Inter-Society Color Council *News*

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CALENDAR

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INTERVIEW WITH ISCC PRESIDENT RODRIGUES

Bonnie Swenholt, who served as a Director with Rodrigues (1980-82) was asked by Past-President Louis Graham to interview him after his installation as ISCC President (1986-88) at Toronto, Ontario, Canada, June 18, 1986. The interview was designed to provide background information on our President and to provide some insight into his plans for ISCC. First the personal background.

Swenholt: Where were you born and where did you receive your education?

Rodrigues: I was born in Bombay, India. I began my college education at the University of Bombay. I transferred to Notre Dame University, South Bend, Indiana, majoring in chemical engineering, and I continued my studies there until I earned a doctorate in this field.

Swenholt: What is your present vocation?

Rodrigues: I am a Research Associate with E. I. Du Pont, Troy, Michigan. My laboratory is concerned with research in instrumental color matching of paint for the automotive industry.

Swenholt: Do you have a family and where do you live?

Rodrigues: My wife, Vicki, and our three children, two boys and a girl, have a home in Bloomfield Hills, a suburb of Detroit. The boys, Ashok and Arun are 16 and 17 years old, Kamala is 14.

Swenholt: How did you become involved with ISCC?

Ridrigues: My supervisor took me to an ISCC meeting in New York City. Not long after that I became involved in the work of some of the project committees. Ralph Besnoy and I were appointed co-chairmen of the one on Metamerism. During my term as President-Elect, I served as Coordinator for the project committees. That is when I realized how important it is to have a coordinator with no other assigned responsibilities. The work of the project committees is a major justification for the existence of ISCC. For this reason, coordination of the project committees deserves the undivided attention of one individual. With this thought in mind, the Board of Directors agreed to appoint Hugh Fairman as Project Committee Coordinator. He has no other office.

Swenholt: I have learned that you have some goals for ISCC that you have already begun to work toward. Please tell us what you hope to accomplish during your administration.

Rodrigues: My chief concern is the project committees. They can work more effectively if each committee establishes

specific goals that can be attained within a reasonable period of time. The appointment of Coordinator Fairman is my first step toward guiding the efforts of the project committees.

Swenholt: Are there other assignments that you have made?

Rodrigues: Yes, President-Elect Joy Luke will chair a Committee on Long-Range Planning and Implementation. Planning is vital for the health and growth of ISCC. Some good plans evolved a few years ago, but we have not done a good job of implementing them. Some things have been accomplished, but I am confident that we can do more to meet the needs of the membership. For example, ISCC was founded as an *Inter-Society* Color Council; so maintaining a close tie with each "society" (member-body) is a primary concern. Past-President Davenport has agreed to serve as Member Body Liaison Officer. The Editorial Staff of ISCC News is anxious to have continuous communication with each member-body through the delegation chairman. Pursuit of these three activities: (1) Specific goals for project committees, (2) Long-range planning + implementation, and (3) Closer ties with Member Bodies, should result in a stronger Council that will provide better intergration among members from art, science, and industry who are pursuing answers to color-related problems that we all face.

One thing that the Board of Directors needs to do immediately is to review the duties of the chairman of each standing committee. We need to be sure that each Chairman understands his duties, and we need to know the logistics of his plans for carrying them out. Some committees ahve been less fruitful than we had expected, and this may have resulted from an inadequate statement of what was expected. We plan to remedy this situation.

Swenholt: Thank you very much, President Rodrigues, for granting this interview.

PROJECT REPORTS

Report on Project 22
Materials for Instrument Calibration
Danny Rich, Chairman

The committee met June 16, 1986 at Ryerson Polytechnic Institute, Toronto, Ontario, Canada. There were 28 people in attendance. Chairman Rich called the meeting to order and read the minutes of the 1985 meeting. No corrections or additions to the minutes were recommended.

Rich indicated that the results of the *Halon* round robin had been published in the 15 July 1985 issue of *Applied Optics.* He also indicated ASTM E12.02 would soon send the third draft of method E308b on Spectrophotometry to committee ballot. Janos Schanda of Hungary indicated that the editor had found some errors in the tables of *CIE Publication 15.2 Colorimetry,* but that it should be in print by the end of 1986.

Rich indicated that he had prepared a draft of the revision to ISCC Technical Report 78-2, *Guide to Material Standards and Their Use in Color Measurement.* He offered copies to anyone interested in proofreading or editing the text. He also requested input from the committee on pertinent references to be added to the annotated bibliography.

Rich indicated that he had received a draft copy of a CIE report entitled, *Survey of Reference Materials for Testing the Performance of Spectrophotometers and Colorimeters,* and that the report has been submitted to the *CIE Journal* for publication. Schanda affirmed this and stated that the report will definitely be published by CIE in some form.

Rich described a new Standard Reference Material (SRM) from the National Bureau of Standards. It is a pressed powder wavelength standard for the NIR (700 - 2000 nm). A paper describing the SRM will be published in the July/August 1986 issue of the *Journal of Research of the National Bureau of Standards.* He also described two white reflectance materials, a glass known as MC-20, which is a multi-component alkali-containing borosilicate glass, opacified with fluoric and phosphoric compounds. Its reflectance is said to be between 94% and 97% throughout the wavelength range of 400 nm of 750 nm. The material is soon to be available from Laurel Industries, 280 Laurel Avenue, Highland Park, IL 60035, (312) 432-8204. Schanda reported that W. Erb at PTB in Germany has a replacement for MS-20 glass. Fred Simon indicated that Coors Ceramic Co. has a material made of beryllium oxide that can be used as a reflectance standard in the visible and near-IR. The material is used as a substrate for high performance electronic components. Finally Rich described another company that has announced a high reflectance coating that is highly stable and durable and has a higher reflectance than barium sulfate coatings. Roy Berns indicated that RIT is now licensed to supply *Halon* plaques.

The discussion then turned to the topic of fluorescent performance standards. Rich indicated that after last year's meeting some people asked about picking up the results of Project Subcommittee 18's work on fluorescent materials and identifying an appropriate performance standard. There was very little discussion concerning an obvious need. Schanda commented that people in Europe use the CIBA-GEIGY plastic tiles impregnated with a fluorescent whitening agent. Robert Mason indicated that those tiles are no longer available. He volunteered to check into other sources of FWA containing materials. Calvin McCamy indicated that the Hohensteiner Institute has a FWA brightened cotton standard that is used in Europe. He noted that at least two types of FWA standard are necessary, since the plastic chips were not adequate representations of fluorescent textile surfaces. It was the consensus of the committee that we should pursue this topic further and at least identify or recommend sources of performance standards. Rich also indicated that NPL (England) provides a calibration service for fluorescent materials.

Report on Project 25F
Strength of Colorants – Fibers
Carl Wright, Chairman

Concentrates for simple preparation for the 1986 meeting are now ready for distribution. You will be receiving them near the end of January.

As discussed in the summary of the 1985 results, this year we will evaluate two lots of concentrate versus each other, rather than making an intentional 10% reduction to 90% strength. We will be looking again for the correlation of strength determination between plaque and fiber, but also for the correlation of chromaticity before and after strength adjustment.

Samples this year are provided by Mobay, Indol, PMS, and Ampacet. Mobay provided PG7 presscake to Indol which has flushed to a 50% loading. PMS extruded the presscake with 12 MFR flake to make a 25% concentrate. Ampacet supplied a 50% Ti02 concentrate (Dupont R-101) for tinting.

Since we have changed our procedure this year, we will once again prepare samples at two concentrations as we did in years before 1985. The two concentrations will be at 0.1% and 0.5% pigment (0.4% and 2.0% concentrate). For plaque samples, Ti02 concentration will be held constant at 3.0% (6.0% of a 50% dispersion).

FORMULAS

PLAQUE

	A	B	C	D
5-001 GREEN	2.0		0.4	
5-002 GREEN		2.0		0.4
AMPACET WHITE	6.0	6.0	6.0	6.0
PP	92.0	94.0	93.6	93.6
	100%	100%	100%	100%

Measure B vs. A and D vs. C for color differences in FMCII and CIELAB. Measure strength at 640 NM and also report adjusted DE in FMCII and CIELAB.

FIBER

	A	B	C	D
5-001 GREEN	2.0		0.4	
5-002 GREEN		2.0		0.4
PP	98.0	98.0	99.6	99.6
	100%	100%	100%	100%

Measure fiber samples as described above for plaques.

We would like to request that all the participants who have the capability do both plaque and fiber preparations. Since this is the first year of a new format, we want to gather as much data as possible.

We are running behind schedule this year and we apologize for the delay. Please prepare samples and measurements as quickly as possible and send the data to me or George Sonn. If any questions arise, please contact me at (404) 941-5940 or George Sonn at (201) 242-1300.

Report on Project 25P
Strength of Colorants – Pigments
Jacqui Welker, Chairperson

During the last year, this subcommittee has received numerous data in response to the round robin tint strength determination of various red pigments. All participants received a standardized test procedure to follow, the required pigments and materials for the test and a standardized form for reporting the results.

Eight companies were included in this study of which seven have responded. The other company reportedly never received the materials or lost them in personnel changeovers.

A short summary of the results is presented comparing company to company results and different ways by which tint strength was calculated:

1) The mean % tint strength values were within the ±12.5% difference expected in strength for a ±1.0 gram change in tint level. This was the finding from this subcommittee's previous work.

2) The data revealed generally good correlation between tint strengths calculated at the wavelength of maximum absorption and the corresponding broad band tristimulus region.

In one instance the integral of the K/S curve over the visible spectrum was used to calculate strength. These data were in good agreement with the other set calculated using the maximum absorption method.

3) Some of the raw data were sent to Dan Phillips for further evaluation on software which calculates strength in four different ways.

a. at the wavelength of minimum reflectance,

b. at the corresponding tristimulus value for that particular wavelength

c. the area under the K/S curve over the visible spectrum,

d. at the average of the three wavelengths around the wavelength of minimum reflectance.

The various strength calculations for any one set of data agreed to within 1 unit of strength. This is expected since a pure pigment is being used in the studies. Differences in the calculations would be more apparent when standard and batch of a pigment are being evaluated (i.e. – shade differences).

In practice, the color difference after adjustment is observed. This indicates whether or not a viable correction can be made. In shade differences, generally one method of calculation will give a suitable color difference after correction.

The data is attached for further inspection. All measurements are specular included.

The following table summarizes the pigment evaluated and method of strength calculation used by company:

Company	*Pigment*	*Tint Strength Calculation*
A	Perylene Red 179	A max absorption, X,Y,Z
B		B ditto
C	Cadmium Red 108	C ditto
D		D max absorption
E	F3RK70 Red 170	E K/S integral
F		F max, X,Y,Z

At the next meeting of the subcommittee I feel it is time we reevaluated where we are and what directions we wish to a pursue in the future. Please feel free to attend and share your ideas.

Report on Project 27
Indices of Metamerism
Hugh Fairman, Chairman

During the year the Committee published *New Terminology for Metamerism Revisited* in Color Research and Application, Vol. 11, No. 1, Spring 1986, pp. 80-81. The Committee urged others to promulgate the term *paramerism* for those pairs of samples exhibiting both simple color difference and metamerism simultaneously.

The Committee has decided to publish the results of its metamerism questionnaire. The results will be submitted to the Board of Directors for publication approval.

The Committee is still actively engaged in data reduction of the results of its observational experiment of several years ago. This work should be completed by the time of the next Annual Meeting.

Recently the Committee has undertaken an experiment to obtain a large number of metamerism rule match points for a well distributed body of observers in support of CIE Technical Committee TC 1-07, Observer Metamerism. This experiment should begin to accumulate data by the time of the Williamsburg Conference in February, 1987.

The Committee looks forward to two new tasks for the coming year. First the Committee will draft a reply to a letter to the editor of a major journal which criticizes the Committee's recommended use of the term *paramerism,* and secondly, the Committee has been asked by Dr. Jozef Cohen to draft a document for publication which will recommend standardized terminology and matrix names for the matrices involved in metameric decomposition theory.

