## The Manual of Photography

formerly The Ilford Manual of Photography

Revised by

Ralph E. Jacobson

# The Manual of Photography

formerly The Ilford Manual of Photography

Revised by

Ralph E. Jacobson M.Sc., Ph.D., C.Chem. M.R.I.C.

in cooperation with

Sidney F. Ray M.Sc., F.I.I.P., F.R.P.S.,

G. G. Attridge B.Sc., A.R.P.S. and

N. R. Axford B.Sc.



**Focal Press** 

**London & Boston** 

### Focal Press

Is an imprint of the Butterworth Group
which has principal offices in
London, Sydney, Toronto, Wellington, Durban and Boston

THE ILFORD MANUAL OF PHOTOGRAPHY First published 1890 Fifth edition published May 1958 Reprinted eight times

THE MANUAL OF PHOTOGRAPHY Sixth edition published April 1971 Reprinted 1971, 1972, 1973, 1975 Seventh Revised edition 1978 Reprinted 1978, 1981

©Butterworth & Co. (Publishers) Ltd, 1978

All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, including photocopying and recording, without the written permission of the copyright holder, application for which should be addressed to the Publishers. Such written permission must also be obtained before any part of this publication is stored in a retrieval system of any nature.

This book is sold subject to the Standard Conditions of Sale of Net Books and may not be re-sold in the UK below the net price given by the Publishers in their current price list.

## **British Library Cataloguing in Publication Data**

The manual of photography. — 7th ed. 1

1. Photography

1. Jacobson, Ralph Eric

770

Tr 145

ISBN 0 240 50957 9

Text set in 11 pt Photon Univers, printed by The Whitefriars Press Ltd., Tonbridge & London, and bound by Mansell Bookbinders Ltd., Witham, Essex

## Contents

		Page
refa	ace .	3
11 9	Note that the second se	100
1.	The Photographic Process	13
	The production of photographs	14
e la	Characteristic features of the photographic process	15
	Perspective in photographs	16
	Reproduction of colour	16 17
	Reproduction of tone Reproduction of detail	18
	Negatives and positives	18
	readuries and bositives	10
2.	The Nature of Light	20
	Optics	20
	Light waves	21
	The electromagnetic spectrum	22
	The visible spectrum	23
	White light and colour mixtures	24
	Use of the word "light" in photography	25
3.	Light Sources	27
	Characteristics of light sources	27
	Light output	36
	Constancy of output	37
	Efficiency	37
	Illumination	38
	Economy	41
	Ease of operation and maintenance	42
	Characteristics of some light sources used in photography	42 42
	Daylight Turnette filoment lamps	43
	Tungsten filament lamps Tungsten halogen lamps	45
	Carbon arc lamps	46
	Mercury vapour discharge lamps	47
	Fluorescent lamps	47
	Sodium vapour discharge lamps	48
	Metal halide lamps	48
	Pulsed xenon lamps	49
	Flashbulbs	49
	Electronic flash	53

4.	The Geometry of Image Formation	60
	Interaction of light with matter	60
	Refraction	61
	Image formation	64
	The simple lens	65
	Image formation by a positive lens	66
	Formation of images by compound lens	68
	Graphical construction of images Relation between object distance, image distance and focal length	69 71
	Image size	72
	Focal length and angle of view	72
	Covering power of a lens	75
	Geometric distortion	75
	Lens definition	76
	Depth of focus	78
	Depth of field	80
	Perspective	83
	How important is perspective in a photograph?	87
	Viewing prints in practice	88
5.	The Photometry of Image Formation	89
	Stops and pupils	89
	Aperture	90
	Vignetting	92
	Illuminance of the image formed by a camera lens	93
	Image illuminance in wide-angle lenses	98
	Exposure compensation for close-up photography	99
	Light losses and lens transmittance	100
	Flare, flare spot, ghost images	100 101
	T-numbers	102
	Lens coatings	102
		100
6.	Lens Aberrations	106
	Chromatic aberration	107
	Lateral colour	109
	Spherical aberration	110
	Coma	112
	Distortion Astigmatism	114
	Curvature of field	115
	Diffraction	116
	Resolving power of a lens	116
	Stopping down and definition	117
	*	
7		110
# *		119
	Compound lenses	119
	Development of the photographic lens  Modern camera lenses	121
	The depth and selection of the second	126 127
	Wide-angle lenses Long-focus lenses	130
	Zoom lenses	133
	TOTAL PROPERTY OF THE PROPERTY	.00

8.	Types of Camera		135
	Introduction		135
	Survey of development		135
	Camera types		138
	Simple cameras		139
	Rangefinder cameras		139
	Twin-lens reflex cameras		142
	Single-lens reflex cameras		144
	Technical cameras		147
	Special-purpose cameras		148
	Automation of camera functions and operations		150
9.	The Elements of the Camera		153
7	The lens		154
	The lens hood		156
	Filters		156
	Supplementary lenses		156
	Stereo attachments		158
	Diffusion discs		158
	Converter lenses		158
	Extension tubes and bellows		159
	The shutter		160
	Between-lens shutters		160
	Focal-plane shutters		162
	The diaphragm		164
	Simple viewfinders		166
	Direct-vision optical viewfinders		166
	Ground glass screen viewfinders		168
	The focusing mechanism		170
	Focusing aids Focusing scales		171 173
	The exposure meter	*	174
	Accessory exposure meters		177
	Integral exposure meters		177
	Integral meters with external cells		177
	Through-the-lens exposure measurement		177
	Automatic exposure control		181
	Flash synchronisation		183
	The second of th		
10.	Camera Movements		187
	Displacement movements		187
	Rotational movements		191
	Practical considerations and design limitations		195
11	Optical Filters and Attachments		198
(A 18 M	General properties and characteristics of filters		
			198
	Commercial forms of colour filters Filter sizes and availability		200
	Effect of filters on focusing		203
	Colour filters for black-and-white photography		204
	Colour filters for colour photography		207
	Filters for colour printing		212
	Special filters		212
	Filters for darkroom use		218
	Optical attachments		220

