

The Pigmentary System: Physiology and Pathophysiology

Edited by

James J. Nordlund
*Dermatologist and Professor Emeritus,
Group Health Associates, Cincinnati, OH, USA*

Raymond E. Boissy
*Professor of Dermatology and Cell Biology,
University of Cincinnati College of Medicine,
Cincinnati, OH, USA*

Vincent J. Hearing
*Chief, Pigment Cell Biology Section,
Laboratory of Cell Biology,
National Institutes of Health, Bethesda, MD, USA*

Richard A. King
*Director, Genetics Division, Department of Medicine,
Institute of Human Genetics, University of Minnesota,
Minneapolis, MN, USA*

William S. Oetting
*Associate Professor, Genetics Division, Department of Medicine
Institute of Human Genetics, University of Minnesota, Minneapolis, MN, USA*

Jean-Paul Ortonne
*Professor of Dermatology and Chairman, Department of Dermatology,
University of Nice-Sophia Antipolis,
Nice, France*

SECOND EDITION

 **Blackwell**
Publishing

The Pigmentary System: Physiology and Pathophysiology



A



B



C



D



E



F



H



G



I

A: These two individuals illustrate the wide range of skin and hair color. [Marianne Greenwood (right) graciously shared the photographs from her book *Varför Gråter Puman?*] B: Classical Celtic women with blue eyes and red hair. C: Typical Scandinavian with blue eyes. D: Native American. E: A Peruvian girl. F: Himalayan woman and child. G: A Venezuelan woman. H: Two teenagers from New Guinea. I: Man from the New Hebrides Islands. See Chapter 27 for further information.

The Pigmentary System: Physiology and Pathophysiology

Edited by

James J. Nordlund
*Dermatologist and Professor Emeritus,
Group Health Associates, Cincinnati, OH, USA*

Raymond E. Boissy
*Professor of Dermatology and Cell Biology,
University of Cincinnati College of Medicine,
Cincinnati, OH, USA*

Vincent J. Hearing
*Chief, Pigment Cell Biology Section,
Laboratory of Cell Biology,
National Institutes of Health, Bethesda, MD, USA*

Richard A. King
*Director, Genetics Division, Department of Medicine,
Institute of Human Genetics, University of Minnesota,
Minneapolis, MN, USA*

William S. Oetting
*Associate Professor, Genetics Division, Department of Medicine
Institute of Human Genetics, University of Minnesota, Minneapolis, MN, USA*

Jean-Paul Ortonne
*Professor of Dermatology and Chairman, Department of Dermatology,
University of Nice-Sophia Antipolis,
Nice, France*

SECOND EDITION

 **Blackwell**
Publishing

© 2006 Blackwell Publishing Ltd
Blackwell Publishing, Inc., 350 Main Street, Malden, Massachusetts 02148-5020, USA
Blackwell Publishing Ltd, 9600 Garsington Road, Oxford OX4 2DQ, UK
Blackwell Publishing Asia Pty Ltd, 550 Swanston Street, Carlton, Victoria 3053, Australia

The right of the Author to be identified as the Author of this Work has been asserted in accordance with the Copyright, Designs and Patents Act 1988.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, except as permitted by the UK Copyright, Designs and Patents Act 1988, without the prior permission of the publisher.

First published 1998 by Oxford University Press
Second edition 2006
1 2006

Library of Congress Cataloging-in-Publication Data

The pigmentary system : physiology and pathophysiology / edited by
James J. Nordlund . . . [et al.].—2nd ed.

p. ; cm.

Includes bibliographical references and index.

1. Pigmentation disorders. 2. Melanocytes. I. Nordlund, James J.

[DNLM: 1. Pigmentation Disorders—physiopathology. 2. Melanocytes.

3. Pigmentation—physiology. WR 265 P6309 2006]

RL790.P53 2006

616.5'5—dc22

2005030369

A catalogue record for this title is available from the British Library

Set in 9/12 pt Sabon by SNP Best-set Typesetter Ltd., Hong Kong
Printed and bound in India by Replika Press PVT Ltd

ISBN-13: 978-1-4051-2034-0

ISBN-10: 1-4051-2034-7

Commissioning Editor: Stuart Taylor
Editorial Assistant: Saskia Van der Linden
Development Editor: Rob Blundell
Production Controller: Kate Charman

For further information on Blackwell Publishing, visit our website:
<http://www.blackwellpublishing.com>

The publisher's policy is to use permanent paper from mills that operate a sustainable forestry policy, and which has been manufactured from pulp processed using acid-free and elementary chlorine-free practices. Furthermore, the publisher ensures that the text paper and cover board used have met acceptable environmental accreditation standards.