Report on Project 32
Image Technology
Paula Alessi, Chairperson

This annual report consists of a summary of the two times that this committee met at the annual meeting in Toronto. Interest in the activities of this committee has heightened as evidenced by the large turnout (over 50) at both of this year's sessions.

To kick off the Monday June 16th meeting, Alessi, distributed an agenda and a current membership list. Everyone in the room was also asked to sign an attendance sheet and to indicate on that sheet whether or not they would like to be a member of this committee. This process allowed us to pick up 14 new members.

To start the meeting, Alessi reviewed the scope of Project #32, Image Technology. This project addresses problems common to photography, printing, video display, and television involving the rendition, measurement, and specification of color. Solutions require the interaction of members from diverse fields shairng a common interest in the color problems associated with their imaging systems. Since the scope is so broad, the main emphasis of this commiftee is placed on the area that needs the most work. All efforts address the two-way relationship between a video display and a hardcopy (i.e. a graphic arts or photographic material).

After this brief introduction, Alessi asked each attendee to introduce himself and state his interest in image technology. The attendees comprised a wide variety of people from many different backgrounds and with diverse interests.

The first important agenda topic was discussion of the video display bibliography. Alessi distributed a rough draft of a bibliography that she put together based on some input from a few members. It was characterized as a rough draft because it lacked major topic headings for all entries and also because the same bibliographic conventions were not consistently used throughout. Since Justin Rennilson's CIE Technical Committee TC 1-10, Colorimetry of Self-Luminous Displays, is much further along in writing an annotated video display bibliography, Alessi suggested that we contribute our entries to him for incorporation into the more comprehensive document. This would avoid redundancy of effort and place the responsibility for a video display bibliography with CIE TC 1-10.

This does not suggest that ISCC Project Committee 32 doesn't need a bibliography. Bill Cowan pointed out the differences in the scope of CIE TC 1-10 and ISCC 32. In particular ISCC 32 is more concerned with color reproduction issues where the video display terminal may be used rather than calibration and photometric procedures for video displays which is the primary concern of CIE TC 1-10. Cowan suggested a new scope for a bibliography that might better serve ISCC 32 if it concentrated on image transfer rather than on calibration and measurement. Alessi proposed the following structure

for this color-reproduction-type bibliography together with names of people who would be responsible for compiling sections.

Color Reproduction Bibliography entries for:

I. Electronic Displays – Larry Tannas & Joann Taylor

II. Photographic Applications – Paula Alessi

III. Graphic Arts & Printing Applications – Dusty Rhodes
Includes ink-jet, thermal, electrophotography, etc.

IV. Electronic Display – – – –> Any of hardcopy media
from
<– – – – above

Committee members are encouraged to send whatever references they have (name, title, category, annotation, if possible) to each coordinator. Here are the addresses.

Larry Tannas, 1426 Dana Pl., Orange, CA 92666; Joann Taylor, P.O. Box 500 MS 50/320, Beaverton, OR 97077; Dusty Rhodes, 1941 E. Braeburn Rd., Altadena, CA.; Paula J. Alessi, Eastman Kodak Company, 1669 Lake Avenue, Rochester, NY 14650

The next item on the agenda was discussion of the relationship between ISCC 32 and American Society for Testing of Materials (ASTM) subcommittee, E12.06, Appearance of Displays. As ISCC 32 evolved more and more into the video display arena, it became clear that certain measurement and viewing standards were needed. Since the Inter-Society Color Council is not a standardizing body, it is not the appropriate place to carry out such work. Nick Hale, E-12 Chairman, suggested that ASTM Committee E12 on Appearance of Materials, is a more appropriate place to carry out standards work, and ASTM E12.06 was formed about two years ago. The two main areas that this subcommittee will concentrate on are an electronic display measurement that will be written in two parts (one describing spectroradiometric techniques and a second describing colorimetric techniques) and then an optimum viewing environment standard. Bill Cowan and Danny Rich have promised to draft a standard practice for measurement and calibration. Viewing environment is being addressed by first reviewing current documentation on the subject.

The next topic for discussion was the relationship bewteen ISCC 32 and CIE TC 1-10, Colorimetry of Self-Luminous Displays, chaired by Rennilson. As was mentioned earlier, we will be working together on a video display bibliography that is oriented towards measurement and calibration. A second major effort being pursued by this CIE committee is defining methods of assessing the parameters which influence the perception of color in video display applications. This is a shared interest with ISCC 32 and Rennilson and Alessi will keep in touch to exchange information as things progress.

The last topic for Monday's meeting was discussion of the experiment designed in 1985 to define the mapping function that would allow one to translate between video display color space and hardcopy color space. Alessi defined the objective of the experiment as follows: To determine whether the color appearance is a match when the colorimetric values for a set of reproduced object colors are the same on a video display screen as on hardcopy. In trying to understand this objective, Peter Kaiser posed this scenario. Assume the observer is a standard observer and our radiometric techniques were accurate enough to obtain good measurements. Then if the tristimulus values of a color on the CRT and a color on the hardcopy match, shouldn't the appearance match? Other participants who have dealt with this problem daily reminded us that a colorimetric match does not imply an appearanc match. Dusty Rhodes mentioned the importance of taking into account the effect of surround when trying to carry out such a matching experiment. Larry Tannas stated that the problem with CRT experiments like this one is the effect of ambient light on color shifts and contrast ratio. The definition of viewing conditions for an experiment such as this one is difficult. We'd rather not just consider ambient light because that is at a lower level than typical office lighting. Peter Kaiser suggested that the committee approach this problem in a slightly different manner. Why not begin with a trivial experiment which involves doing a very careful job of setting up the colorimetric match between the CRT and the hardcopy. The measurement techniques, although tedious, are well known and have been well documented by Cowan. Once we have achieved as accurate a colorimetric match as is possible for a particular set of viewing conditions, we can begin to add complexity to the experiment by systematically varying other parameters of interest. For example, we could study how the colorimetric match between a CRT and hardcopy changes when the level of the surrounding illumination is varied. This prompted Kaiser to suggest that the committee change the objective of this experiment to read as follows: To determine how viewing conditions affect color appearance when the colorimetric values for a set of reproduced object colors are the same on a video display screen as on a hardcopy. Other participants reminded us that little is known about the state of adaptation for video display viewing. It would be desirable if, when discussion experiments of this kind, we could consider how we would define the state of adaptation for the eye. Roy Berns reminded us that observer metamerism is another important issue that must be studied in this context. Dick Ingalls posed an interesting twist to the topic of CRT to hardcopy color space mapping. He suggested that the interest is not necessarily in an exact match between CRT and hardcopy color as much as it is in using the CRT as a vehicle of reference for obtaining the final desired hardcopy color. Ingalls' work has suggested that success can be achieved when using the CRT color as a reference position from which hardcopy color is to be produced. In spite of the fact that the CRT is used as a source for reference colors and not exactly matching colors, this would still imply that the mapping func-

tion between CRT and hardcopy color space is known. Norm Burningham questioned whether such a mapping function exists, especially for reflection output. Ingall assured us that his presentation at the color reproduction symposium would clarify his point and perhaps might make defintion of this mapping function more obvious.

Monday's meeting ended with a philosophical discussion of whether or not this committee should define experiments to be done by others. One year ago we outlined this mapping function experiment with the intention that, if completed, it would help many of us deal with these problems with more understanding. It seemed like the perfect project for a graduate student and RIT was willing to be the location where this work would be conducted. The problem was to find adequate support for the project with equipment and funds. Now, a year later, the experiment has changed objectives. Definition of the state of adaptation for video display viewing has become the objective, and acquisition of equipment and funds is still incomplete. It has been a frustrating year. Where did we go wrong? Cowan posed a good answer. It is not the role of a committee such as this to lead the field in video display color. A more useful role for a committee is to serve as a central location for compiling and exchanging state-of-the-art information.

The second meeting of this project committee was held Wednesday morning June 18th. It was almost as well attended as the first.

The main purpose of this meeting was for Ricardo Motta, a graduate student at Rochester Institute of Technology, to share his Master's thesis project with us. His thesis will attempt to define the state of adaptation of the eye in video display viewing. Unfortunately the discussion period was short and it became so bogged down in equipment details, that Motta never really did get to the punchline. However, it provided an opportunity for him to air questions that have lingered in his mind on general video display topics that our audience could answer.

After hearing Motta's presentation, a very important issue regarding future direction for this committee came to the floor. It related to the point that Cowan raised at the end of our Monday meeting. It should not be the responsibility of this committee to define research projects that are to be carried out elsewhere. Our efforts could be better spent by serving as a forum for people working in the video display color arena. They could share their findings and get feedback on problems that they cannot solve. Chairperson Alessi already had thoughts along these lines. For next year's annual meeting, this committee will probably meet twice as it did this year, but the two meetings will have different purposes. The first one will be an open meeting of a general information nature. We will devote more time to newcomers explaining who our committee is, how it got started, what our interests are, what kind of work we have been doing, and what we hope to accomplish in the future. We will also answer any questions they may have concerning this committee or work that they may be doing with video displays. This open meeting may feature some of our committee members sharing their work in the video display color area. The second meeting should be a members-only session which will involve communication among workers in the field and the experiments they have carried out. Since our membership does consist of many of the people who are at the forefront of this technology, this would be a good group with which to communicate and from whom feedback would be valuable. At this point, it is more important to share information in video display color. As we go along we may find ourselves in a position to recommend some research projects to an academic institution, such as RIT, but that will not be our main objective.

We don't have to wait for next year's annual meeting to begin this communication process. Since there is a significant number of committee members in the northeast, Alessi agreed to try to set up some interim meetings to try the information exchange technique to see how it works. For members in industry, it may be difficult to divulge experimental work, but it will be appreciated if every attempt is made to share non-confidential information. Alessi will be contacting members about details.

Before adjourning the meeting, Alessi asked everyone to think about what was said concerning future directions for the committee. If better ideas come to mind, everyone is encouraged to share them with her as soon as possible so the planning process can begin in a timely fashion.

Report on Project 33
Human Response to Color
Joy Luke, Acting Chairperson

ISCC Committee No. 33 met in Toronto all afternoon on June 16, 1986, during the ISCC Annual Meeting to allow time for three presentations and a working session. Mary Buckley had resigned as chairwoman due to the press of other obligations and a new chairman was needed, as well as a consensus on the direction the committee will take in the future. Joy Luke, Coordinator for Committee No. 33, served as acting chairwoman for this one meeting.

The first section of the meeting included a report by Anna Campbell Bliss describing her search through the literature for original medical, scientific and psychological research relating to color and light and its impact on the built environment. Emphasis is being given to the design of facilities for health care (hospitals, nursing homes, clinics, etc.) and special problems of the aged and handicapped. She remarked that the most original research in recent years comes from the fields of vision research and geriatrics. Her study, which will be published in the form of an annotated bibliography, has been supported in

part by the American Society of Interior Designers (ASID).

Anna distributed a list of the subject categories being covered and major references used. The bibliography will help designers refer to the original research rather than misleading popular literature, which "seems to regurgitate outdated studies and the musings of parapsychologists." She also mentioned that color and light relevant to child development was an important area for future study, possibly by Committee No. 33.

After discussing the research for the bibliography, which will be detailed in the ASID delegation report, she showed a series of slides relating to vision problems and asked for comments by the committee. The slides were taken of a model architectural environment, still in preliminary form, with which she hopes to illustrate what a person with defective vision actually sees. Based on medical research, problems such as cataracts, glaucoma and defective color vision will be illustrated. There were a number of helpful suggestions to make the photo study useful not only to designers but, with appropriate documentation, to scientists as well.

Signora Ronchi mentioned the recent AIC meeting in Monaco where papers indicated that high pressure sodium illumination has an effect on the perception of color similar to that of people with tritanopia, the blue-yellow vision defect. People with severe diabetes have color vision similar to normal vision in high pressure mercury illumination.

Bonnie Bender showed a group of beautiful slides taken for a talk given earlier to the Color Marketing Group. They illustrated the radical changes in natural illumination at different times of the day, in varying weather conditions. in changing seasons and in different geographical locations; and how the appearance of the scene is changed. Even though, as Bonnie said, everyone knows these changes exist, they are taken so much for granted that it is worthwhile to be reminded again of both the size and reasons for these radical shifts in natural illumination.

