

Inter-Society Color Council *News*



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Number 307
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MAY-JUNE –
JULY-AUGUST 1987

Important Notices

CALL FOR PAPERS

ISCC/SID Joint Technical Meeting, May 8-10, 1988, Baltimore, MD.

Meeting Theme: Video to Hard Copy to Video in Color

The 57th Annual Meeting of the Inter-Society Color Council (ISCC) is planned to be jointly sponsored this year by the Society for Information Display (SID), a member body, with M. Nick Hale (ISCC) as Meeting Chairman, and Mr. Lawrence Tannas, Jr. (SID), as Program Chairman.

The technical subject of the meeting is intended to focus on the problems associated with accurately transferring colors from computer graphic and video presentations to electronic-optical scanner. With the extensive proliferation of sophisticated computer-aided design on high-resolution color displays and electronic color printers and copiers, it is increasingly desirable for aesthetic and utilitarian reasons, to accurately transfer color from one system to another. The problems are compounded by the fact that electronic display images use additive colors and hard copy images use subtractive colors.

Abstracts of one hundred words outlining a proposed paper for a 25-minute presentation are solicited on theory, solutions, and problems associated with the topic. The conference is intended to be tutorial in nature and will include theoretical papers as well as state-of-the-art solution papers with demonstratable hardware. Suggested topics include: Color theory, flat-panel and CRT display color techniques, electronic printer color techniques, standards, human factors of color, requirement for color, transfer of color, and measurement, characterization, calibration, and viewing of color.

The technical papers sessions are scheduled for the after-

noon of May 9th and the day of May 10th, with an author interview, hardware demonstration, and poster session in late afternoon of May 9th and 10th. The poster session is being planned for the conference by Ms. Paula Alessi (ACS/ISCC). Submitted abstracts will be *automatically considered for the poster session*.

Send abstracts to Lawrence W. Tannas, Jr., 1426 Dana Place, Orange, CA 92666 (Tel: (714) 633-7874; Fax: 714/633-4174) on or before December 10th, 1987.

CALL FOR POSTER PAPERS !!!

The 1988 Annual ISCC meeting will feature a first in the history of the organization. A poster paper session acknowledging the work of you, the ISCC membership, will be held. In the past, we have used poster sessions with varying degrees of success to report on the ISCC project committee work only. In 1988 we plan on setting a precedence for providing each ISCC member with the opportunity to share their work in the area of color by presenting a poster paper rather than an oral presentation. The topics for the poster papers are completely open. Whether you are an artist, a scientist, an industrialist, an educator, a student, or a researcher, we welcome your poster paper entries in any area of color that you feel may be of interest to all. In spite of the fact that the annual meeting is not until May of next year, it is not too early to submit papers for this poster session. Here's your chance to familiarize us with the fascinating color work that you may be doing on a daily basis. Please send your entries, in the form of a title and abstract to: Paula J. Alessi, 10 Bay Park, Webster, NY 14580.

Please feel free to call Paula at 716-477-7673 with any questions that you may have.

ANNUAL MEETING ISSUE

GODLOVE AWARD PRESENTED

Mr. President, ISCC Members, Ladies and Gentlemen, it is both an honor and a privilege to present this year's ISCC Godlove Award to Chuck Reilly in recognition of his significant technical achievement in the field of color science and technology.

Chuck has dedicated his entire career to the advancement of color science and its application. Now a retired consultant, he was formerly a Research Fellow at the Du Pont Company where he guided their color technology programs for over 30 years.

He served with distinction as an OSA Fellow on the OSA Committee on Uniform Color Scales and a Chairman of the old CIE Technical Committee 3.2 on Color Rendering.

The awards committee recognizes Chuck's outstanding accomplishments in both color theory and instrumentation citing his development of the Cube Root Color Coordinate equations in 1958 which led, with his guidance to both the CIEL*a*b* and OSA-UCS cube root equations. The committee also noted his development of such instruments as the Colormaster and Ducolor Colorimeters.

Chuck has also been an inspiration and teacher to many others in the field of color and I would like to quote another's view on this subject:

"In addition to his research, I feel his most important contribution to color science has been his technical leadership in fostering the color research careers of his colleagues. Chuck has been an advisor, sponsor, teacher and role model to an array of color scientists who continue to contribute to the field through research, publication, committee participation and organizational leadership."

Finally, as a colleague, I would like to say something about the man himself. He has told me many times and I quote:

"If you want to get something accomplished, you have to be willing to let others take the credit."

NICKERSON ISCC SERVICE AWARD

This Nickerson Award is a most prestigious award. It is presented for outstanding long term contribution toward the advancement of the Council and its aims and purposes. It is a very great pleasure for me to make these introductory remarks for our recipient – Harry K. Hammond III. I have known Harry and his professional contribution for 25 years and have worked directly with Harry at Gardner Laboratory and then Pacific Scientific Co.

Harry received a BS degree in Engineering Physics from Lehigh University in 1938. He was a member of the staff of the National Bureau of Standards (NBS) from 1939-1977,

working in Photometry, Colorimetry, Radiometry and Product Evaluation Technology. His work involved development of standards for appearance attributes such as color, gloss, and haze as well as new or improved test methods. He has been active in the American Society for Testing and Materials (ASTM) since 1946. He was Chairman of the Optical Properties Subcommittee of the Paint Committee (D-1) from 1957 to 1970. He has been a member of Committee E-12 on Appearance of Materials since it was founded in 1948 and has served as Chairman of the Committee for the years 1970-1976. He received the ASTM "Award of Merit" in 1963 and with it the designation of Fellow of the Society. From 1977 to the present he has been associated with the Gardner Laboratory and its successor, Pacific Scientific Instrument Division.

Hammond currently serves as Chairman of ASTM delegates to the National Committee (USNC) of the International Commission on Illumination (CIE). He has attended each Quadrennial Meeting of CIE around the world since 1967. He served as Secretary of USNC from 1967 to 1971.

Hammond has been an active member of the Inter-Society Color Council for many years. He served as a Director (1974-1976) and an Editor of ISCC News (1986). He has served as a member of the Finance Committee. However, I think what sets Harry apart are his hidden and sometimes taken for granted contributions. He is a volunteer. He is a *worker*. He has promoted the ISCC to new members. He has greeted new members in a way to encourage their involvement in Council affairs. He has developed close relationships with members worldwide. He has been faithful in attendance at meetings often at his personal expense. We who are privileged to know Harry admire and respect him greatly.

And perhaps more important than all else, Harry is fortunate to have a loving and supportive wife, Pauline. It is she that gives him the help and the freedom to do so much for others.

It is with great pleasure that I present the Nickerson ISCC Service Award to this most deserving candidate Harry K. Hammond, III. This award is symbolic of the gratitude of the members of the ISCC and their recognition of Harry's many contributions.

E.T. Connor

PRESIDENT'S REPORT

When I took office a year ago, I outlined three areas of emphasis for my administration:

- (1) Project Committees
- (2) Member-Bodies
- (3) Organized Structure.

I am pleased to report we are making very good progress in all three areas:

(1) As I reported last year, we had streamlined the organization of the Projects committee, clearly defining responsibilities of chairmen and the coordinators. We appointed Hugh Fairman overall Chairman and he has implemented that plan very well. He has instituted a two-year review process for each committee and (to date) all odd-numbered committees reviewed their short-term goals which were carefully considered and approved by your Board of Directors.

(2) We have initiated closer contact with all our member-bodies which I expect will lead to more participation by member-bodies in ISCC and vice versa. Both the President-Elect, Joy Luke, and I have directly contacted each member-body over this past year and have received many inputs from them.

(3) We are taking a two-pronged approach to structuring the Organization of the ISCC. One is through the Planning Committee to look closely at the goals and procedures of the Project Committees and the Annual Meetings. We must make them more dynamic while properly catering to all diverse segments of this *Inter-Society* Color Council. The other is to properly define responsibilities of every Standing Committee and outline procedure and guidelines for them to follow. I have assigned prime responsibility for these two tasks to Joy Luke, the President-Elect because they are of such great importance.

I look at this as my interim report to you. We are satisfied that we have made definite progress. I am confident we will complete this work over the next year. I thank you and ask for your continued support.

Allen B. J. Rodrigues
President, ISCC

TREASURER'S REPORT

The Council's net worth amounted to \$56,189 as of December 31, 1986.

\$ 1,743 – Checking Acct. – non interest bearing
7,515 – Savings Acct. – interest bearing
44,966 – Certificate of Deposit – interest bearing
<u>54,224</u>
1,965 – 1987 Prepaid Expense
<u>\$56,189</u>

In the 12 month period of 1986, expenses exceeded income by \$7,073, a negative "swing" of \$17,821 from the prior year. This was due to reduced net income from meetings and significant expense increase. The 1986 Income & Expense is shown below, along with 1985 for comparison.

INCOME

1986		1985
\$11,384	dues	\$9,971
4,130	interest	5,165
2,136	Annual Meeting, Net	5,897
1,043	Williamsburg Mtg. Net	6,215
3,189	Subtotal from Meetings	12,112
385	Mis	1,047
<u>\$19,088</u>	TOTAL	<u>\$28,295</u>

EXPENSE

\$15,485	Newsletter	\$13,030
2,047	Publicity	388
1,327	Awards	760
2,500	Donation (RIT)	0
210	Color Res. & App. subscrip	979
900	Audit	0
1,695	Pres., Sec., Treas. Off	1,105
1,638	Board of Directors	224
57	Committee	60
40	Misc.	261
<u>\$26,161</u>	TOTAL	<u>\$17,547</u>

SURPLUS or (Shortage)

(\$ 7,073) [Income-Expense] \$10,748

The Treasurer thanks the Officers, Directors and members of the Finance Committee for their advice and assistance.

Respectfully submitted,
E.T. Connor, Treasurer, ISCC

SECRETARY'S REPORT

The number of Member-Bodies of the Inter-Society Color Council currently stands at thirty. This figure included the Individual Member Group (IMG), and the Technical Association of the Graphic Arts (TAGA). ISCC is pleased to announce the readmission of TAGA as Member-Body of the Council, and extends its welcome and best wishes to this group. At its meeting on February 8, 1987, the Board of Directors elected Fred W. Billmeyer, Jr. an Honorary Member of the Council. With the death of Carl Foss on November 25, 1986, the number of living Honorary Members is now 12.

The number of individual members (IMG) in the Council fluctuates, depending on the timing of the account relative to action of the Treasurer in dropping delinquent members. As of April 1, 1987, there were 745 IMG's (including student and retired) on the rolls. Seventy-eight new members joined ISCC in 1986.

The following table lists the number of ISCC members in each of several categories as of April 1, 1987:

<i>Membership Category</i>	<i>Number of Members</i>
IMG: United States	617
Canada	17
Other countries	79
IMGR (Retired):	21
IMGS (Students):	11
Honorary Members:	12
Delegates:	175
AIC Representatives:	35
Member-Body Liaison:	29
Library Subscribers:	22
Editors, Member-Body publications:	29
TOTAL	955

It should be noted that the total is not the sum of the various categories listed. Many delegates and AIC representatives are also IMG's so would appear in the figures for more than one category.

ANNUAL BUSINESS MEETING

The annual business meeting of the Inter-Society Color Council (ISCC) was held 1987 April 7 following the Awards Luncheon. The business meeting was called to order by President Allan B.J. Rodrigues at 12:35 P.M. Dr. Rodrigues expressed his thanks to the program co-chairmen of the Annual Meeting, Dr. Nancy Jo Howard and Mr. Ralph Stanzola, for an extremely interesting and successful meeting. He also thanked Mrs. Louise Stahl and Dr. Norman Burningham for their work on arrangements for the meeting.

Dr. Rodrigues introduced Treasurer Edward T. Connor, who read the citation for Mr. Harry K. Hammond, III, the 1987 recipient of the Dorothy Nickerson – ISCC Award for outstanding service to the Council. The President presented the award to Mr. Hammond.

Dr. Rodrigues presented the annual report of the president, which is reproduced elsewhere in this Annual Report issue. He then turned the meeting over to the President-Elect, Mrs. Joy T. Luke, who presented her annual report. Mrs. Luke's report was not available for this issue.

The Secretary, Ms. Therese R. Commerford, and the Treasurer, Mr. Edward T. Connor, then gave brief oral reports, referring to their written reports which are included in this issue.

President Rodrigues next recognized the directors of the Council, and presented Certificates of Appreciation to the three retiring Directors, Dr. Nancy Jo Howard, Dr. Danny C. Rich and Dr. Peter K. Kaiser. The new Directors, Dr. Roy Berns, Mr. James Grady and Ms. Jacqui Welker, were introduced to the assembled members.

The Board of Directors voted to award honorary membership in the Council to Dr. Fred W. Billmeyer, Jr. Dr. Billmeyer was unable to attend this meeting, so Dr. Rodrigues announced that the Honorary Membership certificate would be presented to him at an appropriate time.