Blackwell Publishing makes no representation, express or implied, that the drug dosages in this book are correct. Readers must therefore always check that any product mentioned in this publication is used in accordance with the prescribing information prepared by the manufacturers. The author and the publishers do not accept responsibility or legal liability for any errors in the text or for the misuse or misapplication of material in this book.

Contents

- Contributors, x
Foreword, xv
Preface, xvii
Acknowledgements, xviii
Frontispiece can be found between pages ii and iii
- Part I: The Physiology of the Pigmentary System**
Section 1: Historical and Comparative Perspectives of the Pigmentary System, 3
- 1 A History of the Science of Pigmentation, 5
Sidney N. Klaus
 - 2 Comparative Anatomy and Physiology of Pigment Cells in Nonmammalian Tissues, 11
Joseph T. Bagnara & Jiro Matsumoto
- Section 2: The Science of Pigmentation, 61**
- 3 General Biology of Mammalian Pigmentation, 63
Walter C. Quevedo Jr. & Thomas J. Holstein
 - 4 Extracutaneous Melanocytes, 91
Raymond E. Boissy & Thomas J. Hornyak
 - 5 Regulation of Melanoblast Migration and Differentiation, 108
David M. Parichy, Mark V. Reedy, & Carol A. Erickson
 - 6 Melanoblast Development and Associated Disorders, 140
Richard A. Spritz
 - 7 Biogenesis of Melanosomes, 155
Raymond E. Boissy, Marjan Huizing, & William A. Gahl
 - 8 Melanosome Trafficking and Transfer, 171
Glynis A. Scott
 - 9 Melanosome Processing in Keratinocytes, 181
H. Randolph Byers
 - 10 The Regulation of Melanin Formation, 191
Vincent J. Hearing
 - 11 The Tyrosinase Gene Family, 213
William S. Oetting & Vijayaradhi Setaluri
 - 12 Molecular Regulation of Melanin Formation: Melanosome Transporter Proteins, 230
Murray H. Brilliant
 - 13 Transcriptional Regulation of Melanocyte Function, 242
Kazuhisa Takeda & Shigeki Shibahara
 - 14 Enzymology of Melanin Formation, 261
Francisco Solano & José C. García-Borrón
 - 15 Chemistry of Melanins, 282
Shosuke Ito & Kazumasa Wakamatsu
 - 16 The Physical Properties of Melanins, 311
Tadeusz Sarna & Harold A. Swartz
 - 17 Photobiology of Melanins, 342
Antony R. Young
 - 18 Toxicological Aspects of Melanin and Melanogenesis, 354
Edward J. Land, Christopher A. Ramsden, & Patrick A. Riley
 - 19 Regulation of Pigment Type Switching by Agouti, Melanocortin Signaling, Attractin, and Mahoganoid, 395
Gregory S. Barsh
 - 20 Human Pigmentation: Its Regulation by Ultraviolet Light and by Endocrine, Paracrine, and Autocrine Factors, 410
Zalfa Abdel-Malek & Ana Luisa Kadekaro
 - 21 Paracrine Interactions of Melanocytes in Pigmentary Disorders, 421
Genji Imokawa
 - 22 Growth Factor Receptors and Signal Transduction Regulating the Proliferation and Differentiation of Melanocytes, 445
Ruth Halaban & Gisela Moellmann
 - 23 Aging and Senescence of Melanocytes, 464
Debdutta Bandyopadhyay & Estela E. Medrano
 - 24 The Genetics of Melanoma, 472
Vanessa C. Gray-Schopfer & Dorothy C. Bennett
 - 25 The Transformed Phenotype of Melanocytes, 489
Dong Fang & Meenhard Herlyn
- Part II: The Pathophysiology of Pigmentary Disorders**
Section 3: An Overview of Human Skin Color and its Disorders, 497
- 26 A More Precise Lexicon for Pigmentation, Pigmentary Disorders, and “Chromatic” Abnormalities, 499
James J. Nordlund, Tania Cestari, Pearl Grimes, Henry Chan, & Jean-Paul Ortonne
 - 27 The Normal Color of Human Skin, 504
James J. Nordlund & Jean-Paul Ortonne
 - 28 Mechanisms that Cause Abnormal Skin Color, 521
Jean-Paul Ortonne & James J. Nordlund

