

Inter-Society Color Council *News*

1981 GODLOVE AWARD

Nominations are invited of potential recipients of the 1981 Godlove Award of the ISCC. The merit of a candidate will be judged by his/her contributions to any field of interest related to color, whether it be direct, in the active practical stimulation of the application of color, or in the dissemination of knowledge in color by writing or lecturing, based on original contributions by the nominee.

Any individual member of the Council is eligible to make a nomination, which should be sent to:

Dr. Alan R. Robertson
Division of Physics
National Research Council
Ottawa, Ontario K1A 0R6
Canada.

Details of the information required for a nomination will be found on page 1 of the July-August 1979 ISCC *News*. The deadline for receipt of nominations is 30 June 1980.

MEETING OF COMMITTEE 33: HUMAN RESPONSE TO COLOR

Annual Conference, Rochester, N.Y.
Monday, April 21, 9 A.M. - 12 A.M.

Since 1973 the meetings of this committee served to expose different aspects of the broad subject, by inviting speakers who work in specific areas of research or application, or who represent viewpoints that need be considered in the context of Human Responses.

The time has come to discuss how these different areas of interest could serve as stepping stones for decisive investigation that will lead towards conclusive results, applicable to human habitation and to architectural spaces designed for specific activities, as well as to other functional color uses on objects etc.

Do color stimuli, resulting from the spectral radiation of light sources, filtered or modified by building elements or objects, influence physiological and psychological functions and so produce recognizable behavior patterns?

PROF. JOHN E. FLYNN, AIA/FIES, University of Pennsylvania, President of the Illuminating Engineering Society of North America, will introduce the subject by reporting on a recent study for The National Bureau of Standards, titled: **THE INFLUENCE OF COLOR IN ARCHITECTURAL ENVIRONMENTS.**

DR. RICHARD CORTH, Westinghouse Electric Corporation will discuss **COLOR STIMULUS INTERACTION WITH BIOLOGICAL FUNCTIONS.**

DR. D. GEOFFREY HAYWARD, Director, Environment & Behavior Center, University of Massachusetts, will present **A CONCEPTUAL FRAMEWORK FOR RESEARCH ON LIGHTING AND BEHAVIOR.**

NUMBER 264 JANUARY-FEBRUARY 1980

DR. WILLIAM A. THORNTON, FIES, Research-Engineering Consultant, Westinghouse Electric Corporation, will speak on **THE COLOR-PREFERENCE INDEX AS GUIDE FOR CUSTOMER-ACCEPTANCE OF PRIME COLOR ILLUMINATION.**

Thought provoking programs of past years by recognized authorities in diverse fields are continued by four outstanding researchers.

I expect those who consider themselves members of this committee to contribute their share of ideas and active participation toward our goal. Requests for speaking time should be in my hands latest by the end of March.

Alexander F. Styne, IDSA/FIES, Chairman
Committee 33: Human Responses to Color

HELSON MEMORIAL SYMPOSIUM ON CHROMATIC ADAPTATION

This year's Williamsburg Conference, entitled the Helson Memorial Symposium on Chromatic Adaptation was held on February 3-6, 1980. The symposium was co-sponsored by the Inter-Society Color Council and the Association Internationale de la Couleur (AIC).

Williamsburg, Virginia is a marvelous reconstruction of a colonial American town. Registration fees to this symposium provided all the necessary tickets in order to enjoy the tours and facilities of this fine attraction. Unfortunately, a full program of ten invited papers and six contributed papers did not permit one to enjoy any of the sightseeing attractions without also missing part of the symposium.

The symposium was an unqualified success when judged by the extent to which the papers generated discussion. Each invited paper was allotted 45 minutes for the presentation and 20 minutes for discussion. All of the papers required the full 30 minutes in order to satisfy the exchange of information and ideas that the presentations generated. Indeed in many cases discussion had to be cut off in order to continue with the program.

Chromatic adaptation was discussed from virtually every point of view. Wright explained how chromatic adaptation is a problem that needs to be explained in order to understand how the color vision system operates. He also pointed out that chromatic adaptation is an important tool used for the purpose of studying color vision. Then he went on to review the many techniques and methods used to study chromatic adaptation and basic vision incorporating chromatic adaptation as a research methodology. Pugh reviewed the current state of Stiles' two color threshold technique and the resulting Pi mechanisms. Boynton's paper elaborated on the use of chromatic adaptation in psychophysical and electro-physiological studies. He showed that chromatic adaptation is already evident at the receptor stage of color vision processing. The papers by Hunt and Halstead clearly showed the important applied considerations con-

cerning chromatic adaptation. Hunt's paper described in colorful detail the importance of chromatic adaptation in photographic image reproduction. Halstead on the other hand provided clear description of the role that the variety of lamps with a differing spectral power distributions play on chromatic adaptation in our every day internal lighting environment.

