Shadow Tissue: A Woven and Print Collaboration through Practice-led Research

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ABSTRACT  Shadow tissue is a fabric developed from printed warp yarns, followed by weaving with variable weft yarns. The weaving allows a shift in the printed pattern, creating a shadow effect. The process was perfected by Lancashire company Turnbull & Stockdale in the 1920s. Recently, the successor firm Turnbull Design has productively brought this style into a contemporary context by digitally printing the warps. Evidence of the past hands-on experimentation with the technique survives in the Turnbull & Stockdale archives, as sample books and fabric lengths. As a practitioner, I was interested in the process, but did not have the historical background to dig deeper and understand more behind the evolution of the process. Consequently I sought out the assistance of textile historian Dr Philip A. Sykas (Manchester Metropolitan University). Our collaborative proposal, “Experimental Archaeology Meets Textile Design: The Rediscovery of Shadow Tissues,” received a research grant from The...
Leverhulme Trust. The project was envisaged as a discovery of the lost technique of shadow tissues, with historical facts uncovered and communicated by Sykas. Both of us worked in an archaeological manner, literally and metaphorically excavating the archives and digging among ledgers, designs, annual reports, and samples. Practical work began with an experimental and responsive approach to testing techniques, reported back from initial findings by Sykas. This article charts the development of this two-year research project, from the archival information, through initial investigations, to finally understanding the possibilities of innovation through thinking and making.

KEYWORDS: print, weave, archive, warp printing, shadow tissues

Introduction
The shadow tissue process was a technique employed by Turnbull & Stockdale in the 1920s. It was a method shrouded in tacit knowledge and consequently this project required the skills and observations of three parties: a historian, a printer, and the commercial owner of the archive. The aims of the project were not to mimic the old and reproduce new textiles in a contemporary manner but to dig deeper and understand the methods used in the 1920s and reenvision these in a new form. This was achieved by systematic trialing through textile weaving and printing practices, while at the same time responding to historical facts. This paper is not intended as a study of the historical technique and the workings of Turnbull & Stockdale but to illustrate how, through uncovering past knowledge, I could create and develop new ways of looking at this complicated hybrid technique, which requires the mastery of print and weave methods, and at how these methods can interchange and work together, each informing the other. This interchange has occurred in both a theoretical and practical manner and at the same time has expanded the practice of a weaver and printer.

The shadow tissue project offered a vehicle for the playful interchange of techniques and a familiar way of working using a different language. From the beginning it was important not to mimic the past but to have a more scientific approach, to explore the historical technique in the manner of experimental archaeology—a strategy aimed at a deeper understanding and avoidance of copying methods. I am naturally collaborative, but this was a more complex undertaking because it was multidisciplinary. My collaborators were the textile historian Dr Philip A. Sykas, with experience in company archives; the textile entrepreneur, Paul Turnbull, owner of Turnbull Design Ltd and great-great-grandson of the founder of Turnbull & Stockdale; and a research assistant, weaver Beth Milligan. While Milligan and I could work side-by-side, contact with the others was less frequent.
and more often through written communication rather than face-to-face meetings. This allowed time to digest and fully explore the historical and critical dimensions brought sporadically to the project by Sykas and Turnbull, while still maintaining artistic independence. In this way, we did not merely follow the historical pathway, while flagging up areas where tacit craft-based knowledge contributed to its development. Rather we were able to freely and creatively evolve new ways of exploiting shadow tissue techniques that bring in current materials and technologies. The following text is an indication of the step-by-step analysis of research methods and thinking that is aligned to process.

Methodology
The approach to this project is clearly practice-based, bringing together through experimentation, discussion, and analysis the skills and knowledge of a weaver and printer. The practical work was driven from a historical perspective, allowing the practitioners to tease out and digest through practice the rediscovered archival information. This approach to practice engages in understanding the origin of technique across disciplines while at the same time working with a practical agenda bringing about new techniques and cloth, built from a base of experimentation in response to historical methods. Without the historical platform to start from we would have had no basis for forming our opinions for development. This is exemplified by understanding that, in the past, slippage of printed warps (a shifting of the printed image on the warp before weft insertion) was a continual technical challenge for the weavers; however, this was something we ultimately sought to create as an opportunity to be exploited.