Dr. Rodrigues gave a short history of the Godlove Award, explaining that the award was established by Mr. I. H. Godlove in 1956, in honor of her late husband who was an early member of the ISCC. The award recognized outstanding original work in the color area. President Rodrigues next introduced R. Paul Tannenbaum, who read the citation for this year's recipient of the Godlove Award, Mr. Charles D. Reilly. The Godlove Award for 1987 was presented to Mr. Reilly by President Rodrigues.

The meeting was adjourned at 1:15 P.M.
Respectfully submitted,
Therese R. Commerford, Secretary

AMENDMENT TO CONSTITUTION

In accordance with Article vii – Amendments, of the Constitution of the Inter-Society Color Council, Inc.: notice is given of a proposed amendment to said Constitution. At its meeting on February 8, 1987, the Board of Directors recommended a change to Article II - A of the Constitution. The Board seeks to delete from the Constitution any *suggestion* that the ISCC is a standards-writing or granting organization. The voting delegates of the Council will receive ballots no less than 90 days after the mailing of the ISCC News in which this notice appears. The current wording, and proposed new wording of Article II - A is as follows:

Article II - Aims and Purposes

Current Wording:

A. To stimulate and coordinate the work being done by the various members leading to the standardization, description, and specification of color by these members.

Proposed New Wording:

A. To stimulate and coordinate the work being done by the various members leading to the uniformity of description and specification of color by these members.

PROJECT COMMITTEE REPORTS

Project 22—Materials for Instrument Calibration

Project committee 22 met on 1987 April 06 during the annual meeting of the ISCC. At the meeting several topics were brought up for discussion. The first topic was the survey of materials for instrument calibration that was prepared by a

CIE technical committee. It was indicated that the CIE has decided not to publish the survey in a form that contains references to the manufacturers and distributor of Th. standard materials. It was suggested by the membership that the chairman of this project committee write to Dr. Janos Schanda about this decision and see if the CIE might be willing to allow the ISCC to publish the data as part of the *Guide to Material Standards and Their Use in Instrument Calibration*. The chairman agreed to do this.

The next topic was the revision of the guide which is still in progress. The chairman noted that only F.W. Billmeyer, Jr. has submitted any suggestions for changes to the text or the format that was distributed at the 1986 meeting. Chairman Rich then requested the membership present to send him any new references that they would like to see included in the guide. Mr. Rich hopes to have the guide ready for review by the ISCC Board of Directors at the fall meeting.

Next there was some discussion about new white materials for use as calibration standards. No one had any new information. The one or two manufacturers who have been showing an interest in making white standards have not yet begun shipping a product.

The work at the National Bureau of Standards (NBS) was reviewed. J. Hsia was not present but chairman Rich had talked with him earlier about current work. The first topic was the grey scale based on sintered PTFE plaques. Mr. Hsia indicated that they have had excellent results for plaques with reflectance factors up to 50%. Above 50% the plaque no longer has a uniform appearance, but is rather flecked with black pigment. Several suggestions were made for alternate pigments to the carbon black that is currently being used. These suggestions include colored ground glass, metal salts, chromium oxide, and silver halide. These suggestions will be passed on to Jack Hsia. The Bureau is also working on fluorescent standards made in the same manner. So far they have not been able to obtain a reliable accelerated light fastness test for the standards. Several suggestions were again submitted by the membership for consideration by Jack Hsia. The two most significant suggestions were for Jack to talk with either Robert Feller, who has done a lot of work on light fastness of colorants, or the pigment supplier, or both. Ron Bostick of STC indicated that he has created near duplicates for CIBA white tiles #11 and #9.

Alan Robertson of the National Research Council (NRC) in Canada indicated that they are constructing a reference spectrophotometer similar to the one at the NBS. He felt that they will begin providing high accuracy measurements in the following order; transmittance, diffuse reflectance, and fluorescence. Finally, the NRC may begin selling standard reference materials just as the NBS does now.

A review of the CORM meeting last September at Oxford was given. Alan Robertson discussed his paper on the use of

BCRAs to analyze instrument errors. The reprint book should be out shortly. Roy Berns of RIT indicated that they have tried the Robertson technique and found it to be very good at spotting instrument performance problems.

Henry Hemmendinger reviewed his work on the significance of wavelength errors. He indicated that one cannot correctly characterize metameric pair unless one can measure the color (reflectance factor) on an absolute basis for both photometric and wavelength scales. He recommends the use of the Venable an Ekerle method of finding the inflection point of the didymium filter for wavelength calibration. Henry indicated that a wavelength scale precision of ± 0.3 nm is required to accurately assess the color difference between a metameric pair. Alan Robertson and Roy Berns agreed with Henry's findings based on experiences in their own laboratories.

The meeting was adjourned by chairman Danny Rich.

Respectfully submitted,

Danny C. Rich

Project 25-F—Measurement of Color in Fibers

I. 1986-87 Results.

The results from the previous year's work (1985-86) were reviewed. That work had been performed on two different lots of 25% BS Phthalo Green Concentrate. Table I represents the results of averages of different preparations. In summary, plaque preparation resulted in a strength value of 97.28% versus 91.27% and 89.17% in fiber preparations. The 91.27% fiber results were an average of all participants for the 1985-86 year and the 89.17% results were from a single source in 1987.

The difference in results caused some controversy as to how to proceed with the committee's work. The biggest question was whether to continue with two lots (real world) or to use one lot and make an intentional 10% reduction as was done in previous years.

II. 1987-88 Plans

The final agreement on how to proceed for 1987-88 is as follows:

- (1) Work from one lot of BS Green Concentrate and make intentional 10% reductions.
- (2) Use the same formula for plaque preparations as in the past (.10% and .50% pigment with 3.0% TiO_2).
- (3) Fiber spinnings are to be done at 0.01%, 0.10% and 0.5% pigment levels. All fiber samples are to be spun from precolor, no letdowns. Each level must also have a 10% reduction, therefore a total of six spinnings are required.
- (4) All participants must provide their test method for all samples, i.e., for plaques, was the sample extruded and pressed out or batch mixed and pressed out. For fiber spinnings report denier, cross sections, etc.

The concentrates to be used will be sent out as early as possible. All participants are urged to get samples prepared and forwarded as early as possible this year. We have made very little progress lately and would like to accomplish a lot of work this year.

Project 25P—Tinting Strength of Pigments

Following are some excerpts from the article written by Dan Phillips on behalf of Project Committee #2P. It covers the earlier work done by the committee on Phthalo green. The complete report has been submitted to the ISCC Board for its approval.

In the determination of tinting strength (TS) it is implied that two samples are involved — a standard and a batch. TS is a relative quantity involving the extent to which the batch is equivalent to the standard. It is the nature of the equality that leads to problems in defining and measuring TS.

