in perfect alignment with the back of box, and remains in this position while the shuttle is moving across, and while pushing forward the loose picks. The distance from the reed to the raceboard is the distance allowed for the forward movement of the picks, and other adjustments equal, this would give the maximum loop. The less distance the reed is moved forward, the less the length of loop. The reed is held in a strong wooden frame which is securely fixed to the upper ends of two vertical arms *A*, fulcrumed upon studs *B*, bolted to the lay swords *S*.

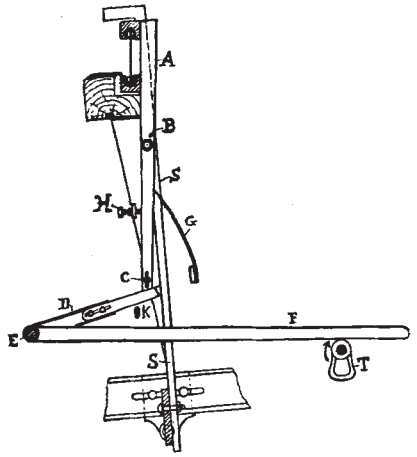

Fig. 16

At the lower end of arms *A*, there is an adjustable stud *C*, capable of being acted upon by the notched arm *D*, which is set-screwed upon shaft *E*, which extends across the loom inside the framing. Lever *F* is also fastened on shaft *E* midway, so as to rest on cam *T*, which for a 3-pick terry makes one revolution for 3 picks.

On the 1st and 2nd picks, cam lever *F* is down, as shown in Fig. 15; notched lever *D* is also down and out of the path of stud *C*, therefore vertical arm and reed are normal and beating-up does not take place.

On the 3rd pick, as shown in diagram 16, cam *T* lifts lever *F*, and raises notched arm *D*, so that it is opposite stud *C*, and as the lay comes forward the upper part of vertical arm *A* and the reed is given an additional move forward to drive the three picks to their position in the cloth, and form the loop. The lever *F* may be lifted by a chain, so as to permit of easy changes, or it may be lifted from the dobby. The flat bow springs must be strong enough to press the vertical arm against the adjusting stud *H*, yielding on the beat-up picks. By means of said stud *H* the reed is adjusted to be level with the box-back. The times terry or forward movement of the reed in beating up may be increased or decreased by loosening bolts, and sliding lengthening piece *D* away from, or near to, shaft *E*. More time terry, or a longer loop, can be made with this motion than with the first motion mentioned and this with greater ease. There is always a space between reed and raceboard when the shuttle is passing across. In practice the shuttle does not run so true in this type of motion as in those with ordinary raceboard, particularly is this the case when there is more than 12 inches of reed space without yarn. As the shuttle meets the ground warp it rises and as it enters the box at the opposite side it has a tendency to shake in the box.

FABRIC ANALYSIS.

(Continued from August issue.)

Dissection of Woolens and Worsteds.

There is probably no branch of textile work which is more dependent upon practical experience for its accurate accomplishment than that of estimating from a finished sample of woolen or worsted cloth the original counts of the yarns employed, the ends and picks per inch, as well as the width in the reed the fabric should be set in the loom. In this they differ from cotton, linen and silk fabrics, which in finishing are not subjected to such severe processes.

The difficulty which arises in connection with woolens and worsteds, more particularly the first, is due to the extreme variations which occur in different makes of cloth, *viz:*

(1) in the loss in weight when subjected to the processes of scouring and finishing;

(2) in the amount of shrinkage in width and length from the loom to the finished state.

So far as regards the counts of yarns, the above influences more or less tend to neutralize each other, for while the shrinkage of the fabric makes each thread shorter, and therefore proportionately thicker and heavier in the finished cloth than it was originally, the loss in weight makes each thread proportionately thinner and lighter. The shrinkage of the cloth affects the setting, and the number of threads per inch in the loom must necessarily vary from the number in the finished cloth, according to the degree of contraction which takes place.

It is an easy matter to count the ends and picks per inch in a sample, and to estimate the counts of a given pattern, but beyond that no rule can be employed which is applicable to all cases. It is purely a matter of observation, coupled with the preservation of records of cloths which have already been made, and then of using the experience gained in this way in estimating the weaving particulars from a finished sample by working retrogressively.

Loss in Weight.