- Section 4: Disorders of Hypopigmentation, Depigmentation and Hypochromia, 539*
- 29 Genetic Hypomelanoses: Disorders Characterized by Congenital White Spotting—Piebaldism, Waardenburg Syndrome, and Related Genetic Disorders of Melanocyte Development—Clinical Aspects, 541
Richard A. Spritz
- 30 Genetic Hypomelanoses: Acquired Depigmentation, 551
Rozycki Syndrome, 551
Jean L. Bologna
Vitiligo Vulgaris, 551
James J. Nordlund, Jean-Paul Ortonne, & I. Caroline Le Poole
- 31 Genetic Hypomelanoses: Generalized Hypopigmentation, 599
Oculocutaneous Albinism, 599
Richard A. King & William S. Oetting
Albinoid Disorders, 613
Philippe Bahadoran & Jean-Paul Ortonne
Ataxia Telangiectasia, 621
Anne-Sophie Gadenne
Hallerman–Streiff Syndrome, 623
James J. Nordlund
Histidinemia, 623
Marnie D. Titsch
Homocystinuria, 625
Allan D. Mineroff
Oculocerebral Syndrome with Hypopigmentation, 626
Jean L. Bologna
Tietz Syndrome, 630
Jean-Paul Ortonne
Kappa-Chain Deficiency, 631
Jean-Paul Ortonne
Menkes' Kinky Hair Syndrome, 631
Tanusin Ploysangam
Phenylketonuria, 634
Allan D. Mineroff
- 32 Genetic Hypomelanoses: Localized Hypopigmentation, 636
“Hypomelanosis of Ito” and Mosaicism, 636
Wolfgang Küster & Rudolf Happle
Focal Dermal Hypoplasia, 645
James J. Nordlund
Hypomelanosis with Punctate Keratosis of the Palms and Soles, 646
Jean L. Bologna
Darier–White Disease (Keratosis Follicularis; 124200), 647
Jean L. Bologna
Nevus Depigmentosus, 649
Stella D. Calobrisi
Tuberous Sclerosis Complex, 652
Pranav B. Sheth
- 33 Genetic Hypomelanoses: Disorders Characterized by Hypopigmentation of Hair, 657
Bird-Headed Dwarfism (Seckel Syndrome), 657
Stan P. Hill
Down Syndrome, 658
Rosemary Geary
Fisch Syndrome, 659
Stan P. Hill
Premature Canities, 659
James J. Nordlund
Mandibulofacial Dysostosis (Treacher Collins Syndrome), 660
Rosemary Geary
Myotonic Dystrophy, 660
Peggy Tong
PHC Syndrome (Böök Syndrome), 661
Stan P. Hill
Pierre Robin Syndrome, 661
James J. Nordlund
Prolidase Deficiency, 662
Pranav B. Sheth
- 34 Metabolic, Nutritional, and Endocrine Disorders, 664
Metabolic and Nutritional Hypomelanoses, 664
Peter S. Friedmann
Hypomelanosis Associated with Endocrine Disorders, 667
Peter S. Friedmann
- 35 Chemical, Pharmacologic, and Physical Agents Causing Hypomelanoses, 669
Chemical and Pharmacologic Agents Causing Hypomelanoses, 669
Stefania Briganti, Monica Ottaviani, & Mauro Picardo
Physical Agents Causing Hypomelanoses, 683
Jean-Philippe Lacour
- 36 Infectious Hypomelanoses, 686
Jean-Philippe Lacour
- 37 Inflammatory Hypomelanoses, 699
Jean-Philippe Lacour
- 38 Hypomelanoses Associated with Melanocytic Neoplasia, 705
Lieve Brochez, Barbara Boone, & Jean-Marie Naeyaert
- 39 Miscellaneous Hypomelanoses: Depigmentation, 725
Alezzandrini Syndrome, 725
Wiete Westerhof, David Njoo, & Henk E. Menke
Idiopathic Guttate Hypomelanosis, 726
Wiete Westerhof, David Njoo, & Henk E. Menke
Leukoderma Punctata, 729
Wiete Westerhof, David Njoo, & Henk E. Menke
Lichen Sclerosus et Atrophicus, 731
Philippe Bahadoran
Vagabond Leukomelanoderma, 732
Wiete Westerhof, David Njoo, & Henk E. Menke
Vogt–Koyanagi–Harada Syndrome, 734
Wiete Westerhof, David Njoo, & Henk E. Menke
Westerhof Syndrome, 741
Wiete Westerhof, David Njoo, & Henk E. Menke