12.	The Sensitive Material	222
	Latent image formation	223
	The emulsion binder	225
	Manufacture of photographic materials	226
	The support	227
	Coating the emulsion on the base	230
	Sizes of films and papers	232
	Packing and storage of films and papers	232
	racking and storage or films and papers	233
13.	Spectral Sensitivity of Photographic Materials	235
	Response of photographic materials to shorter than visible radiation	235
	Response of photographic materials to visible radiation	238
	Colour sensitising	238
	Orthochromatic materials	239
	Panchromatic materials	239
	Infra-red materials	240
	Other uses of dye sensitisation	241
	Determination of the colour sensitivity of a material	241
	Wedge-spectrograms	242
14.	Principles of Colour Photography	245
	Colour matching	245
	The first colour photograph	247
	Additive colour photography	248
	Subtractive colour photography	250
	Additive processes	254
	Subtractive processes	256
	Integral tripack	257
	megrarmpack	257
4 =	Compile	
15.	Sensitometry Subject	258
		258
	Exposure	259
	Blackness of the image	260
	Effect of scatter in negative	262
	Callier coefficient	263
	Density in practice	263
	The characteristic curve	266
	Main regions of the negative characteristic curve	267
	Variation of the characteristic curve with the material	270
	Variation of the characteristic curve with development	270
	Gamma-time curve	272
	Variation of gamma with wavelength	274
	Placing of the subject on the characteristic curve	274
	Average gradient (G)	275
	Contrast index	276
	Effect of variation in development on the negative	277
	Effect of variation in exposure on the negative	278
	Exposure latitude	280
	The response curve of a photographic paper	283
	Maximum black	284
	Exposure range of a paper	285
	Variation of the print curve with the type of emulsion	285
	Variation of the print curve with development	287
	Requirements in a print	288
	- Taganamana ma pina	200

