REFLECTION OF LIGHT BY TEXTILES.

(Continued from June issue.)

Pile Fabrics.

The rich deep color of velvets and other pile fabrics is due to the manner in which they reflect the light.

Fig. 7 is a sketch showing how light is reflected by pile *A* composed of fibres standing perpendicular to

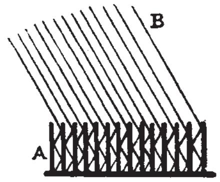

Fig. 7

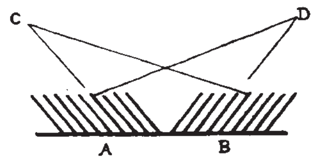

Fig. 8

the surface or body, presenting only the tips of the fibres to the light, so that there is the least possible surface reflection. The white light *B* falling on the sides of the fibres is reflected downwards from one fibre to another, until it is absorbed or reaches the body of the fabric. The sides of the fibres present a very large surface to filter the light, and reflect back colored rays, which are diffused in all directions between the fibres until they finally emerge from the surface, giving deep, rich, pure colors, comparatively free from white light.

That these deep colors are produced by reflection, and not owing to changes in dyeing, is shown by fabrics containing cut and loop pile, the loops presenting the sides of the fibres to the light, and the resulting color is not so pure, containing a large quantity of white light reflected from the surface of the loop, and therefore appearing lighter in shade.

If the pile is flattened or opened out so as to expose the sides of the fabrics to the eye, the fabrics appear similar in shade to the loops.

Very rich effects are obtained when the pile is crushed irregularly, so that it lies in various directions. Those fibres that are perpendicular to the observer, and whose tips only are visible, appear the deepest in color; the remainder varying in brightness according to the irregularities in intensity of the light reflected by their sides.

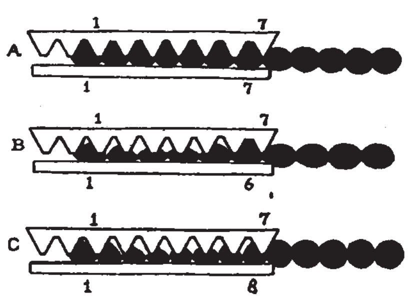

Fig. 9

Fig. 8 is a sketch showing pile leaning to the left at *A*, and to the right at *B*. From the position *C* the tips only of *A* would be visible, which would appear very dark, while the sides of the fibres at *B* would be comparatively light. The light and shade would be reversed when viewed from position *D*.

Finishing processes are often employed to increase or modify the power of a fabric to reflect light, and at other times completely alter its character as a reflecting surface. In the raw state, fabrics are often covered with loose fibres, which interfere very much with the outline of the threads, reflecting light irregularly. Scouring and filling, by removing dirt and softening the fibres, make a more compact mass. Dry raising or brushing liberates the ends of the loose fibres, so that they may be easily removed by cutting or singeing. Pressing gives a level and uniform surface. All these processes tend to develop the woven effect, and render it clear and distinct.

Tensioning the warp more than the filling while the fabric is wet, thus straightening it out, causes the filling to bend more, and the warp less, altering their relative curvatures, and bringing the filling more prominently upon the surface. If this tension is maintained until the piece is dry, then warp and filling are fixed in their new relative positions, and a corresponding alteration occurs in their reflecting surface.

Finishing is also used to develop the natural lustre of the materials, and sometimes to give an artificial lustre.

Different materials vary very much in lustre and reflecting power. Silk fibres have the smoothest and most lustrous surface, and therefore the richest effects and greatest contrasts of light and shade are seen in these goods. Mohair and Lustre Worsted also give plenty of contrast; while Cotton (unmercerized) diffuses the light in all directions, and presents comparatively little contrast of light and shade.