As a rule, the greatest loss is sustained during the scouring of the cloth, as it is in this process that the various impurities which are present in the piece are removed. These impurities consist of the oil which is added to the wool before spinning, and the sizing matter which is put on the warp; also a certain amount of dirt which has been contracted during the weaving of the cloth is removed, though this, of course, has no effect on the counts of the yarns.

The amount of each of these depends upon the character of the fabric. Thus, low woolen cloths, which are largely composed of shoddy, are usually heavy in oil, and may lose from 15 to 20 per cent and upwards during the scouring. On the other hand, yarn-dyed fabrics are free from oil, though there may be sizing matter on the warp, and, as a rule, they only lose from 2 to 5 per cent in weight. Woolen cloths of the tweed and cheviot type, made from mixture yarns, contain more oil than worsted fabrics, and frequently lose from 10 to 15 per cent in weight, while the latter lose from 5 to 10 per cent. Flannels should lose less in weight than the ordinary run of woolen cloths, as the yarns employed in their manufacture require to be fairly free from grease and dirt in order that a mild scouring agent may be employed.

A further loss in weight takes place during the processes of fulling, gigging and shearing; in each of these operations a small quantity of flock is produced, which varies in amount according to the condition of the fabric and the severity of the process. The loss is usually only a very small percentage of the weight of the piece, being greatest in faced fabrics of the doeskin and beaver type, which are heavily felted, wet gigged and slightly cut to even the pile. Clear-faced worsted fabrics, which are neither fulled nor gigged, suffer very little loss in weight after the scouring, since the flocks produced during the shearing process make no appreciable difference to the weight per yard of the piece; while the same remarks apply to fabrics of the cheviot type, which are only slightly fulled.

The difficulty of estimating the effect of the loss in weight on the counts of the yarn is made greater, owing to one series of threads being liable to suffer in the scouring and finishing to a greater degree than another. For example, in a botany worsted fabric backed with low woolen filling, the face yarns may contain no more than from 5 to 7 per cent of oil, while the low woolen backing yarn may contain double the amount. Again, (though this is of minor importance)

when such weaves as satins and broken twills are employed, the raising and shearing processes will affect only that series of threads which forms the face, except when the same finish is applied to both sides of the piece.

Shrinkage from the Loom to Grey Cloth.

In addition to estimating the length of warp and the width in the reed required to produce any given length and width of finished cloth, it is important that an accurate idea be formed of the dimensions of the cloth in the grey—(1) because the contraction of the material from the loom to the counter is variable, and (2) in order that a suitable degree of shrinkage, according to the desired result, may be allowed for in the scouring and finishing processes.

The variation in the shrinkage of the material from the loom to the grey cloth may be due to several causes. Yarns made from fine wools of the merino type are more flexible and bend more readily than those made from coarser wools. When a thick warp, coarse in the sett, is interwoven with fine filling, there is more shrinkage in width and less in length than when the warp and filling are equal in thickness, while the opposite is the case when a fine warp rankly set, is crossed with thick filling, though in neither case does this apply when the thick yarn is used solely for backing purposes. When a filling corkscrew or any weave of the filling-rib character is employed, the material contracts more in width and less in length than when a plain or ordinary twill weave is employed, while the conditions are reversed when a warp corkscrew or warp-rib weave is employed. A change in the weave frequently causes a change in the dimensions of the cloth in the grey.

For example: A piece of cloth woven with $\frac{3}{3}\frac{1}{1}$ 8-harness twill will (other things being equal) shrink less in width and more in length than if woven with a $\frac{4}{4}$ 8-harness twill, owing to the difference in the relative number of intersections in the two weaves, though, as will be shown later, this does not necessarily indicate that there will be a difference in the dimensions when finished.

As a rule, worsted fabrics shrink on an average about 7 per cent, and woolens up to 10 per cent, from the reed width to the grey width, and 5 per cent is the usual allowance for the take-up of the warp in weaving.

In warp-backed fabrics, if the backing weave be similar to the face weave, the contraction of the face and back warps during weaving is about equal; but if a loose sateen backing weave be employed, the back warp will shrink about one inch to the yard less than the face warp.

On the other hand, in a double fabric composed of a fine face yarn in a twill weave, and a thick backing yarn in plain weave, it is frequently found that the back warp contracts about one inch to the yard more than the face warp.