Chris Burton spoke about the problems inherent in choosing hospital interiors where people are under stress and sometimes must spend a long time. She said that a post-occupancy evaluationc an be an important tool for determining a patient's response to the interior eivironment. Burton suggested that a similar evaluation widely used might offer valuable information to interior designers responsible for future hospital interiors.

SECOND SECTION

In addition to the suggestions made by the three speakers, several committee members addressed the group concerning the direction the committee might take in the future.

David Johnson proposed a study of the one-person office as a limited and practical first step to the study of the effect on people of interior environments where they must regularly spend a long time.

Bender noted that other national organizations have objectives similar to those of Committee No. 33 and may be working on related projects. She suggested they be contacted. The Illuminating Engineers Society (IES) has groups working on studies concerning light and color and Bender proposed (1) that articles on their past research should be collected; and (2) contact be made with those committees to see if a joint project would be possible, or if it would be appropriate to have them report on their work at a Committee No. 33 meeting in the future.

In the discussion Barbara Schirmeister and others said that the most frequent request to ASID is for guidelines on appropriate color in hospitals, retirement homes, prisons and other public places where people are confined. There seemed to be agreement that, although there are no hard and fast rules to follow, it might be helpful to put out some type of publication that listed, without any recommendations, some approaches to common design problems that have proved effective in specific instances in the past. The idea would be open options, rather than to give solutions.

Walter Granville, who served as co-chairman with Mary Buckley of Committee No. 33, discussed a list of factors believed to influence the human response to color. Copies of the latest revision 10/25/83 were made available to those present. Mary Egan Haines had suggested the inclusion of "Personal color preferences from past experience," which Walter felt was an excellent addition. Other comments will be welcome.

Walter thinks of the list as an outline that would orient the reader as to what the human response to color is about. He intends to write a couple of paragraphs on each item and will circulate a draft for comment.

Finally, Alex Styne, who served as chairman of Committee No. 33 until 1982, spoke to the committee about the importance of having a specific goal if anything is to be accomplished.

The acting chairwoman asked for a motion and vote on whether the committee wished to become a different type of committee serving as a forum for presentations and an exchange of information on human response to color, or whether the committee wished to remain as a Project Committee working on one or two well-defined projects. Evelyn Stephens moved that the committee remain a Project Committee. The vote was for remaining a Project Committee, and further discussion, for the establishment of task groups with separate projects. The acting chairwoman asked committee members interested in working on one of the task groups to give their names to the following:

(1) David Johnson, Gardner/Neotec, 2431 Linden Lane, Silver Spring, MD 20910, if interested in working on a study on the effect of color and illumination in the one-person office.

(2) Bonnie Bender, 355 24th Street, Avalon, NJ 08202, if interested in studying the affect of color and illumination on

mood and physical health.

(3) Walter Granville, 312 Elm Court, Libertyville, IL 60048, if interested in working on the summary of factors affecting human response to color.

(4) Christina Burton, P.O. Box 4720, Texas Tech University, Lubbock, Texas 79409, if interested in studying color in the hospital environment.

Strong interest by several people plus a written plan will be needed for the Board of Directors to approve the task groups.

Following the meeting, at the request of President Davenport, several committee members and the Committee No. 33 Coordinator, Walter Granville agreed to chair Committee No. 33, subject to confirmation by the Baord of Directors. He plans to oversee the work of any task groups and lead the committee toward specific goals. Bill Thornton agreed to work with the task groups since illumination will be an important part of any of them.

LIST OF FACTORS BELIEVED TO INFLUENCE THE HUMAN RESPONSE TO COLOR

Basic Responses to Color

It is believed useful to consider the human response to color as consisting of a sensory, an emotional and an intellectual aspect. These are simultaneously applicable to some extent in every response. The list which follows gives factors that influence the response.

1. The Arts: painting, architecture, literature, performing arts, etc.
2. Styles of color usage in fashion including fads and trends.
3. Personal color preferences from past experience.
4. Lighting: style of lighting and its use to create different moods. Need for more light with increasing age. Glare masks ability to see, especially with increasing age. Tinted and reflective glass effects. Color rendition of light sources.
5. Surface finish: choice of texture and gloss.
6. Geographical factors: climate, including seasonal changes. Character of landscape.
7. Social factors: crowding, territoriality, personal space, privacy.
8. Ethnic factors: culture and tradition.
9. Other considerations: viewers sight line to colored areas and signs. Skin color. Identification colors: safety, fire exits, radiation hazard, fire extinguisher location, etc. Color Memory. Ease of maintenance; a consideration in choice of color and surface finish. Visual phenomena: color vision defects, color adaptation and constancy, after images, discrimination of color differences, metamerism, illuminant stable colors.

Draft by Walter C. Granville, 312 Elm Court, Libertyville, Illinois, 60048, rev. 06/25/86 from comments during the CSC/ISCC conference in Toronto.

Report on Project 34
Color Difference Problems
Sy Commandy, Chairman

ISCC annual meeting June 18, 1986, Toronto, Canada. Approximately 44 members or guests attended this meeting of whom 13 indicated an interest in being active on this committee.

The main topic covered regarded the samples prepared by Target Color (Richard and Marjorie Ingalls) for use in the color difference analysis program. On display were the Blue and Green samples prepared by unique photographic-computerized process developed by the Ingalls. The samples were arrayed in the relative positions they occupied in color space surrounding the standard. Each set is comprised of 54 samples and a standard controlled to very tight colorimetric tolerances.

Our next step is to develop a method for the visual assessment of each group of samples. For this purpose an interim meeting of the active members of this committee will be held in the fall (possibly in conjunction with the ISCC Board meeting in Philadelphia). All interested parties will be contacted in this regard as soon as plans are finalized.

Some concerns regarding the stability of the color sample to be used and possible lighting needs for their evaluation were discussed. Results of this discussion were that the samples were felt to have excellent stability and will in any case be handled in such a manner so as to prolong their lifetimes. The color composition of each sample group is identical due to the process used to produce them and therefore should not present a problem in terms of potential metamerism influencing color difference results.

A brief review of the new "Recommended Practice" developed by the Detroit Colour Council was given by Dave Alman. This practicd, SAE J1545, entitled "Instrumental Color Difference Measurement for Exterior Finishes, Textiles and Colored Trim" should be of interest to all those involved in this practice. It is recommended that color tolerance limits be set using L*, C* and H* (Lightness, Chroma and Hue) rather than any single value. Copies are available from the DCC (Dave Alman).

Report on Project 35
Color of Living Tissue
Stephen Bergen, Chairman

Subcommittee 35 held its Annual Meeting on Monday, June 16, 1986 in Toronto, Ontario, Canada. The meeting was educational, with lively discussions and fruitful exchange of information.

The first item on the agenda was to honor and pay tribute to one of the leaders in the field of color in Dentistry, Dr. Robert Sproull. Robert forged the way and laid the ground work for melding the science of color with the art of Dentistry. It was

Bob's energy and research that introduced the spectrophotometer into the Dental world. Robert also was responsible for making the American College of Prosthodontists a Member Body of the I.S.C.C. He was the first Chairman of this Color Matching Committee. He is the author of numerous articles and chapters in Dental literature. Dr. Sproull was presented with a lucite multicolored pyramid on an engraved mirrored base. We're sure that Bob will continue to contribute his expertise and guide us thorugh the exciting years ahead. Thank you Dr. Robert Sproull.

The meeting continued with a discussion of the Council on Dental Materials, Instruments and Equipment of the American Dental Associations recommendations for the guidelines for submission of Dental shade guides. At this point, these guidelines have not been officially accepted by the A.D.A., however those areas which directly concern themselves with color were brought to the attention of the I.S.C.C. membership. Included in the requirements are recommendations that color specimens shall be identified and arranged according to Munsell or another similar visual color order system. Many of the individuals in attendance at this committee meeting were surprised that the shade guides we use at present do not meet these basic criteria. We gave encouragement and a vote of support to the A.D.A. that these and the other specifications will soon be official requirements for manufacturers to meet.

This Committee was informed that the Glossary of Color Terms for Dentistry was completed this year by Dr. Richard McPhee and his Color Committee of the American College of Prosthodontists. The glossary was submitted to Dr. Jack Preston who is responsible for coordinating and integrating all submitted terms into the new Glossary of Prosthodontic terms to be published next year. Thanks and kudos to all involved.

Mr. John O'Brien of Colorgen, a Massachusetts based corporation, presented the use of his company's "Dental" spectrophotometer with a fiberoptic probe. With the aid of a graphic video display he presented the history and development of the instrument which he would later display. His presentation was clear and exciting.

The instrument, connected to an intelligent computer, has the capability of reading and analyzing spectral data from a tooth, and displaying its' appropriate data and curves on a C.R.T. or printer. The table top spectrophotometer is a state of the art instrument and holds much promise for Dental as well as many other fields. Sample matches were shown and discussed. Individuals present at this meeting had their teeth "read." Although the methods and algorithms for interpretation of the graphs must still be analyzed and finalized, the repeatability of readings were at acceptable levels. The instrument has applicability clinically as well as for extensive tooth color research. Mr. O'Brien assured the membership that the cost of the instrument will not be prohibitive. A spectrophotometer with these capabilities a few years ago cost in the range of $25,000. Colorgen's instrument should project around or perhaps under $4,000.

Other areas of application of this spectrophotometer are the paint, automotive and cosmetic industries. A configuration is already available for the paint industry. Once a fiberoptic instrument is available, many applications heretofore impossible, or at least impractical, can be reexamined. We wish Mr. O'Brien and his company a speedy and successful road ahead and thank him for his extraordinary presentation. When the instrument is brought to market it will be a landmark contribution to Dentistry.

The ISCC Annual Meeting in Philadelphia in 1987 will bring more updates and advances in this quickly changing field.

Report on Project 37
Artists' Materials
Hilton Brown, Chairman

The annual meeting of ISCC Project Committee No. 37, Artists' Materials, was held on Monday, June 16, 1986, at Ryerson Polytechnical Institute, Toronto, Ontario, Canada. About 50 people attended.

It was the chairman's observation that the people who attended represented a cross-section of those attending the CSC/ISCC Annual Meeting. There was a dominance of unfamiliar faces when the meeting began. The people who remained for the entire session, however, were active members of either ISCC Project Committee No. 37 or the ASTM DO1.57 Subcommittee on Artists' Paints and Related Materials or both. ASTM DO1.57 on Artists' Materials met on Sunday, June 15, and, people remained for the ISCC Project Committee No. 37 meeting.

The chairman began the meeting by distributing the agenda together with the following documents: Standard Practice for Visual Determination of the Relative Lightfastness of Artists' Materials, Artists' Questionnaire on Adhesion within Paintings, and Paintings Conservators' Questionnaire on Adhesion within Paintings, as well as the prospectus for the Sixth Annual Faber Birren Color Award Show.

The chairman gave a brief review of the accomplishments of ISCC Project 37 since it was formed in 1977 and of ASTM DO1.57.

The chairman then introduced the idea of developing a publication similar to the ASTM *Standards on Color and Appearance Measurement.* Joy Turner Luke spoke briefly about the possibilities of such a publication coming out of DO1.57. After a short discussion of the contents of such a publication it was decided that publication should be delayed until more standards and practices have been developed.

The chairman brought up the question of the need for additional publications in light of the fact that the Ralph Mayer Center for Artists' Techniques at the University of Delaware had already developed the following: *The Artists' Materials*

Pigment Dictionary Data File, The Acrylic Polymer Emulsion Paints Data File, and *The Artists' Techniques Data File.* Additional data files are currently under development by the Mayer Center on subjects such as oil paints; alkyd, resin-oil, and solvent-based acrylic resin paints; casein, egg tempera, and PVA paints; painting media, solvents, and varnishes; watercolors, gouache, and tempera paints; drawing inks; soft pastels; oil pastels; crayons; charcoal; colored pencils; pastel fixitives; felt tip markers; canvas artists' papers and cardboards; artists' brushes and painting knives. The chairman mentioned that the information in the Mayer Center data files is being continuously updated. Treva Pamer asked if information already recorded although outdated was preserved. The chairman replied that information is not erased but preserved for future reference. There was a brief discussion about the possibility of having a computer access to the Mayer Center data files.

