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COTTON

Several plants, all belonging to the same genus "Gossypium", have their seeds covered with fibers which can be used for spinning. Although they are of the same genus, the plants do not look the same at all. The smallest grow in Egypt, Arabia, Persia and China. These plants are only about 2 or 2½ feet tall. The cotton grown in North America is more of a shrub up to 5 feet high. In India it looks more like a tree of a medium size from 10 feet up.

History. Cotton was probably known and used in China as early as 2000 BC, but it was never very popular there. It was also well known in India at about 1000 BC. It was imported to Greece in the 5-th century BC, but its cultivation did not start in the eastern Mediterranean until 300 BC. In the first century BC cotton was used in Rome but not cultivated yet.

Although there were attempts to grow cotton on European soil in the 2-nd century AD, it took eight more centuries to establish cotton cultivation in Spain and Italy, and anotherfive before it reached Balkan countries

Northwestern Europe (France, England) started importing cotton about 1200 AD. It was probably spun and woven for the first time in Germany in 1300.

In 1492 the first cotton is brought to Europe from Bahamas, and in 1520 - from Brazil. In the 16-th century cotton is spun and woven in France on a large scale, but the cotton industry did not reach England until the beginning of the 17-th. At about the same time (1619) the first cotton is grown in Virginia, from where its culture spreads all over the South.

In 1700 England tries to protect their wool industry by forbidding the use of cotton, but this law is repelled 36 years later.

The first cotton has been exported from North America in 1753. In 1800 the total production of cotton in United States was about one thousand tons, of which one hundred was exported. The present production in USA is more than 3 million tons - half of the total world production.

There is no doubt that cotton has been cultivated, spun and woven in Central and South America for centuries before the first white colonists, but the chronology of events in this part of the world is extremely uncertain, and we can only surmise that cotton could be grown there even before the Christian era.

Physical properties. The quality of cotton depends on the length of fibers. The longest fibers of nearly 2" has the Sea Islands cotton. Then comes Egyptian variety with fibers about 1½", then the American cotton (around 1"), and finally the Indian cotton of lowest quality and with shortest fibers (½" to 1"). There is a strange relationship between the size of the plant and the quality of the fibers: the taller the plant the poorer the cotton.

In America the best is probably the Gulf Cotton grown in the States around the Gulf of Mexico.

The thickness or diameter of cotton fibers does not change as much as their length - it is always around 7 or 8 tenthousandth of an inch.

The cotton fibers are flat and twisted. The colour of American cotton is white; Egyptian is yellowish, and Indian - greyish.

Cotton has lower tensile strength (resistance to breaking) than silk, ramie, or linen of the same size. But it is stronger than wool. Damp cotton is stronger than dry cotton. It has a very high resistance to friction, and it is quite elastic (6 - 7%)

The count of cotton is based on No.1 being 840 yards long. A higher number indicates how many times the yarn is finer. For instance No.300 has about 150 miles of yarn in one pound. In metric system the number indicates the meters in one gram of yarn. To convert the number of cotton in metric system into the English one, we multiply the former by .59.

Chemical properties. The chemical composition of cotton:

Fiber	83.7 %	Mineral ash	1.7 %
Water	6.8 %	Protein	1.5 %
Nitrogen	5.8 %	Fat	.5 %

Cotton does not dissolve in concentrated caustic soda ($NaOH$), nor in saturated hot solution of soda ($NaCO_3$), but it dissolves in acids.

Processing of fibers. When cotton is picked the fibers stick to the seeds, and they constitute only about 30% (by weight) of the whole crop. Thus the first operation after picking is to separate the fibers from the seeds. This is called Ginning. The fibers are carded before spinning, but exceptionally good cotton is often combed as well. The best cotton can be spun into a very fine yarn - as fine as No.450. Egyptian cotton - up to No.90. Indian cotton only up to No.20.

Mercerizing. If a cotton thread or finished cotton fabric is treated with cold saturated solution of caustic soda, it changes its appearance and its properties as well. The fibers swell to the point of becoming cylindrical. There is a considerable shrinkage, but since the mercerization is done when the threads are stretched, this shrinkage results in straightening of all fibers. At the same time the fibers become half-transparent and shiny. In result we have yarn which is smoother, more shiny, heavier, and stronger than plain cotton.