Earlier work of ISCC Project Committee #25P involved the search for a specific definition of TS. It became apparent that this was fruitless. There are many different definitions of TS in use among pigment users and no *one* exact meaning for TS can be given.

Rather than try to first define an exact meaning, Project Committee 25P decided to examine strength determination methods in use and perform an experiment involving sample preparation and measurement. It was hoped that by reviewing the parameters involved and the results obtained, a clear definition of TS could be derived.

It was decided that instrumental methods of TS evaluation were of interest. Visual estimation methods with their inherent subjectivity and lack of easily quantified results would not be studied. In a preliminary round robin experiment with pairs of samples a great deal of experimental variation resulted and no statistically supportable conclusions could be drawn. The committee decided to perform a closely controlled experiment with a small number of participants.

Initial work involved four participants. Two paint companies and two pigments supplies. It concentrated on the dispersion of Phthalo Green pigment.

The experimental variation in the sample preparation and measurement steps was larger than might be expected. The range of results dependent on the operator was also large. Anyone routinely making TS comparisons should be aware of the nature and extent of experimental variation before expecting to make precise TS comparisons.

This emphasized the need for as much uniformity as possible between parties involved in TS comparisons. This would include practices such as using the same lot of white test base, use of a method giving a good degree of dispersion, actual preparation of a standard sample rather than use of stored numerical values from one initial standard preparation, use of

the same measurement conditions, etc.

Application of a surface correction to measured data magnified the TS differences. This is to be expected because the surface correction increases the difference between measured reflectances in the ranges used in TS calculations. In this experiment the surface corrected data gave results closer to the known strength differences. Much more work would be needed to conclude that surface corrected data always give a truer result.

Measurement in the specular excluded mode gave slightly increased strength differences. However, analysis of the measurement data showed that the effect of the measurement mode depended to a great extent on which lab did the measurements. The degree to which the specular component of reflectance is excluded varies from instrument to instrument. It is better to measure specular in, especially if parties involved have different instruments.

As a result of the green study the following suggestions for further work were made.

This study provided important information on variability of sample preparation and measurement. It should serve to remind us that the calculation of %TS to two decimal places using a single measurement of a casually prepared sample is not correct. Anyone involved in TS determinations should have some idea of his or her ability to obtain consistent results. Moving beyond experimental variation studies this committee should broaden the range of pigment types studied to answer questions regarding measurement procedures. Because of the large number of industries and applications in which pigments are used only so much can be done regarding recommendations on sample preparation. However, beginning with pairs of samples already made and ready to measure the surface correction and measurement parameter questions should be examined. Samples created with a known strength difference can be used to check the effect of surface correction to see if it gives values closer to the known differences. The use of tristimulus vs. minimum reflectance needs to be evaluated with a number of types of samples. These should include some pairs which have some shade difference between lots as is the case in real situations. There are cases where the methods will agree and cases where they do not. If the committee can point out where this occurs and make recommendations on this and other measurement options an important service will have been performed. The goal should be to promote uniformity of methods.

Most of the suggestions for further work were addressed in more recent studies.

In 1985-86 two organic and two inorganic reds were evaluated; red oxide, cadmium red 108, organic red 170 and organic perylene red 179. Our goal in this round was to determine if single wavelength or broad band was better for the evaluation of tinting strength. Since the samples were split and compared

to themselves as with the greens little difference was detected.

1986-87 was the year to bite the bullet and deal with the extremes of the real world.

Project 27—Indices of Metamerism

This past year, the committee has accomplished the following items:

- 1) The committee wrote a reply to a letter-to-the editor of *Color Research and Application* concerning the reasons for which the committee desires to promulgate the word “paramerism,” and had the reply published in the *Journal*.
- 2) The committee completed a draft of an article for publication in *Color Research and Application* stating the results of its questionnaire on metamerism terminology and related words. This draft was approved by the Board for publication and submitted to the *Journal*.
- 3) The committee performed the statistical calculations on its visual metamerism experiment, reducing the experimental data to a scale in which the samples were assessed by visual means. What remains to be done now is to compare that scaling to several calculated methods of assessing index of metamerism.

Project 32—Image Technology

The primary activity of this committee over the last year was conducted at the annual meeting held at the Barclay Hotel in Philadelphia. Two meetings were held. The first was an open informational session on Monday, April 6th and the second was a closed workers meeting on Tuesday, April 7th.

The first session was very well attended with approximately 25 people present. The agenda for this session consisted of four major topics.

I. Review Scope & Objectives

The scope was stated as follows: This project committee 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 sharing a common interest in the color problems associated with their imaging systems. Since the scope of this committee is so broad, the main emphasis has been placed on the area that needs the most work: the two-way relationship between video display and hard copy. This main emphasis is a very important topic that is being actively pursued by many committee members, but the competition is so intense (as the state-of-the-art technology is changing daily) that most are not at liberty to share information in an open committee forum. Thus in defining objectives we have had to change our strategy. There are three objectives that we are currently pursuing. The first involves an ongoing activity to com-

pile a general color reproduction bibliography that would include video display entries as well as other imaging systems of interest to this committee. The second involves a collaboration with ASTM E12.06 to investigate what has been done and what remains to be done in other areas of measurement specification for video displays and definition of optimum viewing environments for video display applications. The third objective, which represents the largest departure from the posture this committee has taken in the past, is to serve as a forum for workers to share data relevant to any imaging system that they are at liberty to reveal in an informal yet informative fashion. These objectives have yet to be approved by the board of Directors.

II. Relationship with ASTM E12.06, Appearance of Displays

Once our committee became involved in discussing how one specifies color for video displays, it was evident that no standard methods for calibration and/or measurement existed. People seemed to be doing what appeared to be intuitively obvious based on their knowledge of the colorimetry of other imaging systems. They would generally try different techniques until they found something that worked. To avoid the reinventing the wheel syndrome for each new person entering the video display color arena, we felt that some of these accepted techniques for calibration and/or spectroradiometric measurement of video displays should be written up as standard methods for all to follow. Since the ISCC is not a standardizing body, project committee #32 cannot be responsible for writing such a standard method. It was suggested by Nick Hale, the chairman of ASTM E12, that since many of our ISCC committee members were already ASTM members, perhaps we could work together on developing the standards and issuing them through the ASTM, which is a standardizing body. Hence ASTM E12.06, Appearance of Displays, was born. At first Paula Alessi wore chairperson hats for both committees, but now the ASTM E12.06 effort is chaired by Danny Rich. Danny's committee is now in the process of drafting a standard practice for obtaining spectroradiometric measurements for video display color calibration.

