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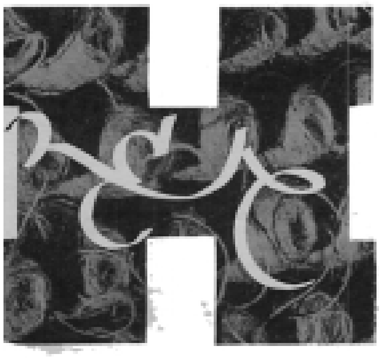

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July - August 1959 No.46

THE STORY

OF THE TECHNOLOGY OF HANDWEAVING - 2.

When speaking about the history we must disregard primitive weaving, not only because its chronology is uncertain, but it is also different for every country. What was long forgotten past for India, is the present for American Indians, and both may be a distant future for New Guinea.

The countries which knew industrial weaving (i.e. done by specialised craftsmen to supply the needs of a large community) were: China, India, Egypt, Greece, and Rome. Smaller countries bordering on these large centres of civilisation were surely partaking of their technical achievements and do not need to be considered separately. Europe, or at least central Europe is a problem and we shall discuss it after Rome.

China discovered quite early the silk worm, and the extreme finess of this yarn required appropriate weaving methods. No amount of patience could produce fine silk fabrics without shedding motion and without shuttle. Thus China seems to the motherland of modern handweaving.

India probably got the idea of a foot-power loom from China. In the Hindu version it was a dugout in the ground. The weaver sat on its edge with his feet in two stirrups which activated the shafts. The loom frame was made of bamboo sticks simply planted in the ground but it contained all the essential parts of our modern loom.

Egypt never came anywhere near the technical perfection of the Far East. There were two types of looms: one vertical, and one horizontal. Both had lease-rods, but at first only one tabby shed could be open by following the lower lease-rod: the other had to be picked-up. Later on there is a heddle-stick for the other shed of tabby. Beating was done with a flat stick. Shuttles if any were of the flat type. There is no evidence of shedding motion operated by treadles, stirrups, or levers. But they had a cloth beam, and the warp could be much longer than the loom itself, although it was not wound on a warp beam.

Greek looms were still more primitive than the Egyptian ones. They were always vertical. The cloth beamm was at the tope between two uprights. The warp hung from it and was wound around stones or special weights made of clay. As the weaving proceeded the warp would be unwound from these weights. The beating was done upwards, which must have been particularly awkward. No evidence of any shedding motion, or even of heddle-sticks.

As far as the Mediterranean area is concerned we have the following picture: 2,000 BC and probably much earlier we have in Egypt a horizontal frame loom (the warp stretched as on a sample frame). This loom slowly disappears and is replaced by a vertical model of a similar design (the warp is not weighted). It is possible that this loom came to Egypt from Syria. Greece uses only vertical looms, but with weighted warp. Rome adopts later on the Greek loom. In the meantime the vertical Egyptian type travels west and north, when the Greek loom which as we already have mentioned became "official" Roman type, enters Egypt with the conquerors.

In the fifth century the Greek loom disappears from the Mediterranean basin; the vertical Egyptian takes its place and remains in universal use until the tenth century, By this time it was slightly improved: both cloth and warp were wound on rollers, and the sheds were opened with heddle-sticks with doups. But still no treadles, and no shuttle which could be thrown.

At about the same time appears a new type of weaving loom: horizontal with two and then three shafts operated by treadles. This third shaft constitutes a very important development, because it made possible weaving of twills. It is said that this invention came from Syria, but it is rather unlikely, because the 3 shaft loom was very soon followed by 4 shafts and even by the draw-loom. Obviously it

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was not a local development, but a "break through" from the Far East. As we shall see later the same type of foot-power loom was known at about the same time (the tenth century) much farther north in countries which had no relations with Syria.

It seems that when the foot-power loom travelled all the way from China to the Western Europe, the vertical loom went in the opposite direction and was adopted in China for weaving tapestries.