Besides mercerizing there are other methods of improving the appearance of cotton. It can be glazed with wax and glue. It can be treated with diluted nitric acid to ressemble wool, or with solution of fibroin to make it look like silk.

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SETT OF WARP FOR HEAVY YARNS

The existing tables or formulas for setting the warp are very often of little use to the modern craftsman because the yarns we are using now are much heavier than the ones used in traditional weaving. The table which we published in MW No.8 is for medium counts of yarn. It does not give good results for grists below No.5. The table which we publish this time is really the right hand lower corner of the former table enlarged several times.

We must repeat here that there is no such thing as the "best" sett of warp for any given yarn and weave. The sett depends first of all on the kind of fabric we want to produce. The closer the sett, the firmer and stiffer the fabric. The more open it is - the softer and weaker the cloth. We cannot go too far in either direction however.

The curves given in the table are for a rather open fabric. The number of ends per inch may be therefore increased safely by as much as 25%, if firmer texture is required. One curve shows the sett for tabby, and one for twill. But since there are so many other weaves here are a few suggestions as to the corresponding setts:

The same as tabby: all weaves with solid tabby background such as huckaback, spot, bronson. Swivel may be set a little closer.

The same as twill: basket, waffle, solid lace without tabby.

Pattern weaves with tabby binder (overshot, crackle, summer-and-winter) - about 10% more open than tabby.

Higher twills whether turned or not, of the type: 1:3, 1:4 etc., satins, damasks - the sett must be closer than the one given for the twill. The higher the number of the twill or satin - the closer the sett.

Warp face fabrics (rep, etc) - sett about twice as close as for tabby.

Weft face fabrics - sett more open than for tabby, but it depends on the yarn used for weft. For instance satinet with the same yarn for warp and weft should have a sett about 25% more open than tabby.

Double fabrics have the sett exactly twice as close as the sett for a single fabric of the same kind.

Now, how to use the table? First we decide on the yarn and the weave. Then we find the number of the yarn on the horizontal line at the bottom of the table. From this point we draw an imaginary vertical line until it meets the curve which corresponds to our yarn and weave. From the point of intersection of this line with the curve we draw another imaginary line, but horizontal this time, toward the right hand border of the table and find there the sett of warp.

For instance if we weave place mats in linen No.1½, and we decide on tabby, then in the table we shall find the answer on curve No.4. No.1½ is half way between No.1 and 2. From this point we look up to the curve No.4, and from the curve - to the right. We find our answer: 10 ends per inch.

When we work with yarns without number, we must find out first how many yards per pound has our yarn and then divide it by 840 in case of cotton, and by 300 in case of linen, ramie etc.