Tone reproduction Reciprocity law failure Intermittency effect Sensitometric practice Sensitometers Densitometers Densitometers Elementary sensitometry  16. The Reproduction of Colour Colours in the spectrum Colours of natural objects Effect of light source on appearance of colours Response of the eye to colours Primary and secondary colours Complementary colours Low light-levels Black-and-white processes Colour processes Formation of subtractive image dyes Colour sensitometry Imperfections of colour processes Corrections of deficiencies of the subtractive system Masking of colour materials  17. Developers and Development Composition of a developing solution The developing agent		Paper contrast grades	289
Reciprocity law failure Intermittency effect Sensitometers Densitometers Densitometers Densitometers Elementary sensitometry  16. The Reproduction of Colour Colours in the spectrum Colours of natural objects Effect of light source on appearance of colours Response of the eye to colours Complementary colours Low light-levels Black-and-white processes Colour processes Formation of subtractive image dyes Colour ensitometry Imperfections of colour processes Corrections of deficiencies of the subtractive system Masking of colour materials  17. Developers and Development Composition of a developing solution The developing agent The preservative The alkali (or accelerator) The restrainer Water for developers Miscellaneous additions to developers Monochrome developers Phenidone-hydroquinone developers Phenidone-hydroquinone developers Fine grain developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developers Pre-packed developers The technique of development Machine processing The required degree of development Development by the time-temperature method The basis of published development times Development at high temperatures		The problem of the subject of high contrast	291
Intermittency effect Sensitometric practice Sensitometres Densitometers Densitometers Elementary sensitometry  16. The Reproduction of Colour Colours in the spectrum Colours of natural objects Effect of light source on appearance of colours Response of the eye to colours Primary and secondary colours Complementary colours Low light-levels Black-and-white processes Colour processes Colour processes Formation of subtractive image dyes Colour sensitometry Imperfections of colour processes Corrections of deficiencies of the subtractive system Masking of colour materials  17. Developers and Development Composition of a developing solution The developing agent The preservative The alkali (or accelerator) The restrainer Water for developers Miscellaneous additions to developers Monochrome developer formulae in general use Metol-hydroquinone developers Fine grain developers High-definition developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developer with use Replenishment Preparing developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by the time-temperature method The basis of published development times Development at high temperatures		Tone reproduction	291
Sensitometers Densitometers Densitometers Elementary sensitometry  16. The Reproduction of Colour Colours in the spectrum Colours of natural objects Effect of light source on appearance of colours Response of the eye to colours Primary and secondary colours Complementary colours Low light-levels Black-and-white processes Colour processes Formation of subtractive image dyes Colour sensitometry Imperfections of colour processes Corrections of deficiencies of the subtractive system Masking of colour materials  17. Developers and Development Composition of a developing solution The developing agent The preservative The alkali for accelerator) The restrainer Water for developers Miscellaneous additions to developers Monochrome developer formulae in general use Metol-hydroquinone developers Phenidone-hydroquinone developers Fine grain developers High-definition developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developers Pre-packed developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by the time-temperature method The basis of published development times Development at high temperatures		Reciprocity law failure	295
Sensitometers Densitometers Densitometers Elementary sensitometry  16. The Reproduction of Colour Colours in the spectrum Colours of natural objects Effect of light source on appearance of colours Response of the eye to colours Primary and secondary colours Complementary colours Low light-levels Black-and-white processes Colour processes Formation of subtractive image dyes Colour sensitometry Imperfections of colour processes Corrections of deficiencies of the subtractive system Masking of colour materials  17. Developers and Development Composition of a developing solution The developing agent The preservative The alkali (or accelerator) The restrainer Water for developers Miscellaneous additions to developers Monochrome developer formulae in general use Metol-hydroquinone developers Phenidone-hydroquinone developers Fine grain developers High-definition developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developer with use Replenishment Preparing developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by the time-temperature method The basis of published development times Development at high temperatures		Intermittency effect	298
Sensitometers Densitometers Elementary sensitometry  16. The Reproduction of Colour Colours in the spectrum Colours of natural objects Effect of light source on appearance of colours Response of the eye to colours Primary and secondary colours Complementary colours Low light-levels Black-and-white processes Colour processes Formation of subtractive image dyes Colour sensitometry Imperfections of colour processes Corrections of deficiencies of the subtractive system Masking of colour materials  17. Developers and Development Composition of a developing solution The developing agent The preservative The alkali (or accelerator) The restrainer Water for developers Miscellaneous additions to developers Monochrome developer formulae in general use Metol-hydroquinone developers Phenidone-hydroquinone developers Fine grain developers High-definition developers Extreme contrast (lithographic) developers Monobaths Colour developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by the time-temperature method The basis of published development times Development at high temperatures Development at high temperatures		Sensitometric practice	298
Densitometers Elementary sensitometry  16. The Reproduction of Colour Colours in the spectrum Colours of natural objects Effect of light source on appearance of colours Response of the eye to colours Primary and secondary colours Complementary colours Low light-levels Black-and-white processes Colour processes Colour processes Formation of subtractive image dyes Colour sensitometry Imperfections of colour processes Corrections of deficiencies of the subtractive system Masking of colour materials  17. Developers and Development Composition of a developing solution The developing agent The preservative The alkali (or accelerator) The restrainer Water for developers Miscellaneous additions to developers Monochrome developer formulae in general use Metol-hydroquinone developers Phenidone-hydroquinone developers Fine grain developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by the time-temperature method The basis of published development times Development at high temperatures Development at high temperatures		Sensitometers	300
Elementary sensitometry  16. The Reproduction of Colour Colours in the spectrum Colours of natural objects Effect of light source on appearance of colours Response of the eye to colours Primary and secondary colours Complementary colours Low light-levels Black-and-white processes Colour processes Formation of subtractive image dyes Colour sensitometry Imperfections of colour processes Corrections of deficiencies of the subtractive system Masking of colour materials  17. Developers and Development Composition of a developing solution The developing agent The preservative The alkali (or accelerator) The restrainer Water for developers Miscellaneous additions to developers Monochrome developer formulae in general use Metol-hydroquinone developers Phenidone-hydroquinone developers Fine grain developers High-definition developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by the time-temperature method The basis of published development times Development at low temperatures Development at high temperatures			301
Colours in the spectrum Colours of natural objects Effect of light source on appearance of colours Response of the eye to colours Primary and secondary colours Complementary colours Low light-levels Black-and-white processes Colour processes Formation of subtractive image dyes Colour sensitionetry Imperfections of colour processes Corrections of deficiencies of the subtractive system Masking of colour materials  17. Developers and Development Composition of a developing solution The developing agent The preservative The alkali (or accelerator) The restrainer Water for developers Miscellaneous additions to developers Monochrome developer formulae in general use Metol-hydroquinone developers Phenidone-hydroquinone developers Fine grain developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by the time-temperature method The basis of published development times Development at low temperatures Development at light temperatures			308
Colours in the spectrum Colours of natural objects Effect of light source on appearance of colours Response of the eye to colours Primary and secondary colours Complementary colours Low light-levels Black-and-white processes Colour processes Colour processes Formation of subtractive image dyes Colour sensitometry Imperfections of colour processes Corrections of deficiencies of the subtractive system Masking of colour materials  17. Developers and Development  Composition of a developing solution The developing agent The preservative The alkali (or accelerator) The restrainer Water for developers Miscellaneous additions to developers Monochrome developer formulae in general use Metol-hydroquinone developers Phenidone-hydroquinone developers Fine grain developers High-definition developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developer with use Replenishment Preparing developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by the time-temperature method The basis of published development times Development at high temperatures		Elementary conditions by	
Colours in the spectrum Colours of natural objects Effect of light source on appearance of colours Response of the eye to colours Primary and secondary colours Complementary colours Low light-levels Black-and-white processes Colour processes Colour processes Formation of subtractive image dyes Colour sensitometry Imperfections of colour processes Corrections of deficiencies of the subtractive system Masking of colour materials  17. Developers and Development  Composition of a developing solution The developing agent The preservative The alkali (or accelerator) The restrainer Water for developers Miscellaneous additions to developers Monochrome developer formulae in general use Metol-hydroquinone developers Phenidone-hydroquinone developers Fine grain developers High-definition developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developer with use Replenishment Preparing developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by the time-temperature method The basis of published development times Development at high temperatures	16.	The Reproduction of Colour	310
Colours of natural objects Effect of light source on appearance of colours Response of the eye to colours Primary and secondary colours Complementary colours Low light-levels Black-and-white processes Colour processes Formation of subtractive image dyes Colour sensitometry Imperfections of colour processes Corrections of deficiencies of the subtractive system Masking of colour materials  17. Developers and Development Composition of a developing solution The developing agent The preservative The alkali (or accelerator) The restrainer Water for davelopers Miscellaneous additions to developers Monochrome developer formulae in general use Metol-hydroquinone developers Phenidone-hydroquinone developers Fine grain developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developers Pre-packed developers The technique of developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by the time-temperature method The basis of published development times Development at high temperatures			310
Effect of light source on appearance of colours Response of the eye to colours Primary and secondary colours Complementary colours Low light-levels Black-and-white processes Colour processes Formation of subtractive image dyes Colour sensitometry Imperfections of colour processes Corrections of deficiencies of the subtractive system Masking of colour materials  17. Developers and Development Composition of a developing solution The developing agent The preservative The alkali (or accelerator) The restrainer Water for developers Miscellaneous additions to developers Monochrome developer formulae in general use Metol-hydroquinone developers Phenidone-hydroquinone developers Fine grain developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developer with use Replenishment Preparing developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by inspection Development by the time-temperature method The basis of published development times Development at high temperatures Development at high temperatures			310
Response of the eye to colours Primary and secondary colours Complementary colours Low light-levels Black-and-white processes Colour processes Formation of subtractive image dyes Colour sensitometry Imperfections of colour processes Corrections of deficiencies of the subtractive system Masking of colour materials  17. Developers and Development Composition of a developing solution The developing agent The preservative The alkali (or accelerator) The restrainer Water for developers Miscellaneous additions to developers Monochrome developer formulae in general use Metol-hydroquinone developers Phenidone-hydroquinone developers Fine grain developers High-definition developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developer with use Replenishment Preparing developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by inspection Development by the time-temperature method The basis of published development times Development at low temperatures Development at ligh temperatures			312
Primary and secondary colours Complementary colours Low light-levels Black-and-white processes Colour processes Formation of subtractive image dyes Colour sensitometry Imperfections of colour processes Corrections of deficiencies of the subtractive system Masking of colour materials  17. Developers and Development Composition of a developing solution The developing agent The preservative The alkali (or accelerator) The restrainer Water for developers Miscellaneous additions to developers Monochrome developer formulae in general use Metol-hydroquinone developers Phenidone-hydroquinone developers Fine grain developers High-definition developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developer with use Replenishment Preparing developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by inspection Development by the time-temperature method The basis of published development times Development at low temperatures Development at high temperatures			312
Complementary colours Low light-levels Black-and-white processes Colour processes Formation of subtractive image dyes Colour sensitometry Imperfections of colour processes Corrections of deficiencies of the subtractive system Masking of colour materials  17. Developers and Development Composition of a developing solution The developing agent The preservative The alkali (or accelerator) The restrainer Water for developers Miscellaneous additions to developers Monochrome developer formulae in general use Metol-hydroquinone developers Fine grain developers Fine grain developers Fine grain developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developer with use Replenishment Preparing developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by the time-temperature method The basis of published development times Development at low temperatures Development at ligh temperatures			314