Reflective Practice: Analyzing and Making
Sykas began his historical investigation of the Turnbull & Stockdale archives three months prior to the start of the practical research. This was a strategic collaborative plan to allow the historical findings to feed into the practical stages—to encourage an interaction that would inspire or provoke our work. Prior to the first report being presented we proceeded with the simplest form of a shadow tissue, and stripping back the complications of print we reflected on The Techniques of Kasuri by Jun and Noriko Tomita (1982). Working within this ostensibly simple technique (also known as Ikat), cotton and linen yarns were selected, wrapped, and dyed. Our dyed yarns were set up for weaving as single or paired warps. From working through a series of trials, we observed how seemingly minor variations in the weaving process could make a considerable difference. For the first trials (Figure 1), the warp and weft used the same base yarn, limiting the variables so as to highlight the changes brought about by different lifting plans on a basic four-shaft loom:
1. 1/3 twill—weft-faced on one side and warp-faced on the reverse.
2. Balanced 2/2 twill—where the same amount of warp and weft is visible.
3. Plain weave.

This elementary manipulation changed not just the texture, but also the color and intensity of the pattern. This exploration was an important step for easing us into the research, priming our capacity with a solid grounding of tactile and practical process-led understanding.

**Color and Conversations: From Tied Resist to Multicolored Warp Printing**

Having played with hand-tied resist warps and the effects of basic weaving variations, it was time to consider color. As a result of discussions about historical color constituents, Sykas put us in touch with some source materials of the shadow tissue era. “The Whys and Wherefores of Calico Colour Recipes” (McGregor 1927) made it clear that color was not just a matter of dyestuffs but also of thickeners. Like our 1920s colleagues, we were to find that the “whys and wherefores” of something as straightforward as thickener selection were profound. During a conversation in 2011, we discussed our problem of clogged warp threads; it must be remembered that, in
warp printing, the printed color paste remains on the warps throughout the weaving process and presents a considerable obstacle to the weaver. It was only through historical research that we discovered that nineteenth-century weavers used special reeds that could be lowered to expose a fresh portion of the reed as it became clogged with paste. Sykas suggested that we consult Knecht and Fothergill’s *Principles and Practice of Textile Printing* (1942). It became clear from this text that gum tragacanth was an alternative thickener, which prevented the warps from clogging. This was tested in conjunction with a mercerized cotton yarn, as by then Sykas had also brought our attention to the early work with mercerized yarns at Turnbull & Stockdale. The use of gum tragacanth solved the clogged warp problem, but the color yield was lower. Adoption of mercerized yarn did improve handle and helped to recover some of the lost color yield from the use of gum tragacanth. Our experiments led us to choose reactive dyes, which require the use of alginate thickeners, but we continued to use mercerized cotton yarns. In conversation with Turnbull, we were guided by a desire to develop a process viable for the present day, rather than clinging too closely to historical procedures.

**Abbotsford: A Turnbull & Stockdale Classic**

Observing the hand-blocked printed samples of shadow tissue in the company archive, we were astonished at the technological feat that had been achieved by Turnbull & Stockdale in the early 1900s. These samples spoke clearly of their knowledge of design, yarns, colors, print processes, weave construction, and loom control. From our initial trials we knew that minor alterations made big differences, and this would be multiplied in an environment of complex repeat designs of twelve or more colors. Turnbull chose the pattern that was to mark our first unraveling of the craft knowledge embedded in shadow tissues: “Abbotsford,” a thirteen-color archive Jacobean-style pattern, designed by the Haward Studio early in 1919. Initially hand-block printed on linen, using the pattern as a shadow tissue probably first occurred in the 1920s; its bold color separations, and its ability to withstand the vertical compression caused by weaving, made “Abbotsford” a suitable candidate for warp printing. The clarity of color separation in the pattern made it a good vehicle for us to try different yarns, weave densities, and depths of shade, all of these properties yielding valuable information from which we could develop our own interpretation of a shadow tissue, backed up by historical findings. We adopted “Abbotsford” as our own way of looking back at the original process with an experimental eye, not only to test techniques suggested by the historical work, and thus embrace experimental archaeology, but also to pose new questions. In order for us to systematically work through the historical possibilities suggested in Sykas’s reports, the technical scenarios were broken down into the following categories for practical investigation.
1. **Screens and Coloring**
Paradoxically, regardless of whether a cloth is woven or printed, it is defined in the same way through pattern, color, and texture. But this common ground is blurred by years of practice within a particular discipline. Within the context of collaborative research, it was crucial for a printer and weaver to exchange skills and ideas. For a weaver who has not printed before to be faced with thirteen screens to register and match is a daunting task. Likewise, printing on an unstable warp was outside my comfort zone. Nevertheless, removal of familiar tools and studio practices creates an appropriate milieu for collaboration to take place.

