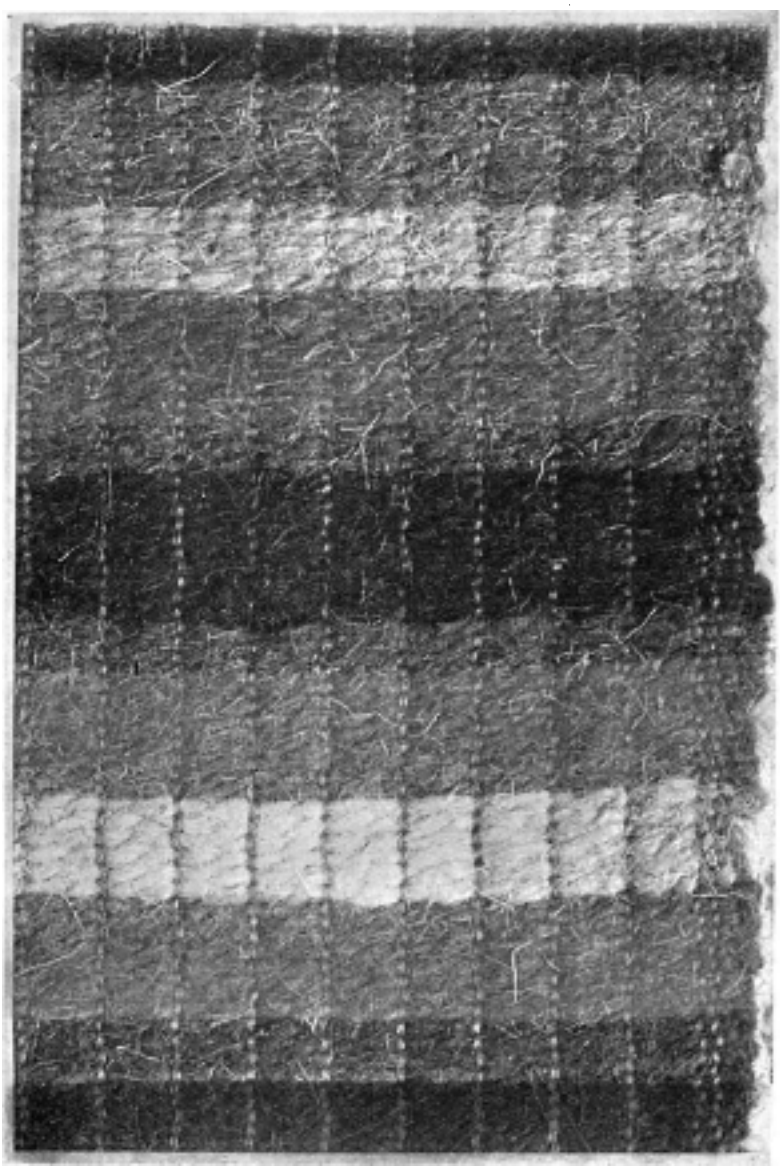


FIG. 156.

chenille consists of strong-fibred wool. The web is firmly woven, and this implies the acquirement of a compact pile in the rug or carpet. The yarns are two-fold and of good tensile property,

with the wool of which they are spun possessing a fair length of staple and some degree of lustre, and these features impart to the chenille and to the nap of the rug durability and mellowness of colour tone. There are $3\frac{1}{2}$ shots of fur yarn per inch in the fabric.

Though this description of Axminster is elementary in construction, it provides the full figuring scope obtaining in the compound varieties of chenille manufacture, which figuring scope is equally extensible with that available in the designing of Wilton and Brussels carpets. The colour range is only limited by the order of shuttling practised in producing the chenille webbing. In the Jacquard figured carpets, as explained, the tinting range is prescribed by the number of frames, and should planted colours be used, the colour toning, in a line of the carpet, is confined to six shades of yarn. In the chenille Axminster the colours may be varied and located at will in the development of the decorative style.

This colouring range, combined with the facility the system of work affords in diversifying the nature and quality of the pile in the carpet, causes the chenille practice, in design and fabric structure, to be suitable and also applicable to an extensive variety of rugs and carpets, the latter seamless and weavable in different dimensions up to several yards in width and length. The fact that the tufted yarn may be carried or shuttled into the " catcher " sheds in the warp, and that no wires are required in the weaving operation, enables carpets of any reasonable size to be woven in one piece, and varied in design and in colour treatment throughout the pile surface.

Figs. 155 and 159 and the specimen on Plate IX. emphasise these technicalities in the manufacture of chenille structures. The first is woven on the principle illustrated in Fig. 153, a sectional drawing of the fabric. The pile is woven in fawn, maroon, cream white, tan, brown, light olive, rose pink, deep and pale blue, and green and pale green. Analysing the design composition shows the edging and ground of the field of the rug to be produced in fawn, with such edging lined in two tones of blue. The border has a light olive ground with the dark-shade ingredients of the ornament in the photographic illustration in deep blue, and the lighter ingredients in tinted white, rose pink, light blue, and pale green. The trellis corner features are developed in blue and brown shades. The intermediate bands of effect between the field and the border have a green ground in

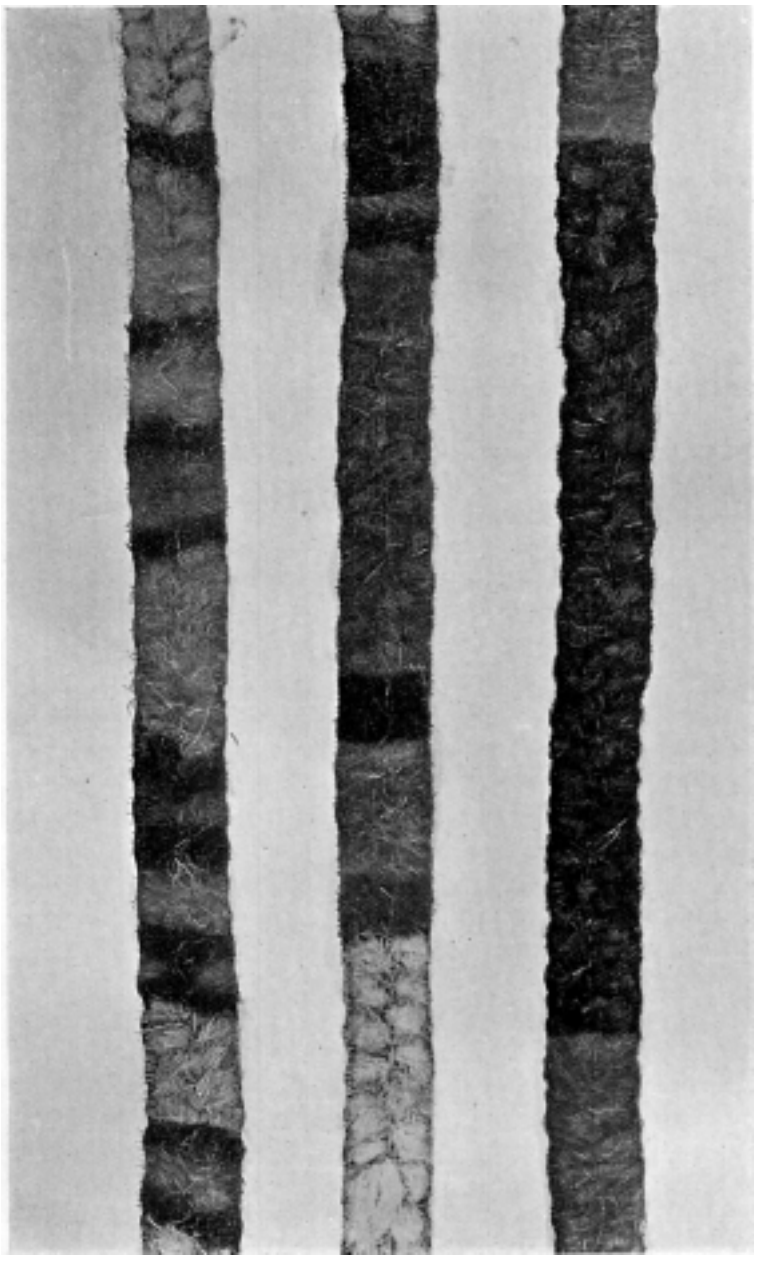


FIG. 157.

contrast with the fawn shade in the ground of the field of the rug. This species of colour contrast in ground colour tones in

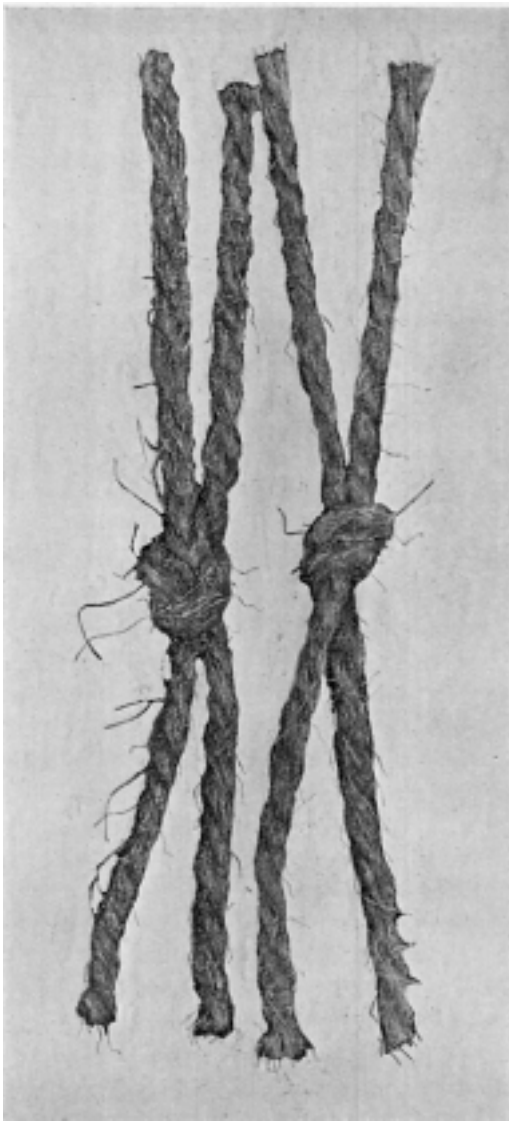


FIG. 158.

the three distinctive parts of the decorative scheme is important, inasmuch as it connects up the tinting units applied to pattern elements in each section of the ornate style. The centre rosette

in the festoon figuring in the field is woven in deep blue, fawn, cream, tan and pale green, with the surround ornament in maroon, light olive, rose pink and tinted white, elaborated with touches of blue and pale green. The features reproduced in dark tones are formed throughout the rug in blue and brown shades. The smaller groups of pattern units in the middle portion of the specimen are woven in blue in the leaf forms, and brown and rose pink, maroon and cream, and cream and fawn in the floral details.

The design and colouring of the whole rug are suggestive and typical of the style of decorative work feasible in the cheaper grades of chenille Axminster fabrics, and also of the principle of duplicating the ornate effects by producing the coloured pattern forms in pile on both sides of the rug in the process of chenille yarn weaving, and of chenille yarn setting in the construction of the rug.

A firmer and better class of manufacture is illustrated in Fig. 159. It is compound in build and woven by the practice described relative to section A of Fig. 149, the foundation of the rug being in diamond make, and consisting of coarse-fibred thick woollen yarns. In addition, there are the stuffer yarns in jute, the float yarns in the same material, and the catcher yarns in cotton. The filling yarn is also woollen of $1\frac{1}{2}$ to 2 yards per dram. The whole structural formation is firm but yielding in the pile surface to the tread, corresponding in this respect with Wilton manufactures.

The fur yarn is woven in 3-fold 16 skeins woollen with ten picks per inch, making a compact pile of $\frac{1}{8}$ of an inch in length. To compare the density or number of the pile ends in the reversible example in Fig. 155 with that of the specimen in Fig. 159, take the shots in an inch of the fur yarn and multiply them by the shots of fur yarn per inch in the rug, and the result by two, each shot presenting two ends in the pile of the fabric, thus :—

PILE ENDS PER SQUARE INCH OF CHENILLE RUGS.

Reversible Rug, Fig. 155.

Chenille webbing—2-fold 7 skeins woollen = 14 shots per inch.
Fur yarn in rug = $3\frac{1}{2}$,,
$\therefore$ $14 \times 3\frac{1}{2} = 49$, shots or threads of pile, $\times 2 = 98$ ends of pile yarn per square inch.

Rug Specimen, Fig. 159.

Chenille webbing—3-fold 16 skeins woollen = 10 shots per inch.
Fur yarn in rug = 5 ,,
$\therefore$ $10 \times 5 = 50$, shots or threads of pile, $\times 2 = 100$ ends of pile yarn per square inch.

The greater density of the nap in Fig. 159 is due to all the pile ends being on one side of the rug, whereas in Fig. 155, 49 ends are utilised in forming the pile on one side and 49 in forming the pile on the reverse side of the fabric; and also to each pile yarn in its structure consisting of three instead of two threads loosely twisted together. The two-fold yarn is, however, the thicker, being $\frac{1}{25}$ of an inch in diameter as compared with $\frac{1}{31}$, the diameter measurement of the three-fold 16 skeins thread.

The ratio of colour units (double shots) in the chenille webbing and of shots per inch of the fur yarn in the rug fixes the scale of the design or point paper. Thus, designs for the reversible manufacture in the setting specified may be worked out either as $3\frac{1}{2} \times 3\frac{1}{2}$ squares per inch or 7×7 paper. If the former, each colour unit on the paper would be equivalent to 4 shots in the chenille yarn, but if the latter, to two shots. For designs in the setting for Fig. 159 the scale of the paper should be 5×5, each square corresponding to one colour unit in the pile or to two shots of weft in the chenille webbing.

The rug in Fig. 159 is an effective design and colour example, the ornament being diversified, rich in detail and in tinted contrasts. The border consists of such chenille yarn shades as black, blue grey, light fawn, crimson red, sage green, lavender, chocolate, pink and ochre; and the field of blue and smoke grey in the ground, and of black, chocolate, blue grey, sage green, fawn, deep, medium and tinted red, medium blue, lavender, dark and light heliotrope and black in the figuring. The marginal lines of the rug are woven in black, grey and fawn, with the corner decorative forms in the border edged with black, and their interior elements in two shades of green and light grey specked with brown and ochre colouring. The lighter-tinted diamond effects in the border have a fawn ground, and the darker-tinted diamond effects a grey ground, both edged with black, but with the details in the first in lavender and red, and in the second in chocolate, crimson and rose colour.

The ornament in the field comprises the geometric figuring in outline interlacing with the upper and lower heart-shaped figuring also in outline; and a number of conventional floral and leaf forms effectively delineated in the coloured yarns specified. Thus the demarcation lines of the ornament are produced in fawn lined with black, with the ground of the field in blue grey tinged with smoke colour, imparting mellowness of tone to the whole surface of the rug. In the floral features at both ends of the

FIG. 159.

rug, the upper and side petals are developed in fawn, tan and lavender and other petals and leaf forms in grey, red, medium blue, fawn and sage green. The central part of these flowers is a mass of mingled tinting, in which chocolate brown, tan, two tones of blue, grey, three tones of red and two of fawn are combined. The decorative types lettered B have sections woven in grey, green, pale green and fawn intermixed with light red and edged with black, and with their centre parts in warm colour tones tinted with lavender and blue. Those lettered B^1 are developed in green, blue and sage green, each graded in tone, with their details in two tones of heliotrope, fawn, grey, blue and lavender, and with black for divisional and edging effects.

The rosette form—on line C, C—in the centre of the field is worked out in light and medium tones of colour, including such shade combinations as (1) deep and pale fawn, (2) medium and tinted red, and (3) medium and pale green in the middle portion of the figure, with fawn, rose pink, and red brown as contrasting hues, and black as a divisional shade. Certain parts of the subdued and secondary figuring in the ground are produced in brown, red, and fawn, relieved with green, and other parts in black outlined in fawn, with detail types in light fawn and rose colour, or in two tones of heliotrope blended with black and green.

The chenille Axminster rug on Plate IX. is oriental in design character, but produced in subdued and mellow tones. It possesses the fineness, density, and smooth softness of pile surface distinguishing the close-woven Wilton. Moreover, in textural flexibility and velvety richness, and also in artistic effect, it favourably compares with the finer varieties of Persian loomwork. Both in ornate quality and in structural efficiency the rug may be taken as showing how effectively the chenille fabric may be made to resemble, in pile attributes and in decorative composition, hand-tufted manufactures.

In addition, the ornate style of this specimen indicates the facilities the chenille method of pile formation affords in developing surface ornament diversified in subject and in colour treatment. The pattern forms combined are as varied in type, and as clearly delineated, as the more elaborated pattern types weavable in either the harness or the vertical-warp loom. A possible imitation of this decorative scheme is obtainable in a five-frame, planted colour, Wilton, and in a 6/4 Jacquard machine of 2600 wires tying up some 2120; but the colour tinting of the rug would, in

the process, be deteriorated. The restriction in the use and location of colour tones in the fabric, which the Jacquard principle of weaving imposes, would result in more prescribed colour toning in the depiction of the pattern units in the decorative style than is observed in the illustration.

This species of rug designing also shows the scope feasible in coloured-yarn application in the chenille system of pile production. The colour practice is obviously variable with the tinted elements in the ornate plan, and with the order in which such elements are required to be grouped and distributed in the pile of the rug. As the colour units increase in number and in method of combination, the weaving of the chenille becomes increasingly complicated, but the complication which ensues, in the well-organised routine of work established and described, is capable of being efficiently handled. Colour variation, however complex in the design, is not restricted by the machinery employed in the weaving of the fur yarn, as in the weaving of pile fabrics in the harness loom. It is extensible at will in the acquirement in the rug or carpet of any specific variety of surface decoration.

The ornament in this specimen—Plate IX—includes bird, animal, plant, floral and geometric types, yet each is appropriately coloured and delineated. The birds are variously depicted, as in shades of blue with olive-green wings tipped with black, in lavender blue and black tones, and in golden brown with the wings in blue and black demarcation lines. The floral subjects, filling in the cupola space of the field, have a black or dark blue centre and fawn-coloured edging, in contrast with the lighter shades used in portions of the floral and leaf forms in the upper corner sections of the field.

The fabric is suggestive of the Persian symbolical style of design. It is elaborate in conception and in detail constructiveness. In keeping with many of the larger varieties of Eastern-rug patterns, the ornament is framed on the centre or turn-over base, as seen in the richly-decorated dome-like shape, and also in the position and setting of the bird, animal and other ornate forms in the respective sides of the rug. A light fawn or drab shade is applied to the central figuring in contradistinction to the deeper tone of colour used in the corner features and in sectional details of the various pattern types. The pedestal at the base of the design is geometric in character, but in ornate contrast with the pattern elements in the centre of the lower border and also with those of the leaf and floral forms in the

PLATE IX.

CHENILLE AXMINSTER RUG

field. In the colour tones in which it is developed it constitutes a suitable fundamental structure of the whole ornate scheme. Its basic lines are woven in blue, lavender, fawn, black, and sage green combined in such a manner as to produce softness of tinted tone, and to harmonise with the colouring of the decorative types with which it is associated. Throughout the ornamental plan the leaf, flower and other figured features are connected one with the other in natural sequence, suggesting, in this sense, a species of style elaboration having, in all its units of effect, a principle of constructiveness in common. Repetition of pattern subjects, as in the formation of the design from central elements seen in both the field and the borders, results, on this principle, in the acquirement of symmetry combined with diversity of decorative style.

The pile ornament consists, in this instance, of fine wool-fibred yarns in tone-upon-tone and in contrasting colours, including deep, medium and lavender blue, olive and sage green, and fawn, tan and brown, with black as a lining and edging shade.

Varied and effective detail work obtains in the development of the designs in the borders, the broad bands of which have a dark blue ground. On this colour of pile the different ornate forms are woven in fawn, brown, olive green and blue lavender. Each corner section comprises floral features which make a complete pattern type, so drafted and arranged as to fit and synchronise with the ornamental types in the border bands they link together. The interchanging of the several colour tones in the figuring and in the ground of the small lines of mingled detail, adds to the decorative interest and quality of the border.

The firmly-constructed but flexible foundation of the rug is made of cotton, linen and jute yarns, and the pile of 2-fold worsted. Samples of the fur yarn, of a similar quality to that employed in the weaving of the fabric, are reproduced actual size in Fig. 160. Each pile shot is $\frac{1}{2}$ an inch in length and consists of soft spun yarn, slackly twisted in the folding and in the reverse direction to the twine in the single threads, the wool used being of a fine crossbred quality. The rug is woven with 12 shots of fur yarn per inch, hence the design would be drafted on 12×12 paper such as that shown over the chenille yarn specimens. Comparing this setting with that of the mat in Fig. 140, it will be observed that the size or counts of the weft yarn and shots per inch in the chenille vary in the ratio of the ends per square inch of pile. In the coarser manufacture there are 10 shots of 2-fold 3-skeins

woollen in the chenille webbing, yielding 4 double shots or pile tufts per inch in the closed fur yarn, and in the finer manufacture 28 shots of 2-fold 14's worsted in the chenille webbing, yielding 12 double shots or pile tufts per inch in the fur yarn.