Low light-levels Black-and-white processes Colour processes Formation of subtractive image dyes Colour sensitometry Imperfections of colour processes Corrections of deficiencies of the subtractive system Masking of colour materials  17. Developers and Development Composition of a developing solution The developing agent The preservative The alkali (or accelerator) The restrainer Water for developers Miscellaneous additions to developers Monochrome developer formulae in general use Metol-hydroquinone developers Phenidone-hydroquinone developers Fine grain developers Fine grain developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by inspection Development at low temperatures Development at low temperatures Development at ligh temperatures			315
Black-and-white processes Colour processes Formation of subtractive image dyes Colour sensitometry Imperfections of colour processes Corrections of deficiencies of the subtractive system Masking of colour materials  17. Developers and Development Composition of a developing solution The developing agent The preservative The alkali (or accelerator) The restrainer Water for developers Miscellaneous additions to developers Monochrome developer formulae in general use Metol-hydroquinone developers Phenidone-hydroquinone developers Fine grain developers Fine grain developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developer with use Replenishment Preparing developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by inspection Development at high temperatures Development at high temperatures			315
Colour processes Formation of subtractive image dyes Colour sensitometry Imperfections of colour processes Corrections of deficiencies of the subtractive system Masking of colour materials  17. Developers and Development  Composition of a developing solution The developing agent The preservative The alkali (or accelerator) The restrainer Water for developers Miscellaneous additions to developers Monochrome developer formulae in general use Metol-hydroquinone developers Phenidone-hydroquinone developers Fine grain developers High-definition developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developer with use Replenishment Preparing developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by inspection Development at low temperature method The basis of published development times Development at high temperatures			315
Formation of subtractive image dyes Colour sensitometry Imperfections of colour processes Corrections of deficiencies of the subtractive system Masking of colour materials  17. Developers and Development Composition of a developing solution The developing agent The preservative The alkali (or accelerator) The restrainer Water for developers Miscellaneous additions to developers Monochrome developer formulae in general use Metol-hydroquinone developers Phenidone-hydroquinone developers Fine grain developers High-definition developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developer with use Replenishment Preparing developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by inspection Development at high temperatures Development at high temperatures			318
Colour sensitometry Imperfections of colour processes Corrections of deficiencies of the subtractive system Masking of colour materials  17. Developers and Development Composition of a developing solution The developing agent The preservative The alkali (or accelerator) The restrainer Water for developers Miscellaneous additions to developers Monochrome developer formulae in general use Metol-hydroquinone developers Phenidone-hydroquinone developers Fine grain developers Fine grain developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developer with use Replenishment Preparing developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by the time-temperature method The basis of published development times Development at low temperatures		the contract of the contract o	320
Imperfections of colour processes Corrections of deficiencies of the subtractive system Masking of colour materials  17. Developers and Development Composition of a developing solution The developing agent The preservative The alkali (or accelerator) The restrainer Water for developers Miscellaneous additions to developers Monochrome developer formulae in general use Metol-hydroquinone developers Phenidone-hydroquinone developers Fine grain developers High-definition developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developer with use Replenishment Preparing developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by the time-temperature method The basis of published development times Development at low temperatures			321
Corrections of deficiencies of the subtractive system Masking of colour materials  17. Developers and Development  Composition of a developing solution The developing agent The preservative The alkali (or accelerator) The restrainer Water for developers Miscellaneous additions to developers Monochrome developer formulae in general use Metol-hydroquinone developers Phenidone-hydroquinone developers Fine grain developers High-definition developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developer with use Replenishment Preparing developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by inspection Development at low temperatures Development at high temperatures			329
Asking of colour materials  17. Developers and Development  Composition of a developing solution The developing agent The preservative The alkali (or accelerator) The restrainer Water for developers Miscellaneous additions to developers Monochrome developer formulae in general use Metol-hydroquinone developers Phenidone-hydroquinone developers Fine grain developers Fine grain developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developer with use Replenishment Preparing developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by inspection Development to the time-temperature method The basis of published development times Development at low temperatures Development at high temperatures			331
Composition of a development  Composition of a developing solution The developing agent The preservative The alkali (or accelerator) The restrainer Water for developers Miscellaneous additions to developers Monochrome developer formulae in general use Metol-hydroquinone developers Phenidone-hydroquinone developers Fine grain developers High-definition developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developer with use Replenishment Preparing developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by inspection Development by the time-temperature method The basis of published development times Development at low temperatures Development at high temperatures			333
Composition of a developing solution The developing agent The preservative The alkali (or accelerator) The restrainer Water for developers Miscellaneous additions to developers Monochrome developer formulae in general use Metol-hydroquinone developers Phenidone-hydroquinone developers Fine grain developers High-definition developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developer with use Replenishment Preparing developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by inspection Development by the time-temperature method The basis of published development times Development at low temperatures Development at high temperatures		Masking of colour materials	333
Composition of a developing solution The developing agent The preservative The alkali (or accelerator) The restrainer Water for developers Miscellaneous additions to developers Monochrome developer formulae in general use Metol-hydroquinone developers Phenidone-hydroquinone developers Fine grain developers High-definition developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developer with use Replenishment Preparing developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by inspection Development by the time-temperature method The basis of published development times Development at low temperatures Development at high temperatures	17	Developers and Development	336
The developing agent The preservative The alkali (or accelerator) The restrainer Water for developers Miscellaneous additions to developers Monochrome developer formulae in general use Metol-hydroquinone developers Phenidone-hydroquinone developers Fine grain developers High-definition developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developer with use Replenishment Preparing developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by inspection Development by the time-temperature method The basis of published development times Development at low temperatures Development at high temperatures			337
The preservative The alkali (or accelerator) The restrainer Water for developers Miscellaneous additions to developers Monochrome developer formulae in general use Metol-hydroquinone developers Phenidone-hydroquinone developers Fine grain developers Fine grain developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developer with use Replenishment Preparing developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by inspection Development by the time-temperature method The basis of published development times Development at low temperatures			337
The alkali (or accelerator) The restrainer Water for developers Miscellaneous additions to developers Monochrome developer formulae in general use Metol-hydroquinone developers Phenidone-hydroquinone developers Fine grain developers High-definition developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developer with use Replenishment Preparing developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by inspection Development by the time-temperature method The basis of published development times Development at low temperatures			340
The restrainer Water for developers Miscellaneous additions to developers Monochrome developer formulae in general use Metol-hydroquinone developers Phenidone-hydroquinone developers Fine grain developers High-definition developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developer with use Replenishment Preparing developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by inspection Development by the time-temperature method The basis of published development times Development at low temperatures			342
Water for developers Miscellaneous additions to developers Monochrome developer formulae in general use Metol-hydroquinone developers Phenidone-hydroquinone developers Fine grain developers High-definition developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developer with use Replenishment Preparing developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by the time-temperature method The basis of published development times Development at low temperatures Development at high temperatures			343
Miscellaneous additions to developers Monochrome developer formulae in general use Metol-hydroquinone developers Phenidone-hydroquinone developers Fine grain developers High-definition developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developer with use Replenishment Preparing developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by inspection Development by the time-temperature method The basis of published development times Development at low temperatures			343
Monochrome developer formulae in general use Metol-hydroquinone developers Phenidone-hydroquinone developers Fine grain developers High-definition developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developer with use Replenishment Preparing developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by inspection Development by the time-temperature method The basis of published development times Development at low temperatures			
Metol-hydroquinone developers Phenidone-hydroquinone developers Fine grain developers High-definition developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developer with use Replenishment Preparing developers Pre-packed developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by inspection Development by the time-temperature method The basis of published development times Development at low temperatures			345
Phenidone-hydroquinone developers Fine grain developers High-definition developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developer with use Replenishment Preparing developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by inspection Development by the time-temperature method The basis of published development times Development at low temperatures Development at high temperatures			345
Fine grain developers High-definition developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developer with use Replenishment Preparing developers Pre-packed developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by inspection Development by the time-temperature method The basis of published development times Development at low temperatures Development at high temperatures			347
High-definition developers Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developer with use Replenishment Preparing developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by inspection Development by the time-temperature method The basis of published development times Development at low temperatures Development at high temperatures			348
Extreme contrast (lithographic) developers Monobaths Colour developers Changes in a developer with use Replenishment Preparing developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by inspection Development by the time-temperature method The basis of published development times Development at low temperatures Development at high temperatures			349
Monobaths Colour developers Changes in a developer with use Replenishment Preparing developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by inspection Development by the time-temperature method The basis of published development times Development at low temperatures Development at high temperatures			352
Colour developers Changes in a developer with use Replenishment Preparing developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by inspection Development by the time-temperature method The basis of published development times Development at low temperatures Development at high temperatures			352
Changes in a developer with use Replenishment Preparing developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by inspection Development by the time-temperature method The basis of published development times Development at low temperatures Development at high temperatures			353
Replenishment Preparing developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by inspection Development by the time-temperature method The basis of published development times Development at low temperatures Development at high temperatures			353
Preparing developers Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by inspection Development by the time-temperature method The basis of published development times Development at low temperatures Development at high temperatures			354
Pre-packed developers The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by inspection Development by the time-temperature method The basis of published development times Development at low temperatures Development at high temperatures			356
The technique of development Machine processing The required degree of development Obtaining the required degree of development Development by inspection Development by the time-temperature method The basis of published development times Development at low temperatures Development at high temperatures		Preparing developers	357
Machine processing The required degree of development Obtaining the required degree of development Development by inspection Development by the time-temperature method The basis of published development times Development at low temperatures Development at high temperatures		Pre-packed developers	359
The required degree of development Obtaining the required degree of development Development by inspection Development by the time-temperature method The basis of published development times Development at low temperatures Development at high temperatures		The technique of development	361
Obtaining the required degree of development Development by inspection Development by the time-temperature method The basis of published development times Development at low temperatures Development at high temperatures		Machine processing	365
Development by inspection Development by the time-temperature method The basis of published development times Development at low temperatures Development at high temperatures		The required degree of development	367
Development by the time-temperature method The basis of published development times Development at low temperatures Development at high temperatures		Obtaining the required degree of development	368
The basis of published development times  Development at low temperatures  Development at high temperatures			369
The basis of published development times  Development at low temperatures  Development at high temperatures		Development by the time-temperature method	369
Development at low temperatures Development at high temperatures			372
Development at high temperatures			373
			373
			374

