

DYEING, BLEACHING, FINISHING, Etc.

THE ORIGIN OF SOME DEFECTS IN TEXTILE FABRICS.

By Walter M. Gardner, M.Sc., F.C.S.

PROFESSOR OF CHEMISTRY AND DYEING, BRADFORD TECHNICAL COLLEGE.

(All rights reserved.)

In order to produce a perfect piece of cloth it is not only necessary that the raw material of which it is composed should be of good quality, but that all the various operations involved in its manufacture should be carried out with proper skill and care and with a due regard to each other. Thus the carder, or comber, the spinner, the manufacturer, the dyer and the finisher should each work with a sufficient knowledge of the bearing of his particular operation on other processes of manufacture.

It is therefore very desirable that the dyer should know something about yarn and cloth structure and manufacturing processes generally, while the manufacturer should be acquainted with the nature and effect of scouring, fulling and dyeing operations. The high degree of specialization in the textile trades renders co-operation between the various branches specially necessary, and, at the same time, specially difficult. It is not at all unusual for five or six different firms to be concerned in the production of a piece of cloth and only the manufacturer or the merchant is in a position to know even the names of the whole of the firms.

As a particular case a striped cloth made with white and colored cotton warp threads and a colored worsted filling may be taken. The merchant may take the pieces from the manufacturer with the filling undyed in order that the particular coloring of the pieces may be varied according to the orders received from customers. The manufacturer then orders from the warp dyer the necessary number of bleached warps and dyed warps and after weaving these with the "gray" worsted filling delivers them to the merchant. The latter then sends them, usually in batches at different times, to the piece dyer who dyes the filling and finishes the pieces. In such a case the difficulty of finding the cause of an imperfect result is sometimes very great. Supposing for example, some of the warp threads in the finished piece are found to be broken. This defect of "cracked ends" may arise from a variety of causes; the spinning of the cotton may have been defective or the warp dyer may have tendered the warp in bleaching or dyeing, or again the defect may be due to an improper texture of the fabric structure, or to tendering of the warp during the operation of piece dyeing, or rupture by too great tension during the finishing processes. If however, the exact character of the finished cloth is known by all concerned, and each has a knowledge of the whole series of processes of which his own forms a part, and the general aim is kept in view throughout, there would be much less likelihood of such defects occurring. For example, if the warp dyer knew that the warp would necessarily be subjected to great strain by the finisher he would take special precautions to

avoid any weakening of the warp threads and the manufacturer would avoid "crowding" his picks. Then if the piece dyer knew the exact process employed by the warp dyer, he would be the better able to avoid any injury to the warp during the dyeing of the filling.

This example may serve to emphasize the statements as to the desirability of co-operation and mutual knowledge of processes and will also indicate the great difficulty of producing perfect results. As a matter of fact no single piece of textile material is free from blemishes, but it is only when these are of some magnitude that they legitimately constitute commercial "defects."

It will be obvious from what has been stated that a general investigation of the origin of defects in fabrics would involve the consideration of the whole range of operations involved in the various stages of manufacture and of the influence of each process on others. When such a book is produced it will be a most valuable addition to the literature of the textile trades but its compilation will need the collaboration of experts in each of the various branches of manufacture; and all that will be attempted in this series of articles will be a survey of some of the causes of defects which more particularly concern the dyer.

Good dyeing and finishing is perhaps the most important branch of the textile trades as regards the selling qualities of the manufactured article, for however well designed and constructed a fabric may be and however good the raw material from which it is made, its value as a salable material greatly depends on the taste and skill brought to bear in dyeing and finishing. If faulty, the value is correspondingly decreased, but on the other hand the dyer is often able to greatly enhance the value of a cloth made from inferior raw material or of indifferent design or inferior workmanship, by a skilful treatment in dyeing and finishing.

The defects in the dyeing of textile materials are so varied that any classification of them is not easy. Such grouping may, however, be attempted in two ways, *viz.*: (1) as to cause and (2) as to character. In regard to the latter such defects as the following would be distinguished.

1. Irregular colors.
2. Spots and stains.
3. Bad matches.
4. Fugitive dyes.
5. Dyes which rub off or smear.
6. Defects which cause a reduction of the lustre, impoverishment or tendering of the fibre.

An attempt at treating the subject on these lines would however lead to much repetition in explanation of causes: since, for example, defective scouring may give rise to most of the irregularities above mentioned.

The more convenient classification is therefore that based as far as possible on the underlying causes and from this point of view the following headings may be distinguished.