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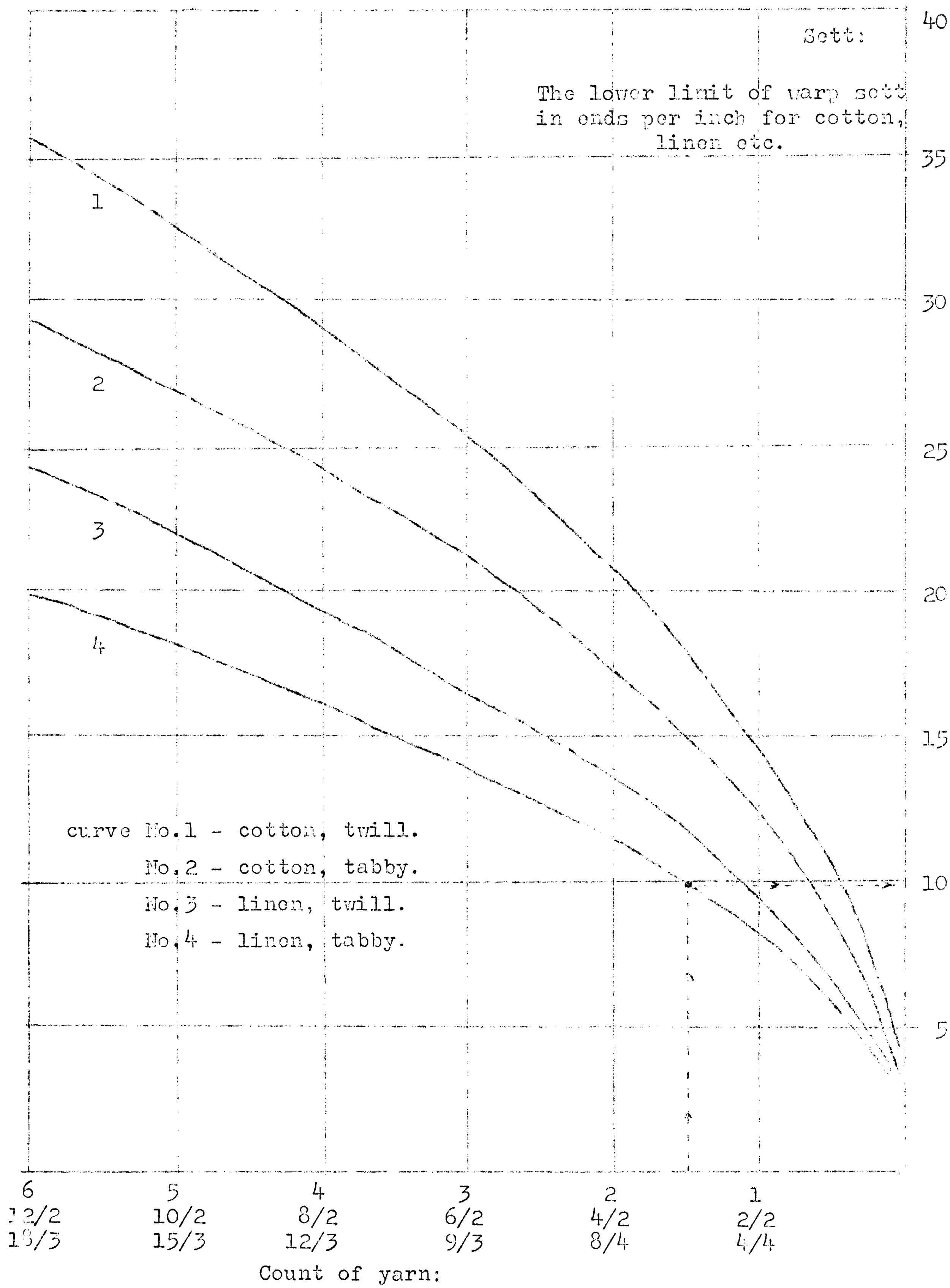
Sett:
The lower limit of warp sett in ends per inch for cotton, linen etc.
40
35
30
25
20
15
10
5
1
2
3
4
curve No.1 - cotton, twill.
No.2 - cotton, tabby.
No.3 - linen, twill.
No.4 - linen, tabby.
6
12/2
18/3
5
10/2
15/3
4
8/2
12/3
3
6/2
9/3
2
4/2
8/4
1
2/2
4/4
Count of yarn:

CHENILLE

or Twice Woven Fabric.

Chenille (literally "caterpillar") is a weave which gives a very heavy pile fabric. It may be made as heavy as wanted - even inches thick, but it cannot be made very light. Consequently we use this technique most often to make rugs.

The pile is in the weft. But it does not mean that the weft is made into pile, as in corduroy. Here the weft itself already has a pile. The weft is composed of a "core" or a bunch of several very fine and strong threads, which are interwoven at right angles with comparatively short pieces of soft, heavy yarn (fig.1). These short pieces will form pile later on. Their length may be from one quarter of an inch to one inch or even more.

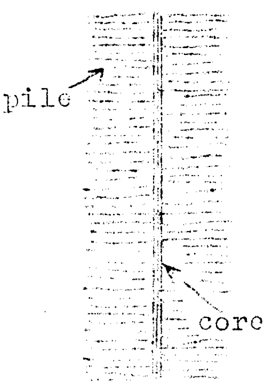

Fig.1

This weft is called also "chenille", because of its likeness to a caterpillar. It may be flat as in fig.1, or twisted so that it becomes completely round with the pile pointing in all directions, and the core completely invisible.

The round variety can be bought in different sizes and colours, or it can be woven at home. The flat chenille weft is usually hand-woven.

Whichever of these wefts we use, the final weaving of chenille fabric is done on a heavy, but very open warp. Since the warp is (or should be) completely covered with weft, there is no point in using any other weave but tabby. We shall speak later about the exceptions. Binder is used optionally.

It is worth while, first - before we shall start describing different weaving operations in detail, to consider the texture of chenille fabrics. Fig.2 A shows a cross-section of a fabric woven with flat chenille weft. "W" - is the warp, "P" - pile, "B" - binder, and "C" - core. Here all the pile is either above or below the warp. The fabric may be very thick, but will have a comparatively smooth surface on both sides, as long as the length of pile in the weft is reasonably uniform.