Appropriate setting is practised in the looming and weaving of both examples. The rug being, however, made of the finer

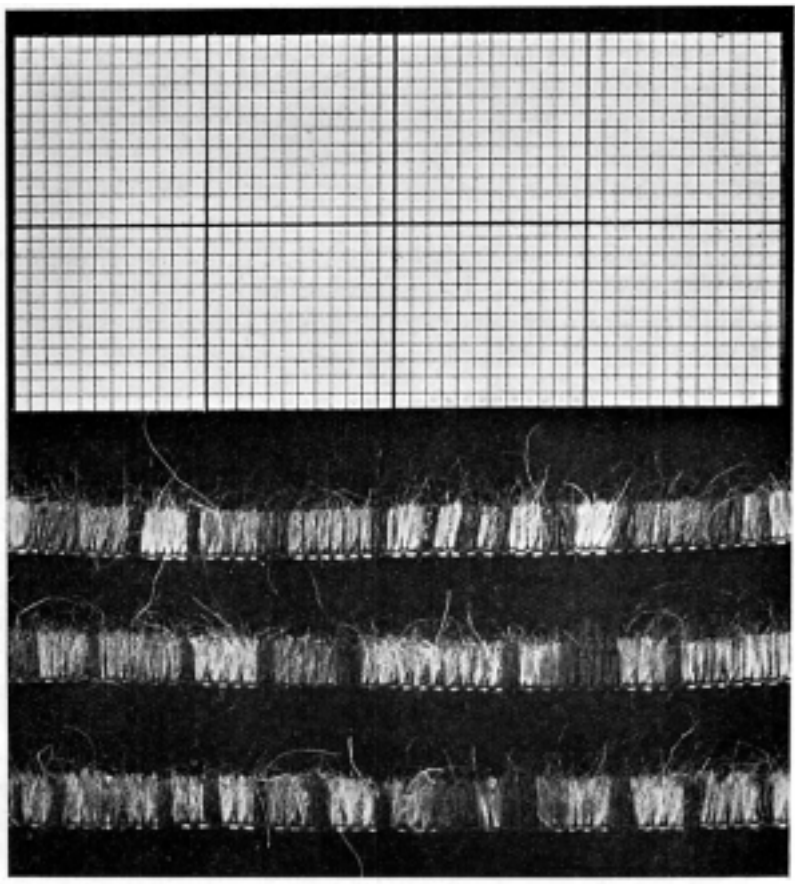


FIG. 160.

pile yarns has 144 units of pile per square inch as compared with 16 units of pile in the same area of surface in the production in Fig. 140. Each unit being composed of two shots or four ends, a square inch of pile in the rug contains 576 ends. It has been indicated that the finer varieties of Persian carpets are woven 20 × 20 or 200 tufts (= 400 ends) per square inch, and that the better grades of Wilton and velvet-pile manufactures have some

124 tufts or 248 ends ($9\frac{1}{2}$ splits $\times$ 13 wires per inch) in a like area of surface. The filament fulness of the nap in the Wilton is augmented, as explained, by the selection of multi-ply pile yarns such as 3-ply 2-fold 14's or 16's worsted. For multiplicity of individual pile units in a given part of the fabric, the oriental production is the finer structure, but for multiplicity of ends of pile in a corresponding part of the fabric, this chenille type of manufacture is the closer.

In regard to the enrichment of the pile by using multi-fold yarns in its formation, this is equally feasible in each principle of velvet-pile carpet weaving. Thus, each pile unit in the rug in Plate IX might, if desired, be woven in four instead of in two shots, applying higher counts of worsted yarn in the shuttling of the chenille webbing, which would necessarily double the ends per square inch of pile, and also tend to improve its density and velvety character; or the fur yarn might be woven two shots per pile unit, applying four-fold yarn of a finer count instead of two-fold yarn as in the example, and this again would add to the filament value of the nap.

Royal Axminsters—Moquettes

In both the chenille and the royal Axminster or Moquette manufactures the complete series of the pile yarns used appears on the surface of the carpet, in which technicality they correspond with Eastern productions but differ from pile carpets woven in the harness loom. There are no groups or inactive pile threads underneath the velvet nap. This implies some economy in the weight and cost of the wool-fibred yarn in the build of the carpet. In three, four, five and six-frame Wilton or Brussels fabrics some $\frac{2}{3}$, $\frac{3}{4}$, $\frac{4}{5}$, and $\frac{5}{6}$ of the total pile threads employed are invisible, being concealed by the remaining fractional portions of the pile threads forming the figured surface.

From the analysis given of the chenille structure it is clear that all shots of weft in the fur yarn become constituent parts of the nap of the carpet or rug. A similar principle obtains in the weaving of the tufted Axminster or Moquette fabric; but, whereas in the former the pile is a *weft*, in the Axminster it is a *warp* product. The units of pile in the chenille consist as shown of ends of weft threads, inserted into the carpet in the form of a woven fur; in the Axminster the pile tufts consist of warp threads, cut to the required length of nap in the operation of

carpet weaving. Such threads may be defined as supplementary warps wound on to spools, with each spool containing as many pile threads as there are units of pile in the width of the carpet. For producing the chenille fur, coloured shot is added to coloured shot in the order of the colour effects in a transverse line of the design; for producing the pile in the Axminster, spool after spool—Fig. 161—is prepared by warping and winding-on, so that each spool coincides, in the coloured yarns it receives and also in their arrangement or order of combination, with the order of the coloured units in the line of the design it is intended to reproduce in the carpet pile.

The spools are carried in an endless chain and are brought by it and other mechanical means, in their correct sequence as determined by the pattern style, into a convenient position for

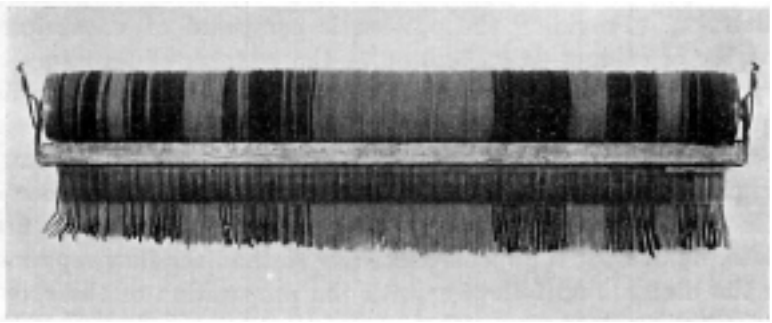


FIG. 161.

enabling the complement of pile yarns to be placed within specific warp sheds in the process of fabric weaving. The formation of the pile sheds, in the making of the Wilton or Brussels carpet, corresponds with the insertion into the carpet structure of the tufts of yarn from the spools. As understood, the sets of stamped cards in the harness loom change the order of the shedding of the pile yarns, and result, in so doing, in the development of the pile figuring; and, similarly, the series of spools, as they come into use in the Axminster loom, change the coloured-thread ingredients in the rows of pile to produce the design. The cards select, through the needles of the Jacquard, the pile threads to be raised for the insertion of each wire, but, in Axminster weaving, the spools convey the coloured pile yarns (= design units), in their prescribed relation and row by row, into the carpet surface to which they are bound by shots of weft.

The function of the spools is, therefore, two-fold, to supply,

during weaving and as required, the yarns—either in lengths cut after insertion or in tufts of the proper length cut prior to insertion —for forming the pile surface, and to present the coloured yarns in the relative order for the production of the decorative style.

Fig. 161 is a photographic view of a spool or reel of pile yarn with its tube or thread-guide attachment. It is for a 3/4 yard carpet and contains 189 threads arranged as below and usable in forming one row of pile in the design and across the carpet :

Maroon	4 – – – – – – – – – – – – – – – – – – – – – – – – – – – – – – – – 4
Black	1 – 3 – – – 1 1 1 – – – 2 – 9 – – – 1 1 2 1 1 1 – – 1 1 1 – – 3 1 –
Crimson	– 1 – 2 4 1 – 1 – – – 11 – – – – – – 1 5 1 – – – – 11 – – 1 – – 6 1 1 – –
Blue	2 – 1 1 1 1 1 1 2 – 2 – – – – – – – – 2 – 5 – – 2 1 1 1 2 1 1 2 – –
Green	– – – – – – – – – – – – 2 – – – 3 – – – 5 – 3 – – – – – – – – – – –
Orange	– – – – – – – – – – – – 1 1 1 1 – – – – – – – – – – – – – – – – – –
Brown	– – – – – – – – – 2 1 – 1 1 2 – – – – – – – – 1 2 – – – – – – – – –

The yarns for each spool require to be separately warped and wound-on. Providing the pattern is composed of a restricted number of colours—*e. g.*, 5, 6 or 7—the warping of the series of spools, commencing with the first row of coloured units in the design and proceeding seriatim to the last row, may be done by re-setting the bobbins of yarn in the warping creel. If, as may happen, certain lines in the pattern coincide with each other in colour assortment, then these may be dealt with in the first place, numbering the spools according to the lines they represent in the design, and following with the preparation of the spools differing in colour plan. Sections of the design, coloured in the shades of the yarn to be used in the carpet, or, in instances in which several lines in the pattern scheme are duplicated, a warping ticket, drafted in the form indicated above, may be employed. Whichever practice is adopted, it is evident that the object to be attained is to make each spool a coloured-yarn counterpart of a specific transverse row of colour effects in the design, each single thread on the spool taking the place of a particular square of colour on the ruled paper.

The designs are drafted, as in loop and velvet-pile productions, on the scale of paper coinciding with the carpet setting. In the standard grade of manufacture, that of which the spool in Fig. 161 is illustrative, there are seven pile ends and seven rows of pile per inch, indicating that the pattern would be drawn on 7 × 7 looming paper. In the 3/4 width of carpet there are 189, and in the 6/4 width 378 pile ends, which implies that the paper for the designing of the former would be divided into 27 and for the latter into 54 large squares. These are the possible pile-

thread units in these two widths of the fabric. In length, the number of rows of pile, and consequently the number of spools, are variable with the type of the decorative style applicable.

A feature of this system of design origination and of carpet manufacture is the provision it affords in colour range in the development of the pile structure. Moreover, on this principle of colouring, the carpet surface may be elaborated to any suitable degree without adding to the intricacy of the weaving process. Increasing the number of the colour units, as also the number of variations in the ornate scheme, only entails some additional quota of labour and care in the making of the yarn spools. Should the spools differ in yarn-coloured units throughout the whole series of the rows of pile in a repeat of the design, they are, when set in the conveying chains, as readily manipulated as spools containing a lesser number of yarn shades, or of spools less diversified in yarn arrangement. Having equivalent results to the action of the cards in Jacquard weaving, the spools, whether simple or complex in the process of warping, are automatically controlled, and, in their turn, automatically introduce into the fabric, in the manner subsequently described, their respective portions of pile threads.

These constructive principles render the tufted Axminster a make or build of carpet specially suited to the production of a decorative pile richly varied in colour treatment. This is exemplified in the 5/8 stair specimen in Fig. 162, to an enhanced degree in the border example on Plate X, in the "body" design in Fig. 163, in the heavy-pile carpet in Fig. 164, in the effective centre and border style on Plate XI, and the multi-coloured geometric design in Fig. 166.

The influence of Chinese woven art is seen in the ornate structure and tinted quality of the example in Fig. 162. The first is a combination, in the field, of interlacing types in the central figure, and of twig, leaf, flower and butterfly forms, with the border lines in a variety of key pattern. The colour toning is the result of using a buff shade in the ground of the carpet and of tan, warm brown, light fawn, sage, olive and green, deep, medium and light blue, and pearl or tinted grey in the delineation of the various pattern elements. The border effect is woven in black and tinted grey, with edging lines on the outside in two shades of blue followed by an inch band in fawn and a marginal line in black. The lines dividing the field from the border are produced in dark blue and tan.

FIG. 162.
A=enlarged section, Fig. 178.

On the buff-coloured ground of the centre of the carpet the larger geometric ornament is developed in medium and light blue, with outlines in dark blue and olive green. The twig, leaf and bud details, decorating the edging of this ornament, are woven respectively in blue and green and in two tones of warm brown, with the middle portions of the conventional flowers in fawn or deep blue. The butterfly forms in the lower section of the specimen are edged in tinted grey, with the wings in three shades of blue, or in two shades of blue and green, the slender body in deep fawn or black, and the feelers in blue; while the smaller butterflies in other portions of the design are outlined in pale fawn with the wings in blue tones and other parts in tan and sage green. The octagonal feature has a blue ground with its ornament in brown, fawn and green, and the lantern features are depicted in fawn and blue or in blue and brown, with tinted grey spottings. The design is not elaborate, but the form types are distinctive in character and developed in colour tones which suitably enforce their detail features. The warm colours—brown, tan and fawn—as also the blues and greens, are similarly graded in tone depth, an arrangement which facilitates the combination of shades of the same or different hues in producing the decorative parts of the pattern ornament in equality of tone contrast.

With the weaving data for the carpet 2-fold 58's woollen (yards per oz.) as pile yarn, cotton for the foundation warp, linen for stuffer warp, and jute for filling yarn, and with 7 rows of pile and 7 splits, or 21 ground and stuffer threads, per inch, the manufacture is of the ordinary character. On the other hand, the richly decorated and coloured example on Plate X is made of 3-ply 2-fold 16's fine crossbred worsted, the pile being $\frac{3}{8}$ of an inch in depth. The design of this fabric is pure carpet ornament or flat surface decoration. It is suggestive of the floral border styles producible on the Axminster principle of weaving, and is drafted to be usable in combination with the "body" design in Fig. 163. The yarn shades employed in the pile of both specimens are worked out to a three-tone scale and consist of the following colours :—

Blue	*Green*	*Heliotrope*	*Rose*	*Drab*
Dark blue	Toned green	Toned heliotrope	Toned rose	Deep drab
Medium blue	Pale green	Pale heliotrope	Pale rose	Toned drab
Pale blue	Tinted green	Tinted heliotrope	Tinted rose	Pale drab or fawn

The selection of colours thus toned enables the leaf, stem, and floral features in the design structure to be clearly differentiated from each other, and also effectively delineated without

having recourse to shading, which would express the pattern forms more or less in relief. The several units of ornate and colour effect of which the style consists are arranged and combined in the manner indicated below—

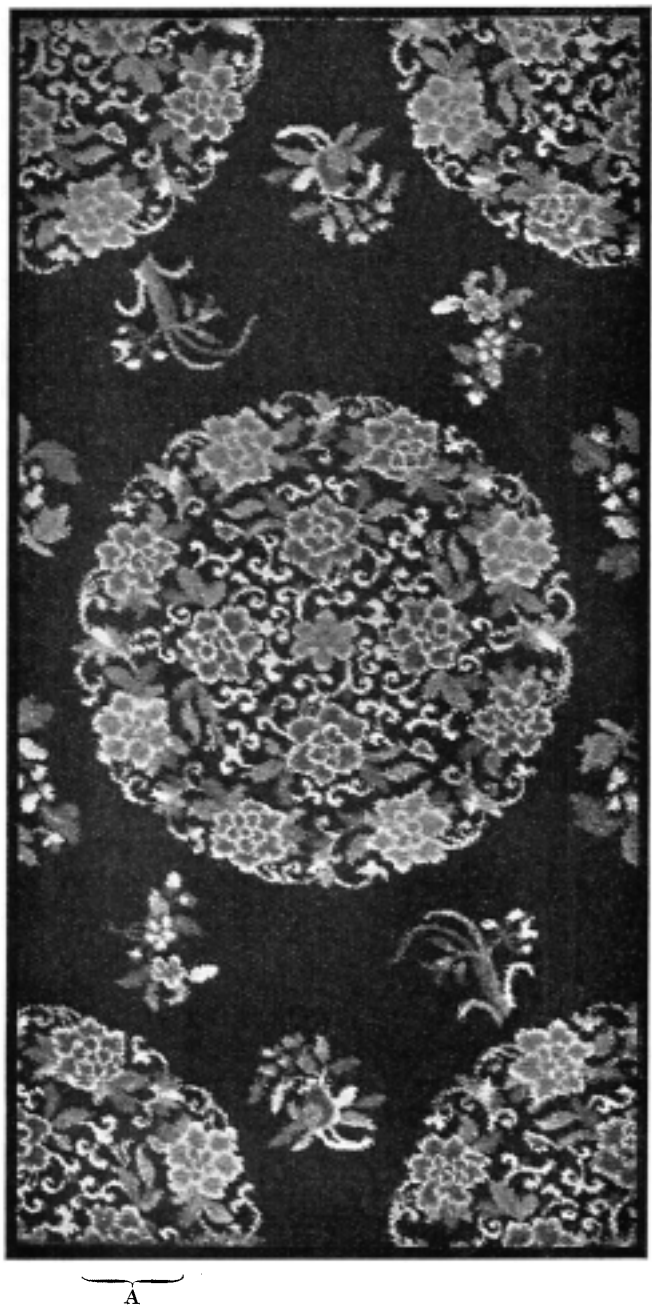
Unit 1. A narrow line in blue.
„ 2. „ „ pale blue.
„ 3. „ „ blue.
„ 4. A small decorative band, 2 inches in width, with a drab-coloured ground.
„ 5. A narrow line in blue.
„ 6. „ „ pale blue.
„ 7. A decorative band, 8 inches in width, with a deep blue ground.
„ 8. A narrow line in pale blue.
„ 9. „ „ blue.
„ 10. A decorative band, 4 inches in width, with a drab ground.
„ 11. A narrow line in blue.
„ 12. „ „ pale blue.
„ 13. Marginal line in deep blue.

It will be seen from the specimen on Plate X that the figuring in bands 4 and 10 is partially produced in drab and fawn shades and partially in blue, green and rose tones, the more minute elements being woven in tints of heliotrope. Two of the flowers in band 7 are developed in rose and pale rose, and the third or centre flower in lemon fawn and golden tan. Both these floral forms are, in colour composition, in pleasing harmony with the green shades of the leaves and the deep fawn and brown shades of the stems; while the full deep hue of the ground lends bloom and richness to the design scheme.

Similar colour treatment obtains in the weaving of the " body " ornament in Fig. 163. It should be noted how fully the Axminster practice of carpet construction provides for the clear delineation, in multi-colouring, of such varied detail and floral features as here illustrated. Every type of form combined is appropriately tinted and expressed in the pile structure which corresponds with that in the " border " specimen. By also employing like tones of colour in both designs, the lighter floral units of the circular ornament in the monotone reproduction are developed in the same shades as the flower near the middle of band 7—Plate X—and the deeper-shaded forms in three tones of heliotrope. The bud, leaf, and stem units between these features—outer circle of main figuring—are woven in green and rose tints, contrasting with the drab shades applied to the scrollwork in the interior of the centre section of the pattern. The space between the four floral forms placed in a diamond relation is further decorated with leaf and bud details in green and fawn, and heliotrope and rose tints respectively.

PLATE X.

ROYAL AXMINSTER CARPET BORDER



A

FIG. 163.
A = enlarged section, Fig. 179.

The small detached floral forms are a distinctive characteristic of the ground of the style, each being specially treated as to colour toning. Taking the three lower figures in the specimen, the one between the two halves of the circular ornament has its leaves and stems in medium and pale green and fawn, its flower in rose and pink, and its buds in heliotrope; the leaves of the figure to the right are also in green tones, the stems in light brown, the harebell in heliotrope and fawn tints, the flower and buds in tinted rose, and the stems in fawn; while the small figure on the left of the design has the lower flower edged in tan, with fawn petals and green middle, and the upper flower edged in deep rose, green middle and tinted rose petals, the leaves being developed in drab, fawn and different shades of green.

The execution of this and other styles of ornament in the Axminster fabric consists, first, in the accurate transference of the pattern forms on to the ruled paper; second, in matching the coloured tones in the design in coloured yarns; third, in the grouping of such yarns on the spools in the exact sequence in which the colour units they severally represent occur in the weft lines of the design; and, fourth, in arranging for the use of the spools of yarn in the consecutive order in which they are required to be employed in developing the rows of tufts in the pattern of the carpet.

Seamless carpets of different sizes, such as 18 ft. × 15 ft., 16 ft. × 15 ft., 15 ft. × 12 ft., 13 ft. 6 ins. × 10 ft. 6 ins., 12 ft. × 9 ft., 10 ft. 6 ins. × 9 ft., etc., in addition to the ordinary 3/4 and 4/4 " body " widths, are woven on this principle. The pile and setting are also variable, though by far the larger bulk of modern Axminsters are set to the 7 × 7 scale. Two examples in which the pile surface resembles in appearance that of the heavier varieties of Turkish and other hand-tufted productions are illustrated in Fig. 164 and on Plate XI. This resemblance is partly due to the use of compound threads, carded in structure and thick in counts, in the pile tufts, as in the Chinese and Morris specimens in Figs. 171 and 182; and partly to the inclination given to the tufts in binding them into the carpet. In this build of fabric, the pressure of the binding shots on the centre of the tufts, embedding them to a degree in the carpet foundation, has a somewhat similar effect on the pile character to hand tufting (as seen in the large-scale section, Fig. 181), but not as regards the fastness with which the tufts are woven. To withdraw the tufts from the hand-made carpet the knotting has to be undone;

FIG. 164.

to effect the same in the machine-made product is comparatively easy, as they are simply built into the fabric by the crossing shots of weft, not being wrapped round and tied to the warp threads.