How sure are we of our facts? Most of it is pure speculation, because the earliest "proof" of treadle loom being used in Western Europe comes from the 14-th century! But the analysis of fabrics, interpretation of texts, pictures etc, give us a pretty good picture of what was happening.

But the situation north of the Mediterranean is not clear at all. For instance if we can trust Julius Caesar it seems that England did not know weaving at all, but France (Gallia) at the same time already produced twills on a commercial scale. Would that mean that the foot-power loom was known in Western Europe in zero AD? This is extremely unlikely. Yet, we know that the foot-power loom came to the central Europe earlier that to the Mediterranean basin.

In pre-roman times we find vertical looms with weighted warp (Greek type) nearly everywhere. Iceland, Scandinavia, Switzerland, Poland, Germany. But they disappear long before the tenth century, and are immediately replaced by the "modern" horizontal looms, with treadles, shafts, and shuttles. A shuttle used in Central Europe in the tenth century looks exactly like the shuttle we are using now.

Now, what happened? Why the weighted warp was not followed by the vertical frame loom, as in the South of Europe? Where are the intermediary stages?

Obviously here again the development was not of local origin, and the looms came from the same source as the foot-power looms which invaded the Mediterranean area, i.e. from the Far East. How the idea travelled - we cannot even start guessing. But the best proof that the modern loom was not invented in central Europe is, that once it was established there, it remained in its original form for nearly a thousand years! Surely if the local craftsmen were so gifted, that they could bridge the gap between the Greek loom and the foot-power loom without going through other stages, then they would not stop there, but kept developping this particular model. Yet no material changes in the construction took place during some ten centuries, exeept when there was an obvious influence from the outside

The eleventh century must have been to the weaving world, what the twenteeth is to the science. The dvelopments (we do not use the word "discovery") followed one another at such a rate that now we cannot visualise the whole process. The Draw-loom appears in Spain at the same time when in other coutries of the Western Europe even the four-shaft foot-power loom is unknown. With the improved conditions of trade, weaving technology spreads everywhere and becomes stabilised in the following centuries. Then nothing much happens for a long time. There are local variations of the pattern and yarn, there is a trend toward very elaborate tapestries, quite independent from the development of the draw-loom. The factor of efficiency does not come into consideration. The best weaving is done leisurely with complete disregard of cost and time.

The first sign of the impeding decline of weaving is the invention of the flying shuttle (beginning of the eighteenth century). Its purpose was to make possible weaving of wide fabrics by a single weaver. But once invented, it has been used also to speed up the whole process.

Jacquard could be called the spiritual father of power weaving, but he was also a gravedigger of the Craft of weaving. His machinery for the first time could produce any length of most complicated fabrics, and any number of most elaborate pieces, provided that they were identical. Thus the mass production started long before the invention of the power loom.

Handweaving as a profession declined very fast under the pressure of the power loom, and and it died out in the first half of the nineteenth century. It survived in poorer or more conservative countries for another century. Then came the revival of handweaving.

It is much too early to write the history of this last period. We are actually making this history now, and its future is in our hands.

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SHORTCUTS

BEAMING.

Under this chapter we could describe so many interesting and out-of-the-way techniques that it would make a book. This is because human ingenuity has been working for decades to find a way to do the beaming without a helper. Besides the usual ways there are also such unorthodox ones as tying a piano to the end of warp and make it advance toward the loom when beaming is in progress. Another, only for weavers living in sky-scrapers, is to throw the warp out of the window with any heavy object attached to its end, and then beam over the window sill. Strange as it may seem, both these methods would work very well.

To come to more practical suggestions, we must first realise what is wrong with the traditional beaming. Nothing of course in case of sectional beaming or a warping mill, provided that in both cases the equipment is well designed. Otherwise there are two objections: the need of a helper, and too much friction, resulting in comparatively slow beaming. The first of them is probably more important.

A. Low-tension beaming without helper.

What the helper is doing, really can be done by the "beamer" except for maintaining proper tension during beaming. If we could get along without tension, we could eliminate the helper.