2. **Abbotsford Weave**
In a shadow tissue, the printing is done on a set of parallel warp threads. Creating this warp has much in common with the ordinary process of setting-up for weaving. For our tests, we aimed at a balanced plain-weave structure where approximately equal amounts of warp and weft would show in the final fabric. In order to hold the warps in place during printing we prewove bands at intervals along the warp to keep the warp threads from slipping relative to each other, and to enable the warp to be held in tension across the print table. Later on in the project we were to exploit slippage as part of the design process. This thinking would certainly not have been relevant in the days of Turnbull, who strived to control slippage. Historical shadow tissues often played with the contrasting effects given by light- and dark-colored wefts. Light-colored wefts make the overall tone paler, but preserve the contrast in the light colors, while dark-colored wefts make the overall coloring darker but retain the contrast between the dark colors, making these appear more intense. We tried both effects, in addition to combining two shades of yarn as often seen in the historical shadow tissues, where it provided a visual texturing effect (Figure 2).

3. **Yarns and Conversations**
Early on in the plan we visited Manchester to view images that Sykas had assembled from the archive and to discuss what could be gleaned about the historical technique. He had already brought our attention to the possibilities of mercerized yarns, which absorb dyes more readily, prompting us to explore the effect of mercerized cotton on our samples. He found that most manufacturers of shadow tissues stuck mainly to easily engendered differences caused by using either light wefts or dark wefts. Our print color tests had illustrated the effect of light wefts interacting with warp dyes of full-strength shades. We had also observed the effect of substituting dark for light wefts on the “Abbotsford” pattern. The shift in appearance and color balance from such a simple substitution was dramatic and seductive. The next stage in our systematic trialing was to extend our experimentation by looking at yarns, now taking into consideration
Figure 2
changes in weft texture through examination of contrasting wefts. In order to explore this systematically we subdivided areas for consideration, focusing our experimentation on the contrasts seen in Turnbull & Stockdale’s woven patterns: smooth versus slubby, thick versus thin, and bright versus mat. Sykas also referred to paired wefts creating randomized texture. This could either be a visual texture deriving from two contrasting colors, or an actual texture through the use of fancy yarns. Using two contrasting weft colors thrown in the same shed allowed a random packing of yarns whereby sometimes one, sometimes the other, lies on top. Our experiments uncovered some of the huge potential in such color effects. Photomicrography (images taken through a microscope) also revealed some of the “know-how” hidden within the surviving samples. It was observed that small differences in the density of the weave—a change of two wefts per centimeter—could produce noticeable variations through the degree of movement allowed in the packing of the contrasting wefts. With fancy yarns, the interactions are more complex than with colors; the thick and thin parts of the yarns can cluster to form wave effects. Such weft effects seem to complement the randomized slippage of printed warps, further blurring the edges of the design. Contrasting colored wefts lend visual movement, while slubs and other fancy yarns lend depth, to plain weave structures that might otherwise appear flat or static. These experiments reinforced our idea that in the shadow tissue technique the fabric is actually an intersection of two patterns—the second pattern being the structure that the weft layers into the printed design.

At this stage in the research we had created many samples of multiple variations based on our own trials prompted by the Sykas reports; at this point the trials are too numerous to recount in detail and the stages of development outlined above are just a flavor of our thinking and the methods applied.

Illuminating the Shadows: A Pivotal Moment

Up to this point, our explorations had proceeded from the technical knowledge fed back from historical reports and from viewing the archive samples. We had gained an understanding of color linked to warp and weft changes and the transformational character of print/weave processing. Regular reviews had been invaluable in the critique and analysis of how historical findings mapped onto our experimental work, but I now felt a need for a change in direction; a shift that would incorporate my past experience in screen-printing methods alongside the new-found knowledge of the shadow tissue technique.

I began to question what was missing from the traditional warp print. One issue related to the lack of strength of color, first brought about by the inherent character whereby the weft shade interrupts or blends into the print and warp colors. In 1932 William Turnbull wrote: “whereas the result of using a white or cream weft is to take away
50 per cent of the colour value, the effect of black weft increases the depth of the shades.” While the weft effect can be exploited as an attractive quality of shadow tissue, I wanted to try and change the emphasis in order to create a stronger color palette. All the printing applications we had used up to this point were employed in Turnbull & Stockdale’s time—either direct printing, where the print color is darker than the ground color or, if the ground is dyed, where a “fall-on” print color modifies the ground.

