



# Proceedings of the International Colour Association (AIC) Conference 2021

Milan (Italy), August 30<sup>th</sup> - September 3<sup>rd</sup> 2021



Published by  
**International Colour Association (AIC)**



Sponsored by  
**Gruppo del Colore**  
(Associazione Italiana Colore)



© 2021 International Colour Association (AIC) International Colour Association Incorporated  
PO Box 764  
Newtown NSW 2042  
Australia  
[www.aic-colour.org](http://www.aic-colour.org)  
All rights reserved.

## **DISCLAIMER**

Matters of copyright for all images and text associated with the papers within the Proceedings of the International Colour Association (AIC) 2021 are the responsibility of the authors. The AIC does not accept responsibility for any liabilities arising from the publication of any of the submissions.

## **COPYRIGHT**

Reproduction of this document or parts thereof by any means whatsoever is prohibited without the written permission of the International Colour Association (AIC). All copies of the individual articles remain the intellectual property of the individual authors and/or their affiliated institutions.

ISBN: 978-0-6484724-3-8  
eISSN: 2617-2429  
ISSN: 2617-2410

## **HOW TO CITE THIS BOOK**

AIC (International Colour Association). 2021. Proceedings of the International Colour Association (AIC) Conference 2021. Milan, Italy. AIC.  
How to cite an article included in this book:  
Author's name. 2021. Title of the article. In: Proceedings of the International Colour Association (AIC) Conference 2021. Milan, Italy. AIC, page numbers of the article.



## INDEX

<b>AIC President's Message</b>	<b>11</b>
2020-2021 EXECUTIVE COMMITTEE	13
<b>AIC 14<sup>th</sup> Congress Milano 2021</b>	<b>15</b>
Gruppo del Colore-Associazione Italiana Colore President's Message	15
The AIC2021 14 <sup>th</sup> Congress - Chairs introduction	17
<b>AIC 14<sup>th</sup> Congress Milano 2021 is organized by Gruppo del Colore – Associazione Italiana Colore</b>	
GENERAL CHAIRS	19
ORGANIZING COMMITTEES	19
SCIENTIFIC PEER REVIEW COMMITTEE	20
SPONSORS	25
PATRONAGE	25
<b>CALL FOR PAPERS</b>	<b>26</b>
<b>PROGRAM AT A GLANCE</b>	<b>29</b>
<b>SCIENTIFIC PROGRAM</b>	<b>30</b>
Monday August 30 <sup>th</sup> , 2021 (single session)	30
Tuesday August 31 <sup>st</sup> , 2021 (2 parallel sessions)	34
Wednesday September 1 <sup>st</sup> , 2021 (2 parallel sessions)	41
Thursday September 2 <sup>nd</sup> , 2021 (2 parallel sessions)	50
Friday September 3 <sup>rd</sup> , 2021 (single session)	59
<b>INVITED LECTURES</b>	<b>64</b>
Color deficient see this way ... Or don't they?	64
The influence of cfa choice on automotive and other critical imaging systems	64
Color in fashion design	65
Conservation science and changing colours - approaches to measuring and managing change	66
Lighting and color design in the show	66
Leonardo's colour today: from the dark to the light	67
Chromatic sustainability: a new approach to color design	68
<b>AWARD LECTURES</b>	<b>69</b>
AIC Award for Colour in Art, Design and Environment (CADE) 2021	69
Citation - Jean-Philippe Lenclos: AIC Award for Colour in Art, Design and Environment 2021 recipient	69
AIC CADE Award Lecture	69
AIC Deane B. Judd Award 2021	70
Citation - John McCann: AIC Deane B. Judd Award 2021 recipient	70
AIC Judd Award Lecture	70
<b>PREMIO COLORE GdC – Associazione Italiana Colore 2021</b>	<b>71</b>



<b>INVITED LECTURES</b>	<b>73</b>
Robin Jenkin - "The influence of CFA choice on automotive and other critical imaging systems"	75
Pietro Marani - "Leonardo's color today: from the dark to the light"	85
Clino Trini Castelli - "Umbrella Diagram - 1981-2021, four decades of forecasts and CMF design"	97
<b>AWARDS</b>	<b>103</b>
Jean-Philippe Lenclos - CADE Award Lecture: Living in colour - Vivre en couleur	105
John McCann - Judd Award Lecture: Color Vision responds to Natural Scenes: Roles of Glare, Receptor Quanta Catch, and Neural Spatial Comparisons	117
<b>COLOR AND MEASUREMENT / INSTRUMENTATION</b>	<b>129</b>
Kanoko Makino, Kaoruko Kitamura, Haruno Tsuda, Yuki Oe, Nozomu Yoshizawa - Colour appearance of a white space with greenish daylight	131
Shimpei Fukagawa, Hiroyuki Iyota, Hideki Sakai, Mai Isomi - Development of color and gloss measurement system with wide-range temperature and humidity control unit	137
Pei-Li Sun, Raymond Chiang - Identify the characteristics of optically variable inks with deep learning	143
Shuheï Watanabe, Takahiko Horiuchi - Estimation of authenticity model considering the colour: Leather as a case study	149
Jiaxun Zhang, Haisong Xu, Hao Jiang - Cross-media color reproduction under mixed adaptation condition	155
Ye Zhang, Kaiyin Chen, Shulei Ma - Study on colour effect of transparent material under colour-light	161
Qinyuan Li, Jinxing Liang, Yan Lu, Kaida Xiao, Michael Pointer - Quantification of the effect of colour appearance and materials on the visual-tactile properties of fabrics	167
Shahin Aldhahir - Differential Color Perception Theory	173
Esther Perales, Andrea Morales, Alejandro Ferrero, Juan Carlos Fernández-Becáres, Marjetka Milosovic, Joaquin Campos, Khalil Huraibat, Jorge Pérez, Valentín Viqueira - Impact of the color hue on the sparkle perception	179
Khalil Huraibat, Esther Perales, Eric Kirchner, Ivo Van der Lans, Alejandro Ferrero, Joaquín Campos - Multiangle visual validation of a physically based rendering of goniochromatic colors	185
Rada Deeb, Graham Finlayson - The Locus Filter	191
<b>COLOR AND DIGITAL</b>	<b>197</b>
Yiming Huang, Haisong Xu, Zhengnan Ye - HDR image quality evaluation for mobile displays	199
Li Yumei, Liao Ningfang, Wu Wenmin, Deng Chenyang, Li Yasheng - Research on HDR image tone mapping algorithm based on modified ICAM06	203
Sandhiya Jayaprakash Brindha, Monica Vatteroni, Gabriele Simone - HDR imaging using CMOS technology inspired by human eyes for Automotive applications	209
Yi-Tun Lin, Graham Finlayson - Recovering Real-World Spectra from RGB Images under Radiance Mondrian-World Assumption	215
Pengpeng Yao, Jack Hc Wu, John Xin - The use of LED-based illumination for Multispectral Imaging System	221
Cristian Bonanomi, Kedar Sathaye - Imaging colorimeters to evaluate Camera Monitor Systems	227
Simone Bianco, Marco Buzzelli, Gianluigi Ciocca, Raimondo Schettini, Mikhail Tchobanou, Simone Zini - Analysis of Biases in Automatic White Balance Datasets	233
Chloe Game, Michael Thompson, Graham Finlayson - Chromatic Weibull Tone Mapping for Underwater Image Enhancement	239
Marco Buzzelli, Simone Bianco, Raimondo Schettini - Angle-Retaining Color Space for Color Data Visualization and Analysis	245
Ana Belén López-Baldomero, Manuel Rubiño, Carolina Ortiz, Carlos Salas - Comparison of color gamuts generated by digital printing devices under different conditions	251
Alfonso De Lucas Tron - The perceptual calibration of color. An exploration	257
Hao Cui, Renzo Shamey - Diagnosis of Psoriasis using image segmentation and deep learning	263
Yuteng Zhu, Graham Finlayson - Designing a Single Pre-filter for Making a Group of Cameras more Colorimetric	269
Jake McVey, Graham Finlayson - Fast and Optimal Contrast Limited Tone Mapping	275
Arjan Gijzenij, Peter Spiers, Stephen Westland, Pim Koeckhoven - Deriving representative color palettes from mood board images	282