This can be done with any yarn provided that we use a continuous roll of paper at least as long as the warp to separate the layers of yarn on the warp beam. This paper must be heavy: the heavier the better; for mixed warps even corrugated paper. We have the following choice. Building paper, the cheapest grey kind, not tarred, impregnated or saturated with anything at all. It is sometimes called sheathing paper. It is cheap but it does not last. Then there is wrapping paper, the heaviest kind; it is sold in different widths and it is expensive. It lasts for ever if care is taken not to fold it, and not to tear the edges. Finally we have corrugated paper also in a selection of widths, good only for comparatively short warps because of its bulk. It is expensive.

The warp should be stretched out in front of the loom as far as the space permits, and after it has been straightened out (by combing if necessary) it is laid on the floor on a large sheet of clean paper. Now we put any soft and heavy object on top of the warp: upholstered stool upside down; a cushion weighted with bricks, or with a Webster dictionary; a folded blanket with a similar weight, etc.

Now we start beaming. After making one turn we insert the paper, and check very carefully that it is just in line with the warp. Then we keep turning looking from time to time on the warp, and most of the time at the paper which must be pushed or pulled to keep in line. When the weight comes to the loom, we straigntened the warp again and move the weight back as far as possible. And so on until the whole warp is on the warp beam.

But what we have now is a warp with very little tension. If we tried to use it as it is, it would keep slipping, and hardly any weaving could be done. Therefore we first thread and sley it, tie it in (to the apron), and then turn the crank on the warp beam for a while as if beaming again. This will tighten the warp to any desired degree, and nothing can happen to the yarn since it will simply slide on paper. If we tried the same technique but without paper it would ruin the warp for ever.

B. High-tension beaming without helper.

Find a place on the wall just opposite the centre of the loom and a little higher than the breast piece. Drive a long screw in this point. Make sure that the screw went through the plaster, or building board, and got hold of something solid. If it is brick or cement, first drill a hole (star drills) and use an expansion bolt. Then get a length of sash cord, more than twice as long as the distance from the back of the loom to the wall. This is the whole equipment.

The warp is laid on the floor in front of the loom, spread over the raddle, attached to the warp beam, and straightened out as far as the wall.

Yes, but we have forgotten about the pulley. It must be a small one (about 1") of the kind used in boats with an eye at one end. The pulley is tied to the screw in the wall. One end of the sash cord is looped around the warp (make sure that it won't slip) taken over the pulley and to the back of the loom. Now with the right hand we turn the crank of the warp beam, and with the left hold the sash cord to get the desired tension. Our left hand is our helper; otherwise there is no difference between this method and the traditional beaming. We can use paper or warp sticks, or nothing according to the kind of yarn and the sett of warp. When we finish one length, we repeat the whole performance until the warp is beamed.

C. Beaming with reduced friction.

Nearly any kind of beaming will succeed provided that there is not too much friction, which results in tangling and breaking of yarns. Here are suggestions as to how to avoid friction:

1. Beam only over a Raddle. Never through a reed, and (which is still worse) through the heddles. What is more: remove the lease-rods before beaming. This means of course that we must make two leases (or crosses), one at each end of the warp. The first lease is used only for spreading. Then the lease-rods are removed for beaming and inserted again in the second cross for threading.

2. Whatever method of warping we use, let us make sure that the tension is uniform all through before beaming. Even one single warp end looser than the rest means no end of trouble.

3. Any wood surface over which the warp must slide during beaming must be absolutely smooth, and better not varnished, because varnish may become sticky in hot weather or under friction. The proper finish is linseed oil rubbed in, sanded and waxed.

4. Whenever possible beam under low tension, and tighten the warp later on.

5. Do not chain the warp. Take the warp gradually from the warping frame, reel, or whatever warping equipment you have, as the beaming proceeds. If the warp must be kept in storage or shipped, wind it around a large piece of plywood .

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Beaming with a warping mill is the easiest, and fastest. When all other conditions are fulfilled it should proceed at a rate of about ten yards per minute.