- 40 Miscellaneous Hypomelanoses: Hypopigmentation, 745
 Disseminated Hypopigmented Keratoses, 745
Wiete Westerhof, David Njoo, & Henk E. Menke
 Hypermelanocytic Punctata et Guttata
 Hypomelanosis, 746
Wiete Westerhof, David Njoo, & Henk E. Menke
 Progressive Macular Hypomelanosis, 748
*Henk E. Menke, Germaine Relyveld, David Njoo,
 & Wiete Westerhof*
 Sarcoidosis, 751
Wiete Westerhof, David Njoo, & Henk E. Menke
- 41 Miscellaneous Hypomelanoses: Extracutaneous Loss of
 Pigmentation, 754
 Alopecia Areata, 754
Wiete Westerhof
 Heterochromia Irides, 756
Wiete Westerhof, David Njoo, & Henk E. Menke
 Senile Canities, 760
Wiete Westerhof, David Njoo, & Henk E. Menke
 Sudden Whitening of Hair, 764
Wiete Westerhof, David Njoo, & Henk E. Menke
- 42 Hypochromia without Hypomelanosis, 767
Jean-Philippe Lacour
- Section 5: Disorders of Hyperpigmentation and
 Hyperchromia, 769**
- 43 Genetic Epidermal Syndromes: Disorders Characterized
 by Generalized Hyperpigmentation, 771
 Adrenoleukodystrophy, 771
Sheila S. Galbraith & Nancy Burton Esterly
 Familial Progressive Hyperpigmentation, 774
*Nancy Burton Esterly, Eulalia Baselga, Beth A. Drolet,
 Susan Bayliss Mallory, & Sharon A. Foley*
 Fanconi Anemia, 776
Sheila S. Galbraith & Nancy Burton Esterly
 Gaucher Disease, 778
Sheila S. Galbraith & Nancy Burton Esterly
- 44 Genetic Epidermal Syndromes: Disorders Characterized
 by Reticulated Hyperpigmentation, 780
 Berlin Syndrome, 780
Eulalia Baselga & Nancy Burton Esterly
 Cantu Syndrome, 781
Eulalia Baselga & Nancy Burton Esterly
 Kindler Syndrome, 781
Eulalia Baselga & Nancy Burton Esterly
 Dermatopathia Pigmentosa Reticularis, 784
Eulalia Baselga & Nancy Burton Esterly
 Dyschromatosis Universalis Hereditaria, 786
Eulalia Baselga & Nancy Burton Esterly
 Epidermolysis Bullosa with Mottled
 Pigmentation, 788
Eulalia Baselga & Nancy Burton Esterly
 Familial Mandibuloacral Dysplasia, 790
Eulalia Baselga & Nancy Burton Esterly
 Hereditary Acrokeratotic Poikiloderma, 792
Eulalia Baselga & Nancy Burton Esterly
 Hereditary Sclerosing Poikiloderma, 795
Eulalia Baselga & Nancy Burton Esterly
 Mendes Da Costa Disease, 796
Eulalia Baselga & Nancy Burton Esterly
 Naegeli–Franceschetti–Jadassohn Syndrome, 798
Eulalia Baselga & Nancy Burton Esterly
 Reticulated Acropigmentation of Dohi
 (Dyschromatosis Symmetrica Hereditaria), 799
Eulalia Baselga & Nancy Burton Esterly
 Reticulate Acropigmentation of Kitamura, 802
Eulalia Baselga & Nancy Burton Esterly
 Rothmund–Thomson Syndrome, 804
Eulalia Baselga & Nancy Burton Esterly
- 45 Genetic Epidermal Syndromes with *Café-au-lait*
 Macules, 809
 Familial Multiple *Café-au-lait* Spots, 809
Nancy Burton Esterly
 Neurofibromatosis, 809
*Nancy Burton Esterly, Eulalia Baselga,
 & Sheila S. Galbraith*
 Neurofibromatosis 1 with Noonan
 Syndrome, 816
Nancy Burton Esterly
 McCune–Albright Syndrome, 817
Sheila S. Galbraith & Nancy Burton Esterly
 Segmental Neurofibromatosis, 819
Nancy Burton Esterly & Eulalia Baselga
 Silver–Russell Syndrome, 820
*Nancy Burton Esterly, Eulalia Baselga,
 & Sheila S. Galbraith*
 Watson Syndrome, 823
Nancy Burton Esterly
- 46 Genetic Epidermal Pigmentation with Lentiginosities,
 824
 Lentigo Simplex, 824
Mary K. Cullen
 Lentigo Senilis et Actinicus, 829
Mary K. Cullen
 Centروفacial Lentiginosis, 837
Mary K. Cullen
 LEOPARD Syndrome, 842
Mary K. Cullen
 Carney Complex, 851
Mary K. Cullen
 Other Lentiginosities, 863
Mary K. Cullen
- 47 Genetic Epidermal Syndromes: Localized
 Hyperpigmentation, 873
 Anonychia with Flexural Pigmentation, 873
*Nancy Burton Esterly, Eulalia Baselga,
 & Beth A. Drolet*
 Incontinentia Pigmenti, 873
Sheila S. Galbraith & Nancy Burton Esterly
 Periorbital Hyperpigmentation, 879
*Nancy Burton Esterly, Eulalia Baselga,
 & Beth A. Drolet*