During my time at Belford Prints (1986–2004; my own fabric-printing company), I had thoroughly explored discharge printing, a style where the printing removes the ground color. I proceeded with a somewhat alchemic approach, using trial and error to seek innovative results. Discharge is a printing method that is difficult to control, but I felt it offered the possibility of achieving a stronger color palette. Modern discharge formulas enable light or bright dyes (illuminants) to be printed at the same time as a ground color is removed, giving dramatic effects. Our first trial was naturally “Abbotsford” and using hand-dyed yarns, working on the basis that “less is more”; we selected four of the thirteen screens for the chosen illuminating colors. The results we achieved were in line with expectations of a stronger color, lending an entirely fresh look to the shadow print technique (Figure 3).

Following on from the traditional “Abbotsford” design we felt it was time to generate new designs in which ideas could be developed to promote the combined processes of discharge warp

![Abbottsford discharge shadow tissue. Beth Milligan, 2014.](image)
printing. To help achieve this choice of design, we experimented with simple geometric patterns, allowing us to create simple options quickly and letting the technique as opposed to the design do the work. From trials we selected two patterns with woven-textile references, “Herringbone” and “Houndstooth,” thus lightheartedly adding another layer to the print–weave concept. By selecting such simple and familiar patterns, we would also be better able to understand the shifts away from the familiar brought about by a change of process and to assess the variations that would occur. A sense of play was reentering the work after a long sojourn into archives and controlled experiment (Figure 4).

Figure 4
Following on from the simple geometrics and knowledge gained from working with these recognized shapes, we needed to develop this technique with a sideways attachment to archives. This arose from a visit to Turnbull Prints in January 2012, when there was a chance to break away from the dissected research and explore found designs from the archive of the 1960s. I was searching for just one or two patterns, simple in character but good color carriers, to form the next series of shadow tissue experiments. Editing from hundreds of designs was difficult, but the choice was made easier by knowledge gained in the earlier parts of the project, which had given a sense of the type of pattern that responds to the transformative procedures of a shadow tissue. Had I selected designs prior to the trials my considerations would have been from a pure print perspective. While I was searching in the archive, Sykas was cataloging a pattern book containing one of the last shadow tissues produced by Turnbull & Stockdale—a pattern known as “Feathers,” originally designed for a woven texture in the early 1930s. “Feathers,” a four-color print already developed as a shadow tissue, easily lent itself to further investigation. It had the beauty of a classic geometric, with a simple pattern of regular curved shapes that could be varied by the rhythm of the coloring. I sensed it would be an adept vehicle, not only as a direct print but also in discharge printing and different weave structures.

One of the main problems faced with warp printing is to control slippage; examination of archive samples illustrated that Turnbull & Stockdale controlled this with technical supremacy. However, during some of our trials we inevitably encountered slippage (Figure 5), and on close examination of these trials observed that this often happened completely around the printed shape, giving a halo effect or a double shadow tissue effect. We tried many times to recreate this in a controlled manner, the irony being trying to manage an uncontrolled outcome. Searching for this controlled look led us into a new area of warp shifting, giving rise to unexpected results.

**Floating Textures**

To date, most of our exploration had used the printing process as a variable, while the final fabric was realized in a plain-weave structure. Not wishing to neglect the potential of weave in shadow tissue development, we decided to try the effect of some textured weave structures on our printed warps. I was reflecting on Milligan’s previous work and her mode of thinking as a weaver. I now wanted the project to capture more of this cognitive process. Printing starts with a fabric and takes it through a set of transformations, usually focusing on color; it can be very direct and interactive. Weaving begins with yarns and a conception of their interaction in three dimensions, taking in what happens on both sides of the cloth as it is being formed. The preparatory work is extensive and generally determines the final result. In any craft, such habits of thought become
Figure 5
embodied through experience and eventually give the practitioner a different approach to the process of creating work. Working collaboratively allows one to engage with another perspective and also reveals the submerged apparatus of our own thinking.

As a printer interested in “alchemical” transformations of cloth, I was fascinated by the three-dimensional, tactile qualities of Milligan’s fabrics, in which color can be used quite sparingly. These fabrics resulted from her understanding of cloth structures, coupled with skill and patience in the setting up of the loom. The resulting textures were something I felt could be exploited in the shadow tissue project. We wished to expand on this work and think about how we could use the printed image in a less obvious way, aiming to produce fabric textures that the casual observer would not be able to identify as printed or woven and lending the cloth a mysterious “floating” character. Milligan found it a natural progression to move on to an eight-shaft loom allowing the possibilities of twill structures, influenced in part by our printed Herringbone design. This was an opportunity to feed back another layer of geometry into the design; progressing from Herringbone we returned to “Feather” and, seeking a contrasting color palette, inserted a black weft (Figure 6). This gave the effect of a tapestry weave, intriguingly similar in appearance to some of the discharge-printed “Abbotsford” trials. This effect was a desirable result, and from a production perspective, being able to obtain it without the chemical complexities of the discharge process was an added bonus.

