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PROBLEMS IN TEACHING

The yarn and the sett of warp.

What we should have in mind when teaching weavers, is to give them enough technical knowledge to become creative. As long as one is not quite familiar with the tools one uses, there are too many limitations of a purely technical nature, and too much frustration in overcoming these difficulties. Creativeness under such circumstances is constantly thwarted. Consequently teaching should put more stress on understanding than on performing. Prescriptions, ready formulas, complete drafts and directions should be avoided as much as possible. Instead the student should be made to work out his problems by himself.

We shall apply this principle here to the question of selecting yarn for warp, and finding the proper sett. Very often this part of weaving is treated in the same way as cooking recipes: take 2/16 cotton, set it at 35 ends per inch and you will have a towel. But why 2/16, and why 35 - and not 20 or 50?

First of all - what is really the count of yarn? As we all know it indicates the weight: so many yards per pound. And somehow we think that it indicates the thickness as well. But how? What we often do not realise is the fact that in most cases the yarn has no definite diameter. In case of wire there is a quite simple relationship between the weight and the diameter, because the cross-section of a wire is a circle. But the cross-section of yarn shows a number of fibers (virtually points) widely spaced and separated by air.

If we take a micrometer and try to measure the thickness of yarn, we can always get at least two readings: first when the yarn starts touching metal on both sides, and the second when the mike is tightened as far as it will go. These two readings may be very far apart in case of a soft yarn, and quite close with a hard twist. For instance 2/6 cotton may give the figures: .035" and .007". But the same cotton twisted harder will give .025" and .012".

Since the "diameter" is not only indefinite, but even variable there cannot be any hard and fast rule directing us in the choice of the sett of warp. For instance if we want to find out how many ends per inch will cover completely the weft, and take as the basis our mike readings - we can have anything from 30 to 150 ends per inch for a 2/6 cotton. The lower limit of 30 means something - this is the lowest number which will cover the weft, but 150 is obviously impossible. No shed would open with so closely set warp. But then we may find out that with a different

make of the same 2/6 cotton the figures will be different, because the apparent thickness of the yarn depends on the twist, and not only on the weight.

The above example shows quite clearly why formulas for the sett of warp are without much value. At the best they can give you a general idea, but will not solve any practical problem.

There is no necessity to have a micrometer to be able to establish the lower limit of the sett for warp-face fabrics. We can as well take a ruler, and wind the yarn on it so that one thread just touches the next, and then count the number of windings which cover one inch.

The upper limit i.e. the highest sett which will still give an opened shed, or rather all sheds is only matter of experience. It depends to a great extent on the construction of the loom, and the weaver himself. The general principle is that the softer the yarn the higher this limit when compared with the lower one. If the lower is 30, then the higher may be 60 for soft, and 40 for hard twist.

So far we have been speaking about the fabrics where the warp covers the weft. The problem is much more difficult when it does not. For instance when we have a 50:50 fabric, we can weave it very open or very close, according to the effect desired. Then what in this case is the lowest and the highest limit?

The lower limit of sett will be such one which still does not produce the slippage after the fabric is finished. When the warp or the weft threads are subjected to friction going in one direction they should not move in the fabric and produce holes. The slippage depends not only from the grist of yarn used, but on other factors as well: twist, smoothness of yarn, finishing etc. For instance when the fabric is supposed to be sized (as cheesecloth) it may be woven much more open, than when it is not. Wool which is going to be fulled or felted can be more open too. Domestic wool (about 2000 yards per lb) usually set at 18 ends per inch, may be set at 9 and still produce a firm fabric if it is fulled afterwards. But slippery yarns such as rayon must be woven much more closely than cotton of the same count.

The upper limit is such a sett which will still give a 50:50 fabric with the heaviest possible beating. Consequently it depends not only from the yarn, but from the weight of the batten and the width of warp. So again we have no rules, and we have to experiment to find the answer.

Sometimes the upper limit may not be the one we were speaking about. When weaving tabby, a fabric woven at the closest sett of warp may be so tough as to be practically useless. For instance a linen towel woven with single 14 should not have more than 30 ends per inch, although it is possible to make it even 45, because beyond this limit it will be next to impossible to iron it smooth. But again it depends what kind of linen we use.

If the problem is so difficult with 50:50 fabrics - it will be more so with other ratios between warp and weft. Let us go to the other extreme and cover the warp with weft. With a given yarn for both, we may speak about the upper limit of the sett. This is the highest number of ends per inch, which still gives a warp-face fabric. This however involves such factors as the weight of the batten, and the width of the fabric again. The lower limit is still less well defined.

One may protest here that after all in the industry they do not go when designing a new fabric through hundreds of experiments with

all possible setts of warp, that they must have rules and formulas. This is perfectly true, but the kind of formulas they use are far from being simple and they just cannot be applied to the handweaving. Not only because they require the knowledge of higher mathematics, but because to use them one has to have much more information about the physical properties of yarn, than we can ever learn when buying our supplies, and it would require a well equipped scientific laboratory to find them out by ourselves.

Still there are certain simple rules which may be useful. For instance if we find a very satisfactory proportion between yarn and sett in a particular fabric, we may use this proportion to make similar fabrics (the same weave, the same material) in different weights. The table on page 4 is based on such a simple rule: the weight of the yarn is proportional to the square of its thickness. For instance 2/4 yarn is twice as heavy as 2/8 - but this does not mean that the thickness is double also. If we increase the weight twice, the thickness will increase by only 41%. To get twice the thickness we must find a yarn four times as heavy. Thus the sett of warp must be inversely proportional to the thickness and not to the weight of yarn. The formula is:

$$S = k \sqrt{C};$$

where S is sett in ends per inch, C - the count of yarn, and "k" - a coefficient which remains the same if the weave and the material remain unchanged. It is about 12 for cotton woven in tabby, 9 for wool, 7 for linen.

The table on page 4 is nothing but the same formula expressed graphically. The horizontal axis shows the count of yarn, and the vertical one - the sett. The table gives approximate figures for the lowest sett with different yarns woven into 50:50 fabrics. In practice closer setts than these given in the table will be used very often, but it is impossible to judge how much closer they should be without experimenting. There are two lines for each yarn: one roughly corresponding to tabby, the other to twill. Still lower setts may be used for processed fabrics.

At this stage the student is advised to make samples with different setts on small frame looms. These samples are then finished and compared until the best possible combination of yarn and sett is found. They are tried for slippage, creasing, resistance to ironing etc. All such samples with appropriate notes should be preserved for further use. The notes should contain not only the usual information about weave and yarn, but very detailed description of finishing, and all possible information about the yarn: composition, twist, behaviour in weaving, name of the manufacturer etc.

The main stress in teaching should be laid here on the complexity of the problems connected with selection of the proper sett, and on the unreliability of the formulas, thus developing student's initiative and resourcefulness in meeting the difficulties.

Sett:

