NATURAL DYES

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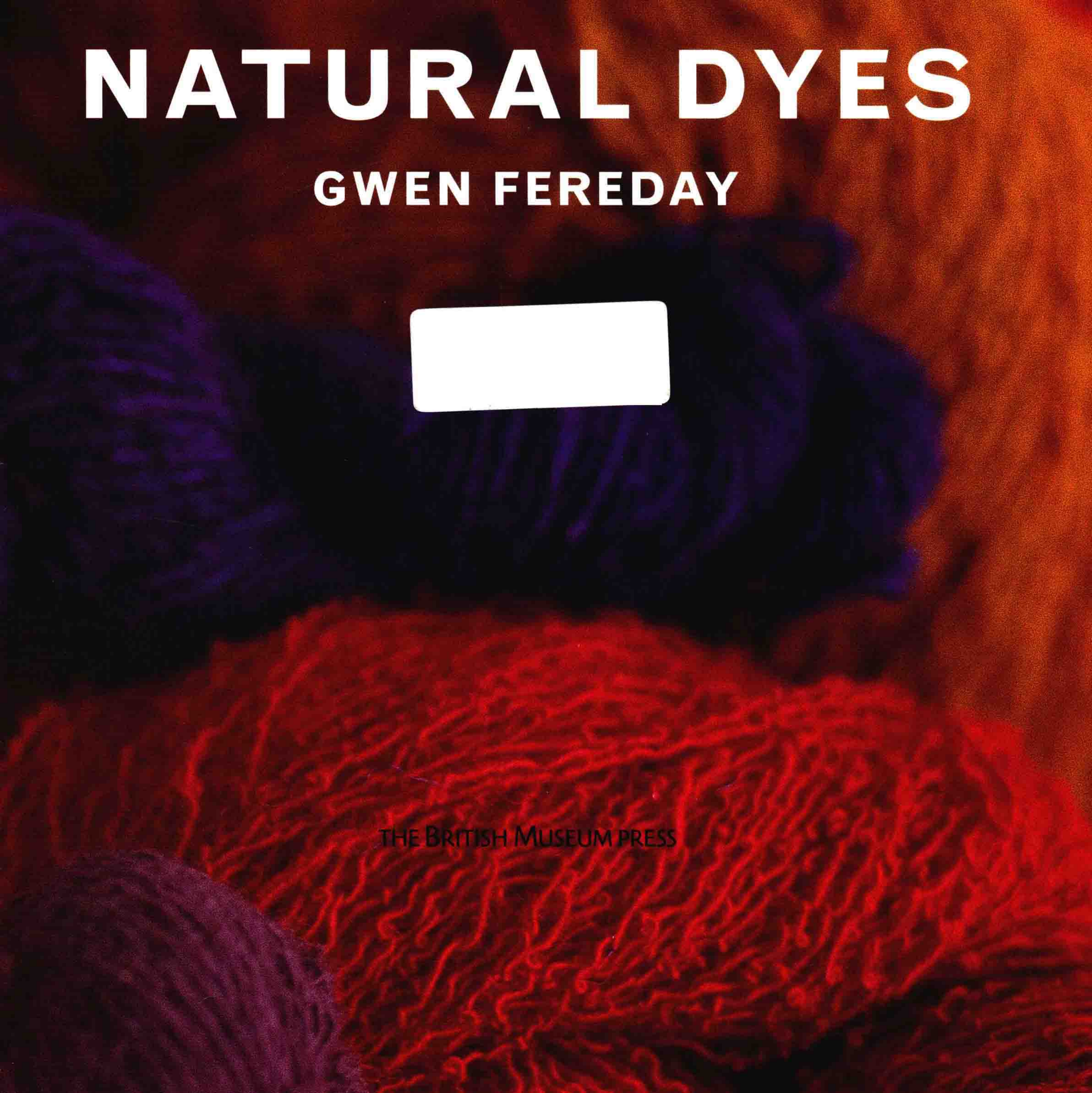

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CONVERSION CHART

WEIGHTS AND MEASURES
Metric with approximate Imperial and American equivalents:

1 gram	=	0.04 ounce
100 grams	=	3.53 ounces
5ml	=	1 teaspoon
15ml	=	1 tablespoon
30ml	=	1 fluid ounce
1 litre	=	1.76 pints
		2.13 US pints

