ISCC: Notes

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INTER-SOCIETY COLOR COUNCIL

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NEWS LETTER No. 14

July 1936

Note: The News Letter is issued from time to time by the Inter-Society Color Council to all members for the purpose of bringing to their attention the current activities of the Council and to serve in a clearing house capacity in keeping members informed concerning recent publications on color in the arts, sciences, industries and education.

The material for the News Letters is obtained from several sources, particularly from the representatives of member-bodies. It is hoped that each member-body representative will keep the News Letter in mind and furnish material that may be of interest. The basic color problems of all groups are alike and one industry can learn much from the others.

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All members are urged to send items of interest (similar to those in this News Letter) to R. G. MacDonald, Secretary of the Inter-Society Color Council, 122 East 42nd Street, New York, N. Y.

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SUMMER CONFERENCE ON COLOR

to be held in the George Eastman Research Laboratories of Physics
Massachusetts Institute of Technology
Cambridge, Mass.

Thursday, July 23, at 9:30 a.m.

Loyd A. Jones, Eastman Kodak Company - A Survey of Color Measurement
John W. Forrest, Bausch & Lomb Optical Company - Spectrophotometers of the Visual Type
Herbert E. Ives, Bell Telephone Laboratories - The Applicability of Photoelectric Cells to Spectrophotometry and Colorimetry
K. S. Gibson, National Bureau of Standards - The Accuracy of Spectrophotometric Measurements

Thursday, July 23, at 2:00 p.m.

J. L. Michaelson, General Electric Company - Some Applications of Spectrophotometry
G. F. A. Stutz, New Jersey Zinc Company - The Optics of Pigmented Films
Carl E. Foss, International Printing Ink Corporation - Spectrophotometric Studies of Pigmented Films
Lester C. Lewis, Mead Corporation - Simplification of Spectrophotometric Methods in the Paper Industry

Friday, July 24, at 9:30 a.m.

Selig Hecht, Columbia University - The Mechanism of Vision
Deane B. Judd, National Bureau of Standards - The Standard Observer in Colorimetry
David L. MacAdam, Massachusetts Institute of Technology - Computations Involving the Standard Observer
Max Knobel, Barss, Knobel & Young - Photoelectric Colorimeters
H. P. Gage, Corning Glass Works - Artificial Daylight and its Application in Colorimetry

Friday, July 24, at 2:00 p.m.

Walter M. Scott, Gustavus J. Esselen Inc. - The Munsell System of Color Specification
Dorothy Nickerson, U. S. Bureau of Agricultural Economics - The Solution of Grading Problems by the Use of a Disk Colorimeter
F. H. Norton, Massachusetts Institute of Technology - Color Formation in Ceramics
K. S. Gibson, National Bureau of Standards - Specification of the Colors of Railway Signal Glasses
A. W. Kenney, E. I. du Pont de Nemours & Company - The Industrial Significance of Color Measurements

Saturday, July 25, at 9:30 a.m.

M. Rea Paul, National Lead Company - Color Tolerances in Industry
Deane B. Judd, National Bureau of Standards - Color Tolerances in Terms of Material Standards
W. D. Appel, National Bureau of Standards - Color Problems of the Textile Industry
I. H. Godlove, E. I. du Pont de Nemours & Company - Colorimetry in the Dyestuffs Industry, with Special Reference to Fastness
Deane B. Judd, National Bureau of Standards - The Specification of Whiteness
R. E. Rose, E. I. du Pont de Nemours & Company - The Importance of Dyestuffs Properties Other than Color Value

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WHO'S WHO IN COLOR

Following is a letter recently sent to a few members of the Color Council inviting them to serve with the Chairman as members of the Subcommittee on Who's Who in Color. It is published to show the plans of this committee.

"You have doubtless seen in a recent News Letter that the Executive Committee of the Inter-Society Color Council approved at their last annual meeting the formation of a committee to prepare a "Who's Who in Color." You are requested to serve on this committee.