Several people expressed a need for inexpensive educational brochures written for the general public concerning such issues as lightfastness and durability of artists' materials, and reliable working methods. No conclusions were reached.

The chairman showed slides of lightfastness tests of artists' materials that he had conducted in 1982 and of adhesion tests of oil and acrylic paint films carried out at the Winterthur Museum in 1986. Joy Luke displayed lightfastness tests conducted in Sperryville, Virginia, using the ASTM practice currently under development. The chairman displayed the actual test samples of oil and acrylic paint films on canvas as well as the Scott Tester Charts used to collect the physical data in the adhesion study.

Draft 3 of *Standard Practice for Visual Determination of the Relative Lightfastness of Artists' Materials* was discussed. Due to time restrictions, it was decided to discuss only the introduction to the Standard Practice. After discussion of some of the problems associated with an introduction to an ASTM standard practice as well as a reading of the Draft 3 Introduction, the chairman asked Ann O'Roark, to read her revised introduction. It was received by the committee, but it still needs minor revision.

The chairman briefly reviewed the history of the adhesion study, and he stated that a national survey is to be conducted with questionnaires that he had drafted. The questionnaires are to be sent out by Artists Equity Association to as many as 5000 artists. The Ralph Mayer Center for Artists' Techniques will send 100 questionnaires to conservators of contemporary paintings. The chairman read excerpts from the preliminary report on a study being conducted by Virginia Rasmussen, one of his graduate students, on *A Determination of the Adhesive Strength of Artists' Oil Paint Films to Artists' Acrylic Emulsion Priming Medium.* The methodology and implications of the study were discussed briefly. Ray Kinmoth described some of his attempts to define and measure paint adhesion.

Report on Project 40
Color Education
Evelyn Stephens, Chairperson

The four main topics discussed at the meeting in Toronto, June 18, 1986, were: (1) speakers, (2) bibliography, (3) slide collection, and (4) color education meeting.

SPEAKERS BUREAU

After a discussion of responses to a request for speakers, it was decided to ask the ISCC Board of Directors to fund the publication of a pamphlet that would contain a photocopy of each of the responses. Funds are needed to produce the pamphlet and to distribute it to those who responded to the questionnaire and to the 85 requests from colleges for a list of speakers.

Publicity on the existance of a Speakers Bureau could be requested in ISCC News and COLOR Research and Application. Depending on the response to this publicity, a decision could be made as to whether the pamphlet should be produced in a more sophisticated manner.

BIBLIOGRAPHY

Nancy Jo Howard has three computer disks on color: (1) information for children, (2) sources in print, (3) sources out of print. She is using an Apple computer program designated DFS. It allows searching and sorting, and it costs about $70. The bibliography could be made available on two disks. If printed, it would be a stack of paper 1.5 inches thick. The committee decided to provide hard copy, without charge, to 90 libraries that responded' to the questionnaire and to ISCC. Roland Connelly suggested that the bibliography be offered for sale to industries and others as hardcopy or disk. A request for funding for this project will be made to the ISCC Board of Directors.

SLIDE COLLECTION

There was much discussion on this topic. There is a great need for slides on various aspects of color. Many people have collections of their own. The suggestion was made that we collect original slides rather than go through the hastle of copyright. Another suggestion was to have all slides prepared in a consistent format.

There were many suggestions for topics to be covered in a set of 20 slides. A representative list follows:

basic color theory
color appearance
light – color
– value
– electromagnetic spectrum
colorimetry

color matching
color order systems
Munsell notation
standards
specifications and tolerances
acceptability

Those present agreed that the project committee should meet again before the ISCC meeting in Philadelphia, April, 1987. A meeting is needed to try to categorize the slides available from Nancy Howard, Bill Thornton, Roy Berns and others who are willing to contribute slides.

COLOR EDUCATION MEETING

Howard suggested that the Project Committee plan a short but intensive meeting on color education and that it not be held in February or at Williamsburg in 1987. She pointed out that there is no scheduled ISCC meeting at Williamsburg in 1988.

Another topic of discussion was the need for a color science brochure on "What is Color Science?" The brochure should list the broad range of jobs held by people with a color science education. Connelly suggested putting an item in ISCC News asking for brief job descriptions from people working in color science.

Ed. Note: Request for job descriptions appears in this issue. See item headed "Help Requested." Note also that a report of the previous meeting of Project 40 in Pittsburgh, Pennsylvania, April 15, 1985, appears in ISCC News No. 300, March-April 1986, page 9.

BOARD OF DIRECTORS MEETINGS

The Board of Directors of the Inter-Society Color Council meets at the call of the President, usually three times a year, and when possible in conjunction with scheduled ISCC meetings. One meeting is regularly held in the spring, just before the Annual Meeting; another in the fall, usually in October, at the site of the next Annual Meeting. A third meeting is held in the winter, usually in February, just before the Williamsburg Conference, when one is scheduled.

The meetings usually begin in the evening after dinner, about 7 p.m., and recess about 10 p.m. until the next day when they begin immediately following breakfast and continue until about 4 p.m., depending on the number of items on the agenda.

In 1986, Board meetings were held in Williamsburg, Virginia, February 8-9, in Toronto, Canada, June 14-15, and in Philadelphia, Pennsylvania, October 17-18. Meetings in 1987 are scheduled for Williamsburg, February 7-8, and Philadelphia, April 4-5.

Any member of ISCC having business to put before the Board of Directors should advise President Rodrigues of that business no less than eight weeks before a scheduled Board Meeting and request permission to appear before the Board if he so desires.

AIC MEETING REPORT

Color in Computer Generated Displays

The 1986 Interim Meeting of the International Color Association (AIC) was held at Ryerson Polytechnical Institute, Toronto, Canada, June 19-20, 1986. The meeting covered the background to, and current research, in the area of color in computer generated displays. This meeting followed the three day joint meeting of the ISCC and the Canadian Society for Color (CSC). More than 100 people attended.

The program was divided into four half-day sessions, each with a different session chairman. The titles and the name of the chairmen of the sessions were as follows:

1. Using Color for Information Display, Chairman W.B. Cowan.
2. Color Standardization, Chairman A.R. Robertson.
3. Monitors and Vision, Chairman J. C. Beatty.
4. Hardcopy and Other Media, Chairman P. Cavanagh.

The meeting was opened by John C. Beatty. In his brief introduction, he defined common terms used by researchers in computer generated color displays. He described three color models, in order to familiarize attendees with terms they may not have recognized.

The first session on Using Color for Information Display began with a general paper by Joann Taylor and Gerald Murch. Taylor presented the paper *The Effective Use of Color in Visual Displays: Text and Graphics Applications.* The first part of the talk centered on a description of the most common technology for color display by use of a monitor. Slides were used to illustrate the way the shadow-mask color CRT works. The discussion then turned to resolution, addressability and a parameter known as resolution/addressability ratio (RAR). The color gamut was covered with respect to the number of binary code bits and the available number of intensity levels.

Although mathematically a display may be capable of producing millions of unique R,G,B combinations, many of them would not produce perceptually different colors. (This cannot be stated too strongly or too often in the opinion of the author. It is abundantly obvious to people who work with color everyday, but far from obvious to those who do not.)

After discussion the difference between photometric luminance and perceptual brightness, Taylor emphasized maximum legibility as the main target in displaying text. Not all color combinations of text and background will give equal legibility. In graphic applications, these problems can become even more pronounced. The talk ended with common sense advice on the effective use of color in displays.

The next two papers dealt with some practical aspects of using color for information display. The first of these, by Colin

Ware and John C. Beatty, was titled *Using Color to Display Structures in Multidimensional Discrete Data.* This paper discussed the interesting problem of displaying in two dimensions information dependent upon many dimensions. The commonly used method, that of the draftsman's plot, has its drawbacks as the information covers all pairwise comparisons but does not allow simple visual integration over a number of dimensions. The mind can, however, visualize the three dimensions of color, and these can be combined with the graphical two dimensions of space to provide a method for representing five dimensions simultaneously. The ability to use color in this way has only been available recently because the requirements for manipulating color with precision and freedom are such as to necessitate good computer graphics capabilities. This research demonstrated that color coding is a very useful method of displaying multidimensional information.

The paper by Haim Levkowitz and Gabor T. Herman *Color in Multidimensional Multiparameter Medical Imaging* dealt with a problem similar to that of the previous paper, namely mapping multidimensional data simultaneously by using color. The major difference was the specific application, medical imaging. Medical researchers use a variety of computer generated imaging techniques such as computerized tomography (CT), magnetic resonance imaging (MRI), positron emission tomography (PET) and cerebral blood flow (CBF). A method that would allow several of these images to be displayed at the same time wihtout loss of information would be of great advantage.

Various color spaces were considered, each with its advantages and disadvantages. The RGB space was found to be most useful when aligning the medical images from different imaging devices. The IHS (intensity, hue, saturation) spaces, however, have an intuitive correlation that is missing in the RGB space, resulting in the conclusion that the IHS space is the better for displaying multiparameter information after the images have been correctly aligned. Slides showing multiparameter color imaging demonstrated the usefulness of this technique.

The morning session concluded with the paper by Charles M. M. deWeert, *Superimposition of Color Information,* which described his experimental work on the perception of overlapping color information. His slides showed two separately colored recognizable words which overlapped onto a third color. The hypothesis tested was that each word would be most easily recognized if the color of the overlap area was the additive mixture of the colors of the two separate words. De Weert reported on his two experiments that tested both the implicit and explicit knowledge of additive color mixing. He concluded that subjects are more likely to have implicit rather than explicit knowledge of color mixing.

The Color Standardization section began with a paper by Paul J. Tanenbaum, *The Colorimetry of Color Displays: 1950 to the Present.* His talk was based on the annotated bibliography currently being prepared by CIE Technical Committee TC 1-10 on Colometry of Self-Luminous Displays. Tanenbaum gave a most interesting review of the early work which lead to the National Television Systems Committee (NTSC) standard. He also described some of the factors necessary for the accurate and reproducible calibration of a modern CRT. Tanenbaum included 22 references in his extended abstract published in *Color Research and Application Volume 11 Supplement 1986.*

Paula Alessi gave a paper titled *Overview of ISCC and ASTM Committee Work on Video Displays.* The purpose of this brief paper was to inform symposium participants about the work of these committees and to invite those interested to join in their work.

ISCC Project Committee 32, Image Technology, is compiling a general video display bibliography. It also plans to investigate what has been done and what still needs to be done in the areas of phosphor calibration and optimization of viewing conditions for video displays. Finally, the committee would like to develop a mapping function to convert from video display color space to hardcopy color space.

ASTM Subcommittee E12.06, Appearance of Displays, has been assembled to develop standard test methods and practices in spectroradiometric measurement of video displays, optimum viewing environment for video displays, and characterization of video display phosphors.

The paper by Brian Wandell, *Color Rendering of Color Camera Data,* was a mathematical discussion of the two visual procedures for accurate color rendering of a video image. One procedure is to achieve accurate color rendering by postprocessing sensor responses. The other procedure is to match the spectral sensitivities of the camera to those of the human photoreceptors. This can be done by using costly color filters, but even then it is extremely difficult. The novel suggestion in this paper was to approximate spectral reflectance functions of objects in the image by the sum of a few fixed basis functions. With a correct estimate of the surface reflectance function, it would be possible to compute the color coordinates of any point in the image. The method only works for the fixed geometrical set up of the camera at the time of image acquisition. It cannot be used to predict the color of a specularly reflective object for a different camera viewing angle.

