COLOR RESEARCH AND APPLICATION
IN THIS ISSUE, October 2014

We begin this issue by noting the celebration of a life of one of our Editorial Board Members, Harry K. Hammond, III, who passed away at age 97.

Our first two articles are specifically on issues of color measurement. First James Gardner discusses "Spectral deconvolution applications for colorimetry." Recently it has been suggested that deconvolution based on the Richardson-Lucy algorithm is an effective method of reducing instrumental broadening effects in radiometric spectra. In this issue, Dr. Gardner applies the deconvolution technique to two specific applications in colorimetry: the calibration of the wavelength scale of a medium-resolution array spectrometer and chromaticity measurement of light-emitting diodes. He explains the numerous benefits that the spectral deconvolution has in the colorimetric applications.

Portable spectrophotometers have become smaller and now easily held by hand when doing colorimetric measurements. Often these instruments use a single beam for measurement, which requires that the illumination source must remain must remain unchanged between measurements of the standard and the sample. However, when measuring a specimen the light reflects off the specimen being measured, fills the measurement cavity, and falls back onto the measurement target. Thus the incident flux received by a test specimen will be different from the incident flux received by the reference standard during calibration. In our next article, "Correction of single-beam sample absorption error in a generalized spectrophotometer cavity," Walter W. Sloan derives a mathematical model for quantifying single-beam sample absorption error in a hemispherical 45°/0° measurement instruments and explains how to use the model to correct for sample absorption error in any single-beam spectrophotometer.

We use the next few articles to move from the measurement field to articles on what you see. If you are interested in the measurement of real objects, you may want to know where you can find the spectral data nearly 86000 natural and man-made materials. Changjun Li, M. Ronnier Luo, M.R. Pointer, and Phil Green have amassed and examined a new database of spectral reflectances of real surface colors. In the "Comparison of real colour gamuts using a new reflectance database" they conclude that the currently published color gamuts are not a complete depiction of the materials in this database and there is a need to derive a new gamut that better represents the real surface data.

With the aim of creating color application guidelines for designers to better understand color and eventually to create improved environments for children and their families, Jin Gyu (Phillip) Park studied the "Correlations between color attributes and children's color preferences." It is not just preferred hue that is important, but saturation and brightness of the color often makes a big difference. The role they play changes from childhood to adult preferences. In his study of children 7 to 11 years of age, he finds not only what children like, but also that children seem to prefer walls to be the colors that they like in general, whereas adults show context dependent color preferences.

In the first issue this year, there was an exchange of comments from Michael H. Brill, Robert C. Carter, and Rolf Kuehni on the topic of modeling brightness perception. In this issue Tony Vladusich contributes a "Note: Brightness scaling according to gamut relativity," which provides a new twist to this debate in terms of a recently introduced theory of brightness and lightness perception, called gamut relativity. Vladusich suggests

that while not providing a complete description of brightness or lightness perception, gamut relativity provides a means to reconcile the log vs power function debate and also provides a simple and elegant method for computing the weight/exponent value of the brightness scaling function.

In earlier work Mark Rea and Jean Paul Freyssinier reported a line of minimum tint in chromaticity space for sources of illumination of correlated color temperatures from 2700 K to 6500 K. Chromaticities along the line of minimum tint represent, for a given CCT, chromaticities where the neural signals from the two spectral opponent channels were minimized. Now in "White lighting: A provisional model within an orthodox theoretical framework" they report on using this framework to empirically test whether this representation could predict the amount of tint perceived in six different sources of "white illumination" and to propose a provisional model for describing the tint and the amount of tint perceived in "white illumination" used in architectural applications.

For our next two articles let us look at color on displays. As the use of mobile color displays has increased, so too has the use of dimming on liquid crystal displays to save power on the displays. The conventional thought was that dimming degraded the color reproduction on the display, however Minkoo Kim, Jong-Man Kim, and Seung-Woo Lee disagree. They found when using certain dimming technologies that the average color difference of the dimmed displays when compared to the original colors was less than the undimmed displays. Thus in "Standard color liquid crystal displays by a dimming technology" they propose a dimmed LCD as a standard color display.