Hurvich and Jameson provided an excellent theoretical review of chromatic adaptation concentrating primarily on the contributions by Helson, Judd and Helson, and Von Kries. They went on to describe the two stage theory of color vision in which they played such a prominent role by revitalizing the Hering opponent processes theory. Hurvich and Jameson described how this two staged model (Young-Helmholtz theory and Hering theory) handles the problem of chromatic adaptation. Finally, they described some new experiments which further explore the two-process mechanism and showed how study-state versus alternating chromatic adaptation stimuli result in recoveries which yield a baseline shift.

McCann explained how the retinex model of color vision handles chromatic adaptation. True to the title of his paper, "New Approaches," the highlight of McCann's presentation described how a new digital image processor was used to better investigate the mechanisms of chromatic adaptation in highly complex scenes. Bartleson described relationship of chromatic adaptation to color matches and evaluations of small and large color differences. His presentation also graphically illustrated the role that chromatic adaptation plays on color appearances.

The contributed papers provided additional information on the current state of research. Fry discussed the fundamental color primaries and showed how they could be studied and analyzed by means of chromatic adaptation. Breneman, like McCann, took on the difficult task of evaluating complex scenes. He showed that, when studying chromatic adaptation in color transparencies at low levels, utilizing the von Kries transformation provides a poor predictor of chromatic adaptation whereas this transformation worked rather well at high levels. Buchsbaum provided a mathematical analysis of complex scenes utilizing the principles of communications theory. Schanda described in some detail the relationship between spectral power distribution of lamps and color rendering properties of these lamps. Guth provided a movie demonstrating color shifts due to post-receptor adaptation. Considering some of the papers which preceded Guth's presentation it was generally agreed that the color shifts demonstrated by Guth were clearly post-quantal-catch adaptation but that his demonstration did not necessarily rule out any further processing in later stages of the receptor. Walraven discussed adaptive hue shifts attributable to the red green and blue receptor mechanisms and the Pi mechanisms.

Dr. Wyszecki had the task of carefully listening to all the papers presented during this symposium and providing a summary that would describe where we stand today on the subject of chromatic adaptation. Wyszecki departed from his role as a physicist-mathematician-color vision researcher and took on the job of a pathologist by performing an excellent post mortem.

If I may be permitted a personal observation: Any scientist who has had a modicum of experience in his field and has enjoyed the opportunity of attending scientific conferences and meetings can easily suggest a program of speakers that would be truly excellent, but the difficulty comes in actually being able to convene all of the selected speakers at the appointed time. The ISCC made it possible to bring the invited speakers

from as far away as Japan, England, and California to Williamsburg, Virginia. The importance and central role that these Williamsburg conferences play in color and color vision research is attested to by the excellent invited and contributed papers that were presented this year. I would like to think that if Professor Helson were still with us today and could have attended this symposium he would have been immensely proud.

For the readers convenience I have reproduced the program below.

Invited papers.

Why and How Chromatic Adaptation has been Studied – W. David Wright.

Theory and Mechanism – Leo M. Hurvich & Dorothea Jameson.

Pi Mechanisms – Edward Pugh.

Electrophysiology and Psychophysics – Robert M. Boynton.

A New Non-linear Model of Chromatic Adaptation – Yoshinobu Nayatani.

New Approaches – John J. McCann.

Implications for Color Appearance – C. James Bartleson.

Image Reproduction – Robert W. G. Hunt.

Color Rendering and Chromatic Adaptation – Margaret B. Halstead.

Where we Stand – Gunter Wyszecki.

Peter K. Kaiser
Chairman

VIGNETTES FROM THE PRESIDENT'S DESK

Constituent Organizations as well as IMG members of the ISCC may well be interested in the two recently issued CIE Publications. One of these, CIE Publication No. 45, deals with "Lighting for Ice Sports" while the second, CIE Publication No. 46, deals with "Review of Publications on Properties and Reflection Values of Materials Reflection Standards."

The report "Lighting for Ice Sports" consists of 22 pages of text and seven figures and presents a survey of experience in lighting for ice sports. It specifies general lighting requirements with regard to illuminance, uniformity, modeling, glare control, color, and color rendering. It provides guidance for selecting lamps and luminaires as well as for the arrangement and installation of the lighting system.

The Publication No. 46 would be of interest to those dealing with reflectance measurements. Conventional spectrophotometers are not capable of measuring reflectance quantities directly, but can only compare the reflectance of a sample with that of a particular reference standard. These standards should have some specific basic properties. This report, consisting of 100 pages of text with many tables, contains information on optical and physical properties of those reflectance materials that are now widely used as reference standards of reflectance.

Those who are interested in technique for absolute reflectance measurement are referred to CIE Publication No. 44 "Methods for Absolute Reflectance Measurements."

Copies of these publications may be obtained from Dr. J. L. Tech, Secretary, U.S. National Committee, CIE, NBS, Washington, D.C. 20234.

