INTER-SOCIETY COLOR COUNCIL

NEWS LETTER

NUMBER 132 November, 1957

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BOARD APPROVES THREE NEW SUB-COMMITTEES

At the October 22nd meeting, the Board of Directors of the ISCC accepted three new problems recommended by the Chairman of the Problems Committee.

Problem No. 21 - Standard Practice for Visual Examination of Small Color Differences.

Problem No. 22 - Material Standards for Colorimetry of Opaque, Translucent and Transparent Materials.

Problem No. 23 - Expression of Historical Color Usage.

Interested Member-Bodies were asked to send their representatives to the Problems Committee meeting held in Rochester, New York, October 21st to discuss and consider these and other problems submitted to the ISCC.

Problem No. 21, Norman Pugh, Chairman. Two sources of difficulties in comparing samples and standards were identified: conditions under which comparisons are made and variations in skill of observers. If objectives are attained, many of the causes of disagreements may be eliminated.

Objectives:

1. To establish illuminating and viewing conditions suitable for judging small color differences of specimen panels for the purpose of determining the adequacy of a color match.

2. To determine whether it is practical to apply existing tests for color perceptibility or aptitude to define the eligibility of individuals to participate in such judgments.

3. To establish written procedures to cover good general practices with respect to viewing conditions, qualifications for observers and specimen preparation for the purpose of establishing uniform conditions for color matching so that unbiased observers, singly or acting as a jury, might examine color differences satisfactorily according to these written procedures (such procedures to be compatible with trade practices).

4. To publish recommendations based on the results of these studies in an authoritative journal in a form that will encourage wide-scale adoption by suppliers and consumers of color commodities.

The problem initially will be limited to opaque, non-metameric materials.

Problem No. 22, Mr. Billmyer, Chairman; Mr. C. E. Foss, Vice-Chairman. There is an increasing need for stable standards which are durable enough for handling and cleaning. Ceramics, which are available in limited color ranges and organic plastics based on stable resins and modern pigments or dyestuffs may be suitable.

Objectives:

1. To determine the types of materials most suited for use as colorimetric standards for opaque, translucent and transparent materials. Factors to be considered are color stability, color uniformity, color gamut available, durability, cleanability, economy and ease of preparation.

2. To develop specifications for the preparation of a set of representative standards according to the findings in (1). The specifications should provide an adequately broad coverage of the color gamut in opaque, transparent and at least one level of translucent quality.

3. To arrange for preparation, standardization and distribution of the standards.

4. To develop standard procedures for the care and use of these standards according to sound principles of colorimetry and for long-range use and applications.

Problem No. 23, Helen Taylor, Chairman; Everett Call, Vice-Chairman. This problem consists basically of an attempt to set up a universal way of expressing the data obtained from color choice surveys, so that they may be intercompared regardless of source. The problem concerns itself only indirectly with the way in which the data are obtained. It does not concern itself at all with gathering the information and has nothing to do with predictions <u>from</u> the data. The hope is that by making possible direct comparison of older studies more knowledge will be gained which will be useful to those studying current choices.

Objectives:

To develop a technique of expressing historical color usage of consumer products in order to facilitate intercomparison among industries.

NEW MEMBERS The following applications for individual membership were accepted at the last Board of Directors' meeting held on October 22, 1957.

Associate Individual Members	Particular Interests:
Miss Margaret S. Furry Clothing and Housing Research Division Institute of Home Economics Agricultural Research Service U.S.D.A. Beltsville, Maryland	Instruments, measurement and specification of color, and whiteness and fluorescent effects in the laundering of fabrics.
Miss Rita M. Halsey USN Medical Research Laboratory USN Submarine Base New London, Connecticut	Techniques for determining color discrimination and identification under various conditions. Application of discriminability data to color coding systems and to visual theory. Special problems of color specification.
Mr. W. G. Huckle Imperial Paper and Color Corporation Glens Falls, New York	The evaluation of color pigments for a wide variety of applications; the specification of colors, both from our point of view and our customers' viewpoints; the measurement and description of color and color differences as applied to the applications of pigments.
Mr. Frank Kelley, Jr. 205 La Plaza Anaheim, California	Straightforward industrial applications of spectrophotometry and colorimetry with emphasis on industrial control systems of reflecting surfaces.
Dr. Percy H. Tannenbaum Institute of Communications Research University of Illinois Urbana, Illinois	The connotative meanings of colors; communication by color; psychophysical aspects of color perception; color TV.

Affiliate Individual Members	Particular Interests:
Mr. William B. Dall Box 547 Bellport, L.I., New York	Color measurement and specification, color trends and cycles and color forecasting in textiles.

Mr. John C. Holle Interchemical Corporation Finishes Division 1754 Dana Avenue Cincinnati 7, Ohio	---
Mr. Nicos M. Komodromos E. I. du Pont de Nemours & Company Research Laboratories Flint, Michigan	Standardization, description and specifications of color.
Miss Helen M. Paulson U. S. Naval Medical Research Laboratory USN Submarine Base, Box No. 400 New London, Connecticut	Color vision tests, color vision anomolies, colorimetric specifications for optical media for U. S. Navy, color vision requirements in Naval tasks.
Miss Doris Rossman J. C. Penney Company 330 West 34th Street New York 1, New York	Color designation, specification and communication.
Mr. Meredith K. Sikkema Saran Production Laboratory The Dow Chemical Company Midland, Michigan	Those concerned with the production of plastics. This involves controlling the color of unpigmented plastics; establishing control specifications of a standard series of colors and of matching new colors.