The quality of lustre consists in the ability to reflect a large quantity of white light in one direction without dispersion or alteration, and thus a very slight change of angle of the surface causes a great difference in the intensity of the light; the shaded portions also are luminous, reflecting the minor lights received from other quarters, but appearing darker by contrast, because there is more difference between the light and dark portions of lustrous goods than there is in dull fabrics.

Lustrous fabrics always possess a comparatively smooth surface; while dull fabrics have more irregular surfaces, and allow the light to penetrate further, diffusing it in all directions, so that the light received from different quarters is more blended together.

A smaller quantity of light is reflected, and it is more evenly distributed, thus presenting a duller appearance with less contrast between light and shade.

A piece which has been stretched out in width on the tenter when wet, and dried to that width, (thus setting the fibres in a strained position) will remain the full width indefinitely; but as soon as it becomes wet again the strain is removed, the elasticity of the fibre comes into play, and the fabric shrinks in width; so some kinds of lustre are not permanent, and the fabric shows every spot of rain, the fibres when wet changing position and reflecting light differently.

In boiling, steaming, and crabbing, the fabric is subjected to the action of heat and moisture under pressure. The heat and moisture soften the wool fibres, which also swell as they absorb moisture. The pressure is applied by wrapping them tightly round rollers, so that there is not room for the fabric to increase in bulk, and for the individual fibres to retain the same outline; the fibres swell out irregularly, filling up the small vacant spaces, and moulding each other to a flatter and smoother surface.

The softening of the fibres by heat and moisture removes their elasticity and resistance to change of shape and outline, causing them to settle down into less space, fill up vacancies, and form a more compact mass. It is difficult to determine whether the increase of bulk by the absorption of water, or the collapse due to the softening of the fibres, is the most potent factor in producing a smoother and more lustrous surface.

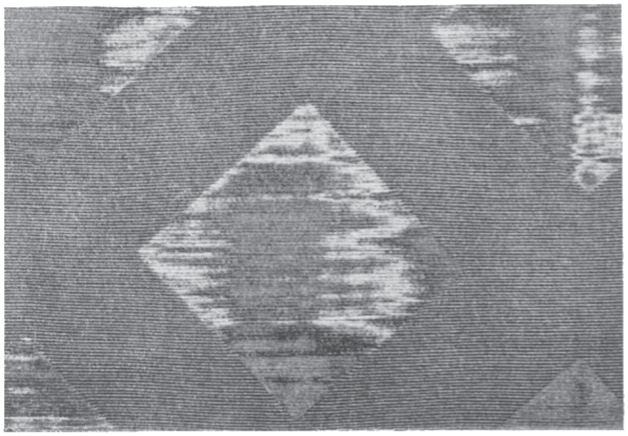

Fig. 10

The longer the process is continued, the more water is absorbed (to a certain limit) the more compact becomes the mass, and the more permanent the result. The fibres alter in shape and position, causing the fabric to have a smoother surface, and when dry, their recovered elasticity is exerted to preserve it.

The action of mercerization in producing artificial lustre upon cotton yarns is exerted in a different manner. Instead of moisture causing the fibres to swell, chemicals are used which cause them to contract and shrink; but the yarns and pieces are held fast to prevent the fibres from shrinking in length, and the contraction being all in thickness, they are drawn out smaller, receive a smoother surface, and become more lustrous.

Finishing is also employed to completely alter the character of the reflecting surface. Wet raising by drawing out the fibres and forming a nap changes the surface from a series of curved threads interlacing each other, to a smooth surface of separate fibres all laid at about the same angle, and therefore reflecting light in a similar manner.

Finely corrugated rollers are sometimes employed, flattening out the curves of warp and filling, and impressing a number of minute ridges or designs upon the surface; thus substituting angular for curved surfaces, causing them to reflect light without so much dispersion, and so increasing lustre.

