DIVISION 2: PHYSICAL MEASUREMENT OF LIGHT AND RADIATION

ACTIVITY REPORT
August 1998

Division 2 Physical Measurement of Light and Radiation
Director: Dr. F. Hengstberger
Associate directors: Ms. T. M. Goodman
Mr. N. Johnson
Mr. G. Vandermeersch
Editor Mr. J. Moore
Secretary Dr. Y. Ohno

Division 2 currently has 34 country members as below.

Argentina  L. A. Cogno
Austria    M. Matus
Australia  J. Gardner
Belgium    G. Vandermeersch
Brazil     G. Moscati
Bulgaria   V. Konstantinova
China      G. Ye
Croatia    M. Zeljko
Canada     J. Zwinkels
Denmark    L. Larsen
Finland    T. Timonen
France     J. Bastie
Germany    G. Sauter
Great Britain  T. Goodman
Hong Kong  H. W. Lai
Hungary    G. Dézsi
India      B. Bhattacharya
Italy      M. L. Rastelo
Japan      M. Nishi
Netherlands A. J. Bouman
New Zealand J. F. Clare
Norway     B. Brekke
Poland     J. Pietrzykowski
Romania    F. Ionescu
Russia     V. Ignatyev
Slovak Republic J. Krempasky
Slovenia   S. Erste
South Africa F. Hengstberger
Spain      A. Corrons
Sweden A. Ottosson
Switzerland P. Blaser
Thailand U. Chanchanchop
Turkey L. Öztürk
USA N. Johnson

Underlines indicate that the country representatives changed since the last report.

The 1997 CIE Division 2 meeting took place on May 19, 1998, at NIST, Boulder, Colorado, USA. In conjunction with this Division 2 meeting, the following TCs met on May 18, 1998 at NIST Boulder. Minutes of these TC meetings are to be distributed to TC members by the TC chairpersons. Brief reports on these TCs are included in the Division 2 Meeting minutes below.

- TC2-16 Characterization of the performance of tristimulus colorimeters (Soardo substituted Rastello)
- TC2-29 Measurement of detector linearity (Goodman)
- TC2-32 Measuring Retroreflectance of wet horizontal road markings (Hodson)
- TC2-36 Retroreflection: definition and measurement (Rennilson)
- TC2-37 Photometry using detectors as transfer standards (Ohno)
- TC2-39 Geometric tolerances for colorimetry (Rich)
- TC2-43 Determination of measurement uncertainties in photometry (Sauter)
- TC2-40 Characterizing the Performance of Illuminance and Luminance Meter (Rattunde)
- TC2-25 Calibration methods and photoluminescent standard for total radiance factor meas. (Zwinkels)

The minutes of the Division 2 meeting are given in the following pages. The abbreviations as below are used.

- AD: Associate Director
- Brep. Board of Administration Report
- CIECB: CIE Central Bureau
- CIEBA: CIE Board of Administration
- CM: Country member
- D2: Division 2
- ML: Member List
- NC: National Committee
- TC: Technical Committee
- TR: Terms of Reference
- ST: Status

Minutes of CIE Division 2 Meeting
Tuesday, May 19, 1998
Boulder, USA

Attendance:
John B. Arens (USA)
Richard Austin (USA)
Elyas Balta (USA)
Jean Bastie (France)
Anton J. Bouman (Netherlands)
David Burns (USA)  
Theodore Cannon (USA)  
Antonio Corrons (Spain)  
Dennis Couzin (USA)  
Ronald Daubach (USA)  
Gyula Dezsi (Hungary)  
Edward Early (USA)  
David Ellis (USA)  
George Eppeldauer (USA)  
Arnold Gaertner (Canada)  
Jim Gardner (Australia)  
Teresa M. Goodman (UK, D2 AD)  
Franz Hengstberger (S. Africa, D2 Dir)  
Neil A. Hodson (USA)  
Jack J. Hsia (USA, CIE President)  
Norbert Johnson (USA, D2 AD)  
Carolyn Jones (USA)  
Rainer Köhler (BIPM, France)  
Alan Kravetz (USA)  
Lars L. Larsen (Denmark)  
Calvin S. McCamy (USA)  
Kathleen Muray (USA)  
Yoshi Ohno (USA, D2 Secretary)  
Leyla D. Öztürk (Turkey)  
Albert C. Parr (USA)  
James M. Palmer (USA)  
Jerzy Pietrzykowski (Poland)  
Reiner Rattunde (Germany)  
Justin Rennilson (USA)  
Robert D. Saunders (USA)  
Georg Sauter (Germany)  
John Scarangello (USA)  
Frederick T. Simmon (USA)  
Paolo Soardo (Italy)  
Heinz Terstiege (Germany)  
Pierce Webb (USA)  
William Weber (USA)  
Klaus Witt (Germany)  
Philip F. Wychorski (USA)  
Gan Xu (Singapore)  
Richard Young (USA)  
Joanne C. Zwinkels (Canada)

Total 47 persons including 13 country representatives (indicated by underlines).

**Regrets received by Secretary**

- B. Bhatacharya (India)  
P. Blaser (Switzerland)  
P. Bhagat (USA)  
J. Clare (New Zealand)  
G. Czibula (Germany)  
K. Ganesha (India)  
A. Hanson (UK)
1. Call to order
The Division Director, F. Hengstberger, opened the meeting, and welcomed all present. He thanked the Council for Optical Radiation Measurements (CORM) for inviting this Division 2 meeting as a joint event, and thanked NIST Boulder that offered the venue for the meeting. He asked all present to introduce themselves.

2. Approval of agenda
The circulated agenda of this meeting was approved by an addition of "0. Opening".

The Director asked the attendees the impression of the last D2/D4 joint meeting in Durban. Rennilson mentioned that it was very worth while and made a good progress on the cooperation between the two divisions on some overlapped issues. Terstiege supported it. Div.2 will plan more joint meetings with other Divisions (1, 4, and 6) in the future.

3. Approval of 1997 Division 2 meeting minutes
The circulated minutes of 1997 Division 2 Meeting in Durban were approved with no change.

4. Secretary's report (Y. Ohno)
(1) Div. 2 now has 34 country members, the same as last year. Hong Kong became a part of China, but we still have its country member because CIE considers it as a "geographical area" which is defined in the CIE Statutes and it can be treated as a country. There were changes of three country members since last meeting:
   Argentina: J. A. Cogno replaced R. D. Rozano.
   Hong Kong: H. W. Lai replaced T. M. Chung.
   New Zealand: J. Clare replaced M. G. White.
   Netherlands: A. Bouman. replaced J. M. M. Claassens

(2) The 1997 Activity Report, which included the minutes of the 1997 D2 meeting, was prepared and distributed in December 1997. This was distributed by mail also. The Call for Nomination of DD was distributed to all CM by mail also. 15 circulars in total were distributed by e-mail and fax. All the circulars, except small follow-up e-mails, are published also on the CIE D2 Website.

(3) The D2 mailing list now contains 98 persons, that includes 34 country members and 23 TC chair persons. Among them, 81 have e-mail addresses (82 %), a rapid progress from 64 % at the last meeting in Sep. 97. 9 persons are accessed by fax, 8 by mail. The Secretary are using e-mail and the website as a main communication means. Those who still do not have e-mail addresses are strongly recommended to

Underlines indicate country representatives.
get one. Documents are often sent as e-mail attachments. Now, MS Word file (doc) is used, but PDF file
(more platform-independent) will also be used. CIE CB plans to use PDF for electronic balloting.
Suggestions and/or information on any problems in e-mail circulars are welcome to the Secretary.

(4) The D2 website, established in March 1997, was reconstructed in January 1998, to include much more
information. We had Division Secretaries meeting in October 1997 at CIECB regarding division websites,
and it was agreed that Division 2 website is recommended as a model for other divisions. Div. 1, 3 and 6
are now developing their websites. In the D2 website, we have pages for each Technical Committee. All
the TC chairpersons are encouraged to send to the Secretary any materials to be published in this TC page.
Any other ideas how to use our website are welcome.

(5) CIE Workshop and Symposium - Standard methods for specifying and measuring LEDs &endash; was
held on Oct.22-25, 1997, at CIECB, Vienna. This meeting was organized by CIECB and Division 2, and
attended by about 50 participants. There were a two-day tutorial session and a two-day workshop session.
Hengstberger, Moore, Sauter, Ohno, Muray, Sliney, and Schanda were the lecturers of the tutorial. During
the workshop session, the new publication on LED measurements (from TC2-34) was introduced and
discussed by the participants. The key part of the document is the definition of the Averaged LED
Intensity (in A and B geometries), which should bring uniformity in the intensity measurements. The
discussion identified some improvements to be made particularly on the luminous (and radiant) flux
measurements. The LED document was published as CIE Pub. 127, and the proceedings of this meeting
was published as CIE x013-1997.

(6) CIE Expert Symposium on Color Standards and Imaging Technology, was held on Nov. 21-22, 1997 in
Scottsdale, USA, in conjunction with IS&T Color Imaging Conference, Nov. 17-20. This meeting was
organized by CIE Div. 1 and the CIECB, and chaired by A. Robertson. Talks from Div. 2 included Berns
(former TC2-26 chair), Hanson (TC2-42 chair), Ohno (D2 Secretary), and Rich (TC2-39 chair). Schanda
also attended representing CIECB. There were representatives from many committees in different
organizations and groups (ISO, IEC, JTC1, ITU, etc.), and overlaps and chaotic situation between
organizations were addressed. The discussion at the end of this Symposium lead to a proposal for CIE to
create a new Division to take a leadership in the standardization in imaging technology area. Abstracts of
talks at this Symposium are available in the Proc. 5th IS&T Color Imaging Conference. (The issue on the
new CIE Division proposal is also reported in Section 11. General.)

5. Editor's report
A written report from the Editor was read by the Secretary as below.
No new material has been received by the Editor since the Division meeting in Durban in September last
year.

(1) TC 2-22 Luminous Flux of HP Sodium Lamps
Documentary material obtained from the former TC Chairman was handed to the Editor at the Durban
meeting with a request that he should compile from it a report on the conclusions of the intercomparison.
The report will appear in the next appropriate CIE Collection which is likely to be published towards the
end of 1998.

(2) TC 2-34 Measurement of LEDs
Publication CIE 127-1997, Measurement of LEDs, has now been published. It was launched by a four day
Tutorial Workshop and Symposium on LEDs which took place at the CIE Central Bureau in October last
year. Although they appeared in the Editor's Report last year, work on the Technical Reports prepared by TC
2-14, TC 2-33 and TC 2-35 has still to be completed. Details will be given in the reports of the individual
TCs.
6. Progress report of Technical Committees

6.1 Technical Committees

Progress reports on the technical committees were given by Associate Directors, Goodman and Johnson, and by Director, Hengstberger for AD Vandermeersch.

TC2-04 Secondary standard sources
Chair: J. Moore (Great Britain) AD: Goodman
ML: Bandyopadhyay (India), Corrons (Spain), Gaertner (Canada), Jiang (China), Low (USA), Metzdorf (Germany), Nishi (Japan), Schanda (Hungary)
TR: Produce a technical report on the selection and operation of stable secondary standard sources.
ST: The greater part of the report has been completed for some time. Objections were made in Durban relating to planned photographs and illustrations, which might be able to be identified. Increasing the number of different types of lamps illustrated may solve this. Chairman plans to circulate for TC ballot at the end of June.

TC2-14 Measurement of Reflectance and Transmittance, Including Turbid Media
Chair: P. Polato (Italy) AD: Johnson
ML: Bianchini (Italy), Gundlach (Germany), Hsia (USA), Morren (Belgium), Verrill (Great Britain)
TR: Define the standard geometric conditions for the measurement of transmittance and reflectance.
ST: The document "Practical methods for the measurement of reflectance and transmittance" went through TC ballot. The document is now going to be sent for Board and Division ballot. CIECB is proposing to do electronic balloting using PDF file at an FTP site. Divi.2 supported this idea with no objection. Suggestion was made to include instructions how to download Acrobat reader (from Adobe website). A possibility of turning this document into CIE standard should be considered in the future. (Brep9807- The Division ballot is in progress. The BA ballot will follow.)