CONTENTS

- Pigmentary Demarcation Lines, 880
Sheila S. Galbraith & Nancy Burton Esterly
- Dowling–Degos Disease, 882
Sheila S. Galbraith & Nancy Burton Esterly
- 48 Genetic Epidermal Syndromes: Disorders of Aging, 884
- Acrogeria, 884
Nancy Burton Esterly, Eulalia Baselga, Peter M. H. Chan, & Beth A. Drolet
- Metageria, 886
Nancy Burton Esterly, Eulalia Baselga, Peter M. H. Chan, & Beth A. Drolet
- Progeria, 886
Nancy Burton Esterly, Eulalia Baselga, Peter M. H. Chan, & Beth A. Drolet
- Xeroderma Pigmentosum, 889
Anita P. Sheth, Nancy Burton Esterly, Eulalia Baselga, Peter M. H. Chan, & Beth A. Drolet
- Werner Syndrome, 894
Nancy Burton Esterly, Eulalia Baselga, Peter M. H. Chan, Beth A. Drolet, & Cindy L. Lamerson
- 49 Congenital Epidermal Hypermelanoses, 898
- Dyskeratosis Congenita, 898
Susan Bayliss Mallory, Peggy L. Chern, & Sharon A. Foley
- Ectodermal Dysplasias, 901
Susan Bayliss Mallory, Peggy L. Chern, & Sharon A. Foley
- Transient Neonatal Pustular Melanosis, 905
Susan Bayliss Mallory, Peggy L. Chern, & Sharon A. Foley
- Universal Acquired Melanosis, 906
Susan Bayliss Mallory, Peggy L. Chern, & Sharon A. Foley
- 50 Acquired Epidermal Hypermelanoses, 907
- Acanthosis Nigricans, 907
Norman Levine & Cynthia Burk
- Acromelanosis Progressiva, 914
Norman Levine & Cynthia Burk
- Becker Nevus, 915
Norman Levine & Cynthia Burk
- Café-au-lait Spots, 917
Norman Levine & Cynthia Burk
- Carcinoid Syndrome, 919
Norman Levine & Cynthia Burk
- Confluent and Reticulated Papillomatosis, 922
Norman Levine & Cynthia Burk
- Cutaneous Amyloidosis, 924
Norman Levine & Cynthia Burk
- Dermatosis Papulosa Nigra, 928
Norman Levine & Cynthia Burk
- Ephelides (Freckles), 929
Norman Levine & Cynthia Burk
- Erythema ab Igne, 931
Norman Levine & Cynthia Burk
- Erythema Dyschromicum Perstans, 933
Norman Levine & Cynthia Burk
- Erythromelanosis Follicularis Faciei et Colli, 935
Norman Levine & Cynthia Burk
- Erythroze Péribucale Pigmentaire of Brocq, 937
Norman Levine & Cynthia Burk
- Extracutaneous Neuroendocrine Melanoderma, 938
Norman Levine & Cynthia Burk
- Felty Syndrome and Rheumatoid Arthritis, 939
Norman Levine & Cynthia Burk
- Hyperpigmentation Associated with Human Immunodeficiency Virus (HIV) Infection, 941
Philippe Bahadoran
- Melanoacanthoma, 946
Norman Levine & Cynthia Burk
- Phytophotodermatitis, 948
Norman Levine & Cynthia Burk
- Polyneuropathy, Organomegaly, Endocrinopathy, M Protein, and Skin Changes: POEMS Syndrome, 951
James J. Nordlund
- Urticaria Pigmentosum and Mastocytosis, 954
James J. Nordlund
- Poikiloderma of Civatte, 959
Vlada Groysman & Norman Levine
- Riehl's Melanosis, 961
Scott Bangert & Norman Levine
- Atrophoderma of Pasini et Pierini, 963
James J. Nordlund, Norman Levine, Charles S. Fulk, & Randi Rubenzik
- Hyperpigmentation Associated with Scleromyxedema and Gammopathy, 965
Kazumori Urabe, Juichiro Nakayama, & Yoshiaki Hori
- Ichthyosis Nigricans, Keratoses, and Epidermal Hyperplasia, 965
James J. Nordlund
- Morphea and Scleroderma, 967
James J. Nordlund
- Pigmentary Changes Associated with Addison Disease, 969
Cindy L. Lamerson & James J. Nordlund
- Pigmentary Changes Associated with Cutaneous Lymphomas, 972
Debra L. Breneman
- 51 Hypermelanosis Associated with Gastrointestinal Disorders, 979
- Porphyria Cutanea Tarda, 979
Eun Ji Kwon & Victoria P. Werth
- Cronkhite–Canada Syndrome, 983
Eun Ji Kwon, James J. Nordlund, & Victoria P. Werth
- Hemochromatosis and Hemosiderosis, 986
Joerg Albrecht & Victoria P. Werth
- Primary Biliary Cirrhosis, 992
Joerg Albrecht & Victoria P. Werth
- Inflammatory Bowel Disease and Pigmentation, 995
Joerg Albrecht & Victoria P. Werth