ODD WEAVES

IRREGULAR HUCKABACK LACE

By "irregular" we mean here any huckaback which has no definite units in threading and treadling. Thus for instance a unit of 6x6 huck may be followed by 10x10 or 14x14, or even 18x18 as in the following draft:

```
 x x x   x x     x x x   x x          x x x x x x x x x   oo
           x      x x      x           x x x x           o o
         x     x x        x       x x x x               o o
x x x x x x   x x x      x x   x x x x x x     x x x   oo
tabby  6x6    10x10     6x6         18x18      tabby  4321
```

Fig.1

We can also use only half a unit against another half a unit:

```
 x x x   x x x x       x x          x x x    x x x x x x
          x x x          x           x x       x x x
         x          x x        x x x x          x
x x x x x        x x x     x x x x x      x x          x x x
```

Fig.2

Finally we can combine the traditional units with the unsymmetrical hucaback (MW 45), as in fig.3:

```
 x x x   x x x       x x x x x      x x       x x       x x x
          x x       x x x x x        x x        x
         x       x x          x x x       x x x       x x
x x x x x       x x          x x x      x x x x    x x x x x x
```

Fig.3

In this last case we must remember to preserve the tabby order, that is not to jump from 1 to 3 and from 2 to 4. The tie-up is always as in fig 1, and the treadling follows the threading, although this is not compulsory. Thus the treadling for fig.1 should be: 2323232423 13242423131324231324242424231313131323232323.

What is the practical application of irregular huck? There are the following possibilities:

1. TEXTURE. When a comparatively open fabric is wanted with an irregular texture, we can use any of the above drafts, but the last is the best. Take the units at random or use cards as in Accidental Drafts (MW 26/1). In texture weaving the treadling should not follow the threading. The only rule it must obey is the sequence in which the treadles are used: 1 follows 3 or 4; 2 follows 3 or 4; 3 follows 1 or 2; and 4 follows 1 or 2. As long as this order is preserved we shall have true tabby in the selvedges.

With mixed warps use the heavier or more interesting yarns on shafts 2 and 3, and in weaving: on treadles 1 and 4.

2. HUCKABACK LACE ON OVERSHOT DRAFTS. Any Overshot draft written entirely on opposites can be used to weave huck-lace. But it will have rather poor edges, and therefore tabby selvedges on 1 and 4 should be substituted (fig.4).

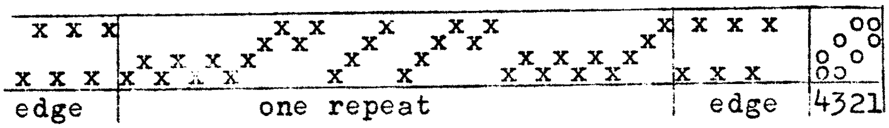


Fig.4

The treadling will be: 232323 (edge); 2424242413132413241313242424
2413 (repeat); 23232323 (edge).

3.TWO-BLOCK PATTERNS IN HUCKABACK LACE.

With four shafts huck gives only one block of pattern plus ground. But by combining different units of huck we can have small, two-block patterns on a tabby ground as in fig.5. The difference between drafts 4 and 5 is that in the former the whole fabric is irregular lace, when in the latter the fabric is essentailly tabby with patterns in lace. This must be taken into account when figuring out the sett of warp.