"The purpose of the committee is to provide an authoritative reference list of those who are working in technical or in practical fields of color in this country. It is doubtful whether at the present time, any attempt should be made to include colorists in purely artistic fields except those artists who are identified with technical or educational phases of the work. As you will note, a committee member has been appointed from each of the societies represented in the Council. It is expected that each representative will cover the group interested in color in his own society and any allied groups which are not represented by membership in the Council. As a committee member, you will be sent a questionnaire on which you will be requested to list the names and addresses of persons in your society and other members of the same group, who may not be members of the society, so that to each of these persons a questionnaire may be sent which will request full information regarding his color activities. As a committee member you will be asked to look over the rough draft of this questionnaire, to suggest additions, comments, and criticisms when it is ready, so that we may be sure to request all the information which seems desirable to this committee for use in compiling the "Who's Who in Color."

"When answers to these detailed questionnaires are received from individuals, each committee member will be asked to go over the list with which he is familiar in order to prepare it for inclusion in the final list. It is hoped that after this has been done the work of the committee can be completed at one full meeting, at which time the details of assembling and publishing the material can be discussed and settled. This meeting will not be called until the individual questionnaires have been gone over by members of the committee.

"It is my hope that you will accept this committee assignment, since only with a capable committee can we do this job in the proper manner. Will you please let me know as soon as possible that you are accepting the appointment so that I may forward to Mr. Paul the completed committee list?"

Yours very truly,
Dorothy Nickerson, Chairman,
"Who's Who in Color" Committee
Bureau of Agricultural Economics,
Washington, D. C.

P. S. Representatives of groups not at present associated with the Council will be asked to assist the committee by supplying additional lists of names."

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COLOR MATCHING OF DYES COTTONS

The following reply to a member by the Chairman of the Color Council Problems Committee is reproduced herewith for the information of the members. The nature of the reply will indicate the problem presented.

"This will reply to your letter to Dr. Scott, a copy of which was furnished me by Mr. Macdonald, Secretary of the Council.

"There are four members of the Council with whom I believe you might like to confer. They are Mr. W. D. Appel, Delegate for the American Association of Textile Chemists and Colorists; Dr. I. H. Godlove, Delegate for the Optical Society of America; Miss Dorothy Nickerson, Individual Member, and myself. Mr. Appel is chief of the textile section at the National Bureau of Standards and is now engaged in directing research on control of the color of dyed materials by photoelectric means. Dr. Godlove is employed in the dye laboratory of the du Pont Company; he has had wide experience in visual matching. Miss Nickerson is color technologist at the Bureau of Agricultural Economics; she works with the color of raw cotton and has recently been studying the fading of dyed cotton. In both of these activities, visual matching is used. Miss Nickerson has selected and trained many color matchers.

"In the hope that you can arrange to confer with me here in Washington, I shall not attempt a complete discussion of the questions which you raise. The human eye is far from perfect, of course; its sensitivity varies from moment to moment, depending on what object is being looked at, on how strongly the object is illuminated and on the surroundings. An experienced color matcher can largely avoid the errors which a novice is prone to make because of this variation. He avoids them by reversing the samples and by examining them in such a way as not to use a more sensitive part of the retina for one sample than for the other.

"The number of whites or blacks which can be distinguished is certainly not smaller than the 300 mentioned by you. Two colors separated by 0.0004 on the uniform chromaticity-scale triangle (JOSA, 25, 24: 1935; copy inclosed) are distinguishable in chromaticity by an experienced observer provided the illumination be sufficiently strong, the samples large, uniform, and of nearly the same lightness, and provided about 30 seconds be used for the examination. This makes about 3,000 parts of the spectrum distinguishable by chromaticity alone, and about 1,000,000 different chromaticities altogether. Variation in lightness would extend this to about 100,000,000 distinguishable colors, but because of pigment and dye limitations, only a fraction of these, perhaps 10,000,000 are producible as surface colors.