Emilie Robert, Magali Estribeau, Rémi Barbier, Gregory Swiathy, Justin Plantier, Pierre Magnan - Impact of the training data used in LLS optimization for faithful scene-specific color correction of raw images	287
Barbara Blaznik, Franci Kovač, Grega Bizjak, Sabina Bračko - Fastness of black dye-based ink-jet printing inks in aqueous solution in the presence and absence of oxygen	293
Brandon Hopley, Graham Finlayson, Michal Mackiewicz, Julie Bremner, Tony Dolphin, Riccardo Arosio - Improving image registration using colour transfer methods in remote sensing applications	299
Pedro Pardo, Francisco Díaz Barrancas, Halina Cwierz López - Color Constancy in virtual reality scenes. A first step toward a color appearance model in virtual reality	305
Marisol Fernández-Carvelo, Miguel Angel Martinez-Domingo, Eva M. Valero, Juan Luis Nieves, Javier Romero, Javier Hernández-Andrés - Band selection for different dehazing algorithms in the visible range	311
<b>COLOR AND LIGHTING</b>	<b>317</b>
Maurizio Rossi - A proposal for the definition of colored light sources in lighting CAD	319
Laura Bellia, Francesca Diglio, Francesca Fragliasso - Lighting quality for home-working spaces: a survey	325
Laura Bellia, Urszula Błaszczak, Francesca Fragliasso, Lukasz Gryko - The colours of light in indoor environments: Mixing daylight and electric light spectra to define a proper match	331
Hyeonju Park, Hyeon-Jeong Suk - Design Guidelines for Light Interfaces of Home Appliances	337
Jingyi Lin, Keyu Shi, Ming Ronnier Luo - Colour Performance Evaluation for LED Simulator Technology	343
Stine Louring Nielsen, Emma-Sofie Hestbech, Nanna Hasle Bak, Michael Mullins - Moving in Colour Illuminated Space: An Exploration of Analysis	349
Ayse Nihan Avci, Saadet Akbay - OLED Lighting and Human Circadian System: A Review	355
Lorrain Caumon, Georges Zissis, Céline Caumon, Élodie Bécheras, Estelle Guerry, Christelle Infantes - Colours, light and well-being: characterisation of chromatic phenomena in collective housing	361
Andrea Siniscalco - A design approach to lighting and color rendering in indoor sets	367
Mengyuan Chen, Stephen Westland - User acceptance of innovative blue light therapy to treat seasonal affective disorder	373
Oscar Santilli - Colored light shapes. Protect and enhance the colors of artworks	379
<b>COLOR AND PHYSIOLOGY</b>	<b>385</b>
Kota Akiba, Midori Tanaka, Takahiko Horiuchi - Effect of ipRGC on Colour Perception of Display Device under Various Illuminants	387
Miyoshi Ayama, Minoru Ohkoba, Tomoharu Ishikawa, Shoko Hira, Sakuichi Ohtsuka - Difference Scaling and Color Naming of Red-Green Color Deficiencies	393
Firdevs Gökmenoğlu, Saadet Akbay - Effects of Colour on the Sense of Immersion in Virtual Interior Environments	399
Hideki Sakai - Brightness evaluation under the closed-eye condition: Measurement of optical transmittance of eyelid	403
Taesu Kim, Hyeon-Jeong Suk - EEG Responses to In-Car Dynamic Cluster Light	409
Francisco Díaz-Barrancas, Halina Cwierz, Pedro José Pardo - A study of physical and perceived linearity in a virtual reality environment	415
Kari Bjerke Gjørde, Anne Kristin Kvitle, Phil Green, Peter Nussbaum - How accurate is an on-line test for colour vision deficiency?	421
Laura Rey-Barroso, Mónica Roldán, Francisco J. Burgos-Fernández, Susanna Gassiot, Anna Ruiz Llobet, Ignacio Isola, Meritxell Vilaseca - Evaluation of Confocal Microscopy as a Diagnosis Tool on Red Blood Cell Diseases	428
Kazim Hilmi Or - A specific use of colour and dyes: "Vital dyes in ophthalmology"	433
Marisa Rodriguez-Carmona, Benjamin E. W. Evans, John L. Barbur - Assessing colour vision using single and multi test protocols	437
Flávia Mayer - The Construction Of Color By The Congenitally Blind	443
Francisco J. Burgos-Fernández, Tommaso Alterini, Fernando Díaz-Doutón, Meritxell Vilaseca - Colorimetric analysis of eye fundus structures with multispectral retinography	449
<b>COLOR AND PSYCHOLOGY</b>	<b>455</b>
Mahshid Baniani - What color is your mood? The association between moods and colors	457
Jinyoung Kim, Jiyeon Lee, Yungkyung Park - Why are common nature colors (soil, sand, trees, sky, stones, etc.) useful? Why does it go well with all colors?	463
Byeongjin Kim, Taesu Kim, Hyeon-Jeong Suk - Comfortable Brightness for Watching Television in the Dark	469