The calibration of monitors is of interest to everyone involved in computer generated displays. William Cowan presented a paper authored with Nelson Rowell, *On the Gun Independence and Phosphor Constancey of Color Video Monitors.*

Cowan discussed reasons for wanting to calibrate monitors as well as the properties of an ideal monitor. The four most important properties are: temporal stability, spacial uniformity, gun independence, and phosphor constancy. Later, he gave practical advice on specific measurements and calculations required to test gun independence and phosphor constancy

based on his experiments. Cowan encouraged the participants to use his techniques to test gun independence in order to build a body of data on the reliability of color monitors.

The final paper of the first day was *Color Education and Color Synthesis in Computer Graphics* by Gary Meyer and Donald Greenberg. Gary Meyer presented the very relevant and interesting discussion on the synergism between color science and computer graphics.

Color science can be taught more effectively by using computer graphics. It is possible to interactively demonstrate color space transformations with the set of programs described. Three dimensional figures are easily displayed and rotated through different viewing angles. Transformation of data from RGB to CIEXYZ, L*a*b*, L*u*v* or the TV coordinates YIQ can be achieved by the push of a button. Various views of the Munsell color solid can be displayed. The synthesis of color computer graphics is made much easier by a knowledge of color science. Color modeling was illustrated by a slide of a very realistic twilight scene that was entirely computer generated. Other illustrations showed specular reflections modeled by using ray tracing techniques. The radiosity method was also described. In this method, the light reflections and emissions are considered to be perfectly diffuse. Meyer demonstrated how easily the illumination conditions could be changed to illustrate the color changes that occur when going from daylight to incandescent-lamp light.

The morning session of the second day was on Monitors and Vision. Donald MacLeod began the session with his paper on *Computer Controlled Color Displays in Vision Research: Possibilities and Problems.* He discussed how color discrimination threshold experiments have been simplified and greatly helped by the general availability of display processors that have enough memory to represent raster-based images in color on a pixel by pixel basis.

Heterchromatic brightness matching is carried out simply by the minimum motion procedure. The observer sees two superimposed gratings drifting in opposite directions when there is a difference in luminance between the two gratings. The research has shown that purely chromatic stimuli have little capacity ot excite motion-sensing mechanisms and they lessen form perception. A combination of brightness and chromatic contrast is more likely to give the illusion of a three dimensional figure. MacLeod's example showed the usefulness of these displays in color vision research. He discussed some of the limitations and cautions to be considered when using a color monitor. In spite of these cautions, however, it is likely that computer controlled color monitors will play a major role in color vision research.

Jeffrey Mulligan presented *Minimizing Quantization Errors in Digitally-Controlled CRT Displays.* He discussed problems encountered when using the standard eight-bit digital-to-analog converter for display of low-contrast patterns. The problems occur in spite of the theoretical 16 million or so colors possible from combinations of eight-bit data with the three phosphor colors. Adjusting the contrast knob of the monitor does not entirely solve the problem as it also reduces the dynamic range. Excess spacial resolution may be traded for an increase in intensity resolution by use of half-toning techniques.

Mulligan chose the error diffusion algorithm to give an increase in intensity resolution. He briefly described some of the problems of error diffusion and his solutions to them. Scanning and processing an image pixel by pixel requires either a powerful processor or a large amount of time. Rather than use real time processing, he took advantage of the use of look-up tables. The methods described in this paper are recommended for use when processing power is available but state-of-the-art display equipment is not.

The paper presented by Lucia Ronchi, co-authored with Luciano di Fraia, was titled *Visual Depth of Focus Measured for Various Colored Displays.* The paper discussed factors controlling the range of sharp vision in a multicolored display. Two main factors govern how long an image will stay in focus: the depth of focus of the eye and the ability of the eye lens to accommodate. Three subjects over 50 years of age were used in the experiments. For subjects over the age of 50, the ability of the eye lens to accommodate is severely restricted and the sensitivity to defocus depends almost entirely on the depth of focus of these eyes. The results indicate that color, size, display quality and illuminance level all have an effect on the range of depth of focus of the eye. Illuminance seems to have the major effect on the depth of focus, the higher the illuminance, the larger the depth of focus. Higher quality displays also make defocusing more noticeable than do lower quality ones.

Factors in Using Color Video Monitors for Assessment of Visual Thresholds was the title of the paper by Algis Vingrys and P. Ewen King-Smith. Vingrys presented the paper. He began by describing the way he sets up his monitor. He uses 12-bit analog outputs applied to analog multipliers to control the contrast, color and timing of the test target. The chromaticity of the test spot may be specified in many different ways, but the one recommended is a polar coordinate system. This system has two advantages: (1) the coordinates are not infinite for zero red, green and blue signals, and (2) opposite test stimuli are distinguishable as they are represented by different angles. Vingrys described experiments to examine some of the physical limitations of a color monitor. In particular, they looked at luminance transients and the artifacts that may be generated when electron beams misconverge.

Stuart Anstis gave one of the most interesting papers of the two-day meeting, in the opinion of this reporter. It was titled *Computer-Generated Screening Test for Colorblindness.* There were five co-authors, namely, Patrick Cavanagh, Daphne

Maurer, Terri Lewis, Donald MacLeod and George Mather. Anstis described the basis ~~of the~~ method which relied on a difference in color luminosity to produce a reversal in the direction of the stimulus motion. The observer saw color stripes on a monitor moving to the left or right with respect to a fixed stripe. The beauty of this technique is that it can detect colorblindness in non-verbal subjects such as babies. The baby observes a monitor and the experimenter observes the motion of the baby's eyes. The direction of motion of the baby's eyes provided an indication of normal vision or colorblindness.

The first experiment identified all observers classified as protans (red-weak observers) but was not so clear cut with some deutans (green-weak observers). A modification of the first test was able to overcome the problem of separating deutans from normals.

The computer graphics systems required to generate these images are becoming less expensive and, more importantly, increasingly portable. This latter point should benefit research on infant subjects.

The afternoon session on Hardcopy and Other Media began with two papers presented by Gary Starkweather. The first was titled *Electronic Color-Printer Technologies.* This was a review of available color-printer technologies. Those considered were color xerography, color inkjet, color electrography, color thermal transfer and color thermal-sublimation transfer. Comparisons were based on the following: printer speed potential, printer purchase cost, copy quality, noise, consumables cost, paper requirements, reliability, image generator impact and ability to make transparencies. The conclusion was that thermal transfer printing should receive the highest rating. This reporter disagrees with the conclusion based on his experience with inkjet printing. Further discussion of this topic is needed.

Starkweather's second paper was titled *A Color-Correction Scheme for Color Electronic Printers.* He began by restating the fundamental difference between a color display system such as a monitor and hardcopy produced by a color printer. The color process used for a monitor is additive while that for a printer is subtractive. The actual dyes available for use in subtractive systems are less than ideal. Standard correction methods use measurements on full dye patches. The novel method described was to use eight patches at various lightness levels for each of the three dyes. This correction was designed for a three color printer. Slides were shown to demonstrate how this technique can compensate for unwanted densities and lead to better color correction than the conventional method.

Maureen Stone also gave two papers. The first one was titled *Color, Graphic Design, and Computer Systems."* In this paper, she described the computer network setup of the Imaging Research Group of the Computer Science Laboratory at the Xerox Palo Alto Research Center. This involved a number of different software packages linked to a variety of display devices such as monitors and printers. The packages had been written to aid graphics designers in the specification and selection of colors. The colors could be varied in real time and viewed on a screen. The various hardcopy devices and monitors of the system were all calibrated. This allowed the software package to convey information about the relative gamuts. Thus it could indicate if a particular color on a particular monitor might be reproduced by a particular hardcopy device. Device dependent models allowed better fidelity, but had less flexibility for use across multiple devices.

In her second paper, Stone described the methods used for reproducing the color illustrations in the printed proceedings of this meeting, published as a supplement to *Volume 11 of Color Research and Application.* The paper was co-authored by William Cowan and John Beatty. The illustrations provided for the papers were supplied in a wide variety of forms consisting of digital information, CIE tristimulus values, monitor RGB values, photographic prints, and transparencies. Each image was transformed to halftone screens for reproduction. The success of the transformations was illustrated by the high quality of the color reproductions published in the supplement.

The final paper of the proceedings, given by Urban Williamsen, was titled *Interior Colour-Combination Schemes by Computer.* Williamsen described the Swedish Natural Color System (NCS) which has been adopted as a Norwegian Standard. He specifically explained an implementation of this system for use in paint stores. Its aim was to guide customers in their choice of color by displaying the colors on a monitor. The display was restricted to the particular arrangement of colors in the NCS system. The colors then would be selected and cans of paint in those colors could then be purchased. Alternatively, using the same system, a customer could bring in a swatch of color, have it measured, and then purchase a can of paint in the desired color. The system described is not fully implemented, but is expected to be operational in the next few years.

The meeting was very well attended, and those attending enjoyed an informative and thought-provoking two days.

Francis O'Donnell, reporter

Williamsburg Conference, February 8-11, 1987

The conference will honor Richard S. Hunter for his extensive contributions to appearance science over a period of sixty years. The theme of the conference is Appearance as it relates to directional and spatial distributions of light intensity, including gloss, metallic colors, translucency retroreflection and measurement principles. The two-and-one-half day program of invited and contributed papers will present a balanced coverage of appearance evaluation principles and specific applications. The objective of the conference is three fold: (1) To provide a meeting of specialists in the field, (2) To stimulate appearance research, and (3) To exchange views on current research. The Williamsburg Conference format is designed to allow ample

time for discussion of papers and for discussion at other times during the conference so that speakers and attendees can actively exchange information. With this end in view the attendance is limited to 100 persons.

The announcement of the meeting with Registration Form was mailed October 10, 1986, to all ISCC members. Anyone who did not receive a copy should request one without delay from the Publicity Chairperson, Mary Ellen Zuyus, Hunter Associates Laboratory, Inc., 11495 Sunset Hills Road, Reston, VA 22090, telephone (703) 471-6870. Applications need to be received by December 21, 1986.

The list of papers and speakers is as follows:

Introductory Remarks and Tribute to Mr. Richard S. Hunter, Allan B. J. Rodrigues, ISCC President.

Conference Objectives, David H. Alman, Program Chairman.

Invited Paper: Geometric Attributes of Appearance, Calvin S. McCamy, Kollmorgen.

History of Gloss Measurement, Richard S. Hunter and William H. Venable, Hunter Associates Laboratory.

Measurement of Gloss from Color Images, Gudrun Klinker, Steve Shafer and Takeo Kanade, Carnegie-Mellon.

Invited Paper: Gloss Psychophysics, Wolf Czepluch, Bundesanstalt fur Materialprufung.

Orange Peel and Paint Appeal, Gregory W. Cermak and Monica H. Verma, General Motors.

New Portable Orange Peel Meter for Paint Coatings, Morihiro Matsuta, Kanji Kito and Tsuyoshi Kubota, Toyota.

Interaction of Illumination, Pigmentation and Light Scatter on Food Appearance, D. B. MacDougall, Institute of Food Research.

Invited Paper: Take a Moment to Specify Appearance Measurements, William H. Venable, Hunter Associates Laboratory.

CIE Activities in Appearance, Allan R. Robertson, National Research Council of Canada.

Goniospectrophotometric Characteristics of Common Transfer Standards with Respect to the CIE Normal/45 Geometry, Frank Grum, Mark D. Fairchild and Roy S. Berns, Rochester Institute of Technology.

Comparison of the use of Standard ASTM and CIE Test Methods for Color Measurement of Retroreflective Materials with the Prediction of the Color Appearance under Actual Day-Night Conditions, Justin J. Rennilson, Advanced Retro Technology and W. N. Hale, Jr., Hale Color Consultants.

Directional Color Measurement of Metallic Flake Finishes, David H. Alman, Du Pont.

Model for Interpreting Three-Angle Measurements of Flake Finishes, William H. Venable, Hunter Associates Laboratory.

Invited Paper: Gonio-reflectometry, Wolfgang Erb, Phsyikalish Technische Bundesanstalt.

ASTM Activities in Appearance, W. N. Hale, Jr., Hale Color Consultants.

Goniophotometry as an Appearance Research Tool, Larry E. Steenhoek, Du Pont.