"According to expert graders of white and near-white paper (Paper Trade Journal, May 23, 1935, copy inclosed) an appreciable fraction of these 10,000,000 surface colors would be classed as near-whites. There are about 2,500 permissable chromaticities at a given lightness and about 20 out of the 100 lightness steps making 50,000 distinguishable near-whites, or one-half of one per cent of the total. This does not include variations in glossiness, transparency and texture. Many observers find it hard to match samples which differ in any of these respects, and some observers call, for example, a glossy white a color different from a matt white, although the only difference is in glossiness. To summarize, then, it is not difficult to believe that some observers can distinguish and remember 300 different whites.

"There is also inclosed a paper by Priest (Oil and Fat Industries, 5, 63: 1928) describing a method of testing sensibility to chromaticity difference. The least difference detected here (0.1 Lovibond red at 35-yellow 7.6 red) corresponds to 0.0008 on the uniform-chromaticity-scale triangle or about twice what an expert color grader will pick up after a thirty-second examination. Later tests at higher field brightnesses showed that exceptional observers could detect a difference of 0.05 Lovibond red in spite of the rather small field (6° circular).

"You may also be interested in an instrument which was recently designed and built (D. B. Judd, A Subtractive Colorimeter for the Measurement of Small Chromaticity Differences between Surfaces of Moderate Spectral Selectivity of Reflectance, JOSA 26, 225; 1936).

Respectfully,
Deane B. Judd, Chairman,
Committee on Color Problems"

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HANDBOOK OF COLORIMETRY AVAILABLE

The "Handbook of Colorimetry", is the result of three years' work by the Staff of the *M. I. T.* Color Measurement Laboratory under the direction of Professor A. C. Hardy, and its aim is to facilitate the specification of color both in the laboratory and in industry.

Colorimetry is a relatively new science. Until physical instruments were developed which measure color in terms of quantities and wavelengths of light, the only available methods of color specification had of necessity to be based on samples of the various colors. The fact that these samples are subject to change with time, even under the best of conditions, has made it impossible to accumulate an extensive and accurate body of knowledge concerning the diverse phenomena of color and color vision. This handbook is concerned with the basis for the interpretation of the data obtained from physical measurements of colored materials, which may be expressed either in purely physical terms or in terms of the response of the normal observer as defined by the International Commission on Illumination in 1931.

This handbook not only surveys the entire subject of colorimetry for the benefit of those who are approaching the subject for the first time, but also discusses the characteristics of light sources, the physical measurements of colored materials, and the laws of color mixture. The recommendations of the International Commission on Illumination, interpolated to wavelength intervals of one millimicron, are included in this book.

The "Handbook of Colorimetry" sells for $5 per copy and may be obtained from the Technology Press, Massachusetts Institute of Technology, Cambridge, Mass.

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SPECTROGRAPHIC CATALOG AVAILABLE

Catalog D-20 on "Instruments for Spectrographic Analysis", revised 1936, has just been received from the Bausch & Lomb Optical Company, Rochester, N. Y. Among the subjects covered are Theory and Principles of Design of Quartz Spectrographs, Analytical Spectrography, Quantitative Analysis, Sector Photometry, Selection of Instruments, Spectrum Measuring Microscope and Bibliography of Spectrographic Analysis.

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DR. GATHERCOAL RECEIVES MEDAL

Edmund Norris Gathercoal, professor of pharmacognosy of the School of Pharmacy of the University of Illinois, Chicago, has been awarded the Remington Honor Medal for 1936 of the New York Branch of the American Pharmaceutical Association "in recognition of his service to pharmacy as chairman of the Revision Committee of the National Formulary VI, his work in promoting higher standards for pharmaceutical products, his efforts to bring about the standardization of color nomenclature, his exhaustive study of prescription ingredients, his research in pharmacognosy and his record of many years of faithful service as a teacher."

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NEW MEMBERS OF COLOR COUNCIL

The Executive Committee of the Color Council has announced that the following individual members have been elected:

JOHN E. FITE JR., Krout & Fite Mfg. Company, Allegheny Avenue and Emerald Street, Philadelphia, Pa., manufacturers of tapes, bindings and narrow fabric. Mr. Fite is particularly interested in the color matching of cotton textiles.

