Inter-Society Color Council *News*

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IN THIS ISSUE 363

50 YEARS AGO IN ISCC *NEWS*- SEPT-OCT 1946

With this issue ISCC *News* begins vintage reprints. We hope you will enjoy reading them.

PRESCRIPTION - Would you like to walk into a store, select from a series of 1,000 chips the MIXED PAINTS color you want, and have a can of it mixed for you while you wait? This, in brief, is a picture of what Sloane's in New York and Marshall Field's in Chicago, with others soon to follow, are doing with the Nu-Hue system developed recently by Carl Foss and Fred Rahr, both ISCC members, for the Martin Senour Paint Company. A paint bar with spigots set in soda-fountain fashion has been set up at Sloane's and at Marshall Field's. A customer goes in, selects from the 1,000 chips of the Nu-Hue cabinet the color he wants, hands it to the operator of the bar who, from a basic series of eight paints - six hues, a white and a gray - matches the color according the proportions given on the back of the chip selected. These paints are available in three finishes: flat, semi-gloss and gloss.

Releases about this work began last spring. In May a number of Council members saw the charts and 1000-chip cabinets at Fred Rahr's office, and some were able to visit the bar at Sloane's. The job is a beautiful one, one for which Mr. Rahr, Mr. Foss and the Martin Senour Company deserve to be congratulated. They selected a series of a thousand colors systematically spaced within color limits that can be matched with a minimum number of paints, and developed paint formulas for matching each of these thousand colors. As a result they have produced a paint-gamut system which can be illustrated three-dimensionally in terms of a cone. Six hues, red, orange, yellow, green, blue and purple are placed at equal distances on the periphery of the base. The paints of these hues are mixed to fill in the hues of the outer circle. They are stepped in towards gray at the center of the base. White is at the top of the cone. Color-chips are made in steps to illustrate ten chart levels such as are illustrated on the folder Mr. Rahr was kind enough to supply us for distribution with this number of the News Letter.

At the periphery of the bottom chart there are 54 hues. On this level there are nine rings around a gray center. Each ring, as it approaches the center, is decreased by six. Each chart above this bottom level has a stated amount of admixed white

(Continued→)

paint, this amount increasing as the levels increase toward white. Each succeeding higher-level chart has one less ring, decreasing systematically from nine rings at the bottom level to zero rings at white. The 1,000 color chips in the system illustrate the extent to which paint mixtures of six hues, white and gray, can be developed. It is not intended that all colors shall be covered in the system, but it is intended to include all the colors usually used in interior and exterior paint colors. Since colors are matched to dry samples in the 1,000-chip file, the problem of having wet matches dry out lighter than desired is avoided.

An early release states that custom paint mixing offers a service long needed; the paint dealer will no longer be limited to promoting those colors which the manufacturers supply on the basis of past demand. He is now able to offer, in addition to his usual decorating line 1,000 different colors in any finish from his simple inventory of six Nu-Hue colors, gray shade and white. Since the most difficult formula consists of only two Nu-Hue colors, gray and white in simple parts, the dealer will find it easy to mix accurately any "prescription" to order in less than 15 minutes.

It should be pointed out, however, that it is not intended that this colorant mixture gamut system should take the place of, or be confused with, color-order systems such as those of Munsell or Ostwald, which differ in fundamental ways. It is intended as an arrangement of chips in a paint-gamut system to illustrate, and require, the use of this particular paint manufacturer's products. We have seen paint cards of several manufacturers which have formulas on the back for obtaining the color on the chip; but this series is the most ambitious and most completely worked out in systematic order to illustrate what can be done with so few as eight paints. The price of the 1,000-chip set, 3 x 5 cards in a plastic case, is one hundred dollars. The charts are in Plexiglass® and are available at two hundred dollars. Paints to match by prescription, as sold by the gallon, at Sloane's and Marshall Field's, are higher than usual, but undoubtedly well worth it to those who have vainly tried to get a particular color match for the walls of a room. (We well remember the difficulty and complaint Dr. LeGrand Hardy had a few years ago when he tried to get a high-value neutral gray for the walls of a clinical laboratory!)

Harry Hammond III
BYK Gardner, USA

MEETING REPORT: COLOUR PERCEPTION: PHILOSOPHICAL, PSYCHOLOGICAL, ARTISTIC, AND COMPUTATIONAL ASPECTS

On February 9-10, 1996, the Cognitive Science Program at Simon Fraser University sponsored its ninth annual conference, "Colour Perception: Philosophical, Psychological, Artistic, and Computational Aspects." The meeting, chaired by Dr. Brian Funt of the Computer Science Department, was held in Vancouver, B. C., Canada at the Simon Fraser University at Harbour Centre. As would be typical at a meeting of the ISCC, the communities of science and art were well represented. However, atypical of ISCC attendance was a large representation from the field of philosopy (both speakers and attendees). The conference featured 13 speakers and about 120 attendees. The philosophical discussions illuminated certain fundamental differences in the points of view of the scientists and artists.

A salient theme of the meeting, the *ontology* of color, centered on the philosophical question "What is color?" Philosophers generally hold two alternative views about this question: that color is a state of the beholder (subjectivism), and that color is a property of the outside world (objectivism). Frank Jackson (Australian National University) leaned toward objectivism in describing color. On the other hand, David Hilbert (from Northeastern University) saw reality and value (demonstrated through evolution) in the observer's role arranging colors into more or less similar categories. Evan Thompson (Boston University) also held that the objectivity of color must be tempered with the role of the observer. He tied color to the observer's need to perform actions in the visual environment. An infant learns by doing as well as by seeing, and robot vision has been most successful when the robot controls its relationship to the environment.

The ontology of color resonated through the whole conference, even in the talks that were not philosophy lectures per se. John Mollon (Cambridge University) gave a talk that complemented Hilbert's in its evolutionary interpretation of color categories. Mollon drew the analogy that, just as flowers co-evolved with pollinators, certain fruit trees co-evolved with primates so they could get their seeds dispersed. Robert Woodham (University of British Columbia) offered the different view that color vision evolved to infer the shape of a surface from its shading under colored lights. Steve Shafer (Microsoft Corp.) challenged all simple views of the ontology of color. When we see an image reflected from metal, even color attribution (hence the question "What is color?") becomes ambiguous. John McCann (Polaroid Corp.) further emphasized this ambiguity. In a slide of a painting that represents shadows and illuminated areas, the colors can be attributed to the depicted light and shadow, to the paints, or to the light on the screen from the slide projector.

Michael Snow (a noted Canadian artist) also was fascinated with the potential ambiguity of color attribution, and displayed this ambiguity through many of his sculptures and paintings. One of his paintings comprised many shades of dark blue, which all look alike until the viewer has taken the time to allow eye movements and sequential contrasts to reveal the subtleties. Who would say that the color is intrinsic to the object when it changes so importantly in the varied acts of viewing? Sanford Wurmfeld (Hunter College Department of Art) further emphasized the active role of the observer (and particularly eye movements) in the perception of colors.

Brain Wandell (Stanford University) offered another variant of the subjectivist/objectivist view. Wandell used magnetic resonance imagery (MRI) of the brain to discover the sites and magnitudes of brain activity associated with color vision. In this way, the act of observation itself being observed, and the observer is part of the precondition for color.

In counterpoint to this discussion, Michael Brill (David Sarnoff Research Center) suggested that view of the perceiver may be imperfect, and based on assumptions that might not be correct. Given eye movements, local (macular) pigmentation that disturbs color matches, and other influences that are known to disturb even symmetric color matches, the question, "What is a color match?" is open to discussion.

The talks by Graham Finlayson (York University) and Brian Funt together provided a more hopeful view of the current assumptions about color, based on innovations that make use of the assumptions. An example was a color-correction algorithm that is able to compensate for changes in illuminant spectrum on a scene.

The Vancouver Color Conference provided a rare opportunity to explore the philosophical foundations of our various points-of-view on color. Whereas artists and scientists have traditionally found it difficult to discuss matters with each other, here the philosophical theme helped communication. The theme invited participants to think in a third language - neither artistic nor scientific - in which points of view and assumptions could be expressed in common.

(This report is a condensed version of a more extensive review published in CR&A **21**, pp318-321, August 1996)

Michael H. Brill
President-elect ISCC
David Sarnoff Research Center

VISION RESEARCH

Call for Papers for a Special Isuue of 'Vision Research' on "Models of Recognition"

One of the ultimate goals of visual processing in artificial and biological vision systems is the recognition of objects and events in the world. The past decade has seen a surge in the computational and experimental study of visual recognition. Increases in our understanding of the early stages of visual processing have provided a strong scientific foundation from which to explore such high-level aspects of vision. Advances in computer technology have allowed realistic testing of recognition models in computer vision systems, and the creation of rich visual displays for the study of human recognition in natural contexts. Recent advances in the physiological study of face and object recognition in higher cortical areas has fueled our desire to understand the underlying computational mechanisms. The study of recognition has encompassed a broad range of issues including the representation of objects and events, matching of the viewed image to internal representations, indexing into model databases, segmentation and grouping of image features to facilitate recognition, and the role of selective attention and research in the recognition process.

The journal 'Vision Research' is devoting a special issue to the computational study of visual recognition. We welcome contributions on the design and analysis of computational models of aspects of the recognition process. We also encourage contributions that present experimental observations on the human recognition process, with a computational framework.

Please submit one copy of your manuscript to Ellen Hildreth and four copies to the central office of 'Vision Research'. Submissions deadline is December 31, 1996.

Ellen Hildreth
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THE ENIGMA OF THE MISSING MUSEUM

While I was collecting material for the article that I published in the ISCC *News* No.361, I became curious about the whereabouts of the "Museum of Science and Industry in New York City. I make frequent visits to New York City and I never saw nor heard about this Museum. Phone calls to New York City left my question unanswered.

About four weeks ago I received a note from Dr. Leo M. Hurvich. With it he sent me a reprint of an article that he wrote: "Two Little Knowns: A Color Exhibition and A Science Museum." The article appeared in the August 1996 issue of Physics Today. He wondered if I called attention to the ISCC members about the article in a forthcoming issue of ISCC *News*. My prayers were answered; the article is about the 1931 Color Exhibition as well as the Museum of Science and Industry. It is an interesting article in that it describes how a museum moves around in New York City. If you can get a copy of the article , I recommend you to read it.

Gultekin Celikiz
Editor

COLOUR GROUP

COLOUR GROUP OF GREAT BRITAIN MEETS TO CELEBRATE W. D. WRIGHT'S 90TH BIRTHDAY, OCTOBER 2ND 1996

As you may know, the Colour Group is organising a scientific meeting to mark the 90th Birthday of one of its founder members and its first Chairman, Professor W. D. Wright.

This will be held on 2nd October, in the Blackett Laboratory, Physics Department, Imperial College, London, SW7 2BZ, and will consist of a lecture programme (open to all), followed by a dinner in the evening. We hope to present Professor Wright with a commemorative booklet consisting of the lecture abstracts plus personal messages or reminiscences.