In some Axminster manufactures, as in the case of the example in Fig. 164, the loops of the pile units penetrate through the carpet and show on the reverse side, as seen in the natural scale illustration of a sectional part of this example reproduced in Fig. 181A. This has the effect of causing the carpet structure to resemble still more closely that obtained in vertical-warp weaving, and of imparting a wool quality to the under side of the fabric which is commonly composed of cotton, linen, and jute yarns, that form a level basis texture, concealing the pile yarns, to which the pile is secured.

The particulars of the pile structure in the two specimens under consideration are :—

FIG. 164, 164*a*.—AXMINSTER, WITH PILE YARNS PENETRATING THROUGH THE CARPET.

Pile tufts, composed of 4 single threads of 6–7 skeins woollen or a combined yarn of $1\frac{1}{2}$ yards per drachm.
Tufts per square inch = 16.
Ends ,, ,, = 16 × 8 = 128.
Length of tuft yarn = $1\frac{1}{4}$ inches.
,, pile tufts = $\frac{7}{16}$ of an inch.
Diameter of pile ends = $\frac{1}{32}$,,

AXMINSTER SPECIMEN ON PLATE XI.

Pile tufts, composed of 3 single threads of 7 skeins woollen or a compound yarn of $2\frac{1}{3}$ yards per drachm.
Tufts per square inch = 49.
Ends ,, ,, = 49 × 6 = 294.
Length of tuft yarn = 1 inch.
,, pile tufts = $\frac{5}{16}$ of an inch.
Diameter of pile ends = $\frac{1}{35}$,,

It should be noted that the thicker the yarn in the pile the greater the degree of take up in the doubling and binding of the tufts. With smaller yarns the pile tufts from the yarn lengths in these examples would be increased, but impoverished in filament compactness. The penetration of the tufts, as evident from the data for Fig. 164, shortens the surface nap, but it adds to the resiliency and softness of the tread of the carpet, as well as to the fastness and durability of the pile.

The design of this thick and heavy grade of manufacture is composed of conventional plant and of rectangular forms, with the ground filled in with floral, leaf and branch features. The

colour scheme is developed in the field on white or the natural colour of the strong-fibred wool employed in the preparation of the pile yarns. It comprises two shades of blue, two of fawn, and two of red, in equivalent tone depths, and of green and yellow or lemon drab. Each shade is of a mellow quality, being distinctive but delicate in hue.

The ground colours in the decorative bands in the border contrast with each other and with the white in the "body" pattern. Thus, in the narrow bands the ground is in light red with the ornate elements in deep and pale blue, deep and pale drab, and in green and white; and in the broader band, light blue or lavender, with certain parts of the ornament in white edged with light red, parts in deep fawn or drab edged with deep blue, and parts in green edged with lemon drab, with the intermediate pendant bell-shaped units in pale red, white and deep red, edged with deep blue, and the corresponding perpendicular units in deep drab, deep red and white, edged with pale red. For divisional lines between the field and the border the colours are white, green and blue, and between the broad and smaller bands of pattern green and deep red, with the marginal lines developed in lavender, white and deep drab.

By thus differentiating the colour base in the border sections, each type of patternwork is made distinct in tone, and, at the same time, the whole border colouring is made to assume a tinted quality in pronounced contrast to the decorative structure of the field delineated on a white surface. This structure is of a more conglomerate description than the border figuring, consisting of large elemental features in the central and side portions of the specimen, and of all-over or running ornate details in the groundwork. The central feature is of an irregular floral nature, with its vandyked outlines in deep blue and its conventional leaf forms woven in fawn, white and green, and its details in deep drab and lavender. The rectangular form in the centre of the figure has a pale red surface on which is developed small floral units in blue, white, lemon, drab and deep red. The upper geometric figuring in the central line of the field is outlined in deep and pale blue with its corner ornament woven in similar colours as also the fan shape set crosswise; while its varied pattern types are woven in pale drab, green and pale blue. Character is given to the floral and leaf ornament in the ground by the strong branch forms which connect the different parts of the design with each other, such branches being delineated in blue and deep fawn—

running from right to left of the specimen—and in deep and pale blue in the reverse direction. Additional contrasts in the decorative figuring, due to colour combination, are acquired by developing the ground ornament in the lower part of the specimen in deep red, and in pale red in the upper part. The species of effect so tinted also differ in floral suggestiveness, which equally applies to the design types below and over the rectangular pattern, involving changes in the method of grouping the colour tones. Thus the leaf forms in the ground of the upper section of the design are produced in lemon drab and red, outlined in deep blue, and the elongated drooping leaf—at the top left side of the specimen—in blue and red, and fawn and blue, with centre vein in white; and the large figure—half shown—in two reds, outlined in blue. If, as in this illustration, in modifying the ornamental types combined the colour practice is also modified, the design style acquires a more decided tone value than if one colour practice is applied to each variety of ornate effect. Both systems of colouring are utilised and both have a specific function in carpet designing.

A strong geometric scheme of ornament, developed in three shades of drab, medium purple blue, crimson red, and black, is illustrated in the Axminster carpet on Plate XI. The " body " pattern comprises octangular and rectangular figures arranged on the alternating base, and diamond forms, with connecting-branch details. Simplicity in decorative arrangement, combined with the use of a small number of colours differentiating in tone and hue, imparts ornamental effect and quality. The octagonal figures have a crimson red ground, with the hooked and T-shaped units in deep and medium drab, and the centre units in blue specked with drab. They are clearly outlined in crimson, black and blue on the light drab ground of the carpet. In contrast with these figures those of the oblong character are edged in broken lines of black, and of drab and blue, with their surface ornament in blue and black, and in black and deep drab. The mingled colouring of the subsidiary diamond objects and small spottings links up with the colouring of the larger figured units. The ground ornament forms an interesting feature of the design, consisting of hooked and branch types in black outline with central elements in crimson and blue.

The border design is fittingly diversified and tinted to harmonise and contrast with the decorative scheme of the body of the carpet. It comprises five varieties of pattern, namely :—

(1) A band, 2 inches in width, with a black ground and Eastern ornate effects in crimson red, medium and pale drab.
(2) A band, 5 inches in width, with a pale drab ground linking the border style with that of the field of the fabric, with the figuring edged with black and woven in red, blue and drab tones.
(3) A band, 2 inches in width, with a black ground, and with the ornament in blue alternating with pattern types in dark and medium drab and in pale drab and red.
(4) A band, 2 inches in width, with a deep drab ground, with the elongated or lozenge forms produced successively in red with drab and blue centre, in blue with red and drab centre, and in light drab with red and blue middle details—all outlined in black.
(5) A band, $1\frac{3}{4}$ inches in width, with a black ground, and with the ornate elements in red and drab and in drab and blue.

The margin of the border is a pleasing line and colour composition, being formed of intermingled effects in two tones of drab and blue, a line in black and in light drab, and of two gimped lines in blue and deep drab, with the edging line in black. Similarly the demarcation lines for separating the field from the border, and pattern stripings in the latter from each other, are varied in colour arrangement, including :—

Between the field and band 1.	A line in light drab. ,, black. An intermingled line in red and blue. A line in medium drab.
,, bands 1 and 2.	A line in medium drab. ,, blue. ,, black.
,, bands 2 and 3.	A line in black. ,, blue. ,, drab.
,, bands 3 and 4.	A line in drab. An intermingled line in blue and red. A line in black.
,, bands 4 and 5.	A line in black. An intermingled line in blue and red. A line in light drab.

The use of divisional lines of colour in border designing has been indicated in other examples. Their width dimensions and colour toning are significant in defining each variety of ornament, and also in bringing the border colouring into symmetrical relation with the colouring of the pattern forms and of the ground of the central part of the carpet.

The geometric style of ornament in Fig. 165 is of a diamond character, with the figuring developed in a full range of colouring. This carpet is of the standard Axminster description, the pile being made of folded worsted yarn and containing 49 tufts per square inch, with the foundation arranged one thread of cotton (binder), two threads of cotton (stuffer), and one thread of linen (binder), and wefted two upper shots of cotton yarn and two

lower shots of 2-fold crossbred worsted made of strong, coarse staple wool.

The colours combined in the production of the pile surface are toned and tinted derivatives of red, blue, and green, and comprise two light shades of buff in the ground, and in the ornament, deep maroon or chocolate, terra-cotta, olive brown, tan, deep fawn, and pinky fawn or salmon; medium grass green, slatish or greyish green, olive green, sage and pale sage; and navy or deep blue, peacock blue and greenish blue. While the figuring is of the diamond, star and rosette order, it is shapely, well proportioned, and rich in decorative quantities. It forms an instructive example in (1) the method of developing elementary ornate units in varied colour combinations; (2) colour arrangement and distribution, especially as practised in differentiating pattern elements from each other, and in making them separately and in their composite relation effective in style; and (3) acquiring an elaborated design scheme by combining plain pattern structures, and decorating their surface with ornament symmetrical in kind and diversified in tinted composition. All the standard geometric forms, circular as well as rectangular types, are adapted for this species of colour decoration.

The style of such ornament is dependent for character and distinctiveness of tone, after the skeleton forms have been drafted and their plan of arrangement determined, on the ornate features applied to their surface and on the colour scheme practised. The degree to which the design figures A and B are thus elaborated in the specimen is suggestive of the principles of design and colouring comprised. The outer band of the former consists of four component parts, embodying two species of patternwork, that at the base and top of the figure, and that on its respective sides. Such figures may be tinted to mellow into the ground colouring of the fabric or to be in strong contrast with it. The latter is done in this instance, form A being outlined in deep maroon, green, tan, sage green and terra-cotta. The central ornament should be distinct in shape, and also in colour toning, from the diamond or other principal figure, but it is requisite that it should be proportionate in size to its integral position in the figure.

All the colour tones combined in the carpet are employed in the development of types A and B. For the ground of the ornament, printed in grey tones in the photographic illustration, terra-cotta is used in contrast with the blue in the border of the oblong form

PLATE XI.

SEAMLESS AXMINSTER

(A=Enlarged Section, Fig. 180)

A

B B

A

FIG. 165.

edged in fawn, with the small stars in olive brown. Orange is applied to the ground of the middle ornate feature outlined in maroon with decorative details in terra-cotta and fawn. The floral forms in the side sections of the diamond figuring are woven in orange and sage green, with the centre spotting in fawn; and the corresponding floral units at the apex and base of the diamond in pinky fawn, olive green, sage and light fawn, with the edging lines in maroon. A subdued character is given to the tre-foil leaf forms on the marginal edge of the figure by weaving them in maroon, green and blue.

For imparting a discriminative quality to form B, and also for emphasising it as a constituent part of the design, the ground shade of its outer sections is sage green, in contrast with the terra-cotta shade applied to similar sections of form A. Its inner ornament is also differently tinted from that of the larger diamond figure. The marginal rim of the whole form is produced in green and tan, having a maroon outline. The central elongated cross figure is outlined in blue and terra-cotta, with its middle spotting in maroon and ground in blue, and with its decorative units at the top and the bottom in blue and warm brown and at the ends in terra-cotta and blue. The rosettes have a maroon ground, pinky fawn spot, and fawn outline.

The distinctive practices adopted in the colour treatment of the leading pattern types in this example are characteristic of this class of carpet designing. They add to the ornamental value of the pattern. Similarly, by developing each species of effect in the ground of the carpet in different colour tones, as is done in this illustration, the ornament of the whole surface of the carpet is made interesting in structure. Diversity in form composition is accentuated, but in such colour units as to produce harmony and balance.

The machine-tufted Axminster is ordinarily a three-shot weave of carpet, formed in foundation warps in cotton and linen, and stuffer warp in cotton, linen or jute. With the yarns grouped 1 end of ground or binder (*e.g.*, 3-fold 16's cotton), 2 ends of stuffer (3-fold 9's coloured cotton) and 1 end of ground or binder (4's linen) the order of shedding is :—

Shed 1—(double shot), when the pile tufts are inserted and for binding the same, cotton ground threads up and linen ground and stuffer threads down.
Shed 2—(double shot), linen ground threads up and cotton ground and stuffer threads down.
Shed 3—(double shot), cotton ground threads and stuffer up and linen ground threads down.

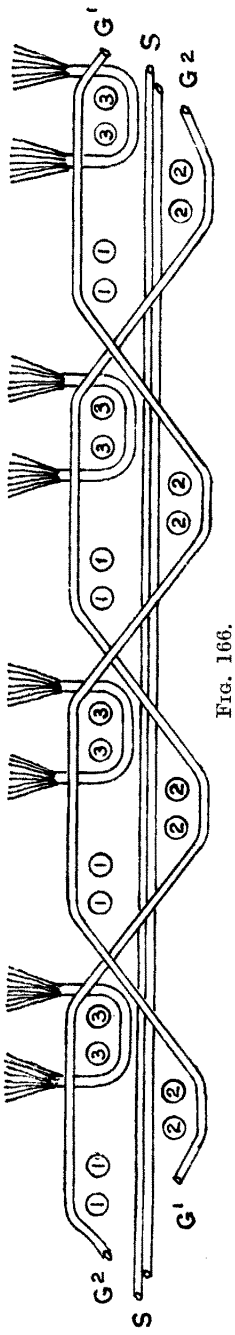


FIG. 166.

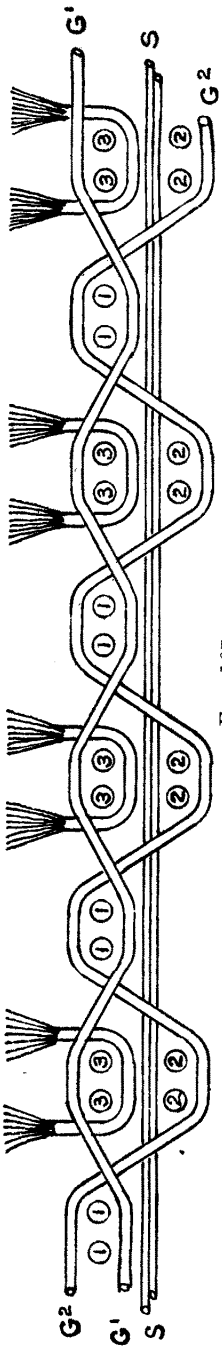


FIG. 167.

Jute weft—of such count as 2-fold $7\frac{1}{2}$ lb.—is commonly used, but the weft yarn for the underneath or backing shots is also made of coarse-stapled wool, for giving a fuller quality of foundation fabric. As the picks of weft are carried across the sheds by a needle, which makes a forward and backward passage for each division in the warp threads, the shots are inserted in pairs. For binding these on the opposite side of the loom to which they are inserted by the needle carrier, a small sewing machine shuttling device is employed, the shuttle of which runs to and fro in a semi-circular race, and passes its stitching thread into the loops of the needle-inserted weft yarn.

Structural sections of the carpet are shown in Figs. 166 and 167. In each illustration, g^1 and g^2 are the ground-chain threads, s the stuffer warp, 1,1, the upper binding picks, 2,2 the lower binding picks, and 3,3, the shots for binding the pile tufts. On the first principle of intertexture, only two warp beams are necessary, namely, for the ground and the stuffer chains; but on the second principle, owing to the take up of threads g^2 being greater than that of the ends g^1, three warp beams are employed. With the tufts bound in a like manner by shots 1,1 on both sides, as on the second principle, the tufts have a vertical relation, in which they are firmly held. A straight, well-secured pile is the result, but one that is more liable to develop shadiness and to appear streaky than the first principle of pile formation. The tufts bound as in Fig. 166 give a full cover and present a slight slanting direction, owing to the shots of weft, following their insertion, being interlaced with the same ground threads as the shots binding the pile tufts. This arrangement causes shots 1,1 and 2,2 to be compressed into juxtaposition, whereas in Fig. 167, the shots 1,1 pass under threads g^2, and shots 3,3 under threads g^1, keeping the two pairs of shots more separate, and causing the ground shots to sustain the pile tufts to an equal degree on their respective sides. The reverse side of the carpet in the first of these weave structures is perfectly level, but in the latter it has a ribbed appearance due to threads g^2 passing underneath the pile shots 3,3 and the ground shots 2,2, while threads g^1 only pass underneath shots 1,1.

The weaving of the carpets is carried out in the Axminster loom, one of the prior inventions for which was patented in this country in 1856 by Albert L. Skinner, Yonkers, N.Y., America. The modern Moquette and Axminster loom is, in its main essentials, a development of this weaving mechanism, the shedding, warp let-off, and fabric take-up motions of which are controlled by

similar mechanical parts to those obtaining in the ordinary build of power looms.

The three fundamental features in the construction of the Axminster loom are: (1) the employment of yarn spools in the production of a figured pile surface; (2) the insertion into the carpet structure of tufts of pile yarn in one of two forms, (*a*) by cutting the yarns from the spools after being placed and secured in the carpet, and (*b*) by cutting the yarns from the spools into tuft-pieces and then inserting such tufts into the carpet; and (3) the passing of the shots of weft into the sheds in the warps by means of a needle carrier.

To deliver warp threads of a specific colour and arrangement from a series of spools or miniature beams in a particular order into the fabric at fixed times in the weaving operation is, as explained, the function of the endless chains in which they are conveyed, and is not, in itself, a complicated work. If this only were implied it would be, comparatively, a simple mechanical problem. Yarns from special beams are employed in carpet weaving, but the beams are mounted in fixed supports, and the yarns are continuously supplied therefrom in the figuring of the texture; they are not cut into fractional lengths and introduced into the fabric by special devices. The conversion of arranged yarns from selected spools into a velvet pile built into a carpet structure is the peculiar work of the Moquette or Axminster loom. It involves, according to practice (*a*), the removal of spool after spool as required from the conveying chains; the placing of a spool so removed in a position immediately over the warp line to unable its tubes or yarn guides to introduce into certain warp sheds the free ends of yarn; the binding of the yarns so introduced into the carpet; the cutting of the yarns into tufted units; and the replacing of the spools in position in the chains.

By practice (*b*) the spools, during the weaving of the carpet, are held in the chains with sufficient firmness to enable the yarns to be drawn off and cut as the spools are presented in position. For removing the yarns in proper quantities, and for fixing the yarn tufts into the carpet, nippers are employed. A modification of this practice of tuft cutting and application by means of nippers or grippers dispenses with the spool chains and the presenting of spool by spool for pile production, by arranging the yarn bobbins in frames and using carriers for conveying the yarn tuft to the grippers. Each system of mechanism is necessarily

intricate in design and construction, and renders nicety of adjustment essential in automatic running.

On principle (*a*), which is in general use, when a spool has been brought by the chains into a feeding position, or within a short distance from the fell of the carpet and with the sley at the back centre, the spool carriage is lowered by end levers in such a way that the yarn tubes enter the shed in a line with the splits in the reed. As this is done the tubes have a momentary curved downward movement which results in the laying or trailing of the ends of the yarns in close proximity with the last row of tufts woven. The chain shed being in the meanwhile open, the weft needle or carrier inserts a double shot over the central portion of the yarn lengths. At this juncture the tubes are raised with a slight forward action to effect the doubling of the yarns round the weft shots, or the closing of the free ends of the yarn with the yarn lengths of the tube guides. The sley, in being brought forward, carries the pile yarns and their covering shots up to the breast comb or bar. The shed in the warp is now either changed or remains unaltered with the spool carriage stationary, and two ground shots of weft are inserted for binding the yarns into the carpet fabric. Having in this way effected the insertion of the pile yarns, the tufting carriage and tube attachment are lifted to a sufficient degree for drawing off the required length of yarns from the spool for a subsequent routine of pile yarn insertion. During this period the bottom shed is formed in the warp and a double shot woven, which further binds the tufts in position, and also makes the reverse side of the carpet. With the tufting tubes lifted clear of the warp, the cutting of the tufts takes place. This is done by two blades moving laterally and on a level with the carpet surface, and which have a shear-like action; and, secondly, by a circular cutter consisting of a revolving knife in front of the yarns, and operating in conjunction with a fixed straight blade behind the yarns. Following cutting, the spool and its tubes are mechanically replaced in the carrying chains. The different motions constituting the weaving cycle are automatically performed, being timed and adjusted to synchronise with each other.

The system of using nippers or grippers for insertion of the severed-yarn tufts into the fabric has been developed in looms for weaving seamless and other widths of carpets of the description illustrated on Plate XI and Fig. 164. Particularly have improvements been made on these lines in combination with yarn carriers,

actuated by Jacquard mechanism imparting different degrees of lift to the yarns delivered from the various spools or bobbins. The latter are mounted in frames as in Brussels and Wilton productions. Some sixteen frames are, however, employed in practice and these, with the aid of " planting," afford an almost unlimited range for design and colour effects.

" The yarns from the bobbins are led between guide bars and through perforated plates into the carriers, which are vertical strips of steel or brass grooved back and front and drilled with a series of slots, through which the ends of the yarn pass, being held in position by small springs. The frames of yarn are threaded through the holes in the carriers in order, so that the yarns of the top frame pass through the highest hole in the carrier, the second frame through the second hole, and so on. Viewed from in front, the ends of each frame of yarn will be seen in horizontal lines one above the other in the front grooves of the carriers.

" These carriers are connected by cords or wires with a differential lift mechanism, which is actuated by the Jacquard in such a way that the blank or perforation on the Jacquard card, corresponding with a certain colour, causes the carrier to be lifted until that colour is at the required height. It can readily be understood that cards perforated in different ways, and presented to the Jacquard at once, can cause the carriers all across the loom to be lifted varying heights in such a way as to show at the required level a horizontal row of thread ends, corresponding to a row across the width of the paper design. The sequence of these rows, of course, forms the pattern.