R. H. RINGEN, John W. Masury & Sons, 42 Jay Street, Brooklyn, N. Y. makers of paints.

FREDERICK M. WOLFF, Westinghouse Lamp Company, Bloomfield, N. J. Mr. Wolff's work consists of the design of demonstration equipment and writing of lectures having to do with the physical characteristics of color and the application of color in the field of illumination.

C. E. LIBBY, Professor of Pulp and Paper Manufacture, New York State College of Forestry, Syracuse, N. Y. Prof. Libby would like to obtain information on the best methods which may be employed for the identification of dyestuffs with relation to the intermediate from which the dyestuff was made. A secondary consideration is the identification of coloring matter in paper with relation to its class (acid, basic, substantative).

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A PSYCHOLOGICAL COLORIMETER

Following is a statement by Sidney M. Newhall of the Department of Psychology, Johns Hopkins University, Baltimore, Md. concerning an instrument which he constructed recently and for which he has found use.

While this instrument can be used without alternation for determining color characteristics of material objects, it may be called "psychological" in the sense that it was designed and is being used for investigating color perception, adaptation, after-images, and allied transient phenomena. It provides for the presentation of stimuli and the specification of responses and so functions as a combined visual stimulator and trichromatic colorimeter. The mixture employed to match the image to be specified is quickly variable on the centroid principle by operating three conveniently placed controls. Stimulation is flexible in regard to dominant wavelength, purity, brightness, size, form or pattern, surround, and duration. Illuminants A and B are included in the instrument which is calibrated on the I. C. I. standard coordinate system. A detailed description will be published in the Psychological Monographs in the near future.

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THE DETECTION OF SMALL COLOR DIFFERENCES IN DYED TEXTILES*

R. D. Nutting**

There has been a long felt need by dyers and by color technologists in general for a method of accurately measuring and specifying color. It is generally recognized that the trained human eye is a most sensitive mechanism for the detection of small color differences. However, the eye is not an analytical instrument and can not separate the various colored light components that enter the eye and are translated by the brain into the sensation of color. A rainbow is merely sunlight separated into its colored light components by passing through tiny droplets of water suspended in the atmosphere. Yet no one looking at sunlight is actually able to see these colors.

It is a familiar phenomenon that materials matching in color under daylight may not match under lamplight or some other source of illumination. The reason is simply that daylight and lamplight contain different amounts of the colored components. In order to be a perfect match two materials should agree under all possible illuminations or in other words, they should appear identical under the various colored light components which are present in the more common types of illuminants. These colored light components into which white light may be dispersed are known collectively as the visible spectrum.

It has been found that these differences in color are caused merely by differences in the *wavelength of light*. A perfect match then, is one in which the materials reflect equal amounts of light at each wavelength (or colored component) of the visible spectrum.

An instrument used for determining the amount of light reflected from a material at each wavelength is known as a spectrophotometer. The record of a spectrophotometric examination is reported most conveniently in the form of a graph on which the amount of light reflected at each wavelength of the visible spectrum is plotted against the wavelength. Connecting these plotted points results in a continuous line known as a spectrophotometric curve. Two materials having identical spectrophotometric curves will always match in color regardless of the type of illumination under which they are viewed.

There are two outstanding reasons why spectrophotometers have not been used more widely in the past. In the first place such measurements have always been made by visual observation and such a procedure is extremely tedious and time-consuming. This serious drawback has been entirely removed with the development of a photoelectric, automatically recording spectrophotometer at the Massachusetts Institute of Technology, by Professor Arthur C. Hardy. With this instrument it is now possible to obtain in a few minutes a complete spectrophotometric curve that formerly required hours to draw by the visual method.

A second objection to the use of instruments for color matching is the long standing belief among dyers and color technologists that no instrument has ever been designed to equal the sensitivity of the human eye. Actually dyeing experiments have been performed that show beyond any doubt that the Hardy spectrophotometer is considerably more sensitive than the eye.