- Pellagra, 995
Eun Ji Kwon & Victoria P. Werth
- Peutz–Jeghers Syndrome, 999
*Nancy Burton Esterly, Eulalia Baselga,
& Beth A. Drolet*
- 52 Acquired and Congenital Dermal Hypermelanosis, 1003
Sacral Spot of Infancy, 1003
Sang Ju Lee, Seung Kyung-Hann, & Sungbin Im
Nevus of Ota, 1006
Sang Ju Lee, Seung Kyung-Hann, & Sungbin Im
Nevus of Ito, 1012
Sang Ju Lee, Seung Kyung-Hann, & Sungbin Im
Phakomatosis Pigmentovascularis, 1013
Sang Ju Lee, Seung Kyung-Hann, & Sungbin Im
Other Congenital Dermal Melanocytosis, 1015
Sang Ju Lee, Seung Kyung-Hann, & Sungbin Im
Acquired Dermal Melanocytosis, 1016
Sang Ju Lee, Seung Kyung-Hann, & Sungbin Im
Carleton–Biggs Syndrome, 1017
Sang Ju Lee, Seung Kyung-Hann, & Sungbin Im
Acquired Bilateral Nevus of Ota-like Macules
(ABNOM), 1017
Sang Ju Lee, Seung Kyung-Hann, & Sungbin Im
Blue Macules Associated with Progressive Systemic
Sclerosis, 1018
Sang Ju Lee, Seung Kyung-Hann, & Sungbin Im
- 53 Mixed Epidermal and Dermal Hypermelanoses and
Hyperchromias, 1020
Melasma, 1020
Sang Ju Lee, Seung Kyung-Hann, & Sungbin Im
Melanosis from Melanoma, 1023
Sang Ju Lee, Seung Kyung-Hann, & Sungbin Im
- 54 Drug-induced or -related Pigmentation, 1026
Peter A. Lio & Arthur J. Sober
- Section 6: Disorders of Pigmentation of the Nails and
Mucous Membranes, 1055**
- 55 The Melanocyte System of the Nail and its Disorders,
1057
*Robert Baran, Christophe Perrin, Luc Thomas,
& Ralph Braun*
- 56 Pigmentary Abnormalities and Discolorations of the
Mucous Membranes, 1069
John C. Maize, Jr. & John C. Maize, Sr.
- Section 7: Benign Neoplasms of Melanocytes, 1091**
- 57 Common Benign Neoplasms of Melanocytes, 1093
Pigmented Spindle Cell Nevi, 1093
Julie V. Schaffer & Jean L. Bologna
Speckled Lentiginous Nevus (Nevus Spilus), 1098
Julie V. Schaffer & Jean L. Bologna
Melanocytic (Nevocellular) Nevi and Their Biology,
1112
Julie V. Schaffer & Jean L. Bologna
- 58 Rare Benign Neoplasms of Melanocytes, 1148
Nevus Aversion Phenomenon, 1148
James J. Nordlund
Melanocytic Neuroectodermal Tumor of Infancy, 1148
Julie V. Schaffer & Jean L. Bologna
Pilar Neurocristic Hamartoma, 1157
Julie V. Schaffer & Jean L. Bologna
- Section 8: Treatment of Pigmentary Disorders, 1163**
- 59 Topical Treatment of Pigmentary Disorders, 1165
Rebat M. Halder & James J. Nordlund
- 60 Chemophototherapy of Pigmentary Disorders, 1175
Rebat M. Halder & James J. Nordlund
- 61 UVB Therapy for Pigmentary Disorders, 1183
Thierry Passeron & Jean-Paul Ortonne
- 62 Sunscreens and Cosmetics, 1188
James J. Nordlund & Rebat M. Halder
- 63 Surgical Treatments of Pigmentary Disorders, 1191
Rebat M. Halder & James J. Nordlund
- 64 Laser Treatment of Pigmentary Disorders, 1198
*Rebat M. Halder, Lori M. Hobbs,
& James J. Nordlund*
- Index, 1205
Plate section can be found between pages 494 and 495