	Two-bath development Reversal processing Self-developing materials Control of effective emulsion speed in development Adjacency effects Sabattier effect Development of papers		376 376 378 378 382 383 384
18.	Processing Following Development		385
	Rinse bath		385 386
	Acid stop bath		386
	Fixing baths		389
	Hardening		391
	Making up fixing baths		392
	Time required for fixation		393
	Changes in a fixing bath with use		
	Useful life of a fixing bath		394
	Replenishment of fixing baths		394
	Silver recovery		395
	Rapid fixing		397 397
	Substitutes for sodium thiosulphate		398
	Bleaching of silver images		399
	Washing		400
	Hypo eliminators and washing aids		401
	Tests for permanence		402
	Drying Stabilisation processing		403
	Uses of wetting agents in photography		403
	Oses of wetting agents in photography		
19.	Film Speed		405
10.			405
	Methods of expressing speed		410
	Speed systems which are or have been in general use		415
	Arithmetic and logarithmic speed systems		415
	Conversion between speed systems		415
	Speed ratings in tungsten light		416
	Speed ratings of commercial films		418
	Speed ratings for colour materials		421
	Practical value of speed numbers		421
20	Comera Europura Determination		400
20.	Camera Exposure Determination		422
	Correct exposure		423
	Exposure determination using photographic material		427
	Exposure criteria		429
	Exposure meters		432
	Determination of exposures for flash photography		437
0.6	Photo workin Powers		
21.	Photographic Papers		442
	Types of printing papers		442
	Type of silver halide employed		443
	Paper contrast grades	35	445
	Paper surface		446
	Nature of the paper base		447
	Colour papers		448
	Development of papers		448