TC2-16 Characterization of the performance of tristimulus colorimeters
Chair: M. L. Rastello (Italy) AD: Goodman
ML: Denner (South Africa), Goodman (Great Britain), Hengstberger (South Africa), Moore (Great Britain), Muray (USA), Ohno (USA), Rattunde (Germany), Robertson (Canada), Sauter (Germany), Schanda (Hungary), Steindl (Austria), Terstiege (Germany)
TR: To produce a report recommending methods for assessing the performance of tristimulus colorimeter heads for measuring chromaticity coordinates.
ST: Report given by P. Soardo who held a TC meeting for Rastello on May 18th in Boulder with about 30 participants. The fourth draft (changes marked on the third draft) was distributed and discussed. Suggested changes will be compiled by the chairperson to make the fifth draft, which will be distributed before Warsaw Session when the next TC meeting is planned.

TC2-17 Recommendation for integrated irradiance and spectral distribution of simulated solar radiation
Chair: D. Kockott (Germany) AD: Goodman
ML: Aydilii (Germany), Goodman (Great Britain), Ignatiev (Russia), Justus (USA), Kaase (Germany), Kasten (Germany), Kok (South Africa), Wilkenson (Australia), Zerlaut (USA)
TR: Revise and update CIE Publication No.20 (1972)
ST: The draft document 'Solar simulators for testing purposes' was circulated to all D2 members for comments following the Durban meeting, to ensure a wide range of applications was considered. This has generated some response and the chairman is now preparing a revised draft.

TC2-19 Measurement of the Spectral Coefficient of Retroreflection
Chair: N. Johnson (USA) AD: Johnson
ML: Arens (USA), Brekke (Norway), Fisher (USA), Hsia (USA), Hubert (France), Kurioka (Japan), Price (Great Britain), Rendu (France), Rennilson (USA), Richey (Germany), Schreiber (Germany), Sugiyama (Japan), Terstiege (Germany), Vandermeersch (Belgium)
TR: Identify the critical measurement parameters, tolerances, and requirements for, and conduct an international intercomparison of, the spectral coefficient of retroreflection.
ST: The TC document is mostly finished. Some data are to be included in the document. The chairman plans to send the final draft for TC voting by Warsaw Session. Further TC meetings are not planned.

**TC2-23 Photometry of Street-Lighting Luminaires**
Chair: G. Vandermeersch (Belgium)  AD: Vandermeersch
ML: Arens (US), Blaser (Switzerland), Blochouse (Belgium), Claassens (NL), Corrons (Spain), Price (Great Britain), Rattunde (Germany), Rossi (Italy), Simons (Great Britain), Sorensen (Denmark)
TR: Prepare a technical report on the photometry of street lighting luminaires.
ST: No report this time.

**TC2-24 Users guide for the selection of illuminance and luminance meters**
Chair: K. Ganesha (India)  AD: Goodman
ML: Andor (Hungary), Arens (USA), Austin (USA), Bastie (France), Chang (Taiwan), Dibbern (Germany), Eppeldauer (USA), Gardner (Australia), Goodman (UK), Hengstberger (S. Africa), Moore (UK), Muray (USA), Ohno (USA), Rennilson (USA), Ritzol (USA), Saurer (Germany), Sojourner (USA)
TR: Prepare a user's guide for the selection and use of illuminance and luminance meters.
ST: A letter from the chairman was received by Secretary prior to the meeting. The chairman reports as follows. He has not been receiving any responses, from the members of the TC, on the draft outline circulated in April, 1997. He presumes that the current TC members do not appreciate urgent need for the guidelines of the draft. The chairman has prepared the third draft outline but needs some data to be collected from the users at large. He has prepared a questionnaire for wide circulation. He is mailing these along with a brief note on the need for the guidelines, a copy of a paper presented by him in the ISLE Symposium in New Delhi in Jan. 1997, with additions by 10th June, 98. An advance copies of these papers will be sent by May 30th. The program will go now with a strict time schedule requesting every member to respond within a given date. Depending on the response received by 15th of July, the TC will be formalized and further communications sent. The chairman hopes to complete this work by Warsaw Session.

**TC2-25 Calibration Methods and Photoluminescent Standard for Total Radiance Factor Measurement**
Chair: J. Zwinkels (Canada)  AD: Johnson
ML: Bristow (Sweden), Erb (Germany), Leland (USA), McCamy (USA), Nayatani (Japan), Puebla (Germany), Racz (Hungary), Simon (USA), Witt (Germany), Verrill (Great Britain)
TR: Prepare a CIE report on methods for measurement of total radiance factors of photoluminescent materials. Recommendations for realizing and calibrating photoluminescent standards by the one and two-monochromator method will be included.
ST: The TC met on 18 May in Boulder. The 7th draft, distributed in Feb. 98, was discussed. The document is essentially complete. Outstanding action items are: inclusion of figures, editorial changes, expansion of Appendices in Section 3.2 on Two Monochromator Methods, and inclusion of Serial Filter Method in Section 3.1 on One Monochromator Methods. The next meeting is planned in conjunction with ISCC and TAGA Annual Meeting, May 5-7, 1999, Vancouver, B.C. The 8th draft of the document should be ready for TC voting.

**TC2-28 Methods of characterizing spectrophotometers**
Chair: J. Verrill (Great Britain)  AD: Goodman
ML: Andor (Hungary), Bastie (France), Berns (USA), Distl (Germany), Eckerle (USA), Konstantinova (Bulgaria), McCamy (USA), Robertson (Canada), Sugiyama (Japan), Ulyanov (Russia), Zwinkels (Canada)
TR: Write a CIE report on the characterization of spectrophotometers by means of reference materials and other methods, with particular reference to linearity, wavelength error, stray light, and integrating sphere errors.
ST: The third draft was circulated to TC members in April. The text completed by the chairman and figures and references have been added. It is expected that there will be one more draft before voting and
then a 5th draft for the vote, which should be completed before the end of this quadrennium.

**TC2-29 Measurement of detector linearity**  
**Chair:** T. Goodman (Great Britain)  
**AD:** Goodman  
**ML:** Andor (Hungary), Bastie (France), Bittar (New Zealand), Budde (Canada), Distl (Germany), Dezsi (Hungary), Mihailov (Russia), Mostl (Germany), Ohno, Parr (USA)  
**TR:** Prepare a CIE guide on methods for the characterization of the linearity of detectors of optical radiation, including different principles by which the linearity of detectors can be determined and causes of non-linear behavior, to aid users of optical radiation detectors in the selection and use suitable devices for specific applications.  
**ST:** A brief TC meeting was held on 18 May 1998 to summarize current status and request additional inputs by the end of June in order for the third draft to be prepared for circulation in early November. Comments on the third draft will be requested by the end of the year.