Contributors

Zalfa Abdel-Malek PhD

Research Professor of Dermatology, Department of Dermatology, University of Cincinnati College of Medicine, Cincinnati, OH, USA

Joerg Albrecht MD

Department of Dermatology, University of Pennsylvania, Philadelphia, PA, USA

Mayra Alvarez-Franco (deceased)

Formerly of the Departments of Dermatology and Pathology, Yale University School of Medicine, New Haven, CT, USA

Joseph T. Bagnara PhD

Professor Emeritus, Department Cell Biology and Anatomy, University of Arizona College of Medicine, Tucson, AZ, USA

Philippe Bahadoran MD PhD

Assistant Professor of Medicine, Service de Dermatologie, Hôpital l'Archet, Nice, France

Debdutta Bandyopadhyay PhD

Instructor of Dermatology, Huffington Center on Aging, Baylor College of Medicine, Houston, TX, USA

Scott D. Bangert MD

Banner Good Samaritan Hospital, Department of Medical Education, Phoenix, AZ, USA

Robert Baran MD

Head of Nail Disease Center, Cannes, France

Gregory S. Barsh MD PhD

Professor of Genetics and Pediatrics, Beckman Center for Molecular and Genetic Medicine, Stanford University School of Medicine, Stanford, CA, USA

Eulalia Baselga MD

Consultant in Pediatric Dermatology, Hospital de la Santa Creu I Sant Pau, Barcelona, Spain

Dorothy C. Bennett MA PhD

Professor of Cell Biology, St George's Hospital, University of London, London, UK

Raymond E. Boissy PhD

Professor of Dermatology and Cell Biology, Department of Dermatology, University of Cincinnati College of Medicine, Cincinnati, OH, USA

Jean L. Bolognia MD

Professor of Dermatology, Department of Dermatology, Yale University School of Medicine, New Haven, CT, USA

Barbara Boone MD

Resident in Dermatology, Universitair Ziekenhuis Ghent, Ghent, Belgium

Ralph P. Braun MD

Assistant Professor, Pigmented Skin Lesion Unit, Department of Dermatology, University Hospital, Geneva, Switzerland

Debra L. Breneman MD

Associate Professor of Dermatology, University of Cincinnati, Cincinnati, OH, USA

Stefania Briganti PhD

San Gallicano Dermatological Institute, Rome, Italy

Murray H. Brilliant PhD

Lindholm Professor of Genetics, Department of Pediatrics, University of Arizona College of Medicine, Tucson, AZ, USA

Lieve Brochez MD PhD

Professor of Dermatology, Department of Dermatology, University Hospital of Ghent, Ghent, Belgium

Cynthia J. Burk MD

Section of Dermatology, University of Arizona Health Sciences Center, Tucson, AZ, USA