ISCC project committee #32 is kept abreast of ASTM E12.06 activities by virtue of the fact that many of our members serve on the ASTM committee.

III. Relationship with CIE TC 1-10, Colorimetry of Self-Luminous Displays

Here the bond is not as strong as it is with ASTM. However we do keep abreast of this CIE committee's activities through mutual members. J. Rennilson, who currently chairs this CIE effort is also a member of ISCC committee #32 and keeps us well informed with regard to their progress. Also Bill Cowan is

an active member of both efforts. Up until now the efforts of this CIE committee have been twofold. The first is the development of a very comprehensive video display bibliography. Once we learned that this activity was well underway, we switched the emphasis of our bibliography to cover color reproduction systems other than video displays. Bill Cowan's draft of the CIE annotated video display bibliography served as an inspiration for the draft of our color reproduction bibliography. The second effort of CIE TC 1-10 is to recommend a color space that is appropriate for self-luminous display applications. A technical report toward that end has been issued in *draft* form but no final recommendations have been made as yet.

LeRoy DeMarsh was very helpful in pointing out that *ISCC*, *ASTM*, and *CIE* are not the only organizations active in pursuing video display color technology. The following organizations were mentioned with contact people where they were known: *EIA* (Pete Keller of Tektronix), *SID* (Larry Tannas), *IEEE* (John Horn of Tektronix), *SAE* (Dave Elliot of Lockheed for avionics displays), *ANSI* (Harry Snyder of Virginia Polytechnical Institute for Human Factors issues) and *ISO*. As *ISCC* chairperson, Paula will try to contact each of these groups to make them aware of our efforts in the area of color specification for various imaging systems to promote sharing and cross-fertilization of ideas.

IV. Color Reproduction Bibliography

A proposal for this bibliography was presented by chairperson, Paula Alessi. The intent is for this document to survey the color reproduction literature in the imaging areas of photography, printing, television, video display and video display to hard copy translation. Since color reproduction refers to how an imaging system reproduces an original, the emphasis will be on characterizing the color properties of both the original and the reproduction. There was quite a bit of discussion on how one defines an original and a reproduction. Photography, in the most traditional sense, defines the original as the object being photographed and the reproduction as the resulting reflection print or transparency rendition of that original scene. However there are many photographic, as well as printing, imaging systems that go through many stages before the final reproduction is achieved. Also the original does not necessarily have to be a tangible object that exists in nature. The original may be an electronic video display image. Furthermore, what may be the reproduction for one imaging system could very well be the original for a second imaging system. Examples of this have been cited many times by this committee. We are often asking ourselves, "given a photographic reflection print of the Macbeth Color Checker, how close can a video display unit come to a reproduction of that print?" Bearing all of these concerns in mind it became obvious that this bibliography

must be divided up into subsections each of which specifically defines the original and the reproduction to which the remaining entries refer. There will, of course, be some general sections that will apply to all imaging systems regardless of how the original or the reproduction may be defined.

As was mentioned earlier, Paula found Bill Cowan's approach in laying out an annotated bibliography for self-luminous displays to be an excellent inspiration and tried using it as a guide for putting together the initial draft for this annotated color reproduction bibliography. The outline features the same split into major sections as was proposed by Bill. The first section will emphasize basic or classical colorimetry, which by now is more or less well understood. The second section features a description of color reproduction models. Like the first section, this is an area that is understood perhaps to different levels depending on the imaging system of interest. The third section (like the second section of Bill's draft) will focus on appearance, which still has a long way to go not only in terms of our understanding the phenomena, but also in terms of first defining the phenomena.

The subheadings under each major section are:

CLASSICAL COLORIMETRY

This section refers to CIE colorimetry as we know it for the 2 & 10 degree observer.

1.1 *Reviews*. This section should contain references which describe the whole process of CIE colorimetry from 1931 to the present.

1.2 *Basic Colorimetry*. Reference here should review how classical colorimetry has been used in the color reproduction process of the imaging system of interest.

1.3 *Measurement Techniques for the Original & the Reproduction*. CALL FOR PAPERS. This section will emphasize references to both the spectral & geometric measurement procedures as they apply to each imaging system:

1.3.1 Spectroradiometric Measurement Procedures.

1.3.2 Spectrophotometric Measurement Procedures.

1.3.3 Colorimetric Measurement Procedures.

1.3.5 Temporal Measurement Procedures.

.1 Physical Measurement Procedures.

.2 Visual Measurement Procedures – (Colorimetric Validity of Pulsed Sources).

1.3.6 Spatial Measurement Procedures.

.1 Spot Size.

.2 Evenness Across the Display.

1.4 *Input Data Calibration Techniques*. This section contains references that describe any calibration procedures necessary to fully characterize the original or the reproduction for the particular imaging system of interest. Also this section should define how one gathers the necessary input data for the color reproduction models.

2. Color Reproduction Models

This section refers to models used to predict the physical situation of how an original will be reproduced in color space by each system.

2.1 Definition of a Color Reproduction Aim. References here describe the goal to be achieved in going from the original to the reproduction on.

2.2 Calibration Test Methods. References here describe the test methods used to assess how well an original is reproduced.

2.3 Original →→→→ Reproduction. This section contains references that describe the details of the black box that takes each imaging system from the original to the reproduction.

2.4 Verification of These Models. References here assess the validity of these models.

2.5 Color Difference. This section contains references that quantify the color difference between the model results and those actually obtained by each system.

3. Appearance

Here appearance refers to what the original and/or the reproduction looks like.

3.1 Reviews. This section should contain references which review aspects of appearance from past to present.

3.2 Viewing Conditions. References here should describe how viewing conditions play a role in the appearance of the original and the reproduction.

3.2.1 Surround Conditions.

3.2.2 Illumination Conditions.

3.2.3 Viewing Parameters, i.e., Distance, Size, Orientation, etc.

3.3 Surface Characteristics. References here should describe how surface characteristics, such as front surface reflection play a role in the appearance of the original and its reproduction.

3.4 Adaptation Conditions. References here should describe how adaptation conditions play a role in the appearance of the original and its reproduction.

3.5 Color Appearance Metrics.

3.5.1 Definition of Perceptual Quantities.

3.5.2 Definition of Psychophysical Quantities.

3.5.3 Definition of Psychometric Quantities.

3.5.4 Definition of Psychoquantitative Variables.

3.5.5 Verification that Measurements Correlate with Psychoquantitative Variables for Each Imaging System Reproduction Process.

3.5.6 Color Difference.

.1 Definition of Equations.

