COLOR RESEARCH AND APPLICATION
IN THIS ISSUE, DECEMBER 2014

The CIE system, which was formulated in the 1930s based upon the work of David Wright and John Guild, became the foundation of modern colorimetry, the science underlying modern, instrument-based, industrial color production. Colorimetry soon led to the British developing National Standards for divers applications from electrical wiring to traffic lights. In our first article T. W. Allan Whitfield discusses "The Men Who Coloured Britain", architecturally speaking. He introduces three men who through standards provided a color palette covering the entire built environment of Britain: Horatio Lawrence (Bill) Gloag, David Medd, and Alex Hardy.

That was then, but where are we now? New applications include devices such as digital cameras to evaluate our colored environment. However, careful calibration of the digital camera's R, G, B output in terms of a colorimetric space such as CIEXYZ is necessary for accurate representation of colors in the environment. This is not so easily accomplished. In "Irradiance-Independent Camera Color Calibration" Brian Funt and Pouya Bastani propose two computational methods for camera color calibration that require only that the relative spectral power distribution of the illumination be constant across the color checker, while allowing its irradiance vary, and yet resolve for a color correction matrix that remains unaffected by any irradiance variation that may be present.

Our next article is an example of the use of another new device for modern colorimetry. Meritxell Vilaseca, Barbara Schael, Xana Delpueyo, Elísabet Chorro, Esther Perales, and Jaume Pujol show a new hyperspectral system, which can be used in the industry to perform spectral readings reliably with a high spatial resolution. The hyperspectral system consisted of a CCD camera, a spectrograph and an objective lens with an additional linear moving system allowing the mechanical scanning of the complete scene. They describe the system and features in "Repeatability, reproducibility and accuracy of a novel hyperspectral system

Speaking about gloss, in our next article, "Towards the soft metrology of surface gloss: a review" Frédéric B. Leloup, Gael Obein, Mike Pointer, and Peter Hanselaer go beyond the measurement of specular gloss to discuss understanding how the human visual system arrives at a particular sensation of surface gloss, and which factors influence this process. They provide an overview of the most important developments and findings regarding gloss measurement and gloss perception over the past 15 years. Then they discuss alternative measurement methods, and present suggestions for future research.

This is the third time this year we have an article on color constancy. There are many color constancy algorithms, but generally they can be divided into groups based on the technique or assumptions. One such group uses the assumption that the average of all colors is gray. The algorithms in this group works well, but they fail when this assumption is not fulfilled. Mehdi Faghih and Mohsen Ebrahimi Moghaddam have proposed an extension of this family of color constancy algorithms by using a neural network trained offset to move toward neutrality.   In "Neural Gray: A Color Constancy Technique Using Neural Network" they describe their experiments on some benchmark datasets showing how the proposed approach improved the performance of Gray algorithms, and also outperformed state of the art methods.

Our next two articles look at color differences and tolerances with special emphasis on blacks and whites. Most recent color difference metrics are based on acceptability of product color, and most recent work has been on developing metrics that are more consistently applied over color space as a whole including vivid colors. In "Color Tolerance Study on White in Practical Aspect: Perceptibility Versus Acceptability," Nooree Na, Kyungah Choi, Jeongmin Lee, Hyeon-Jeong Suk examine whether there is a difference in metrics when perceptibility is the key factor rather than acceptability. They also looked at whether off-white in various directions were less or more well tolerated using printed color patches. In contrast, Renzo Shamey, Juan Lin, Weethima Sawatwarakul, and Renbo Cao compare the performance of the more recent color difference formulae when evaluating black textile samples. The "Evaluation of Performance of Recent Color-Difference Formulae Using a New NCSU Experimental Black Dataset" shows the CAM02 color difference equations exhibited the best agreement against visual data with statistically significant improvement over other models tested and the CIEDE2000 (1:1:1) equation also showed good performance in this region of the color space.

When investigating the color of textiles, sometimes microscopic investigation is necessary. However, this raises the question of the use of transmittance measurements instead of the standard reflectance measurements used on larger textile specimens. In "Reflectance versus transmittance: the effects of light scattering on red colorants (carmine, Amazonian red annatto, and Peruvian cochinilla rojo and rosado) in biological, textile and museum science" Howard Swatland tackles this issue. Studying four red colorants, he found while the broad descriptions of their color were similar, the detailed differences in their spectral characteristics of transmission and reflectance were important for their selection in various applications.

Our next article is an example of researchers Jian Lin, Li Xu, and Huiyuan Zhang applying a technique that had been developed in an entirely different discipline, to solve a color production problem. In this case the technique is "hybrid biogeography-based optimization" or BBO and the application area is "optimal spot color matching." Biogeography is the science of the distribution of species and ecosystems in geographic space and through geologic time. BBO is an evolutionary algorithm that optimizes a function by iteratively improving candidate solutions with regard to a given measure of quality, or fitness function. The basic technique has been extended from its original use to many other applications, in this case the problem of developing the optimum formulation for a spot color. Read about "Hybrid biogeography based optimization for constrained optimal spot color matching."

Pichayada Katemake and Razvan Ion Preda are attempting to preserve one of Thai's endangered cultural treasures – the colors used in traditional Thai mural paintings. In their article "Complete Study of Traditional Thai Colours Used in Mural Paintings. Traditional Thai Colour Name Dictionary" they describe how they worked with 10 artists who have the knowledge and experience with traditional Thai color names and are involved in restorations of mural paintings. Working with this group they developed a dictionary of 147 Thai colors, and compared the methods the artists produced the colors to find what was thought to be the most historically correct formulation for all but 8 of the colors.

Color is used by man and nature and often we believe the color itself has a

purpose that gives meaning to the observer. In our final article of this issue Calvin Or and Heller H. L. Wang examine whether and how our cultural group and or our occupation affects our interpretation of specific colors. Their article "Color-Concept Associations among Chinese Steel Workers and Managerial Staff" compares the responses of industrial workers and managers to the responses of broader cultural groups of Chinese and Americans people in general. While they found broad acceptance of red for stop or danger, and green for go or safety, other colors had few, if any, consistent interpretations. Thus once the optimal colors to represent certain concepts have been identified, other reinforcing coding and staff training is necessary to strengthen these color-concept associations.

Danny C. Rich wrote a Letter to the Editor about Roy S. Bern's recent article "Extending CIELAB: Vividness, V^*ab, Depth, D^*ab, and Clarity, T^*ab" [Color Res Appl 2014;39:322-330]. In this issue's Communications and Comments section both the letter and a response by Dr. Berns are included. Also in this issue two new publications from the International Commission on Illumination (CIE) are introduced. They are the Joint ISO/CIE International Standard ISO/CIE 19476:2014(E) Characterization of the Performance of Illuminance Meters and Luminance Meters and the CIE Publication 211:2014 Colour Appearance in Peripheral Vision.