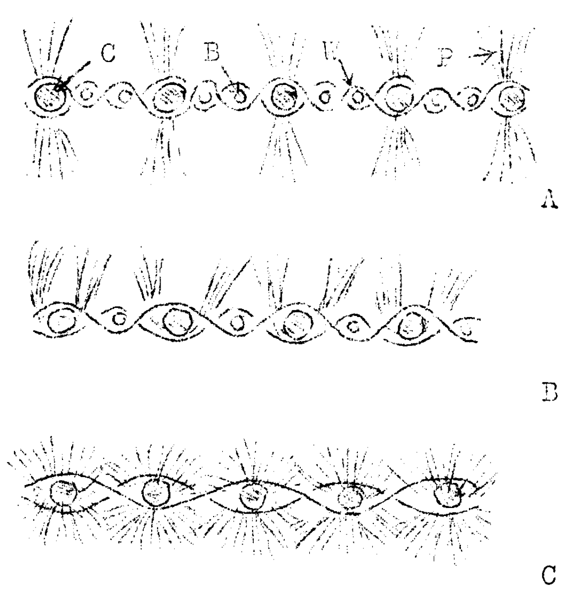

Fig.2

If we can manage to get all the pile on one side of the fabric (by methods described later), then the fabric looks as in fig. 2 B. The surface will not be quite so smooth, but there is the obvious economy of material for the pile - 50% to be exact.

When we use round chenille weft it is impossible to get all the pile out of the shed (fig.2 C). Some of it will be crushed by the batten, and interwoven with the warp. What effect has this on the fabric? First of all the shots of weft will not be woven as closely as in the first two cases. Then they will keep to a certain extent their cylindrical shape, so that the fabric will be ribbed in the direction of the weft.

The last kind of chenille (the round weft) is the fastest in weaving, the first (flat) comes next, and the second (pile on one side) is the slowest.

Thus if the woven piece is an imitation of a knotted rug we must use either the first (fig.2 A), or the second (fig.2 B) method. If it is "just chenille" then the third one will be the most economical.

We may mention here that there is a fourth possibility: if we start with the first method, but weave it rather fast and carelessly, then a part of the pile gets imprisonned in the shed and the resulting texture is very uneaven, so that in places the warp will show, and the pile will be of varying length. However this "method" is not justified since it gives results inferior to the third one (round chenille) and is not any faster.

It was necessary to make this survey of chenille fabrics, because the choice of weft to work with, depends on the final effect desired.

Chenille Weft.

As we mentioned already, certain varieties of chenille weft can be found on the market. These are usually rather fine, and not suitable for heavy rugs. And in any case we are more interested in the weft which we can make at home. The latter has many advantages, and one of them is, that hand-woven chenille weft is the only suitable for pattern rugs.

The weaving itself of chenille weft is comparatively simple. But before we start, we much plan very carefully. The first consideration is the thickness of the rug, or the length of the pile. Then the yarn to be used. Finally the quality of the fabric.

Let us suppose that we are weaving a rug with pile 1" long, all in one colour. Wool for the pile. Quality as good as we can make it.

We have to be a little careful about the yarn for the pile, because we shall need large quantities of it. The wool does not need to be high grade (it is cut into short pieces anyway), but the colour must be fast, or at least not fading. Whether it is "boil-proof" or not is immaterial - nobody boils rugs. Thus, good "domestic" wool for about ∅ 2.- a pound is the best proposition.

For the first warp - the one which later becomes the "core" of the chenille weft - we can use either fine cotton, or single linen. Linen is much better - first it does not slip easily, making the core more compact, - second it does not pull the edges in, which is particularly important in pattern rugs weaving. But of course one must be familiar with handling of single linen warps (MW No.1). If it is linen - No.18 to 25 will be the best. Cotton No.16/2 to 20/2 will do. Never use mercerized cotton for this purpose. Colour should be neutral: natural for linen, beige or grey for cotton. Or it may be the same as the colour of the pile.

Now we figure out our warp. We shall weave several strands of chenille weft at the same time. The wider the first warp - the more weft can be made. If the pile is 1 inch long on each side of the core, then each strand of weft is 2" wide. We shall use 8 or 10 warp ends for the core, so the warp will have as many ends as strands of weft multiplied by 8 or 10. Let's make it 10 in the present case.