TEMPERATURE
To convert from Centigrade to Fahrenheit:

$9 \times °C/_5 - 32 = °F$

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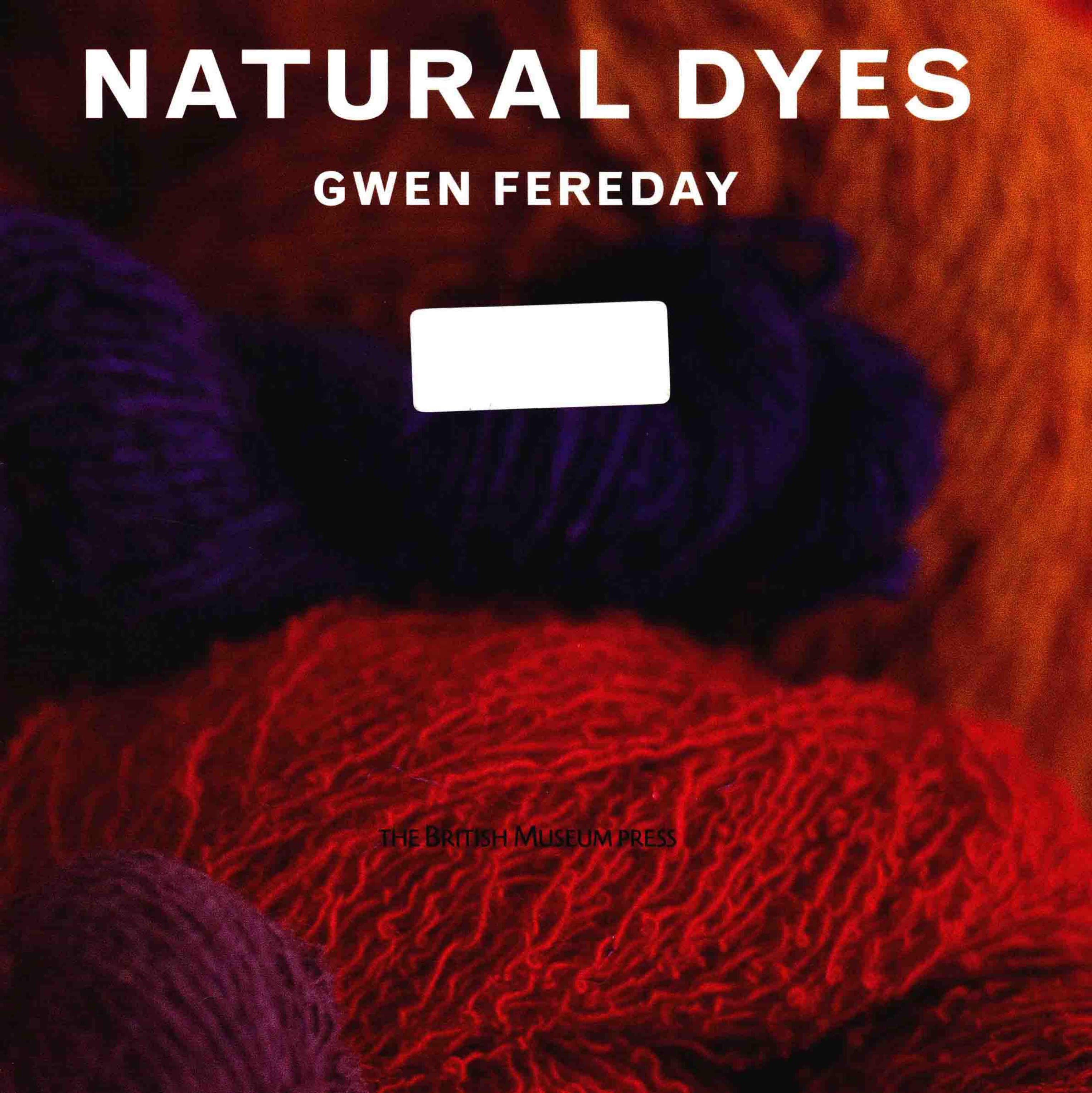