Yours sincerely,

J.L. Barbur K.H. Ruddock

Speakers and title of their speech:
Prof. R. W. G. Hunt, City University : Models of Colour Appearance
Prof. J. D. Moreland: Macular Pigment; precious bane
Prof. J. L. Barbur, City University: The Use of Chromatic Signals in Human Vision
Prof. D. H. Foster, Aston University: Colour Constancy and Color Deficiencies
Prof. D. Regan, York University, Ontario: What Cricket Players Can Teach Vision Scientists
Sarah Stanniford & Linda Bullock: National Trust Aspects of Colour
Dr. D. A. Palmer, Westminster University: It isn't All Colour
Dr. M. R. Pointer, Kodak: The Relationship Between Print Acceptability and CIELAB Colour Difference
Dr. F. J. J. Clarke, NPL: A Visually Uniform Colour Spectrum to Represent Monochrome Thermal Images
Mrs. J. Birch, City University: Colour Vision Testing
Dr. A. B. Morland: Colour Vision Dysfunctions Associated with Cortical Abnormalities
Prof. K. H. Ruddock, Imperial College: David Wright's legacy at Imperial College

EXHIBITION: COLOR SYSTEMS IN ART AND SCIENCE

This exhibition will start in November 1996 at Leubsdorf Art Gallery (Hunter College), New York City. The Exhibition consists of 72 color plates (on steel tables) first shown at the Biennale - Venice, followed up by venues in Germany, Switzerland, and Austria. It is hoped that 3-4 more venues in the United States can be found during 1997 and 1998.

To give you a little idea about the exhibit, I will quote the first three paragraphs of the introduction to the catalogue accompanying the exhibition and written by Ernst Peter Fischer.

"Many paths lead to an overview of the colors of our world. Artists and scientists have traveled along two of them. The scientific traveler may branch off onto additional routes along the way, by making a survey from a chemical standpoint, proceeding on the basis of physics, following physiological clues, making genetic analyses, pursuing the various possibilities offered by linguists and psychologists, not to mention those of the very individuals who seek to measure colors themselves, the colorimetrists. Colors offer a broad playground for human curiosity. Since antiquity, countless attempts have been made to master their diversity and make them comprehensible via a color system or a color theory. Exhibition and catalogues provide a look at the history of such endeavors, as well as an overview of the course of their development.

One fascinating aspect of these color systems is that along with their external diversity they harbor two internal diversities. Laid out and intermingled here are the ideas of philosophers, poets, painters, physicists, physiologists, psychologists, textile manufacturers, chemists, entomologists, and colorimetrists. They originate from many different countries: England, Sweden, Switzerland, the United States, Germany, Italy, Hungary, France, and so on.

Every color system here represents one more in an ongoing series of unsuccessful attempts to capture the free kaleidoscope of colors in a geometric cage. Every possible manner of ordering, toward the ultimate (and unattainable) goal of arranging colors so as to have equal gradations seen or perceived in every direction within a geometric constuction. To this end, lines and arcs, circles and squares have been laid down, or we encounter spheres and cones, cubes and cylinders, until finally we are confronted with really complicated three-dimensional constructs, derived on the basis of mammoth calculations."

Color systems are being developed continually and it is not possible to show all of the systems. This exhibit includes fifty-six color systems. Along with these systems, some "pre-systems," in which the originators did not arrange the colors with any systematic order in mind, are included. Likewise, some novel personal interpretations of "Metasystems" are provided as an addendum: these are descriptions intended to elucidate how certain cultures or traditions have dealt with colors and have used them symbolically. The "pre-systems" include those of Pythagoras, Aristotle, Plato, Grosseteste, Alberti, and da Vinci. The Color Systems include those of Forsius, Aguiloius, Fludd, Kircher, Waller, Newton, Mayer, Harris, Lambert, Schiffermüller, Sowerby, Goethe, Runge, Hayter, Chevreul, Field, Maxwell, Helmholtz, Benson, Bezold, Wundt, Hering, Blanc, Rood, Lacouture, Höfler, Ebbinghaus, Ridgway, Munsell, Ostwald, Jacobs, Becke, Pope, Boring, CIE-1931 System, Luther and Nyberg, CIE-Rösch, CIE-MacAdam, CIE-Stiles, Birren, DIN-System, Johansson, Müller, Hickethier, Hesselgren, ISCC-NBS System, OSA-System, NCS-Sytem, Küppers, Coloroid, Gerritsen, CIEL*a*b*, ACC-System, HLS System, RGB-System, Albert-Vanel, and the CMY-System. The Metasystems are related to Hindu traditions, also Hebrew, Islamic, Chinese, Protestant, and Catholic traditions, I Ching, anthropology, astrology, heraldry, symbology, and other sources.

ISCC members may be interested in viewing the exhibit in New York.

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COLOR RESEARCH AND APPLICATION

IN THIS ISSUE, OCTOBER 1996

Rolf Kuehni starts this issue off with a look at art in the Italian Renaissance period. In the last issue, in an article about the appearance of metallic materials, McCamy used the example of fabrics to describe luster and contrasted luster with fabrics that were termed "changeable," that is the hue changed with the angle of view. Known as *changeant* in French or *cangiante* in Italian or shot fabrics in English, these iridescent fabrics have played a role in fashion throughout history. They have also been a challenge for painters and other artists to depict. Their use in artwork, primarily in Florence and Padua, took one more meaning than merely portraying the fashion. In "*Cangiante* : a Fabric and a Coloristic Device in the Art of the Renaissance," Kuehni describes the history of changeable fabrics. In particular he focuses on *cangiantismo* in Italian Renaissance art.

Jumping from the artistic vision of the Renaissance, we land in the technology of the twentieth century, machine vision. When a person looks at a scene, there is seldom any difficulty recognizing what is seen and classifying various parts of the scene as separate objects. Through a lifetime of experience, people have learned to interpret the retinal image that they receive through their eyes, and thus

(Continued→)

recognize t' e doorway, the table, a glass on the table - all as separate objects. Without hesitation, or even much conscious thought, a person can walk through the doorway, to the table, and pick up the glass. We see each item as a unit even though there are great variations in radiation reflecting from the surfaces to our eyes because of shadows, surface reflections and transmission through transparent items. We are not confused by the differences in the visual field. Yet when it comes to machine vision, segmentation of the visual field into separate objects is one of the primary problems. How do we teach a machine what we seem to know intuitively? There have been other articles in this journal concerning aspects of machine vision. Now we have an article on "The Relationship between Colour Metrics and the Appearance of Three-Dimensional Coloured Objects." In this article, Christine Connolly explores the relationship between color descriptors used in classical color theory and machine vision, and the appearance of three-dimensional objects exhibiting geometric lighting effects.

Several color-appearance models have been under development over the past ten years or so. A relatively new model, RLAB, was introduced by Mark D. Fairchild and Roy S. Berns in 1993 to be used primarily for cross-media color reproduction applications. This model is an extension of CIELAB, thus it has the terms lightness, redness-greenness (a), yellowness-blueness (b) hue angle, and chroma. However it extends from a color model to an appearance model, because it allows for different white points, luminance levels, and/or surrounds. Like the many other color appearance models, since its introduction, the RLAB model has undergone evaluations, and then adjustments. In "Refinement of the RLAB Color Space," Mark Fairchild, after reviewing the testing of the RLAB model, describes the evolutionary enhancements to the RLAB model that both simplify it and improve its performance.

Another part of colorimetry that has been undergoing evolution for an even longer time is the color difference metric. In 1976, CIELAB and CIELUV were adopted to promote uniformity of practice, until a better formula could be developed. Since then several metrics have gained wide acceptance, two of the most notable are CMC and BFD. CIE94 is an even newer addition. CIE Publication 116-1995, Industrial colour-difference evaluation suggested a potential improvement achieved by the CIE94 color-difference model when a linear function of lightness is introduced as a weighting factor for the lightness difference. The team of Melgosa, Hita, Poza, and Pérez examined and reported on the effectiveness of "The Weighting Function for Lightness in the CIE94 Color-Difference Model."

For our next article we leave the field of colorimetry and move to considerations for interior design. The satisfying effects of colors used in an area is a primary concern for interior designers. In "Quantitative Evaluation of Color Harmony via Linguistic-Based Image Scale Interior Design," Yu-Chuan Shen, Yung-Sheng Chen, and Wen-Hsing Hsu tackle the long-ignored problem of a concrete procedure for evaluating color harmony. The solution of this problem is the missing link to the development of a computer-based color consultation system for interior design. By using a new pleasure-related function and a data base of fashion trends, the designer is able to analyze the mental impression of products from the perspective of the costumer.

The final article in this issue is a tutorial. While the system of colorimetry based on the CIE system, under either the 1931 standard observer or the 1964 10° observer, is in common use in the field of color science, many are not as familiar with cone excitation space that is widely used by color vision scientists. This space is based on a transformation of the König fundamentals and the revised luminous efficiency function of Judd. This cone chromaticity space can be transformed into useful spaces for color vision research. Drs. Vivianne Smith and Joel Pokorny detail the development and characteristics of this colorimetric specification system based on human cone photoreceptors. For those with a background in color science, but interested in relating the developments in human color vision research, "The Design and Use of a Cone Chromaticity Space, A Tutorial," by Vivianne C. Smith and Joel Pokorny, is an article that you will want to have handy and refer to often.

Ellen C. Carter
Editor
Color Research & Application

INDUSTRIAL APPLICATION OF COLOR DIFFERENCE RESEARCH

A Summary

On Wednesday, May 15, 1996, Dr. Roy S. Berns, Director of the Rochester Institute of Technology (RIT) Munsell Color Science Laboratory (MCSL) hosted a meeting of scientists interested in color difference research oriented towards industrial applications. Those present were Dr. David Alman, DuPont, Dr. Manuel Melgosa, University of Granada, Drs. Alan Robertson and Rejean Munger (National Research Council (NRC) in Canada, Paula J. Alessi, Eastman Kodak Co., and Dr. Ethan Montag, RIT Munsell Color Science Laboratory. Dr. Roy Berns hosted this meeting in response to a request by Dr. D. Alman. Dr. Alman shared his two purposes for the meeting. First, it would provide an opportunity for collaboration among the four groups around the world currently doing color difference research (i.e. RIT MCSL, Universidad de Granada, NRC and BAM - Klaus Witt was invited but unable to attend). Since the number of research groups is so small, it was hoped that the work could move along at a faster pace than what has been accomplished in the

past. Second, Dr. Alman hoped that this meeting would clarify the next step forward beyond the CIE TC 1-29 recommendation to provide the pathway for continuing to improve color difference evaluation for industry.

The day began with presentations from the research groups an d ended with discussion of what to do next. Copies of each presenter's overheads are available on request.