**Deconstructed Shadows**

The experimentation with weave structures began to take our shadow tissue technique to another level. Whereas our earlier samples were occupied with the technical mastery of combining weave and print, and delving into the traditional aesthetics of warp prints, the new results revealed further potential. But while the painterly and tapestry-like effects were pleasing, we still sought something that more fully exploited the synergy of print and weave—not combative but transformative.

Looking back on our work, we found a glimpse of what we were looking for in the haloing effect caused by accidental slipping of the warps during previous trials (see Figure 5). Historically, slippage has been a problem associated with warp printing, and great pains were taken to stabilize the fluid warp yarns and keep them in adjustment while weaving. From our contemporary perspective, we saw that slippage could be an opportunity as much as a problem. Working on an eight-shaft loom had amplified the possibilities of slippage, and we considered how we might exploit this—to make it work in realizing a fabric whose appearance speaks of its hybrid creation. Slippage, along with our knowledge of design and structures, could expand the element of randomness always present in shadow tissue. To better measure our progress in a controlled “distressing” of a
Figure 6
pattern, we felt that the starting point should be as precise and linear as possible. A hand-drawn stripe was selected, printed running at a ninety-degree angle to the warp, as opposed to the original setup of running parallel to the warp. As we learned to expect from previous experience in this research, minor variations could result in significant changes, and our expectations were not disappointed. The basic stripe took on a sophisticated tonal quality (Figure 7).

To develop the concept of slipped straight lines printed at varying angles we selected a dodecahedron as the basis for a new pattern (Figure 8). This was executed as a single-color screen, with shading lines on the design set at different spacing to allow for a shadowed or tonal feel. Our version aimed at a double shadow by permitting the printed lines to shift and slip. At the onset of the project we would have considered this a totally unsuitable design, owing precisely to the problems we now sought to exploit. Our direction was now emphasizing the qualities of the print–weave mixture. Neither obviously print nor weave, the rigid geometry of the design disappeared, and the weave structure was able to assert itself in twill lines and bands. This look satisfies an aesthetic that moves beyond the modernist use of natural surfaces and reintroduces a hand-crafted element.

Figure 7
Deconstructed stripe, before (hard stripe in the background) and after (smaller fabric swatch on top).
Beth Milligan, 2014.
The pleasure in the shaping derives from an uninhibited natural flow interacting with a structure imposed by human thought, combining nature and artifice in equal measures.

**Conclusion**

When embarking on the initial grant application with Sykas several years ago, we had a notion of what we wished to achieve, initially prompted by different professional connections with Turnbull. The
first thought was to see what we could find out about the shadow tissue prints within the extensive Turnbull & Stockdale archive. In the beginning it was a slow process, looking back and relearning the basics of Ikat and then spending months working on the classic Abbotsford print, many times not really wishing to ever see it again. This was, however, a very important part of laying down our foundation of techniques and understanding, methodically recognizing the importance of small changes making big differences. If we had tried to do this project in less than two years we would never have achieved the depth of quality and a measure of the enormous skills achieved by Turnbull & Stockdale. This prompted the necessity for deeper inquiry on our part, to go beyond the literal, and this manifests itself in the later designs and techniques such as the discharge warp printing and the slipped dodecahedron. The strategic method of research, reflection, and making was critical to eventually leading us to the later implementation of innovative and successful warp-printed designs that are neither a print nor a weave, but can stand alone as a new mysterious shadow tissue. None of this work would have been achievable without the trust of and permission from the Turnbull family, including Paul Turnbull and his commercial vision; Philip Sykas, who painstakingly unearthed valuable snippets of information that had a large impact on our knowledge base; and Beth Milligan, who generated the print and weave samples. Both the printer and weaver involved in this project have extended their own practices through the methods employed, and the careful analysis of these practices have the potential to lead to rich new insights.

Acknowledgments
I would like to thank The Leverhulme Trust for funding the project. Thanks are also due to the Research Institute of Art and Design, University of Ulster, and to Dr Philip A. Sykas, as co-researcher with myself on the project. A full version of the project is available online from MMU Online Store: http://buyonline.mmu.ac.uk/browse/extra_info.asp?compid=1&modid=1&catid=110&prodvarid=93

Note
1. Mercerization is a process invented by John Mercer of Great Harwood in 1850, whereby treatment with a strong alkali makes vegetable fibers more receptive to dyes.

References