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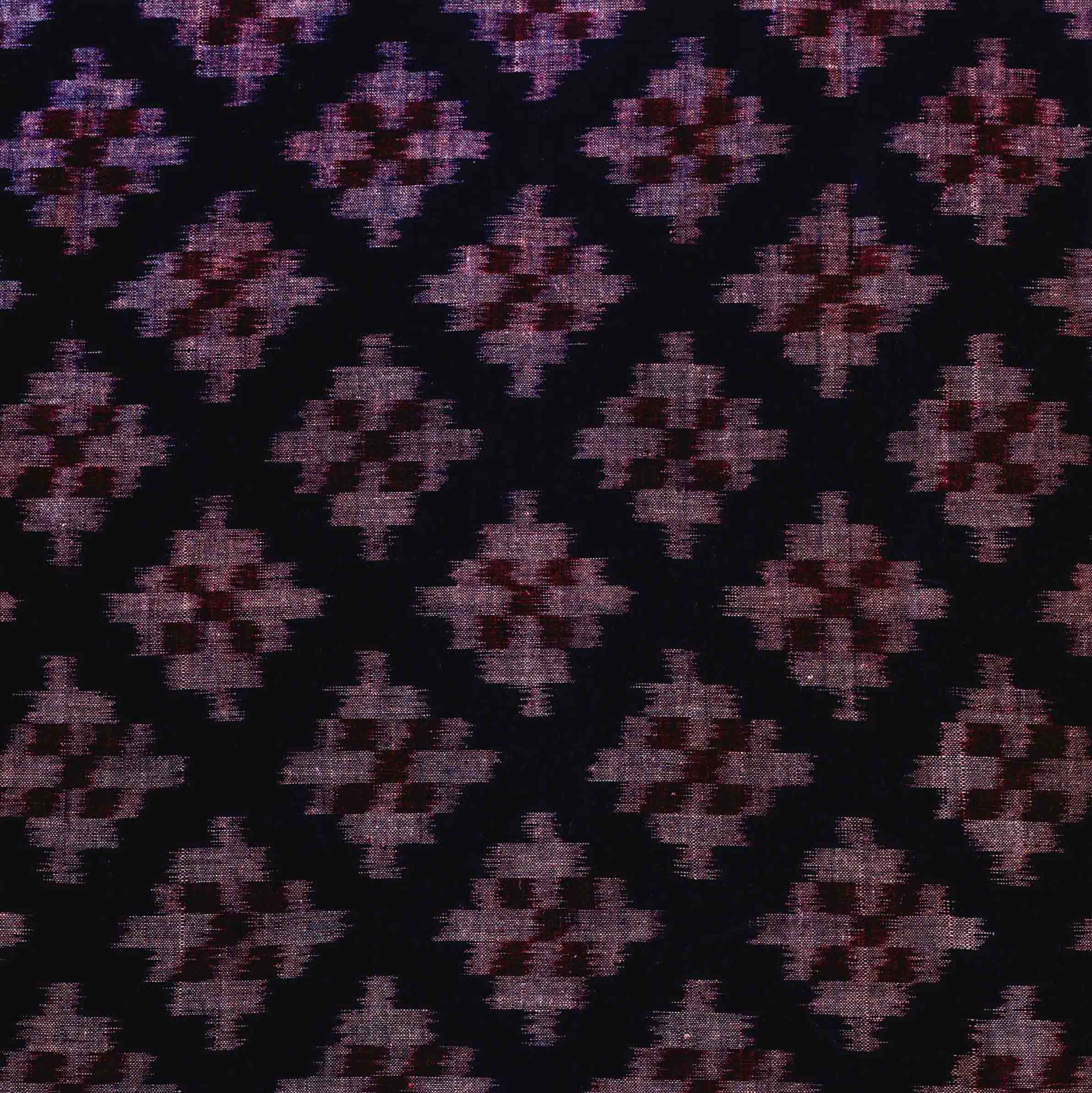