**TC2-30 Diode Array Radiometry**  
**Chair:** AD: Johnson  
**ML:** Abasari (Hungary), Andoh (Japan), Goodman (Great Britain), Jones (USA), Mihailov (Russia), Pfleger (Austria), Sauter (Germany)  
**TR:** Prepare an annotated bibliography for the CIE journal on diode array radiometry. Make appropriate recommendations for future work in diode array radiometry.  
**ST:** The chairman, Wychorski, has resigned due to his increasing work load. But, he was present at the meeting, and gave a report. The document is currently the 4th draft, having 78 pages in 3 sections. None of them is copyrighted. Small part of the document is not complete. There is also a separate database file with about 800 entries of references. This data base is copy-righted, and payment is needed for use. About 1/3 of the references are in the written document which is not copy-righted. There was discussions, and Div.2 agreed to publish the document in the CIE Collection coming up at the end of the year. Whychorski will work with AD Johnson to publish this document in the Collection.  
(After the D2 meeting, James Palmer (Univ. Arizona, USA) agreed to take over the chairmanship to finish up the document for publication.)

**TC2-32 Measuring Retroreflectance of Wet Horizontal Road Markings**  
**Chair:** N. Hodson (USA)  
**AD:** Johnson  
**ML:** Dibbern (Germany), Hubert (France), Johnson (USA), Meydan (Australia), Meseberg (Germany), Rennilson (USA), Schmidt-Claussen (Germany), Schreuder (Netherlands)  
**TR:** To prepare a guide for the methods of measuring coefficient of retroreflected luminance (specific luminance) of horizontal road markings under wet weather conditions.  
**ST:** The new chairman, Hodson, has taken over the TC. The TC met on May 18th in Boulder with 11 participants. The partial draft document was distributed and discussed. The TC is looking for new members who have expertise on rain simulation area and visibility pavement marking. The TC plans to meet again this year in October in conjunction with the Div. 4 meeting in Bath, England, hopefully to attract Div.4 people. The TC also plans to meet in Warsaw in 1999.

**TC2-33 Reformulation of CIE Standard Illuminants A and D65 (Revision of CIE/ISO 10526)**  
**Chair:** K. Mielenz (USA)  
**AD:** Johnson  
**ML:** Hsia (USA), Moore (Great Britain), Robertson (Canada), Terstiege (Germany), Verrill (Great Britain)  
**TR:** To rewrite CIE Standard S001 in terms of thermodynamic temperatures, and in a manner such that the spectral distributions of the standard illuminants are preserved, but are independent of international temperature scales.  
**ST:** The final national committee ballot is complete, and the document has been published as CIE S 005 "CIE Standard illuminants for colorimetry". Voting by ISO members for a joint ISO/CIE Standard is in progress. This document will supersede the ISO/CIE 10526. This TC is closed.

**TC2-34 LED Measurements**
Chair: K. Muray            AD: Goodman
ML: Angerstein (Germany), Bando (Japan), Bym (USA), Carr (USA), Distl (Germany), Goodman (Great Britain), Heidel (Germany), Hwang (Taiwan), Jones (USA), Lester (USA), Moore (Great Britain), Ohno (USA), Rastello (Italy), Sauter (Germany), Scarangello (USA), Schanda (Austria), Schumacher (Germany), Sojourner (USA)
TR: To investigate and recommend standard LED measurement methods including parameters to be measured.
ST: Report given by the chairperson. A CIE Workshop on LED measurements was held in October 1997, and after the Workshop, the TC document was published as CIE 127. The new term Averaged LED Intensity is introduced in the document. More work is to be done on the total flux measurement and spectral measurement, and a follow-up TC may be necessary. Jones commended the work by the TC referring to the usefulness of the CIE 127 in industry. Ohno and Scalangello commented on the need for further standardization on LED total flux (forward or partial flux) measurement. Sauter added that this LED document (luminous intensity part) should be published as a CIE/ISO standard. In any case, as the document has been published, this TC is now closed. The follow-up work should begin under newly proposed TCs (See Section 8).

TC2-35 CIE Standard for \( V(I) \) and \( V'(I) \)
Chair: K. Mielenz (USA)            AD: Johnson
ML: Bastie (France), Gardner (Australia), Hengstberger (South Africa), Moore (Great Britain), Ohno (USA), Parr (USA), Robertson (Canada), Sauter (Germany), Schanda (Hungary)
TR: To prepare a new CIE Standard on the present \( V(I) \) and \( V'(I) \) functions.
ST: No report received from the chairman. Sauter reported as an active member. There was a problem of the document status interfering with the competence of CCPR. Sauter had a discussion with the CCPR president, and in January this year, sent to the chairman suggested changes to the document to solve this problem. The Secretary added that, according to recent conversation with the chairman, he is working to revise the document, once again, to respond to Sauter's comments as well as many other comments he received from several other members after editing in 1996 by the Editor. The document will go through another voting.

TC2-36 Retroreflection: Definition and Measurement (Revision of CIE Publication 54, Liaison with CEN/226)            AD: Johnson
Chair: J. Rennilson (USA)
ML: Arens (USA), Couzin (USA), Dibbern (Germany), Heenan (USA), Johnson (USA), Kramp (Germany), Nanjo (Japan), Schmidt-Clausen (Germany), Terstiege (Germany), Werner (Sweden)
TR: To revise and update publication 54. To standardize test methods and measurement geometry for measuring the photometric and colorimetric properties of all types of retroreflectors under both day and nighttime conditions. To prepare this CIE document in ISO format to be issued as a joint CIE/ISO standard.
ST: The TC met on May 18 in Boulder, for two hours, with 6 members and 10 observers. The 8th draft report was distributed and discussed. The new draft incorporates the comments for the 7th draft which were previously distributed. A few sections need improvement, and a further version to be prepared for discussion in Bath, October 1998, after which, the document is to be approved by TC. The chairman plans a short meeting in Warsaw, too. The liaison with CEN is maintained only through the members of the TC who also serve on CEN committees. There has been no official liaison function established, and the work of this TC is not recognized by CEN at the moment. Some official channels of communication need to be established at the top level of CEN and CIE.