ADVANCES IN COLOR TECHNOLOGY

Joint Symposium American Chemical Society
Industrial & Engineering Chemistry Division/
Inter-Society Color Council
August 27, 1980
San Francisco, California

Introduction – “The Function of the ISCC, CIE & AIC in Color Research”	Prof. Fred Billmeyer Rensselaer Polytechnic Institute
“What is Color? – An Introduction to Colorimetry”	Dr. Gunter Wyszecki National Research Council of Canada
“Specification of Color Appearance”	Dr. James Davidson Kollmorgen Corporation
“Instrumentation for Color Measurement”	Mr. Danny Rich Rensselaer Polytechnic Institute
“Color Difference Evaluation”	Mr. Rolf Kuehni Mobay Chemical Corporation
“Calculations for Colorant Formulation”	Dr. Robert Marcus PPG Industries, Inc.
“Solution Measurements”	Mr. Charles Garland E. I. du Pont de Nemours & Co.
Lunch – “Instant Color Film”	Dr. Robert Tuite Eastman Kodak Co.
“Chemical Origins of Color”	Sister M. V. Orna College of New Rochelle
“Light Induced Color Changes”	Prof. H. C. A. Van Beek Delft University of Technology
“Color and Liquid Crystals”	Dr. Glenn H. Brown Kent State University
“Recent Advances in Inorganic Pigments”	Dr. Kenneth Batzar E. I. du Pont de Nemours & Co.
“Recent Advances in Organic Pigments”	Dr. Lawrence R. Lerner Harmon Colors Corporation
“Recent Advances in Dyes”	Dr. James F. Feeman Crompton & Knowles Corp.

NEWS OF MEMBER-BODIES

To The Chairman of Member-Bodies

It is essential you update your delegation status to ISCC before the annual meeting in Rochester, New York. This information is needed for the membership list.

The Color Marketing Group has a new Chairman and three new delegates, they are as follows:

Jim Brown – Chairman
Celanese Fibers Marketing Company

Carol Jacques
Celanese Paint and Specialties

John Rinderman
Burlington House

Donald D. Schnedier
DeSoto, Inc.

Robert Brandner & Ann Dillon
Voting Delegates Now

For the 1981 Annual Meeting I would like to see more exposure of each of our member-body societies, their functions, projects, and other information. The idea is for a continual slide presentation during our meeting and also presentation boards for members to view. Franc Grum has volunteered help in producing photographs and slides. In the meantime consider bringing information which tells a visual story. Hopefully I may have a demonstration model to show you in April.

Joyce S. Davenport
Liaison Officer

Color Marketing Group

“COLOR ON PARADE” is the theme of Color Marketing Group’s Spring meeting which will be held at the recently restored Fairmont Hotel, May 4 - 6, 1980.

The main program begins on Sunday, May 4th, with the following format:

A Panel Discussion

“Run for Your Money – Roto-gravure is Big Business for You and Me”

Introduction

Consumer Needs

Phyllis Farrel
Director of Styling
Pantasote, Inc.
Printing/Laminating Division

Film Preparation & Galleries

Norman S. Shapiro
Vice President – Marketing
MS Chambers & Son, Inc.

Positive Transfer as shown in Laminates – Woodgrains

John Hagen
Technical Sales Representative
Mead Paper
Specialty Paper Division

Proofing – Illustrated by Floor Coverings

William Griffith
Plant Manager
Chambers
Storck Division

Consumer Wrap-Up

Ann Jacobson
Vice President of Styling
Newco, Inc.

The three Direction Committees which follow are scheduled for two one hour sessions.

Education

Speaker: Dorothy Tricarico
Curator of Textile & Design Lab
Fashion Institute of Technology

“Inspiration Unlimited”. Making use of museum collections for continuous creative development.

Speaker: Alessandro De Gregori
Associate Professor
Department of Design
Carnegie-Mellon University

“Color Education for Designers”

Marketing Directions

“MOVIN’ ON”

A movie showing a case history of a successful marketing communications tool.

Presented by: Albin J. Milwid
Vice President
Director of Styling
Mannington Mells
and
Leslie Ann Mogul
Account Executive
Gray & Rogers, Inc.

Technical Directions

Speaker: Robert Hillman
Senior Product Engineer
Color and Photographic
Sears, Roebuck & Company

“Black” and White and Everything in Between”

Light Sources and its effect on display, merchandise and ultimately the Consumer.

Speaker: Michael J. Dunn
Marketing Manager
Industrial Pigments
H. Kohnstamm Company, Inc.

“Colors for Packaging”

The use of non-toxic pigments for toys, foods and other consumer needs.

Reception and Dinner

This is a color spectacular — we suggest you bring your cameras for this after dinner event — to be followed by a dance.

Monday Morning

Workshop sessions.

Monday Afternoon

The choice of two tours — must preregister.

1. Roto Cylinders — a guided tour of a rotogravure engraving plant — showing many speciality processes from delicate postage stamps to floor covering designs.