Akira Asano, Ayaka Shimura, Chie Muraki Asano - Effect of red color and external interferences in selection tasks	475
Ray-Chin Wu, Chao-Lung Lee, Ming-Hsiu Mia Chen, Chien-Wei Chang, Yun-Maw Cheng - A study on colour emotions of the mask	481
Andrew Chalmers - Is "Naturalness" a valid lighting concept	485
Yoonjeong Jo, Yungkyung Park - Changes in Color Appearance and Preference of Rose Affected by Color Temperature and Illuminance	491
Ichiro Katayama, Kin'nosuke Yamaji - Effect of the shade due to the surface unevenness of objects on whiteness perception	497
Muhammad Farhan Mughal, Ming Ronnier Luo, Michael R. Pointer - Perceived attractiveness across Chinese and Pakistani ethnic groups	503
Tzuhao Liu, John Hutchings, Ming Ronnier Luo - The Valence and Arousal contribution of colour parameters	510
Rui Vasques, António José Macedo Coutinho da Cruz Rodrigues, Diamantino S. Abreu - Visual and sensory perceptions between static and dynamic colors	515
Pia Lopez-Izquierdo - The Emotional Language of Colour	521
Sachiko Noguchi, Rumiko Takata, Kaori Segawa, Ichiro Katayama - Application of color feelings prediction formulas to the estimation of two-color combination feelings of "kimono"	527
Shi-Min Gong, Wen-Yuan Lee - Color Preference for Color Combinations Applied onto Three-Dimensional Color Configuration	533
Alessandro Bortolotti, Loreta Cannito, Stefano Anzani, Riccardo Palumbo, Maurizio Rossi - Lighting emotions: a review of the emotional influence of color perceived lightness	539
Anna Marotta, Alessandra Brosio - Color as a therapeutic adjuvant: theories and applications in the hospital setting	545
Barbara Matusiak, Marzieh Nazari, Kine Angelo - Colour shift due to Chromogenic dynamic glass	551
Juan Serra, David De Andrés, Ana Torres - ColorDoku 3d, gamification to improve perceptual color discrimination ability and spatial vision	558
Katherine Carpenter, Susan Farnand - Determination of the Representative Color of a Smartphone Image	563
Nian Xiong, Henry J. Trussell, Renzo Shamey - Psychophysical Study of the Perception of Color Gradient Boundaries	569

## **COLOR AND PRODUCTION** **575**

Vesna Marija Potočić Matković, Ana Sutlovic, Martinia Ira Glogar - Colour fading in the polyurethane coating depending on the substrate and conditions of natural weathering	577
Ji Eun Lee - Evaluation of Emotional Images According to Differences in Post-processing of Plastic Cosmetics Containers	583
Georgina Ortiz Hernández, Citlali Q. Ortiz Hernández, Oscar Francisco Bustamante - Shape, Color and Meanings. Comparison of Two Studies	589

## **COLOR AND RESTORATION** **596**

Junglim Lee, Yungkyung Park - Colour Prediction Method of Digitalized Korean Court Documentary Painting	598
Wensi Lin, Mengyue Zhang, Jisheng Wang, Mengqi Li, Jing Chen - The Experimental Restoration of the Colour of Nanjing Brocade from China	603
Yuton Jiang, Luke Li, Yihua Zheng - Quantitative color examination and restoration of historical architecture: the study of polychrome decoration of a Qing-style timber-frame structure in Tsinghua University (Beijing, China)	609
Martina Redi, Sofia Ceccarelli, Alessandra Terrei, Noemi Orazi, Fulvio Mercuri - Diagnostic analysis for colour restoration of a painted Japanese emakimono	615
Marcello Picollo, Costanza Cucci, Andrea Casini, Filippo Cherubini, Lorenzo Stefani - Hyper-Spectral Imaging Technique: Application for Colorimetric Analysis of Paintings	621
Guido Frison, Maurizio Aceto, Angelo Agostino, Dimitris Mylonas, Alberto Calatroni - Spectrographic analysis of the colourants of cultural items: from a qualitative to a semi-quantitative data treatment through BCTs	627
Jimena Vanina Odetti, Alberto Reyes González - Color, landscape and cultural heritage. The case of the Pitillal river, in Puerto Vallarta, Jalisco, Mexico.	633
Olivia Kuzio, Susan Farnand - LED-based versus Filter-based Multispectral Imaging Methods for Museum Studio Photography	639
Eric Kirchner, Carola van Wijk, Henni van Beek, Tammo Koster, Pim Koeckhoven - A new target to test color accuracy in technical photography of fine arts	645



Hortense de La Codre, Charlotte Marembert, Rémy Chapoulie, Laurent Servant, Aurélie Mounier - Hyperspectral mapping (VIS-SWIR) of materials of three 18th C. tapestries of Royal Manufactures in France (Gobelins, Beauvais, Aubusson)	651
Márcia Hazin, João Pernão - The NCS color notation as a guide to produce colors from traditional pigments in conservation: The case study of two painted ceilings from eighteenth-Century Churches in colonial Brasil	653
Ângela Santos, Vanessa Otero, Márcia Vilarigues Colours of pre-cinema projections: the evolution of hand-painted magic lantern glass slides' palette	659
<b>COLOR AND BUILT ENVIRONMENT</b>	<b>666</b>
Jean-Luc Capron - Spatio-temporal Factors of Colored Light Sequences in the Built Environment: the case of a choral concert – Part One	668
Camilla Giani, Cristina Boeri - Children's colour preferences in the school context	673
Estelle Guerry - Prehension and qualification of chromatic and lighting environment. Study case – Paimio Sanatorium, Alvar Aalto	679
Justyna Tarajko-Kowalska - Is "yellow house" really "yellow"? Survey on determining the range of perceiving the yellow color on building facades depending on the hue, lightness and chroma	685
Ana Sutlović, Martinia Ira Glogar, Ivana Padavić, Koraljka Kovač Dugandžić - Plant Transfer Printing on Cotton and Silk	691
Sari Yamamoto - Practice-based research on color planning for educational facilities	697
Asako Nakamura, Fabrizio I. Apollonio, Marco Gaiani - Urban color mapping in Tokyo: the case study of Hillside terrace	703
Lanqing Gu, Adamantia Batistatou, Yvonne N. Delevoye-Turrell, Jenny Roe, Martin Knöll - Using artificial ground color to promote a restorative sidewalk experience: an experimental study based on manipulated street view images	709
Changying Xiang, Barbara Szybinska Matusiak - Aesthetic Evaluation of Facade Integrated Coloured Photovoltaics Designs-an International Online Survey	715
Esra Küçükkılıç Özcan, Fatma Rengin Ünver - A screen experiment on the assesment of façade colour perception factors	722
Patrizia Falzone - Complexity of the theme of the Painted Façades in the large and medium historical centers in relation to the environmental contexts to which they belong	727
Doreen Balabanoff - Colour and Design of Birth Spaces: A transdisciplinary review of the literature	733
Zhaohua Lei, Fabrizio I. Apollonio, Marco Gaiani - A multiscale approach to the urban space color analysis starting from the case of study of the Collegio di Milano	739
Filippo Cherubini, Andrea Casini, Costanza Cucci, Marcello Picollo, Lorenzo Stefani - Application of hyperspectral camera and spectroradiometer for spectroscopic and colorimetric measurements on polychrome surfaces in a controlled environment: pros and cons of the presented technologies	745
Jorge Llopis, Juan Serra, Irene De la Torre - Color, ceramics and architecture in the Spanish Renaissance. Serlian serial ceramics and their role in the construction of a new spatiality	751
Beichen Yu, Simon Bell, Giorgio Ponso - The emerging trend of saturated colour in the contemporary urban environment: an updated view of colour	757
Ralf Weber, Kine Angelo, Thomas Kanthak, Maya Weber - A Color Inventory of and a Color Guide to Dresden's Neustadt	763
Francesca Salvetti, Michela Scaglione - The use of color in the urban landscape through regeneration projects of the degraded open spaces of the city	769
Margherita Cicala, Luciano Lauda - The color in the street art of Gianluca Raro and Fabio Biodpi: between social impact and urban periphery in Scampia	775
<b>COLOR AND DESIGN</b>	<b>781</b>
Aigerim Shunayeva, Taesu Kim, Bokyoung Lee, Hyeon-Jeong Suk - Style assessment of home appliances in various interiors using virtual reality	783
Gyunpyo Lee, Taesu Kim, Hyeon-Jeong Suk - Is Blue still a Representative for Future Vehicles?	789
Boram Kim, Hyeon-Jeong Suk - Visualization of chair color data through network analysis	795
Terumi Konno, Koichiro Kakiyama, Yasuhiro Kawabata - Observed changes in garment color selection of university students across normal and test periods	801
Masato Sakurai, Ryoma Yamamoto - Relationship Between Taste Impression and Color in Snack Packages	807
Tomoharu Ishikawa, Takumi Nakajima, Yoshiko Yanagida, Minoru Mitsui, Kazuya Sasaki, Miyoshi Ayama - Effect of Sensation Modalities on Texture Evaluation of Beige Fabrics by Japanese and Chinese	813