Stella D. Calobrisi MD

Medical Director, The Dermatology Clinic, Boca Raton, FL, USA

Tania Cestari MD PhD

Associate Professor of Dermatology, Department of Dermatology, University of Rio Grande do Sul, Hospital de Clínicas de Porto Alegre, Brazil

Henry H. L. Chan MBBS MSc (Clin Derm) MD FRCP
FRCP(Ed) FRCP(Glasg) FHKCP FHKAM (Med)
*Specialist in Dermatology and Honorary Clinical Associate
Professor, University of Hong Kong and Chinese University of
Hong Kong, Hong Kong*

Peter Man Hon Chan MD
*Clinical Research Fellow, University of Minnesota, Eagan, MN,
USA*

Peggy L. Chern MD
*Department of Dermatology, University of Iowa Hospitals and
Clinics, Iowa City, IA, USA*

Mary K. Cullen MD
*Department of Cell Biology and Physiology, Clinical Instructor,
Washington University School of Medicine, St Louis, MO, USA*

Beth A. Drolet MD
*Department of Dermatology, The Medical College of Wisconsin,
Milwaukee, WI, USA*

Carol A. Erickson PhD
*Professor of Molecular Cellular Biology, University of California at
Davis, Davis, CA, USA*

Nancy B. Esterly MD
*Professor of Dermatology and Pediatrics, Department of
Dermatology, The Medical College of Wisconsin, Milwaukee,
WI, USA*

Dong Fang MD PhD
Staff Scientist, The Wistar Institute, Philadelphia, PA, USA

Sharon A. Foley MD
*Department of Dermatology, Washington University School of
Medicine, St Louis, MO, USA*

Peter S. Friedmann MD FRCP FMedSci
*Professor of Dermatology and Head of Division,
Dermatopharmacology Unit, Southampton General Hospital,
Southampton, UK*

Charles S. Fulk MD FACP
*Department of Pathology, Vanderbilt University, Nashville, TN,
USA*

Anne-Sophie J. Gadenne MD
*Department of Dermatology, University of Cincinnati College of
Medicine, Cincinnati, OH, USA*

William A. Gahl MD PhD
*Clinical Director, National Human Genome Research Institute,
National Institutes of Health, Bethesda, MD, USA*

Sheila S. Galbraith MD
*Assistant Professor of Dermatology, Dermatology Department,
Medical College of Wisconsin, Milwaukee, WI, USA*

José C. García-Borrón PhD
*Professor of Biochemistry and Molecular Biology, School of
Medicine, University of Murcia, Murcia, Spain*

Rosemary J. Geary MD
President, East Valley Dermatology Center, Chandler, AZ, USA

Vanessa C. Gray-Schopfer PhD
*Signal Transduction Team, Cellular and Molecular Biology Section,
Institute of Cancer Research, London, UK*

Pearl E. Grimes MD
*Vitiligo and Pigmentation Institute of Southern California, David
Geffen School of Medicine, University of California at Los Angeles,
Los Angeles, CA, USA*

Vlada Groysman MD
*Section of Dermatology, University of Arizona Health Sciences
Center, Tucson, AZ, USA*

Ruth Halaban PhD
*Senior Research Scientist, Department of Dermatology, Yale
University School of Medicine, New Haven, CT, USA*

Rebat M. Halder MD
*Professor and Chairman, Department of Dermatology, Howard
University, Washington, DC, USA*

Seung-Kyung Hann MD PhD
*Director, Korea Institute of Vitiligo Research, Yongsan-Gu, Seoul,
Korea*

Rudolf Happle MD
*Professor of Dermatology, Department of Dermatology, Philipp's
University of Marburg, Marburg, Germany*

Vincent J. Hearing PhD
*Chief, Pigment Cell Biology Section, Laboratory of Cell Biology,
National Institutes of Health, Bethesda, MD, USA*

Meenhard Herlyn DVM, DSc
*Professor and Chair of Program of Molecular and Cellular
Oncogenesis, The Wistar Institute, Philadelphia, PA, USA*

Stan P. Hill MD
Denver, CO, USA

Lori M. Hobbs MD
*Assistant Professor, Department of Dermatology, Howard
University, Washington, DC, USA*

Thomas J. Holstein PhD
Professor Emeritus, Roger Williams University, Bristol, RI, USA

Yoshiaki Hori MD PhD (deceased)
*Formerly Honorary Professor, Department of Dermatology, Kyushu
University, Fukuoka, Japan*