" It remains to cut off the tufts, to lay them in their place at the fell of the cloth, and weave them into the carpet.

" There is a set of grippers, in shape very similar to the neck and beak of a bird, mounted on three shafts, and arranged so as to revolve in about a semicircle between the carriers and the fell of the carpet. The Jacquard, having operated so as to present the ends of the required colour in the carrier in a horizontal line, the grippers come up in front of them with open beaks, which are inserted just into the carrier grooves, and then close, nipping the ends of the yarn. The whole of the frame in which the carriers are mounted is then withdrawn away from the points of the grippers a sufficient distance to give the required length of tuft. A flat-toothed comb of hardened steel, of the same pitch as the grippers, carriers, and carpet, drops down with its points between the threads so as to hold them steady, while a travelling knife,

or set of knives, passing along the face of the comb, severs the tufts. The grippers then descend into the warp threads, laying the tufts against the fell of the carpet; the needle or shuttle passes over them and through the shed, carrying the binding weft, which is beaten up by the open sley, at the same time as the grippers open to release the end of the tuft, and double it upwards. Two other shots are inserted, while the grippers move in their semicircular path upwards to seize the next row of tufts, and again downwards to lay them in place." [1]

This Brinton invention forms an ingenious and advantageous system of Axminster weaving. In the first place, in dispensing with specially-prepared yarn spools and the carrying of such in endless chains, it greatly simplifies the practice in grouping, presenting and inserting the pile-yarn units for carpet construction, being in these features a progressive improvement on the system obtaining in the Skinner and Crompton looms. In the second place, in providing for the use of sixteen frames of pile yarn, controlled by Jacquard mechanism, it offers a field in designing and colouring unequalled in other principles of Axminster manufacture. In the third place, the tuft-cutting device is efficient, reducing the surface waste to a negligible quantity and the amount of shearing requisite in trimming and finishing the carpet to a minimum.

The pile being, in Axminsters, machine-tufted, is not of the true knotted structure, but it may, nevertheless, be made, by yarn selection and tuft formation, to possess some of the qualities of thickness, resiliency, and durability of the hand-tufted carpet.

[1] *Carpets*, R. S. Brinton.

CHAPTER X

PILE STRUCTURE AND QUALITY

Fundamental and Controlling Factors—Varieties and Grades of Hand-tufted Pile—Influence of Wool Staple—Applications of Mohair, Camelhair and Lustre Materials—Pile Flexibility and Springiness—Filament Fineness and Pile Quality—Yarn Structure and Surface Tone of Pile—Woollen and Worsted Yarn Pile Characteristics—Purity of Colour in Wool an Essential—Thread Units in Pile Tufts—Analytical Data of Eastern and Western Hand-tufted Weavings—Pile Contrasts in Persian, Chinese, Turkey and British Manufactures—Flexible or Thin and Heavy or Thick Grades of Carpets—Weight of Wool Fibre in Yarn Tufts—Varied Multiplicity of Pile Tufts per Square Yard of Carpet Surface—Effect of Knotted Compactness—Royal Axminster Variety of Fine, Deep Pile Carpets—Structural Base or Foundation of Carpets—Tensile Property and Counts of Warp and Weft Ground Yarns relative to the Pile sustainable—Woollen as Compared with Cotton and Linen Yarns for Ground Fabric Construction—Differentiations in the Foundation of Irish and Chinese Examples—Summary of Elements affecting Tufted-Pile Structure and Quality—Pile Length and Carpet Value—Pile Density and Fineness in Royal Axminsters—Technicalities Applicable to Hand-tufted Structures common to Machine-made Carpets—Power-Loom Practice and Pile Construction—Efficiency of Looped Pile—Structural Types of Wilton Pile—Dimensions and Grouping of Wilton Pile Units in Carpet Surface—Velvet and Wilton Pile Varieties Compared—Saxony Velvet or Deep Pile—Equalities in Fur-Yarn Pile—Constructive Character of Chenille Nap—Axminster or Machine-tufted Pile—Comparison of Axminster and Wilton Structures—Form and Filament Consistency of Pile Units—Absence of Pile Rows and Causes Thereof—Distinguishing Features of the Standard, the Close-woven, and the Thick Varieties of Axminsters—Sections of Foundation Fabrics—Axminster with the Pile Tufts penetrating the Reverse Side of the Carpet.

PILE structure and quality are determined by three factors—the fibrous materials of which the pile is composed, the thread units in the pile tufts, and the weaving practice. Each of these factors has been explained as found essential in treating of the various makes and styles of carpet weaving and manufacture. They form, however, a special subject for investigation and analysis, which will be more fully dealt with in reference to the sectional photographic reproductions, to natural scale or thereabout, of the following specimens.

		Rug or Carpet Variety	*Constructive Principle*
Fig. 168 = Pile	Section	A, Persian rug, Plate XII	Hand-tufted
Fig. 169 = „	„	A, " Savona " carpet, Fig. 26	„
Fig. 170 = „	„	of Donegal thick-pile carpet	„
Fig. 171 = „	„	of Chinese carpet border, Plate XIII	„
Fig. 172 = „	„	A, Brussels square, Fig. 121	Loop-pile Wilton
Fig. 173 = „	„	A, Fine Wilton border, Fig. 129	Wilton
Fig. 173A = Reverse	„	A, „ „ „	„
Fig. 174 = Pile	„	A, Wilton square, Fig. 126	„
Fig. 175 = „	„	A, " Cinema " Wilton, Fig. 130	„
Fig. 176 = „	„	A, Tournay velvet, Fig. 133	„
Fig. 177 = „	„	A, Fine Chenille rug, Plate IX	Chenille or fur yarn
Fig. 178 = „	„	A, Axminster stair carpet, Fig. 162	Axminster or machine tufted
Fig. 179 = „	„	A, Axminster " Body " carpet, Fig. 163	Axminster or machine tufted
Fig. 180 = „	„	A, Axminster seamless carpet, Plate XI	Axminster or machine tufted
Fig. 180A = Reverse	„	of Axminster seamless carpet, Plate XI	Axminster or machine tufted
Fig. 181 = Pile	„	A, Axminster heavy-pile carpet Fig. 164	Axminster or machine tufted
Fig. 181A = Reverse	„	of Axminster heavy-pile carpet, Fig. 164	Axminster or machine tufted

Considering, in the first place, the hand-tufted varieties, the Persian rug is made of a semi-lustre grade of wool, the " Savona " of medium crossbred, the Donegal of cheviot, and the Chinese border of short-stapled merino wool. The effect of using wools differing in filament diameter, filament length, and in staple lustre and elasticity, is seen to result in four descriptions of pile surface. Brightness of tone is the distinguishing feature of the first, filament cover of the second, strength of tufted units of the third, and compacted filament density of the fourth specimen. Pile lustre is acquired by selecting materials possessing a lustrous staple. For this purpose the Eastern weavers use mohair or camel hair in addition to wools of a partial-lustre variety. Mohair is too smooth and slippery, as also too long in the staple, to be adapted for the quality of nap esteemed in carpets. In the production of long-pile rugs its properties are suitable for the imitation skin characteristic, but in such rugs thick yarns are applicable and these impart flexibility and strength to the pile ends. In the shorter nap of the ordinary carpet, in which much finer yarns are requisite, mohair yields a pile that has a tendency to flatten in the wear. This is noticeable in certain parts of the semi-lustre yarn pile specimen, Fig. 168, and it is increasingly apparent on examining the complete rug, Plate XII.

Elasticity of staple, which imparts resiliency and wearing strength to the pile, is relatively low in straight and lustrous stapled materials. It is a property obtaining to a superlative

PLATE XII.

PERSIAN RUG

(A=Section Enlarged in Fig. 168)

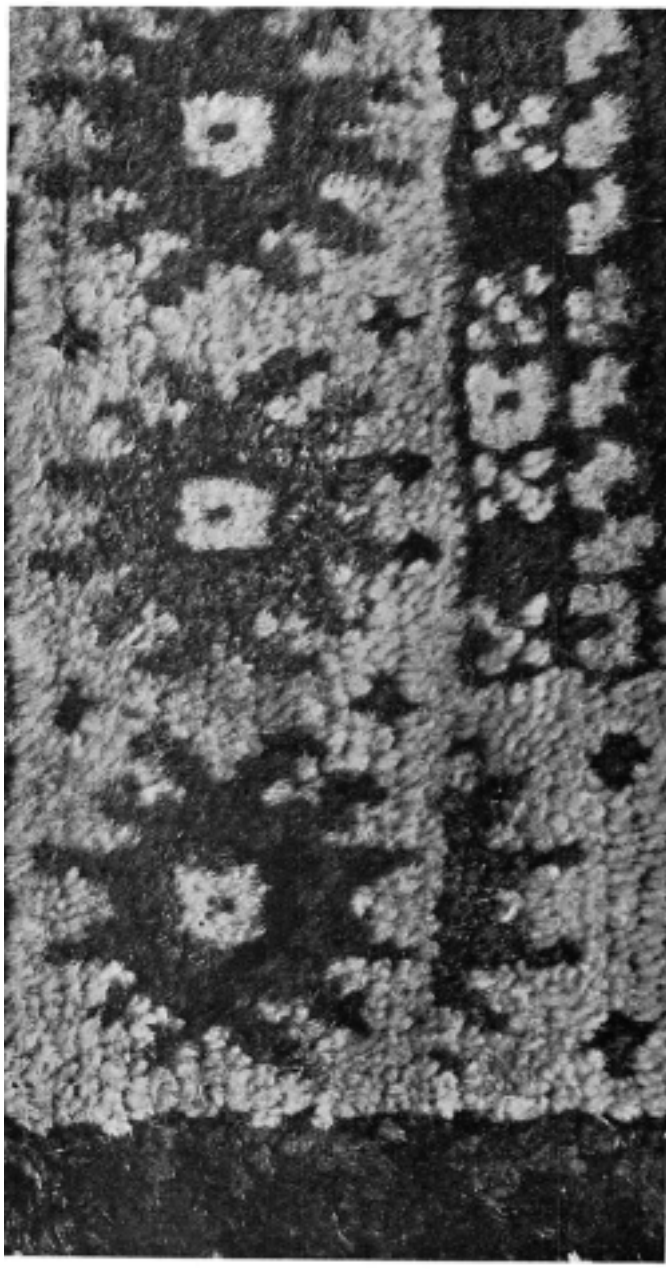


FIG. 168.
(Section of Plate XII, Persian Rug.)

degree in merino wools, and to a lesser degree in wools of the cheviot class, but in the latter, and also in crossbred wools, the filament diameter plays an important part in the flexible and durable character of the pile produced. This is exhibited in the carpet specimens in Figs. 169 and 170, both made of wools of a medium filament fineness and staple length. The difference in the pile surface of the two is not so much due to any appreciable dissimilarity in the wool applied as to technicalities in manufacturing, that is, in yarn construction and in tufting practice. The quality of the wool fundamentally affects the firm, serial formation of the pile units. Fractional parts of the fibres, which average some three inches in length, extend through the yarn tufts; the latter are, therefore, equalised in filament consistency and in structural property. Different conditions as to fibre fineness and length obtain in the yarns in the Chinese productions, Fig. 171 and Plate XIII. These are spun from a short-stapled wool of the merino category, and on the woollen principle. They give a full, flexible nap, in which the tufted strength is a resultant of the comparatively large number of filaments in a cross section of the threads of which it is composed. Though the pile ends, as contrasted with those in the two preceding examples, are small in size, they are exceptionally uniform and compact in structure.

In each of these carpets, as in all classes of woollen or worsted pile manufactures, the soft, springy nature of the carpet surface is largely a product of the elasticity in the staple of the wool applied. All varieties of sound wool, fine or coarse in fibre, possess this property of resiliency and flexibility. It is the cause of the pile of the carpet, on pressure being removed, assuming its normal or woven condition. When the wool used is deficient in elasticity, the pile, on undergoing frequent treading, lies flat and by degrees sinks into the structural part of the carpet. This defect is also liable to arise should the pile be too long in proportion to its filament density. In some of the inferior grades of carpets an apparently well-covered pile surface obtains in which tufted length takes the place of tufted closeness, and a pile of this description is easily trodden down.

The efficiency of all animal fibres is high as compared with vegetable fibres for pile production. Jute and cotton are employed inasmuch as they exhibit a satisfactory degree of tensile strength, but, relatively, they lack staple elasticity, and result in a pile which becomes flat and dead in the process of wear.

Fineness of fibre has an influence on the tone and richness of

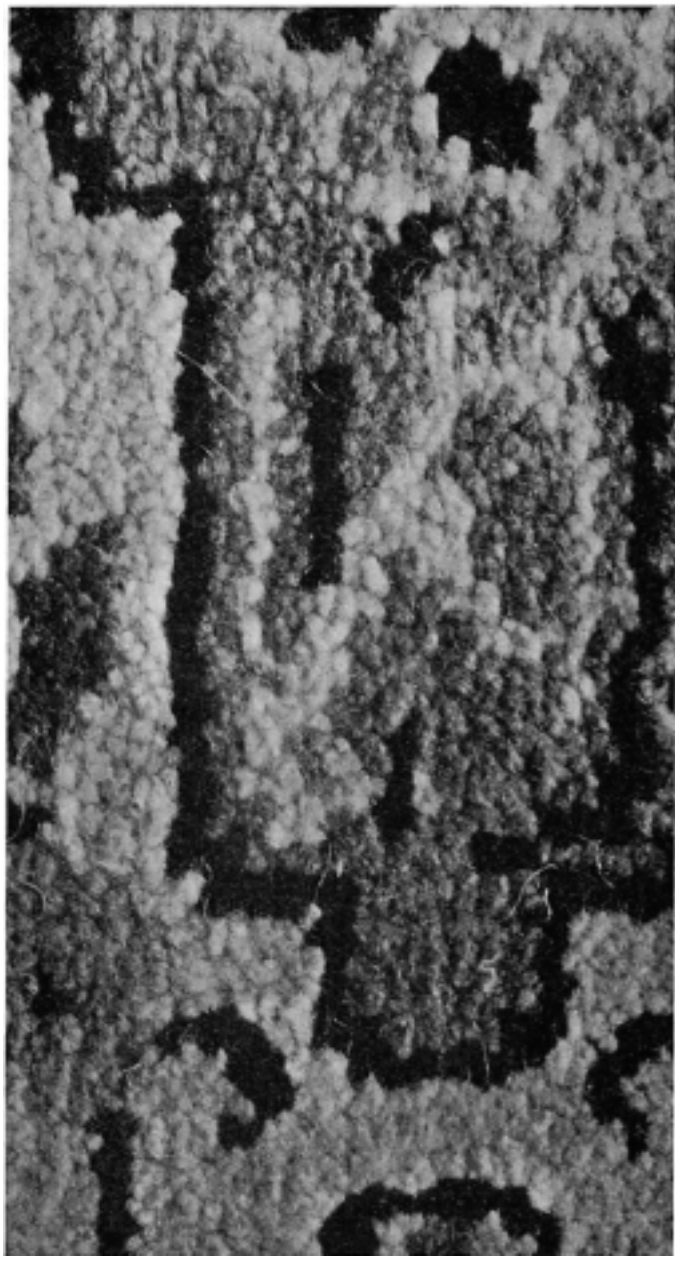


FIG. 169.
(Section of Fig. 26.)

the pile woven. This affords an explanation of the close, dense pile in Fig. 168 (A, Plate XII), as also of that of a reduced fineness and closeness in Fig. 169, in which the yarn filaments are not so small in average diameter. For the count of yarn—yards per drachm—used in the former a thicker-fibred wool would be applicable, but it would reduce the filament units in the pile surface and make it coarser in appearance. To change the wool, for example, from the merino to a crossbred quality, or to a wool in which the fibres were, on an average, some 20 per cent. larger in diameter than those in the wool applied, would reduce the number of filaments in the pile to this amount. The finer the fibre the better, softer, and richer the pile obtained; and, by the same rule, the thicker the fibre, the coarser and rougher, in degree, the pile surface. This applies in the production of pile yarns for all descriptions of carpet. It is not the size of the yarn which determines the true quality of nap, but the variety of the wool of which the yarn is spun.

Brightness of colour tone, which is a distinguishing feature in each of these hand-tufted weavings, is variable in some measure by the yarn structure. The more this is of the carded type, the deeper and fuller the colour hue, and the more it is of the combed type, the brighter the tinted pile surface. The Persian rug, Plate XII, is made of hand-spun yarns, and though of a woollen character, the fibres are in a more complete parallel relation than in similar yarns producible by machine operations. This relation freely exposes the lateral sides of fibres, or their circumferential scales, to the light, so that the yarns possess a colour tone between a carded and a combed thread. On the other hand, the Chinese specimen, Plate XIII and Fig. 171, consists of a true woollen yarn, made of short fibres promiscuously crossed and intermingled, hence its pile is characterised by depth of colour hue. The "Savona" pile, Figs. 26 and 169, is formed of a good quality of crossbred worsted, the level structure of which develops tinted clearness and freshness. The Donegal, Fig. 170, is made of a like quality of fibre, but of a thick worsted roving which imparts softness of tone to the pile colouring.

To develop the maximum degree of lustre in the wool or other fibre it is obvious that yarns produced on the worsted principle should be selected, while to develop depth in colour toning yarns of the woollen structure should be employed. Hence for all deep shades—maroon, brown, blue and green—carded yarns yield richness of colour hue. In worsted yarns the colour hue

PLATE XIII.

CHINESE HAND-TUFTED CARPETS

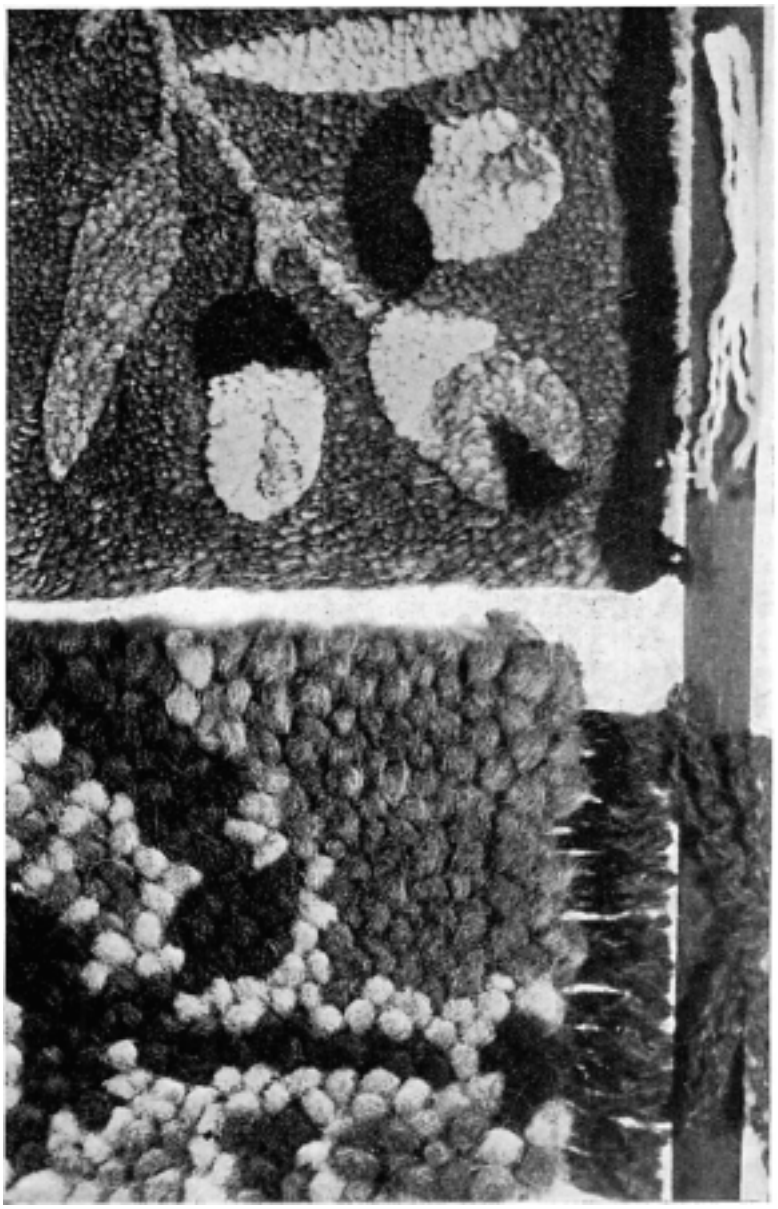


FIG. 171.
(Section of Plate XIII.)

FIG. 170.

would be a degree brighter but less saturated in tone. Each kind of yarn has its specific applications. The woollen has the denser covering and deeper toning properties; while the worsted has the smarter covering and toning characteristics. In hand-tufted carpets and in Wilton and chenille carpets both yarns are used for these respective objects. In Axminsters, worsted yarns, varying in ply and in counts, are almost invariably selected.

Apart, however, from these considerations, it has to be understood that, in order to acquire purity of colour, the wool used should, when scoured, be a clean white. This is imperative. For the delicate tones of fawn, green, yellow, red, blue and purple seen in antique Eastern carpets, fibrous materials of a snow-white purity must have been selected. Neither vegetable dyes, nor careful, skilled handling in dyeing, are competent of obtaining these coloured results in yarns made of an indifferent shade of wool or mohair. Any grade of wool run with yellowish or greyish fibres should be rejected as unsuitable for dyeing pale lavender, green, pink, salmon, heliotrope, etc. Such fibres are detrimental to the even dyeing of dark and medium shades, but increasingly so to the dyeing of tinted colours.