Yumi Awano, Masayuki Osumi - The visual effect of costume woven with peacock feathers and the symbolism in Japanese culture - Evaluation derived from gonio-photometric spectrum analysis and microscopic observation	818
Eunji Han, Yungkyung Park - A study on associative color attributes of Antonyms in Korean language	823
Agata Kwiatkowska-Lubańska - Colour and ornament in the Polish Art Deco style. Karol Homolacs and his colour course at the Cracow Workshops 1913-1926	828
Verena M. Schindler, Yulia A. Griber - The evolution of environmental colour design in the French period	833
Anna Kmita - CMF in commemorative ceramics. Project of a color and texture palette on the example of "Ckliwe na szklwie"- Nostalgic Glaze. Personal collection of memories on ceramic plates.	837
Marcus Farr, Andrea Macruz - Colored Response: Technology, Thermo-chromic Material Systems and Human Awareness	843
Francesco Scullica, Elena Elgani, Umberto Monchiero - The relevance of color in post COVID-19 interior design	849
Anna Barbara, Reejy Atef Abdelatty Mikhail, Maria Camila Álvarez García - The Odor of Colors: Correspondence from a Cross-Cultural Design Perspective	855
Gyeonghwa Lee, Vien Cheung, Tang Tang - - The role of colour designers in the design process	861
Michel Albert-Vanel - Combinations of colours as an analogue model in Modern Art	867
Gisela Costa Pinheiro Monteiro, Robert Hirschler - A mount-it-yourself 3D colour model for designers	873
Ingrid Calvo Ivanovic, Marta Elisa Cecchi, Clorinda Sissi Galasso, Ambra Borin, Claudia Mastrantoni, Martina Scagnoli - The Colours of Individual and Collective Memory: Mnemosphere, a Visual Atlas of Memory, Emotions and Atmosphere of Places	879
Luwen Yu, Stephen Westland, Vien Cheung, Guobin Xia - Analysis of research strategies to determine colour preference II: AFC, rank-order and rating	885
Déborah Epicoco, Christine Mohr, Mari Uusküla, Michael Quiblier, Maliha Bouayed Meziane, Eric Laurent, Domicela Jonauskaitė - Making sense of free associations with PURPLE – A new coding scheme testing French speakers in three countries	891
Inez Michiels - Design Semantics Database	897
Martinia Ira Glogar, Sandra Flinčec Grgac, Antonia Zanchi Sarwari, Jose M. Canal - Interaction of Colour and Cotton Fabric Surface Coated with Ultrafine Cellulose (UFC)	903
Guobin Xia, Philip Henry, Francisco Queiroz, Stephen Westland, Luwen Yu - Colour–cognitive performance interaction in Virtual Reality (VR): A study of gender differences	909
Delia Dumitrescu, Marjan Kooroshnia, Erin Lewis, Kathryn Walters - Colour, texture, and luminance: Textile design methods for printing with electroluminescent inks	915
Elizaveta Kushnirenko - Color in Fashion Design: orange that changed our perception of Luxury - the use of color at Hermès Paris	921
Xuechang Leng - The meaning of blue-green tiles on the roofs of the Qinzhen Hall complex at the Summer Palace	927
Rebecka Pires - Application of color in domestic interior design: an analysis of the 1960s, 1970s and 1980s	933
Gianluca Guarini, Maurizio Rossi - Procedure to obtain trustful colors in renderings produced by BIM	939
Ana Paula Pinheiro, Rui Duharte - Color and Sustainability in Fashion Design: DUARTE, Portugal	945

## **COLOR AND CULTURE** **951**

Martino Pavignano, Ursula Zich - Colour, material and prototyping for Architecture	953
Enrico Zampieri, Vincenzo Baldoni, Simone Garagnani, Andrea Gaucci, Michele Silani - Digital reproduction of colors and materials used in pottery: a case study from the ancient Picenum	959
Marcela Sepúlveda - Polychromy from the Atacama Desert (South America). An interdisciplinary approach for an archaeology of color	965
Camilla Tartaglia - The hidden history of woad blue: a path through technology and diffusion of “European indigo” in 18 <sup>th</sup> -century technical literature	971
Qian Huang - A Study on the Color of Miao’s Badai Culture in Fenghuang County of China	977
Zoriana Lotut - Reading Medieval Colour. The Case of Blue in the Canterbury Tales	983
Xiaochan Ge, Xue Mao, Jie Xu - Identifying the colour of Longquan Celadon Porcelain	989
Lia Luzzatto - Colors in the feminine between the Middle Ages and the Renaissance	993
Renata Pompas - Chagall e Malevič: the colors of the imagination and the colors of the absolute	999
Dimitris Mylonas, Alexandros Koliouisis, Mari Uusküla - Synonymy in the language of colour	1005
Letizia Bollini, Martina Falta - Brides in black widows in white. Semantic evolution of the social and cultural meaning of the colours	1011
Yulia A. Griber, Dimitris Mylonas, Galina Pamei - Age-related differences in richness and diversity of Russian color lexicon	1017
Anna Marotta, Rossana Netti - Knowledge as a project parameter: comparative colour theories	1023





Anna Marotta - Scientific basics in art from the Theories of Color: Authors, methods, rules, applications	1029
Cristiana Bartolomei, Cecilia Mazzoli, Caterina Morganti - The building materials of Luis Barragán: light and colour	1035
Joaquim Santos - Tili Wiru Tjuta Nyakutjaku - Towards an Extensive Cultural Paradigm	1041
Mark D. Fairchild - System for Visual Assessment of Wine Color	1047
Petronio Bendito - Algorithmic Color Methods of Media Arts	1053
Zhaohua Lei, Elza Tantcheva-Burdge, Vien Cheung - Investigation into the Colours of the DunHuang Murals from the Tang Dynasty	1060
Henriette Jarild Koblanck, Monica Moro - Straw/Light – Colour	1065