These experiments were made by dyeing swatches of wool with a yellow dye and with a mixture of yellow and red dyes. The percentage of yellow dyestuff was maintained constant in every case while the amount of red was varied as shown by the following table.

Sample No.	Du Pont Tartrazine O	% Du Pont Crocein Scarlet Conc.
1	1.0%	Zero
2	1.0	0.0001%
3	1.0	0.0002

Similar experiments were performed previously and the results, published in American Dyestuff Reporter 20, 389, (1933) by C. Z. Draves showed that the presence of 0.0002% of the red could be quite definitely distinguished visually but that 0.0001% was not always distinguishable from the yellow dyeing alone.

These experiments were repeated by Dr. R. E. Rose of the E. I. du Pont de Nemours Company, and by the author, with the same results by visual examination. The spectrophotometric curves, however, very definitely distinguish between Samples 1, 2 and 3. The brightness of these samples, computed from the curves are found to differ by appreciable amounts.

Sample	Brightness
1	54.2%
2	55.9
3	57.3

It is hoped that the results given here will definitely serve to remove any prejudice that may have been formed and will encourage other investigators to apply it to their particular problems of color measurement.

Further experiments*** have been made with the Hardy spectrophotometer to demonstrate that calculations based on spectrophotometric curves may be utilized to specify color tolerances. Numerous commercial matches were obtained from a well known woolen house and from a cotton furnishing mill. These samples were obtained in pairs, each pair representing a standard dyeing made at one time and a match dyeing made to duplicate the standard. All samples had been accepted by customers as satisfactory matches.

In every case the spectrophotometric curves of the later dyeings differed from those of the original standard dyeings. For the light, bright colors these differences were usually large but were much smaller for the dark full shades. This was to be expected, from the previously mentioned results. The purpose of these experiments was merely to show just what limits of tolerance, acceptable to the customer, might be observed in terms of spectrophotometric curves. These curves may be conveniently translated, by straightforward calculations, into an international color language of dominant wavelength, purity and brightness. These designations correspond physically to the more familiar terms of hue, saturation and brilliance and it is shown that they may be conveniently used to designate limits of tolerance within which dyers and color technologists may work.

Notes:

* Abstracted from a paper published in J. Opt. Soc. Am. 24, 135 (1934); Am. Dyestuff Reptr. 23, 251 (1934); and Textile Research, 4, 323, (1934)

** Formerly Senior Fellow, The Textile Foundation. Present Address: Krebs Pigment Department, E. I. duPont de Nemours & Company Inc., Curtis Bay, Md.

*** "Color Tolerance: Its Measurement and Specification for Dyed Textiles," R. D. Nutting; Am. Dyestuff Reptr. and Textile Research 6, 104 (1935).

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CERTAIN COLORS IN MODERN PACKAGING PREVENT DETERIORATION IN OIL-BEARING FOODS

Mayne R. Coe
Food Research Division, Bureau of Chemistry and Soils,
U. S. Department of Agriculture.

The subject of photochemistry has been brought to the foreground through its wide applications in the industrial arts. Especially is this true in the packaging field where certain colored wrappers are used for the purpose of delaying the onset of rancidity in oil-bearing foods.

Light has long been known to catalyze this form of spoilage, but not until recently has it been shown that certain wave lengths of light promote rancidity more than do others. Investigations have been conducted by the Bureau of Chemistry and Soils with various color filters chosen to absorb known wavelengths of light, so that all regions of the spectrum were utilized selectively for irradiation. In this manner it was found that the region which promotes rancidity the least is green delimited by 4900 to 5800 Angstrom units. The ultra-violet, indigo and blue of the visible spectrum appear to be next in activity. Yellow, orange and red are also active in producing spoilage by rancidity, but about twice the amount of irradiation with these wave lengths is necessary to produce the same amount of change or spoilage as with blue. The green region of the visible spectrum and the infra-red of the invisible appear to be practically inert to rancidity development.