Dr. Manuel Melgosa - University of Granada

The first presentation was given by Dr. Manuel Melgosa from the Department of Optics at the University of Granada. Dr. Melgosa described the most important color difference research developments that have occurred at the University over the past four - five years. The four main topics included were:

1. Testing the performance of recent color-difference formulae
2. A few analyses of the CIE94 color difference model
3. Suprathreshold color-difference ellipsoids based on the RIT-DuPont dataset
4. Threshold measurements and other specific applications

Here is a summary of the most important conclusions.

1. Testing the performance of recent color-difference formulae

Two performance parameters were used to assess the performance of a colr:-difference formula. First S1% is the standard deviation of the computed color-difference (ΔE) normalized to the arithmetic mean of ΔE. S1% is a homogeneity measure in that it measures the difference between several regions of color space. S2% is the arithmetic mean of the coefficient of variation of the color difference. S2% is a homogeneity measure in that it indicates the local uniformity in different directions around a color center. Using chromaticity differences (ellipses) and color-differences (ellipsoids) from datasets reported in the literature and the Rit-DuPont dataset, the S1% and S2% performance measures were lower for the three CIELAB-based models (i.e. CMC, CIE94 and BFD) than for CIELAB and CIELUV for both object and aperture colors. In particular, the CIE94 model gave the best results for chromaticity differences.

2. A few analyses of the CIE94 color-difference model

Several sets of classical and recent experimental data were used to check the weighting and parametric functions used in the CIE94 color-difference model. Optimal weighting functions from S2% for the RIT-DuPont dataset are close to those adopted by CIE94. Optimized values for K1, K2, K3, and K4 using such experimental datasets as Luo & Rigg, Wyszecki & Fiedler, Brown, Brown-MacAdam, and MacAdam, were in good agreement with the CIE94 model. The weighting functions for lightness, K5 and K6, however, did not agree well with the CIE94 model if conditions differed from the reference conditions. Therefore the best opportunity for improving the CIE94 model would be an improvement in its lightness weighting/parametric functions.

3. Suprathreshold color difference ellipsoids based on the RIT-DuPont dataset.

The method used to compute ellipsoids was the minimization of the following S function:

$$S^2 = \sum ((\Delta V^2 - \Delta E^2))^2 \text{ where } \Delta E^2 = b_{11}(\Delta a^*)^2 + b_{22}(\Delta b^*)^2 + 2b_{12}(\Delta a^*)(\Delta b^*) + 2b_{13}(\Delta a^*)(\Delta L^*) + 2b_{23}(\Delta b^*)(\Delta L^*) + b_{33}(\Delta L^*)^2$$

assuming a common origin for all vectors at each center and a constant visual difference, ΔV, from this origin to each of the T50 points. The nearest a*b* ellipses to each of the RIT-DuPont 19 centers showed good agreement with the Luo & Rigg data of 1986, except for in the blue region. After a size normalization, the *x,y* ellipses for the RIT-DuPont data agreed with those reported by others at the 1978 CIE centers and with those reported by Cheung, Witt and Rigg (with the exception of the yellow center where Witt's ellipse agrees well with that reported by Indow *et. al.*).

4. Threshold measurements and other specific applications.

Most of their experiments have been done with a Donaldson colorimeter or a Wright visual colorimeter and they featured only a small number of observers (3) making a very large number of visual assessments around each of the five CIE color centers. They studied the difference between aperture and object mode assessment. They found only a slight difference in ellipse area and no difference in ellipse orientation between aperture and object mode.

Finally Dr. Melgosa concluded his talk with two specific applications where the University of Granada measurement and color difference assessment expertise was successfully used to solve problems of soil scientists evaluation disturbed vs undisturbed soil samples and of contact lens manufacturers in evaluating soft contact lens cleanliness.

Roy Berns, Lisa Reniff, Yue Qiao - RIT Munsell Color Science Laboratory

Roy Berns described some color difference experiments done for the color difference consortium that explored hue discrimination and tested hue weighting functions of current color difference formulae. Lisa Reniff and Roy Berns were advisors on this project. Yue Qiao performed all the experiments.

Thirty nine CIELAB color centers were chosen: 12 hue locations at L*= 40 and C*=20, 12 hue locations at L*= 40 and C*=35, 12 hue locations at L*= 60 and C*= 20, CIE green, CIE red, and CIE blue test colors. A Fuji Pictrography Digital printer was used to generate test stimuli. The printer's uniformity was shown to be quite good in the L* and a*

directions, but not very good in the b* direction. A three-dimensional lookup table was used to convert from aim CIELAB center point data to red, green, and blue code values that would drive the printer. The actual sampling of print test stimuli around each color center was quite noisy.

Forty one observers performed the following psychophysical experiment. Each observer was shown an anchor color difference pair of gray samples both at a Munsell Value 5. They were also shown a test pair of samples chosen from the 39 CIELAB color centers. They were asked to answer whether the color difference represented by the test pair was greater than or less than the color difference represented by the anchor pair.

A logit statistical data analysis method was used. Coefficients were fit using a maximum likelihood model. The effect of hue angle on hue discrimination was shown for each hue circle by plotting the T50 points as a function of hue angle. The 95% confidence limits representing the 2σ level were also included on the plots. These plots show similar peaks and valleys from hue angle 120° up to 320°, regardless of L* and C* level. These visual experimental results were compared with those color difference results predicted by the CMC, BFD and CIE94 formulae. These experimental results were more similar to BFD predictions than to predictions from any of the other formulae, but the exact locations of the peaks and valleys differed from the predicted BFD locations.

Next an attempt was made to fit the experimental data with a mathematical function. The function that worked best was found by combining a fourth order polynomial with a cosine function of different frequencies. It is disturbing that this function was found to have a large error at a minimum corresponding to a hue angle of 50° for L*= 40, C* = 20, 35° for L*= 40, C*= 35, and 65° for L*= 60, C* 20.

These results uncovered a hue angle and chroma dependency on hue discrimination. However, the large sample variability prevented a robust model from being found. RIT intends to repeat some of these experiments on the three color centers at the inflection points. Three different sources of samples will be used: the original Fuji Pictrography prints, spray-painted samples supplied by DuPont and promised to have less variability than the digital printer, and stimuli presented on a self-luminous display.

Rejean Munger and Alan Robertson - National Research Council (NRC)

Rejean Munger reported that he and Alan Robertson are doing color difference research with hopes of improving or validating present color difference formulae.

Their first investigation was to examine the hue dependence of hue discrimination at threshold. The self-luminous display provided the research tool. While keeping L* constant at 50 and C* constant at 25, hue angle variations representing threshold differences around reference colors were presented to observers, who were asked if a test field differed from the reference field. There were 20 hue angle variations around each reference hue and 5 presentations of each hue, making a total of 100 color difference judgments. A 10-bit computer system was used. Quantization errors were concentrated at low hue angles. The threshold data were plotted with CIELAB hue angle in degrees as the abscissa and normalized CIELAB color difference (i.e. normalization to the average) as the ordinate. Confidence limits were shown for each data point. Such data for all observers showed a pronounced peak at a hue angle of approximately 240°. Comparison of these NRC data with other published data showed that the peak is more pronounced than data from the Luo-Rigg perceptibility study, the McDonald formula, or the CMC formula.

It was desirable to investigate the gap effect pointed out by Boynton; as the gap increases between two colored samples, there is a color difference increase in the blue-yellow direction and not in the red-green direction. An imposed separation of 1 or 2 pixels between the test and reference fields showed the peak still to be prevalent at approximately 240°. The data around the peak changed as a function of field size. In general, the color difference became larger as the distance between fields increased. It was interesting to note that 70% of the tested color centers fell on the triton confusion lines. This led to a switch to the LMS cone excitation space in the calculation of a hue threshold function. It was found that the color difference is dominated by a change in the S cones. When a hue angle threshold model was developed in terms of cone excitation space, a peak at about 260° resulted. Thus the prominent peak found in the experimental results was probably real and not an artifact of the self-luminous display. It was decided that CIELAB is not an optimum color space to use for conducting this work because perceptually equal hues are not linear.

Future work at NRC will focus on a new forced choice paradigm. Observers will be shown four samples separated from each other by 1 pixel. They will be asked: "Which one is different?" This design should force more of a physiological response. The axes chosen for sample generation will be based on a cone excitation space, which should be more linear in perceptual hue spacing.

Klaus Witt - BAM

Klaus Witt sent a FAX expressing two important messages. First, he is trying to come up to speed on assuming the CIE reportership for Color Difference. His goal is to produce a report for the CIE Division 1 meeting in Kyoto and also present it at the AIC conference. He also commented on the status of his own research work doing extended scaling experiments on the CIE color centers. Here he employed gray scale assessment to scale small color differences from 1 to 10 threshold steps. He found no serious breakpoints of scale extension from threshold to larger color differences.

(Continued→)

Dave Alman - DuPont

Dave Alman's talk was on "Industrial Experience with CIE94." He shared answers to the question: "What does industry want in color-difference evaluation?" There are two different levels that will satisfy industry. The first is an improved evaluation level, which demands close association to visual judgments for a product in its end use. This first level also demands a minimum level of software changes because there already exists a wealth of CIELAB color difference information in the form of training and database. Agreement on a color difference evaluation procedure among business, industry, nations and countries around the world is also desirable. The second level is an automated evaluation level, which features reliable, automated decision-making systems and elimination of the visual color match negotiation process.

Dave's next topic was the results of some field trials of the CIE94 equations that he performed at DuPont. First he brought samples and data showing that the CIE94 chroma scale (C94) is more nearly an interval scale (i.e. linear chroma spacing between samples) than the CIELAB C* chroma scale.

Dave reported on a variability study of 3256 solid color matches, 80% of which had a color difference of 0.6 CIE94 units from the standard. (These represented visual passes by only one observer.) The visual evaluations were done under CIE D65 simulators. The samples were uniform glossy paint. There was no separation between samples of each pair and all judgments were done against a middle gray background. Results were categorized by L*, C*, and h. The variability of color difference values was assumed to be limited by the visual sensitivity. The measures of variability studied were standard deviation (non-robust and sensitive to extremes), interquartile range (i.e. difference between 25% and 75%), inner 80% range and inner 90% range. He showed plots of ΔL^* measures of variability by L*. The standard deviation was shown to be a fair measure of variability. Plots of ΔC^* variability by C* showed the CIE94 equation again provided a good fit to the visual data. Plots of $\Delta H^*/S_h$ (S_h corrected for chroma dependence) variability by hue angle showed a slight hue angle dependence for CIE94.

Dave's last topic was L* sensitivity functions for metallic colors. Plots of lightness-difference weighting functions for metallic colors as proposed by Gottenbos CMC (1.5 :1), DIN and ASTM E12.12 indicated consitant major trends. The weighting functions increased strongly with L*. Plots also showed that lightness scales change as a function of background. His last plot showed how different the L*, L_{CMC}, L-Godlove, and L-Foss lightness scales are. The variability among the lightness scales is within the realm of what has been shown for different parametric effects. Industry is confused. There are too many lightness scales and there is not enough data to show which should be used.