All wools vary in degree as to colour purity according to the parts of the fleece from which they are derived. The dissection of the pile threads in the Persian specimen shows that wools of a like filament fineness and length have been employed, signifying the care exercised in the classification of the sorts of wool available. Inequalities in filament fineness and variations in staple measurement may induce different dyeing properties, resulting in irregularity of tinted hue. To some extent these inequalities are counterbalanced by the efficient manner in which the filament ingredients are intermixed in yarn construction, but the less they are present in the pile yarns the richer and purer the colour tone produced.

Moreover, materials differing in this sense to an evident degree result in a pile uneven in surface features. This is observed in raised as well as in cut-pile fabrics. Evenness as also density of nap is, for instance, the consequence, in the woollen doeskin or beaver, of using yarns consisting, throughout their formation, of fibres of a like structure and quality. With the fibres differing perceptibly either in diameter or in length, a nap is formed varying in softness and smoothness, if not streaked on the surface with the longer and thicker filament units. As in the pile carpet

the fibres in the tufts are levelled in cutting, streakiness does not develop, but the pile is none the less irregular in structural composition when the fibres in the yarns have been indifferently

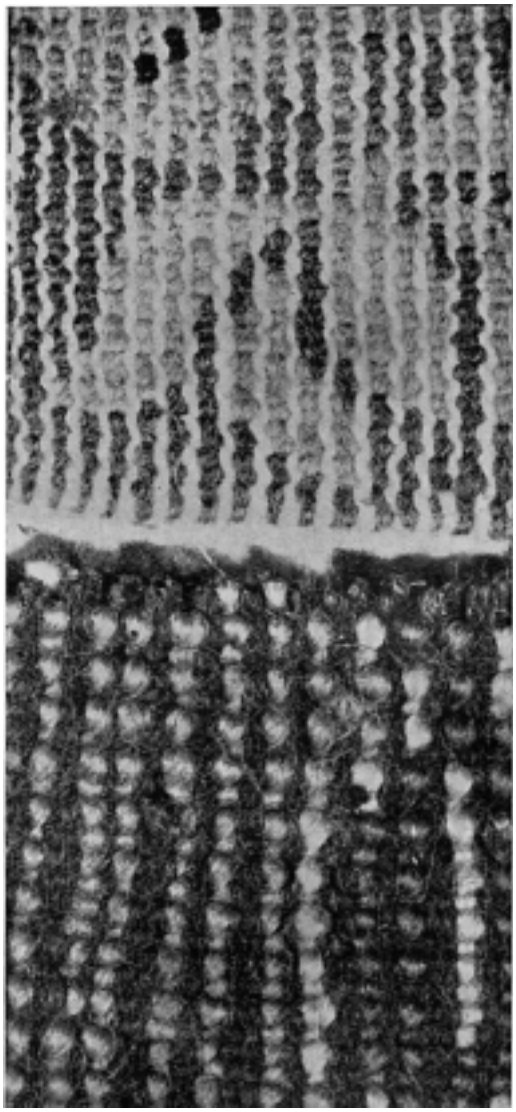


FIG. 171A.

FIG. 170A.

classified in the sorting of the wool, as also when they have been imperfectly admixed in the processes of yarn making. In such instances the fibres of the greater length and of the thicker diameter prove the more assertive units in the pile, to which they

impart their properties to the partial elimination of the features due to the finer filaments in the wool.

The thread units in the yarn tufts have a less subtle but equally marked influence on the carpet quality and wearing value as the fibrous materials employed. With a view to explaining this, reference will be made to the analytical data appended, illustrative of the yarn units combined, and of the weaving practices followed, in the production of Persian, Turkish, Chinese, Japanese and British hand-tufted manufactures—

ANALYTICAL DATA. HAND-TUFTED RUGS AND CARPETS.

Persian Rug. Plate XI.

Warp : 2-fold 18 skeins, crossbred wool. 19 threads per inch.
Foundation Weft : 15 skeins, same quality as warp yarn. 18 shots per inch.
Pile Yarn : 10–11 skeins, double threads, wool of a semi-lustrous quality. 9 × 9 and 9 × 10 knots per square inch.
Length of Pile Tufts : 1 inch, yielding a pile of ⅜ of an inch in depth.
Weaving : 1 row of tufts and 2 ground shots.
Ends of Pile Yarn per square inch : 90 knots or tufts × 4 (ends per tuft) = 360.
Approximate Weight of Pile Yarn per square yard : 40½ ozs.

Turkish (Oushak) Carpet, 5 × 6½ yards.

Warp : 2-fold 9 skeins, strong-stapled wool. 10 threads per inch.
Foundation Weft : 3½ skeins, medium twisted, similar class of wool as warp yarn.
Pile Yarn : 3 skeins, double threads = 1½ yards per drachm : strong-fibred wool. 5 × 5 knots or tufts per square inch.
Length of Pile Tufts : 1½ inches, yielding a pile of ⅝ of an inch in depth.
Weaving : 1 row of tufts and 2 ground shots.
Ends of Pile Yarn per square inch : 25 knots or tufts × 4 (ends per tuft) = 100.
Approximate Weight of Pile Yarn per square yard : 56¼ ozs.

Chinese (Peking Weaving) Border. Plate XIII and Fig. 171.

Warp : 5-fold 10's cotton. 14 threads per inch.
Foundation Weft : 5-fold 10's cotton, soft spun and twisted. 14 ground shots per inch.
Pile Yarn : 3-ply 8 skeins. Fine, short wool. 7 × 7 or 49 tufts per square inch.
Length of Pile Tufts : 1 inch, yielding a pile of ⅜ of an inch in depth.
Weaving : 1 row of pile tufts and 2 ground shots.
Ends of Pile Yarn per square inch : 49 tufts × 6 (ends per tuft) = 294.
Approximate Weight of Pile Yarn per square yard : $41\frac{5}{16}$ ozs.

Donegal Carpet. Fig. 170.

Warp : 2-ply 2-fold 6½ skeins woollen—Cheviot quality of wool. 8 threads per inch.
Foundation Weft : 2-fold 3·5 skeins woollen. 8 shots per inch.
Pile Yarn : Thick roving, 1 yard per drachm. Crossbred wool. 4 × 4 or 16 tufts per square inch.
Length of Pile Tufts : 2 inches, yielding a pile of ¾ of an inch in depth.
Weaving : 1 row of tufts and 2 ground shots.
Ends of Pile Yarn per square inch : 16 tufts × 2 (ends per tuft) = 32.
Approximate Weight of Pile Yarn per square yard : 72 ozs.

Hammersmith Rug. Fig. 182.

Warp : 16 ends of 30's cotton as one, and three such compound threads twisted together. 10 threads per inch.
Foundation Weft : Thick yarn, 4 threads as one, made of coarse fibre. 5 shots per inch.

Pile Yarn : 5 skeins, four threads as one, merino quality of wool. 5 × 5 or 25 tufts per square inch.
Length of Pile Tufts : 1¾ inches, yielding a pile of ⅝ of an inch in depth. 5 × 5 or 25 tufts per square inch.
Weaving : 1 row of tufts and 1 ground shot.
Ends of Pile Yarn per square inch : 25 tufts × 8 (ends per tuft) = 200.
Approximate Weight of Pile Yarn per square yard : 78¾ ozs.

Shaped Carpet. Plate I.

Pile Yarn : 2-fold 3's worsted, double threads.
Length of Pile Tufts : 2¼ inches, yielding a pile of ⅞ of an inch in depth.
Knotting : 5 × 5 or 25 tufts per square inch = 100 pile ends.
Ground Warp : worsted.
Ground Weft : Woollen.

"*Ladoga*" *Carpet.* Plate II.

Pile Yarn : 7 skeins Saxony, 6 threads as one.
Length of Pile Tufts : 1½ inches, yielding a pile of ⅝ of an inch in depth.
Knotting : 5 × 5 or 25 tufts per square inch = 300 pile ends.

"*Savona*" *Carpet.* Fig. 26 and 169.

Pile Yarn : 6–7 skeins Saxony, 6 threads as one.
Length of Pile Tufts : 1½ inches, yielding a pile of ⅝ of an inch in depth.
Knotting : 6 × 6 or 36 tufts per square inch = 432 pile ends.

An examination of the pile features as reproduced in the scale photographs of the specimens in Figs. 168, 169, 170 and 171, reveals the effect of combining different thread units in the pile tufts. With double threads, as in Fig. 168, and by relatively close knotting, the pile is rendered dense in filament composition. In the Donegal weaving—Fig. 170—filament density is acquired by employing a thick worsted roving as the pile yarn, but as this is a single and not a multi-ply thread, its two ends form a bead-like nap. This beady characteristic is present in some degree in Fig. 169, but the filament cover is more varied in quality as a result of each tuft being formed of six single threads, each of the twelve ends of which is a fibrous co-efficient. Fig. 171 illustrates the principle of obtaining a fine, clear pile by using three threads as one and forming each tuft of six ends, which, on account of the threads being more twisted and smartly trimmed by the weaver's cutting knife, are less diffusive in filament character than the ends of the pile in Figs. 168, 169 and 170.

Comparing more minutely the two strongly differentiated pile structures illustrated, namely the Donegal and Chinese weavings, the former is made of yarn tufts 2 inches in length and of 1 yard per dram yarn, giving a ¾ of an inch pile in the carpet, and the latter of yarn tufts 1 inch in length of 8 yards per dram yarn (three threads counted as one or a 3-ply thread of 2⅔ yards per dram), giving a ⅜ of an inch pile. In the Donegal there are 16 tufts per square inch and in the Pekin manufacture

49 tufts in a like area. The Irish production is woven one row of knots and two shots of thick woollen yarn and the Chinese one row of knots and two shots of cotton yarn, yielding the two types of foundation seen in Figs. 170A and 171A, one comparatively pliable and the other comparatively hard in texture. Both carpets are sound in construction, but the treading property, as determined by softness and flexibility, is higher in the pure woollen than in the union structure.

Clearly a carpet with 49 pile tufts per square inch is fuller in the pile than one of 16 tufts. The value and serviceability of the carpet surface are, however, dependent on other features besides that of knotted frequency. Dissection of the threads of the pile tufts in the two examples gives the diameter of single threads in Fig. 171 as $\frac{1}{38}$ of an inch, or of the three threads formed into one for knotting as $\frac{1}{21}$; and that of the pile yarn in Fig. 170 as $\frac{1}{13}$ of an inch. In actual wool filament weight, the pile in the Donegal exceeds that of the Chinese specimen; but in fibrous quantity as reckoned numerically the closer woven carpet exceeds the heavier structure. Thus in each square yard of the Donegal there are 1152 yards of 1 skein pile yarn, or 72 ozs. of wool fibre, and in the Chinese 5292 yards of 8 skeins pile yarn, or $41\frac{5}{16}$ ozs. Relative to the pile surface and its tufted formation, there are in each square yard of the specimen illustrated in Fig. 170, 20,736 tufts, or 41,472 ends of yarn, and in that illustrated in Fig. 171, 63,504 or 381,024 pile ends. The pile yarn in the Eastern or finer variety of Donegal consists of three threads, which results in each square yard of pile surface containing 124,316 ends of yarn; while in other descriptions of these carpets in which closer knotting is practised, as in Fig. 29, the number of ends in a given section of the pile surface is much larger.

Other technical features in pile formation are exhibited in Figs. 168 and 182. In the Persian rug, with 90 knots per square inch, and with each tuft formed of two threads ($= \frac{1}{30}$ of an inch in diameter), there are 116,640 knots, or 466,560 ends per square yard; while the Hammersmith mat, with 25 knots per square inch, and with each tuft consisting of four threads of 5 skeins yarn ($= \frac{1}{14}$ of an inch in diameter), there are 32,400 or 259,200 ends in a like portion of pile surface. The relative thicknesses of the compound yarns—$\frac{1}{30} : \frac{1}{14}$ of an inch—in which the pile is woven in the two productions, approximate to the filament density, making, however, in combination with the greater length of pile yarns in the English weaving—$1\frac{3}{4}$-inch as compared with

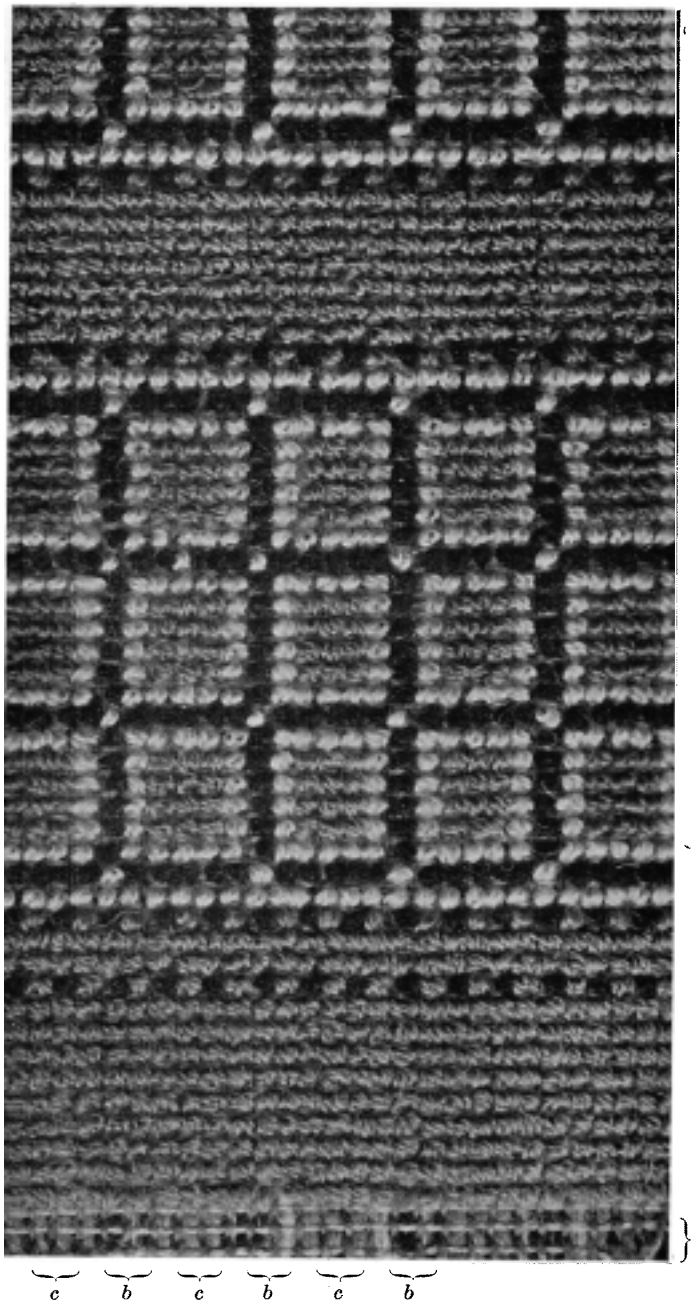


FIG. 172.
(Section of Fig. 121.)

1-inch tufts in the Eastern example—the Hammersmith fabric much the heavier in wool fibre.

One practice produces a fine, flexible carpet structure, and the other a carpet structure of a thick, firm, heavy description. Knotted compactness enables ornamental details to be neatly and smartly defined, and affords scope in colour minutiae as acquired by using fine tufts of yarn in forming the pile. It is a technicality on which the oriental weaver relies for the precise delineation of delicate and involved ornate features. With four threads in each tuft, and the single threads moderately thick in counts, the space occupied per tuft in the pile surface is a fraction larger than with each tuft composed of two threads of a smaller diameter or higher counts. In this Persian specimen a pile tuft fills $\frac{1}{90}$ of an inch, (*i. e.* minimum diameter, but, being a soft spun woollen yarn, 25 to 30 per cent. should be added for the actual diameter of the yarn in the carpet setting), and in the Hammersmith $\frac{1}{25}$ of an inch. These fractional parts represent the elemental ratios in which the design types are producible in the two settings or systems of weaving they exemplify; and also show that, in the proportion in which the yarn tufts are increased in multiplicity in a given area, the greater the facility in expressing distinctly small detail effects in decorative forms. This basic principle does not, however, imply that such effects are not obtainable in carpets less frequent in the knotting, but that they are expressed in such in a broader and more pronounced scale.

The finer and thinner varieties of carpets, being well built and firmly woven both in the foundation and in the pile, while flexible in character, are durable in structure, but not so well adapted for hard wear as those of the heavier class, of which the Oushak setting is illustrative. This is made of wool and counts of yarn similar to the standard Donegal, but a degree closer in the knotting. The nap is dense in fibre and of excellent covering property. The carpet for which the particulars are given measures $5 \times 6\frac{1}{2}$ yards. It has been in use as a dining-room carpet for more than twenty years, and shows few signs of the friction it has undergone. The colour tones—Turkey red, green and blue—are as fresh and bright as when woven, and the pile possesses its original filament density and richness of surface.

The Morris principle of weaving results in the manufacture of one of the thickest kinds of rug, heavy and full in the pile and of exceptional wearing strength (Fig. 182). The length

of the pile imparts softness of surface—one yielding to the tread, yet possessing a high degree of elastic property. The thickness of the individual knots, composed of four single threads, contributes to this characteristic of the rug. Being made of yarns spun from fine wool of a springy staple, such compact knots help to give filament substance to the ground or backing fabric. In a sense they also form an intermediate layer of material between the pile surface and the foundation fabric of the mat.

The exceptional softness, flexibility and velvety structure of the pile surface in the specimens on Plates I and II and in Figs. 26 and 169 are the result, first, of selecting wools of the proper quality and fineness, secondly, of using appropriate thread units in the pile tufts, and, thirdly, of establishing the pile on a wool yarn foundation. The pile of the shaped carpet—Plate I—is formed of double threads of 2-fold 3's fine crossbred worsted; the single as also the folded yarn being perfectly even and level in formation, and of a sufficient tensile strength and firmness to give a pile of nearly an inch in length in which the tuft units project in uniform serial lines from the ground of the carpet. In the "Ladoga"—Plate II—and in the "Savona"—Figs. 26 and 169—specimens the pile tufts consist of soft spun woollen yarns made of fine-grown Australian wool. The quality and fineness of the wool plus the well-prepared and spun yarn—which in trueness of structure approaches a combed thread—result in a rich, dense, deep pile, that of which a sectional view is given in Fig. 169 containing no less than 432 ends of thread per square inch. By grouping the six threads in each pile tuft in three's in knotting, the ends of the threads are formed into filament clusters, which mellow the colour toning and also add to the fibrous surface quality of the carpet.

The structural base of the carpet or rug is an important factor in pile weaving. It requires to be firm and compact, and composed of yarns of a suitable thickness and breaking strain. The warp threads have to sustain the knotting, and to carry the pile both in the process of weaving and of wear. In the lighter builds of carpets the strain on the threads is less than in the heavier builds, but only relatively or in ratio of the size of the yarns in the pile tufts. The operation of halsing yarn tufts—fine or thick—to the warp ends is not done without tension and friction on such threads. The tufts are first passed round the threads and then drawn by their respective ends into fast, close knots. Thick yarns necessitate in this work considerable

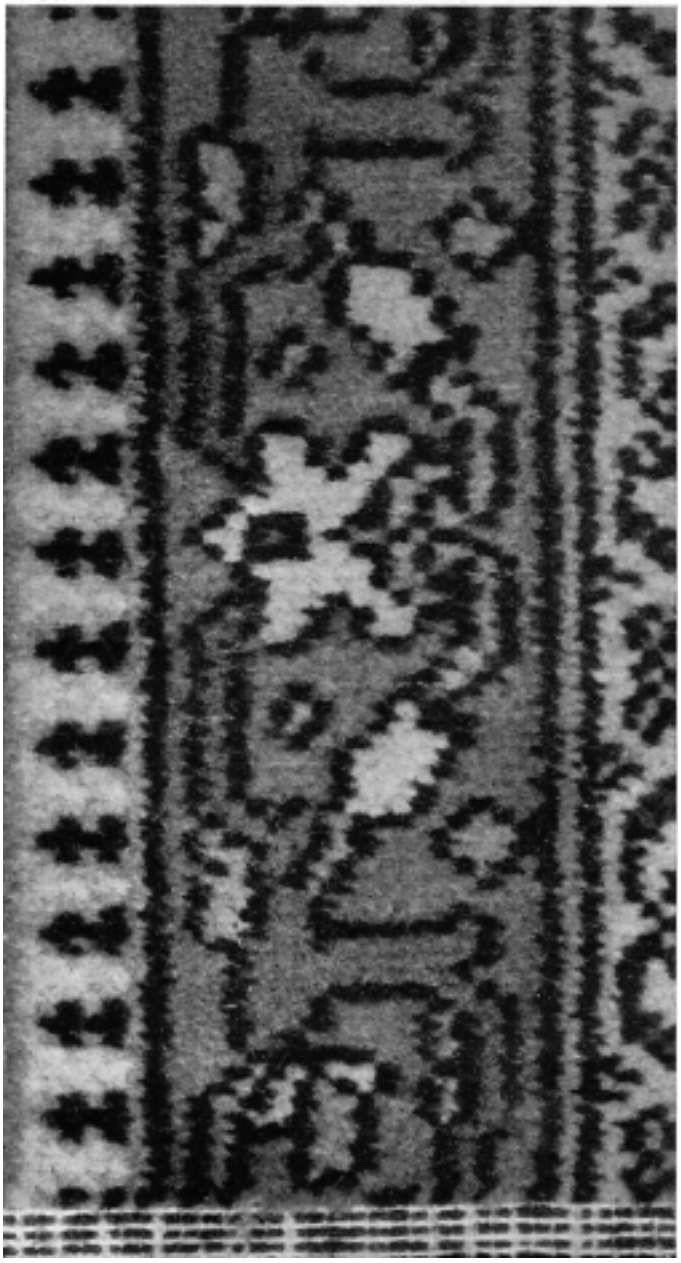


FIG. 173.
(Section of Fig. 129.)

drag on the threads in the warp: in the use of smaller yarns the amount of the drag is diminished, but the warp ends are also finer in counts. It follows that the warp threads, in all varieties of tufted weaving, should be two-, three-, or multi-ply, and of a thickness and strength corresponding with the weight of pile tufts they are designed to support in the woven manufacture.

