reason that the bending takes place in the fine threads only, whilst the thick ones are laid as so many straight cylinders. But if the fine threads are not laid sufficiently close together, that is, as close as their diameters will permit without compression, they are liable to slip on the thick straight threads and so the stability of the cloth is gone. In many cases, more especially in heavy goods for men's wear, a binding thread must be introduced to check this tendency to slipping, otherwise the fabrics would be utterly unserviceable.

When the rib or cord runs across the piece, the conditions must be reversed, the warp being fine and the weft thick and straight. In the majority of cases these cloths are more dangerous to make than the others, on account of the lateral strain being more frequent than the longitudinal, consequently close attention must be paid to the building of fabrics of this class.

At this point what is termed the "balance of cloth" will come in as it often does, and frequently without reason. Then let the designer consider the closeness and fineness of one of the two sets of threads and set it against the bulk and openness of the other, and the balance of structure will be found to very soon adjust itself.

Then in passing from a plain cloth to a three-thread twill, a young designer may very naturally ask, what relations should the warp and weft bear to each other? A general answer to that can be given at once. The material which predominates on the surface, in the order of interweaving, should also predominate in actual quantity. But this actual quantity may be either in the form of a large number of fine threads or in thicker threads. In the case of the twill in question (2 and 1) a large number of fine threads, by preference, whether warp or weft, are on the face, but in some fancy twills bulky threads may be preferable. Here the purpose to which the cloth is to be applied, and the general character of the design, must be taken into account.

In dealing with common twills, where warp and weft come to the surface equally, good results are always obtained by having warp and weft equal, but there are many occasions where a special effect is to be produced when this is impossible. In the common four-thread twill, where the weft passes over and under two threads, there are infinite possibilities for building a variety of cloths, from the finest French merino, where the number of picks may be anywhere up to 300 per inch of fine wool, down to the commonest cotton trousering, where as many thick cotton threads are crowded in as possible without making the cloth too stiff. Here the same rules will apply as in making cords on a perfectly plain cloth. Whenever there is to be fine material in one direction and thick in the other, the relative quantities, or number of threads, must be regulated according to their diameters; but this difference must regulate the actual number. The thick threads must have space between them to permit the crossing of the fine threads, and at such an angle as not to cause crushing or crowding; and the fine threads must be laid as closely as possible together, so as to support each other, but not to be subjected to compression.

Then a general rule may be laid down that any cloth, plain or common, may be ornamented by altering the relative bulk and number of threads per inch of warp and weft respectively; but there are some patterns where the two sets of threads must of necessity bear different relations to each other.

So far, much that has been said is simply a reiteration of what appeared in my late article under the head of "Relation of Patterns to Structure," but it is necessary to have a clear understanding so as to follow the practical application.

Then to return to the plain cloth. It is desired to form a rib in the direction of the warp. As already pointed out, the warp should be thick, or a number of threads together, and with corresponding wide spaces between them. The weft should be fine and as close as possible. Then, where is the starting point? There may be one or two. First, determine the number of ribs per inch, or second, the counts of material you are about to work with. I will deal with both propositions, and on the general principles laid down in previous articles.

Suppose the cloth is to be made with cotton warp and worsted weft, and it is desired to have 48 cards per inch. Then it is necessary to find the counts of warp to give a good rib, and on the assumption that the space between the ribs is equal to their diameters, these would be 48 ribs and 48 spaces per inch, equal to 96 diameters of one thread, or a combination of threads forming the rib. Then following the rules, or rather reversing, already laid down, square the number 96. Thus, $96 \times 96 = 9216$, and this divided by the number of yards per hank $(9216 \div 840) = 11$ nearly. So that the counts of warp should be about 11s or 2-20s, or two threads of 2-40s would be as near as the ordinary commercial yarns would permit.

Then, to determine the counts of weft, the degree of fineness of the cloth will be an important factor, not only as to the number of picks per inch, but also as to a possible variation of the number of cards per inch. If the angle of curvature of the weft is to be one of 60 degrees with a vertical line, which I have demonstrated over and over again to be the best for a good cloth, is to be maintained, then all the dimensions must be taken into account. Then to determine the number of picks per inch, find the diameter of the weft thread by extracting the square root of the yards per pound. Suppose the weft to be 48s worsted, then $\sqrt{(48 \times 560)} = 163$. Therefore 163 threads would lie side by side in one inch, but obviously, to put that number of picks per inch in the cloth, would make it too solid. Then a general rule may be adopted, viz., half the number of the diameters that would lie side by side, plus ten per cent. for solidity, and a very stable cloth will be the result. For heavier cloths, this may be increased somewhat, and for lighter cloths decreased, but there is danger in going too far in either direction, as the cloth is liable to be uneven, either from overcrowding or insufficient material.

Now to take the second proposition, and deal with the same counts of warp, so as to make the matter clear and easy of comparison: 2-20's warp or two ends of 2-40's is