.2 Use in determining how well the reproduction represents the original.

3.5.7 Chromatic Adaptation Transforms.

.1 Definition of Equations.

.2 Use in the Translation from Original to reproduction

3.5.8 Color Order Systems.

.1 Definition of Various Systems.

.2 Examples of their usage in each imaging system's color reproduction process.

.3 Comparison of their correspondence with the Psychometric or Psychoquantitative color spaces.

3.6 Appearance issues related to simple images.

3.7 Appearance issues related to complex images.

These subheadings are described in greater detail in an appendix which represents a modified version of Paula's original proposal. The modification resulted from input of all members at the meeting.

Now that everyone has more or less agreed upon the outline, members will be asked to survey the literature for references so that we can begin to place entries in the appropriate section of the bibliography.

As was mentioned earlier, a closed session for the working members of ISCC project committee #32 was held on Tuesday, April 7th, 1987. Members were encouraged to bring data they wished to share with the entire group. Three people actually decided to help make this new approach successful. The first was Pamela McCarthy of Burlington. She brought to our attention the problems that are encountered when a designer wants to use a video display screen for textile design. Once they see a design on the screen that they like, they would like a hard copy representation of it. Quite often when the hard copy does not look like an original fabric *or* like video display representation, they are disappointed. There are many underlying problems that make this translation difficult. First there is the problem of the textile colorant gamut being very different from the printing ink hard copy gamut. Then there is the problem of expecting a luminous display representation of an object to look like an opaque reflecting object. Also there are two color reproduction dilemmas associated with this problem that Pam brought to everyone's attention. The first is failure of the video display to accurately reproduce a textile original and the second is failure of the printed page hard copy to reproduce what was seen on the screen. In actuality, the problem is not as bad as it sounds when you consider that the video display is really only used as an intermediary screener. Ultimately it is most important for the original textile to be accurately reproduced on the printed hard copy. What makes use of the video display screen so attractive is that if the translation works properly, a designer can see a new design without it having to be made on a loom first. It could be screened on a video display. Pam ended her portion of the discussion by putting in a plea for video display units with higher resolution so that she could obtain a more accurate representation of the third dimension that imparts texture and shadows to original

textile samples.

The second member who shared data with us was Julie Skipper of Eastman Kodak. She reported on some work that she had done to determine the white balance acceptability ranges for different consumer receivers and professional monitors. An RCA receiver, a Sony Trinitron receiver, and a Shibasoku monitor were all set to D65 and 30 Foot-Lamberts and tested for white balance acceptability limit along each of the six color axes (red, cyan, green, magenta, blue, and yellow). One result was common to all three devices. White balance changes in the red-magenta direction were most tolerable or acceptable among observers. Acceptability of white balance along the remaining four axes was device dependent and narrow ranges of acceptable tolerances were found for these critical axes. Roy Berns carried Julie's conclusions further by inferring that since red-magenta was the most tolerable direction to deviate from a perfect white balance, then observers would be more inclined to accept a white at a lower color temperature than D65. LeRoy DeMarsh provided more evidence in support of this conclusion by reporting that motion picture sets are deliberately set up with warm neutrals. This makes them more acceptable when we view them in movie theaters under xenon arc illumination that comes close to D65.

Our final speaker was Dr. Roy Berns of the Munsell Color Lab at Rochester Institute of Technology. He spent some time discussing work that his graduate students are performing. One study examined the ability to measure the spectral power distribution of a video display unit with a Tracor and an Optronics spectroradiometer. The concern here is whether or not the measurements can be taken on an absolute basis, since the source is pulsed rather than continuous. Also, does colorimetry apply to pulsed sources? In performing such a measurement, chopping the signal at 30 & 60 Hz gave similar results. Use of the Optronics was recommended over the Tracor.

All in all this was a very successful meeting. Although the members who informally shared data with the group may not have gotten answers to all their questions, many stimulating discussions occurred. Quite a few of us walked away from the meeting with new ideas to try in attempting to solve some of the inherent problems associated with these complex imaging systems. We will most likely continue this type of information sharing session at future meetings.

Respectfully submitted,
Paula J. Alessi

Project 33—Human Response to Color

A meeting was held in Philadelphia, April 9, 1987 to receive ideas on what directions the work of the committee should take, George Brainard, department of Neurology, Jefferson Medical College, reported briefly on the physiological responses of hamsters, monkeys and humans to viewing colored

lights. Results show the responses are dependent on hue. William Thornton has offered to review his measurement procedure.

Kenneth Lemmon, College of Art and Design, Detroit, commented on the importance of the state of mind on a person's response to color. A list of factors believed to influence the human response to color, revised May 1, 1987, incorporates both these points of view.

Copies are available from the chair.

John Hutchings, Bedford, England, in a letter to the chair earlier this year included an interesting and comprehensive diagram showing the interrelation of the factors in the above mentioned list. The chair plans to make copies available at next year's meeting.

I think there has been enough input from this and previous meetings to formulate a new scope for the committee to pursue. It is hoped some of the more interested persons can meet soon to prepare a draft for the committee to consider recommending to the board of directors. Jacqui Welker offered to assemble a bibliography relating to the human response to color. Magenta Yglesias has agreed to be the committee's secretary.

Respectfully submitted,
Walter C. Granville, Chair

Project ?—Color Education

A meeting was held in Philadelphia in connection with the Annual meeting of the ISCC. The meeting was begun with a brief review of the events leading to the decision to have a meeting devoted to color education. About three years ago, Dr. Nancy Jo Howard broached the topic of a special conference for teachers of color to the Education Committee. After some discussion, the committee agreed that this type of conference could prove to be invaluable and that it should be held in lieu of a Williamsburg Conference: it was also felt that this type of meeting should be held during the summer months and preferably at a dorm type facility. This conference will be held in June 1988 at the Fashion Institute of Technology (FIT).

A rough outline for this meeting was presented by Mrs. Evelyn Stephens; it was expected to include high school and college teachers and industry. After some discussion it was decided to narrow the scope to include only teachers in high schools and colleges and to aim for the first two weeks in June 1988. Since public schools may still be in session some thought will be given to running some sessions at night.

A discussion about the possible number of attendees followed; it was decided to limit the size of the group and to screen the applications; this is not a conference to teach color, but a conference for color/color science educators who are willing to share their teaching methods, ideas, demonstrations, etc. It is hoped that this will lead to an expansion of "color

education;" that we will learn from one another.

Another item discussed was the sale of teachers' aids at the conference. This may include color slides, discs, handouts, etc.