	Fixation	453
	Bleach-fixing	454
	Washing	454
	Stabilisation of colour prints	456
	Drying	457
	Glazing	458
	Clearing and reducing prints	460
	Toning prints	460
		460
	Stabilisation papers	400
22	Deletion and Enlarging	162
22.	Printing and Enlarging	462
	Contact printing	462
	Projection printing	463
	Condenser enlargers	464
	Diffuser enlargers	465
	Practical differences between condenser and diffuser enlargers	466
	Condenser-diffuser enlargers	468
	Light sources for enlarging	469
	Lenses for enlargers	470
	Negative carriers	471
	Heat filters	472
	Easels and paper holders	472
	Determination of exposure times in enlarging	472
	Dodging and shading	478
	Correction – or introduction – of perspective distortion	479
	Minimising graininess	479
	Soft-focus enlargements	480
	Colour printing	480
	Colour filtration	483
		487
	Colour enlarger design	488
	Types of colour enlarger	491
	Methods of evaluating colour negatives for printing	494
	Colour print evaluation	494
23.	After-treatment of the Developed Image	496
23.	, , , , , , , , , , , , , , , , , , , ,	
	Reduction	496
	Classification of reducers	496
	Intensification	499
	Classification of intensifiers	499
	After-treatment of prints	499
	Toning	500
0.4	The Observation	500
24.	The Chemistry of Colour Image Formation	. 502
	Chromogenic processes	502
	Silver-dye-bleach process	513
	Dye-releasing processes	516
	Important chemistry	522
25.	Evaluation of the Photographic Image	532
	Structural aspects	532
	Photographic turbidity	533
	Resolving power	533
	Graininess	536
	Granularity	530