Discussion

Dave's talk led into a discussion of what should be done next to advance color difference evaluation beyond CIE94. Dave expressed a strong preference for the color difference consortium and NRC to address the hue angle dependence now and put the results into CIE94 as soon as possible. Then all work could be more importantly focused on improving the lightness scale. This approach emphasizes the desire to deliver on the periodic improvement philosophy that CIE TC 1-29 promised.

The following action items resulted from the final discussions:

1. The minutes of this meeting will be shared with Klaus Witt because he is the CIE Reporter on color-difference. He can incorporate these minutes into his CIE Division 1 report.

2. A new CIE Technical Committee proposal will be put forward at the CIE Division 1 meeting in Kyoto in May of 1997. The proposal will focus on modifications of CIE94 as part of the periodic improvement philosophy.

3. NRC will change their experimental design to improve precision. This includes using a new 12-bit system and a new paradigm for the psychophysical experiment. In their future experiments, they will also change L* of the samples relative to L* of the background.

4. The University of Granada may do work on lightness weighting functions. They would also like to do some experiments on self-luminous displays.

Paula Alessi
Eastment Kodak Company

THE FOURTH COLOR IMAGING CONFERENCE:

COLOR SCIENCE, SYSTEMS AND APPLICATIONS
November 19-22, 1996
The Radisson Resort
Scottsdale, Arizona

The Color Imaging Conference has become the premier technical conference for scientists, technologists and engineers working in the areas of color science, and systems and their application to color imaging. 1996 marks the fourth year of this topical, annual conference with a significant growth in overall participation as well as an increase in the professional disciplines represented. The conference is international in nature. In 1995 one third of the participants came from outside the United States and Canada.

As the Color Imaging Conference has grown and matured; the focal areas have been expanded dramatically. Professional disciplines represented range from psychophysics, optical physics, image processing, color science, graphic arts, systems engineering as well as hardware and software development. In fact, it is the research and application efforts of this segment of the professional imaging community.

(Continued→)

While color science continues to be a fundamental component, an increasing number of presentations have focused on the application of color in a variety of emerging areas including printing, display, graphics, and imaging science. Beyond representing all areas of color imaging, this year's conference also expands into the areas of graphic arts in particular and computer science in general.

The conference program includes the following tutorials and papers.

The Tutorials: Tutorial Chair: Rob Buckley, Xerox Corp.
Fundamentals of Colorimetry Joann M. Taylor, Color Technology Solutions
Fundamentals of Digital Color Imaging Systems: Paul Roetling, Xerox Digital Imaging Tech. Ctr.
Color Appearance Models: Mark Fairchild, RIT Munsell Lab
Color in Hardcopy: Gary Starkweather, Apple Computer
Color in Electronic Displays: Louis D. Silverstein, VCD Sciences Inc.
Color Management Systems: Ronald S. Gentile, Adobe Systems Inc.
Effective Use of Color: Tim Kohler, Canon Info. Syst.
Complex Color Images: John McCann, Consultant
Digital Halftoning for Color: Charles M. Hains, Xerox Digital Imaging Tech. Ctr.
Photographic Scanning, Digital Cameras, and Reproduction Goals: Jack Holm,Imaging Consultant

The Papers Program:
Introduction
Ron Gentile, Abode Systems, Inc. And Gerald Murch, Xerox Corp.
Color Management Session, Session Chair: James King, Adobe Systems, Inc.
Keynote: A Unified Color Management Paradigm, Edward Giorgianni, Eastman Kodak Co.
A Minimax Method for Sequential Linear Interpolation on Nonlinear Color Transformation, Ayze Agar and Jan Allebach, Purdue University
Color Correction Method Based on the Spectral Reflectance Estimation Using a Neural Network,Yoshifumi Arai, Shigeti Nakauchi and Shiro Usui, Toyohashi University of Technology (Japan)
Color Matching with ICC Profiles: Take One*, Robert Chung and Fred Kuo, Rochester Institute of Technology
Building a Precision Colour Imaging System, David P. Oulton, Isaac Porat, Chris Boston and Rob Walsby,UMIST (England)
Scanning Devices Session, Session Chair: Jan De Clippeleer, Agfa-Gevaert
Analysis of Multispectral Image Capture, Peter Burns and Roy Berns, Eastman Kodak Co.
Colour Calibration and Characterisation of a Digital Camera, U. Lenz, Habil and R.Lenz, CCDV/Munich Munich (Germany)
New Quality Measures for a Set of Color Sensors-Spectral Characteristic Restorability Index and Color Reproducibility Index, Johji Tajima, NEC Corp.
Measure of Goodness for Color Scanner, G. Sharma and H. J. Trussel, NC State University
Scanning Color Negatives, Chris Tujin, Agfa Gevaert (Belgium)
Applications Session Session Chair: Sabina Susstruck, Corbis Corp.
Invited: The History of Photographic Image Fading, James M.Reilly,Imaging Permanence Institute, RIT
Digital Reconstruction of Faded Color Photographic Materials by Digital Image Processing, Franziska Frey, RIT
High Resolution Image Capture of Stained Glass, Lindsay MacDonald, Cheltenham and Gloucester College of Higher Education (England), and John Oldfield, Cornell Univ.
Spectrophotometric Image Analysis of Fine Art Paintings, Henri Maitre, Francis Schmitt, Jean Pierre Crettez and Yifeng Wu, Ecole Nationale Superierure des Telecommunications(France)
Color Management Issues in the United States Imagery System (USIS), Scott Fochee, National Security Programs Team
Gamut Mapping and Color Appearance Session. Session Chair:Shoji Tominaga,Osaka Electro- Communication Univ.
Keynote: Why is Black-and-White So Important in Color? Robert Hunt, Consultant (England)
Learning Color Constancy, Brian Funt, Vlad Cardei, Kobus Barnard, Simon Fraser Univ.(Canada)
Invited: Visualisation and Metavisualisations:Helping a User with Colour Gamut Mapping, Philip K. Robertson, Canon Information Systems Research Australia
Color Gamut Mapping by Optimizing Perceptual Image Quality, Shigeti Nakauchi, Masahiro Imamura and Shiro Usui, Toyohashi University of Technology (Japan)
Gamut Mapping Based on the Fundamental Components of Reflective Image Specifications, Wilkin Chau and William B. Cowan, University of Waterloo (Canada)
Printing Devices Session. Session Chair: Michael Rodriguez, R.R. Donnelley & Sons Co.
Characterising Desktop Colour Printers without Full Control over all Colorants, Jan Morovic and Ronnier Luo, Univ. of Derby (UK)

(Continued→)

Algorithm-Independent Color Calibration for Digital Halftoning, Shen-ga Wang, Xerox Corp.
Color Halftoning with Blue Noise Masks, Qing Yu and Kevin Parker, University of Rochester, Meng Yao, Tektronix Inc.
The Color Gamut of Halftoning Reproduction, Stefan Gustavson, Linkoping Univ. (Sweden)
Predicting the Spectral Behavior of Colour Printers for Transparent Inks on Transparent Support, P. Emmel, I. Amidror, V. Ostromoukhov and R.D. Hersch, Ecole Polytechnique Fédérale de Lausanne (EPFL) (Switzerland)
Poster Sessions. Session Chair: Joann Taylor, Colot Technology Solutions.
Effect of Frame Rate, Ambient Illumination and Saccadic Amplitude on Color Flashing while Saccading in Field Sequential Color Displays, Peter C. Baron, Robert Lin, Smith and James Q. Troung,ABCD Technology
Selection of High Contrast Color Sets, P. Campadelli and R. Schettini, Università degli Studi di Milano (italy)
Art-Works Color Calibration by Using the VASARI Scanner, Abrardo Cappellini, Univ. of Florence (Italy)
A Pictorial Review of Color Appearance Models, Mark D. Fairchild and Lisa Reniff, RIT Munsell Color Science Lab.
The Effects of Image Content on Color Difference Perceptibility, Susan P. Farnard, Eastman Kodak Co.
Spectral Based Color Image Editing (SBCIE), Joyce Farrell, Hewlett Packard Labs
Color Management for Color Facsimile, Jon Yngve Hardeberg, Francis Schmitt, Ingeborg Tastl, Hans Brettel, Jean-Pierre Crettex, Ecole Nationale Supérieure des Telecommunications (France)
The Hexachrome Six-color System Optimized for Stochastic Screening, Stephen Herron, Isis Imaging Corp.
Principal Component Analysis of Spectral Reflectance of Skin Color and its Applications to Color Appearance Modeling, Prancisco Hideki Imai, Norimichi Tsumura,Hideaki Haneishi, and Yoichi Miyake, Chiba Univ. Japan
Retinex Image Processing: Improved Fidelity To Direct Visual Observations,Daniel J. Jobson and Glenn A. Woodell, NASA Langley Research Center; Zia-ur Rahman,Science and Technology Corp.
Gamut Compression for Computer Graphic Images, Naoya Katoh, Sony Corp.(Japan)
Color Segmentation using Eigenvector Line-Fitting Techniques, Alizera Khotanzad and Edd Zink, Southern Methodist University
Image Quality Metrics for Printers/Plotters, Yair Kipman, KDY Inc.
Design and Implementation of an ICC Profile Validator, Tim Kohler, Canon Information Systems
Recovery of Fundamental Spectrum from Color Signals, Hiroaki Kotera, Hideto Motamura and Teruo Fumoto, Matsushita Research Institute Tokyo Inc.(Japan)
Gamut Calculation of Color Reproduction Devices, M. Mahy, Agfa Gevaert NV (Belgium)
Color Clusterization using a Modified HSL Space, Gabriel Marcu and Satoshi Abe, Array Corp. (Japan)
A Comparison of Color Metrics, John McCann, Consultant
Automated Color Determination for Archaeological Objects, Christian Menard, Technical University Vienna (Austria)
Unsupervised Classification of Complex Color Texture Images, Raimondo Schettini and Andrea Pessina Istituto Technologie Informatiche Multimediali (Italy)
Is Color Constancy Task Independent? Jon M. Speigle and David H. Brainard, Univ. Of California/Santa Barbara
Color Mapping Mathod for CMYK Printers and Its Evaluation, Shoji Tominaga,Osaka Electro-Communication Univ. (Japan)
Development and Construction of a Low-cost Colorimeter, Ralf Vohsbeck-Petermann, Computer Graphics Center, ZGDV (Germany)
Design and Performance Analysis of Hierarchical Color Space Quantizers, Xia Wan, Jiankun Li, Yung-Kia Lai, and C-C. Jay Kuo, Univ. Of Southern Cal.
Color Reproduction Based on Low Dimensional Spectral Reflectance Using the Principal Component Analysis, Takayuki Sato and Yoshiki Nakano, oyo Ink Mfg., Ltd.(Japan); Shigeki Nakauchi and Shiro Usui, Toyohashi Univ. Of Technology (Japan)
Image Processing Session: Session Chair: Hiroaki Kotera, Matsushita Research Inst.
Keynote: The Symbiotic Relationship between Computer Graphics and Colour Imaging, Don Greenberg, Cornell University
Invited: A Strategy for Pictorial Digital Image Processing (PDIP), Jack Holm, Consultant
The Maximum Ignorance Assumption with Positivity, Graham Finlayson, Univ. Of York (UK)
Elimination of Highlights using RGB Color Distribution and Image Position, Michael Hild, Osaka Electro-Communication Univ. (Japan)
Ethical Issues in Digital Image Manipulation, Lindsay MacDonald, Cheltenham & Gloucester College of Higher Education (England)
Display Devices Session
Psychophysical Generation of Matching Images for Cross-Media Color Reproduction, Karen M. Braun and Mark D. Fairchild, RIT Munsell Color Lab.
New Soft Proofing Method, Nabuaki Usui and Atsushi Imamura, Dainippon Screen Mfg.Co., Ltd. (Japan)
Effects of Ambient Illumination on the Appearance of CRT Colors, Heui-Keun Choh, Du-Sik Park, Chang-Yeong Kim and