Mrs. Stephens gave a brief description of the facilities available at FIT. It is hoped that there will be three labs with various types of color equipment used as workshops, and two rooms as lecture halls. The workshops will be run simultaneously thereby permitting a breakdown into small groups; each group being led by an invited speaker/leader/demonstrator.

The meeting ended with the announcement that Roland Connelly, Nancy Jo Howard, and Louise Stahl will be working with Evelyn Stephens on the arrangements for this conference.

Project 35—Color Matching of Living Tissues

Subcommittee 35 met at the Barkley Hotel in Philadelphia, PA on 1987 April 7. The meeting was attended by Dr. Robert Sproull, myself and an individual member from the L.D. Caulk Company, as well as several independent members with an interest in our field.

The activities this year centered chiefly around monitoring the progress of the new dental spectrophotometer. A progress report was not available at our meeting but the project is continuing.

At the Annual Session, Dr. Bruce Clark's abbreviated version of his 1930's shade guide was presented and discussed by Dr. Robert Sproull. It gave an interesting contrast between what was then and what is now. One could conclude that Dr. Clark was far ahead of his time, or perhaps that we are presently very far behind in ours.

The *Spectratone* porcelain system was also discussed. It employs a 125 chip shade guide, which is presently available. The matching porcelains are not currently being produced. Acceptance by the Dental community continues to be an obstacle. It is certainly a viable alternative until a spectrophotometer becomes a practical office reality.

DR. C. JAMES BARTLESON 1929-1987

Dr. C. James (Jim) Bartleson, a Kodak scientist recognized internationally as an expert in the fields of light, color, and vision, died suddenly at his home in Pittsford on Tuesday morning, August 25, 1987. He was 58 years old.

Following the precepts of his father, who said, "whatever you do, do it well," Jim ranged as a young man from underwater demolition as a U.S. Marine, to aerial photography as a free-lance camera-man. This led to photographically oriented jobs, first in process development and quality control at the Pavelle Color labs in New York City, and then to a fifteen-year stint as a photographic scientist in the Kodak Research Labs in Rochester. His reputation grew with wide publication of his research papers, and his appearance as a lecturer to sci-

entific groups. In 1967 Jim Bartleson was invited by the Macbeth Corporation, which later became the Macbeth Color and Photometry Group of Kollmorgen Corporation, in Newburgh, N.Y., to become Vice President and Director of Research, a position he held for seven years.

In a life-long learning program, Bartleson obtained an Associate degree in Photographic Science from RIT as a young man, later attended Columbia University, and at the age of 45 took a two-year break in his employment to obtain a PhD from the City University of London in the Department of Ophthalmologic Optics and Visual Science. In 1977 Dr. Bartleson returned to Kodak Research Laboratories as an expert in the field of image assessment. At the time of his death he was a Senior Research Associate in the Photographic Group Research Laboratory and a member of the Scientific Committee of the Laboratories.

Jim was a prolific writer, partly because his work was of consistently high quality and thus worth reporting, and partly because he was very good at writing. Testament to this is the number of his papers that were nominated for awards, and the number that received awards. These came from such diverse organizations as the Society of Motion Picture and Television Engineers (twice), the Japan Graphic Arts Association, the Society of Photographic Scientists and Engineers, and the Kodak Research Laboratories, where he was one of the first winners of the C.E. K. Mees Award. Jim also put prodigious effort into writing books, being author, co-author, or editor of eight books. The five-volume series on "Optical Radiation Measurements" which he contributed to, and edited with the late Franc Grum, will long be a living memorial to both of them.

Jim was also valued as a lecturer, and was an invited speaker at conferences throughout the world. The Isaac Newton medal of the Colour Group of Great Britain recognized, in part, this skill. A striking characteristic of Jim was his phenomenal memory. He seemed to remember everything that he had read or done, and could cite literature references, classical or technical, to volume, and sometimes even to page number. I often wondered if this was a case of a truly photographic memory, or just another example of Jim's drive toward perfection — if it was worth reading, it was worth remembering.

Jim Bartleson devoted much time and effort to his scientific community, partly as a service to his colleagues and his science, but I believe also for the opportunity that it gave him to meet people whom he respected and admired. Jim needed and valued those contacts, for in any one organization, or even any one country, there were not many people working in his field, and even fewer who met the standards that he demanded in a colleague. Unlike most of us, when Jim Bartleson said he was a member of a technical society, it did not mean that he was a passive, dues-paying member. He joined societies in which he

could serve usefully. He was active in over forty professional and standardizing organizations, both national and international, and held important offices in a number of them.

A partial list of these includes:

American National Standards Institute (ANSI) PH2 (Sensitometry) delegate from Photographic Society of America (PSA); P[H22 (Motion Picture) delegate from American Society for Testing and Materials (ASTM); Chairman PH2-40 (photographic Viewing Conditions); Chairman WG 4/PH2-6 (Graphic Arts Viewing Conditions).

Association Internationale de la Couleur (AIC) U.S. representative, President, 1977-1981.

Colour Group of Great Britain, Executive Committee, Newton Medalist.

Commission Internationale de l'Eclairage (CIE) Chairman TC-3.2 Subcommittee on Illumination for Color Reproduction (Color Rendering); Secretary TD-1.3 Subcommittee on Chromatic Adaptation (Colorimetry); Corresponding Member TC-1.3, TC-3.2, TC-1.4 (Photopic, Mesopic, Scotopic Vision); Chairman of CIE Ad Hoc Committee on Nomenclature; Chairman of Working Group 7 on Color Scaling.

International Standards Organization (ISO) Chairman TC42 PWG-7 (Viewing Reproductions); U.S. delegate to TC42 (Photography).

Optical Society of America (OSA) Fellow, Chairman Color Technical Section; Member, Technical Council; Member Ad Hoc Committee on Vision and Physiological Optics; Delegate to ISCC.

Society of Motion Picture and Television Engineers, Recipient of Journal Awards, Member Board of Editors.

As a member of the Inter-Society Color Council, Jim was chairman of the SPSE delegation for twenty years, from 1957-1977; a member of the OSA delegation; liaison officer to the AIC; chairman of the Subcommittee for Problem 6 (Color Terms); member of subcommittees for Problems 20 (Education), 10 (Color Aptitude), 21 (Viewing), 31 (Aerial color Reproduction), 2 (Graphic Arts Reproductions).

Jim Bartleson is survived by his wife, Trudy of Rochester, NY, twin sons, Brandt and Chris of Boston, MA, and Fairport, NY, respectively, a sister, Mrs. Marion Beckwith of Ilion, NY, and two aunts, the Misses Edna and Ethel Bartleson of Wilkes-Barre, PA. Jim was respected as a perfectionist in his work and daily life, expecting their best from others, and not sparing himself to provide his best to them. Though Jim Bartleson has gone, there remains for each of us so much from his living to admire, remember, build upon, and cherish.

