

## Wool, Woolens, and Worsted Through the Microscope\*

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(Concluded from June issue, page 246)

### Study of Yarns

Woolen and worsted yarns are just as amenable to examination by microscopic means as any other yarn. The same factors which are of interest for the other fibers are of interest equally here. Much information is yet to be obtained regarding the elusive property, or better, associated properties known as "handle," "quality" or "excellence." The grading of wool has long since departed notably from its original significance. A more rational method can and should be employed as soon as sufficient data and experimental procedure have been worked out. The woolen mule

nothing of real consequence can be learned. This calls for optical apparatus and trained operators. With correct equipment, and proper handling and adjustment, the results would be amazing.

In manufacturing a yarn made up of long fibered material where short fibers occasionally are found, or when other fibers must be blended with the wool, close check-up of each operation preliminary to and including spinning should be made. In the case of short wool or fiber of some other sort, a decided tendency will be found for the shorter filaments to wrap themselves around the yarn as a whole, and so to produce

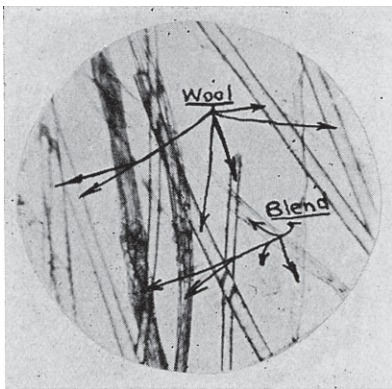


Fig. 3. Mixture of real and imitation wool fibers

is still in use and will be so for some time to come, in spite of the advent of continually improved spinning frames. There would seem to be no way of judging the product of either as to quality without a definite examination of the finished stock in the form of yarn. Unless this yarn can be seen in all its minute detail,

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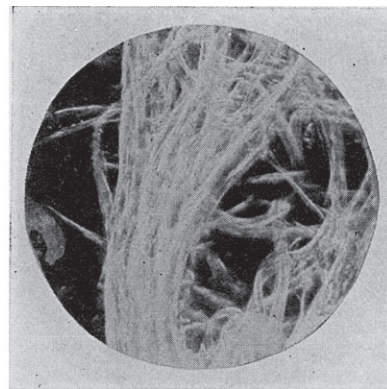


Fig. 4. Wool fibers disintegrated by treatment with acid. The cortical cells are plainly visible

a surface effect as to fiber angle which will show up in the finished goods as an imperfection. In many cases, what appears to be excessive twist is found to consist simply of such a tendril effect in the yarn. These surface fibers do nothing of consequence in adding to the strength of the yarn; they resist the passage of the yarn through the harnesses of the loom; and they are

apt to form tufts of loose fiber after such operations as napping, fulling, and shearing.

Double cloths and backed fabrics are of frequent occurrence in woolens and worsteds. The point paper design may be cleverly worked out as to the method

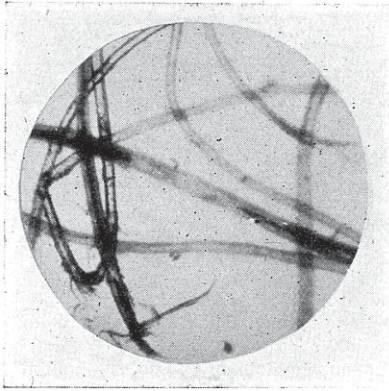


Fig. 5. Shoddy fibers—note the mechanical damage

of tying and the arrangement of yarns of varying counts and twist, but the final judgment must be passed, not on the theoretical work of the designer, but upon the condition of the finished goods. What may appear to be a first rate proposition on paper may not work out at all satisfactorily in the fabric. The only intelligent way to remedy such a condition is to make a quantitative examination of the cross section and surface of the cloth by means of a microscope equipped with the proper accessories. From the data thus obtained it will be possible to do better than guess what the difficulty is and how it may best be remedied.