The threading is plain: 1,2,3,4. The sleying is different however: we sley 10 ends in one dent of a No.12 reed, then skip 23 dents, then again pass 10 ends in one dent, skip 23 dents, and so on. These 10 ends of warp in one dent will form the core of the weft.

The length of the warp depends on the quantity of chenille-weft required. If for instance we intend to weave a rug 30 by 50 inches, and there are 4 shots of pile weft per inch, the total length of weft is: 30 x 50 x 4 = 6000" = 500 feet.

Now, if we have the first warp 24 inches wide, it means that we are going to weave 13 strands of the chenille weft at once (see fig.3). However, the first and the last strand will be useless, since they will have the pile on one side only. This leaves us 11 strands. To find out the length of our warp we divide now 500 by 11 which gives about 46 feet. We must add as usual about 10% for the take-up and about 2 feet for the wastage: 46 + 5 + 2 = 53 feet. This is the total length of our warp.

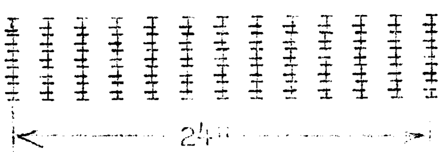

Fig.3

The warp being beamed, threaded, and sleyed we can start weaving the pile weft. First however we have to decide on the number of threads of the pile yarn to be used. We can of course use it singly. The pile weft will be very flat and the pile quite strong. But the weaving of the chenille weft (the first weaving), as well as the weaving of the rug will be rather slow. If we use two, three, or more threads for the pile weft, the first weaving will be much faster, and the second weaving not only faster, but easier as well. With wool 2/4 (1120 yds/lb) we can use as many as 8 threads together. Here as everywhere else the same principle applies: the faster and easier the work - the poorer the quality.

For single or double wool we can use plain shuttles. For heavier pile-weft larger shuttles will be better, because they hold more weft. In any case we cannot weave without certain precautions being taken. The weft cannot turn tightly around the first and last strand of warp. If it does it will climb very rapidly on both edges (fig.4). The beating will be difficult, and eventually the ends will start breaking. For this reason we shall have to leave fringe or loops about 1 or 2 inches long - on both sides. They do not need to be even. The fastest way of making them is to catch the weft around the little finger just before throwing the shuttle, and hold the hand close to the edge, as long as the shuttle is in motion. When it stops we release the fringe and beat.

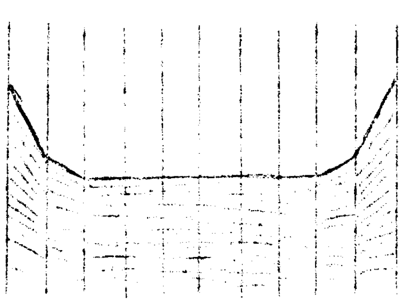

Fig.4

We may notice that groups of warp sleyed each in one dent spread a little when the weaving continues, particularly the first and the last end. This effect is of course not desirable. The more the warp spreads, the more difficult will be the second weaving. To prevent spreading we select yarns which stick to each other by friction. Thus we must avoid smooth and slippery yarns, particularly for warp. Rayon or mercerized cotton are out of question. Single cotton No.10 instead of 20/2 would be preferable, and single linen still better.

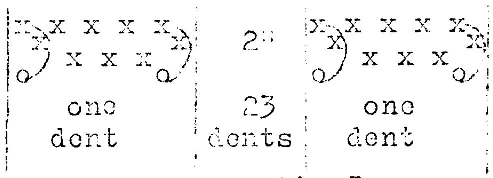

Fig.5

The first and last pair of warp ends in each group can be woven in leno, as in fig.5. In theory this method is very satisfactory, but in practice crossing of warp ends in such a close setting is not so easy. It is worth trying however. In this case we would not use linen because of the tension necessary to open the leno shed.

Once the whole warp is finished, we do all we can to avoid handling the web (we can hardly call it "fabric"). We roll it tight and keep it rolled until we are ready for cutting. We put the roll on a chair on one side of the table, unroll a yard or so and spread it flat on the table. With sharp, long scissors we cut <u>all</u> strands of chenille weft, exactly half way between the cores (groups of warp). Then we move the web forward, letting the cut chenille hang from the table and collect on the floor, and repeat the cutting. Of course one cut is only as long as the table is wide. The chenille weft on the floor will not tangle unless we shall step on it. We proceed with cutting until the whole web is finished.