Scouring and Finishing Effect on Length and Width.

The scouring process, though primarily intended for the thorough cleansing of the piece without shrinking it, always causes a certain amount of contraction to take place in woolen and worsted fabrics, the degree of shrinkage varying from about 5 to 10 per cent, according to the class of material used. Also, the method of scouring which is adopted has some influence on the shrinkage, as it is found that when goods are scoured in the rope form, they shrink rather more in width than when the operation is performed in the open width scouring machine, in which the pieces are retained at full width during the process.

The fulling or felting process is applied to woolen fabrics and to some classes of worsted goods for the purpose of shrinking the cloth in length and width, and in order to bring up the felt or fibre to the face of the cloth. The extent to which the process is carried varies according to the felting capabilities of the wool of which the cloth is composed and the desired finish, but it is always practised to give permanent solidity and strength to a fabric, while no process gives greater wearing power.

The better classes of heavily-felted woolen fabrics made from fine merino wools, such as plain broads, doeskins, beavers, meltons, the heavier kinds of army goods, etc., are almost entirely dependent upon the success of the fulling process in laying the foundation of the required finish. The shrinkage from the dimensions of the cloth in the grey varies from 10 to 25 per cent, according to requirements, and during the process a bare, thready, flimsy and unserviceable texture is transformed into a firm, compact, full fabric.

The importance of having heavily-felted textures correctly set in the loom cannot be over-estimated. If the number of threads per inch are not sufficient, the goods are liable to full too quickly, and the required width is obtained before a sufficient quantity of fibre has been brought on to the face, so that the cloth is lacking in firmness and has a soft, spongy handle. On the other hand, if there are too many threads per inch, the goods will only full with great difficulty, and will cause the cloth to have a stiff, unkind handle; while if the defect be very great, the cloth may cease to full before the required width is obtained, with the result that the threads begin to chafe and become tender. In tweeds, costume fabrics, low woolens and worsted goods, the fulling is intended to give softness rather than firmness, the shrinkage varying from 5 to 10 per cent in the fulling process. Another important point to note is that if the felting be done in the fulling machine, it is possible, within limits, to so regulate the shrinkage in length in accordance with the necessary shrinkage in width that the exact weight per yard of cloth can be obtained.

The tentering process is employed to regulate the width of the piece, in addition to removing any creases which may have been formed during scouring or fulling. Fabrics are frequently shrunk during the preceding finishing processes rather more in width than is required, in order that the tension used for restoring the piece to its proper width will remove the creases. In the same way, in the tentering process it is possible, to some degree, to remedy defects arising from setting the piece too wide or too narrow in the loom.

For example: A non-felted fabric, set 67 inches wide in the reed, can be finished to the same width as a similar fabric set 64 inches wide in the reed; but if they are both of the same length in the grey cloth, the former will be longer when finished, owing to the difference in the tension applied to the two pieces. This is the reason why some fabrics are slightly longer when finished than they are in the grey; the tension which it is necessary to apply lengthwise of the piece in order to obtain the required width restoring in part the length which the warp contracted during the weaving of the cloth. If, however, it is necessary to tension the cloth very much in width during tentering, the length of the piece will be reduced.

The raising (or brushing) process has some influence on the length and width of the piece, because the tension, being usually lengthwise on the cloth, draws the latter out in length and causes a corresponding shrinkage in width. In the process of shearing, and in winding-on for blowing with steam or for boiling, or decatizing, the tension on the piece has the same effect, though it may be only to a small extent. It can be taken as a general rule, therefore, that with the exception of the tentering, the processes between fulling and pressing tend to increase the fabric in length and to reduce it in width.

Variations in Shrinkage of Typical Fabrics.

Worsted fabrics vary in setting from 62 to 72 inches wide in the reed, for 56 inches finished, according to the class of material employed, the structure of the cloth, and the required finish. A typical botany worsted fabric, finished with a clear face and without fulling, may be set about 65 or 66 inches in the reed; but if a slight fulling be practised (which is sometimes done in order to get increased softness of handle, and to improve the firmness and wearing quality of the cloth) it is necessary to set the same number of warp-threads 1 or 2 inches wider in the reed.