Fig. 7. Faulty twist distribution in woolen yarn. The yarn at left is normal—that at the right has been over-twisted and seriously weakened

Sometimes the design need not be altered, but a slight change in the finishing operations may suffice. Sometimes a complete alteration of certain details of the pattern is imperative. In any case, it is only simple efficiency to look at the goods and *see* what the state of

affairs really is. No amount of speculation and tearing of the hair will avail. Energy hitherto devoted to exercising the vocabulary to the disparagement of the designer and the finisher, may better be employed in definitely locating the trouble.

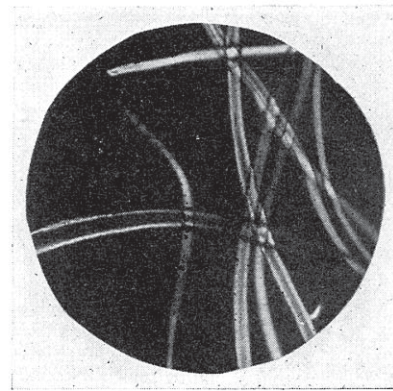


Fig. 6. Wool fibers by polarized light. The presence of colored bands, lengthwise of the fiber is indicated by the shades of grey in the picture. The lighter portions are blues, the medium parts are greens, and the dark places are yellow and red

### Study of Pile Fabrics

The stereoscopic microscope can play an important part in the manufacture, analysis, and design of pile fabrics. Plushes and carpets are too thick and have too great a depth of surface to be conveniently examined with the ordinary magnifying glass or mon-objective microscope. The depth of focus, working

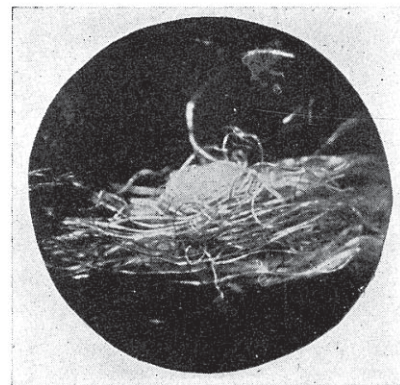


Fig. 8. Short fiber of rayon forming a defective spot on a woolen yarn. The blending of rayon and wool calls for much care to prevent undue breaking down of the rayon fibers, and to assure their adequate control in the drawing and spinning operations

distance, and three-dimensional vision made possible by the double-objective instrument render the task of detailed inspection easy. It is quite possible to keep the tops of the pile tufts in focus while the backing structure of the carpet is still clear. The application



of the instrument to a study of the edge of a cut portion of the material is self-evident. No special mount is necessary for the cloth, and no sectioning—other than a simple cut with a very sharp knife or preferably a razor blade—is required. Simply hold the goods

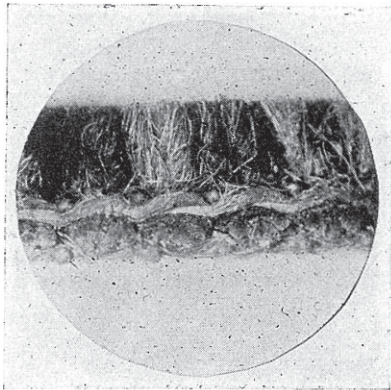


Fig. 9. Cross section of Wilton carpet to show the structure, type, color, and height of pile, etc.

in the fingers so that the edge (which has been smoothly cut at the desired location) will be in the center of the field. The field of view at moderate magnifications will be quite sufficient to include the entire depth of the carpet. It is thus possible to check the placement of tufts in a tapestry construction, and to make certain that the pile tufts of a Wilton type rug are properly protected at the back of the carpet, and that they do not "bunch" undesirably or displace any of the stuffer warp yarns. It is also possible to measure the thickness of the whole or any portion of the carpet; to determine the exact length of the pile tuft