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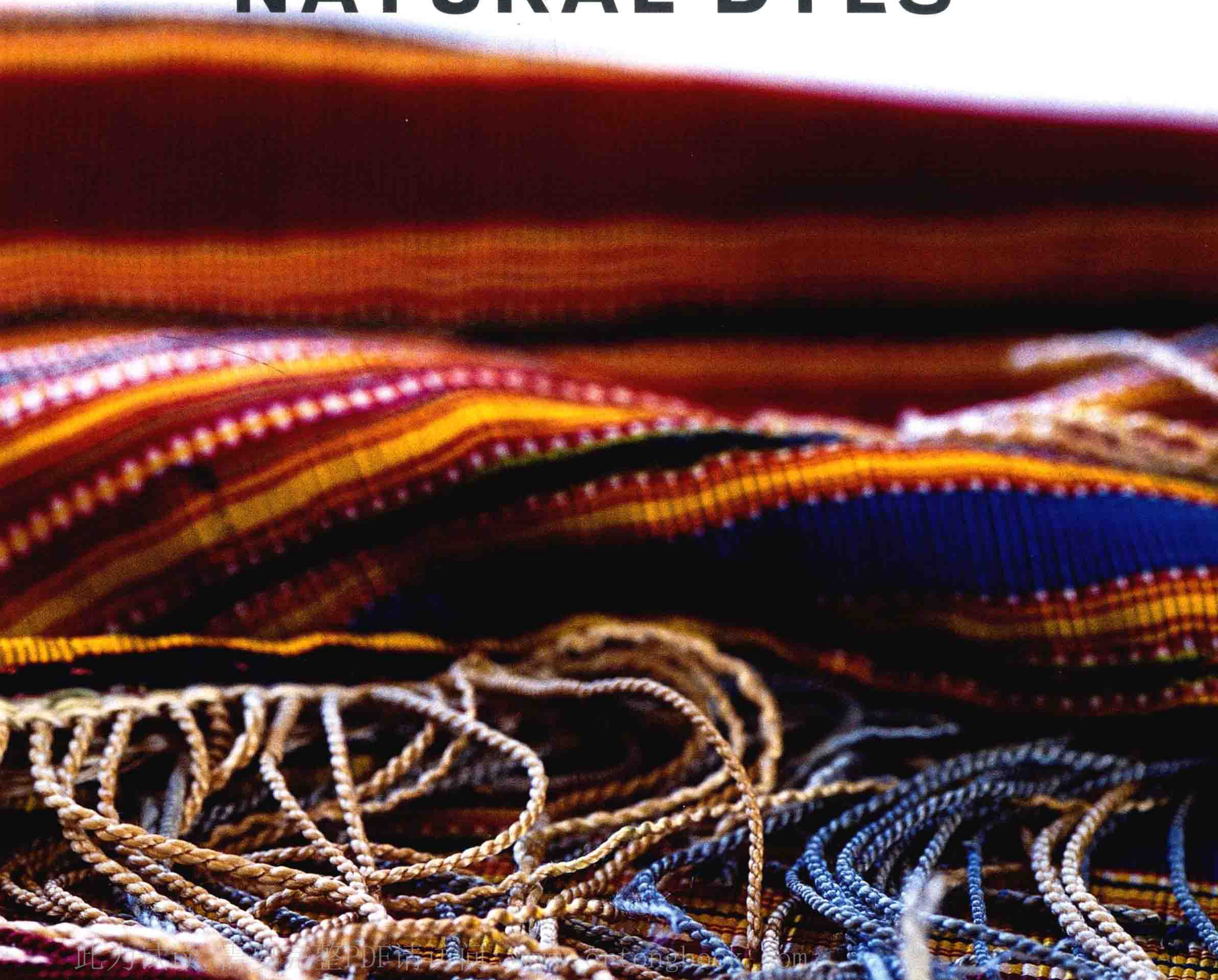

INTRODUCTION

Nowadays we are bombarded with colours, but so many of them give a rather shallow experience to the discriminating eye. Natural dyes reacquaint us with a high-quality sensory experience that can help to inform and refine our colour sense. I have chosen to work with five of the major historic dyes that have been in use for centuries. I have purposely worked with a limited number of raw materials in order to show something of the extensive range of colours that it is possible to create through mixing, over dyeing and mordanting. Although it is impossible to reproduce all the subtle nuances of some of the colours illustrated in PART TWO of this book, I hope the variety and potential of these permutations are apparent.

Why use natural dyes?

The resonance and richness of natural dyes are impossible to reproduce with synthetic dyes, just as synthetic dyes cannot be replicated by natural dyes. I have in mind certain electric blues and fluorescent colours. Synthetic dyes have a purity and clarity as well as a flatness and harshness depending on how they are used. Although I find these qualities very interesting to work with, I cannot help, however, returning to natural dyes on a regular basis. Whatever wonderful technical advances have been made in the textile trade, the quality and character of natural dyes have not been surpassed.