Fine Worsted Serge Fabrics are set from 63 to 65 inches in the reed for a bright, clear finish, but when the half-rough or vicuna finish (which is popular for serge fabrics, since it prevents the tendency of the cloth to glaze or shine under hard wear) is desired, the cloth should be set from 68 to 72 inches, according to the degree of fulling, *i. e.*, felting required.

In Woolen Fabrics there is far greater scope for variety of finish than in worsted fabrics, hence there is more variation in the shrinkage. Taking 56 inches as the finished width, the reed width varies from 64 to 90 inches and even wider, according to the class of material employed and the amount of felting required.

The cheviot finish (which is the simplest finish applied to woolen goods) should only slightly affect the density of the cloth, or the crispness of handle and brightness of color, which are the distinguishing features of a cheviot, are destroyed. The piece is usually set about 66 inches wide in the reed, and fulled about 7 per cent in width and length.

Woolen Cloths Finished with a Clear Face, such as buckskins, Bedford cords, warp ribs, etc., are made from hard-twisted warp to give clearness of weave effect, using a soft-spun filling of a good felting quality, to impart softness of handle to the fabric when finished. In order to admit of clear cutting, the goods are more firmly woven and more closely felted than a cheviot, being set about 68 inches wide in the reed, and felted about 10 per cent.

VENETIANS AND LIGHT COVERT COATINGS, when finished with a clear face, may be set from 64 to 66 inches wide; but if finished soft, with a draw of fibre on the face, more fulling is required, and the fabrics should be set about 2 inches wider in the reed than for a clear finish. The same widths in the reed may be employed for clear and soft Saxony finishes respectively.

MELTON CLOTH, a stout, strong overcoating fabric, is always excessively felted, and is set from 72 to 80 inches in the loom, according to quality. The same widths are applicable to doeskins, plain broads, Saxony cloakings and fancy woolen vestings, which are heavily felted and finished with a dress face. The beaver and box cloth are hard-felted fabrics, and require to be set from 80 to 82 inches in the reed; while in some of the heavier kinds of army goods, the felting is so excessive that the cloth in some instances is set 96 inches wide for 56 inches finished.

UNION FABRICS, composed of worsted warp and woolen filling, when produced in warp-faced weaves of a whip-cord character, usually require that the warp twill should appear on the face of the cloth as clear and as distinct as in a worsted; while the woolen filling, which floats on the back of the piece, should give the qualities of softness and firmness of a woolen. The felting is done entirely by means of the filling, the piece being tensioned lengthways so that the shrinkage in finishing is only in the width. The piece may be set from 68 to 72 inches wide, according to quality, for 56 inches finished.

DOUBLE-CLOTH VICUNA COATINGS composed of worsted warp and woolen filling are usually made with even sided 4-harness twill for the face weave, which, by bringing up the woolen filling, makes it possible to finish the fabric with a fibrous face. Here the shrinkage during filling is almost entirely in the width, and the fabric should be set about 70 inches wide in the reed.

FINE WORSTED-FACE FABRICS, which are backed with thick woolen filling to give softness and fulness of handle, also shrink more in width than in length, may be set from 66 to 68 inches wide in the reed, with about 5 per cent allowance for contraction of the warp.

FINE PIECE-DYED COATINGS, composed of worsted warp and cotton filling for the face, and backed with thick woolen filling, should be set about 66 inches wide in the reed, since the woolen filling permits of the piece being felted in width; but if the fabric be backed with warp, the piece should be set no more than 60 inches wide, as the cotton filling permits of very little shrinking.

Heavily-felted fabrics made with woolen filling and cotton warp should be set from 72 to 80 inches wide in the reed, according to the quality of wool which is used; but as the cotton warp does not shrink during finishing, the finished piece is usually as long or slightly longer than the grey piece. An allowance of 10 per cent or more is, however, frequently required for the contraction of the warp during weaving, owing to the thickness of the filling, which is usually employed.

Dyeing and Finishing Experiences in China.

By G. A. Haley.

In the course of some five years' work as technical representative in China for a firm of color makers, I had an opportunity of travelling over a considerable portion of that country and of visiting dye-houses in twelve of the eighteen provinces of the Republic.

The white man, at one time generally referred to by the Chinese as the *foreign devil,* and now usually known as a foreigner, holds a very privileged position in the country. Having decided to trade with the Chinese, and being unable to live as they live, he obtained concessions of land from the Chinese Government and proceeded to build settlements thereon.