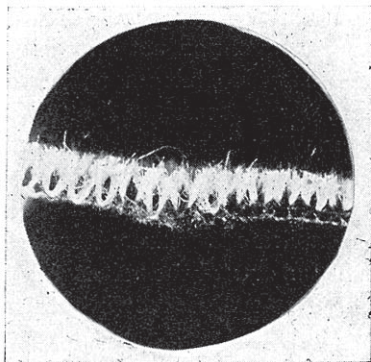


Fig. 10. Cross section of mohair plush to show structure. Left half—looping of pile tufts. Right half—chain warp interlace and crimp

by measuring around the "U"; and to check the crimp or contraction in the chain warp. The checking of the proper wire to use in weaving may thus be readily accomplished. The length of pile yarn needed for a given number of rugs may also be computed from the

resultant data. The regularity of the height of the pile as a result of proper or improper shearing is a matter of a single glance at the edge of the carpet as it passes beneath the microscope. It will also be apparent that the weave can be very conveniently checked on an unknown sample. The angle at which the pile tufts lie in some types of rug is of importance. This angle can be measured. The distribution of color in blend yarns so frequently used for the pile of carpets is important. Cross sections of such yarns can be easily made and examined under the microscope, and the number of fibers of each color and their distribution easily indicated. Very often light and shade effects which may destroy the effectiveness of the proposed design can be traced to improper mixing or blending of color in the tufts. In some cases the pile yarns are not completely penetrated by the dyestuff.

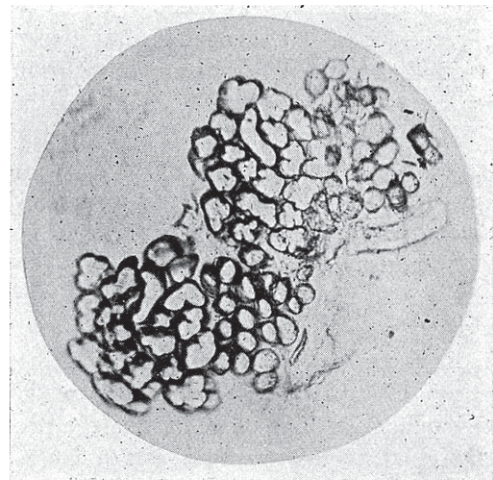


Fig. 11. Cross section of two union yarns made up of 60's worsted and 150 denier rayon for the knitting industry. The lack of perfect focus is due to twist in the plied yarn, which throws the fibers out of a single plane

This is not apparent on surface inspection. If, however, such yarns are cut to form the pile tufts, the undyed center portion shows up distinctly in the finished carpet. It is then too late to do anything about it. Inspection of the yarn before it goes to the loom is so simple and so rapid an operation, that it would seem only ordinary good sense to make the microscopic test as a matter of routine, or at least where any doubt is felt as to the proper dyeing of the material.

Responsibility is being moved back to the manufacturer with the development of trade-marked goods. The inspection of returned material from the ultimate consumer is getting to be an increasingly important problem for the mill man. It is too much to ask the boss dyer or finisher to take care of this work in addition to his other duties. It properly falls to the lot of

the laboratory or research man. Not only may he place the responsibility for the damage, lack of expected durability, etc., but he may often be able to make valuable suggestions for the elimination in the future of similar difficulties. If the manufacturer is responsible he should be glad to be made aware of the fact. If he is not, he will be equally delighted to be able to put his finger on the source of the trouble. While he might justifiably hesitate to accept the findings of a presumably biased dealer or consumer, he can hardly go back of the findings of his own investigator. It is necessary, of course, to have a research-minded man in the laboratory. A man who will find

the facts as they are, and who will attack a problem with no preconceived ideas as to the outcome. The universities and technical schools are trying to furnish just such men, and when the young man realizes the future which the textile industry can offer him in research, he will be willing and eager to take advantage of the educational opportunities which are being made increasingly available. At present the demand for technically trained men for research in textiles is greater than the supply, and it is only elementary economics to be certain that now is the time to plan for the addition to the mill staff of men trained in textile technology.

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