1. *Use of Defective Raw Material.*
2. *Use of Hard or Ferruginous Water.*

3. *Defective Spinning or Weaving.*
4. *Inefficient Scouring and Washing.*
5. *Defects due to Bleaching, Mercerizing, Sizing, &c.*
6. *Mordanting Defects.*
7. *Bad Selection of Dyes.*
8. *Defective Dyeing Processes.*
9. *Defective Finishing Processes.*
10. *Defects due to Machinery and Apparatus.*
11. *Defects due to Drying.*
12. *Unclassified.*

These various causes will be considered seriatim, examples which have occurred in the course of the author's practice being given in most cases.

1. The Use of Defective Raw Material.

WOOL: If any sample of dyed wool is examined under the microscope considerable differences will be noticed in the color of various fibres and even in different portions of the same fibre. This occurs even when the whole of the wool is of the same quality and kind, but such inequalities are not usually apparent as the color of the individual fibres is blended in the eye. In the case of low quality wool, however, white specks may frequently be seen after dyeing, which when examined under the microscope are seen to be structurally different from the dyed fibres, having the appearance of solidified rods of jelly and showing little or none of the cellular structure characteristic of the dyed fibres. These abnormal fibres are known as "kemps" and may be found to a greater or less extent in most wools. When present in considerable numbers the kempy wool is difficult to dye satisfactorily, though some dyes cover these kemps much better than others; for example the basic better than the acid dyes, and a chrome-logwood black better than a diamond black.

Different kinds of wool have very different absorptive power for dyes, and defects not unfrequently arise from the use of two kinds of wool in one material. If hanks of Merino yarn and of English wool are dyed at the same time in the same liquor, the former will usually acquire a much deeper color; and this cause of irregularity should receive much more attention than is the case. If the dyer is aware that various qualities of wool have been used in any particular case he may minimize the difference in dyeing properties by a slight treatment of the material with dilute bleaching powder solution coupled with a special selection of dyes, but usually the spinner and manufacturer are unaware of the above facts and the dyer gets the blame for a faulty piece for which he is really in no way responsible.

Another somewhat similar case is the use of "skin wool" along with ordinary wool. Skin wool is obtained from the skins of animals slaughtered for food and even when clipped from the skin it differs considerably in dyeing properties from wool which has been sheared from the living animal. Skin wool is however often removed by the felmonger by means of lime and this very greatly increases the difficulty of its treatment by the dyer.

Defects appearing as brown or gray stains have recently been very frequent in goods made from certain

English wools. In the case of several defective fabrics, the cause of these has been shown by the author to be a diseased condition of the sheep resulting in the presence on the wool of fragments of cuticle or skin which adhere strongly to the fibre and pass right through to the finished piece. These skin fragments have a very selective action on various dyes, and are readily colored yellow by alkalies. They do not become visible until the pieces are scoured or dyed, but then form a very apparent defect. Such wool should be dyed with acid dyes, and logwood and other mordant-dyes should be avoided.

Naturally colored brown or black wool frequently causes trouble in the case of pale delicate shades. Even with the greatest care it is difficult to prevent a few dark colored fibres getting into a yarn or piece and it is remarkable how such will show up in a finished piece of cream or other delicate tint.

Another great defect which is indirectly due to the wool fibre, sometimes arises from the production of sulphide of copper, iron, or more especially, lead by contact of the fibre, while in an alkaline condition, with metallic pipes, &c. Wool fibre naturally contains sulphur which is partially in an active and partially in an inactive condition. In presence of alkali, solution of the former occurs with immediate production of a dark colored metallic sulphide if the wool comes into contact with a metallic steam pipe. This defect is fairly well recognized, and may be avoided by the use of aluminium vessels, pipes, &c. It may also be eliminated when necessary by alternate treatment of the wool with lime water, and hydrochloric acid, washing between each steeping and repeating the operations until a stain ceases to be produced under the conditions named above.

SILK: The very different dyeing properties of wild and cultivated silk make the dyeing of a fabric in which both are used a matter of extreme difficulty. As a rule, however, silk is dyed in hank form, and mixed yarns are rarely met with. The dyeing of the two kinds of yarn to match in shade is an ordinary dyeing problem and hardly comes within the scope of this article.

ARTIFICIAL SILK: The treatment of materials partially composed of artificial silk is a matter which is a prolific cause of defects in the work of garment dyers and cleaners. There are several varieties of artificial silk and they differ fundamentally in dyeing properties. For example, Chardonnet silk may be dyed to some extent like natural silk with acid dyes, whereas Lehner silk dyes best with basic dyes and Thiele and Viscose silk with direct cotton dyes. Beyond mentioning the necessity for great caution in dealing with such material, little can be said by way of assistance. The dyeing properties of the material should wherever possible be determined by actual trial of a small piece.

All forms of artificial silk are more or less tender when wetted, the tensile strength of most kinds being very low under these conditions. Great care in manipulation is therefore necessary.

COTTON: The chief dyeing defect due to cotton fibre is the appearance of white specks on dyed ma-