The danger is that today our expectations are governed by mechanized production. With industrialization, our culture began to lose touch with the raw materials of production, and now it is usual to expect sameness, regularity and standardization. Irregularity is seen as inferior. Although I am not recommending we retreat to a romantic view of the past, there are traditions that we can perpetuate. Quality of colour is definitely one of them.

The process of natural dyeing

The preparation and application of natural dyes is a complex process, involving a series of treatments that varies according to the chosen fibre and desired end-colour. When something is dyed, tiny molecules of soluble coloured matter stick to the fibres of the material being dyed. This sticking process is strengthened by mordants (metallic salts) that increase the dyestuff's ability to bond with the fibre and help improve its fastness. The techniques involved in this process are fascinating and varied and have been developed over many centuries.

The development of natural dyes

While it is not known exactly when natural dyes were invented, they have been in use for thousands of years in many regions of the world. From the time people started dyeing, they would have collected their own ingredients and experimented with what was available. Knowledge would have been passed on orally and kept within the family, tribe or clan. Dyes, their recipes and their usage were regionally distinctive. While some cultures still maintain their distinctive regional identity, the general trend has been towards diffusion. Regular trading routes played their part in this, making available new exotic dyes and materials, which enabled the establishment of larger-scale, less localized production.

Revival and continuity

The invention and growing use of synthetic dyes in the nineteenth century contributed to a loss of knowledge that had been gathered over centuries. In the early twentieth century, Ethel Mairet (1872–1952) and Elizabeth Peacock (1880–1969), pioneers in the rediscovery of the craft tradition of woven textiles in Britain, undertook valuable research into dyeing pratices.

Ella McLeod (1908–2000), who was responsible for the development of the textile department at the West Surrey College of Art and Design in Farnham (now the Surrey Institute of Art and Design, University College or SIAD), had direct links with these pioneers. Ella's connections with this on-going craft movement fed into her work in education and her collaborations with colleagues.

One of her colleagues, Margaret Bide, was my tutor when I studied weaving and dyeing at Farnham in the early 1970s. She gave me access to recipes and information which she, in turn, had gathered. All this proved invaluable to this project since it has given me the confidence and freedom to experiment and develop my colours, particularly in the dyeing of cellulose fibres, and very particularly in the development of the colour Turkey red.

This book represents an introduction to colour mixing and verifies the validity of continuing to work with time-consuming natural dyestuffs.

HOW TO USE THIS BOOK

The book has been divided into two parts: PART ONE introduces you to the various processes involved in natural dyeing and gives you an overall view of the sources of natural colour; PART TWO is devoted to colour charts, showing a wide spectrum of colours, accompanied by individual recipes. The colours in the charts use only the five historic dyes of madder, indigo, cutch, cochineal and weld, combined with a range of mordants (fixatives) and treatments. The colour charts are broadly based on a 'twelve-hue colour wheel' and there are over five hundred shades from which to choose. You may have an idea of a particular colour that you would like to produce, or you can use the colour swatches in PART TWO for inspiration.

Keeping accurate records of what you have done and how you have done it is vital.

Recipes

PART ONE contains recipes that demonstrate the basic techniques involved in dyeing both animal fibres, such as wool and silk, and vegetable fibres, such as cotton and linen. These are written out in full and form the basis of the abbreviated, but more particular, recipes in PART TWO.

PART TWO is sub-divided into recipes for animal and vegetable fibres. The recipes are numbered – each number relates to a colour shade on the opposite page. The abbreviated recipes are written in the order of procedure, and give the quantities of ingredients needed. They cross-refer to the recipes in PART ONE, and any deviations from the basic recipes are written in *italics*.