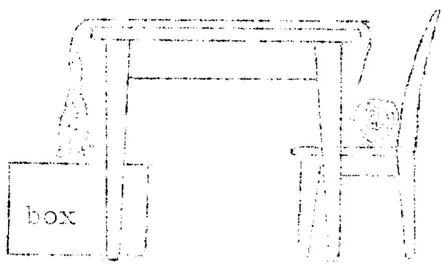

Fig.6

In result we shall have 11 strands of pile weft, each about 46 feet long. These strands of weft should be immediately after cutting rolled tight on pieces of heavy cardboard, and kept until needed.

Another method of preserving the pile weft is to put a large cardboard box under the table (fig.6) before cutting, and let the weft drop in this box. One should not try to arrange the weft in the box in any way - it should stay there the way it has fallen. Then the box can be closed and kept until the second warp is ready, and the pile weft needed for weaving.

The weft woven in leno as in fig.5 is much more resistant and does not need to be handled so carefully.

When weaving the final article, a rug in our case, the warp should be very open. We can use carpet warp or linen No.4 or 6 (or 8/2 to 12/2) set at about 8 ends per inch. Since there is no take-up on the weft (or hardly any), there is also hardly any tendency to pull in the edges, and the warp may be of the same width as the finished rug.

The weft is wound on flat shuttles. One should try to get as much of the weft on the shuttle as possible. Thus large shuttles are indicated. The shuttle is passed through the shed. Then the weft is straightened, so that half of the pile points up and the other - down. We beat very slowly observing the pile. If it has a tendency to twist and consequently to be beaten into the shed instead of projecting outside, we may use a comb to straighten it up. Still better method consists on using a flat stick about half as wide as the chenille weft (1" in our case), about 1/8" thick, and as long or longer than the width of the warp. We keep the warp at a very low tension, and beat first through this stick (fig.7), so that the pile will get through the warp on both sides. Then we remove the stick and beat again, this time hard.

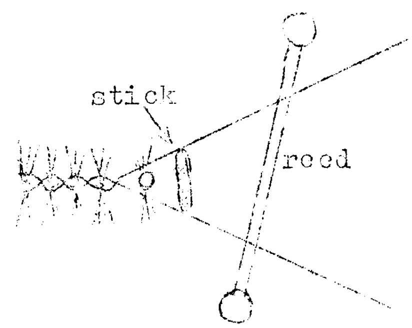

Fig.7

If we want all the pile on one side, the only way to do it is to comb the pile upward. We use the stick again but this time we keep it flat under the pile weft (fig.8) to prevent the pile from getting through the lower layer of warp in the shed. With the stick in the shed we comb the pile until all of it points upwards. Then we remove the stick and beat. Here we shall succeed only with comparatively long pile. A short one will return to its natural downward direction as soon as the stick is removed.

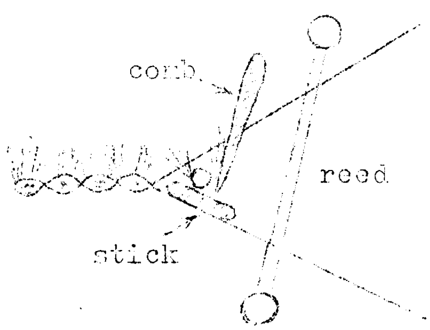

Fig.8

The third method of weaving (with a round weft) does not require so much attention. First we establish by experiment the length of weft our shuttle can carry. Then we measure and cut this length from our stock of chenille. We attach one end to a doorknob, a nail, or anything at all, and then twist the other end until the whole length is more or less round. Then we wind it on the shuttle. The weaving itself is as simple as any one-shuttle weaving, and of course quite fast, but the result not so good.

Binder may be used in the first two cases (pile on both sides, or on one side only), but not in case of round weft, or commercial chenille which is nearly always round.

The purpose of the binder is not to reinforce the fabric - it is quite strong without binder, but to spread the pile farther apart. Consequently fine binder is out of place. It should be as heavy as the yarn for the pile (but used singly), and of the same colour. The obvious conclusion is to use the same yarn for pile and for binder. The number of shots of the binder between rows of pile depends on how thick or thin our pile is supposed to be. It can be found out only by experiment.