## **COLOR AND EDUCATION 1071**

David Briggs - More than Three Dimensions: Communicating the Attributes of Colour Perception in Colour Education	1073
Ching Chih Liao - Analysis and Application of Artwork Color - Awakening Students' Color Aesthetics and Narrative Ability through Artworks at the National Palace Museum in Taipei	1079
Woon Lam Ng - Factors that Influence Color Choice – A Study of Cultural, Symbolical and Synesthetic Behaviors	1085
Gülru Mutlu Tunca, Saadet Akbay, Güler Ufuk Demirbaş - Parametric Design Studio in Interior Architecture Education: A Case of Integration of Colour Design	1091
Paul Green-Armytage, Maggie Maggio - Beyond the Rainbow: A New Sorting Set for Teaching colour	1097
Lea Jeong, Yungkyung Park - Color Names Education Effect on the Color Range Recognition	1103
Jihye Choi, Paolo Calafiore - Colorful safety guide	1109
Junior Vendrami, Marley de Lira, Berenice Gonçalves - Educational resources based on augmented reality applied to Color Theory contents / UFSC	1115
Berta Martini, Rossella D'Ugo, Monica Tombolato - Teaching and learning color. An insight into STEM/STEAM approach	1121
Caroline Bouchez, Blandine Chorein, Dominique Corger - Color and Polymers at ITECH	1127
Saara Pyykkö - How to convert the experience-based university course about colour, light and space for the web?	1134
Franca Zuccoli - Mario Lodi: "Children's colours are festive, flamboyant, vivid colours"	1139
Flora Gaetani, Fausto Brevi, Donatella Balloni - Colour proposals consistency in the CMF for car design education	1145
Craig Kirkwood - We don't know Jack about Hue: the Colour Knowledge Survey	1152

## **COLOR AND COMMUNICATION / MARKETING 1157**

Zena O'Connor - Data visualization: The power and persuasive capacity of color	1159
Qinyue Chen, Yuchun Yan, Hyeon-Jeong Suk - Designing Voice-Aware Text in Voice Media with Background Color and Typography	1165
Boshuo Guo, Stephen Westland, Peihua Lai - Sentiment Analysis Based on Frequency of Colour Names on Social Media	1171
Daniela F. Pinheiro, Teresa Almeida, Domingos Loureiro - Color Specificity: the perception of difference through exhausting repetition	1177
Anica Hunjet, Sandra Križan, Dijana Vuković - Influence of wine color on wine selection and consumption	1183
Lidija Mandić, Maja Strgar Kurečić - The role and significance of color when choosing cars	1189
Peihua Lai, Boshuo Guo, Stephen Westland - Why do people choose their car colours?	1195

## **SPECIAL SESSIONS 1201**

### **INNOVATION AND RESEARCH IN COLOR FOR BEAUTY CARE AND HAIRSTYLE 1201**

Christine Fernandez-Maloigne - History of colors and beauty	1203
Helene De Clermont-Gallerande - A comparative study of lipstick shades preferences by geographical area	1209
Isabel Espinosa Zaragoza - Parallelism as advertising strategy in Maybelline's lipstick colour names	1215
Yuchun Yan, Hyeon-Jeong Suk - Fifty Shades of Beige: An Analysis on the Color System for Liquid Foundation	1221
Xiaoxuan Liu, Rui Peng, Ming Ronnier Luo - The impact of skin colours on visual impression	1227
Yan Lu, Kaida Xiao - Quantifying facial colour appearance of Caucasian and Chinese faces	1233



Kumiko Kikuchi, Shoji Tominaga, Jon Hardeberg - Development of measurement system for optical properties of facial skin using 3D camera and projector	1239
Katsuaki Sakata, Hitomi Shimakura - The reference point for judging human facial skin tone	1245
Simone Liberini, Alessandro Rizzi - Munsell and Ostwald color spaces: a comparison in the field of hair coloring	1251
Alessandro Rizzi, Roberta Suardi, Simone Liberini - Hair color wheels and charts	1257
Alice Toninelli, Simone Liberini, Roberta Suardi, Giannantonio Negretti - Chromatic appearance of nylon swatches in hair color charts	1263
Daniele Fusari - Influence of color discrimination proficiency on wellness professionals' training and craft	1269
Giannantonio Negretti - Hair coloring and customer satisfaction	1275
Lupe Voss, Sherman Wong - More than a tube of Hair Colour - The Emotion	1279
<b>ALL THE COLORS OF CINEMA</b>	<b>1286</b>
Ivan Magrin-Chagnolleau - Handling Color in Photography and Film: From Photo Retouching to Color Grading	1288
Pedro Felipe Pinho Souza - Color correction and color grading: how a film colorist works	1293
Manuela Piscitelli - Colour in characters' identity in the animation cinema	1299
Alice Plutino, Beatrice Sarti, Gabriele Simone, Alessandro Rizzi - A film in a frame: movie barcodes for film restoration	1305
Mark Wentworth, Orly Morgenstern, Tania Erandeni Fuentes Villa - The Lilac Scarf – Color as a visual narrative as depicted in the film Far from Heaven (2002)	1311
Paula Csillag, Amanda Sabião - PIXAR's Colorscripts: Chromatic Analyses of Four Films Using Sens Org Int Model	1317
Sabrina Negri - Fine Arts on Film: The Hand-Painted Work of Stan Brakhage	1323
Giorgio Trumpy, Sreya Chatterjee, Ulrich Ruedel, Barbara Flueckiger - A Material Investigation of Color Film Technology through the Koshofer Collection	1330
Luca Giuliani - Digital color in cinema: an incomplete transition	1335
Beatrice Sarti, Arianna Crespi, Giulia Morabito, Alice Plutino, Alessandro Rizzi - Film Repository for Restoration (FIRe2): identification of photographic and cinematographic films	1341
<b>ALL THE RECENT BOOKS ON COLOR</b>	<b>1347</b>
Maria João Durao - Colour: Urban Space, Architecture and Design	1349
Jodi Sandford - The Sense of Color: A Cognitive Linguistic Analysis of Color Words	1355
Verena M. Schindler, Yulia A. Griber - Publications: The International Scientific Conference of the Color Society of Russia	1361
<b>COLOUR, LIGHT &amp; SOUND: HOLISTIC APPROACH FOR WELLBEING</b>	<b>1367</b>
Thelma van der Werff, Mary Ashby-Green - Colour as a coaching tool with Colournostics	1369
Pascal Vidal - Photonic Medicine, the therapeutic use of light and colours in Medicine	1373
Pauline Allen, Heather Benghiat, Phil Stickland - How the sensory systems impact our journey through life	1379
Susana Ribeiro - Bodygraphy - Chromatic performance on surrounding space	1385
Angelika Klotz - Post-Pandemic Support with Colour, Light and Frequencies	1391
Valérie Bonnardel - Colour, Human experience and cyborgism	1397
Margo Ruiter - The power of earth colours	1404
Claudia Bonollo - The imagined body (2001-2021)	1409
Daniel Asis - Auricular Chromotherapy in the treatment of Psychological Trauma	1415
Arzhan Surazakov - Principles of regenerative therapy with low-intensity laser, colour, ultrasound and magnetic field (coMra)	1420
Abhay Wadhwa - Soul-X: The Experience Center for Mind-Body Harmony	1425
Anadi Martel, Christophe Desteuque - Treating chronic pain and depression with color and sound: recent studies using the Sensora system	1431
<b>PHOTO OF THE CLOSING CEREMONY</b>	<b>1437</b>
<b>INDEX OF AUTHORS</b>	<b>1439</b>

# The hidden history of woad blue: a path through technology and diffusion of “European indigo” in 18<sup>th</sup>-century technical literature

Camilla Tartaglia <sup>1,\*</sup>

<sup>1</sup> Department of Architecture and Urban Studies, Politecnico di Milano; camilla.tartaglia@polimi.it

\* Corresponding author: camilla.tartaglia@polimi.it

## Abstract

Woad, the famous “European indigo” plant, still hides some unknowns in its long history. This study wants to contribute to a better understanding of woad’s diffusion and use in Italy throughout the 18<sup>th</sup> and first half of the 19<sup>th</sup> century, by analysing the technical-agricultural literature of this period. The research allowed to collect some information on the “geography” of Italian woad, on its processing techniques and on its relation to “rival” Indian indigo, showing that Italy still had some relevant woad-producing centres at the time, and that woad was still acknowledged to have a significant dyeing function.