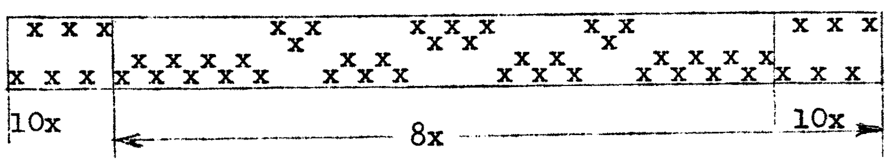


Fig.5

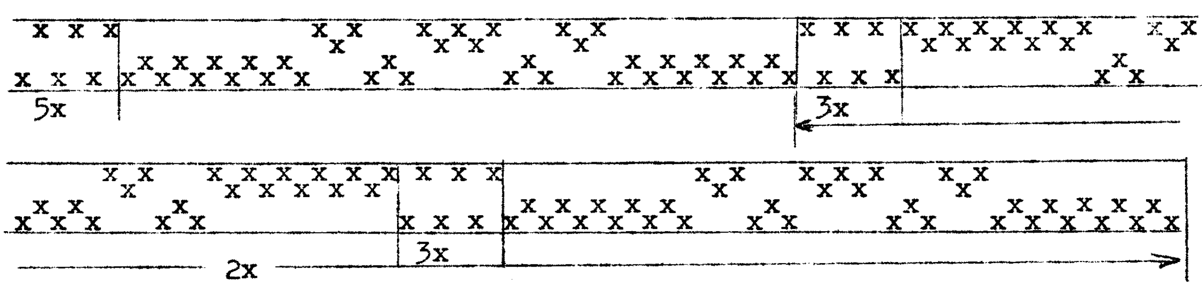
Treadling: 23 - 30x; 2424242423132424231313242423132424242423- once
23 - 30x; etc.

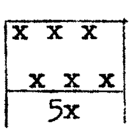
In case of pattern huck one should observe the same rules as for huckaback lace in general: the yarn for warp and weft should be of about the same colour, and the same count; the sett of warp should be a little higher than for tabby alone; the fabric should be woven exactly 50:50, etc.

PRACTICAL PROJECT

Place mats in cotton & rayon.

Threading draft: (read from the left)





;

Warp: 8/2 cotton, old gold; No.of ends 327; Sett: 24 ends per inch; reed No.12; 2 ends per dent;

Weft: 8/2 rayon, yellow; 26 picks per inch.

Treadling: 23 - 15x; 2424242424231324231313242313242424242424242;
32 - 9x; 3131313131313242313242423i32423131313131313132;
23 - 9x etc.

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TURNED TWILLS • 2

THE TIE-UP

To design a tie-up for any particular project, we first make a "short" tie-up draft. It will have as many horizontal rows as there are blocks in threading (lines in a profile), and as many vertical columns as there are blocks or combinations of blocks used in weaving. In fig.1 we have a framework for a tie-up which has two blocks of pattern in threading and four combinations in treadling:

1	2	3	4	2nd block
5	6	7	8	1st block
A	B	C	D	

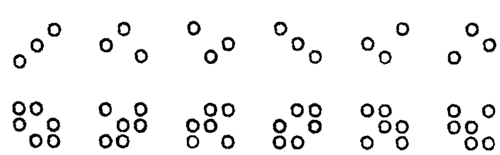
Fig.1

1:2	1:2	2:1	2:1
1:2	2:1	1:2	2:1

Fig.2

If the treadles in the group A are supposed to weave the "ground", or in our case 1:2 twill, all across, then in the square 1 we should have a tie-up for 1:2 twill, and the same in square 5. If B should give block one, then square 6 should have a tie-up for 2:1 twill, and square 2 - 1:2 twill. If C should give block 2, then Square 3 is 2:1, and square 7 - 1:2. Finally the group D is supposed to produce 2:1 twill all across the fabric, therefore both squares: 4 and 8 must have the tie-up for 2:1 twill. Our tie-up now is as in fig.2.

All we have to do now is to insert in each square the proper tie-up: either 1:2 or 2:1. But which is the proper one? Even the simplest twill has 6 different tie-ups for 1:2 and also 6 for 2:1:



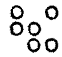
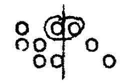
1:2 twill

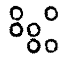
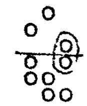
2:1 twill

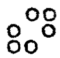
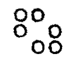
Fig.3

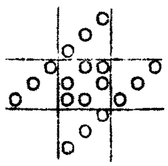
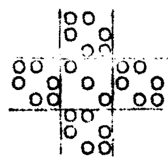
Out of these 12 tie-ups we must select two: one for 1:2 and one for 2:1 twill. Which ones? The answer is very important, and it applies to all Turned Twills:

ANY TWO TIE-UPS WILL DO, PROVIDED THAT THEY MATCH EACH OTHER IN ALL DIRECTIONS. WHEN PUT SIDE BY SIDE ALL MARKS FOR A TIE (o) SHOULD BE OPPOSITE EMPTY SPACES ACROSS THE LINE DIVIDING THE TWO TIE-UPS.