So far we have been discussing rugs of one colour only. But several colours can be introduced without changing anything in the process. For instance when weaving the first warp, we can change the colour of the pile weft from time to time. Let us say that we shall alternate three colours, either quite irregularly or every inch or so.

The result in the second weaving will be hit and miss. The rug will have a mottled appearance. The colours will be more or less evenly distributed all over the fabric, as in fig.9 A. However if we change colours in the first weaving only every 6 or 12 inches, the rug will have a general appearance of striped fabric (as in fig.9 B). The longer the same colour is used in the first weaving, the more striped is the rug. To get solid stripes all across the rug, we have to keep weaving the same colour for a distance at least as long as the width of the rug.

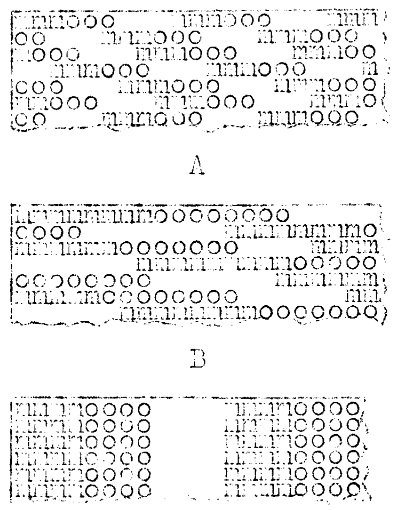

Fig.9

We can have vertical stripes also, but these must be "planned". For instance if our rug is 30 inches wide we may change the colours in the first weaving every 5 inches. On a space of 30 inches we shall have each colour repeated twice. But we shall have to reverse the order of colours every 30 inches, because in the second weaving the direction of the weft is also reversed every 30 inches. Thus we shall have: black, red, white, black, red, white (5 inches of each), and then: white, red, black, white, red, black. In this way the black will always be under black, red - under red and so on.

From this stage there is only one step to the pattern rugs; rugs woven in chenille in practically any pattern. But here the technique must be slightly different. Instead of a continuous chenille weft, we use only short pieces of weft - each as long as the rug is wide. We shall speak about this method in the next issue of MW.

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FROM THE CLASSICS

CHENILLE - by C.G.Gilroy (1844).

The ingenious Alexander Buchannan, of Paisley, Scotland, invented this beautiful fabric, about the year 1820. It derives its beauty and lustre from the peculiar mode of preparing the weft, and the manner in which the colours are afterwards arranged; in so much that a pattern which would require a large harness, as an imitation shawl, can be woven without any other apparatus than a ground mounting and two treadles.

It appears to us, that no person who is unacquainted with weaving can have any idea of the variety and ingenuity of its processes; and even some individuals who consider themselves masters of the art, know, comparatively, very little about it. Notwithstanding the apparent perfection of the methods employed in producing some of the fancy textures which we have already described, yet, we have to record improvements of immense importance upon several of them.

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DRAFTING.

It is obvious from the last lesson that we cannot write a threading draft in full. If we have a warp of 1000 ends, then marking each heddle on a graph paper with 10 divisions per inch, would give us a draft 100 unches or more than 8 feet long.

Thus a practical threading draft is always abridged. For instance, in the last lesson (page 9, fig.10) the main pattern is repeated 31 times, but only one repeat is given, which makes this part of the draft already 31 times shorter than the complete threading.

The first principle then of shortening a draft is to divide it into a number of identical repeats. But it may happen that there are two or more different repeats even in the main pattern, as in fig.1. First we have a small pattern in diamond twill which is repeated 5 times (from D to C). Then comes a pattern in overshot taken 3 times. But then both these patterns are being repeated 15 times as indicates a number below. Thus the main pattern is composed of two repeats: D to C, and C to B. Each of them is taken a different number of times, and they both together form the main repeat: from D to B. The latter is repeated 15 times. Then to balance the pattern we have the part of the draft from B to A - threaded 5 times.

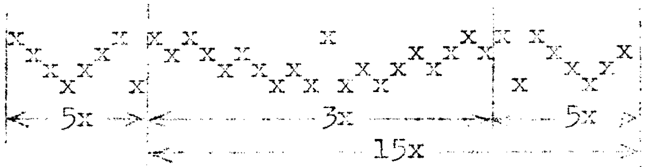

Fig.1

When we want to figure out the total number of ends necessary for this draft, we start with the main repeat from D to B. This is composed of 8 ends (D to C) taken 5 times or 40 ends, plus 20 ends (C to B) taken 3 times or 60 ends. Together 40 and 60 gives us 100 ends for the main repeat. Since this is threaded 15 times - we have a total of 1500 ends. To balance the pattern we have the draft from B to A (8 ends) taken 5 times or 40 ends. So in all we have 1540 ends.