	Sharpness and acutance Quality and definition Modern methods of image evaluation Spread function and the modulation transfer function (MTF) Autocorrelation function and power spectrum Detective quantum efficiency (DQE) Information capacity Colour images	-	540 542 542 544 547 548 552 553
26.	Faults in Negatives and Prints		555
	Faults in black-and-white negatives		555
	Dark bands and patches		562
	Index to faults in black-and-white negatives		566
	Faults in black-and-white prints		568
	Faults in colour materials		570
	Appendix		574
	Processing formulae for black-and-white materials		574
	Developers		575
	Stop bath and fixers		582
	Reducers		583
	Intensifiers		584
	Toners		585
	Reversal processing of black-and-white films		587
	Processing formulae for colour materials		589
	Dye reducers (bleaches)		593
	Conversion of units		594
	Logarithms		595
	Trigonometrical ratios		598
	The pH scale		599
	Some outstanding dates and names in the early history		
	of photography		601
	Bibliography		605
Index			609

# The Manual of Photography

formerly The Ilford Manual of Photography

Revised by

Ralph E. Jacobson M.Sc., Ph.D., C.Chem. M.R.I.C.

in cooperation with

Sidney F. Ray M.Sc., F.I.I.P., F.R.P.S.,

G. G. Attridge B.Sc., A.R.P.S. and

N. R. Axford B.Sc.



**Focal Press** 

**London & Boston** 

### Focal Press

Is an imprint of the Butterworth Group which has principal offices in London, Sydney, Toronto, Wellington, Durban and Boston

THE ILFORD MANUAL OF PHOTOGRAPHY First published 1890 Fifth edition published May 1958 Reprinted eight times

THE MANUAL OF PHOTOGRAPHY Sixth edition published April 1971 Reprinted 1971, 1972, 1973, 1975 Seventh Revised edition 1978 Reprinted 1978, 1981

©Butterworth & Co. (Publishers) Ltd, 1978

All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, including photocopying and recording, without the written permission of the copyright holder, application for which should be addressed to the Publishers. Such written permission must also be obtained before any part of this publication is stored in a retrieval system of any nature.

This book is sold subject to the Standard Conditions of Sale of Net Books and may not be re-sold in the UK below the net price given by the Publishers in their current price list.

## **British Library Cataloguing in Publication Data**

The manual of photography. - 7th ed. 1

1. Photography

1. Jacobson, Ralph Eric

770

Tr 145

ISBN 0 240 50957 9

Text set in 11 pt Photon Univers, printed by The Whitefriars Press Ltd., Tonbridge & London, and bound by Mansell Bookbinders Ltd., Witham, Essex

## Preface to the Seventh Edition

SINCE publication of the sixth edition a number of significant advances in photographic equipment, materials, and practices have been made. Cameras have become more sophisticated and the 110 format has been introduced. Special cameras for "instant-print" colour materials are becoming increasingly popular and two major manufacturers now produce separate systems for this type of photography, Resin coated papers have become available for black and white as well as colour printing together with appropriate processing equipment. The move to smaller format cameras has necessitated the introduction of a new generation of colour films and the processing and printing of colour materials has become simpler and quicker. These and other developments are included in the present edition.

As editor of the new edition I have followed the example set by previous editors in directing the emphasis towards the principles underlying the practice of photography, although this edition still contains much useful practical information which should be of value to all those involved in photography.

In the previous edition two chapters were devoted to colour photography which appeared at the end of the book. In view of the extensive use of colour materials now made by virtually every photographer, much information on colour has been integrated within the main body of the text in this edition, as well as devoting two chapters exclusively to colour.