The weft yarns may be thinner and also softer spun than the warp yarns, but it is essential that their size and tensile property should be equal to binding effectually and holding the tufted knottings in position. These points are exemplified in the carpet settings particularised and in the Chinese and Donegal structures examined. Taking the Persian type, the warp is made of 2-fold 18 skeins yarn, or of yarn some six counts thicker than the single-twist weft yarn. The warp threads in the Chinese example, having to support a heavy pile, are multi-fold in structure, and made of cotton. Their compound character renders them adapted for bearing the tension applied in knotting, and also for maintaining the pile tufts erect and firm in the wear of the carpet. The use of a smaller weft than warp yarn in both these productions provides for closer knotting in the length than in the width direction of the web. In the heavy build of Turkish carpet a strong 2-fold woollen yarn is employed in the warp, interlaced with a moderately-twisted single $3\frac{1}{2}$ skeins weft yarn. The weft thread should as a rule be soft in twine and of a yielding quality to facilitate compact weaving. Its function is to bind and retain the pile tufts in position, but not to carry them. The shots of yarn, following the separate rows of knots, force the knotted or looped portions of the tufts into contact, and make, in unison with the knots themselves, the underside of the carpet. Cotton warp and weft yarns produce a firm, strong foundation cloth, but woollen yarns give a like effect, with the three series of yarns—tuft, weft and warp—more securely adhering together. The two types of under fabric differ in appearance and in filament substance. One is composed entirely of animal fibre and the other of animal fibre in the tuft knots and of vegetable fibre in the ground yarns. In Fig. 170 the knottings, in combination with the crossing yarns, form a solid woollen fabric on which the pile " beds " more satisfactorily than on a cotton ground fabric of the type in Fig. 171. The serrated structure of the wool fibre is a primary cause of interlaced woollen yarns binding effectively. The serrations in the fibres of the yarns intersect and interlock, and

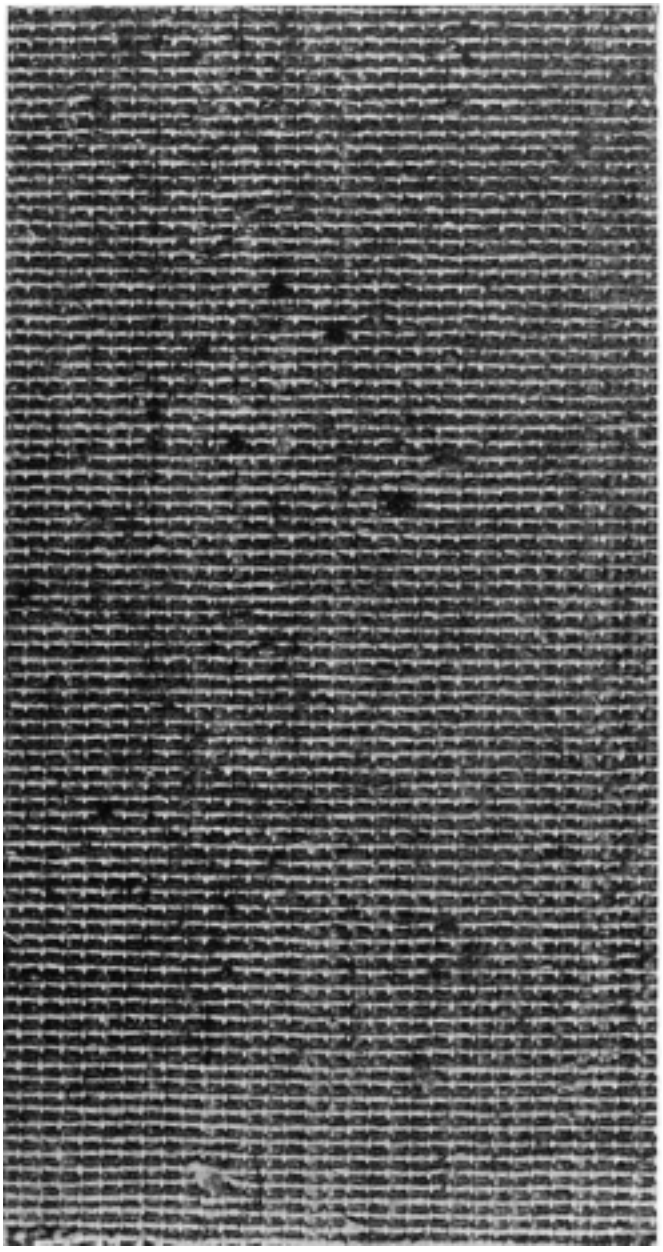


FIG. 173A.

effect thereby a natural cohesion of the yarn units in the texture. The wavy, flexuous nature of the wool staple also induces conditions which contribute to fibre and yarn coherency. Woollen threads are not simply brought into close relation by the weaving practice, but by the structure and affinities of the fibres of which they are formed.

With the yarns spun from vegetable fibre the interwoven threads are less coherently related than in interwoven woollen threads, the coherency of structure being solely dependent on the scheme of thread interlacing. In hand-tufted carpets this signifies that foundation threads made of cotton may be more readily displaced and the pile tufts more easily withdrawn than foundation threads made of wool or hair. Another factor in favour of the woollen ground fabric is that it imparts, as compared with a cotton, or a cotton and linen, ground fabric, additional flexibility and softness to the pile surface, and increased wearing efficiency to the carpet.

Summarising the elements and structural features which determine the soundness, strength, and quality of all descriptions of tufted-woven carpets, they comprise: (1) even weaving both as to knotted regularity and uniform beating up of the shots of weft; (2) yarns of a suitable tensile standard and thickness in the warp for the length and weight of pile in the carpet tufts; (3) weft yarns of the correct counts, material and twine for supporting the knots and securely binding them into the foundation fabric; (4) pile density, whether a product of frequent knotting or of using yarn tufts composed of several threads; and (5) the selection and employment of fibrous materials in each sort of yarn—warp, weft and pile—of a filament quality and fineness, and of a staple length and elasticity, applicable to the class of carpet manufactured. Factor (1) may be determined by examining the back of the carpet for ascertaining if the average knotting coincides with the standard number of tufts per square inch; factors (2) and (3) by the firmness and compactness of the basic fabric formed by the warp threads, the shots of weft, and the knots of the pile yarns; and factor (4) by the thickness and filament composition of the pile tufts relative to the space each tuft is required to fill in the carpet surface. Yarn quality (5) is strictly only determinable by dissecting the threads and averaging the length and fineness of the fibres of which they are spun, though practice in handling carpets enables the connoisseur to judge of "quality" by the

feel and by the structural characteristics visible when the pile and foundation fabric of the carpet are superficially examined.

Moreover, carpet value is affiliated with pile depth. In attaining this in conjunction with pile consistency, there are two elemental factors to be taken into account: (*a*) the thickness and quality of the pile tufts, and (*b*) the scale of the pile knotting. Even in carpets having a short pile, should the tufts be thin in filament substance or the knotting not sufficiently close, the pile suffers in wearing property. Should the pile be long and these conditions obtain, the pile flattens in the use of the carpet. An erect pile is a desideratum whatever the length of the pile units.

From the examples examined it is apparent that "length" is obtainable in either thick or small yarns by using single, double, or multi-ply threads in the formation of the tufts. The thicker, however, the tufted units the greater the consumption of yarn in the process of knotting. The length sacrificed in the take up shortens the pile, but thickens the carpet. As a rule, the heavier the count of the yarns in the tufts the less frequent the knotting and the greater the economy in weaving, and the finer the yarns in the tufts the closer the knotting and the more costly the carpet production.

An erect, compact pile is only to be acquired by adjusting the knotting frequency to the size of the yarns in the pile tufts. This principle is illustrated in the typical makes of carpets for which the weaving data are specified on pages 368 and 369, but reference may be made to two further examples, selected from the high-class grade of manufactures of the Wilton Royal Carpet Factory Co., Ltd. In each the pile is $\frac{3}{4}$ of an inch deep, the tuft yarn units and knotting being as follows:

I.

Pile Yarns: 4-ply 2-fold 16's fine crossbred worsted.
Length of Tufts: 2 inches. 6 × 6 or 36 tufts per square inch.

II

Pile Yarns: 4-ply 2-fold 24's fine crossbred worsted.
Length of Tufts: $1\frac{3}{4}$ inches. 10 × 10 or 100 tufts per square inch.

To produce a similar length of pile in these different yarn counts, the tufts are 2 and $1\frac{3}{4}$ inches in length. In Example I there are 288 (36 × 8) ends of $\frac{1}{60}$ of an inch in (minimum) diameter, and in Example II some 800 (100 × 8) ends of $\frac{1}{74}$ of an inch in diameter per square inch of carpet. The latter is the richer and finer in the pile; but in both carpets the pile units are in absolute line conformity and perpendicular relation. In filament

density and softness the pile is of the velvet structure. Its surface is soft and yielding to the tread, but immediately on pressure being removed the small but resilient thread units regain their vertical line setting.

These qualitative pile features are the result of knotted frequency proportionate to the thickness of the yarn tufts; regular and close weaving; selecting pile yarns even in construction and of the requisite tensile and elastic properties; and of establishing the pile of the carpet on a well-built foundation fabric.

Many of the technicalities applicable to the production of pile structure and quality which have been considered are common to both hand- and machine-woven carpets. To summarise —the class and nature of the wool or material used in the pile threads, the filament substance and yarn units of the pile tufts, and the frequency of the rows of pile elements—tufts or loops—per square inch, have a corresponding influence on the character of the pile, whether produced in the vertical or automatic loom. Whereas, however, there is only one weaving practice in making a tufted pile, several weaving practices are adopted in making the carpet pile by machinery.

Each machine practice, as now understood, gives a pile possessing distinctive constructive features, but developed on a similar variety of carpet foundation. The looped or Brussels pile is a special type, differing structurally from that of the Wilton, Chenille or Axminster pile. Such a looped pile may be modified in value by the ply, counts, and quality of the worsted yarn of which it consists, and also by the number of loops in a given section of carpet surface. The build of this pile is illustrated in Fig. 172, from which it will be observed the loops are perfectly uniform in size and project for a small fraction of an inch from the ground fabric, a section of which is seen at F, with the pile yarns interlaced by the foundation shots at *b* and removed at *c*. This scale section of the specimen in Fig. 121 is of the standard Brussels set—8 splits and 9 wires per inch. Each pile unit is developed in two threads of 3-fold 16's worsted, and is required to fill the space between the ground threads or such vacancies as those observed in parts *c* of Fig. 172. The fuller in filament the pile yarns the better the quality of the pile surface. Practice indicates that with the pile yarns multi-ply in structure the loops possess a diffusive and " filling " property which develops pile value. In the specimens on Plates IV and V the pile yarns

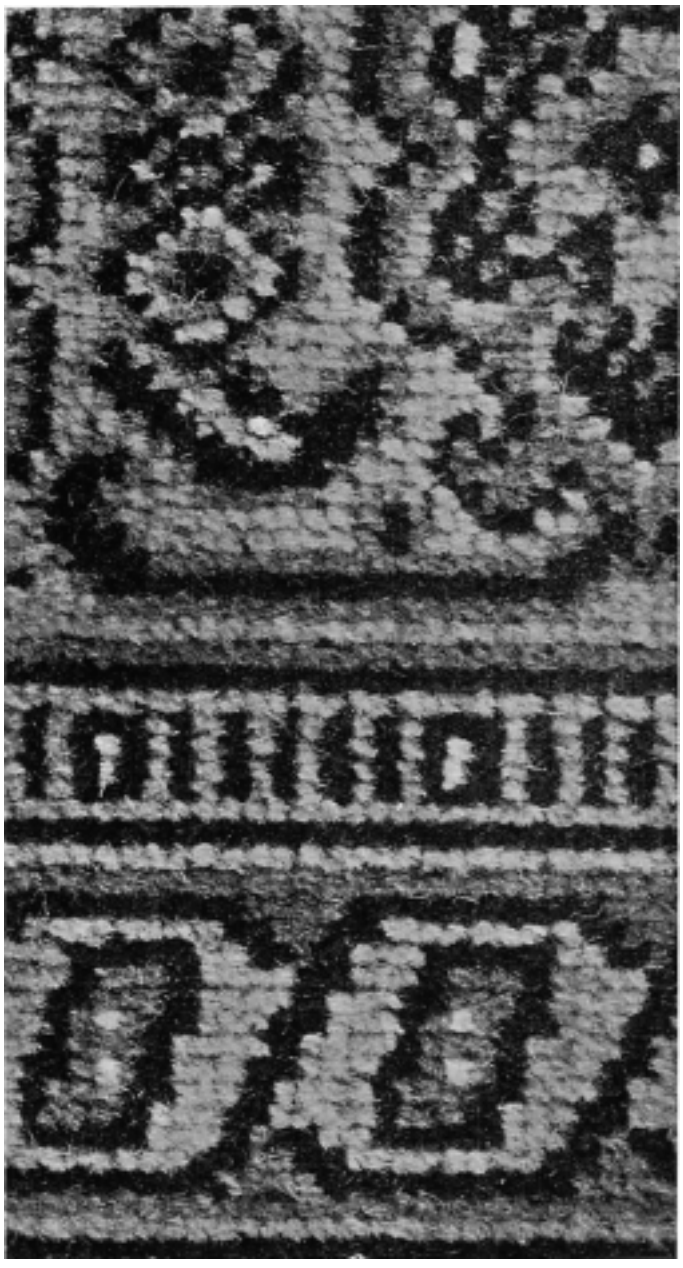


FIG. 174.
(Section * of Fig. 126.)

consist of 3 threads of 2-fold 18's worsted, producing each loop in three 2-fold threads each of $\frac{1}{64}$ of an inch in diameter as compared with each loop in the example in Fig. 172 woven in two 3-fold threads each of $\frac{1}{60}$ of an inch in diameter, the combined counts of the former being 3's and of the latter $2\frac{2}{3}$'s worsted. Both compound yarns are formed of six single threads which renders them of like covering quality and consistency.

By employing the shots of weft for binding the rows of loops as explained in regard to Fig. 172 the transverse lines of pile are in contact with each other. To reduce the ply or counts of worsted yarn, as is done in the cheaper makes of carpet, impoverishes the looped character. A reduction in the number of the rows of pile per inch has a similar detrimental effect. In the first practice the foundation of the carpet is liable to penetrate through the pile in the wear, and in the latter practice the ground shots are liable to become visible between the rows of loops.

The tendency in recent years has been towards carpets having a cut or velvet pile. The inferior grades of Brussels and tapestries put on the market may have fostered this change, as the build of the carpet lends itself either to cheap or better class manufactures. The pile is of a durable, bright structure, and in some respects it possesses advantages over the cut pile. It presents the firmer wearing surface, as bended or looped threads resist friction and treading with greater efficiency than the ends of threads. The wear in the Brussels is on the sides or lateral portions of the fibres and the yarns; in the Wilton and Axminster it is chiefly on the tips of the fibres and yarns. The difference in the wearing properties of the two kinds of pile is not so pronounced when the longer pile is compared, as when the shorter variety of velvet pile is compared with the ordinary Brussels pile, but it exists for the reasons defined.

The Brussels structure also offers advantages in acquiring brightness of colour toning in association with the clear delineation of the decorative features in the design. All the ornate effects in the figuring, even if formed in single pile units, may be distinctly brought out as seen in the clearness of the details in the scale illustration, Fig. 172. The looped form of the pile exhibits the structural parts of the fibres, namely, the outer scales, which freely reflect light. The lustre value of the worsted pile yarns is, therefore, enhanced by the pile structure. The tinted worsted threads gain in freshness of tone by their pile

setting. These elements make the Brussels principle of weaving uniquely adapted to the construction of pile carpets in which the pattern style is required to be emphasised either in colour tone or in outlining; as they also make it adapted for obtaining a pile surface in which the maximum wearing strength of the pile yarns is utilised.

The Wilton (Figs. 126, 129, 173 and 174), the Tournay velvet (Figs. 133 and 176), the fine Chenille (Fig. 177), and the Axminster (Figs. 164 and 180) are all cut-pile carpets. They resemble each other in surface appearance, but differ in qualitative pile values and characteristics.

Treating of the Wilton, three descriptions of manufacture are illustrated, namely the fine-make, the ordinary or standard make, and the deeper or Cinema pile make of fabric. In the first (Figs. 129 and 173) there are 13 rows of pile to the inch, in the second (Figs. 126 and 174) 9, and in the third (Figs. 130 and 175) 10 rows. They also differ in loom setting, containing $9\frac{1}{2}$, 8 and 9 splits per inch respectively. It follows that in the specimen in Fig. 173 there are $123\frac{1}{2}$, in that in Fig. 174, 72, and in the specimen in Fig. 175 90 pile tufts per square inch. The pile yarns in the finest structures consist of 3/2/14's worsted and in the more open set carpet of 2/8's (yards per oz.) woollen. So compact and even is the pile surface in Fig. 173 that the divisional lines between the rows of pile are almost imperceptible in the dark-coloured sections, and only faintly observed in the actual carpet in the sections woven in the lighter shades. The fine-make Wilton is illustrative of the velvety type of pile obtainable in this weaving principle, and of the minute scale on which the unit tufts may be developed, rendering it feasible to produce the detail features in the pattern ornament clearly. It is a pile structure of excellent covering quality, partially due to the frequency and symmetry of the tufted rows, and partially to the multi-ply (6 threads as one) worsted yarn employed in the weaving of the pile. In such carpets the finer the wool filament in the worsted yarn and the more level the pile yarn formation, the higher is the pile value as estimated by fibrous density, surface smoothness and resiliency, and wearing property.

The setting of the second example (Fig. 174) coincides with that of the Brussels in Fig. 172, both carpets containing 72 pile elements per square inch. This facilitates a comparison of the structural features of these two varieties of pile. In the photographic specimens, as in the actual carpets, the well-defined

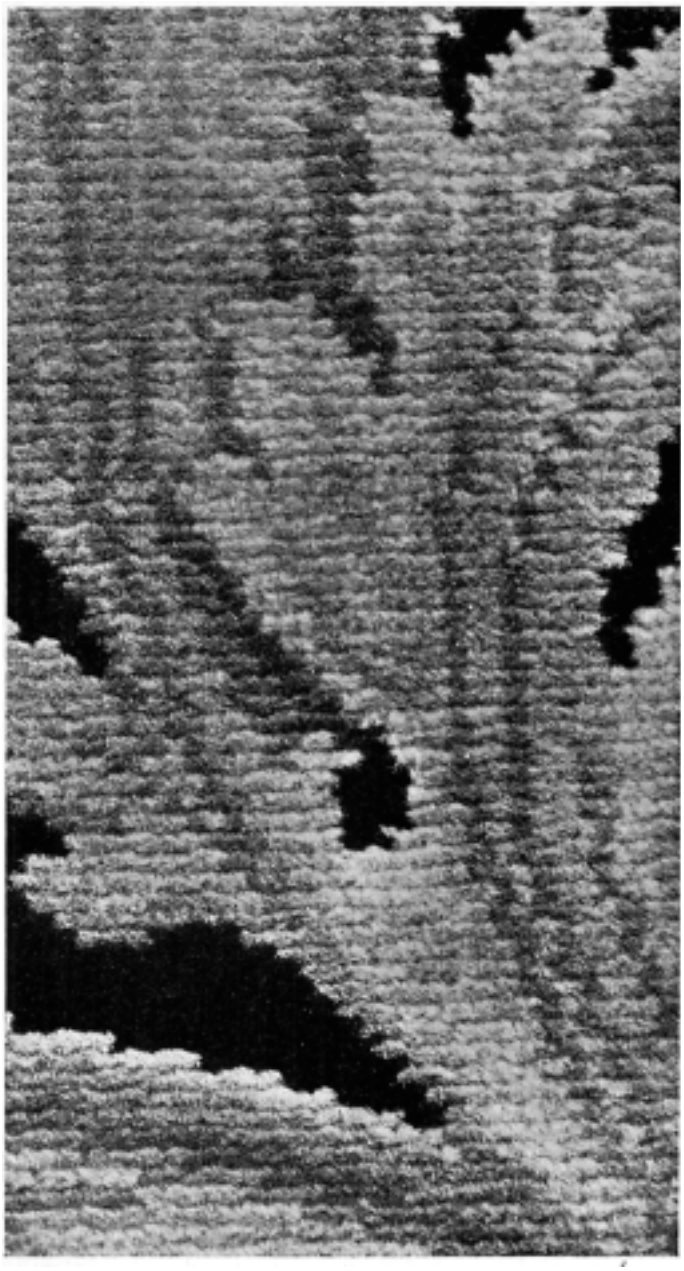


FIG. 175.
(Section A of Fig. 130).

quality of the looped and the diffusive nature of the cut pile are at once apparent—each type of pile being enhanced in character by being developed in worsted and woollen yarns respectively; that is, the loop pile is formed in the yarn structure which best exhibits its brightness of toning and serried thread and filament surface, and the cut pile is formed in the yarn structure which best exhibits its compacted filament substance and tufted units.