TC2-37 Photometry Using Detectors as Transfer Standards
Chair: Y. Ohno (USA)            AD: Johnson
ML: Andor (Hungary), Austin (USA), Bastie (France), Bittar (New Zealand), Czibula (Germany), Corrons (Spain), Dézsi (Hungary), Eppeldauer(USA), Gardner (Australia), Goodman (U.K.), Kohler (BIPM), Muray(USA), Pietrzykowski (Poland), Rattunde (Germany), Rastello(Italy), Sauter (Germany),
Schanda (Hungary), Sojourner (USA), Wychorski (USA)

TR: To prepare a report on the properties of V(l)-corrected detectors that are suitable for disseminating and maintaining photometric units. This report will include methods for the use of these detectors.

ST: The TC had a short meeting on May 18 in Boulder with 38 participants including 13 members. The fifth draft was distributed and discussed. The new draft was previously distributed to the members in April. The draft is complete except for correcting some wording and bringing consistency in usage of a few terms. The W0 issue will wait for an advice from the CCU. The chairman plans to send out the sixth draft for the TC ballot within a few month.

TC2-39 Geometric Tolerances for Colorimetry

Chair: D. Rich (USA)  AD: Johnson

ML: Baba (Japan), Bittar (New Zealand), Decarreau (France), Erb (Germany), Fisch (USA), Hanssen (USA), Jordan (Canada), Johnson (USA), Kravetz (USA), Ladson (USA), Terstiege (Germany), Pietrzykowski (Poland), Verrill (Great Britain), Zwinkels (Canada),

TR: Compile a technical report and recommendations specifying the geometric tolerances for the various geometries in colorimetry, including 0/45, 0/d and others. Parts of this technical report may be suitable for inclusion in a CIE standard specifying several geometric tolerance levels.

ST: The Committee met for the fourth time on May 18th in Boulder. Four Committee members and six guests were present. Discussions during the meeting resulted in the following actions:

1. There was a general agreement that the use of the terminology "bidirectional" should be reserved for instruments with nearly parallel rays and multiple angles of illumination or view. The normal 45/0 instrument has biconical beams and the committee recommends that the change in notation be communicated to Michael Pointer, editor of Publication 17.3.
2. Comments from guest C. McCamy indicated that the current CIE tolerances are tolerancing the wrong information. Based on publications from the NPL, the tolerances for 45°/0° will result in maximum color differences of 3.0 CIELAB units. Tightening the tolerances will result in improvements in the color differences but tolerancing the uniformity of the illumination and viewing cones will result in a greater improvement.
3. ASTM standard 1763 recommends the use of a very small sampling aperture to verify the uniformity of the specimen port. It was recommended by the committee that the committee report include recommendations for using a sampling aperture of physical and angular size (1/20) of the specimen aperture. The committee will also try to include a recommendation for a material standard for testing the uniformity of hemispherical geometry.
4. C. McCamy requested that the report make a clear distinction between the surface reflectance and the specular reflectance.

During the next few months, the chairman will prepare a draft of the final report and distribute the draft to committee members for comment. NIST and 3M have volunteered to supply some measurement data on standard materials to verify the effect of tightening the tolerances. The TC plans to meet at Warsaw in 1999.

TC2-40 Characterizing the Performance of Illuminance and Luminance Meters

Chair: R. Rattunde (Germany)  AD: Goodman

ML: Bastie (France), Czibula (Germany), Dezsi (Hungary), Goodman (UK), Khandelwal (India), Khanh (Germany), Mahidharia (India), Moore (UK), Ohno (USA), Pietrzykowski (Poland), Saito (Japan), Sauter (Germany)

TR: Convert the present CIE Technical Report No. 69 into an ISO/IEC standard. Prepare a combined CIE/ISO standard describing the definitions of quantities influencing the performance of illuminance and luminance meters, as well as defining measurement procedures for the individual error quantities.

ST: Report given by the chairman. The TC had a successful meeting on May 18th with 35 participants. Discussed the second draft which was circulated in March. There were active discussions with many comments from the attendees. The TC added some new members. The chairman requested the attendees to send further comments on the draft within a few months. The third draft will be prepared for discussion.
at Warsaw Session.

TC2-41 Industrial Photometry in Developing Countries

Chair: B. Bhattacharya (India)  AD: Goodman
ML: Chananchop (Thailand), Goodman (Great Britain), Moscati (Brazil), Ohno (USA), Sastri (India), Sauter (Germany), Ye (China)

TR: To prepare a Technical Report giving guidance on recommended practices for photometric measurement (including sphere photometry and goniophotometry), taking account of the special requirements of industrial laboratories in developing countries.

ST: No report received from the chairman this time. This TC was established in 1995. If no progress is made by 1999 D2 meeting, this TC may be closed.

TC2-42 The Colorimetry of Visual Displays

Chair: A. Hanson (Great Britain)  AD: Goodman
ML: Andor (Hungary), Berns (USA), Dalton (Great Britain), Fairchild (USA), Ikeda (Japan), Hardis (USA), Leone (USA), Luo (Great Britain), Maelfeyt (Belgium), MacDonald (Great Britain), McFadden (Canada), Munger (Canada), Reid (Great Britain), Schanda (Austria), Stokes (USA), Sakata (Japan), Stienstra (Netherlands), Ohno (USA), Vienot (France)

TR: To produce a Technical Report summarizing recommended practice for the measurement of the colorimetric and spectroradiometric properties of visual displays.

ST: An outline of the structure of the proposed report was discussed a the Expert Symposium on Color Standards for Imaging Technology in Scottsdale in Nov. 1997. The chairman is also taking care to coordinate the work of this TC with activities in the IEC.

TC2-43 Determination of measurement uncertainties in photometry.

Chair: G. Sauter (Germany)  AD: Goodman
ML: Bastie (France), Corrons (Spain), Goodman (Great Britain), Köhler (BIPM), Moore (Great Britain), Ohno (USA)

TR: To prepare a CIE recommendation as basis for the determination of measurement uncertainties valid for selected quantities used in photometry.