2. Goldie Paley Design Center — part of the Philadelphia College of Textiles and Science.

Tuesday Morning

Luncheon Speaker: Mr. Daniel Cannady
Manager of Decorative Engineering
Micarta Division
Westinghouse Electric Corporation

“Gravure Inks for Packaging and Speciality Printing”

An award winning slide presentation.

Dinner Speaker: Dr. Fred Fortess
Director of Textile and Apparel Research
Philadelphia College of Textiles and Science
“Will You Still Love Me When I’m Old”

Color Fidelity

Will your colors stand the test of time?

Optical Society of America

Optical Society of America names Honorary Member

H. Keffer Hartline has been named an honorary member of the Optical Society of America in recognition of the preeminent service he has rendered in the advancement of optics.

The number of honorary members of the Society is restricted to six. Election to honorary membership requires unanimous action by the Board of Directors of the Society.

Professor Hartline is an emeritus member of the faculty of The Rockefeller University. His research, directed to understanding of the electrophysiology of the retina, has provided results that have influenced the entire field of vision research. He was awarded the 1967 Nobel Prize in physiology jointly with Ragnar Granit and George Wald.

Dr. Hartline received his undergraduate education at Lafayette College, receiving the B.S. degree in 1923. His research career, which has spanned more than 50 years, began the same year with publication of his first paper, “Influences of light of very low intensity on phototropic reactions of animals;” *Journal of General Physiology*, 6, 137-152, 1923.

He was awarded the M.D. degree by The Johns Hopkins University in 1927, having published two more contributions by the time the degree was awarded, one on pecten and the other on electrical responses to illumination. Following a two-year postdoctoral fellowship at Johns Hopkins, and fellowships at the Universities of Leipzig and Munich, Dr. Hartline joined the E. R. Johnson Foundation of the University of Pennsylvania in 1931. He remained there until 1948 except for a year spent on the faculty of Cornell University Medical College. He was professor of biophysics at Johns Hopkins from 1949 until 1953, when he joined the faculty of The Rockefeller University. In 1972 he was named to the Detlev W. Bronk Professorship, the first endowed chair established at Rockefeller.

In research extending over more than half a century, Dr. Hartline has made many original observations of the physical and electrical activities of the optic nerve. Through the use of quantitative mathematical methodology and complex electronic devices, he has recorded and compared the activity of nerve fibers and retinal receptors in vertebrate and invertebrate animals, particularly in the horseshoe crab, *Limulus*, whose compound eye, with its large photoreceptors, long optic nerve, and relatively simple retinal organization, makes it well suited to visual research. The techniques developed by Dr. Hartline are now used in laboratories all over the world. His collected papers were published in 1973 by The Rockefeller University Press and Chapman Hall Ltd., of England, under the title *Studies on Excitation and Inhibition in the Retina*, Floyd Ratliff, editor.

Dr. Hartline’s honors are extensive. In addition to the Nobel Prize, they include honorary degrees from Lafayette College, the University of Pennsylvania, The Rockefeller University, the University of Maryland, Syracuse University, The Johns Hop-

kings University, and the Albert-Ludwigs-Universität Freiburg.

He is a member of the National Academy of Sciences, the American Academy of Arts and Sciences, the American Philosophical Society, the American Physiological Society, the Biophysical Society, the Society for Neuroscience, Phi Beta Kappa, and Sigma Xi. He is also a foreign member of the Royal Society in London. He is a fellow of the Optical Society of America and has been a member for over forty years. He joins Alfred Kastler, Edwin H. Land, Gerhard Herzberg, and Charles H. Townes as an honorary member of the Society.

SOCIETY OF PHOTOGRAPHIC SCIENTISTS AND ENGINEERS (SPSE)

SPSE Symposium on Photofinishing Technology in the 1980's – March 23-25, Las Vegas

Printing Equipment

Variable Correction Slide Printing, by E. Goll and T. Seckel, Eastman Kodak Company, Rochester, New York.

Methods to Distinguish Between Film Characteristics and Subject Failure in Automatic Color Exposure Determination, by B. Fergg and S. Thurm, Agfa-Gevaert AG, Munich, West Germany.

Using the Probabilistic Approach to Optimize the Photographic Quality of a Color Printer, by D. E. O'Brien, Eastman Kodak Company, Rochester, New York.

Exposure Systems for High Speed Printers, by Heiner Schaub, Gretag Ltd., Regensdorf, Switzerland.

Exposure Determination Concepts Using LATD Measurements, by Walter Grossman, Russikon, Switzerland.

Computer Assistance for Optimizing Printer Setup, Controls, and Productivity, by E. Goll and R. Olliver, Eastman Kodak Company, Rochester, New York.

Introduction to Computer Components, by Robert C. Davis, Bremson Data Systems, Inc., Kansas City, Missouri.

Diagnostic Capabilities of Computerized Photofinishing Equipment, by R. Barzee, M. Gontarek, and J. Wisner, Eastman Kodak Company, Rochester, New York.

Paper Processing

Innovation: Key to Decentralized Photofinishing, by Jerry Vaniman, NAC Corporation, Compton, California.