The dimensions of the pile effects vary in Wiltons with the reed setting and the wires per inch. In this ordinary grade of manufacture they are comparatively broad and distinctive in formation. Their scale enables the pile composition to be dissected. Each tuft is seen to fill a small rectangular section of the pile surface. The fibrous edging of the tufts links one pile unit with another. With closer weaving, as in Figs. 173 and 175, the vertical lines between the tufts disappear, and those across the carpet are partially concealed by surface fibre. This example, however, reveals the distinguishing characteristic of the Wilton pile—that of its compressed tuft form.

The Cinema example (Fig. 175) is not so compact in the pile rows as the fine-make Wilton, but its pile is a degree deeper and made of the same class of yarn. The slight increase in pile length adds to the softness of the carpet surface, and produces that filament quality suitable for toning colours, varying in depth, one into the other, so effective in the weaving of shaded styles of ornament. A shorter pile develops the tone contrasts more decisively, while the longer pile causes the different tones to assimilate in the manner observed in the illustration. Here the features in the medium grey grade into those in grey and the latter into those woven in tinted grey. The filament length of the pile favours this quality of toning, and also the formation of dense-surfaced nap. It should be observed that to increase the pile depth in excess of the resilient and tensile strength of the pile yarns is to be obviated. To further lengthen the pile by a degree in this build of Wilton, without using yarns of a stronger and thicker construction, would produce a pile surface disposed to flatten in the wear. The size of the wire employed—·205—accords with the fibre substance of the yarns and also with the yarn counts.

The Tournay velvet (Figs. 133 and 176) is woven with the same number of wires per inch as the latter specimen, but it possesses a shorter and more woolly pile. The fibres in the nap are not so

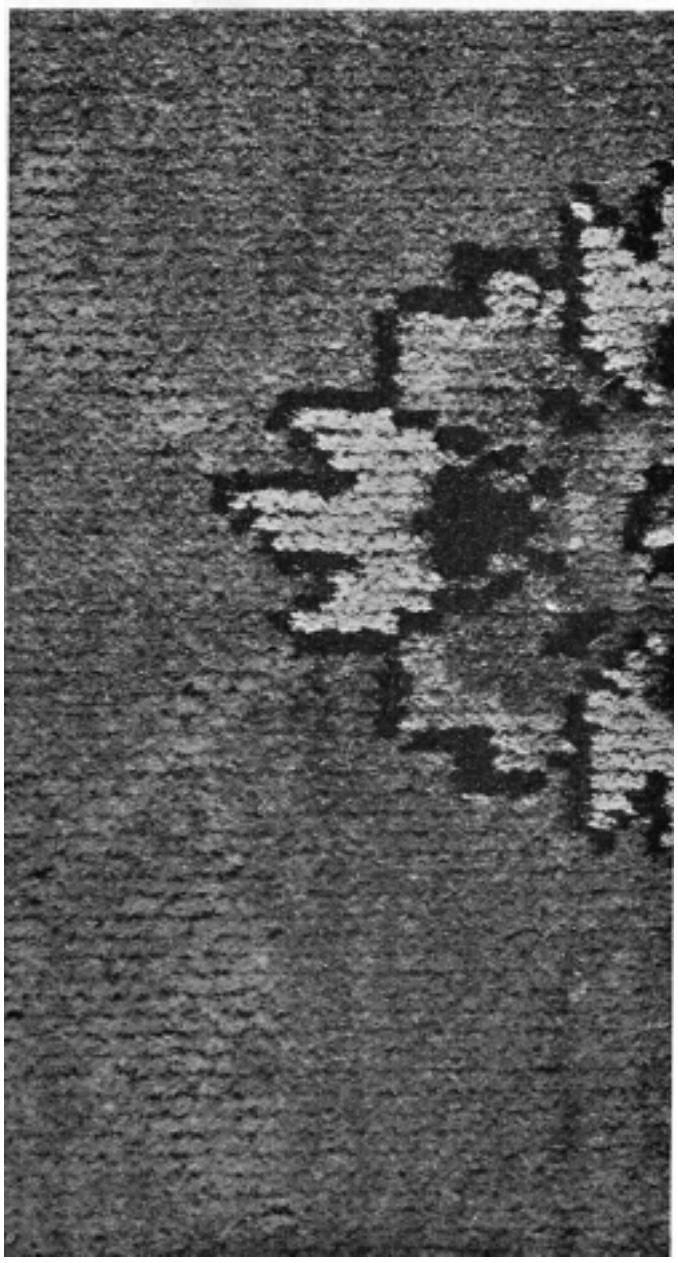


FIG. 176.
(Section of Fig. 133.)

much in a parallel as in a clustered relation. Yarns spun from short-stapled wool, or yarns of a " foody " structure—*e. g.* prepared on the French system of worsted drawing and spinning—yield a nap of this character. In the dark portions of the figuring in the sectional illustration (Fig. 176) as also in the carpet, the pile density is such as to conceal the ground shots perfectly, but the effect of these shots is seen in other portions of the design. The strong contrast between the shade of the weft yarn and that of the colour or colours of the pile yarn is, in some degree, responsible for the development of this feature. Hand-tufted weaving admits of the colour of the ground weft being changed as desired with that of the pile yarn in the carpet. This takes place in the weaving of some Eastern fabrics, but it is not a feasible practice in automatic production. Nor does machine weaving facilitate the use of woollen yarns, of a yielding property, in the foundation of the carpet. Vegetable-fibre yarns, either cotton or linen, do not, as explained, readily admix, or rather cohere in structural composition, with yarns made of wool or animal fibre. Should the Wilton or velvet pile be a 3-shot weave it accentuates the hard, strong binding shots and makes them liable to show between the rows of pile.

It is different in the Saxony or long-pile " velvets "—whether 2- or 3-shot in the weave—in which the pile is from $\frac{3}{8}$ to over $\frac{1}{2}$ an inch in depth, and made of comparatively thick counts of yarn. Here the thickness of the pile ends is a distinguishing feature. These possess some of the beady characteristics of hand-knotted tufts. The elasticity and twisted structure of the yarns, combined with the compactness of the pile units, produce a pile surface of superior softness and wearing durability. In the Saxony " velvets " in Figs. 134, 135 and 136 other surface features are developed. The pile of the carpet in Fig. 136 is thick, close and firm. It is springy, but relatively hard in degree. The tufts are formed, as stated, in three-fold yarn of a carded nature in which the fibres are compactly grouped. The pile in the carpet in Fig. 135 is of a higher resilient property, and also more velvety in tone. Its tuft units are formed in yarns of a pure crossbred worsted structure, with the threads so loosely twisted together in the folding that the quality of the wool and also of the yarn is diffused through the pile surface. Yarn type and pile depth are the source of the differentiations in the surface characteristics of these three examples in long-pile Wiltons or Saxony velvets.

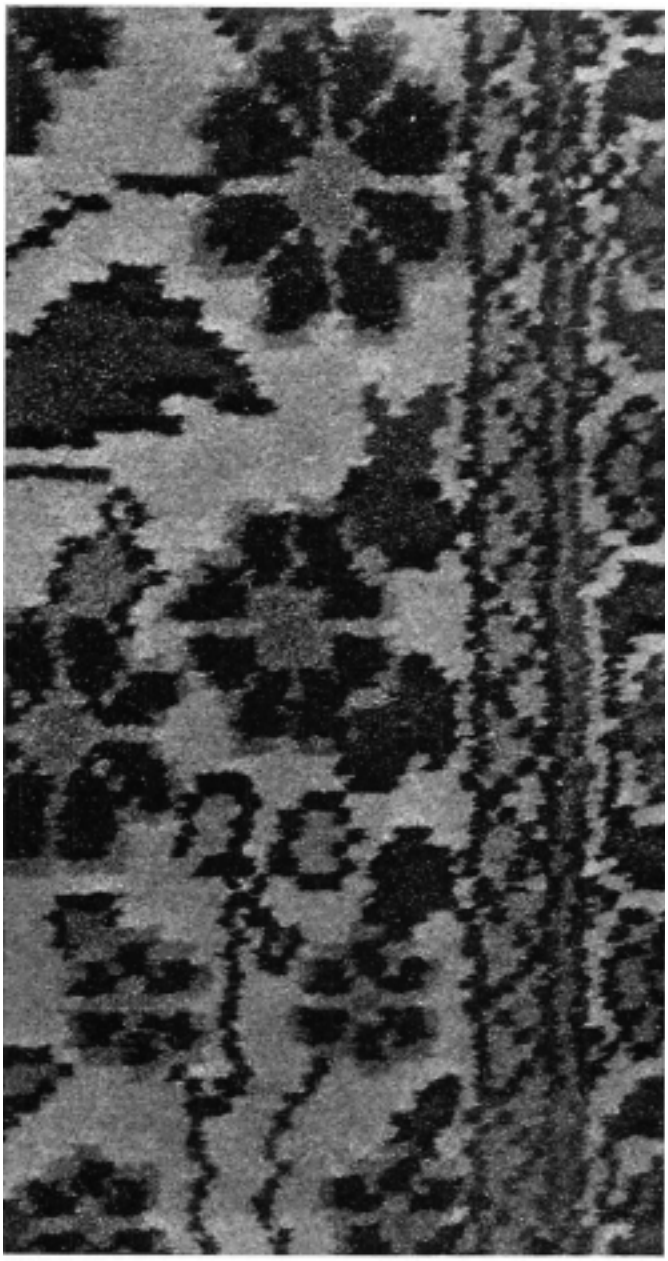
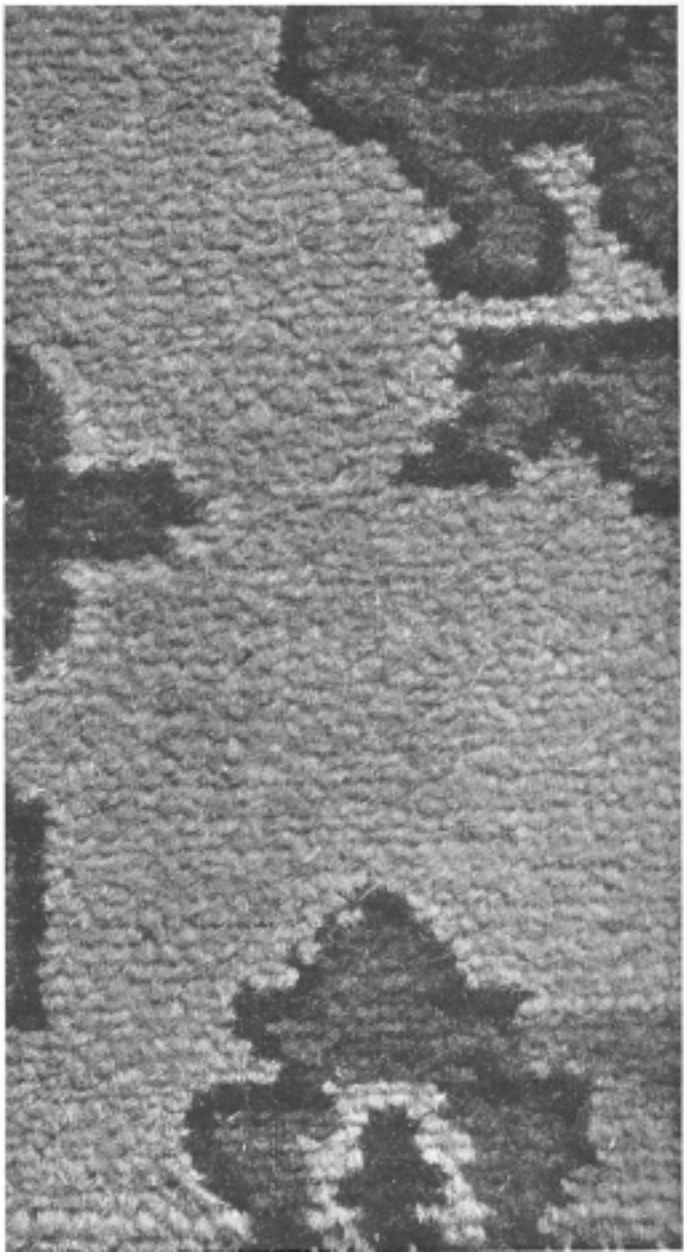


FIG. 177.
(Section of Plate IX.)



(Section of Fig. 162.)

The equality of the Chenille Axminster pile (Fig. 177) is attributable to the method of "fur" production, and to the practice of pile insertion into the carpet. Whereas, in the Wilton and machine-tufted Axminster, the pile is the result, as previously described, of cutting the pile yarns in the loom and during the operation of carpet weaving, it is, in the Chenille Axminster, the result of making a special type of "fur" yarn; which, in its completed pile form, is applied—that is, stitched by warp threads—to the foundation of the carpet. Structurally, this pile differs from that in other descriptions of carpet manufacture. It presents similar features to the velvet pile, with, however, its pile ends firmly secured in the fur yarn by a multiple of gauze-interlacing warp threads. Resulting from a woven "fur" it may, in the process of production, be varied as required in filament and yarn composition, and also in pile unit density, with the greatest facility. In this respect the Chenille principle of carpet weaving offers a wide range for quality production. Between two such extremes in fur structure as those illustrated in the specimens in Figs. 157 and 160 there is ample scope for diversifying the fur features and character.

It will be appreciated that, as this pile is not woven into but attached to the ground of the carpet, it is essentially a surface effect, and as such requires to be effectively bound to the carpet structure. As a type of pile it compares favourably, in the finer builds of fabrics, in exactitude of pile length and smoothness and richness of character, with the fine Wilton or Axminster. This is observed in the particulars given of the choice rug example Plate IX, as it is also evident on examining the scale photograph of a section of the pile of this production in Fig. 177. This rug has a perfect short-pile surface, deep in tone, and even and firm in filament texture. The fur yarn of which it consists (Fig. 160) indicates how consistent in setting and fineness are the tufted units, made of a quality and count of worsted yarns which ensure a pile of uniform softness and of uniform filament density. The more searching the dissection of this example, the better is it found to exhibit the properties which, in combination, produce a valuable pile carpet surface. In the lower grades of Chenille manufacture a like equality of pile structure obtains, but naturally with a corresponding deterioration of the pile compactness and fineness.

Ordinarily the standard varieties of Axminster are made in

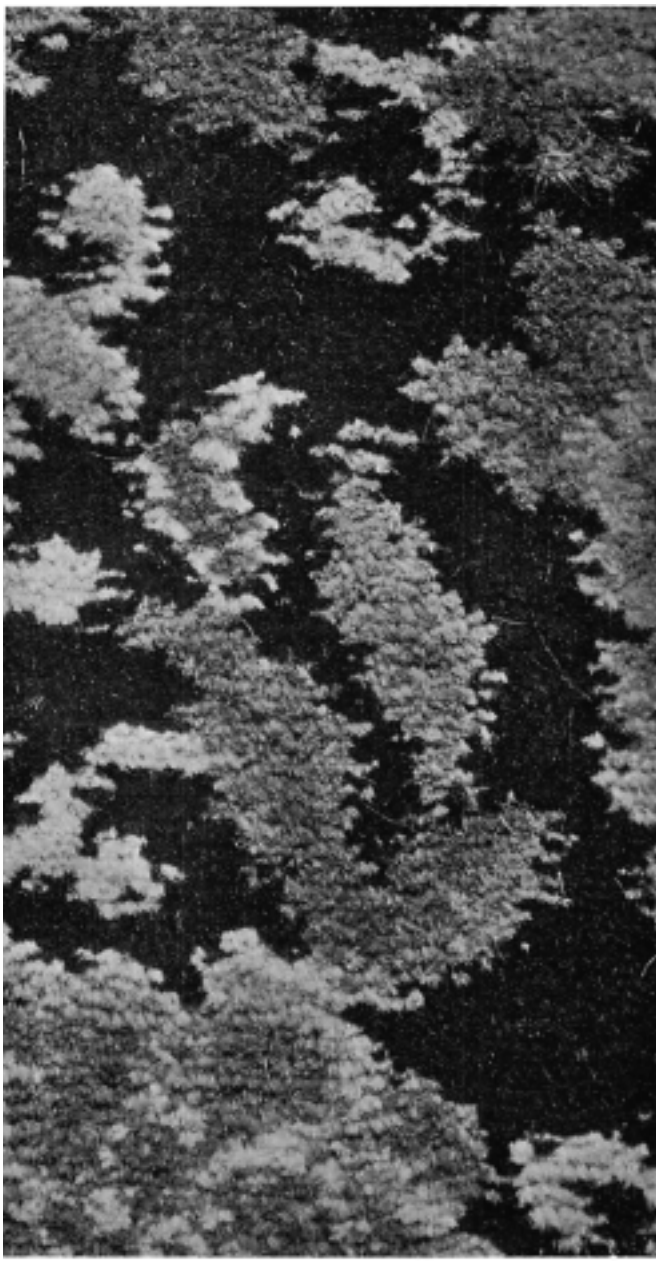


FIG. 179.
(Section of Fig. 163.)

heavier types of pile yarns than the Wilton or velvet-pile carpet. The set of the Axminster loom as defined by the number of threads per spool—189 for a 27-inch width or 7 pile ends per inch—controls this factor. Still, in the finer grades of manufacture, such as those on Plate XI and in Fig. 164, 3-ply 2-fold 12's or 14's worsted yarns are employed, the requisite fulness of pile tuft being acquired by the six double threads in the tufts made of such compound yarns, and by weaving with nine or more rows of tufts per inch in the carpet length instead of the usual seven rows which coincide with the reed setting.

The practices adopted in cutting the yarns into tufts in Axminster weaving produce a pile surface of a distinctive tone—one, however, less prescribed in the tufting, with the pile units less severely defined in structure than in the Wilton carpet. In the latter, the pile yarns are securely bound on each side of the wires before their withdrawal for cutting, and the fastness with which they are thus held contributes to a clean, smart severance of the yarn loops. A corresponding smart yarn cut is attainable in the stretched chenille webbing, as the knives of the cutting machine divide the strips of fur. There is in each of these instances a moderate amount of tension on the yarns while cutting takes place. But by the principle of cutting by shear action or by revolving spiral blades with the yarns held at one point in the fell of the carpet and at the other by a clamping or other device, while cutting is evenly effected, it leaves the ends of the threads a degree more fibrous in appearance.

In addition, the two tuft ends are not in the same exact line with each other as in the Wilton, having some similarity in this feature to the tufted ends in the chenille pile. Being formed simultaneously in velvet or Wilton carpet weaving, and also beaten up into position at one and the same time by the forward movement of the reed, they give a serried-row type of pile development, as seen in Figs. 175 and 176. On the other hand, the two tufted ends are formed at separate operations in the weaving of the Axminster. The free ends of the lengths of yarn from the spool having been placed in position and crossed by a ground shot, the yarn lengths for the reverse ends are doubled upwards, from underneath the shot of weft, by the action of the sley, and, after being secured in a vertical relation by the insertion of a second shot, the rear ends of the tufts are obtained by

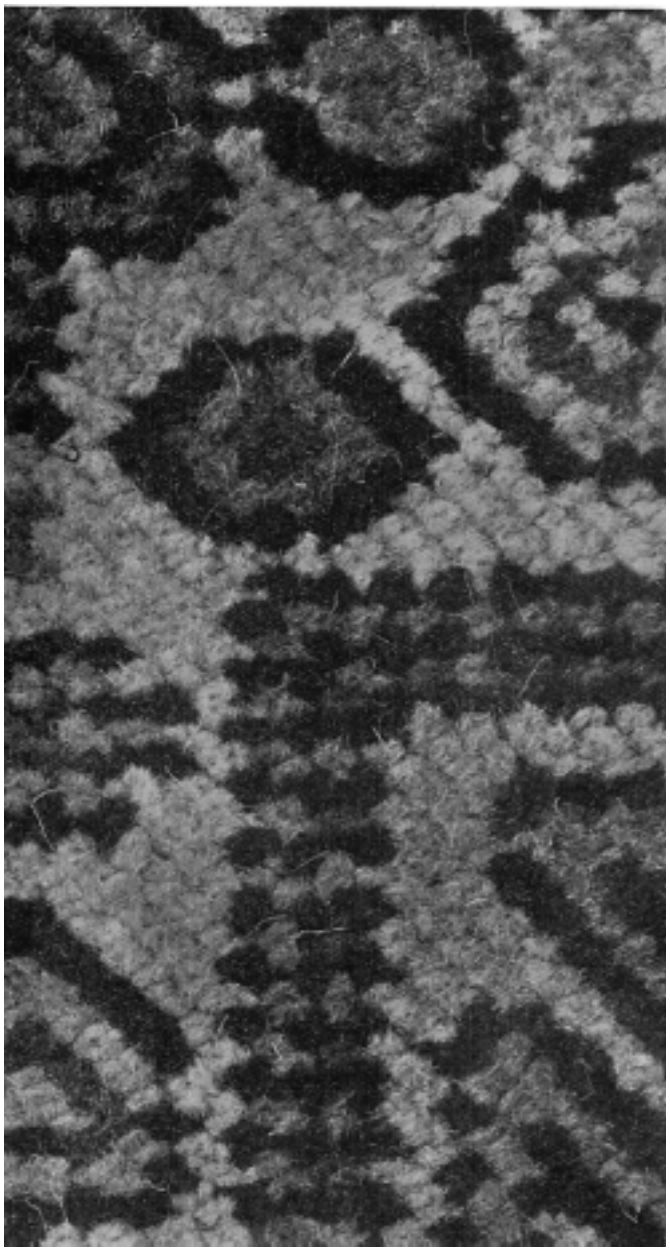


FIG. 180.
(Section A, Plate XI.)