ST: The report was given by the chairman. The TC met for the first time on May 18th in Boulder with about 35 participants. The first draft, distributed in April, was discussed. The word "selected" was added in the TR to make it more accurate. There were active discussions on the structure of the document. There were suggestions for the document to start with a part with more plain descriptions for photometry practitioners, followed by the rigorous mathematical procedures as given in the current draft. Based on the discussions, the next draft will be prepared for the second meeting in Warsaw. (The minutes of the TC meeting was distributed by e-mail on June 25, 1998)

TC2-44 Vocabulary Matters

Chair: J. Moore (UK)  AD: Vandermeersch
ML: Billmeyer (USA), Burghout (Netherlands), Ionescu (Romania), Johnson (USA), Kohler (BIPM), Morren (Bergium), Nishi (Japan), Ohno (USA), Poppe (Hungary), Sauter (Germany), Schanda (Hungary), Woo (Canada)

TR: To provide liaison between Div.2 and TC 7-06 "Lighting Terminology" and support the preparation of the new edition of the Lighting Vocabulary in the field of light and colour measurements.

ST: The report from the chairman was read by Secretary. Work has only just started in this TC. A letter is being sent to members asking them to give their views on changes that they would like to see made to existing definitions in the International Lighting Vocabulary and on new terms that should be introduced. The new ILV will certainly incorporate the new definitions agreed by Division 2 which appear in the CIE Collection on Photometry and Radiometry, Publication CIE 114-1994. These include precise new definitions for distribution temperature and ratio temperature as well as the terminology relating to non-selective detectors. It is still not clear what central policy TC 7-06 will recommend concerning the number and scope of the new definitions to be adopted, but, for the present, I am suggesting that perhaps Division 2 should follow the policy already adopted by Division 1, keeping changes to existing definitions...
to a minimum and limiting the introduction of new terms to those that are regarded as essential. The definitions of terminology contained in the various Division 2 Technical Reports, both those now published and those still in preparation, will be examined to determine which of the terms listed are appropriate for inclusion in the ILV.

Follow-up issues

(1) TC2-10 (Photometry and Goniophotometry of Luminaires) was closed in 1997, but the Director reported that small changes were made on the published document CIE 121, according to the decision made at the last D2 meeting. "luminaires" has been changed to "lamps and luminaires" in the title and abstract.

(2) TC2-22 (Luminous Flux of High-Pressure Sodium Lamps) was closed in 1997, but documentary material is to be compiled into a report by the Editor and it is to be published in the next CIE Collection. The material is at the hand of the Editor.

(3) The Director mentioned that Associate Director, Vandermeersch, is now involved in European standardizing activities and is getting too busy for his CIE work, which is affecting the D2 work on luminaire photometry. It is urgent for Division to find a good leader in this area. Recommendations are welcome. Request was made to Rennilson to look into Div.4 and to Goodman to contact Lou Bedocs in UK.

6.2. Reporters

R2-05 Visual Gloss (J. Taylor, Great Britain)  AD: Goodman
ST: AD reported. The status is still as last year i.e., a TC is not yet appropriate. Work is underway in several countries on the measurement of 'appearance' and a watching brief is being kept to see whether the situation changes. The reporter is to get information from NIST and ASTM subcommittee on appearance: E12-14.

R2-06 Standardization of Measuring Geometry for the Colorimetry of Metallic Coatings (C. McCamy, USA)  AD: Johnson
ST: McCamy reported. There is continuing work on the standardization of methods of observing and measuring the colors of metallic and pearlescent materials, in the American Society for Testing and Materials (ASTM). The working group assigned that task has been made Subcommittee E12.12, Metallic and Pearlescent Colors, of Committee E12, Color and Appearance. Much of the work has been on refining concepts and terminology. Current work is directed toward standardization of methods of observing and measuring the colors of these materials. Multi-angle spectrophotometry is used internationally for this purpose, most notably in the automotive industry. McCamy has reported the development of the concepts, terminology, and methods of observation and measurement of the colors of these materials in two publica-tions. The appearance at a distance of a few meters was treated in "Observa-tion and measurement of the appearance of metallic materials. Part I. Macro Appearance", Color Res. Appl.,21, 292-304 (1996). "Part II. Micro Appearance", treating the appearance at reading distance, has been accepted by the same journal. The most notable finding reported in this latest paper is the importance of binocular vision in the perception of the appearance of metallic materials. These materials may present different colors and differ-ent patterns of glitter to the two eyes, giving rise to perceptions of binocular luster and binocular glitter. The reportership will continue. No need for a TC at this moment.

R2-09 Absolute Cryogenic Radiometers (A. Parr, USA)  AD: Johnson
ST: Report given by Parr. Many national labs now use cryogenic radiometers. In the U.S., they are used
also by commercial sector for space applications. There is a need for a guide on utilization of these devices. The reporter is starting to think about a new TC. A longer report will be prepared for Warsaw with a proposed TR and an outline of the document. Köhler supported Parr's report, referring to the number of the cryogenic radiometers (total ~30 now) in the world, and mentioned that the TR must be carefully made to include characterizations of sources and other instrumentation as well as radiometer itself. The reporter will circulate further ideas for a new TC in next a few months.

**R2-17 Aviation Photometry (Y. Ohno, USA)**  
AD: Goodman  
ML: Bhagat (USA), Hengstberger (South Africa), Verdier (France)  
ST: Ohno reported. The document ARP5029 (Measurement Procedures for Strobe Anticollision lights) is being published from SAE (Society for Automotive Engineers). NIST started providing calibration services for flash photometers, as the FAA(Federal Aviation Administration)'s regulation came into effect. During these activities, a need for a CIE document for photometry of flashing light (no only for anticollision lights but in general) was confirmed. The existing document CIE105 (Spectroradiometry of pulsed optical radiation sources&endash;1993) does not address photometry terms and derivation of photometric quantities for flashing light measurement. Thus, a new TC should be formed for this subject. Visual perception issues are also addressed (e.g., the validity of Blondel & Rey Equation in various conditions and for different types of sources) by the SAE and aviation community, which should be brought to Div. 1. The reporter has also established a contact with ICAO (International Civil Aviation Organization). This reporter will be kept for another year to continue discussion with ICAO on other subjects in aviation photometry.

**R2-18 OIML Matters (G. Sauter, Germany)**  
AD: Hengstberger  
ST: No report this time. Hold this reportership till next year.

**R2-21 Use of detectors as absolute transfer standards for spectroradiometry (N. Fox, Great Britain)**  
AD: Goodman  
ST: New techniques are being investigated at NPL and elsewhere, but are not yet sufficiently well-developed to warrant establishment of a TC. The situation will continue to be monitored.