The biggest centres of foreign trade in China are Hong Kong and Canton in the south, Shanghai, Hankow in Central China, and Tientsin in the north, and of these the largest and most important is Shanghai. These places contain perhaps three-quarters of the total white population of China, the remaining quarter being distributed in the smaller ports and up-country towns. In all these ports the foreigner has his own houses, offices, warehouses, clubs, etc.

By far the greatest proportion of the clothing used by the Chinese is cotton, the requirements of the country in cotton goods being supplied partly by the coarse native handspun and woven cloths, and partly by goods imported from England and to a lesser extent from Japan and America. Large quantities of sheetings, jeans, drills, and bleached shirtings are imported in the undyed condition, and subsequently dyed by native dyers, but considerable quantities of finer cotton cloths are imported in the dyed and finished state.

The Chinese are able to produce only a limited range of cloths, shades and finishes, and are dependent for very many of their requirements on the mills and dye-houses of America and England.

The fibre ranking next in importance to cotton, is silk and of which China grows some of the best.

With the most primitive spinning frames and hand looms, the Chinese produce a wide range of cloths and designs in silk. These goods are dyed and finished almost exclusively in that country.

Wool is worn only to a limited extent, although its use is spreading.

The industries of spinning, weaving, knitting, dyeing and finishing are carried on in China mainly by the same primitive methods which have been in use for centuries past, modified only by the introduction of coal-tar dyestuffs. Within recent years, however, several factories built by Europeans and equipped with modern machinery, have been erected in the country. A stage intermediate between these two extremes is represented by a large number of very small knitting, weaving and dyeing establishments which have been opened within the last decade, and which turn out considerable quantities of cotton socks, towels, and yarn-dyed cotton cloths. The cotton socks and other knitted goods are dyed after knitting, with sulphur or direct colors, whereas the woven cloths are yarn-dyed, mainly with direct colors of very ordinary fastness. In only rare instances are faster colors in use in these establishments, although a few of the more progressive were commencing to dye Para Red, Alizarine and Vat Colors for special purposes, such as towel headings required to be fast to washing and bleaching.

The centre of the cotton spinning and weaving industry on the modern factory scale in China is Shanghai, and here there are several large mills. Until two years ago none of these mills had a dyeing plant, but a large mill has recently put down bleaching, dyeing and finishing machinery, and has thus laid the foundation of a modern cotton dyeing and finishing trade.

In addition to the modern Shanghai mills, there exist in China four woolen mills and two cotton mills established by the Government with the object of supplying the needs of the army and navy.

The genius of the Chinese is seen to better advantage in its native surroundings—for dyeing in China is entirely an art and not a science. Dye-houses exist in every town and almost every village and hamlet throughout the length and breadth of the country.

In picturing a Chinese dye-house one must think of something very different from a dye-house in this part of the world. Steam boilers and engines, jigs and winches, Klauder-Weldon's, hydro-extractors and tentering machines, steam presses and calenders are all unknown and generally unheard of. As a rule one enters the establishment through a shop at the front, which is the show part of the premises, and acts as an office and smoke-room for the proprietor. The dye-house contains as a rule little more than a number of Indigo vats, one or two shallow iron pans used for heating water and for dyeing aniline colors, and a number of earthenware jars in which sundry steeping and dyeing operations are performed. A water tap is a rare luxury. If the dye-house is fortunate it may have a well from which the water is drawn up by hand. In the majority of cases, however, all the water used is carried in buckets by coolies from a neighboring stream or creek, and it is therefore easy to understand that water is a somewhat precious commodity which must be sparingly used.

Cotton material is dyed to a small extent in the form of yarn, but chiefly in the piece. To facilitate handling, the cloth is generally cut into lengths of not more than 20 yards.

Kier boiling, and, indeed, boiling-out of any kind, is completely dispensed with. Instead of it, the cloth is wetted and the size softened by steeping for 1 to 3 days in cold fermenting liquors which the Chinese refer to as *acid water.* The fermentation is obtained originally by means of bran, but as the liquors are kept indefinitely, a brisk fermentation is maintained from the starchy matters contained in the cloth. After steeping, the cloth is rinsed and immediately dyed. In dyeing with aniline colors the cloth is frequently dyed without any previous steeping. Large quantities of imported bleached shirtings, evidently heavily loaded with China clay,