(Continued→)

Yang-Seock Seo, Samsung Advanced Inc. Of Tech. (Korea)
Invited: Computer-controlled CRT Colorimetry: A View from CIE, Roy Berns, RIT
Standards Session: Session Chair: Michael Has, FOGRA
Invited: CRT Colorimetry and Colour Displays, Janos Schanda, CIE
Flash Pix, Chris Hauf and Scott Houchin, Eastman Kodak Co.
Proposal for a Standard Color Space for the Internet - sRGB, Mathew Anderson and Srinivasan Chandrasekar, Microsoft Corp., Ricardo Motto and Michael Stokes, Hewlett-Packard

COOPERATING SOCIETIES
ISCC - Inter-Society Color Council
SEPJ - Society of Electrophotography of Japan
SMPTE - The Society of Motion Picture and Television Engineers
SPSTJ - Society of Photographic Science & Technology of Japan

"RULES OF THE ROAD" FOR METAMERISM AND COLOR CONSTANCY

After Dr. Michael Brill's acceptance speech for the Macbeth Award was published in the ISCC *News* (No.362, pp11-13), he received a letter from Mr. Richard Cryer, a new ISCC member from Etchings, Inc. Greenwich CT (see p.15 of the same issue of the ISCC *News* for his complete address).

Richard Cryer writes:

"I read your article in the ISCC *News*, No.362 (p.11), about your work in color constancy-that is, for your attempts to explain the fact that a surface's color appearance is stable under change of illumination. I know, from the Glossary of Color Terms (1), that 'Metamerism should not be confused with flair or color constancy, which terms apply to the apparent color change by a single [underlining is Dr. Brill's] color....' However, I don't understand how metamerism fits into your article, especially when you say, for example, 'to estimate illuminant-invariant color relationships, as on a multicolored object.' Could you please explain this point?"

Dr. Brill's reply:

I think Mr. Cryer has identified a difficulty with the current terminology of metamerism and color constancy. Here are some thoughts on the relationship between these two concepts:

1. Metamerism is the condition of two different spectral reflectances matching under a particular illuminant. Fundamental to the concept of metamerism are *two* spectral reflectances, *one* illuminant spectrum, and the condition of *sameness* implied by a complete color match (two reflectances under one light).

2. As usually defined, color constancy is the invariance (or insensitivity) of some percept associated with a spectral reflectance when the illuminant is changed. Fundamental to this concept is *one* spectral reflectance, *more than one* illuminant spectrum, and a condition of sameness that now applies to one reflectance under two lights. Clearly color constancy is more difficult to quantify than metamerism, partly because it relies on perceptual processing that occurs after the initial visual transduction (whereas a color match is established at the photoreceptor—i.e., at the very beginning of the visual process.)

I think something is missing in the above definition of color constancy. Even though the color name of a particular reflectance is linguistically inalienable from the reflectance, that color name depends on other reflectances in the visual field under the same light. (The perceptual transformations that subsume color constancy are in the same class as those subsuming simultaneous contrast. The demonstrations of Edwin Land bear this out amply.) This means that color constancy is inherently relational, even though any given color-constant judgment is applied to a single reflectance. No man is an island, and no color is either.

In my Macbeth acceptance speech, I generalized the notion of color constancy to include color relationships that are not attributable to a particular object. In any form, color-constant judgments must depend on relations with colors in the background, because one cannot separate the illuminant and reflectance factors from a single tristimulus specification. That relational quality already had to be implicit in the old definition of color constancy. Now I have introduced the possibility that some of these background colors participate explicitly (as well as implicitly) in the evaluation. An example of a judgment on an ensemble of colors is to evaluate the right-left-hand chromaticity ordering of a Farnsworth-Munsell 100-hue test. I think that such a judgment is essential to successful performance on such a test. If illuminant-invariant, this kind of judgment can be termed *relational color constancy*, the adjective being added so as not to confuse readers of the Glossary of Color Terms. I describe some formal properties of relational color constancy on p.4 of the same issue of the ISCC *News*.

Actually, there is a close connection between metamerism and relational color constancy of the above sort. In a color atlas, if right/left-handed chromaticity ordering is not preserved for a reflectance triplet under illuminant change, then one reflectance can cross the line (in chromaticity space) between the other two in the triplet as the illuminant is changed. This is

tantamount to the atlas folding on itself in color space as the illuminant is changed. Folding brings chromaticities of different reflectances to lie on top of each other. Under some circumstances, this can cause reflectances to match each other fully, and that is metamerism. *But metamerism and other such pathologies can be avoided in a color atlas if the right/left ordering of chromaticities is preserved under illuminant changes.*

Hence relational color constancy is relevant to the possibility of metamerism among the object colors in a large set such as an atlas. The following analogy may make the connection clearer. If all the drivers on a highway obey the rules of the road, there will be no collisions; if all the object colors in an atlas obey the rules of relational color constancy, there will be no metamerism.

(1) "Glossary of Color Terms" Compiled by the FSCT ISCC Committee (Ruth Johnston-Feller, Chair) in conjujnction with the FSCT Definitions Committee (Stanley LeSoto, Chair), Federation of Societies for Coatings Technology, 1981

NEWS FROM ARGENTINE COLOR GROUP (GRUPO ARGENTINO DEL COLOR)

ARGENCOLOR 1996 THE THIRD ARGENTINE CONGRESS ON COLOR

The meeting was held during May 20-22, 1996, at Huerta Grande, Cordoba, Argentina. More than 400 persons attended to the congress, and 60 papers were presented in the oral sessions (in Spanish). Among them:

J. CAIVANO, Semiotics and Cesia: the Meanings of the Spatial Distribution of Light

M. MATTIELLO, Color Measurement: Psychophysical Aspects

R. LOZANO, Color Measurement: Mathematical and Physical Aspects

M. VIGURIA, Color Education

S. DUENAS, Multimedia Application for Teaching Color Theory

J. VILA ORTIZ and M. FERNANDEZ, Complexity in Color Combinations

A. GAISCH and T. KESSLER, Color in Aluminium

H. BERTELLE, *et al..*, Color Quality in Ceramic Pigments

V. JOFRE, Ceramic Color and Cesia

J. IGLESIAS, Invisible Objects

M. AVILA and M. POLO, Color in the Architectonic Language

A. ORTIZ BORDALLO, Color in Architecture

A. PAPPIER and R. OLTOLINA, Color in the Urban Advertisement

L. GARCIA FERRE, Color Typologies in Cities and Neighborhoods

H. PALOMO, *et al.*, Connotative Semantic Potential of Colors

J. CAIVANO and L. RIMOLDI, The Meanings of Color in Different Cultures

C. MANGANIELLO, Communicative use of Color in Primitive Ceramics

P. DORIA, Social and Cultural Implications of Color in Clothing

D, VARELA, Color in Textile Design

M. LOPEZ *et al* ., Communicative Aspects of Color in Paper Currency

C. MANGANIELLO, Color Preference in La Plata City

J. CAIVANO, M. MATTIELLO and B. BIONDINI, Comparative Analysis of the Munsell and NCS systems

J. SANTANA POMARES, Color Nomenclature for all Languages

J. AVILA, Color as Stimulus in Persons with Special Needs

D, CHESTA, Effects of Early Visual Deprivation

A. BIONDINI, M. MATTIELLO and H. SALINAS, On Dichotopic Chromatic Vision

M. BRIZUELA and A. TONTI, Model with Feedback Systems for the Analysis of the Spectral and Temporal Responses of the Visual System to Chromatic and Achromatic Stimuli

F. JIJENA SANCHEZ, Color Tests for Prefecture and Marine

P. MEILAN and M. GARAVAGLIA, Rayleigh's Criterion of Resolution for Luminous Sources of Different Spectral Composition

M. RINALDI, Color Systems in Theatre Illumination

S. MELITA, Light Measurement and Control in Color Record and Reproduction in Films

M. PUNTE, Color and Symbol in Hermann Hesse's "Narcissus and Goldmund"

At present, the Argentine Color Group is working on the publication of the Proceedings, as well as on the preparation of the Fourth Congress, August 1998 at Obera, Misiones, Argentina ArgenColor 2000, The Fifth Congress at Mendoza, Argentina, ArgenColor 2002, The sixth Congress, at San Miguel de Tucuman, Argentina.

After the congress, three persons were appointed as honorary members of the Argentine Color Group: Maria L. Fago de Mattiello, Professor at Buenos Aires University and researcher at the National Council for Research, Jorge Vila Ortiz, Professor ar Rosario University, and Roberto Daniel Lozano, researcher at the National Institute for Industry and founder and former President of the Argentine ColorGroup.

Grupo Argentino del Color J.L. Caivano (President GAC)
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NEWS FROM MEMBER BODIES

AATCC ANNOUNCES A WORKSHOP

American Association of Textile Chemists and Colorists announces their ever-popular annual **Color Measurement Principles and the Textile Industry Workshop** for October 22-23 at their Technical Center in Research Triangle Park, NC. The program, aimed at operator level personnel, will cover basic color theory, visual and instrumental color measurement and practical applications. Registrants will be involved in hands-on participation in sample preparation, strength calculations, reflectance and transmittance measurements, shade sorting, shade formulation, and color difference measurements.

The speakers for this workshop are:

Basic Color Theory and Color Spaces, Richard W. Harold, Hunter Associates Laboratory, Reston, VA.

Instrumentation for Color Measurement, Kenneth R. Butts, Datacolor International, Charlotte, NC.

Spectrophotometric Transmittance Measurement of Dyestuffs in Solution, Donna D. Faber, C. H. Patrick & Co., Inc. Greenville, SC.

Reflectance Measurement and Procedures, Roland L. Connelly, SheLyn Inc., Greensboro, NC.

Dyestuff Strength Determination, Donna D. Faber, C. H. Patrick & Co., Inc., Greenville, SC.