**R2-22 Implementation of Photometric Units (R. Köhler, BIPM)**  
AD: Vandermeersch  
ST: Köhler reported. This reporter was established last year to study the need for a document to guide future implementation of photometric units for non-V(l) functions. This was proposed by Moore in Durban, but Div. 2 did not decide to establish a TC then. The reportership is continued for the time being to watch the situation, contacting Div. 1 also.

**6.3. Liaison report**

**CCPR (Köhler)**  
Köhler reported with a short presentation, overviewing the organization and activities of CCPR (Comité Consultatif de Photométrie et Radiométrie) and BIPM (Bureau International des Poids et Mesures), and then introducing the concept of the CCPR Key Comparisons. The equivalence of national standards is becoming essential for traceability requirements (to national labs) made in ISO Guide 25 and other quality systems. Pressures come from trade agreements such as Transatlantic Agenda/MRA and EC-US Agreement on Trade. Reduction of technical barriers in trade necessitates mutual acceptance of test methods. For example, there is an effort between Euromet and NIST to develop a publicly available data base, which will contain the results of international intercomparisons. The results of the past international intercomparisons of photometric units, including the illuminance intercomparison just finished last year, were also overviewed.

**ISO/TC6 (J. Zwinkels)**  
This is a very active committee. A plenary session of ISO/TC6 was held in Cape Town, S.A., Nov. 1997. The main issues discussed in WG3 (Optical Properties of Paper, Pulp and Board) were: comparison
between NRC and PTB, new authorized laboratories, liaison with ISO/TC 130, indoor whiteness and
ISO-brightness, gloss measurement at 75° and 20° and instruments for d/0° and d/8°. Several ISO draft
standards were received for review and comments were given to CIE CB. These documents were: FDIS
2471 (Paper and board - determination of opacity (paper backing), FDIS 9416 (Paper - determination of
light scattering and absorption coefficient (using Kubelka-Munk theory), and ISO/DIS 11475 (Paper and
Board - CIE whiteness, D65/10°. Comments included addition of CIE and ISO/CIE standards as
normative references and changes to definitions to conform with ILV.

ICO (F. Hengstberger)
This reportership is closed.

IMEKO (J. Schanda)
This reportership is closed.

IEC TC100 /PT61966 -Colour Measurement and Management in Multimedia System (Y. Ohno)
Report given by Ohno. He met with H. Ikeda, the chairman of TC100/PT61966, last November at the
Color Imaging Conference in Scottsdale. Later, the liaison between CIE D2 and TC100/PT61966 was
officially established. This is a very active committee with full use of e-mails and website. The PT (project
team) has about 50 members. The PT published a liaison report in January, which was distributed by D2
Circular Jan/22/98. The PT is developing (or plans to develop) 11 documents related to color management
and color measurement. Some of the documents are planned to be ISO/IEC/CIE joint standards. Among
them, four draft documents (for CRT, LCD, Digital camera, and Default RGB space) were posted on the
website (http://www.map.chiba-u.ac.jp/IEC/100/PT61966) for comments by April 30. This was informed
to CIE D2 mailing list by D2 Circular Mar/19/98 with a request to review these documents. Many poor
descriptions of photometric and radiometric terms and measurement procedures were found in these
documents. Schanda, Ohno, and Hanson (TC2-42 chair) sent comprehensive comments on these
documents. There was a PT61966 meeting on May 14-15 in Derby, England, where they discussed these
four draft documents. None of us from CIE could attend it, but Hanson's staff (Chris Wall) attended this
meeting and gave a liaison report on CIE D2 on our behalf. Many of our comments were adopted.

JTAG2 - ISO/IEC Joint Technical Advisory Group 2 (A. Robertson)
The report from Robertson was received by Secretary. There was a JTAG2 meeting in Geneva in January
13-14, 1998. The key parts of the January JTAG2 minutes are the resolutions supporting the CIE's current
initiative in the field of imaging technology, and the formation of an ad hoc coordinating committee of
which Robertson is a coordinator. Active discussions by the ad hoc committee members took place on
e-mail for the last several months. According to the discussions, the most likely development is a new
Division although there is some support for starting things under the umbrella of Division 1. (Further
report on the new CIE Division is given in Section 12.)

7. Close of TCs and other functions

Technical Committees: TC2-33, TC2-34
Reportership: none closed.
Liaison: ICO and IMEKO

8. New TCs

Per discussion during the TC2-34 report (See 6. Progress report of Technical Committees), Div. 2 agreed
to establish the following two TCs related to LED measurements. The reason for two TCs proposed was to
publish, as soon as possible, the luminous intensity part of CIE 127 as CIE/ISO standards without waiting
for many other issues to be discussed for revision of CIE 127.

(1) **Title: Measurement of LEDs - Revision of CIE 127**  
**Chair:** K. Muray (USA)  
**TR:** Revise CIE Pub. 127 to include improved definitions of quantities and methods of measurement for total flux and partial flux of LEDs and to reevaluate other parts including spectral and color measurements of LEDs.  
**Initial ML:**  
Former TC2-34 members, plus, C. Jones, J. Scarangello  
(This new TC was approved by the Board in June 1998 as TC2-45.)

(2) **Title: CIE/ISO standards on LED intensity measurements**  
**Chair:** J. Scarangello (USA)  
**TR:** To prepare a CIE/ISO standard on the measurement of LED intensity measurements based on the CIE Pub. 127.  
**Initial ML:** Former TC2-34 members, plus, C. Jones, A. Bouman (Netherlands), D. Ellis (USA), K. Bando (Japan).  
(This new TC was approved by the Board in June 1998 as TC2-46.)

G. Xu presented the need for the standardization in characterizing UV radiometers, and proposed a new technical committee. Div.2 agreed to establish this TC.

(3) **Title: Characterization and Calibration Methods of UV Radiometers**  
**Chair:** Gan Xu (Singapore)  
**TR:** Prepare a CIE recommendation on methods of characterization and calibration of broad-band UV radiometers in the spectral ranges of UVA and UVB for industrial applications.  
**Initial ML:** F. Hengstberger (South Africa), F. Wilkinson (Australia), R. Lambe (UK), G. Sauter (Germany), R. Rattunde (Germany), B. Saunders (USA), J. Pietrzykowski (Poland), A. Corrons (Spain)  
(This new TC was approved by the Board in June 1998 as TC2-47.)