Colourimetric Evaluation of Pearlescent Pigments, Franz Hofmeister, E. Merck.

A conference proceedings consisting of summaries of the papers will be provided to attendees during the meeting.

Williamsburg has many interesting attractions to those who have not been there before. The recently opened Dewitt Wallace Decorator Arts Gallery is a new attraction which contains many English and American antiques from the 17th to the 19th century.

Symposium on Vision and Aging – OSA

At the Annual Meeting of the Optical Society of America (OSA) in Seattle, Washington, on October 22, 1986, three invited and four contributed papers were presented on the above subject. The titles, authors and brief abstracts included here are taken from the advance program of the meeting.

INVITED PAPERS

Aging and Topography of Human Photoreceptors, Christine A. Curcio, U. Washington. The potential role of age-related photoreceptor loss in visual deficits of the elderly is being assessed by morphometric analysis of adult and aged retinas.

Spatial Vision and Aging: Undelying Mechanisms, Cynthia Owsley, U. Alabama at Birmingham. Many older adults in good ocular health have higher spatial frequency losses. The role of optical and neural factors in producing this deficit are discussed.

Aging and the Spatiotemporal Resolution of Visual Events, Donald W. Kline, U. Notre Dame. Much of visual aging can be understood using a spatiotemporal model involving alterations in the balance, latency, time constants, and tuning characteristics of the different visual channels.

CONTRIBUTED PAPERS

Foveal Visual Functions in Older Eyes with Good Acuity, Alvin Elsner, Good Samaritan Hospital & Medical Center. Systematic differences of foveal sensitivity exist among people aged sixty and older who have good acuity and good ocular health in each eye.

Age Norms for the Polarity of the Farnsworth-Munsell 100-Hue Test, Kenneth Knoblauch, M. Podgor, M. Kusuda, F. Saunders, R. Hynes, K. Higgins, F. de Monasterio, National Eye Institute. Increases in yellow-blue type errors with increase in age are quantified on a normal sample (N = 75; ages 20-78).

Aging and Human Cone Photopigments, S. A. Burns, Ann E. Elsner, Lawrence Berk, Paul Rosenberg, Eye and Ear Institute. Measurement of human cone photopigment optical density and half-bleach illuminance are not affected by aging in

the normal retina.

Aging in Visual-Vestibular Interactions, Ann E. Elsner, C. Wall III, J. Johnson, Eye and Ear Institute. Voluntary saccades of older observers fail to reach the target in one quasi-ballistic rapid movement more often if the observer is being moved passively.

Color Symposium at Paint Show

The Technical Program of the Paint Show on November 6, 1986, will feature the following four-paper, two-hour Color Symposium.

Pearlescent Pigments: Effects of Particle Size Distribution on Color, Harold A. Miller, The Mearl Corp., Research and Development Laboratories, Ossining, NY.

Color Instrumentation and the Automotive Industry, Sidney A. Paradee, color instrumentation supervisor, Ford Motor Co., Mt. Clemens, MI.

Color Matching Computers, Edward M. Krzes, Pratt & Lambert Inc., Buffalo, NY.

Objective Color-Difference Evaluation – An Update, Rolf G. Kuehni, manager, technical marketing, Textile Dyes Dept., Mobay Corp., Rock Holl, SC.

OSA Meeting on Color Appearance

A meeting on the topic of Color Appearance will be held at St. Johns College in Annapolis, Maryland, June 29-30, 1987, sponsored by the Optical Society of America. The main objectives of the meeting are to promote interaction between researchers from basic and applied color appearance areas, and to provide a showcase for the "state of the art" in all aspects of color appearance research.

Immediately following the Color Appearance Conference, on July 1-3, 1987, the International Research Group on Colour Vision Deficiencies (IRGCVD) will hold its 9th semi-annual symposium at St. Johns College in Annapolis, Maryland.

Color appearance has been defined for purposes of the meeting to be synonymous with suprathreshold color sensation. This definition excludes threshold phenomena such as spectral sensitivity, color discrimination, color matching and colorimetry. Color appearance nevertheless remains a broad topic, ranging from basic questions about color vision to applied problems such as predicting and controlling color appearance in complex real-life environments.

The scientific program will be structured around sessions on five broadly defined subtopics. Each subtopic will be highlighted by two invited lectures from leading researchers in the field. In addition, a special evening lecture, Color in the Hands of the Artist and Eyes of the Beholder, is scheduled for the first day of the meeting.

To obtain a copy of the *Call for Papers* write or call Optical Society of America, 1816 Jefferson Place, N.W., Washington, D.C. 20036, (202) 223-0920.

Abstract Deadline: February 20, 1987.

Colour 89

The 6th AIC Congress, Colour 89, will be held in Buenos Aires, Argentina from Sunday 12th to Saturday 19th March, 1989.

The Congress will be located in an Exhibition and Conference Center (Teatro Municipal San Martin) which belongs to the City Council of Buenos Aires. It is sited at the intersection of Sarmiento and Uruguay Streets in the center of the city with plenty of facilities for transport (buses are very cheap and run very often, normally) including underground at 100m from the entrance. Many places around the Center serve any kind of food.

The Center has a main auditorium (which can be divided in two) with seating for 800. (We think that half of this will be enough, with seating for 400). Furthermore, three other rooms are available with seating capacity between 150 and 250. All of them have projection facilities and audio systems. There is a place for exhibitions (a closed room, all glassed, of about 120 square metres) and lobbies for poster sessions. Reservations will be made before the end of 1986.

There is no University lodging in Buenos Aires. Nevertheless there are plenty of clean, comfortable and reasonably priced hotels close to the Conference Center. We feel it is unnecessary to look for other accommodations.

We are studying the technical program which in principle will have four working days (Monday, Tuesday, Thursday and Friday). Wednesday will be dedicated to a group excursion in the Rio de la Plata Delta-Tigre. Mainly, paper presentations will be by poster sessions. Oral sessions will be dedicated mostly to invited lectures and discussions on important topics. We intend that in these discussions authors will be able to play a role. The discussions will not be restricted only to experts and/or members of one country. We hope to keep parallel sessions to the minimum possible.

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COLOR RESEARCH AND APPLICATION

Articles in Fall, 1986 Issue

Just eight years ago, Alan Robertson, chairman of the CIE committee on color differences, announced in this journal a set of guidelines for coordinated research on this subject. One of these was the identification of five color centers around which it was hoped that further research could be concentrated. In the last two years, we have begun to see the results

of that research, much of it being reported in our pages. This issue begins with an article on the subject by M. Cheung and B. Rigg, *Colour-Difference Ellipsoids for Five CIE Colour Centres.* Not only were new (wool) samples prepared and new experiments on the perceptibility of small color differences carried out, but the results were compared to others in the literature in a comprehensive way.

Many current publications in colorimetry deal with topics that, although not new, have seen a resurgence of interest that brings them more to our attention. We are thus faced with a number of terms that are not completely familiar. Two of these are chromatic adaptation and color constancy. What exactly do they mean? Are they the same, and if not, how do they differ? Do the same models and theories explain both phenomena? For some answers, read Michael Brill and Gerhard West on *Chromatic Adaptation and Color Constancy: A Possible Dichotomy.*

It is not often that we find a nice blend of high technology and art; to many of us, artists seem to be conservative folk that stick to traditional methods of expression. But David Makow, a scientist as well as an artist, has been intrigued by the application of a new "space-age" material, liquid crystals, as an artist's medium. He tells us about it and shows some examples in his article *Reflection and Transmission of Polymer Liquid-Crystal Coatings and Their Application to Decorative Arts and Stained Glass.*

A hundred years before the space age was born, art and the science of the times were also blended; perhaps this should remind us that there is little new under the sun, in color as in many other fields. The eminent French scientist Charles Henry founded an aesthetics and a theory of color harmony on what he thought were sound scientific principles. Rolf G. Kuehni tells us about *The Scientific Aesthetics of Charles Henry* and of the influence his ideas had on his contemporary neoimpressionist artists.

Great Britain is said to be the only country that has adopted color standards for building materials. So says T. W. A. Whitfield and his coauthors in describing *The British Building-Colour Standards: A Model for International Application.* To obtain a suitable codification of colors for the standard, it was necessary for the British Building Research Station to develop a new abbreviated color order system, not unlike in principle but different in practice from the NBS Universal Color Language scheme. It defines 237 colors in terms of the unusual dimensions of hue, greyness, and weight.

Despite its very widespread application in computer color matching, it has seemed to many of us that interest in the underlying turbid-medium theory has lagged in recent years. One example of areas where more work is needed has been the extension of the theory to types of samples that do not meet the assumptions of the original theory. Now James S. Bonham writes about *Fluorescence and Kubelka-Munk theory,* describing a practical, if not rigorous, method of extending that basic turbid-medium theory to the matching of fluorescent colors with the aid of the computer. The production of several tens of million pounds per year of fluorescent colored newsprint in Australia backs up his claims of a successful application.

Fred W. Billmeyer, Jr.

News About the Journal, COLOR

Most of you are aware that COLOR is rounding out eleven years of publication. Fred Billmeyer is to be congratulated on his outstanding service as Editor-in-Chief for the entire period, 11 volumes. This year has been one of transition for the new Editor-in-Chief, Rolf Kuehni, who will take over next year. Kuehni is already responsible for one innovation, namely getting William David Wright to agree to write a column, "Talking About Color. . ." The initial column appeared in the Fall 1986 issue. Dr. Wright has had a long and distinguished career in color; so we shall look forward to reading his column in each forthcoming issue.

Speaking of forthcoming issues, all of us on the Editorial Board are excited about the fact that COLOR will be going from four to six issues a year beginning in 1987. This means that notices of forthcoming meetings, reports on meetings, as well as other time-sensitive material can be included with a shorter lead time. In addition it means that papers can appear in COLOR with less delay. Some time ago, the Editor indicated that there was a manuscript backlog of more than one year. Going to six issues may mean that each issue will contain a few less pages, but each volume will contain more printed pages. Increasing the number of mailings by 50 percent is bound to cause in increase in mailing costs, in addition to the cost of printing more pages and going to press more frequently. So it is not surprising to learn that the subscription price will be increased. A regular subscription in 1987 will cost $98 per year, but ISCC members will be charged only $48. The overseas airspeeding charge will rise to $36. This percentage increase in subscription rates is in line with the percentage increase in frequency of publication and presumably with the increase in number of printed pages per volume. More important, these changes in frequency of publication and number of pages indicate that the publisher, John Wiley and Sons, feels that COLOR is growing up, and presumably will have a long life. We of the Editorial Board certainly hope that this will be the case. It will be, if everyone renews his subscription next year and if we continue to interest new subscribers.

Harry K. Hammond III

HELP

Help Requested – Job Descriptions

Project 40 on Color Education, Resources, and Materials is

contemplating the publication of a brochure on "What is Color Science." One section of the brochure would include job descriptions of people working in color science, not their names, just the job descriptions. Would you be willing to assist the project by providing your job description and those of your colleagues? Send the descriptions to Evelyn Stephens or Rolland Connelly.

Help Received

Walter Granville reported on October 9, 1986, that as a result of the *Help Requested* item in ISCC *News* No. 302, July-August 1986, an offer of a 3rd Edition of the *Color Harmony Manual* was received from ISCC member Cynthia W. Drayton, Paoli, Pennsylvania. She has memories of long hours spent producing the Manual with Carl Foss. Granville writes that he is most appreciative of Drayton's contribution of the Manual and of the request in ISCC *News* that located a responsive owner. Drayton, according to Granville, had pondered what to do with her copy as she approaches retirement. She will send it directly to Professor Werner Spillmann, Winterthur Polytechnic, Department of Architecture, CH-8401 Winterthur, Switzerland.

Ed. Note: Thank you Cynthia Drayton for responding to the request in the *News* for the gift of a manual to Professor Spillman. I'm sure that it will have a fine new home. It is gratifying to learn that people do read the *News* and, even more important, take appropriate action.