Lowering of the Replenishment Rate in Color Paper Processing, by T. Koike, I. Fushiki, and S. Koboshi, Konishiroku Photo, Tokyo, Japan.

Finishing Operations

Intelligent Reprint Systems, by Don Knoll, CX Systems, Seattle, Washington.

Processing Solutions

Developer-Regeneration System by Electrodialysis for Color Paper Processing, by Minoru Yamada, Sachio Matsushita, Hiroyuki Hirai, Isao Tsuyuki, and Yasuhisa Ogawa, Fuji Photo Film Co., Ltd., Tokyo, Japan.

Use on Industrial Scale of a Unit for Recycling Color Paper Developers, by Ferdinando Forschini, Fotomec-San Marco, Pordenone, Italy.

Silver Recovery Technologies Applied to Processing of Color Positive Paper, by Thomas N. Hendrickson, CPAC, Leicester, New York.

The Use of Ion-Exchange Resins in Removing Silver from

Spent Bleach-Fix and Photographic Wash Waters, by Rami Mina, Eastman Kodak Company, Rochester, New York.

Recycling Photographic Wash Waters, by David J. Degenkolb, Photo-Chem Systems and Engineering, Inc., Walnut Creek, California.

Practical Limits of Water Saving in Washing Color Photographic Materials, by Walter Grossman, Russikon, Switzerland.

MEETINGS

Human Factors and Industrial Design in Consumer Products Tufts University – Medford, Massachusetts – May 28-30, 1980

The second national symposium on Human Factors in consumer products will be held at Tufts University, Medford, Massachusetts, on May 28th, 29th, and 30th, 1980. This symposium will focus on the integration of the disciplines of Human Factors Engineering and Industrial Design in the development of consumer products. Jointly sponsored by the Consumer Products Technical Interest Group of the Human Factors Society and the Industrial Designers Society of America, the symposium will be hosted by the Department of Engineering Design, Tufts University.

Make plans now to attend this symposium. An informative program is being planned, and a very reasonable registration fee will include the complete proceedings, excellent meals and refreshments, and (for out-of-town attendees) comfortable, private dormitory accommodations. The Tufts campus in Medford, a suburb of Boston, is most attractive in the late spring. The final program details and fees will be announced in March. To receive information and a registration application, please contact one of the conference co-chairpersons listed below.

Dr. John Kreifeldt
Department of
Engineering Design
Tufts University
Medford, MA 02155

Richard C. Schneider
Digital Equipment Corporation
146 Main Street, ML11-4/E53
Maynard, MA 01754

CANADIAN SOCIETY FOR COLOR

The 8th Annual Conference of the Canadian Society for Color in Art, Industry and Science will be held on 22 and 23 May 1980 at Laval University, Ste. Foy, Quebec. An interesting program has been arranged with talks and other presentations about a variety of aspects of colour. As in the past, the Conference is open to both members and non-members.

The Conference will be highlighted by the following speakers:

Pierre Aerts, Philips Electroncis Ltd., "Light and lighting."

Claude Beique, Supply and Services Canada, "Color applied to graphic designs for identifying services."

Maurice Day, Radio Canada, "How tonal values are determined for television in black and white and in color."

Yvan Maillette, Hoechst Canada Ltd., "Pigments: new trends. Effects of the economic situation, energy and ecology."

Georgia McLellan, Teacher, "Evolution of a teaching program for colour and practical demonstrations."

Denis Pilon, Peerless Carpets Ltd., "New colouring techniques in the carpet industry."

Paulette-Marie Sauve, Artist, "Natural dyes in Quebec."

Alexander Styne, University of Miami, "Light and color in architectural space."

Anne Wilcox, University of Guelph, "A comparison of colour-matched wool fabrics dyed with natural and synthetic dyes."

Francois Varin, Architect, "Techniques for restoration of historic buildings and research into original colorants."

A new feature of this year's Conference will be a workshop on "Colour Quality Control in Industry." Seven invited speakers will present short talks on experience in their industry. This will be followed by an open question period and discussion.

There will also be a workshop on Colour Education which will feature a newly developed colour computing system which can be used to facilitate the teaching of colour.

Social events will include a banquet and a conducted tour of historic Quebec City.

For the convenience of the participants, accommodation has been made available at the University at a very modest cost. Parking facilities will also be available.

The registration fee will be \$50.00 for members of the Canadian Society for Color and \$65.00 for non-members. This will include the banquet and the city tour.

For further information contact: Mr. Ivan Kirouac, SICO, 41 Bates Road, Montreal, Quebec, H2V 1A6, Tel. (514) 272-5771.