The varied reflections and constant play of light and shade in moiré, *i. e.*, watered silks, etc., are also caused by alterations in the character of the reflecting surface during finishing. One method is to press the corded surface of the fabric under a fluted roller which alters the appearance of the cords, flattening them at various angles, so that each cord presents a flat, lustrous surface to the light, and gives an unbroken reflection in one particular direction; the alteration of angle in the various cords is very gradual, so that when the fabric is moved about, the position of the light and shade gradually changes, according to which the cords are at the proper angle for reflecting light to the eye.

Fig. 9 is a sketch (exaggerated) to illustrate how the fluted roller gradually changes the appearance of the fabric. At *A* the flutes in the roller are equal in number to the cords of the fabric; therefore they are all crushed to the same shape. At *B* the fabric is stretched until six cords are equal to seven flutes; all the cords are more or less flattened, and also slightly different in shape. *C* shows eight cords to seven flutes, with corresponding alteration in the surface of the cords. In the fabric the changes are often done more gradually, one cord being gained or lost in a larger number than shown in the illustration.

The rollers are fluted to the same size as the cords, giving them an angular appearance. The pattern is caused by a roller with projections of various shapes and sizes standing out from its surface, which is placed for the fabric to pass over immediately in front of the fluted roller. When one of these projections comes in contact with the fabric, it increases the tension of the warp at that particular place, and draws the cords out of a straight line, thus working them across the flutes, and flattening them in a different manner at that particular place.

After the projection has passed round out of the way, the tension is slackened, and the cords are crowded into the flutes, until they have become straight again. These local variations in the tension cause the figure to have a rounded appearance; also when the tension is altered there is a very gradual change in the position of the flutes in relation to the cords, causing minute differences in the angle of the finished surface.

Fig. 10 is a photo of a moiré, *i. e.* watered effect, produced on a gros-grain ground; the figure effects being watered, plainly showing the gradual change from light to shade, the ground being left plain gros-grain.

Fig. 11

Fig. 11 shows an embossed design produced by finishing, technically known as gauffréing, showing the reflection of light to shade on a figured design imparted upon the surface of an otherwise plain woven fabric structure by means of passing the latter between the nip of suitably engraved rollers. No partway flattening of the filling threads, as is the case in the process of moiréing comes in this instance under consideration. The high surface of the engraved roller is in this instance, smooth and not grooved as in the case of moiréing.

For the process itself, we use what are known as gauffréing calenders, *i. e.,* 2-roller calenders as shown in Fig. 12, in which a suitably etched or engraved roller works in conjunction with its mate, *i. e.,* matrix roller. The latter may be a paper roller, in which the pattern has been embossed in low relief by running the engraved small top roller as carrying the raised pattern, for some time in close contact with said paper roller, and when the pattern from the engraved roller will then be impressed into the paper roller. Care must be exercised that the circumference of the engraved

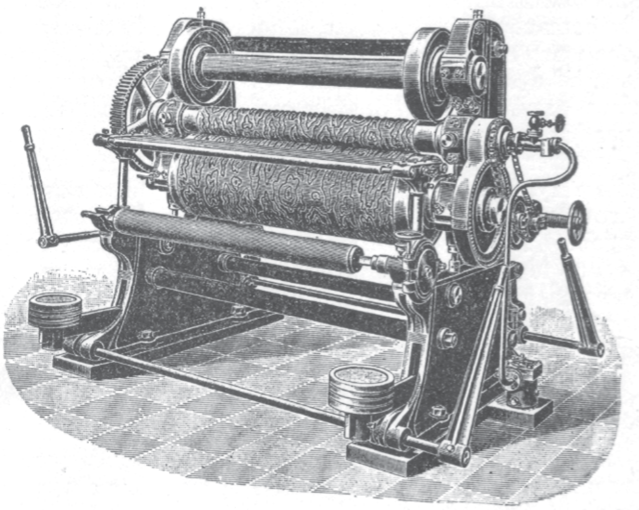

Fig. 12

metal roller is a proper unit of the paper roller, in order that the repeat of the design is properly taken up. Such an arrangement will suit for the handling of light textured fabrics, whereas for heavier fabric structures, the rollers must carry the pattern in prominent reliefs.