PRODUCTS AND SERVICES

Low-Cost Spectrophotometer for Color Measurement

A new low-cost, diode-array spectrophotometer has been developed to measure the color of liquids, powders, solids, and pastes. The instrument uses 45° circumferential illumination and 0° viewing, thereby eliminating the need for multiple measments at different orientations when dealing with products that are directionally sensitive or highly textured.

The instrument features a small sensor head to measure a circular area 6 mm or larger in diameter. A fiber-optic cable conducts light to the sample and returns reflected light to the spectrophotometer.

When coupled to an IBM PC-XT/AT or compatible computer, the software provides a powerful system of color measurement in any of nine different color scales, for five illuminants, and for two observers (2° and 10°). The spectral data can also be used to compute five special color indices, such as yellowness index.

The instrument has been designated "The Color Machine." To receive a brochure or to request additional information, write to Pacific Scientific Instrument Division, 2431 Linden Lane, Silver Spring, Maryland 20910, or telephone (800) 638-2790.

Color Science Workshop

Clemson University's Office of Professional Development announces another offering of the popular Color Science Workshop, November 18-20, 1986.

The Workshop is a hands-on training course in the principles and applications of Color Science in the Textile, Plastics, and Paint industries. It will feature the latest instruments and computers, and they will be available for student use.

The Workshop will be instructed by two well-known authorities, Professor Frederick Simon of Clemson and Roland Connelly of Burlington Industries.

For information on the technical content of the Workshop, call Professor Simon at 803-656-5965, or write to the Office of Professional Development, P.O. Drawer 912, Clemson, SC 29633.

MEETINGS AROUND THE WORLD

18th FATIPEC Congress

This European Congress is held biennially in some European Country, this year in Venice, Italy. FATIPEC is supported by firms operating in the chemical industry, particularly the paint industry. Involvement in color appears to be small, at least at this meeting. The Applications session, September 23, might have gone unnoticed by the *News* but for the fact that our very active ISCC member, Ralph Stanziola, presented a paper entitled: *Color Simulation and the Coatings Industry.* There was no other paper on color among the more than 100 papers listed in the preliminary program, and relatively few papers on other subjects were presented by authors from USA.

Your Editor requested an abstract from Stanziola. He sent a copy of the one he had to submit more than a year ago dated July 31, 1985. He reported that the short time allotted for presentation caused him to direct his remarks to applications in retail stores and design centers. The techniques he discussed involved:

1. Reflection simulation – Maxwell spinning disk concept.
2. Computer controlled color in cathode ray tubes (CRTs).
3. Color cards.

Stanziola said that the color-card application was similar to the one he discussed at the ISCC workshop in Toronto in June. He endeavored to avoid promoting the products of any particular company by showing slides of commercially available equipment from a number of companies (1 Italian, 4 American, and 1 Israeli).

A number of us are interested in Stanziola's experiences in Venice because the International Commission on Illumination (CIE) will meet there, June 17-25, 1987.

The Colour Group (Great Britain)

Notice of 204th meeting, November 19, 1986, indicates that

the entire meeting at Imperial College will be devoted to the *W. D. Wright 80th Birthday Symposium.* Eight interesting papers will be presented by as many authors to be followed by a short response by Wright.

The titles of the papers and their authors are as follows:

Colorimetry up to 1960
R.W.G. Hunt
The City University, London

Advances in Colour science from 1960 to the present
A.R. Robertson
National Research Council, Ottawa

International viewpoint
H. Terstiege
BAM, Berlin

Wavelength and colour processing in human vision
K.H. Ruddock
Imperial College, London

Congenital and acquired colour vision defects
J. Birch
The City University, London

Spectrophotometry – from Wright to WIMPS
M.P. Wassall
Pye Unicam Limited, Cambridge

Reflectance spectrophotometry and painting conservation
S. Staniforth
The National Trust, London

Colour science – getting it right in the future
M.R. Pointer
Kodak Limited, London

Ed. Note: Many of us around the world would like to be there. We will be there in spirit if not in person. Congratulations, Dr. Wright, on your many fruitful years of teaching and researching in the field of color. Best wishes on your 80th birthday from all of us who know you as well as those who only know of your work!

The 205th meeting of The Colour Group will take place on December 3, 1986 at The City University. Colour Measurement of Flares and Colour of Fireworks will be the subject of the meeting.

The *Colour Group Newsletter,* October 1986, also contained a biography of a "New Committee Member," Douglas MacDougall. Your *ISCC News* Editor found it interesting and thinks other readers may also like to know a little about him; so the biography is reproduced here.

MacDougall is a graduate in food science from Strathclyde University and has been a member of the Colour Group since 1964. He joined after his return from Rutgers University in New Jersey where he worked on a food colour stability problem for his PhD. He was a member of the committee until he went to the then newly formed Meat Research Institute at Langford, Bristol (now known as the AFRC Institute of Food Research) to set up a colour measurement laboratory in the Institute's Food Quality Section.

He is currently a project leader in the Development Section and in addition to his continuing research into the many factors affecting the colour of meat and meat products, and other foods, he has an increasing interest in the consumer's response to the display environment, especially the consequence of the colour rendering properties of the illumination to product appearance and acceptance. He has published papers on the colour of meat, the use of Kubelka-Munk analysis to characterise the effect of translucence on food appearance and, more recently, the visual shifts in meat colours as affected by the quality of the light used in supermarket display.

BOOK REVIEW

Appearance Evaluation

Review and Evaluation of Appearance: Methods and Techniques, Rennilson and Hale, editors, ASTM Special Technical Publication (STP) 914, published by American Society for Testing and Materials (ASTM), 1986, pp. 109, $24.

The book contains nine of the papers presented at the symposium sponsored by ASTM Committee E-12 on Appearance of Materials, Montreal, Canada, 23 May 1984. An excellent four-page *Overview* by the editors is included, the first four paragraphs of which are quoted here.

"The evaluation of appearance is as broadly based as any subject addressed by ASTM, being applicable to practically every raw material and finished product. While the major focus is on the production of consumer items that must have acceptable appearance as to color and gloss, appearance evaluation is also used with many nonconsumer products. For example, air contamination is graded by the appearance of filters, while contaminants in liquids is judged both by the appearance of filters and of the product itself.

"Color is frequently an indicator of some important attribute of a product or material. Many medical laboratory tests are color-related. Color is a critical factor in the assessment of disease or of maturity in numerous agricultural products. The color of skin or tissue is closely related to health in humans and animals. The efficacy of suntanning products is evaluated by color, whether they purport to promote tanning or prevent it. A color test kit tells us if our swimming pool water has been adequately treated.

"The industrial and commercial evaluation of appearance is both visual and instrumental. The unaided eye of an experi-

enced observer is a widely used instrument for making color and gloss decisions, especially where photoelectric instruments are not feasible because of cost or portability. Augmenting the eye with material color and gloss standards, or with sets of standards that define acceptable tolerances, greatly improves such visual assessments. ASTM recognizes the value of visual judgments and provides, in ASTM Practice for Visual Evaluation of Color Difference of Opaque Materials (D 1729), guidelines for making such judgments.

"Color and gloss measuring instruments continue to be improved in accuracy, precision, and their ability to handle a greater diversity of materials. As our understanding of color vision and visual color space increases, we are able to specify color order systems based upon uniform color scales; the same is now becoming true for visual gloss scales. The capability of instruments, using onboard computers, to transform their responses into these vital color order systems simplifies the setting of acceptability tolerances for product color. This leads to the automatic correction of colorant input and mixture to insure that acceptability is maintained throughout the production run."

The titles and authors of the papers are as follows:

The Modes of Appearance and Their Attributes, Richard S. Hunter

Psychometric Scaling of Gloss, Francis X. D. O'Donnell and Fred W. Billmeyer, Jr.

Recent CIE Work on Color Difference Evaluation, Alan R. Robertson

A Colorimetric Determination of Dye Content on 100% Polyester Fabrics, Laurie A. Hauch, Susan Glicksberg, and Kwan-Nan Yeh

Measuring the Appearance of Retroreflectors by Application-Oriented Goniophotometry, Norbert L. Johnson

Measurement of Color on Foods: Some Experiences at INTI, Buenos Aires, David Jungman, Roberto D. Lozano, and Cristina Melcón de Bellora

Specifying the Appearance of Escalator Treads: How to Minimize the Disorientation Effect, Theodore E. Cohn

Visual Color Technology Development for Industrial Applications, James T. Degroff

On the Specification of Heterochromatic Brightness, William B. Cowan

MISCELLANEOUS NEWS

TAPPI Prize Established

Elizabeth L. Hunter has made a gift to the Technical Association of the Pulp and Paper Industry (TAPPI) to establish the Richard S. Hunter Prize. The prize provides an honorarium of $1,000 to be granted to the 1986 recipient of the TAPPI Process and Quality Control Division Award and to each future recipient.

The first recipient of the prize was Gary A. Baum, Institute of Paper Chemistry, Appleton, Wisconsin. It was presented at the International Conference on Process and Materials Quality Evaluation, September 22, 1986, at the Waverly Hotel in Atlanta, Georgia. Mr. and Mrs. Hunter attended the award ceremony.

TAPPI has 27,000 members in over 70 countries. It is the world's largest professional society dedicated to advancing the technology and the professional growth of those who serve the pulp, paper, packaging, converting, and allied industries.

Message from AIC President Terstiege

At the beginning of the new quadrennium I would like to thank the past President Dr. R.W.G. Hunt for the excellent work he did for the AIC.

We have now three active Study Groups which organized Interim Symposia in Hungary, Kungälv and Salamanca during the past quadrennium and had meetings at the AIC Congress COLOR 85 in Monte Carlo. The Study Group on Colour Education which was chaired by Dr. J. Schanda at its start now has Dr. O. Estevez as its new Chairman since 1985. The chairmanship of the Study Group on Environmental Colour Design is still with A. Hard. The very important Study Group on Colour Order Systems had its first meeting in September 1981 during the AIC Congress COLOR 81 in Berlin under the chairmanship of the late Dr. G. Wyszecki. From 1983 to 1985 the Group was headed by Dr. F.W. Billmeyer who passed the chairmanship to Dr. J. Bartleson at the AIC Congress COLOR 85 in Monte Carlo. Although the goal of this Study Group was not yet reached, standardizing people of one AIC-Member country already pushed the International Standards Organization (ISO) to establish a Technical Committee TC 187 "Color Order Systems." At the Meeting of the AIC Study Group "Color Order Systems" the establishment of this competing ISO Committee, which was done against AIC and CIE advice, was very much criticized and the Study Group carried a move to advise ISO of their disapproval of its actions.

The new quadrennium starts with an Interim Symposium on Color in Computer Generated Displays which will be organized by the Canadian Society for Color in Toronto, in June 1986. For 1987 a Stiles-Wyszecki Memorial Symposium on Color Vision Models is planned in connection with the CIE Session in Italy. This will be a joint event with CIE TC-1.03 "Models of Heterochromatic Brightness Matching," and the TC Chairman Dr. Peter Kaiser is responsible for the scientific success of this symposium. For 1988 an Interim Symposium on "Environmental Colour Design" is planned to take place in Switzerland. The next AIC Conference, COLOR 89 is scheduled for spring in Buenos Aires. Argentina.

I am looking forward to haveing a successful AIC-Quadrennium and to meeting many participants at the various

AIC ventures.

Heinz Terstiege
President, AIC

More on Monet and Cataracts

The following letter from Edwarrd Ancona, dated September 12, 1986, was sent to Joy Luke as a result of his reading her item on *Monet's Color Vision Problems,* ISCC News No. 302, July-August 1986, page 20.

Dear Mrs. Luke:

Having recently had a cataract operation I was fascinated by your review of the article in *Artist* magazine on Monet's color vision problems resulting from his affliction with cataracts.

A cataract is a defect in the crystalline lens, that part of the eye's lens system lying behind the iris. The most obvious effect on vision is a gradual clouding as the cataract progresses. It is as if one were looking through a diffusing membrane, ultimately arriving at a point where detailed vision is completely lost and only light and dark can be distinguished. Much prior to that time, another effect is often noted: as the cataract grows it distorts the lens in a direction actually to improve near vision, such that presbyopic individuals may develop a myopia or "second sight" and can focus on near objects without glasses.