KEY TO ABBREVIATIONS:

g = gram/s
ml = millilitre/s
sec = second/s
min = minute/s
hr = hour/s
% = percentage (of dry weight of material)
°C = degrees Centigrade

Quantities

This book uses the metric system for its precision and suitability to small quantities. A conversion chart on p.104 gives imperial and US measures. Unless otherwise stated, the recipes are based on using 100g of dry weight yarn. The quantities for most of the other ingredients in the recipes are expressed as a percentage of the dry weight of material. This is simple when you are using 100g of yarn; for example 20% madder dye is 20g, 30% is 30g, 40% is 40g, and so on. Millilitres are equivalent to grams, therefore 4% acetic acid is equal to 4ml of acetic acid. For less obvious weights of yarn, this is the formula: Percentage equals number divided by 100, multiplied by the weight of the material divided by 1, for example,

$$5\% \text{ of } 50g = \frac{5}{100} \times \frac{50}{1} = 2.5g$$

Colour charts in PART TWO

All these colours have been achieved using madder, cochineal, weld, indigo and cutch, combined with a range of mordants and other treatments, such as tannic acid treatment or Turkey red oil treatment.

Each colour has been wound onto a card, and each card has three shades of the same colour: a dark, a medium and a pale, arranged from left to right. Sometimes the tonal difference between the colours is quite marked and at other times it is less apparent. More dyestuff may result in a denser shade or a warmer or cooler effect. These differences are occasionally very subtle but I have chosen to keep them as part of the record.

The materials

Yarn skeins or hanks (loosely coiled bundles of yarn) have been used in all the recipes in this book. For the recipes in PART TWO, I have used a worsted merino wool as the animal fibre because it takes dye well. For the vegetable fibres, I have chosen a mercerized cotton because it absorbs the dye more readily than other vegetable fibres. The recipes can be adapted for use on other materials, such as unspun fibres and cloth (*see* pp.16–17).

It should be noted that individual materials absorb colour differently; it is not just the difference between how animal and vegetable fibres react to dyes. If you want to match a colour, it is crucial to carry out tests using samples of the required fibre.

Keeping records

Maintaining clear and accurate notes on what you have done and how you have done it is very important for good professional practice. It enables you to repeat a colour and also helps you to trouble-shoot if something goes wrong or happens unexpectedly.

- Always keep a sample of the colour.
- Record quantities of yarn, water, fixatives and dyestuff accurately.
- Record the pH of the water you use, as this can affect the colours obtained.
- Record the length of time taken to reach a temperature, what the temperature was and precisely how long the temperature was maintained.
- Record how long the material remained in the dye liquor.
- Record the order of the procedure: for example, was the mordant used before dyeing, or with the dye, or added as an after mordant.
- Label the finished material.

Testing for light-fastness

All colours deteriorate in time, and natural dyes are no exception. Some colours can become darker or duller when repeatedly exposed to light, while others simply become paler. If you have worked hard to achieve a particular shade, it is important to know how it is likely to change with time, especially if you are designing with more than one colour in mind. Mixing a colour by over dyeing one dye with another can also pose potential problems if one colour outlasts the other. This is why so many medieval tapestries have blue forests and grass, the yellows having faded in advance of the blues. When testing your colours at home for light-fastness:

- Mount them in between two pieces of card, leaving half the sample exposed.
- Leave your samples for one month in a window that does not get direct sunlight.
- Check them every seven days and remove a portion of each sample for your records. This will indicate clearly how the colours change week by week, as well as how quickly this happens.
- You may choose to leave your samples exposed to the light for a longer period of time, in which case if you intend to remove a portion of the sample each week you obviously need to allow sufficient material for this from the outset.
- The time of year is significant too, and this should remain as constant as possible.

Testing for wash-fastness

Everyone has experienced the frustration of one dye bleeding onto another in a mixed wash. To establish how fast your colours are to washing:

- Test your yarn by plying (twisting) the dyed yarn with a length of undyed yarn. Wash the samples in a warm soap solution.
- Keep another unwashed sample aside for comparison.
- If the sample being tested colours the undyed yarn, it can be assumed that it may colour other materials that it is placed next to.
- Some colour may wash out but not affect the undyed yarn, though the dyed yarn may look paler than before.
- To see if there is a marked difference you can wind the samples onto card for easy comparison.