G. Eppeldauer presented a proposal for the following TC. The main point of his proposal was that there have been many new detector technologies developed for the last fifteen years, and the CIE 64 needs to be updated. A need for cooperation with the above new TC (3) on UV radiometers was noted.

(4) **Title: Spectral responsivity measurement of detectors, radiometers, and photometers.**  
**Chair:** G. Eppeldauer  
**TR:** To rewrite the technical report CIE 64 (1984) "Determination of the spectral responsivity of optical radiation detectors" to update device and measurement technology, and include the spectral irradiance responsivity measurement for radiometers and photometers from UV to near IR.  
**Initial ML:** J. Palmer (USA), G. Sauter (Germany), R. Kohler (BIPM), R. Rattunde (Germany), J. Pietrzykowski (Poland), A. Corrons (Spain), G. Dezsi (Hungary), J. Gardner (Australia), Xu-Gan (Singapore), P. Boivin (Canada), L. Larsen (Denmark), B. Bauman (USA), T. Larason (USA)  
(This new TC was approved by the Board in June 1998 as TC2-48.)

Y. Ohno proposed the following new TC based on the report given for R2-17 Aviation Photometry (See 6.2. Reporters). Div. 2 agreed to establish this TC.

(5) **Title: Photometry of Flashing Light**  
**Chair:** Y. Ohno  
**TR:** Produce a technical report for photometric measurements of flashing light, including derivation of the photometric quantities applied to flashing light, measurement of light sources, and calibration of photometers for flashing light.  
**Initial ML:** J. Arens (USA), R. Austin (USA), D. Couzin (USA), D. Ellis (USA), F. Hengstberger (South
Africa), H. Kondo (Japan), R. Rattunde (Germany), G. Sauter (Germany), P. Webb (USA)
(This new TC was approved by the Board in June 98 as TC2-49.)


The Secretary received the following written nominations for the next Division 2 Director, listed in the order of receiving the letters.

Teresa Goodman (Great Britain)
Georg Sauter (Germany)
Norbert Johnson (USA)

Further nominations from the attendees were requested, but there was no further nomination. Based on this listing, there will be postal voting by the country members within a few months.

10. Future meetings:

Division 2 meetings
1999 CIE Div. 2 will meet in conjunction with the CIE 24th Session, Warsaw, Poland, starting 23rd of June. Plan a joint meeting with Div. 1. June 24-26 will be technical sessions, and June 28-30 for Div./TC meetings.
Div. 2 also agreed to propose a Joint Workshop with Div. 1 in Warsaw on Measurement of Flashing Light. This workshop may be scheduled during June 24th -26th.
2000 open. CORM-Rochester and NPL are suggested.
2001 Possibly with CORM in Gaithersburg-NIST 100th Anniversary.
2002 open.
2003 J. Rennilson has a proposal to invite CIE Quadrennial Session for San Diego. (Last Session in the U.S. was 1967 Washington DC.)

Other related meetings
1998 International Symposium and Workshop on Measurement of Optical Radiation Hazards, at NIST, Gaithersburg, Maryland, USA, 1-3 September 1998. (Co-sponsored by USACHPPM, NIST, CIE D6, and ICNIRP)
1999 NEWRAD in Madrid, Spain.
2001 NEWRAD at NIST, Gaithersburg, Maryland USA.
AIC in Rochester in the last week of June.
2003 NEWRAD in Sydney, Australia.

11. General

1) Liaison with D6 TCs.
At the last D2 meeting, there was a request from D6 Director to establish liaison with TC 6-34 (Photobiological lamp safety standard) and TC 6-45 (Measurement of optical radiation hazard in work place). AD Goodman to follow up on this issue.

2) NEW CIE Division
The Director reported. As reported in the Circular Jan/22/98, the discussions at the CIE Expert Symposium on Color Standards on Imaging Technology in Scottsdale, USA, Nov. 1997, lead to the recommendation of a new Division in CIE in the area of imaging technology. ISO/IEC JTAG2 also supported this proposal and recommended formation of an ad hoc coordinating committee. Active
discussions by the ad hoc committee members, that included CIE BA members and ISO and IEC committee chairs, took place on e-mail for the last several months. Robertson is the coordinator of the ad-hoc committee. Below is further report from Robertson, which the Secretary reported on his behalf. According to the discussions by the ad hoc committee, the most likely development is a new Division although there is some support for starting things under the umbrella of Division 1. Three key aspects that should be brought to D2's attention are:

1. Liaison with existing work (especially in D1 and D2) will be very important to avoid duplication and to enable experts to attend all relevant meetings without travelling to many different places at many different times. Many of us are already forced to choose between D1 and D2 and if there is a three-way choice each year, the situation will be worse.
2. It is hoped that much of the new work can be done by e-mail, reducing the slowness that inevitably comes from waiting for a physical meeting before taking any action.
3. The CIE Board of Administration is expected to make a decision on starting the new work at its meeting on June 22-24 this year.

Some opinions from attendees were addressed to oppose the formation of a new Division. Further opinions on this issue should be sent to D2 Director who will attend the BA meeting. Div.2, however, does not foresee much problems in terms of Division activities because we now have only one or two TCs that are directly related to color imaging and that may have to move to the new Division if formed. Div. 1 will be seriously affected.

3) Omega-naught issue
There has been a common problem in several photometry TCs, discussed over the past a few years, regarding how to express the equation for the relationship between luminous intensity and illuminance (the inverse square law). A simple equation $I=E \cdot d^2$ appears to leave inconsistency of units; i.e., \([\text{lm/sr}]\) equals \([\text{lm}]\). To solve this problem, some members are suggesting to use $W_0$ as in, $I=E \cdot d^2 / W_0$, but others oppose that \([\text{sr}]\) is a dimensionless unit and it need not be worried about. Schanda is invited to attend the CCU (Comité Consultatif de Unit) meeting on 8-9, September, 1998, and he suggests asking for an advice from CCU to resolve this issue. Div.2 agreed to send an official request to CCT on this issue. (This action has been approved by CIEBA at the June 98 Board meeting.)

4) Recognition by CEN
The Director reported that the Central Bureau had a meeting with CEN for CEN to recognize CIE Standards, and some progress has been made. There will be a movement from CEN. Discussion will continue on.

12. Adjournment
The Division 2 meeting was adjourned at 5 pm.