**Keywords:** dye plants, woad, indigo, technique, eighteenth century

## INTRODUCTION

Since the beginning of the second millennium, the art of dyeing in blue has always been of special importance to European industry. Up to the whole Medieval period, dyers all over Europe used to dye their cloths in a gorgeous blue colour with a colour-yielding plant that goes by the name of *Isatis tinctoria*: woad. Until then, the foreign “cousin” of woad, Indian indigo, coming from the East and yielding a more intense blue, was imported into Europe only in small quantities. Italy, which was at the forefront in Medieval woollen cloth production, had several praised dyeing centres that made great use of woad, and just as many woad cultivation areas which supplied them. The end of the 15<sup>th</sup> century, though, was a game-changer: the pioneer voyages undertaken by European navigators allowed to discover new trade routes to the East Indies, resulting in more and more indigo reaching the Old Continent. The praised Oriental dye had an enormous success, and woad, so far the undisputed queen of European blues, started a relentless downfall.

In contrast to what is sometimes assumed, though, the decline of woad was not abrupt. Several studies nowadays contribute to this evidence, but a precise measure of woad’s use and diffusion after the spread of indigo is still lacking, especially when it comes to the 18<sup>th</sup> and first half of the 19<sup>th</sup> century.

In Italy, in particular, the diffusion of woad in this period has been little investigated by now. Some studies have allowed to gain a better understanding of “late” woad cultivation and production in certain territories, such as the precious contributions of Brunetti (1994), Palombarini (1995-98) and Petrongari (1994) respectively in relation to Piedmont, Marche, and the area of Rieti. Franco Brunello also discusses woad-related processes in 18<sup>th</sup>-century dyeing industry of the Venetian Republic, and Guarino et al. (2000) deal with woad in the Kingdom of Naples in this period. On the whole, however, many issues still remain unclear. Most importantly, it is difficult to estimate to what extent Italian woad was actually used, and therefore how important it was in the productive setup of early industrial times.

To get insight into this topic, the technical literature of the 18<sup>th</sup> and early 19<sup>th</sup> century is a privileged means of knowledge. The Age of Enlightenment was characterized by the pursuit of everything that could prove useful for the progress of humankind: its striving for “scientific” and “technological” improvement was conveyed by a literary production that embraced all fields of human knowledge, including several topics related to the art of dyeing. As to the Italian technical literature, specifically, only a limited part of it has been investigated by now in relation to dye plants and dyeing-related

processes. Therefore, this study wants to take advantage of this peculiar literary production to get some glimpses into the “hidden” history of woad blue throughout the 18<sup>th</sup> and early 19<sup>th</sup> century.

### **THE “PLACES” OF ITALIAN WOAD**

The rush for systematization and improvement that marked the Age of Reason also involved the fields of botany and agriculture, resulting in a considerable number of dictionaries, periodic journals and monographs concerning agriculture being published in Italy between the second half of the 18<sup>th</sup> and the first half of the 19<sup>th</sup> century. Most botanists and agronomists were not specifically interested in dyeing processes, but dealt with dye plants in relation to agricultural issues: bearing in mind that providing the reader with an accurate “geography” of woad was not the authors’ main aim, and that the lively exchange of knowledge between different intellectual environments across Italy and Europe may have sometimes led to reporting second-hand information, the Italian technical-agricultural literature can still offer some precious clues about the diffusion of woad. We hereby examine the points of view of various Italian regions: through the eyes of some selected authors, we can get a firmer grasp of Italy’s woad cultivation, production and trade in this period.

By the second half of the 18<sup>th</sup> century, the glorious Republic of Venice had long lost its former economic power and was facing its imminent end. In the field of dyeing, as thoroughly discussed by Brunello (1968), *La Serenissima* remained mostly anchored in ancient – and sometimes obsolete – treatises. Nevertheless, one of the first Italian attempts to echo the innovative European (mostly French) approach towards the art of dyeing comes from a Venetian treatise: Pietro Arduino, Professor of Agriculture at the University of Padua, gathers information and makes new experiments on dye plants that converge in his treatise, “*Memorie*”, published in Padua in 1766. From Arduino we learn that the woad used by dyers in the Venetian Republic at that time could be either imported from Germany and from Lombardy, or home-grown. *Ça va sans dire*, local woad is said to be the best.

A later author from Veneto, who is interesting to consult since he draws most of his information from earlier sources, is the agronomist Francesco Gera. His agricultural dictionary, “*Nuovo dizionario universale e ragionato di agricoltura*”, published between 1834 and 1850, is a colossal work that summarises current European knowledge on agricultural topics. As late as the mid-19<sup>th</sup> century, Gera decides to devote two articles to woad, in Vol. XII (1840) and in Vol. XXII (1844), describing its cultivation modalities as well as its processing techniques and uses: the very need to explain how to cultivate and use woad is an important clue, and is in all likelihood a sign of an actual and still diffused practice. Concurrently, the author also gives a brief geographical description of woad’s diffusion at the time: he says that it is still cultivated in Germany, in England, both in northern and southern France in the surroundings of Caen, Valenciennes, Castres, Albi, Toulouse and Avignon (Vol. XXII), and that it is still extensively cultivated in many parts of Italy (Vol. XII), although he does not specify where.

Moving to Milan, a city that was at the forefront in Italy’s enlightened literary production, we find another dictionary, the “*Dizionario universale economico-rustico*” written by the Milanese priest Glicerio Fontana under the pseudonym of Creneo Insubre and first published in Milan between 1773 and 1791. In its second edition, published in Rome, this agricultural dissertation devotes a long article to woad (“*Guado, Gualdo, Glasto, Pastello, Isatide*”) in Vol. IX (1794), providing a detailed description of cultivation modalities and processing techniques of woad in Italy. The reader learns that at the time this plant was not sufficiently cultivated in Italy, and particularly in Lombardy, to supply local dyers’ needs, with the result that many provinces had to resort to importing expensive foreign woad.