Health and safety

- Treat all your materials as a potential hazard unless you know otherwise.
- Keep mordanting and dyeing away from food and food preparation areas.
- Never eat, drink or smoke while working.
- Store materials in a cool, dry place, clearly labelled and in well-sealed containers.
- Keep materials out of direct light and away from pets and children.
- Always work in a well-ventilated environment.
- Wear protective clothing, gloves, overalls and a mask to protect against dust and fumes.
- Keep lids on mordant and dye baths to reduce fumes.
- Add acids to water, *never* add water to acids, to reduce fumes, and splashing.
- Follow handling instructions on mordants, mordant assistants and dyestuffs.
- Mordants are particularly hazardous (*see* pp.24–5).
- It is often better to simmer your material than to boil it, since some mordants, such as chrome (potassium di/bichromate), give off toxic fumes when boiled.
- Always dispose of spent mordant liquor and dye material carefully, down the lavatory rather than the sink.
- It is advisable to contact your local public analyst or your sewage company for advice, if you are working on a large scale.

COLOUR

Working with colour is very personal. Colour has the capacity to evoke all sorts of emotions. While few of us have the opportunity to really study its potential as a visual language, the more you work with colour the more sensitive you will become to it. Colours never stand still, they are constantly changing as the light changes. We only have to observe our surroundings during a sunset. Colours can become quite luminous in a golden light whereas a sharp early morning light will give a totally different experience. This phenomenon has held the imagination of artists for centuries and explains why so many of them return again and again to the same subject in an attempt to capture its essence.

The science of colour

The human eye is said to perceive in the region of ten million colours or shades. Colour does not exist without light. Our brain interprets the light received through our eyes as colour. We are made aware of colour and light by means of a series of cones and rods that are situated in the retina, the lining at the back of the eyeball. The rods deal with tone, that is light to dark or absence of colour, like a black and white photograph. The cones deal with colour; there are three sets of cones: one set of cones is sensitive to red, one to green and the third to violet. There are thought to be in the region of seven million cones and one hundred and twenty million rods in each eye, and one million nerve fibres connecting the retina to the optic nerve which, in turn, connects to the brain.

Colour is revealed by light reflecting back off surfaces after partial absorption. Total absorption reveals black or lack of light, while no absorption reveals white or total light. Though light is white, when it is broken up by passing through a prism or water, the light rays separate into wavebands of different lengths and we see what Isaac Newton (1642–1727) recorded seeing in the mid seventeenth century, a rainbow of colours: red, orange, yellow, green, blue, indigo and violet.

The theory of colour

Colour can appear to change depending on which colour surrounds it. For instance, if a neutral grey is placed next to a red it will give the impression of being a greenish grey, whereas if the same grey is next to a blue, it will take on an orange tinge. This was called a simultaneous contrast by the French dye chemist Michel Eugène Chevreul (1786–1889), director of the dye works at the Gobelin tapestry factory in Paris. He also worked out a colour scale that was determined by three variables: hue, saturation and lightness. Hue refers to the colour itself; saturation to the intensity of a colour; and lightness refers to the lightness or darkness of a colour, its tone.

The twelve-hue colour wheel

The colours in PART TWO are loosely based on the 'twelve-hue colour wheel' as devised by Isaac Newton and developed by Johannes Itten (1888–1967), a dominant figure in the Bauhaus design school from 1919 to 1923.

The wheel starts with the three primary colours of red, yellow and blue. There are two types of colour: those associated with light, called additive colours, and those associated with pigment, known as subtractive colours. For the purpose of this book we only look at colours associated with pigment since they relate to dyes.

The three subtractive primary colours are red, yellow and blue, or strictly speaking magenta (blueish red), yellow and cyan (greenish blue), as used in the printing trade. All the colours of the spectrum can be produced by mixing the primary subtractive colours. This is known as subtractive mixing. Secondary colours are achieved when two primary colours are combined to make orange, violet and green. Tertiary colours are created by mixing a primary with a secondary to make yellow-orange, orange-red, red-violet, violet-blue, blue-green and green-yellow.

At a glance, the wheel can be used to find complementary colours. Each colour has a complementary secondary colour. Red is the complementary of green, a mixture of yellow and blue; yellow is the complementary of violet, a mixture of red and blue; and blue is the complementary of orange, a mixture of yellow and red.

While this system underpins the colour charts in PART TWO, it is important to point out that I have not allowed it to limit my exploration of colour. While other people's theories have contributed to my understanding and appreciation, my ultimate choice of colour is driven by personal aesthetic judgement.

The order of the colour wheel is: yellow, yellow-orange, orange, orange-red, red, red-violet, violet, blue-violet, blue, blue-green, green and yellow-green.