Whiteness, Richard W. Harold, Hunter Associates Laboratory Inc., Reston, VA.

Color Difference Evaluation, Robert F. Willis, SheLyn Inc., Greensboro, NC.

Color Sorting Methods, Robert F. Willis, SheLyn Inc., Greensboro, NC.

Application of Statistics to Color Measurements, Charles D. Sweeny, CDS Laboratories Inc.,Lock Haven, PA.

Overnight accommmodations are available at the Radisson Governers Inn, P. O. Box 12168, Research Triangle Park, NC 27709, TEL: (919)549-8631. Reservations should be made directly with the hotel and attendance at the AATCC workshop should be specified to receive the group rate. Shuttle service will be provided between the Radisson Governors Inn and the AATCC Technical Center.

The registration fee for the program is $560 ($495 for individual and corporate AATCC members) and includes luncheons, breaks, a book of papers. Registrants should bring a note pad and a calculator. Early registration is advised since this program fills quickly. To register or for further information, please contact Peggy J. Pickett, AATCC, P. O. Box 12215, Research Triangle Park, NC, TEL: 919/549-8141, FAX: (919) 549-8933.

Peggy J. Pickett.

AATCC COLOR MEASUREMENT COMMITTEE - RA36

The Color Measurement Committee will meet on Tuesday, November 19, 1996 between 1.00-4.00 P.M. at Radisson Governors Inn.

In addition to the agenda, Mr. Hugh Fairman will present an outline of results of radiometric measurements of tri-band fluorescent lamps. Please join us if you are interested in discussing the colorimetric implications of using tri-phosphor lamps.

Radison Governers Inn is located at Hwy #54 and Davis Drive at I-40 (Exit 280), Research Triangle Prk, NC. For further information, please contact AATCC at (919)549-8141.

Ann Laidlaw
Chair
RA36, Color Measurement Committee

AIC COLOR 97 KYOTO THE 8TH CONGRESS OF THE INTERNATIONAL COLOUR ASSOCIATION

The AIC Congress takes place once every four years in one of its member countries. This Congress is the Olympics of color science, engineering, design and arts. At the Olympics, athletes from across the globe gather to compete in sports. The AIC Congress is the corresponding forum for competition in research and ideas in color. At Olympics, people form friendships. In the same way, the AIC Congress offers an environment for both reunions and the creation of new, lasting acquaintances. This is the first time the AIC Congress shall be held in Asia, making it possible for many young people from across the continent to come to an event they would otherwise have difficulty attending. AIC Color 97 Kyoto aims to become a focal point of exchange between Western and Asian people. Kyoto is a beautiful, quiet old city, rich in an academic atmosphere, suitable for frank talks with old and new friends.

At Olympics, innovations for the future progress of sports are unveiled. Similarly, at the AIC Congress, new themes that will lead color science, engineering, design and arts for years to come are introduced. We have prepared three symposia, Color Cognition and Machine Vision, Color Design 21 and Color Management Systems, in the hope that new developments in color will originate from them. We encourage you to come to Kyoto and gain valuable new material for the future growth and progression of research and science in your country.

(Continued→)

CONGRESS INFORMATION

Period: May 25(Sunday) - May 30 (Friday), 1997

Venue: Kyoto International Conference Hall
Takaragaike, Sakyo-ku
Kyoto 606, Japan

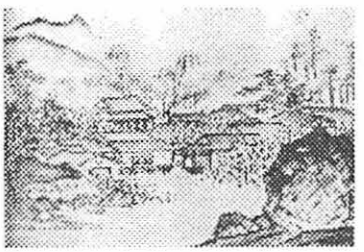
Language; The working language of the Congress is English.

Invitation letters/Visas: Participants may require official invitation letters to the Congress for either local grant applications or entry visas to Japan. Please write to the Secretariat should such a letter be needed.

Exhibitions: An exhibition featuring the newest developments and literature in the fields of color and color technology will take place from May 29-30. Items on display will include the following:

-Colorimetry tools and instruments
-Image processing/software
-Color atlas and Color chips
-Color materials
-Color simulators
-Color printers
-Color monitors
-Textiles
-Luminaire for Color testing
-Newest books & publications

Interested individuals should contact the Secretariat for further information.



HOME PAGE "AIC COLOR 97 KYOTO"

Updated information on AIC Color 97 Kyoto can be found on the home page:

http://is804.tech.chiba-u.ac.jp/AIC97/

A beautiful poster announcing the Congress, which can be downloaded and printed is included in the home page. Participants with prints are encouraged to bring them to Kyoto, notifying the Secretariat in advance. They will then be attractively displayed on-site, making it possible to compare the different colors achieved.

SCIENTIFIC PROGRAM

SPECIAL LECTURE AT THE OPENING CEREMONY

The Color and Character of Japan: Lecturer: Ikuo Hirayama, Former president of the Tokyo University of Fine Arts ; Chairman, Art Research Foundation: UNESCO Goodwill Ambassador; President, The Japan Scholarship Foundation; Chairman, Foundation For Cultural Heritage; Chairman of Japan China Friendship Association.

Designated as a person of distinguished cultural merit by the Japanese Government

One of the foremost artists of Nihonga (Japanese style painting) and a leading figure overseas in the restoration of Japanese art and renowned artist of Silk Road painting.

INVITED LECTURES

During every morning session, invited papers will be presented. On Tuesday, May 27, Carol M. Cicerone of the University of California Irvine will give a lecture entitled, "The Perception of Color from Motion," and Donsoh Park of Ajou University, Korea, will give a talk on "Traditional Color and Local Color in the Environmental Design." On Thursday, Joel Pokorny of Chicago University will speak on, "Visual Function in Heterozygote Carriers of Color Vision Defects," and Osvaldo da Pos of the Universita Degli Stufi di Padova in Italy will talk about "Color Illusion." On Friday, John Verril of the National Physical Laboratory in the UK will give a lecture entitled,"Towards Improved Accuracy of Surface Color Measurements."

SYMPOSIA

S1. Color Cognition and Machine Vision: Coordinator: Keiji Uchikawa (Tokyo Institute of Technology, Japan)

This symposium will focus on the psychophysical and physiological aspects of color cognition and how to apply them to machine and computational vision. Steve Shafer (Microsoft Corp., USA) will deliver a keynote lecture arguing that for both human and computer vision, color is a carrier of physical information, and not just a code for recognizing objects. Brian Wandell (Stanford Univ.) will report on experiments that extend classic theory from uniform patches to patterned stimuli. Shoji Tominaga (Osaka Electro-Communication Univ., Japan) will discuss the systems and algorithms for machine vision application. Moreover, Gunilla Derefeldt (National Defense Research Establishment, Sweden) will survey cognitive aspects of color in terms of behavioral, neuropsychological, and neurophysiological data.

S2. Color Design 21: Coordinators: Miho Saito (Waseda University, Japan) and Paul Green-Armitage (Curtin University of Technology, Australia)

Symposium S2, Color Design 21, will focus on the theme of "The Role of Color in the 21st Century," developing new global paradigms to guide us into the next century. While simultaneously discussing the historical role of Color Design in the 20th Century, contemporary issues such as increasing dissatisfaction with materialism and its effects on human morality and spiritual culture, will also be explored. Experts in a variety of fields of study will tackle such questions as: "What is the

(Continued→)

significance of color design, and what should be its focus for the next century?" Speakers will include Michael Lancaster of Dartford, UK, John Hutchings of Bedford, UK, Christina M. Burton of Texas, USA, Peter Travis of N.S.W., Australia, Nancy Kwallek of Texas, USA and Shigenobu Kobayashi of Tokyo, Japan.

S3. Color Management Systems: Coordinator: Po-Chien Hung (Konica Corp., Japan)

The color management system is now the essential tool for color reproduction in digital imaging. As a person computers and digital image peripherals gain popularity, the use of digital images grows at an exponential rate. The concept of "device independent color" allows communication between peripherals through the CIE standard to be successfully established. In a sense, the color management system weds color science to imaging devices. The possibilities of color management are not restricted only to color communication between media. Color science may facilitate color reproduction in diverse surroundings, environments, and light sources.

In this Symposium, speakers of different backgrounds will review color management in theory and practice. Currently scheduled to speak are Roy S. Berns (Rochester Institute of Technology), Michael Pointer (Kodak Ltd., UK), and Hiroaki Kodera (Matsushita Research Institute Tokyo Inc., Japan). They will discuss color appearance models, the CIE standard, and the practical implementation of the color management system. An exhibition of color equipment for color management will be held concurrently. Hard copies sharing the same image data, downloaded from the AIC Internet home page, will be on display for comparison.

DEADLINE FOR REGISTRATION IS *APRIL 15, 1997*

PRE-EVENT

In commemoration of the opening of **AIC Color 97 Kyoto,** the Color Science Association of Japan will be holding public color seminar. The Official language of the seminar is Japanese and interpretation from foreign languages into Japanese will be provided.

Advanced registration is not required.

Details are as follows:

Organized By:	The Color Science Association of Japan
Managed By:	The AIC Commemorative Color Seminar Steering Committee
Date and Time:	May 24 (Saturday), 1997; 9:45-17:30
Venue:	To be announced in the Preliminary Program
Fee:	*A PARTICIPATION FEE WILL BE CHARGED*
Program:	Morning: Personal Color Seminar/Panel Discussion Afternoon: A) Commemorative Lecture Prof. Jean-Phillipe Lenclos l'Ecole Nationale Supérieure des Arts Décoratifs de Paris B) Public Color Lecture/Panel Discussion

Inquiries should be addressed to:

AIC Color 97 Kyoto/Secretariat
c/o JTB Communications, Inc.
New Kyoto Center Bldg. 5F
Shiokoji Shinmachi, Shimogyo-ku
Kyoto 600, JAPAN

TEL: +81 (Japan) 75-341-1618
FAX:+81 (Japan) 75-341-1917

For Travel Inquiries:

Japan Travel Bureau Inc., Kyoto Office
Convention Department
AIC Color 97 Kyoto
Higashi-shiokoji cho, Shimogyo-ku
Kyoto 600, JAPAN

TEL: +81 (Japan) 75-361-7241
FAX:+81 (Japan) 75-341-1028

HOME PAGE "AIC COLOR 97 KYOTO":
http://is804.tech.chiba-u.ac.jp/AIC97/

HOME PAGE "KYOTO":
http://web.kyoto-inet.or.jp/org/hellokcb/index.html

For inquiries in the USA, contact:Ms. Paula Alessi at Eastman Kodak Co.
TEL: (716)477-7673
FAX:(716)722-1116
e-mail: pjalessi@kodak.com

THE COLOR ASSOCIATION OF THE UNITED STATE

CAUS 1998/1999 Interior Color Forecast

The 1998/1999 Forecast represents evolutionary, rather than revolutionary, change from the 1997/98 card. The Committee has reiterated the importance of warm colors (both reddish and ocher) and downgraded green by halving the number of greenish tones shown.

