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THE DYEING

OF

TEXTILE FABRICS

BY

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WITH 97 DIAGRAMS

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OF

TECHNICAL EDUCATION IN ENGLAND,

THIS WORK

IS, BY PERMISSION, RESPECTFULLY INSCRIBED

BY THE AUTHOR.

PREFACE.

THE object of this Manual is to provide the teacher and student of Dyeing with a useful text-book giving exact scientific and practical information. It is intended also to supply the Dyer with explanations of the scientific principles involved in the operations of his art, in order that he may take a more intelligent interest in his work, and be stimulated to criticise it, and to determine, by means of well-devised experiments, whether his methods are rational and incapable of improvement, or the reverse.

Certain details have been furnished relating to the mode of applying the various Colouring Matters and Mordants, but these must not be regarded as fixed and unchangeable receipts, but rather as starting-points for further experimental work.

The Art of Dyeing being a special branch of Chemical Technology, no apology is offered for leavening the work with a wholesome amount of chemistry. The Dyer is specially urged to make himself acquainted with the general principles of chemical science, for assuredly the more such knowledge is brought to bear upon every detail of the art, the more rapid will be its progress.

It seemed necessary to give the somewhat complex chemical symbols and scientific names of the Coal-Tar colours in order to identify them, since, in the course of time, many of the present commercial names may be replaced by others, or applied to colouring matters not yet introduced. The advanced student will find them useful, for they show at a glance the chemical relationships

existing between colours which possess similar dyeing properties.

The metric system of weights and measures has been adopted because of its advantages both to the teacher and the student of Dyeing, and it is now becoming more and more generally known and appreciated. For those who prefer the English system, however, tables of equivalents are given at the end of the volume.

Considerable care has been bestowed upon the arrangement of the subject matter, to prevent, on the one hand, confusion arising in the mind of the reader as to which fibre is being referred to in any given connection, and, on the other, to enable comparisons to be readily made of the treatment to which each fibre—cotton, wool, or silk—is submitted when applying any given colouring matter or mordant.

To my old and valued friend, Prof. L. Liechti, of Vienna, I tender my best thanks for his friendly criticisms during the progress of the work, and his kind assistance in the revision of the proofs.

My obligations are also due to those Colour-Manufacturers and Engineers whose names are mentioned in the text, and also to the proprietors of the *Textile Manufacturer*, for the loan of a complete set of their well-known journal.

All the principal English and foreign standard works and journals on dyeing have been consulted, and the information has, as far as possible, been brought down to the latest date.

J. J. H.

Yorkshire College, Leeds.
October, 1885.

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CHAPTER I.

COTTON.

1. The Cotton-Plant.—Cotton is the white, downy, fibrous substance which envelopes the seeds of various species of the cotton-plant, *Gossypium*, belonging to the natural order *Malvaceæ*. The seeds, to which the cotton fibres are attached, are enclosed in a 3- to 5-valved capsule, which bursts when ripe; the cotton is then collected and spread out to dry. The seeds are afterwards separated by the mechanical operation termed "ginning," and the raw cotton thus obtained is sent to the spinner. The cotton-plant (Fig. 1) is cultivated with success only in warm climates. There are numerous varieties, of which the following are the principal:—

Fig. 1.—Cotton Plant.

(1) *Gossypium barbadense.*—An herbaceous plant, bearing a yellow flower, and attaining a height of 4–5 metres.

A variety of this species yields the Sea Island cotton, much prized on account of the great strength, length, and lustre of its fibres. It is grown in the North American States of South Carolina, Georgia, and Florida, and on the neighbouring islands of the West Indies.

(2) *Gossypium hirsutum.* — A hairy, herbaceous plant, about 2 metres high, with pale yellow or almost white flowers. It is grown in the States of Alabama, Louisiana, Texas, and Mississippi.

(3) *Gossypium herbaceum.* — A small herbaceous plant, 1 metre high, and bearing yellow flowers. Varieties of this species are grown in India, China, Egypt, and America.

The Madras, Surat, and short-stapled Egyptian cotton, also some American cottons, are obtained from this species.

(4) *Gossypium peruvianum.*—This species, a native of South America, grows to a height of 3–5 metres, and bears a yellow flower. It yields the long-stapled and much esteemed Peruvian and Brazilian cottons.

(5) *Gossypium religiosum.*—This is a low annual shrub, about 1 metre high, and bearing a yellow flower. It is grown in China and India, and yields the so-called Nankin cotton, remarkable for its tawny colour.

(6) *Gossypium arboreum.*—This is a perennial tree, growing to a height of 6–7 metres, and bearing reddish-purple flowers. It is a native of India, and produces a good quality of cotton.

2. Physical Structure.—If cotton wool is examined under the microscope, it is seen to consist of minute fibres. Their general appearance is that of spirally-twisted bands, having thickened borders and irregular markings on the surface (Fig. 2). In the better qualities of cotton—*e.g.*, Sea Island—the spiral character is less

prominent. Transverse sections of the fibres show them to be flattened tubes, having comparatively thick walls and a small central opening (Fig. 3).

A single cotton fibre is, indeed, an elongated, tapering, and collapsed plant-cell, the thin end of which is closed, and the other (namely, that by which it was attached to the seed) irregularly torn. Sometimes broad ribbon-like fibres may be noticed, which are remarkably transparent, and possess irregular folds. Their transverse section exhibits no central opening at all (Fig. 4). They are, indeed, unripe fibres, in which no separation of the thin cell walls has yet taken place. They refuse to be dyed

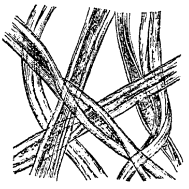

Fig. 2.—Appearance of Cotton under the Microscope.

Fig. 3.—Transverse Sections of Cotton Fibre.

like ordinary ripe fibres, and appear occasionally as white specks in indigo- and madder-dyed calicoes; hence the name *dead cotton* has been given to them. In half-ripe cotton fibres the cell walls are still so closely

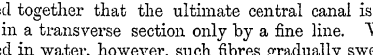

Fig. 4.—Transverse Sections of Unripe Cotton Fibre.

pressed together that the ultimate central canal is indicated in a transverse section only by a fine line. When steeped in water, however, such fibres gradually swell up and form hollow tubes. Cotton fibres vary in length from 2·5 to 6 centimetres, and in breadth from 0·017 to 0·05 millimetres.