COLOR RESEARCH AND APPLICATION

Volume 5 Number 1 Spring 1980

Articles

Global Color Metrics and Color-Appearance Systems, *T. Indow.*

Chromatic Difference Steps of Moderate Size Measured along Theoretically Critical Axes, *R. M. Boynton and N. Kambe.*

Cube-Root Color Spaces and Chromatic Adaptation, *K. Richter.*

Evaluation of Different Color-Difference Formulae by Means of an Experiment on Color Scaling: Final Report, *R. D. Lozano.*

Colorimetry of Wines, *A. C. Little.*

Does Color Make the Joke Funnier? *E. C. Winckler.*

Meeting Report

Tenth Conference of the Color Science Association of Japan, *F. W. Billmeyer, Jr.*

Book Review

Standard Pseudoisochromatic Plates, by Hiroshi Ichikawa, Kaitiro Hukami, Shoko Tanabe, and Genro Kawakami. Reviewed by *P. K. Kaiser.*

JOHN GUILD

John Guild was born on 16 November 1889 and died a few days short of his ninetieth birthday on 23 October 1979. He studied at Imperial College, London and started work at The National Physical Laboratory (NPL) in 1914, where he continued to work on well past normal retirement age to complete 49 years service. Guild soon built a reputation in the 1920's as one of the world's leading experts on colour science and was the UK Member of the CIE Colorimetry Committee.

During this period a long series of lectures and papers by him explored all aspects of colour science then known. These included particularly the relevant aspects of colour vision, colour matching, techniques of observation, optical systems for colour matching and for visual measurement of samples (either by tristimulus matching or by spectral analysis), alternative systems of matching and of reference stimuli, the permissible linear transformations between these, and the relationships between colorimetric and photometric assessment. A whole generation of British colour scientists were inspired, led, and taught the essential physical facts and limitations by him. Those who later founded The Colour Group in 1940 were all indebted to him.

In the late 1920's Guild started systematically measuring the colour matching properties of a group of normal trichromatic observers. Inspired and encouraged by Guild, W.D. Wright started a similar enterprise at Imperial College. Guild had proposed a Standard System of Reference Stimuli (700 nm, 546.1 nm and 435.8 nm together with an "NPL Bluish White") and when Wright's new data were transformed to Guild's system it was realised that, although their equipment, matching stimuli, and normalization methods were individually valid yet strikingly dissimilar, there was remarkably good agreement of the mean data in relation to individual observer differences. The CIE was due to meet at Cambridge shortly, and Guild realised that there was not sufficient proof that the principles, basic data, and methodology of tristimulus colorimetry were adequately known to permit the proposal of an international system of colorimetry for all to use with confidence. During the week before the 1931 CIE Sessions, some of the Colorimetry Committee met at NPL, and Guild and his Divisional Superintendent T. Smith demonstrated equipment, techniques, principles, and the reduction of data for a system of colorimetry. The USA Member, I.G. Priest, was not expecting a definite proposal so soon and took a lot of convincing. In fact Smith and Guild worked late at night through that week (and worked right through one night) in carrying out by hand various proposed linear transformations of the colour matching data of Guild and of Wright to evaluate various modifications suggested by I.G. Priest. At the Cambridge Sessions a consensus was reached that the data were sound and that the basic system of reference for the visual data (R, G, B) and the practical reference system for industrial colorimetry (X, Y, Z) had been well optimized. Of all those who contributed to the 1931 CIE Colorimetry System, Guild has the best claim to be called the founding father.

Curiously, Guild ceased creative work in colour science and spectrophotometry after 1931 in order to make an amazing range of contributions to other branches of applied optics. These were particularly in absolute radiometry, applied photometry, polarimetry, production and testing techniques for diffraction gratings, refractometry, interferometry, testing methods for an immense range of optical instruments in World War II, and uses of optical techniques in engineering and dimensional metrology, which culminated in the metrological use of gratings for controlling machine tools. Guild must have been one of the greatest experimentalists of his time. To consider just one of his other areas of creativity, photometrists realise now just how important was his work in founding the principles and techniques of absolute radiometry, for the new definition of the candela expresses the photometric quantity in terms of the corresponding radiometric quantity.

F. J. J. Clarke

LIBRARY OF CONGRESS

Autochromes: Color Photography Comes of Age

Seventy-five images from the turn of the century have been selected for this rare look at a pioneering process of color photography which used potato starch dyes. In the Lower Level Gallery, Ground Floor, Library of Congress Building. A continuing exhibit.

NOTES TO THE EDITOR

Robert Marcus reports that a species of ant, *Cataglyphis bicolor*, is thought to possess remarkably good color vision. In addition, the ant has more sensitivity out in the ultraviolet than we do. Since Mr. Marcus was reporting information obtained from a newspaper, it was not possible to tell exactly what the experiments meant. For those of you who are curious, the investigator's name is Robert Kretz, and he works in a "Zurich laboratory." I have heard of worker ants and queen ants; could there be decorator ants?

Kenneth Kelly reports another newspaper item that suggests evocative name. Some of the suggestions were: Power Failure Black, Seedless Tomato Red, Oil Spill Umber, and Smog Grey. Perhaps Ken regrets that he was not a bit more imaginative when they came up with those stodgy old names for NBS.