Reds, from ancient terra-cotta to cherry red and cyclamen pink, dominate the center of the card and their influence spreads to the adjacent columns of blues and melon pinks. To the right, the warm story is continued in golden ochers and bronzes, while to the left, the card is given balance with silver tints and refreshing yellowed greens and blues, all of which have an iridescent glow.

There is a new emphasis on clean colors, and almost all the dark, brooding tones of the last card have been replaced with lively, upbeat pastels and saturated midtones. A few committee members had pointed to the rising influence of colors from exotic locations - Central Africa, Tibet - but the group ultimately settled for a more American Palette with softer, budget-conscious colors that will last a long time.

Which will be the best-sellers? That depends on which area each committee member represents. For paint: "Our biggest selling color continues to be white-white" (Charbonneau); for carpets: "The market is towards neutrals" (Facteau); for corporate interiors: "Generally favored is really hot copper and country house blue for accents" (Clodagh); for home furnishings: "Warm color constitutes 70-80% of our sales" (Schirmeister).

Combinations suggested were aqua and copper for impact; soft reds,, grays, beiges and yellows for a summery palette with a hint of Asia; white glazed or sponged with "ancient" colors such as terracotta, ocher and deep red; yellow or ocher with accents of bronze; cool metallics with warm colors; and harmonies of neutrals, taupes and blackened colors.

The Power of Red: Fashion directions are beginning to heed what has been an enduring fact in marketing red's appeal. Red is only now regaining poise on the CAUS color forecasts after a few years in the shadow of neutrals, despite the abundance of red on supermarket shelves and the lasting belief in red as powerful marketing tool, often in its name alone. From beer to laundry detergents, red has proven to have staying power as a compelling source of energy, a color that means "don't touch" yet simultaneously encourages endless consumption. A huge attention getter, red is particularlyhot on the labels of things ingested.

Children relate to the youthful energy associated with bright, primary reds, a phenomenon witnessed by the abundance of red in kid's fashions. Red packages and labels line supermarket aisles, banking on red's appeal to kids, who in turn influence their parents' purchasing patterns. Heinz Ketchup has recently put forth a new, whimsical cartoon-like label in shades of red with the expresses intent to adjust the icon for their main audience: children.

Red also possesses connotations of raciness, aggressiveness and sexual passion. The quintessential red sports car is translated into beers, Red Dog, Red Wolf, or Red Hook, to name just a few. The power of the color name evokes the sense of virile masculinity that marketers hope will encourage a sale. Considering the younger, more savvy consumers, Lorrie Stuart vice president and director of trends at Young & Rubicam was recently quoted saying: "Evoking the color red is more titillating than evoking, say, turquoise."

(*The New York Times* , "The Color Red takes On A Youthful Look," Jennifer Steinhauer, June 30, 1996).

In a time when baby blue nail polish adorns the nails of young hipsters, red still endures as an electric marketing tool. - AMW

Exhibitions: "Two by Two," the first exhibition at The Metropolitan Museum of Art to offer a simultaneous history of apparel with equal attention to men and women, opens in The Costume Institute on September 10 and runs through November 24. The exhibition presents men's and women's clothing pired in a historical survey from the 18th century to the present.

COLOR MARKETING GROUP TO FORECAST "COLOR DIRECTIONS™" FOR 1999 CONTRACT/ COMMERCIAL PRODUCTS

ALEXANDRIA, VA - More than 650 Color Designers will meet to focus on future color and design trends for all manufactured products and services at Color Marketing Group's (CMG) **Fall International Conference, "Color Passages,"** in Seattle, WA, November 3-5, 1996. CMG is a non-profit, international association of color design professional, whose members forecast Color Directions™ one to three years in advance for manufactured products in all industries. At the Fall International Conference, members will participate in cooperative Color Workshops where Color Directions™ will be forecast for 1999 and new Color Palettes developed for Contract/Commercial markets, Retail,

(Continued→)

Hospitality, Office and Health Care.

"During the conference in Seattle, qualified CMG members will participate on either the **1999 Contract Color Directions Workshops** or the **1996-97 Contract Colors Current™** Workshop. In the workshops, members forecast future color trends which will influence product design and determine the colors 'sure to sell' for Contract markets," remarked CMG president Laraine Turner, CMG*, co-owner of The Jolley/Turner Group, Inc., Long Beach, CA. The **1999 Contract Color Directions Workshops** focus on color and design influences which will become apparent in 1999, while the **1996-97 Contract Colors Current Workshops** concentrate on color trends either already appearing in Contract marketing or committed to appearing in the next 12 to 18 months.

CMG members not involved in Contract/Commercial markets will attend **1998 Consumer Color Combinations workshops**, where the "hows" and "whys" of combining colors are discussed and viable, marketable Color Combinations are produced.

Additionally, all Conference attendees will participate in Design Workshops, where small group discussions result in an exciting exchange of information on design trends and influences and how they affect color in future product lines. This year attendees will choose between the **1997-98 Design Influences Workshops** which will examine current design trends and the **1999-2001+ Design Vision Workshops,** which will explore design trends through the end of this century and the beginning of the next.

In addition to the Workshops, color design and marketing experts will address a variety of relevant contemporary topics, including:

- **"Color Passages: A Vision in Glass!"**

Dale Chihuly, internationally reknowned glass artist, will share his inspirational methods using color in design.

- **"On the edge of the Digital Edge"**

Peter Leyden, feature editor, *WIRED* magazine will discuss the evolution of digital technology and future trends in information superhighway development.

- **"Successfully Doing Business in Asian Markets"**

Leading international trade experts will discuss marketing directions in China, India, Indonesia and Japan in a highly-energized panel discussion.

- **"The Art of Dressing Casual"**

The rules for dressing for work have changed. *Eddie Bauer* , well known direct- mail retailer, will show how they've taken the market lead in this trend.

The findings from the Color Workshops held throughout the Conference will be presented to attendees at an exciting, information-packed General Session on Tuesday, November 5. The highlight of Tuesday's session will be a colorful preview of the just-developed 1999 Contract Color Directions Palette.

For more information on CMG's Fall International Conference please call: (703) 329-8500 or write : Color Marketing Group, 5904 Richmond Hwy., Suite 408, Alexandria, VA 22303 USA

FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY

The Federation is pleased to feature Walter C. McCrone as the Key-note Speaker at the Opening Session of its 7th Annual Meeting. The event will be held October 23-25 at the McCormick Place North, in Chicago, Ill.

Dr. McCrone is Director Emeritus of the McCrone Institute, a non-profit corporation devoted to fundamental research in, and teaching of, microscopy and crystallography.

Dr. McCrone's presentation will focus on "Ten Thousand Dollar Per Square Centimeter Coatings." According to the speaker, there are many compositions of coatings useful for protection, aesthetics, and for providing properties such as electrical conductivity, adhesion, abrasion, etc. None, however, is more expensive than some of the aesthetic coatings. Coatings applied to a canvas by Leonardo da Vinci has sold for more than $20,000/cm. Other Old Masters, such as Rembrandt, Titian, and Raphael are not far from this price range. One result of this, states Dr. McCrone, is the growing temptation for some modern artists to "change their name" to Rembrandt, Titian, Raphael - or even Leonardo.

There is an increasing need for scientific techniques to detect art forgeries. In his presentation, Dr. McCrone discusses how these complex coatings are analyzed by Polarized light Microscopy supplemented by Fourier Transform Infrared Absorption and Scanning Electron Microscopy with Energy Dispersion X-ray Analysis to detect these mis-attributions

George R. Pilcher, Technical Director, Coil and Extrusion Business Unit, for Akzo Nobel Coatings, Inc., Columbus, OH, will be the recipient of the organization's highest honor, the George Baugh Heckel Award, for 1996. The Heckel Award recognizes the outstanding ccontributions that Mr. Pilcher has made to the Federation's interest and prestige. Established in 1951, the Award is dedicated to the memory of George Baugh Heckel - Auther, poet, editor, and historian - who served as temporary Chairman when the Federation was organized in 1922 and as Secretary for many years thereafter.

The Federation has announced the nominations for Federation Officer position for 1996-1997. Thomas E. Hill, formerly Vice President/Technical Director of the Consumer Group of

Pratt & Lambert, Buffalo, NY is nominated to serve as President-Elect of FSCT. Mr. Hill is a Trustee of the Coatings Industry Education Foundation (CIEF) and is a member of the FSCT Executive Committee. He served as the Western New York Society Representative to the Federation Board of Directors from 1983-90. In addition, Mr. Hill has served on the Program, Investment, and and Paint Show Exhibits Committees of the Western New York Society. A member of the coatings industry for 26 years, Mr. Hill was educated at West Virginia University and the State University of New York at Buffalo.

Forest Fleming (Piedmont Society), Technical Director of Industrial Wood Building Products Group, Akzo Nobel Coatings Inc., High Point, NC, has been nominated to serve as Secretary-Treasurer of FSCT. Mr. Fleming currenly serves on the Federation Executive Committee and is the Piedmont Society Representative to the Board of Directors. He was President of the Piedmont Society (1989-1990) and served on the Society's Publications and Technical Committees. In 1988, while serving as Membership Chair, Mr. Fleming was presented with a Certificate of Appreciation for exemplanr increase of Society's membership during the 1987-88 year.

He was graduated from Western Carolina University with a BS degree and has been affiliated with the coatings industry for 19 years.

HFES RELEASES NEW COLLECTION OF PAPERS ON HUMAN-COMPUTER INTERACTION

SANTA MONICA, CA - The Human Factors and Ergonomics Society proudly announces the publication of **Human Factors Perspectives on Human-Computer Interaction:Selections from Proceedings of Human Factors and Ergonomics Society Annual Meetings. 1983-1994.** The editors, Gary Perlman, George K. Green, and Michael S. Wogalter, supervised the review and selection of more than 3500 papers to arrive at 79 of the best papers presented at HFES meetings in the last fifteen years.

Each three- to five-page paper addresses one or more of the following aspects of human-computer interaction:

- Analysis (12 papers)
- Design (40 papers)
- Prototyping (12 papers)
- Implementation (5 papers)
- Evaluation (34 papers)
- Other (18 papers)

Topics include human aspects such as vision, error, aging, and novice vs. expert users and machine aspects such as displays, input devices, and software design. The papers followed a number of methodologies: empirical studies, models/theories, development, case studies, and surveys. Also included are author and subject indeces.

Human Factors Perspectives on Human-Computer Interaction makes a valuable addition to any HCI practitioner's or research's library. It is also useful as a reader in undergraduate and graduate classes, and especially as an introduction to newcomers to HCI who are searching for issues and methods that can be employed to investigate those issues.

8 1/2 x 11", 400 pages, paperbound, ISBN 0-945289-05-7. $49 for HFES members; $68 for nonmembers please add $5 for orders shipped outside the U.S.,Add California sales tax for deliveries to CA. Prepayment by check (US $ payable to HFES), MasterCard, or VISA. Quantity discounts on five or more copies (call HFES for information). Book review editors: Review copies are available; call (310)394-1811 or fax (310)394-2410.