When selling displays for users who will view many varied materials from messages, to photos, to video streams, one must remember that there is a significant proportion of the public who does not see color the same as, shall we say, the standard observer. Mª José Luque, Dolores de Fez*, and Pablo Acevedo are part of a Spanish team that has developed methods of showing a normal observer how an image will appear to a dichromat. In "Software for simulating dichromatic perception of video streams" these authors describe the extension of the earlier work to viewing video streams. The user may select different dichromatic color vision models and viewing conditions with the output video generated in different spatial and temporal resolutions and file formats.

In our next article Mari Ferring proposes that the decade of the 1970s was a turning point in Swedish architecture. In "Colour and architecture in 1970s Sweden" she looks at the changing focus of "good" architecture and the role of color in architectural design. During the 60s good architecture was defined by design adapted to modes of production, use of large volumes of space, and modular repetition. This 60's interest in the building design relating to its structure, shifted in the 70s to interest in how architecture and habitats should be designed in ways to acquire significance in people's lives. People became more involved with the new discussion color. She explains how the choices of colors underlining the expressions of structure, authenticity and collective with strong primary colors, grey concrete, and brick was gradually replaced by a striving for harmonic space, tradition and individuality, using a lighter, more nuanced choice of pink and yellow colors toward the end of the decade and beyond.

Our last four articles in this issue have are directed toward various industrial applications of materials such as wood, clays, fabrics, and yes, the resins for dental

fillings. Kaolin is a type of clay, which is used in pottery, paint, plastics, cements, pharmaceuticals and cosmetics. Depending on the application, knowledge of the impurities in kaolin can be of great importance. In "Effect of chemico-mineralogical composition and microstructure on color properties of natural and calcined kaolin," Nedjima Bouzidi, Aissou Siham,Nicolas Concha-Lozano, Pierre Gaudon, Gerard Janin, Laila Mahtout, and Djoudi Merabet report on their study of color and lightness as a function of impurities in the kaolin.

Next So-Yeon Bak, Young-Jae Kim, and Hong-Keun Hyun studied the "Color change of white spot lesions after resin infiltration" in teeth. A dental carie occurs when the enamel outer layer of a tooth loses calcium and becomes more porous. A carie results in a color appearance change known as a white spot lesion and can eventually lead to decay. Resin infiltration has been proposed as a method of stemming the loss and strengthening the enamel layer. However, the color of resin may change over time and temperature exposure. They found that although there was a color change, the color of the resin infiltration remained close to that of healthy enamel overtime.

Polyester fibers have been used widely in clothing and other textiles, however they were known to have color problems such as poor deep coloring, color fastness and uneven dyeing. It was thought that these problems were because of the large quantity of light reflected from the individual fiber surface causing the appearance of dyed-polyester fiber to be visually paler than traditional fiber. Perhaps this could be remedied by changing the shape of the fiber. Xiaosong Liu, Yujing Ning, and Fumei Wang studied the "Deep-black-coloring effect of fabrics made of non-circular cross-section polyester filaments" and found fiber composed of surfaces with varied curvature increase the scattering of light within the interior of the fabric, which strengthens the overall color appearance.

Wood is widely used in buildings and furniture, and its natural color is highly prized. However, over time and exposure to natural elements and man-made contaminants, the appearance of the wood degrades. Thus finishes have been applied to the wood to protect it. But do they work and for how long? Accelerated weathering tests have been developed to study the materials. In "Correlation and modeling between color variation and quality of the surface between accelerated and natural tropical weathering in Acacia" Juan Carlos Valverde and Roger Moya report on a study of the color changes and proposed a model to predict, in a short period of time, the possible effects of natural weathering and of accelerated weathering.

We close this issue with Amy Crane *Roy G. Biv* by Jude Stewart. We also note briefly the publication of two technical reports from the CIE: CIE Publ. 208 - Effect of Stimulus Size on Colour Appearance and CIE Publ. 210 - Photometry Using V(λ)-Corrected Detectors as Reference and Transfer Standards.