Oil-bearing foods are of course, best preserved from the development of rancidity when protected from all light. Our experience shows that a green filter transmitting light between 4900-5800 A. u. is next in protective properties.

Why does green better than any other color prevent or delay rancidity in oil-bearing foods? Every wavelength of light, from the extreme violet to the far red in the visible spectrum, as well as the ultra-violet and infra-red in the invisible spectrum, acts chemically upon substances that absorb it, as Grotthus (1) demonstrated years ago. McNicholas and others have shown that vegetable oils and fats absorb very strongly wave lengths of light in the ultra-violet and blue ends of the spectrum, and to a lesser extent, those in the red end. It is more than probable that the absorption of these wave lengths of light causes animal as well as vegetable oils and fats to become rancid. Consequently, anything that excludes these light waves from oil-bearing commodities tends to delay or prevent the development of rancidity. Wrappers or containers of the proper light-excluding properties, e.g., green (4900-5800 A. u.) filter out the harmful wave lengths of light, allowing only the harmless wave lengths to be transmitted.

This protective shade of green approximates that of chlorophyll green or grass green. Because the proper shade of green is in most cases difficult to judge by inspection, it is advisable to examine all wrappers or container-materials spectroscopically.

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(1) Laws of Grotthus are referred to in Ostwald's Klassiker 152, p. 94.

References

1933 Carpenter, D. C. Effect of Light on Bottled Juices. Ind. Eng, Chem., 25, no. 8, pp. 932-934.

1932 Coe, Mayne R. Light A Factor in Rancidity. Science, 75, no. 1953, p. 585.

1932 Coe, Mayne, R., and J. A. Le Clerc. Photochemical Action A Cause of Rancidity. Cereal Chemistry, 9, no. 5, pp. 519-522.

1934 Coe, Mayne R. The Rancidity Problem and New Developments with Particular Reference to the Effect of Light. Cereal Chemistry, 11, no. 3, pp. 241-258.

1934 Coe, Mayne R., and J. A. Le Clerc, Photochemical Studies of Rancidity; Peroxide Values of Oils as Affected by Selective Light. Ind. Eng. Chem., 26, pp. 245-248.

1934 Coe, Mayne R., and J. A. Le Clerc, Photochemical Studies of Rancidity. Oil and Soap, 11, no. 9, pp. 189-190.

1934 Coe, Mayne R., Rancidity in Foods Delayed by Excluding Certain Wave Lengths of Light. Yearbook of Agriculture, 1934, pp. 307-309 (Yearbook Separate 1450).

1935 Coe, Mayne R., and J. A. Le Clerc, Photochemical Studies of Rancidity; Antioxidants vs. Green Light Protection. Oil and Soap, 12, no. 10, pp. 231-233

1934 Davies, W. L. the Effect of the Wrapping Material on the Fat of Fatty Foods II. Jour. Soc. Chem. Ind., 53, no. 20, pp. 148T-151T.

1878 Draper, John W. Scientific Memoirs, page 412.

1933 Greenbank, G. R., and G. E. Holm. Photochemical Oxidation of Cottonseed Oil. Ind. Eng. Chem., 25, p. 167.

1935 McNicholas, H. J. The Color and Spectral Transmittance of Vegetable Oils. Oil and Soap, 12, no. 8, pp. 167-178.

1935 Morgan, Willard L. Retarding Rancidity Color Transparent Cellulose Wrappers. Ind. Eng. Chem., 27, pp. 1287-1290.

1934 Press release May 24, U. S. Dept. Agr., Office of Information.

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COLOR IN THE GRAPHIC ARTS

From the Typothetae Bulletin, July 15, 1936

New Color Analyzer - American Pressman, p. 33, June 1936.

The Photograph in Full Color, by Coleman E. Everett, Inland Printer, p. 32, June 1936

Don't Be a Color Copy-Cut, Walden Fawcett, Graphic Arts Monthly, p. 24, June 1936

Color Advance Reviewed by American Newspaper Publishers Association, Editor and Publisher, p. 7, May 30, 1936.

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