GENTLE REMINDER!

All appropriate information submitted to this NEWS publication is the full and complete responsibility of the sender.

This publication and the ISCC assumes no responsibility for information changes and inaccuracies.

Thanks,
The Editor

C A L E N D A R

Please send information on Member Body and other organization meetings involving color and appearance functions with dates, places, and information source to:

Harry K. Hammond, III
or
John Peterson
BYK-Gardner, USA
2435 Linden Lane
Silver Spring, MD 20910
Phone: (301)495-7150
Fax: (301)-585-4067

1996

AATCC CONFERENCE AND EXHIBITION
Sept. 15-18
American Association of Textile Chemists and Colorists
Opryland Hotel
Nashville, TN
Information: AATCC
Phone: (919) 549-8141

(Continued→)

SPIE / IS&T
Sept. 24 - 26
Advanced Imaging Networks
Berlin, Germany
Information: IS&T Conference Manager
7003 Kilworth Lane
Springfield, VA 22151
Phone: (703) 642-9090
Fax: (703) 642-9094
email: info@imaging.org
internet: http://www.imaging.org

JERMOV
Oct. 9 - 13
Joint European Research Meetings in Ophthalmology and Vision
Montpellier, France
Information: Chairman Congres
43, Place Vauban
BP 9173
34042 MONTPELLIER
Cedex 1 (France)
Phone: +33 67 15 99 00
Fax: +33 67 15 99 09

INTERNATIONAL COATINGS EXPO AND TECHNOLOGY CONFERENCE
Oct. 22 - 25
Insights & Innovations
McCormick Place North
Chicago, Illinois
Information: Federation of Societies for Coatings Technology
492 Norristown Road
Blue Bell, PA
19422-2350
Phone: (610) 940-0777
Fax: (610) 940-0292

IS&T / OSA
Oct. 20 - 25
Conference on Optics & Imaging in the Information Age
Rochester Riverside Convention Center
Rochester, NY
Information: IS&T Conference Manager
7003 Kilworth Lane
Springfield, VA 22151
Phone: (703) 642-9090
Fax: (703) 642-9094
email: info@imaging.org
internet: http://www.imaging.org

IS&T 12th INTERNATIONAL CONGRESS
Oct. 27 - Nov. 1
Advances In Non-Impact Printing Technologies
Hyatt Regency San Antonio
San Antonio, TX
Information: IS&T Conference Manager
7003 Kilworth Lane
Springfield, VA 22151
Phone: (703) 642-9090
Fax: (703) 642-9094
email: info@imaging.org
internet: http://www.imaging.org

CMG FALL CONFERENCE
Nov. 3 - 5
Color Passages
Sheraton Seattle Hotel & Towers
Seattle, WA
Information: Katie Register
5904 Richmond Highway
Suite 408
Alexandria, VA 22303
Phone: (703) 329-8500
Fax: (703) 329-0155

AATCC NATIONAL COMMITTEES AND COUNCIL
Nov. 19 - 21
Research Triangle Park, NC
Information: AATCC
Phone: (919) 549-8141

IS&T / SID,s FOURTH COLOR IMAGING CONFERENCE
Nov. 19 - 22
Color Science, Systems & Applications
Radisson Resort
Scottsdale, AZ
Information: IS&T Conference Manager
7003 Kilworth Lane
Springfield, VA 22151
Phone: (703) 642-9090
Fax: (703) 642-9094
email: info@imaging.org
internet: http://www.imaging.org

ASTM COMMITTEE D-20 ON PLASTICS
Nov. 18 - 21
New Orleans, LA
Information: Mrs. Katherine Morgan
Phone: (610) 852-9500
Fax: (610) 832-9555

(Continued→)

1997

ASTM COMMITTEE D-1 ON PAINT
Jan. 26 - 29
Fort Lauderdale, FL
Information: Scott Orthey
Phone: (610) 832-9717
Fax: (610) 832-9555

ASTM COMMITTEE E-12 ON APPEARANCE
Jan. 26 - 29
Fort Lauderdale, Florida
Information: Bode Buckley
Phone: (610) 832-9740
Fax: (610) 832-9555

IS&T / SPIE
Feb. 9 - 14
Electronic Imaging: Science and Technology
San Jose Convention Center
San Jose, CA
Information: IS&T Conference Manager
7003 Kilworth Lane
Springfield, VA 22151
Phone: (703) 642-9090
Fax: (703) 642-9094
email: info@imaging.org
internet: http://www.imaging.org

TAGA ANNUAL CONFERENCE
May 4 - 7
Technical Association of the Graphic Arts Annual Technical Conference
Montreal or Quebec City, Canada
Information: Karen Lawrence
Phone: (716) 475-7470

SID 97
May 12 - 16
Boston, MA
Information: Lauren Kinsey, SID
1526 Brookhollow Drive
Suite 82
Santa Ana, CA 92705
Phone: (714) 545-1526
Fax: (714) 545-1547
email: socforinfodisplay @mcimail.com

IS&T 50th ANNUAL CONFERENCE
May 18 - 23
Hyatt Regency Cambridge Hotel
Cambridge, MA
Information: IS&T Conference Manager
7003 Kilworth Lane
Springfield, VA 22151
Phone: (703) 642-9090
Fax: (703) 642-9094
email: info@imaging.org
internet: http://www.imaging.org

COLOUR 97
May 26 - 30
8th AIC Quadrennial Meeting
Colour Œ97 Executive Committee Meeting
May 25
Kyoto International Conference Hall (KICH)
Kyoto, Japan
Information: Paula Alessi
Eastman Kodak CO.
Phone: (716) 477-7673
Fax: (716) 722-1116
email: pjalessi@kodak.com

ISCC ANNUAL MEETING
Sep. 14 - 17
Inter-Society Color Council Annual Meeting with Color and Appearance Division of Society of Plastics Engineers
Marriot Inner Harbor Hotel
Baltimore, MD
Information: Gary Beebe
Phone: (215) 785-8497

AATCC CONFERENCE AND EXHIBITION
Sep. 28 - Oct. 1
American Association of Textile Chemists and Colorists
Marriot Marquis
Atlanta, GA
Information: AATCC
Phone: (919) 549-8141

OSA ANNUAL MEETING
Oct. 11 - 19
Optical Society of America
Long Beach Convention Center
Long Beach, CA
Information: OSA
Phone: (202) 223-0920
Fax: (202) 416-6100
email: mfg@osa.org

(Continued→)

IS&T 13th INTERNATIONAL CONGRESS
Nov. 2 - 7
Advances In Non-Impact Printing Technologies
Sheraton Seattle Hotel
Seattle, WA
Information: IS&T Conference Manager
7003 Kilworth Lane
Springfield, VA 22151
Phone: (703) 642-9090
Fax: (703) 642-9094
email: info@imaging.org
internet: http://www.imaging.org

IS&T / SID's FIFTH COLOR IMAGING CONFERENCE
Nov. 16 - 19
Transforms and Transportability of Color
Radisson Resort
Scottsdale, AZ
Information: IS&T Conference Manager
7003 Kilworth Lane
Springfield, VA 22151
Phone: (703) 642-9090
Fax: (703) 642-9094
email: info@imaging.org
internet: http://www.imaging.org

1998

TAGA ANNUAL CONFERENCE
May 3 - 6
Technical Association of the Graphic Arts Annual Technical Conference
Chicago, IL
Information: Karen Lawrence
Phone: (716) 475-7470

SID 98
May 17 - 22
Anaheim, CA
Information: Lauren Kinsey
SID
1526 Brookhollow Drive
Suite 82
Santa Ana, CA 92705
Phone: (714) 545-1526
Fax: (714) 545-1547
email: socforinfodisplay @mcimail.com

ASTM COMMITTEE E-12 ON APPEARANCE
Jun. 16 - 18
Saint Louis, MO
Information: Bode Buckley
Phone: (610) 832-9740
Fax: (610) 832-9555

AATCC CONFERENCE AND EXHIBITION
Sept. 22-25
American Association of Textile Chemists and Colorists
Convention Center
Philadelphia, PA
Information: AATCC
Phone: (919) 549-8141

OSA ANNUAL MEETING
Oct. 3 - 9
Baltimore Convention Center
Baltimore, MD
Information: OSA
Phone: (202) 223-0920
Fax: (202) 416-6100
email: mfg@osa.org

1999

TAGA ANNUAL CONFERENCE
May 2 - 5
Technical Association of the Graphic Arts Annual Technical Conference
Philadelphia, PA
Information: Karen Lawrence
Phone: (716) 475-7470

SID 99
May
California
Information: Lauren Kinsey
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1526 Brookhollow Drive
Suite 82
Santa Ana, CA 92705
Phone: (714) 545-1526
Fax: (714) 545-1547
email: socforinfodisplay @mcimail.com

AATCC CONFERENCE AND EXHIBITION
Oct. 12 - 15
American Association of Textile Chemists and Colorists
Convention Center
Charlotte, NC
Information: AATCC
Phone: (919) 549-8141

JOBS WANTED!

This Section is intended to help ISCC members that are in need of, and are looking for employment. Here is an opportunity to use the resources at hand.
There is no charge for this servce. However the restrictions are as follows:

1. This service is for ISCC members' use only.
2. No more than 50 words may be used to describe yourself. (Not including name address and/or telephone number).
3. If you are using a P.O. Box, you must supply a complete address.
4. No Agency representing member(s) is allowed.
5. Neither the ISCC *News* nor the editors are responsible for any errors.
6. You must advise us in writing when you have obtained employment.

We hope this new section will be of value to you, the ISCC member. If you have any suggestions/criticisms, please send them to the editor. Let's make this work!

SEEKING EMPLOYMENT IN COLOR REPRODUCTION INDUSTRY OR HUMAN FACTORS.

PhD in visual psychophysics. Detailed knowledge of color vision, colorimetry, human psychophysics, color testing and calibration procedures, and statistics. Broad knowledge of pattern recognition and image processing. Familiarity with signal processing and systems analysis. Knowledge of optics, electronics, and mathematical modeling.

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Please send all other materials on diskette as follows to the above address:

MS DOS-ASCII, (3.5"- 1.44 Meg); MACINTOSH– (Most formats) (3.5"–1.44 Meg, 800K or 400K).

Phone: (215) 836-5729

If necessary, fax material to (215) 836-0448

E-mail: celikizg@hardy.texsci.edu

Please note: the deadline for submission of material is the 1st of each even numbered month. Material received after the 1st will not be printed until the following issue.

All submissions must be in English.

meeting reports

photos

contributions from members

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Past-Pres.	Mr. Roland L. Connelly	SheLyn, Inc., 1108 Grecade Street, Greensboro, NC 27408	roland@shelyn.com	(910) 274-1963	(910) 274-1971

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