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The paper entitled **“A Study of Needled Fabrics Part V: The Approach to Theoretical Understanding”** by **J.W.S. Hearle and M.A.I. Sultan**, **Journal of The Textile Institute (JTI)**, **Volume 59, 1968, pp.183-201** is one of a series of influential contributions published by J.W.S Hearle and M.A.I Sultan in the Journal of the Textile Institute during the 1960s, focusing on systematic studies of the structure and properties of needlepunched nonwoven fabrics. Together with the other papers in the series, this work has become an important source of reference, informing teaching and research for over fifty years: Hearle, J. W. S.; Sultan, M. A. I. *JTI*, 1967, 58, 251-; Hearle, J. W. S.; Sultan, M. A. I.; Choudhari, T. N. *JTI*, 1968, 59, 103-; Hearle, J. W. S.; Sultan, M. A. I. *JTI*, 1968, 59, 161-; Hearle, J. W. S.; Sultan, M. A. I. *JTI*, 1968, 59, 237-; and Hearle, J. W. S.; Sultan, M. A. I. *JTI*, 1969, 60, 478-.

Following rapid growth of the nonwoven manufacturing industry from the 1950s, improved understanding of nonwoven fabric structure, and its relationship with mechanical properties, was essential to support new product development and enable improvements in fabric performance. However, in these early days, relatively few basic scientific studies relating to the structural mechanics and performance of nonwoven fabrics made by different manufacturing techniques were available in academic journals.

This JTI paper was the first to grapple with the specific complexities of needlepunched fabric structure (rather than chemically bonded or thermally bonded nonwovens which are structurally quite different), with the aim of understanding how fabric strength is developed within the fibrous network. Hearle and Sultan systematically develop an early-stage theory, based on the observed characteristics of needlepunched fabric structure reported in their other papers in the series. This required going beyond reporting simple experimental measurements, to attempt a quantitative analysis, albeit as part of a highly simplified model.

The paper is presented with the unique clarity and logic, that characterised so much of John Hearle’s work. The analysis considers important factors relating to fibre network theory, modes of inter-fibre bond deformation, frictional resistance to slippage between fibres, as well as considering the role of fibre entanglement, fibre length, fibre friction and fibre fineness.

Although the assumptions and theory in this paper are simplified, it established important scientific groundwork for studying the structural mechanics of needlepunched nonwovens. As remarked in the Conclusions (p.201): *“Although we are still a long way from deriving a sound theoretical treatment of the mechanics of needled fabrics, the qualitative and the approximate quantitative theories derived in this paper do point the way, and indicate roughly the influence of various factors”*. In so doing, this paper made a major contribution to addressing a significant gap in the academic literature and provided important theoretical foundations for the study of mechanically bonded nonwoven fabrics, that are still relevant today.

Professor Stephen J. Russell