COLOUR GROUP (GREAT BRITAIN)

Notice of 149th Meeting

One-Day Meeting on Post-Receptor Processes in Colour Vision – Wednesday, 9th January, 1980
Abstracts

Inhibitory interactions between red- and green-sensitive cone mechanisms, David H. Foster. The field spectral sensitivities of the red- and green-sensitive colour mechanisms determined by Stiles' method are found to be modified when measured in the presence of a small auxiliary conditioning field. For the green mechanism, a 620-nm auxiliary field coincident with the test flash (diameter 0.15° , duration 200 ms) shifts peak spectral sensitivity towards short wavelengths. For the red mechanism, a 500-nm auxiliary field coincident with the test flash shifts peak sensitivity towards long wavelengths.

This spectral-sensitivity shift is diminished for short test flashes (e.g. 20 ms) and is absent for auxiliary fields much smaller or larger than the test flash. The effect does not occur dichoptically.

It is suggested that the small superimposed auxiliary field facilitates detection by chromatic channels arising from an inhibitory interaction between the outputs of the red- and green-sensitive cones.

Dynamics of a colour-opponent site, J.D. Mollon, P.G. Polden & A. Stockman. During the first minute of exposure to strong adapting fields there may occur curious and rapid variations in the sensitivity of the eye to short-wavelength targets. If the field consists of only a long-wavelength component (e.g. 575 nm, $10^{11.7}$ quanta. $\text{sec}^{-1}.\text{deg}^{-2}$), the threshold for detecting a 436-nm test flash first rises and then falls; if the long-wavelength field is combined with a short-wavelength field (e.g. 440 nm, $10^{10.6}$ quanta. $\text{sec}^{-1}.\text{deg}^{-2}$), the threshold first falls and then rises, asymptoting at the saturated value previously re-

ported for the steady state after 4 minutes (Mollon & Polden, 1977, *Nat.*, 265, 243).

Under the conditions we have examined, the log threshold may change at a rate exceeding $1 \text{ db}.\text{sec}^{-1}$ and a conventional 'staircase' procedure cannot faithfully track such rapid changes in sensitivity. We have therefore been led to develop a special psychophysical method, which we call *transverse titration* or the *Thousand Staircases*. The observer makes successive runs through the adapting sequence, with rests between runs. On a given run, target flashes are presented at a series of delays (Δt) after the onset of the adapting field; the stimulus delivered and the response given at each value of Δt is stored by a laboratory computer and is used to adjust the intensity of the flash at that Δt on the next run. Thus an independent staircase is maintained for each value of Δt .

We relate the results obtained to a model in which signals from the short-wavelength receptors are transmitted only via colour-opponent channels. It is supposed that opponent channels are most sensitive when close to the centre of their response range, that is, when long- and short-wavelength inputs are balanced (Pugh & Mollon, *Vision Res.*, 19, 293); and that the strange variations in psychophysical sensitivity arise as the long-wavelength input to the opponent channel falls during early light adaptation to the bleaching field.

Postreceptor adaptation in normal and clinical vision, P.E.

King-Smith. Two independent studies are described. In one investigation, foveal spectral sensitivity curves were measured in normal subjects on various intensities of a 'neutral' background which was calculated to stimulate the red and green-sensitive cones equally. At all intensities, spectral sensitivities in the range 480-680 nm could be fitted by assuming independent detection from an 'L mechanism' peaking at 555 nm and a 'C mechanism' peaking at 605 nm. The L mechanism is more adapted by the neutral background than the C mechanism, the increase in log threshold being 1.17 times greater. The simplest interpretation of these results is that the additional adaptation in the L mechanism occurs at a post-receptor stage.

In another study, it is shown that, in clinical subjects, visual sensitivity from blue cones is often much more depressed on a yellow background than on white. These results indicate a defect in the adaptation mechanism of the blue-yellow opponent system.

New Psychophysical Methods for the Spectral Analysis of Post-Receptor Mechanisms in Human Vision, K. Ruddock & V.

Waterfield. Psychophysical methods for the spectral analysis of visual function, including colour matching and two-colour increment threshold measurement, yield broad-band spectral responses closely related to the absorption spectra of the cone photopigments (e.g. Brindley, 1970). We describe experiments which involve binocular interaction in adaptation to spatial patterns (Ruddock and Wigley, 1976; Ruddock, 1978), and the results therefore reflect activity in post-receptor visual mechanisms. Three independent spectral responses have been obtained; one is driven by opponent inputs from the red- and green-sensitive cone mechanisms, a second by the green-sensitive mechanism, with a small inhibitory contribution from the red-sensitive mechanism, and the third, spatially coarser than the other two, is driven by the blue-sensitive cone mechanism. It is shown that the spectral response function of the red-green opponent mechanism corresponds to a simple linear com-

bination of the red (π_5) and green (π_4)-sensitive response functions of Pitt (1944) and Stiles (1978), and that this mechanism is absent in the responses of a deuteranopic dichromat. The development and application of experimental methods similar to those described is necessary for the analysis and classification of acquired colour vision defects involving abnormal post receptor function. Such investigations are also of value in the analysis of normal and congenitally defective colour vision.

