Diagonal Sectioning Technique for Studying Fabrics

by

M. R. Pesce and A. S. Wrigley

Reprinted from

TEXTILE RESEARCH JOURNAL

Publication of Textile Research Institute, Inc., and The Textile Foundation

10 East 40th St., New York 16, N. Y.

Volume XIX—No. 10—October, 1949—Printed in U. S. A.

Reprinted from Textile Research Journal, Vol. XIX, No. 10, October, 1949
Printed in U. S. A.

Diagonal Sectioning Technique for Studying Fabrics

M. R. Pesce* and A. S. Wrigley*

THE IMPORTANCE of fabric geometry considerations in the design of functional fabrics was stressed some time ago in the works of Peirce [4] and more recently by Backer [1] and Pollitt [3]. The geometric assumption that yarns can be considered as flexible circular cylinders has permitted the mathematical presentation, in a general way, of the physical characteristics of textile materials. However, in the study of high-sley fabrics the yarn distortion resulting from the extreme weave tightness does not justify extensive computations based on these simplified considerations.

The yarn structure as it actually exists in a fabric can be presented and studied by microscopical techniques such as cross-sectioning the material at right angles to the warp and filling yarns and in planes normal to the fabric surface. In order to reveal the three-dimensional aspects of the fabric interstices, successive sections above, through, and below a cross yarn would be necessary. However, serial sectioning must be done painstakingly and at best it furnishes only a discontinuous picture of the interyarn spaces.

* Microscopy and Photometry Laboratories, Quartermaster Research and Development Laboratories, Philadelphia Quartermaster Depot, U. S. Army.

By using a diagonal sectioning technique, it is possible to obtain, with only one section, an uninterrupted sequence of views through and between alternate yarns.

Diagonal sections can be prepared by embedding the fabric in plasticized methyl methacrylate monomer [2], mounting the polymerized resin block in a biological microtome, and orientating the specimen holder so that the fabric is sliced in a plane tilted at a small angle to the plane normal to the warp (or filling) direction.

An illustration of diagonal cross sections is presented in Figure 1. The sections were cut from a tightly woven experimental Oxford material. Successive but slightly overlapping sections were photographed and then assembled in continuous strips.

The diagonal sections illustrate at a glance the marked differences which exist in the warp and filling directions of the fabric structure. The close packing of the pairs of warp yarns (woven as one) makes it difficult to distinguish between these adjacent ends. Appreciable cross-sectional changes take place in the warp yarns as they pass over and under the filling yarns. At the interfilling spaces, the alternate warp-yarn pairs are crowded together (A in the

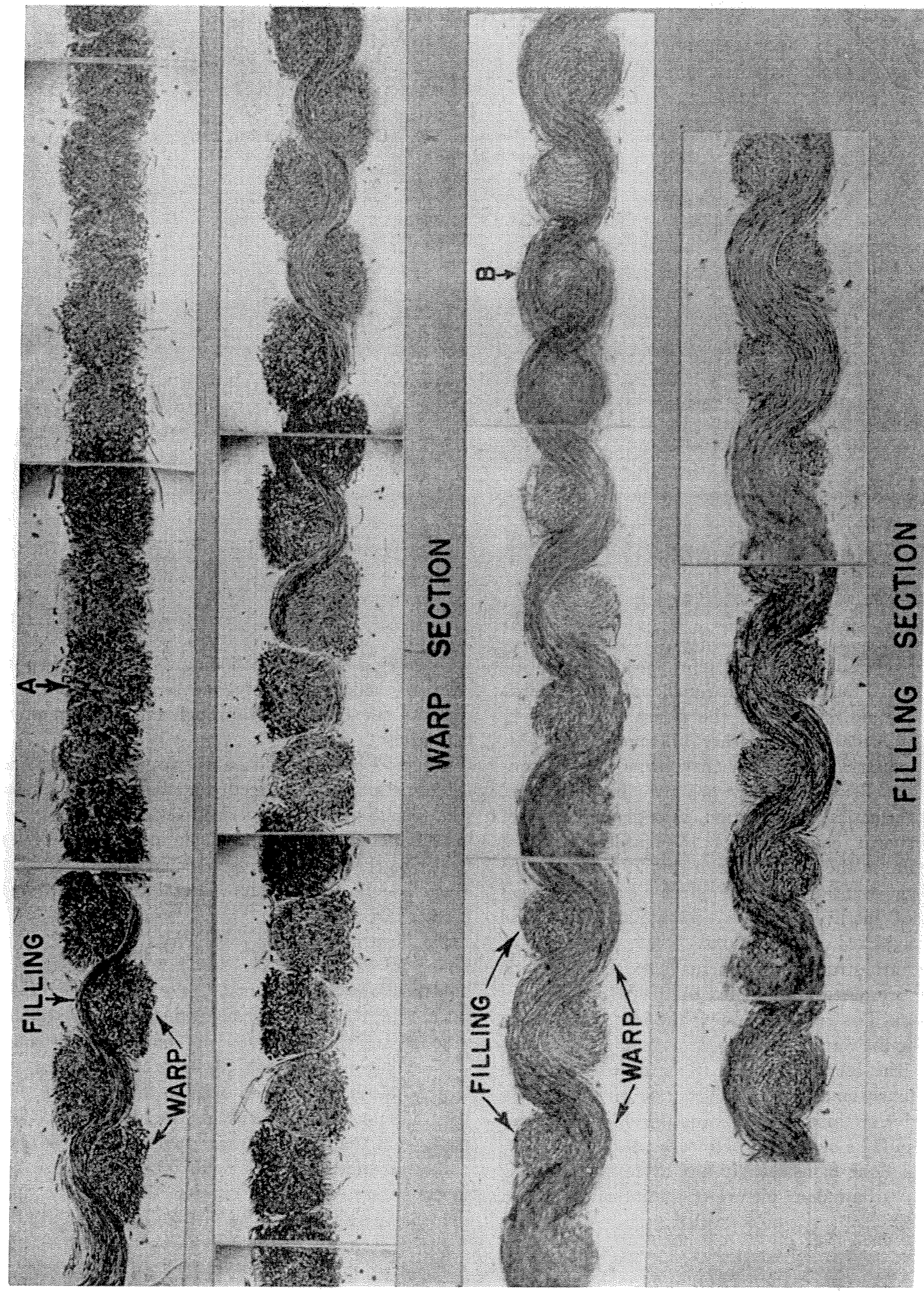

FIG. 1. *Oxford fabric—diagonal cross sections. Magnification 40 ×.*

figure) and the only indication of yarn structure is a gradation of densities between alternate yarn centers.

The filling cross-sectional view shows that inter-filling contact is prevented owing to the tight warp packing. In fact, at one point (B in the figure) along the section, portions of two alternate warp yarns are seen to be in the same plane. Finally, the relative size and crimp of the warp and filling yarns are evident upon comparison of the two sections.

Judging from the usefulness of this simple technique in Quartermaster studies of fabric structure, we believe that others may be interested in knowing about it.

Literature Cited

1. Backer, S., TEXTILE RESEARCH JOURNAL **18**, 650–8 (1948).
2. Broadfoot, H. H., Technical Bulletin, Rohm & Haas Co., Philadelphia, Pa.
3. Pollitt, J., *J. Text. Inst.* **40**, P11–22 (1949).
4. Peirce, F. T., *J. Text. Inst.* **28**, T45–96 (1937).

(Manuscript received July 14, 1949.)