Many chapters have been completely re-written to take into account modern developments in the theory and practice of photography but those chapters which still have relevance to present day theory and practice have been retained, with appropriate additions and modifications.

In a book which deals with many diverse aspects of photography it is not possible for any single author to write authoritatively on all aspects.

Like the previous editor, Mr. Alan Horder, I have enlisted the aid of a number of contributors and should like to acknowledge the contributions of my colleagues at The Polytechnic of Central London. Thanks are due to Mr. S. Ray for contributing Chapters 3 to 11 on light sources, lenses, cameras and accessories, and for contributing sections on colour printing in Chapter 22; Mr. G. G. Attridge for Chapters 13–16 and 24 concerned with sensitometry and colour, and for contributing a section on white light and colour mixtures to Chapter 2; Mr. N. R. Axford for Chapter 25 on image evaluation and for contributing on latent image formation to Chapter 12.

## Contents

		Page
Prefa	ace	3
9 10	Markey and the colored to the second of the	2.0
1.	The Photographic Process	13
	The production of photographs	14
	Characteristic features of the photographic process	15
	Perspective in photographs	16
	Reproduction of colour	16
	Reproduction of tone	17 18
	Reproduction of detail	18
	Negatives and positives	10
2.	The Nature of Light	20
	Optics	20
	Light waves	21
	The electromagnetic spectrum	22
	The visible spectrum	23
	White light and colour mixtures	24
	Use of the word "light" in photography	25
3.	Light Sources	27
	Characteristics of light sources	27
	Light output	36
	Constancy of output	37
	Efficiency	37
	Illumination	38
	Economy	41
	Ease of operation and maintenance	42
	Characteristics of some light sources used in photography	42
	Daylight	42
	Tungsten filament lamps	43
	Tungsten halogen lamps	45 46
	Carbon arc lamps	47
	Mercury vapour discharge lamps	47
	Fluorescent lamps	48
	Sodium vapour discharge lamps Metal halide lamps	48
	Pulsed xenon lamps	49
	Flashbulbs	49
	Flectronic flech	53

4.	The Geometry of Image Formation	60
	Interaction of light with matter	60
	Refraction	61
	Image formation	64
	The simple lens	65
	Image formation by a positive lens	66
	Formation of images by compound lens	68
	Graphical construction of images	69
	Relation between object distance, image distance and focal len	
	Image size Focal length and angle of view	72 72
	Covering power of a lens	75
	Geometric distortion	75
	Lens definition	76
	Depth of focus	78
	Depth of field	80
	Perspective	83
	How important is perspective in a photograph?	87
	Viewing prints in practice	88
5.	The Photometry of Image Formation	89
٥.		89
	Stops and pupils Aperture	90
	Vignetting	92
	Illuminance of the image formed by a camera lens	93
	Image illuminance in wide-angle lenses	98
	Exposure compensation for close-up photography	99
	Light losses and lens transmittance	100
	Flare, flare spot, ghost images	100
	T-numbers	101
	Lens coatings	102
6.	Lens Aberrations	106
	Chromatic aberration	107
	Lateral colour	109
	Spherical aberration	110
	Coma	111
	Distortion	112
	Astigmatism	114
	Curvature of field	115
	Diffraction	116
	Resolving power of a lens Stopping down and definition	116 117
	Stopping down and definition	1.1.7
	* 111000 =	
	The Orange Land	
7.	The Camera Lens	119
	Compound lenses	119
	Development of the photographic lens	
	Modern camera lenses	126
	Wide-angle lenses	
	Long-focus lenses Zoom lenses	
	Zuom lenses	133

-		
8.	Types of Camera	135
	Introduction	135
	Survey of development	135
	Camera types	138
	Simple cameras	139
	Rangefinder cameras	139
	Twin-lens reflex cameras	142
	Single-lens reflex cameras	144
	Technical cameras	147
	Special-purpose cameras	148
	Automation of camera functions and operations	150
9.	The Elements of the Camera	152
3.		153
	The lens	154
14	The lens hood	156
	Filters	156
	Supplementary lenses	156
	Stereo attachments	158
	Diffusion discs Converter lenses	158 158
	Extension tubes and bellows	159
	The shutter	160
	Between-lens shutters	160
	Focal-plane shutters	162
	The diaphragm	164
	Simple viewfinders	166
	Direct-vision optical viewfinders	166
	Ground glass screen viewfinders	168
	The focusing mechanism	170
	Focusing aids	171
	Focusing scales	173
	The exposure meter	174
	Accessory exposure meters	177
	Integral exposure meters	177
	Integral meters with external cells	177
	Through-the-lens exposure measurement	177
	Automatic exposure control	181
	Flash synchronisation	183
10.	Camera Movements	187
	Displacement movements	187
	Rotational movements	191
	Practical considerations and design limitations	195
	0	
11.	Optical Filters and Attachments	198
	General properties and characteristics of filters	198
	Commercial forms of colour filters	200
	Filter sizes and availability Effect of filters on focusing	203
	Colour filters for black-and-white photography	203 204
	Colour filters for colour photography	204
	Filters for colour printing	212
	Special filters	212
	Filters for darkroom use	218
	Ontinal attackers at	220

6 此为试读, 需要完整PDF请访问: www.ertongbook.com