Daan Zwick

Rochester, NY

August 30, 1987

CALENDAR

1987

ASTM COMMITTEE D-20 ON PLASTICS, Nov. 2-6
The Palm Hotel, North Palm Beach, Florida. Information: Robert Morgan, (215) 299-5505.

1988

SOCIETY OF PHOTOGRAPHIC SCIENTISTS AND ENGINEERS, Jan. 10-15

International Symposium & Exposition on Electronic Imaging Devices & Systems, SPIE OE-LAZE Conference, Los Angeles Hilton, Los Angeles, California. Information: Pam Forness, (703) 642-9090.

ISCC DIRECTOR'S MEETING, January 22-23.

Holiday Inn Surfside, Clearwater, Florida (followed by ASTM meeting)

ASTM COMMITTEES D-1 ON PAINT & E-12 ON APPEARANCE, Jan. 24-27

Holiday Inn Surfside, Clearwater Beach, Florida. Information: Robert Morgan, (215) 299-5505.

PITTSBURGH CONFERENCE AND EXPO ON ANALYTICAL CHEMISTRY AND APPLIED SPECTROSCOPY, Feb. 22-26.

New Orleans Convention Center, New Orleans, Louisiana. Information: John P. Auses (412) 795-7667.

SYMPOSIUM ON PHOTOFINISHING TECHNOLOGY, Feb. 25-26

Congress Hotel, Chicago, Illinois. Information: Pam Forness, (703) 642-9090.

SAE 1988, INTERNATIONAL CONGRESS & EXPO, Feb. 29-Mar. 3

Engineering Society for Advanced Mobility, Land, Sea, Air & Space, Cobo Hall, Detroit, Michigan. Information: John Rodman, (412) 776-4841.

TAPPI 88, INTERNATIONAL PULP & PAPER MEETING & EXHIBIT, Feb. 29-Mar. 3

Georgia World Congress Center, Atlanta, Georgia. Information: (404) 446-1400.

AMERICAN SOCIETY FOR PHOTOGRAMMETRY & REMOTE SENSING, ANNUAL CONVENTION, Mar. 13-18

St. Louis Convention Center, St. Louis, Missouri. Information: Mary Buit, (703) 534-6617.

4th INTERNATIONAL CONGRESS & EXHIBIT ON ADVANCES IN NON-IMPACT PRINTING TECHNOLOGY, Mar. 20-25

Fairmont Hotel, New Orleans, Louisiana. Information: Pam Forness, (703) 642-9090.

ASTM COMMITTEE D-20 ON PLASTICS, Mar. 21-24

Sheraton Hotel, Boston, Massachusetts. Information: Robert Morgan, (215) 299-5505.

QUALITY EXPO TIME, Apr. 12-14

O'Hare Expo Center, Chicago, Illinois. Information: Steven Bernstein, (312) 299-3131.

ISCC DIRECTOR'S MEETING, May 6-7.

Sheraton Inner Harbor Hotel, Baltimore, Maryland.

ISCC ANNUAL MEETING, May 8-10

Sheraton Inner Harbor Hotel, Baltimore, Maryland.
Information: Therese Commerford, (617) 651-5469.

ASTM COMMITTEE E-12 ON APPEARANCE, May 11-12

Sheraton Inner Harbor Hotel, Baltimore, Maryland.
Information: Robert Morgan, (215) 299-5505.

SPSE 41st ANNUAL CONFERENCE, May 22-27

Hyatt Regency Hotel, Crystal City, Arlington, Virginia.
Information: Pam Forness, (703) 642-9090.

SOCIETY FOR INFORMATION DISPLAY, May 23-27

International Symposium, Seminar and Exhibition, Disneyland Hotel, Anaheim, California. Information: (213) 305-1502 or (212) 620-3388.

AMERICAN CHEMICAL SOCIETY, June 5-10

195th Spring National Meeting and Third Chemical Congress of North America, Toronto, Canada. Information: (202) 872-4398.

INSTITUTE OF FOOD TECHNOLOGISTS, June 19-22

Annual Meeting and Food Expo, New Orleans Convention Center, New Orleans, Louisiana. Information: David E. Weber, (312) 782-8424.

NATIONAL PLASTICS EXPO, June 20-24

Society of Plastics Industry, McCormick Place, Chicago, Illinois. Information: Jordon Morgenstern (202) 371-5200.

ISCC COLOR EDUCATION CONFERENCE, June 21-23.

Fashion Institute of Technology, NYC.

ASTM COMMITTEE D-1 ON PAINT, June 26-29

Baltimore, Maryland. Information: (215) 299-5543.

SYMPOSIUM ON PHOTOCHEMISTRY FOR IMAGING, June 26-29

Best Western White Bear Country Inn, White Bear Lake, Minneapolis, Minnesota. Information: Pam Forness, (703) 642-9090.

ASTM COMMITTEE D-20 ON PLASTICS, July 11-14

Town and Country Hotel, San Diego, California, Information: Robert Morgan, (215) 299-5505.

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA, Aug. 7-11

Annual Conference, Minneapolis Marriot Hotel, Minneapolis, Minnesota. Information: Diane Darrow, (212) 705-7269.

AMERICAN PSYCHOLOGICAL ASSOCIATION, 96th ANNUAL CONVENTION, Aug. 12-16

Atlanta, Georgia. Information: (202) 955-7705.

AMERICAN SOCIETY FOR PHOTOGRAMMETRY & REMOTE SENSING, Sep. 12-16

Fall Convention, Convention Center, Virginia Beach, Virginia. Information: Mary Buit, (703) 534-6617.

SOCIETY FOR INFORMATION DISPLAY, Oct. 4-6

International Display Research Conference (IDRC), Hyatt Islandia Hotel, San Diego, California, Information: (213) 305-1502 or (212) 620-3388.

ASTM COMMITTEE D-20 ON PLASTICS, Oct. 10-14

Toronto, Canada. Information: Robert Morgan, (215) 299-5505.

OPTICAL SOCIETY OF AMERICA, ANNUAL MEETING, Oct. 31-Nov. 4

Santa Clara Convention Center, Santa Clara, California. Information: (202) 223-0920.

FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY, Oct. 19-21

66th Annual Meeting and 53rd Paint Industries' Show, McCormick Place, Chicago, Illinois. Information: (215) 545-1507.

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DR. C. JAMES BARTLESON
1929-1987

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