Actually on the draft we have only 36 heddles marked instead of 1540. Such a draft can be justly called short, although the term Short Draft is usually applied to drafts still more abbreviated.

What often happens in practice is that the main draft cannot be divided easily into short, simple repeats. For instance the part of the draft from C to B may be much longer - it may have more than a hundred ends. In such a case if the draft is symmetrical, we can draw only one half of it, and at the very center mark it: REVERSE. This means that from this particular point we start threading in reverse. The central heddle of the draft is not repeated. For instance:

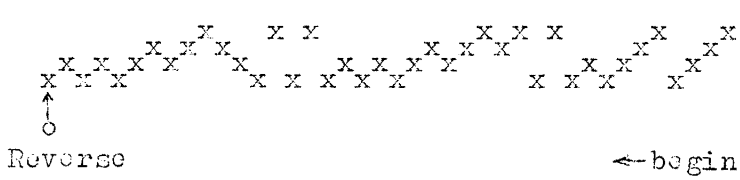

Fig.2

In this case it is advisable to indicate clearly from which direction the draft should be read. Although it is customary on this hemisphere to read from the right, most drafts can be read from either direction. Here however there is only one way. When we come to the last heddle marked "Reverse" we go back to the last but one and so on. Fig.3 gives the second half of the draft:

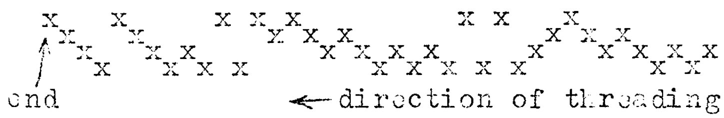

Fig.3

Overshot weave is about the only one in which the threading draft cannot be shorten any further, without using a special method which cannot be applied to any other weave. We shall see later how to deal with other weaves.

Overshot produces floats of different length, and these floats make the pattern. Thus if we can indicate only the position and the length of floats, we shall have enough information to make the full threading draft. By the position we mean the combination of heddle-frames: 1-2, 2-3, 3-4, and 4-1. By the length - the number of warp ends the float skips. Thus the draft on fig.4 can be represented as on

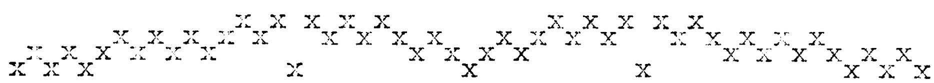

Fig.4

fig.5. The first, lowest line on this new draft means floats produced by the combination of frames 1 and 2. The second: 2 and 3, the third: 3 and 4, and the fourth or top line: 4 and 1. Instead of "x" as in plain threading draft we use now numbers. Each number indicates how long is the float. The first float starting from the right will be made on frames 1 and 2, and it skips 6 warp ends. Thus we place 6 on the lowest line of our new short draft. The next float is on 2 and 3 and it's length is 8. Then comes one on 3 and 4, long 4. And so on. In practice making such a short draft means circling with pencil (or in imagination) groups of heddles on two adjoining heddle-frames. These groups will always overlap one another by one heddle. Then in the short draft we mark: 1-st - the position of the group, and then the number of heddles it contains.

4-1		3		3	
3-4		4 6		6 4	
2-3	8		4 4		8
1-2	6		3		6

Fig.5

Later on we dispense with the numbers of frames marked on the left in fig.5, and the draft will take less space as in fig.6.

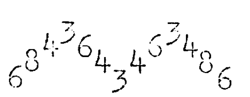

Fig.6

To reverse the procedure - we have a short draft and must develop it into a full threading draft. We take a piece of graph paper, and start marking heddles alternately on frames 1 and 2 until we have 6 of them. But should we start on 1 or 2? The short draft does not say which. The simplest way is to try. If we start on 2 we shall have 7 and not 6 heddles by the time we come to the next float, or the two floats will not match i.e. there will be a gap in threading. Thus we can start on any of the two frames and if the first float turns out to be too long, we simply erase the first heddle. This is the only difficulty. The following floats present no problem.

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