REFERENCES

- Brindley, G.S. 'Physiology of the Retina and Visual Pathway.' Arnold, London, 2nd Edn. (1970).
Pitt, F.H.G. Proc. Roy. Soc. 132B, 101-117 (1944).
Ruddock, K.H. Proc. 11th Congress Intl. Comm. for Optics, 33-46 (1978).
Ruddock, K.H. and E. Wigey Nature, 260, 604-606 (1976).
Stiles, W.S. 'Mechanisms of Colour Vision,' Academic Press, London (1978).

Cortical representation of colour, S. Zeki. New insights into the representation of colours in the cerebral cortex and the variables governing the responses of single cortical colour-coded cells have been gained by the discovery of specific visual cortical areas with high concentrations of such cells. The properties of these colour-coded cells will be discussed in terms of Land's retinex theory.

Colour Preferences, I.D. McManus, A.L. Jones & J. Cottrell. Previous work on colour preferences in man has failed to assess several possibilities:

- i) That hue, value and chroma may all have separate effects upon preference.
- ii) That preferences may change *within* an experimental session.
- iii) That there may be substantial differences between individuals in their preference patterns.

In this paper we will describe an experiment in which all of the above features have been included.

I will also describe briefly some work on the colour of tablets and pills in relation to their pharmacological effect.

PRODUCTS AND SERVICES

Hunterlab Repeats Three Day Workshop

Hunterlab's three day workshop on the measurement of appearance scheduled for February 13, 14, and 15, 1980 attracted more than twenty five participants by December 1, 1979. Due to this over-whelming response, the education department has scheduled another three day session for May 20, 21, and 22, to accommodate the overflow of students.

The course will be held at Hunterlab's facilities in Reston, Virginia. The workshop is a practical approach and provides appearance technologists with a basic knowledge of color science, color scales and techniques for the measurement of color. Other aspects such as gloss, haze, distinctness-of-image, luster, etc. are also covered.

The course includes a four-hour laboratory session with "hands-on" use of the instruments. Ample opportunity is provided for each student to measure his product on any of the Hunterlab instruments.

Because space is limited, call the appearance science department at Hunterlab as soon as possible to assure your space at the workshop.

Free Computer Program Facilitates Pigment Selection

A new computer program that accelerates the process of choosing alternate pigments from several candidates is now available from CIBA-GEIGY Corporation.

The program, entitled INFO, can calculate chromaticity coordinates for an entire tint range after the pigment's optical coefficients for scattering and absorption have been established. (Pigments with very similar or identical coefficients can be directly substituted for one another.)

Available to the general industry for the first time, the specially designed computer program operates from data files created for computer color matching.

INFO speeds the process of choosing alternate pigments from several candidates. If computer color matching facilities are already being used, the actual preparation of several tint levels for each colorant or mixture is not necessary.

This method expedites the assessment of alternative pigmentation for achieving optimum colorimetric properties and reduces the time-consuming and costly task of sample preparation in the plastics, coatings, spun-fibers and inks industries.

Included in the available package is a listing of data requirements, an operational outline and technical papers regarding of the pigment selection process and program as well as the program itself, written in Fortran IV.

The program, based on the mathematical model discussed in "Using Chromaticity Diagrams for Pigment Selection" (*Plastics Engineering*, 33, p. 38 [1977]); "Computer - Selected Pigment Blends As Heavy Metal Replacements." (*Modern Plastics*, 55, p. 62, [1978]), and "Computer-Aided Pigment Selection" (*Modern Paint and Coatings*, 69, p. 70 [1979]) is available at no charge.

INFO is the second in a series of programs made available by CIBA-GEIGY Corporation. The first, entitled EXPOS, characterizes changes in pigment color (fading or darkening) or vehicle color (such as yellowing), changes in surface reflectance (such as changes in glass, bronzing, chalking or dirt accumulation), as well as total change from the sum of all effects.

EXPOS uses data from standard spectrophotometric measurement methods as input and provides the user with the analytical results regarding the nature and extent of the changes that have occurred as well as objective numerical evaluation of the changes. This evaluation is particularly useful for augmenting subjective visual evaluations.

Both programs may be obtained by writing directly to:

CIBA-GEIGY Corporation
Saw Mill River Road
Ardsley, New York 10502
Attention: Dennis Osmer, Manager,
Colorimetry Laboratory

Printer's Note:

In order to keep this issue of the newsletter to eight pages we are temporarily dropping the standing type usually found on the last page. However, we list below three upcoming meetings.

ISCC Annual Meeting. 1980: April 21-22, Rochester, N.Y.

Dry Color Manufacturers Association. 1980: The Greenbrier, White Sulphur Springs, WV, June 15-18

Optical Society of America. 1980: Sheraton Sandcastle, Sarasota, FL, April 30-May 3