Nevertheless, two areas in Italy still grew and traded fine and renowned woad: Castel nuovo Tortonese (likely to be identified nowadays with Castelnuovo Scrivia, in the heart of Piedmont’s historical woad-growing area) and Rieti, part of the Papal States, today capital of the homonymous province in the region of Lazio. Other minor woad-production centres were also Borgo San Sepolcro and Città di Castello in the Valtiberina, another historically important Italian woad area. The author says that Rieti’s “*pastello*” in particular was so renowned, that its trade all across Italy and Europe was a major income for the territory at the time: the main trade destinations were the towns of Matelica and Norcia in the Papal States and, above all, Capodimonte in the Kingdom of Naples. The information about the importance of Rieti’s woad production supports the idea that Italy still had important woad centres in the late 18<sup>th</sup> century, which not only supplied many Italian regions, but also other European countries.

An insight into Tuscany’s agriculture is given some years later by doctor and botanist Ottaviano Targioni Tozzetti, member of a notable Tuscan family of scholars. Among his various works on agricultural topics, his *Lessons on agriculture (“Lezioni di agricoltura specialmente Toscana”)*, published in six volumes between 1802 and 1804, give a special account of Tuscany’s cultivations. A lesson on dye plants is reported in Vol. II (1802) and a specific dissertation on woad in Vol. VI (1804): the author states that woad is still cultivated in Borgo San Sepolcro, in the Marche region and in the surroundings of Cortona, although not as extensively as in the past times of great Tuscan wool industry (Vol. II). The extension of such cultivation must have been especially limited in the *Cortonese* area, though, if we give credit to canon Andrea Zucchini, author of several botanical and agricultural writings related to Cortona: in a dissertation held in 1778 he states that woad, as well as madder, has “*fallen into total oblivion and disuse*” in Cortona (“*da molt’anni indietro andarono in totale oblio, non che in disuso*”).

Finally, a collection of issues concerning Italian agriculture was printed in Milan between 1809 and 1814 in the scientific periodical that goes by the name of “*Annali dell’agricoltura del Regno d’Italia*”. Its eminent author, Filippo Re, at that time Professor of Agriculture at the University of Bologna, was one of the Italian agronomists whose works had most widespread circulation across the country.

When dealing with woad, Re’s *Annals* are surely influenced by Napoleon’s Continental Blockade, which in those years notably endorsed woad reintroduction as a consequence of the lack of indigo import. Nonetheless, several articles included in the *Annals* are prior to the Blockade-induced “woad rush”. Not only do they mention the contributions of Arduino, Fontana and Targioni Tozzetti (*Annali*, Vol. IX), but also other dissertations on woad are reported. From a record written by the Friulan botanist Giovanni Brignoli, Professor of Botany and Agriculture in Urbino (Vol. IX), we learn that at the time woad was documented to grow spontaneously in many parts of Italy (in mountainous regions of Piedmont, in Valle d’Aosta, in the surroundings of Urbino, and all across the Kingdom of Naples), but it was also cultivated on small scale in Friuli. The author states that such cultivations were meant for local use: a certain Cesari, dyer in Udine, is said to have been cultivating woad for 40 years to meet the needs of his personal dyeworks, and the author himself asserts to have been supplying self-grown woad to local dyers for 10 years in the surroundings of Udine.

### **SOME OBSERVATIONS ON WOAD’S PROCESSING TECHNIQUES**

The authors discussed above also provide accounts of how woad was prepared and used, which allow us to delve deeper into woad manipulation described from the point of view of Italian sources.

Overall, we learn that the main steps of the processes were more or less the same everywhere (in Italy as well as in Europe). Harvested woad leaves were ground in woad mills, and the resulting paste was arranged in heaps and composted. After some weeks, or sometimes one or two months, the paste underwent a second grinding step and was then shaped into loaves or elongated balls: when these woad loaves were dry, they were broken up again and sprinkled with liquid (usually water) to reactivate fermentation. The coarse powder obtained in the end was finally ready to be sold and used. The whole process, from the first harvest to the final product, took several months (even over a year according to Targioni Tozzetti). Such descriptions, aligned in their main steps, are spiced up with little details of “local taste” that probably stand for actual local processes: for example, Targioni Tozzetti is the only one to call “*barca*” the heap of woad paste, and to write that the “*barche*” are disinfected by sprinkling them with the juice of fresh woad leaves (*Lezioni*, Vol. VI).

Until now, records of eminent agronomists and botanists have been discussed. But the scientific literature of that period passed on to us also some singular, precious accounts of real woad growers and dyers: this is the case of Gioachino Cesari, dyer in Udine. Cesari must have been quite popular at his time, according to the different notices about him reported in Filippo Re’s *Annali*: he is cited in the letter by Giovanni Brignoli mentioned above (*Annali*, Vol. IX) and a thorough description of his work is given in Vol. X (1811). The latter, in particular, is an interesting dissertation on woad cultivation and dyeing processes written by the Secretary of the Agrarian Society of Aquileia. While writing an account on local woad growers, he examines the case of Gioachino Cesari, reporting and discussing a sort of “interview” in which the dyer speaks about his work.

First of all, we learn that Cesari cultivated woad for the purpose of supplying his own dyeworks, so we are dealing with a rather small-scale cultivation intended for local use. When it comes to the description of woad’s cultivation modalities, we get to know that some little differences occur between Cesari’s ways and the methods recommended by scholars. This is probably due to a factor that distinguished Cesari from most of the authors: experience on the field.

As to woad preparation for dyeing purposes, on the contrary, it is said that between Cesari and the “authors” there are no significant differences but one: Cesari’s process is simpler. It might be interesting to analyse this detail. It seems logical that woad cultivated for use on small and local scale was prepared in a different way than a product that was destined for sale and trade. Scholars’ treatises usually give account of large-scale processes, since these were considered the most relevant ones for the welfare of society and economics, which was a key target of the enlightened enthusiasm for scientific progress. As a drawback, we rarely get to know small-scale processes like this one.

Specifically, Cesari only macerates woad, and after leaving it to rest he directly uses it in the vat; he does not make woad loaves or use any particular additives. What must have been most interesting for intellectuals of the time, longing for a replacement of Indian indigo, is Cesari’s claim that – sadly – woad alone is not sufficient to make a beautiful blue tint: woad is used to get a solid basis, but an unspecified “*calculated dose*” of indigo needs to be added to gain in brightness and preciousness.

### **The relation between woad and indigo**

The previously mentioned words of Gioachino Cesari are one of the “hints” the ancient literature gives us to estimate the relation between woad and indigo at the time, and similar information is hidden in other discussed sources. Almost all of them, when talking about woad, mention the fact that its blue colour needs to be combined with indigo, and the practice of mixing the two blue dyes in “woad vats” in that period is already well known today. Indeed, several authors nowadays wonder whether woad

balls were still used for their colour-yielding function at the time, or if their role in the vat was only to activate fermentation, thus creating the reducing conditions which are necessary to dye with indigo powder.

Pietro Arduino is very clear about woad: it is one of the most important dyes and forms every possible shade of blue and green, and it can be used either alone or combined with indigo, although the latter solution is said to be much better. In 1844, Francesco Gera writes that woad is mixed with indigo to increase the fastness and intensity of the latter: this statement seems to mark woad as the “best” colour between the two of them, in contrast to what other sources say, although later authors like Gera might be biased because of the enthusiasm for woad that arose during the Blockade years.