When prominently raised gauffré patterns are desired in the fabric, both rollers must be suitably engraved, one of the rollers carrying the pattern prominently raised on its surface and a matrix roller carrying the corresponding pattern engraved in low relief on its surface.

Rollers, as will be readily understood, are rather expensive, more so since every new pattern requires a new set of rollers, for which reason the patterns are engraved on shell rollers, of a suitable size to suit the repeat of the pattern, and which shells are then placed upon the plain mandrel rollers as carried by the calender, *i. e.,* gauffréing machine.

Gauffré fabrics, as will be readily understood, are easily affected by dampness, and when the rich embossed effect, which the fabric presents, will disappear.

The Yokohama market has registered a very active business at the beginning of this week, chiefly for American account, and prices have advanced 20 yen per picul. The restriction of cable communication is making itself felt grievously and the usual statistical details are not available.

SHANGHAI reports that the new crop has had a good start and holders in consequence are a trifle easier. There is a good demand for Shanghai rereels and considerable contracts have already been booked in steam filatures, particularly in full sizes. Tussah silks remain unchanged.

Effect of Contraction of Warp or Filling or Both, upon the Fabric.

There is a certain amount of contraction in yarn when converted into cloth, and in no case does the length of the cloth equal the length of the warp used, unless the length is drawn out in the finishing.

This contraction varies with the different weaves employed and the picks per inch. The contraction will be greater with the plain weave than with a satin or twill weave of the same number of picks per inch, since there are more points of interlacing in a plain than in a sateen or twill weave. Of two pieces of cloth of the same weave but with different numbers of picks per inch, the piece with the greater number of picks will have caused the yarn to contract the most.

There is no safe rule to go by in estimating the probable contraction, since the diameter of each count of yarn is different from that of every other count, and besides, there is a variation in the diameter of threads of the same count. There are rules used to estimate the probable contraction, but they are only approximately correct, as frequently the estimated contraction will be 1 or 2 per cent more or less than the actual result.

For practical purposes, a sample is the safest guide, and even then samples cut from the same fabric will vary, owing to unevenness in the yarn and varying tensions during weaving.

It is not alone in the warp that this contraction takes place, but also in the filling. At present we are not interested in determining the amount of contraction of the warp and filling, but in the effect that it has on the appearance of the cloth. The tension on both filling and warp yarns has an influence on the amount of contraction, and if the tension varies the contraction will vary, so that the width and appearance of the cloth will vary.

An important point frequently overlooked and neglected is the tension on the filling in the shuttles. Some loomfixers imagine that all that is required, is to have sufficient tension on the filling to prevent the pick from falling under the prongs of the filling, *i. e.,* centre stop motion fork. The greater the amount of tension on the filling, the tighter that thread will be drawn and the cloth made so much narrower.

In single box looms the variation in tension in the shuttles affects the cloth in alternate strips, but in pick-and-pick looms, or looms with drop boxes on one side, the variation occurs every other pick, or at short intervals.

In cotton goods, the contraction of the filling may not affect the appearance sufficiently to attract the attention of the casual observer, but when combined with excessive tension on the warp, the width of the cloth will be so materially affected that it will be noticed at once.

In connection with woolen goods, this contraction affects the fulling and gives the cloth an uneven appearance, which is attributed to uneven shrinking. In all probability the filling is all of one mixing, and will shrink evenly. The uneven tension on the filling is brought out prominently by the fulling, and the finished cloth has not that smooth level appearance so much desired by the manufacturer. Slack tension on the warp yarn gives the cloth a raw appearance, while an excessive tension will draw it narrower than the required width. As the diameter of the warp beam decreases, the tension increases, and the cloth will be unfavorably affected, unless the tension is carefully regulated.