Cataract surgery today is very sophisticated and is most often performed by extraction of the defective lens and the implantation of a plastic replacement. The surgery is usually done on an outpatient basis; recovery is quick, and vision with the aid of ordinary glasses is excellent. Such surgery is reported to be the most common adult surgical procedure in the United States. In prior years before the advent of implant surgery or of contact lenses, thick "cataract" glasses were necessary to restore focus after the cataract removal.

There is another process which takes place in the eye: a gradual yellowing of the lens, which is normal, increases with age and has no connection with any cataract growth. It obviously affects color vision, but since it is not a defect in the retina, one's color vision might be regarded as essentially normal although perhaps somewhat impeded by the filtering action of the yellowing in the lenses.

A standard part of our color experience is the difficulty of explaining to someone else how one sees colors. The extreme case, of course, is that of color blind individuals, or more correctly, those with anomalous color vision. Through various tests we can determine the extent and nature of their deficiency, but we cannot get "inside their head" to sense their actual experience. In the other direction, we can often be non-plussed by the opinions and passions of those with heightened artistic sensibilities who may seem to see colors differently from the rest of us even though objective tests would show that they and we all had "normal" color vision.

Ordinarily I would have no way to confirm that the lenses in my eyes had yellowed, except perhaps by tests over a period of years documenting any change in my ability to discriminate small differences in color in those ranges involving blue mixtures, such as magenta and cyan. However, having had a cataract operation in one eye only, I suddenly have the opportunity to compare before and after, actually to sample, as it were, someone else's visual experiences. And the effect is startling: as I block each eye in turn, white objects are distinctly yellow in my left eye and clear and clean in my right. The bougainvillea in my patio is a pinkish red in the left eye and a brilliant magenta in the right. The green screen of this word processor tends toward cyan in my "new" eye. (I find that this experience of a notable difference in color perception between the two eyes is shared by those of my friends who have had a cataract operation in one eye.)

I measured as closely as I could the actual difference by finding a Wratten filter combination which would, when held in front of my new right eye, compensate for the difference, and it comes to about 0.20Y + 0.025M, that is, slightly reddish yellow. I don't know if we can presume that amount of lens yellowing to be common among those in the ISCC who have reached the age of 65 as I have (not a disturbing thought, I hope).

I investigated further by checking myself with the Farnsworth-Munsell 100 hue test alternately with my left and right eyes. (For the record, I was able to perform the test almost perfectly some 30 years ago.) On three of the four trays, I made two or three reversals using my left eye which I could easily see and correct with the right. On the fourth tray, covering the gamut from greenish-yellow to purplish-blue, I made a distinctly poorer score with about eight reversals, sometimes even skipping two caps, but again I could correct the arrangement using my right eye. I might note that the particular Farnsworth-Munsell set I have access to is somewhat timeworn and almost all the caps have distracting fingerprints on the color surfaces. Perhaps with a clean set of caps and a more careful test I might have done better, but the impediment of the yellow filter in my old eye is quite obvious.

In another test, I tried to find that Munsell color which, as seen in my left eye, would match a petal from the bougainvillea as seen in the right, and vice-versa. This would indicate the difference in Munsell space between the visual appearances of the bougainvillea in my left and right eyes. The results were: 10RP 4/10 and 5.0RP 4/10. Not surprisingly perhaps, a binocular viewing gives a Munsell match approximately half way between: 7.5RP 4/10. And in fact during my daily activities I am unaware of the difference between my eyes, although at any time when I may stop to make comparisons, the binocular appearance of any color is always approximately midway between the separate colors I see with each eye alone.

With all the above as support, I can proceed to my analysis of Monet's visual and emotional problems subsequent to his

cataract operations. I would conjecture that the cataracts as such did not and could not have changed the basic color vision apparatus in his retinas. It is in the cones and associated nerve structure of the retina where colors are perceived, and I cannot imagine that the cataract operation altered that complex structure in such a way that Monet saw "only blue." It would seem to me that we are hearing the complaint of a sensitive artist to whom, as is characteristic of creative people, small differences seem greatly magnified. After years of looking through increasingly yellowed and cloudy filters, he suddenly had a substantial restoration of visual clarity and a complete disappearance of the filters. The difference would be substantial for anyone. The difference for Monet was obviously intensely dramatic and apparently emotionally incapacitating, eventually requiring a restoration of the effect of his missing yellow lenses by means of tinted glasses.

Again, this would not change him from a state where he truly saw "only blue" to one of full color vision, although certainly, as one hypersensitive to the emotional value of colors in an artistic composition, he might describe it as such. And without my laying claim to anything near Monet's artistic sensitivities, the subjective difference between the appearance of scenes or individual colors as seen separately in my two eyes often strikes me as greater than the actual differences that I have measured with objective tests.

Sincerely yours,
Edward P. Ancona
(SMPTE)

COMMENTS ON MR. ANCONA'S LETTER

Mr. Ancona's experience and comments are very interesting and I believe he is correct in speculating that Monet was more conscious of, and bothered by, changes in his vision than most people would be; and that his statements about seeing only blue following the cataract operation were exaggerated due to the importance to him of seeing colors accurately. It might be worth mentioning that I once had a painter in a class of mine who made a color match on the D&H Color Rule that astounded the other students because the two colors she saw as matching each other appeared so different to everyone else. It is to be expected that there will be a range of matches among normal observers, but the match in this case was outside that range; and yet she was known for the subtle and beautiful color in her paintings. Like Monet, she could not have seen those colors like most viewers did.

I have been told that when the yellowed lens is removed in a cataract operation, more ultraviolet radiation, in addition to a larger amount of blue wavelengths, reaches the receptors. The new plastic lens implant, or thick glasses, would absorb some of this radiation. It would be interesting to see a plot of the radiation reaching the receptors under such circumstances.

Joy Turner Luke
September 26, 1986

Adding Color to Black and White Film

Ed Cairns supplied a clipping from the New York Times of August 23, 1986, that describes a method of adding color to black:

A method of adding color to black and white motion picture film with the help of a computer is described in patent No. 4,606,625, granted this week to David M. Geshwind, a computer graphics consultant in New York.

The video coloring process begins with the transfer of the original film to videotape. Then the black-and-white tape is viewed scene by scene on a video screen. At the first frame of each scene, an art director assigns numerically coded colors to every area of the picture – the background, the props, the actors' clothes, hair, eyes and skin. A special graphics computer then applies these colors to the corresponding image areas of succeeding frames within that scene.

The process must be repeated many times, since the computer cannot know what colors would be appropriate for other scenes. Of the average 200,000 frames that make up a feature film, about 1,000 have to be individually colored. The computer does the rest.

American Craft Museum

The American Craft Museum will inaugurate its impressive new midtown Manhattan headquarters October 26 with one of the largest survey exhibitions of contemporary craft ever organized in the United States. Entitled,"Craft Today: Poetry of the Physical," the exhibition will feature 286 artists and more than 300 craft works created since 1980. Said director of the Museum, Paul J. Smith, "There are 36 states represented in the show, including Alsaka and Hawaii. That may sound like a lot but it really isn't when one sees it in light of all that is going on."

The new American Craft Museum is located at 40 West 53 Street, between Fifth Ave. and the Ave. of the Americas. As the premier showcase for contemporary crafts in the U.S. the new Museum offers a 400% increase in gallery space over its previous building. "Craft Today" will be on view at the American Craft Museum through March 22, after which it will travel to five museums nationwide, the Denver Art Museum, the Laguna Art Museum (Laguna Beach, CA.), the Milwaukee Art Museum, the J.B. Speed Art Museum in Louisville, Kentucky, and the Virginia Museum of Fine Arts in Richmond.

Reprinted from The CAUS Newsletter of October 10, 1986, published by the Color Association of the United States.

OBITUARY

W. S. Stiles, 1901-1985

Dr. Walter Stanley Stiles, who died on December 15, 1985, at the age of 84, was one of the most distinguished colour scientists of our century. After reading physics at University College, London, and mathematics at St. John's College, Cambridge, he joined the National Physical Laboratory in 1925. He remained there until his retirement in 1961. He was created OBE in 1946 for his wartime work on military aspects of visibility and glare. He was elected to the Royal Society in 1957 and was awarded the Tillyer Medal of the Optical Society of America in 1965.

Above all, Stiles was a great psychophysicist. G. Brindley, when introducing in his textbook the distinction bewteen Class A and Class B observations, took Stiles as the prototype of those who admit only Class A observations in psychophysical argument. Stiles showed us how powerful could be the conclusions drawn from a structured set of threshold measurements. The increment-threshold technique, novel when he introduced it in 1929, developed into the two-colour method, in which a brief monochromatic increment is delivered on a monochromatic field. This method has been widely used to test the presence and sensitivity of individual classes of receptor in normal and abnormal vision. And many minor anomalies and inflexions in Stiles' data – always scrupulously plotted – have subsequently turned out to be important phenomena in their own right.

But the most important of Stiles' contributions to visual psychophysics was the model that lay behind his use of the two-colour method. His concept of a 'mechanism' has subsequently been extended to many sensory dimensions and it is now commonplace to test for the existence of 'channels' that are independent in adaptation and in detection.

Among the other scientific achievements for which Stiles will be remembered are his discovery (with B.H. Crawford) of the directional selectivity of the cones; his measurements (with J.M. Burch) of the large-field colour matches of 50 observers, measurements that served as the basis for a CIE standard adopted in 1964; his discovery (with M. Aguilar) that the rods saturate at photopic levels; and his line-element analyses of colour discrimination. His massive trichromator is still in use at NPL.

One of Stiles' closest friends and collaborators was the late Gunter Wyszecki. Their "Color Science" (1967, 1982) will long remain a definitive handbook in our field.

From 1928 to 1931 Stiles served as General Secretary of the Commission International de l'Eclairage. He was Chairman of the Colour Group of Great Britain from 1949 to 1951 and President of the Illuminating Engineering Society from 1960 to 1961. A permanent tribute to his administrative skills are the proceedings of the international conference on colour vision that he organised at the NPL in 1957.

Though he notoriously eschewed subjective description in his scientific work on colour, Stiles was an accomplished amateur painter, and he privately delighted in the richness of our internal palette. In personality, he was modest and kind. On public occasions, he enjoyed the rare talent of being able to express exactly the right sentiment with exactly the right words.

Dr. Stiles is survived by his wife, Pauline, with whom he shared 57 years of marriage.

J.D. Mollon

EDITOR'S CORNER

You may be interested to learn that Peter Kaiser, Chairman of the Editor Search Committee, reports that he has an Editor-in-Chief waiting in the wings. She is still recovering from a serious blow to her health a year and a half ago, but when she recovers sufficient strength she plans to gradually take on the duties of Editor-in-Chief with the help of some Associate Editors, and your present Interim Editor will gradually reduce his contributions of time and effort.

Make no mistake about it, editing ISCC News takes considerable time and effort, don't think it doesn't. It would take considerably less, however, if (1) each member or reader endeavored to contribute some item of news at least once a year, (2) those who accept assignments to write reports did so with the reader in mind who knows nothing about what has gone before, and then submitted their reports promptly, and (3) if everyone who submits material for the *News* sees to it that the material is double spaced. Single spaced copy is difficult to edit and even more difficult to set in type after editing.

Harry K. Hammond III
Interim Editor

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Contact the Editor

CALENDAR

1986

FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY
64th Annual Meeting and 51st Paint Industries Show, World Congress Center, Atlanta, GA, November 5-7

1987

ISCC WILLIAMSBURG CONFERENCE
"Geometric Aspects of Appearance," The Lodge, Colonial Williamsburg, VA, February 8-11

ISCC ANNUAL MEETING
"Industrial Problems in Color Science", The Barclay Hotel, 18th & Rittenhouse Square, Philadelphia, PA 19103, April 5-7

CIE, 21st SESSION
San Giorgio Maggiore, Venice, Italy, June 17-25

FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY
65th Annual Meeting and 52nd Paint Industries' Show, Convention Center, Dallas TX, October 5-7

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