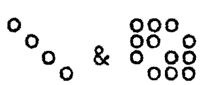
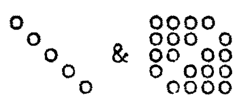
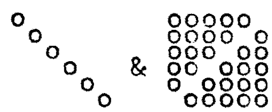
For instance:  and  won't do, because 

 and  are not better, because: 

but  &  are all right, and so are:  &  because:

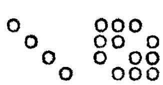
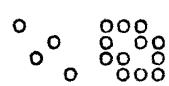
 and  Fig.4

As a rule we start with a simple tie-up with a diagonal of ties running in one direction, and then we select the second tie-up with a similar diagonal in empty spaces running in the opposite direction. Thus for higher twills we shall have:

   Fig.5

1:3 twill 1:4 twill 1:5 twill

Those are not the only tie-ups which fulfil the conditions, but they are the easiest to find. Other tie-ups can be derived from the above ones. If we have a pair selected on the above principle, we can exchange two vertical lines of ties in both tie-ups. For instance:

 exchange 2 & 3:  Fig.6

4321 1234 4231 1324

We count the vertical lines in the direction of the ascending diagonal, and exchange the same two numbers on both sides.

One may wonder why all the fuss about the tie-ups. After all any two tie-ups of the type 1:N, and N:1 must give a turned twill. Indeed they will, but the two twills won't match each other: there will be floats crossing the dividing line between blocks of pattern and, which is still worse: some of these floats may be longer that the standard float of a given twill.

With more than two blocks of pattern the problem of treadles becomes embarassing. For instance if we have a 12-shaft loom, we can weave four blocks of pattern in 1:2 twill. If we are satisfied with single, independent blocks, without plain ground, we need also 12 treadles. But if we want <u>all</u> possible combinations of blocks, there are 16 of them, and each requires 3 treadles, which makes 48 in all. With a 16-shaft loom and 1:3 twill we need 64 treadles. Compound treadling does not help, because we have only two feet. A table loom seems to be the answer, but then the weaving becomes too slow. Dobby, Jacquard and similar shedding machines are all right for very long projects. Otherwise setting them up takes longer than weaving.

Thus we must plan carefully the pattern, analyse it, and make sure that we have enough treadles to weave it. Incidentally analysis gives us at the same time the short tie-up draft, which is necessary to build our tie-up. For instance as a result of analysis we get the profile in fig.7, and also the short tie-up draft. The first tells us

```
mm      mmmmmm mmmmmm    mm      mm           m mm
  mm                               mm         m    m
    mm                               mm       m  m
      mm     mm      mmmmmm mmmmmm     mm     mm   m
```

Fig.7

that we have 4 blocks of pattern, the second that we have 5 groups of treadles. With 1:2 twill we need 12 shafts and 15 treadles. Thus we must weave this project on a 16-shaft loom to get enough treadles, or we must simplify the pattern.

Here are our limitations:

With an 8 shaft and 10 treadle loom we can have two-block patterns in 1:2 and 1:3 twills. With 1:2 twill we have 3 combinations of blocks in a plain tie-up, and 4 in compound tie-up. With 1:3 twill 2 blocks or combinations (0,1; 0,2; 1,2) in plain tie-up. Compound tie-up does not help.

With a 12-shaft, 14 treadle loom we have 4 blocks or combinations in 1:2 twill; 3 blocks or combinations in 1:3 twill; and 2 blocks, or combinations in 1:4 or 1:5 twill.

Finally with a 16-shaft loom we have 5 blocks of 1:2 twill, 4 blocks of 1:3 twill, 3 blocks of 1:4 twill, and 2 blocks in 1:6, or 1:7 twill. Obviously the last three will be satins if so desired.

So much for the tie-ups.

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