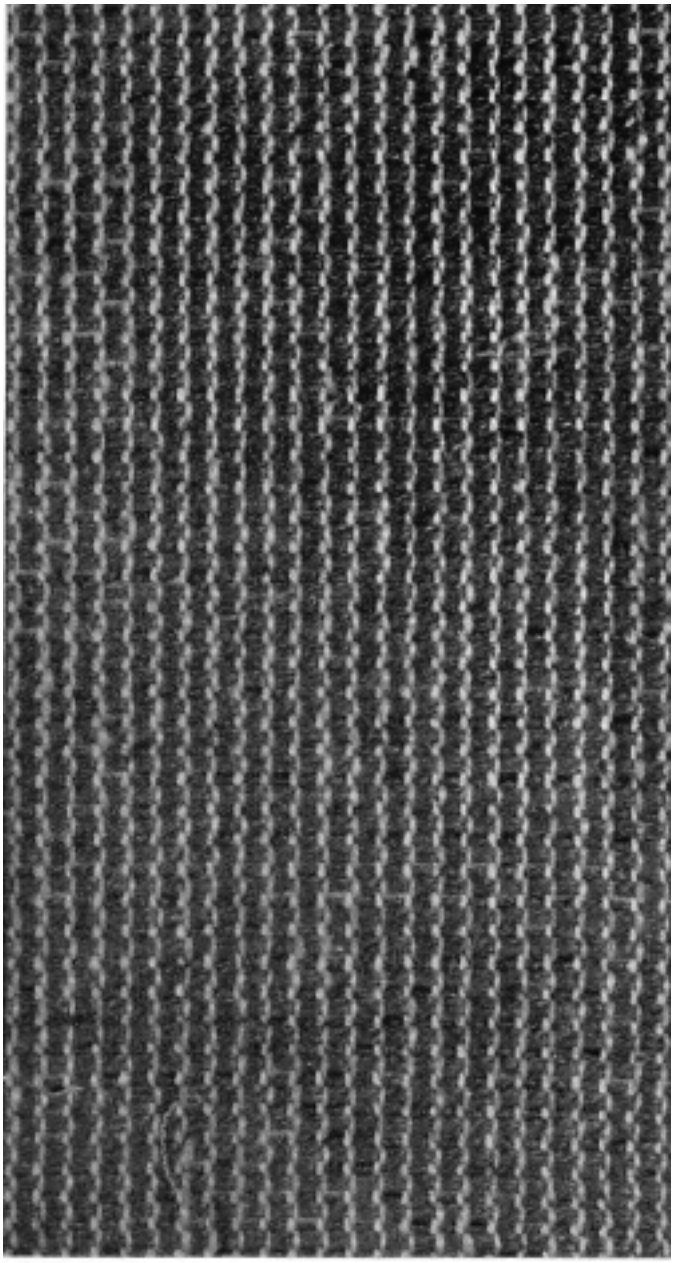


FIG. 180A.

cutting. The two ends of the tufts, in consequence of this compound practice, are not in an exact line with each other, though both are similarly bound into the carpet and upright in position. The effect of this is observed in the pile surface produced, and also in the enlarged illustrations of the Axminster specimens in Figs. 178, 179 and 180. One end of each tuft is slightly out of line with or to one side of its companion end, an arrangement which eliminates the tufted-row formation characteristic of the Wilton.

The pile, as particularly noticeable in the ground portion of Fig. 178, presents a somewhat corrugated surface appearance. Comparing, first, this Axminster type with the ordinary Wilton type in Fig. 174; and, secondly, the specimen in Fig. 178 with that in Fig. 175, will enable these two varieties of cut-pile carpets to be readily distinguished. It will be observed that the pile units in the standard Axminster (Fig. 178) do not, as in the standard Wilton (Fig. 174), form rectangular tufts of fibre in which the two ends are amalgamated into one. On the contrary, each end retains its separate character and occupies its specific setting in the pile surface. The two ends form a duplicated pile effect, while in the Wilton the two ends of the tufts form a unified pile type. The rows of tufts are more or less waved or sinuous in formation. They are not plainly divided from one another by the ground shots, as in the specimen in Fig. 174. The tufted rows dovetail with each other, the thread units in the respective tufts partly filling the interstices between the rows. In the closer-woven Axminster (Fig. 179) the continuity of the pile texture, in the larger sections of the design, is so pronounced that the serried grouping of tufts is barely traceable. The outlines of the figuring are not expressed in sharp geometric lines, but in irregularly-shaped pile units, and this imparts a soft quality of tone to the decorative yarns. Producing the Axminster pile in thicker yarns further accentuates the pile characteristics defined.

The foundation of the pile carpet and the different weaves used in constructing it have been treated of in describing the different varieties of carpet manufactured. It is understood that it must be strong and durable, and of a type not to show through the pile, and yet of sufficient thickness and substance to support the pile surface. The pile yarns in the hand-tufted carpet make a looped carpet basis forming part of the reverse side, and this, as indicated, is allowed in the heavy-make of

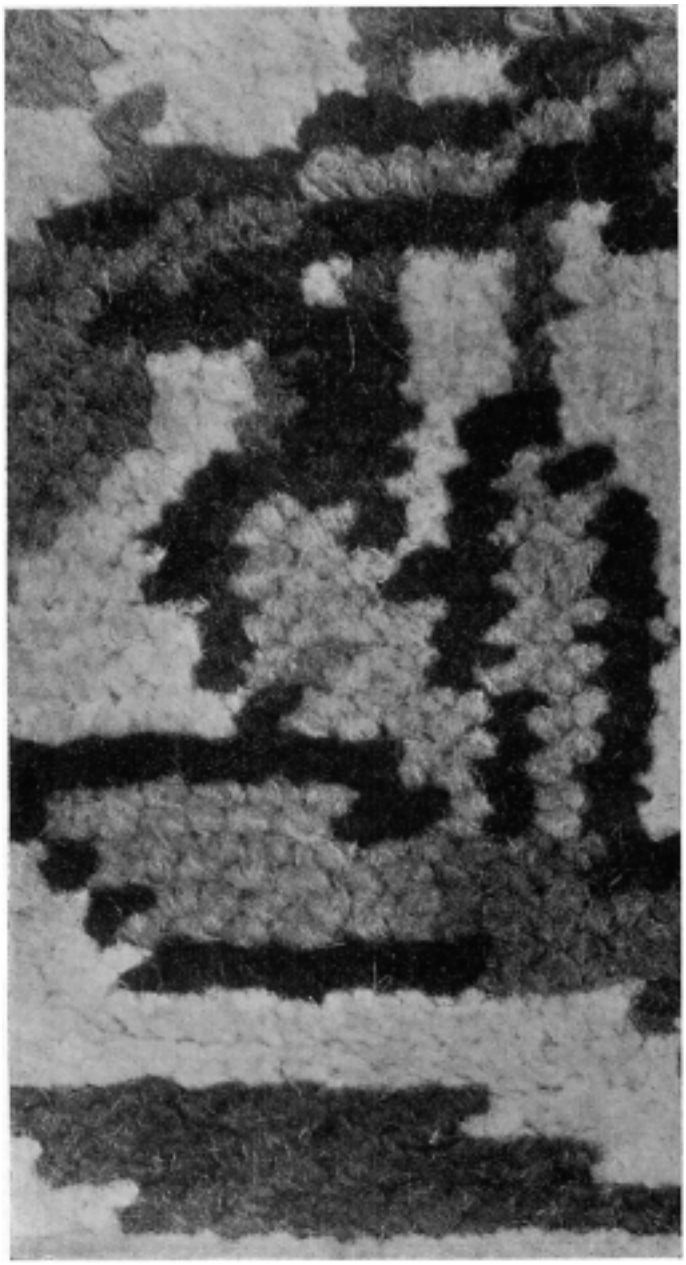


Fig. 181.
(Section of Fig. 164)

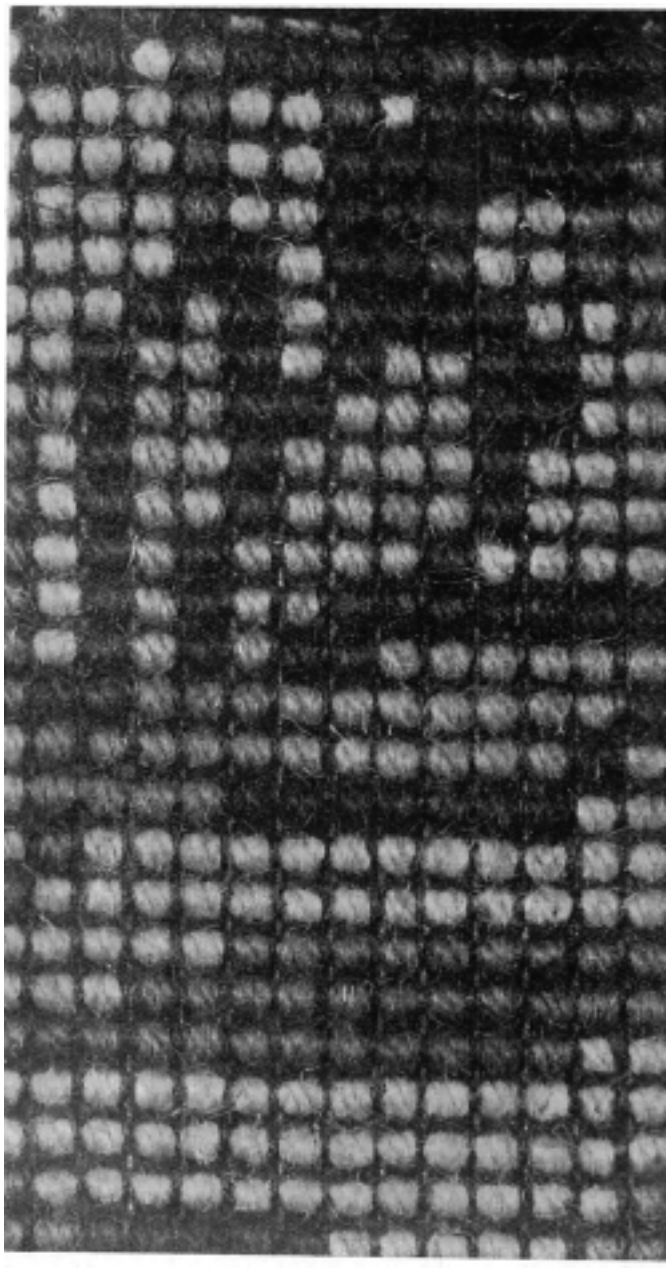


FIG. 181A.
(Reverse side of Fig. 181.)

Axminster in Fig. 181, the underside of which is illustrated in Fig. 181A. In the general classes of Axminster the foundation is made as shown in Fig. 180A and in Wilton as shown in Fig. 173A.

FIG. 182.—Hammersmith Rug.

APPENDIX

The following were received after the death of Professor Roberts Beaumont :—

I. Chinese Hand-tufted Rug, reproduced in the Frontispiece.

(Sent by Mr. Lo Ting Yu—a former student under Prof. Beaumont in the Department of Textile Industries, Leeds University—from the Kai Yuen Woollen Factory, Peking.)

II. Samples of Japanese Hand-made Carpets and photographic illustrations of their manufacture.

(Collected by Mr. R. Nara, Nippon Keori Kaisha, Ltd., Kobe—also a former student—from the works of Mr. Denshichi Murata, Purveyor by Special Appointment to the Imperial Japanese Household Department, Sakai, nr. Osaka.)

The carpets are made with cotton, wool, jute, and silk pile wefts. Fig. 1 is the carpet with the cotton pile.

FIG. 1.

FIG. 2.

Fig. 2. A general view of the loom; R being the reed; W, the warp on the loom; P, the pile weft.

The reed is moved forward and backward, making a plain shed for the ground weft (Fig. 7); it is then pulled down to beat up the ground pick, and swings back into position by means of weights.

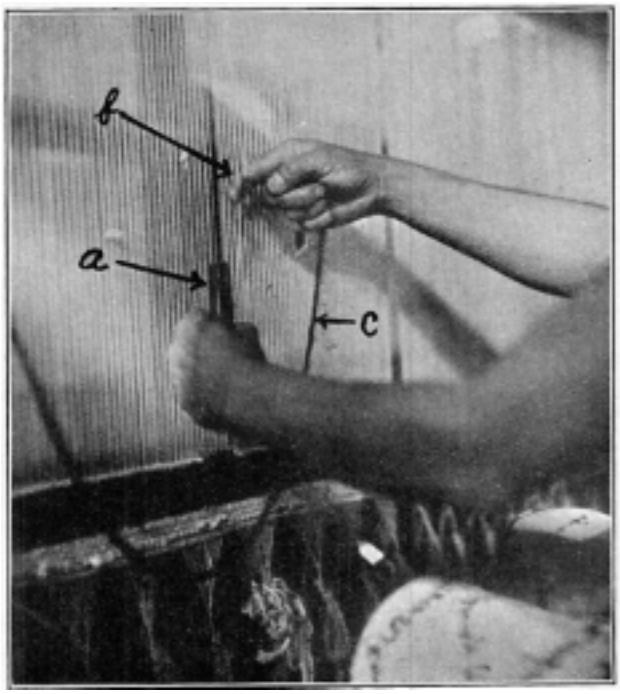


FIG. 3.

Fig. 3. The insertion of the pile weft, *c*, by the right hand, *b*, the scissors, *a*, being held by the left hand, and roughly cutting the pile weft end after being wrapped round the warp threads.

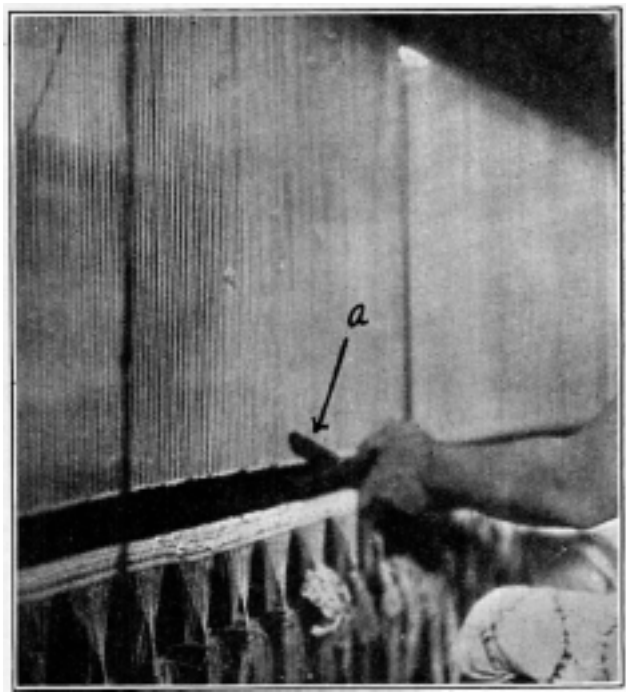


FIG. 4.

Fig. 4. The final cutting of the pile ends by the left hand with scissors, *a*, the cutting being done from right to left after the insertion of each row of pile.

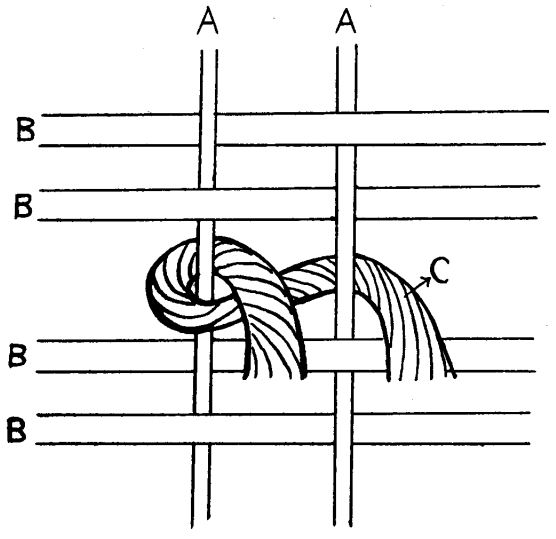


FIG. 5.

Fig. 5. The structure of the hand-made carpet; A, A, the cotton warp; B, B, B, B, the ground weft; C, the pile weft.

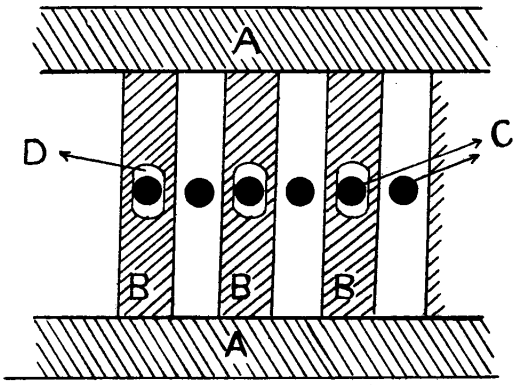


FIG. 6.

Fig. 6. A horizontal view of the reed with a section of the warp; A, A, the thick wooden frame; B, B, B, flat pieces of bamboo with holes, D, for the warp; C, a cross section of warp threads.

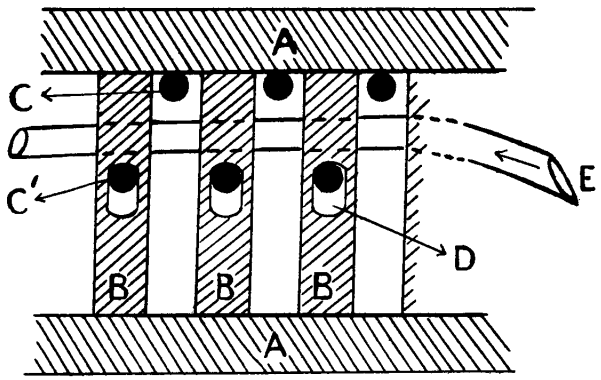


FIG. 7.

Fig. 7. The reed is pulled forward for the insertion of the ground pick, E, between the warp threads, C and C′.

III. Sample of Chinese Hand-tufted Carpet and designs in colour for Chinese Carpets.

(Also collected by Mr. R. Nara from the carpet works of Mr. Tinbei Funahashi, Tientsin, one of the chief factories for hand-made carpets in China.)

FIG. 8.

The designs are given in Figs. 8 and 9.

The method of manufacture for these carpets is similar to that used in Japan.

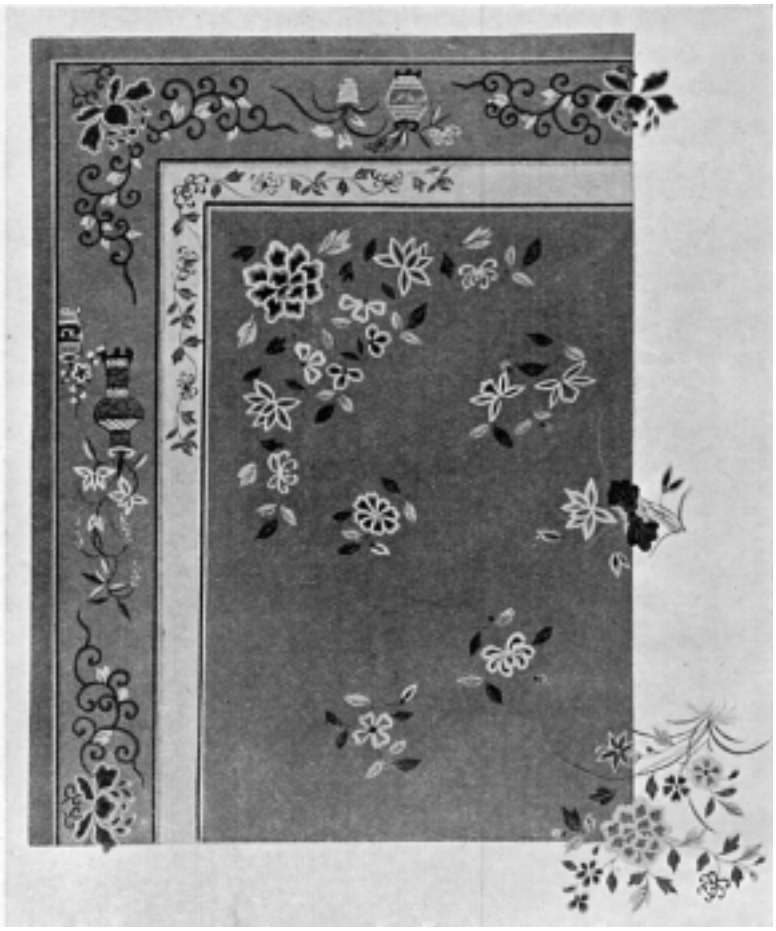


FIG. 9.

INDEX