Fontana’s dictionary provides us with interesting information on the relative prices of the two dyes. At the end of his article, he states that woad yields an excellent, very colourfast deep blue colour, which is used as a base for obtaining many other colours and also to “fix” indigo on cloths: “*woad* – he continues – *was once preferred to indigo [...], but now indigo has prevailed over woad because it is more beautiful and maybe because it is cheaper than woad itself*”. Thus, if we give credit to Fontana’s words, the convenience and the availability that marked woad’s success over indigo during the Middle Ages had been turned around in favour of indigo at this point.

Overall, it appears that woad was still acknowledged to have a relevant dyeing function. The specific role of its blue colour was frequently mentioned. However, it was barely used alone by then: it mainly seems to have been used as a “base” or in mixtures, above all with its long-time rival indigo. In the eyes of today’s reader, it seems that scholars and small-scale dyers had an important point in common: woad was still said to be an important dye, but indigo was an indispensable ingredient in the vat.

## **CONCLUSIONS**

A selection of 18<sup>th</sup> to early 19<sup>th</sup> century technical literature dealing with woad in Italy has been presented. Although this sort of brief “review” does not claim to be exhaustive and will be enriched with other sources in the future, it can still lead to some conclusions.

A first observation is that woad was still a relevant topic at the time. Several different “intellectual environments” across Italy were interested in providing and discussing information on this plant. The very need to explain how to cultivate and prepare it most likely indicates an actual need for guidelines and a practical outcome: indeed, today’s reader must bear in mind that enlightened authors mostly wrote about what was actually useful.

From the “geographical” analysis, we can conclude that the importance of several historical Italian woad-producing centres had changed. The major Medieval woad area of inner Tuscany seems to have significantly declined by then, whereas Piedmont’s production was still quite renowned and supplied several Italian regions with “Lombard woad”, although we learn that neighboring Lombardy also needed to import some woad from abroad. The area of Rieti, on the other hand, which was as well a historical woad area but had always been less important than the former two, was now at the forefront in Italy’s woad production. A measure of Reatin woad’s importance is given by its trade routes, which not only supplied many Italian areas, but even reached other European countries. The Kingdom of Naples, in particular, seems not to have grown enough woad within its boundaries to meet the needs of the factories promoted by the Bourbons, and had therefore to turn to Rieti’s supplies.

Overall, we get to know that the trade of Italian woad was still quite intense at the time, both between different Italian regions and outgoing towards Europe. But we also learn that woad had an important local dimension, being cultivated on small scale for local use. As to this last topic, the



literature of this period – typically searching for the useful – provides us with some precious records of authentic working procedures like the ones of Gioachino Cesari, “hidden” within learned dissertations.

In conclusion, the collected information shows that Italy still had some relevant woad-producing centres between the second half of the 18<sup>th</sup> and the beginning of the 19<sup>th</sup> century, which in some cases reached out to European trade routes. It seems that this woad was not just a supporting component in indigo vats, but that it still had an active role in dyeing in blue, although its combination with indigo was unavoidable. Finally, further insights into the trade of woad in Italy and additional observations about the following steps of woad’s productive cycle – that is, the processing procedures that lead from the colouring matter to the final application product – will be discussed in future contributions.

### **ACKNOWLEDGEMENTS**

This study has been conducted with the contribution of DASTU “Fragilità Territoriali” Research Project funded by the Italian Ministry of Education, Universities and Research (MIUR), within the Departments of Excellence Initiative 2018-2022.

### **REFERENCES**

- Arduino, P. 1766. *Memorie di osservazioni e di sperienze sopra la coltura, e gli usi di varie piante che servono, o che servir possono utilmente alla tintura, all'economia, all'agricoltura, ec.* Padova: Stamperia del Seminario.
- Balfour-Paul, J. 2011. *Indigo. Egyptian mummies to blue jeans.* London: The British Museum Press.
- Borlandi, F. 1959. Il commercio del guado nel medioevo. In: *Storia dell'economia italiana. Saggi di storia economica vol. 1*, C. M. Cipolla, ed. Torino: Edizioni Scientifiche Einaudi, 263-284.
- Brunello, F. 1964. L'arte della tintura a Venezia nel secolo XVIII. In: *Cultura e Scuola*, 10, ed. Roma: Ente Nazionale per le Biblioteche Popolari e Scolastiche, 270-275.
- Brunello, F. 1968. *L'Arte della Tintura nella storia dell'umanità.* Vicenza: Neri Pozza Editore.
- Brunetti, A. 1994. Il gualdo lombardo. In: *Beiträge zur Waidtagung*, 4/5 (1-3), H.E. Müllerott, ed. Arnstadt: Thüringer Chronik-Verlag, 64-66.
- Cardon, D. 2007. *Natural dyes. Sources, tradition, technology and science.* London: Archetype Publications.
- Fontana, G. 1793-97. *Dizionario universale economico-rustico. Seconda edizione corretta ed aumentata.* Roma: Michele Puccinelli.
- Gera, F. 1834-50. *Nuovo dizionario universale e ragionato di agricoltura.* Venezia: Giuseppe Antonelli.
- Guarino, C., Casoria, P., and Menale, B. 2000. Cultivation and use of *Isatis tinctoria* L. (Brassicaceae) in Southern Italy. *Economic botany*, 54(3), 395-400.
- Palombarini, A. 1995-98. Il Guado ed altri vegetali nell'economia delle Marche in Età moderna. In: *Actes/Papers/Beiträge. 2ème Congrès international “Pastel, Indigo et autres Teintures naturelles: Passé, Présent, Futur”*, D. Cardon & H.E. Müllerott, ed. Arnstadt: Thüringer Chronik-Verlag, 161-68.
- Petrongari, A. 1994. Produzione e commercio di guado a Rieti nei secoli XVIII° e XIX°. In: *Beiträge zur Waidtagung*, 4/5 (1-3), H.E. Müllerott, ed. Arnstadt: Thüringer Chronik-Verlag, 67-72.
- Re, F. 1809-14. *Annali dell'Agricoltura del Regno d'Italia.* Milano: Giovanni Silvestri.
- Targioni Tozzetti, O. 1802-04. *Lezioni di Agricoltura Specialmente Toscana.* Firenze: Guglielmo Piatti.
- Zucchini, A. 1778. *Sopra la Luteola sativa. Pianta, che sotto il volgar nome di Bietola gialla da tempo immemorabile si coltiva, ed è in commercio per la Tintura nell'Agro Cortonese.* Sine loco.

1 COLOR AND MEASUREMENT INSTRUMENTATION	2 COLOR AND DIGITAL	3 COLOR AND LIGHTING	4 COLOR AND PHYSIOLOGY
5 COLOR AND PSYCHOLOGY	6 COLOR AND PRODUCTION	7 COLOR AND RESTORATION	8 COLOR AND BUILT ENVIRONMENT
9 COLOR AND DESIGN	10 COLOR AND CULTURE	11 COLOR AND EDUCATION	12 COLOR AND COMMUNICATION MARKETING



Proceedings of the  
International Colour Association (AIC)  
Conference 2021  
Milan (Italy), August 30<sup>th</sup> - September 3<sup>rd</sup> 2021