COLOR ASSOCIATION RELEASES ADVANCE COLORS FOR 1958

According to Estelle M. Tennis, executive director of the Color Association, the new 1958 collection of Fall and Winter colors for Woolens and Worsteds; the Spring and Summer Hosiery Colors and the new colors for Man-Made Fibers and Silk, have been issued earlier than last year to meet the advanced styling needs of the Association's members.

1958 promises to be an exciting color year in fashion. The Jungfraujoch, jewel-like lakes, verdant meadows, vibrant blue sky -- all these and many more attributes of the crisp atmosphere of colorful Switzerland will be brought to mind in the bright, new outlook for color in Sportswear. The collection called "SHADES OF THE ALPS" adds interest with its very names from spicy Alpine Copper to the Tyrolian Violet. Engadine Pink, a light raspberry shade, the greenish-tinged Swiss Gold, Mountain Blue, a brilliant purplish undertone, Lake Turquoise, a deep jewel hue, Forest Glow, an orangy rust and Scenic Green, a lively forest shade -- all of these promise to light up the corner where you are.

For those who follow the sun the forecast is clear animated pastels, which include Resort Blue, Golden Sun, Island Coral, Patio Lime, Play Aqua, Cruise Mauve and Pink Sunset.

Twelve groups of harmonizing shades called DOUBLE TONES will play an important role for Autumn of 1958. Blue comes out on top in fashion rating with new variations. Lapis Blue, a radiant royal, teamed with Maritime Blue, a spirited light Navy will be prominent along with a bright cobalt type called Pencil Blue used with the deeper Blue Clipper.

Red, that wonderful perk up color, will continue to be successful with two new scales added. The bluer note expressed in Beauty Rose and Rubyglint giving a rich jewel tone. The flashing yellowish shades will be Viking Red and Firebrand Red.

Beiges and Browns will maintain their strong positions in the neutral range, but for those who prefer more zip in their color there will be the spicy hues of Tropic Cinnamon and Spiced Apricot of an orange cast. French Blond with its lovely creamy quality will blend well with Parisian Brown while the deeper and more subdued Bitter Chocolate pairs off with muted Oatbeige. Twine Grege, Woodtaupe, Cloud Silver and medium Mineral Gray are also represented in the family of Fall neutrals. Last but not least you will have Greens adding considerable interest to the Autumn colorscape with the subtle yellow-tinged Bronzemist and a light Green Cactus.

Sportswear colors will not be the only colors lighting up the corners next year. The gleaming jewel-bright hues called STARS OF THE NIGHT will lend lustre to the Winter evening scene for the Man-Made Fibers and Silk. The night will become brilliant with Jewel Pink, Party Blue, Gold Glamour, Emerald Glean, Sapphire Glow, Gala Coral, Radiant Violet and Glitter Red.

The Italians, who have leaped to the foreground these past few years in the fashion field have inspired the lighter color motif of this advance collection. The charm of sunny Italy brought forth these clear bright pastels: Roman Blue, Florentine Pink, Capri Turquoise, Venetian Yellow, Como Coral, Tivoli Green, Tuscan Melon and the lovely Italian Lilac.

A special feature of the Autumn preview for Man-Made Fibers and Silk will be the group of eight TOWN SHADES. These colors comprise the greenish-tinged Gold Mustard, Amberspice of an apricot cast, Blue Lustre in the royal range, the swagger Avenue Green, Plaza Blue with an undertone of purple, the firey Boulevard Red, Urban Gray which is a steel tone and the vintage shade, Grape Cordial.

Six pairs of tone-on-tones forecast significant color movements for the Fall with Blue the leader here too, and represented in Basilica Blue, a brilliant stained glass version with a violet cast, grouped with the light Autumn Azure. Gulf Aqua and Blue Channel are the new greenish sea tones.

Reds will be intense and glowing and continue to lift the spirits with new versions of Wine Sparkle and Luminous Red.

The fact that President Washington wore a "made-in-America" suit to his inauguration to encourage the then infant textile industry and that the suit's color was Brown may or may not have indicated a fashion trend. Nevertheless,

Beige to Brown tones have always been good. They will receive special emphasis as the leading neutral range with Brown Maple, honey-toned Macaroon Beige and the muted Shadowbeige plus the subdued Ultrabrown. In the bronze or olive scale, Frog Green and Seaweed, subtle yellow-tinted greens, are regarded as promising.

The 1958 Spring and Summer Hosiery Card will feature costume-blended hosiery colors with definite tonal qualities. Each of the nine new hosiery shades will closely harmonize with a leading color note in the ensemble. Miss Tennis believes that through the strong appeal of color and the blended look, hosiery now has greater fashion significance, thus offering excellent opportunities for its profitable promotion this coming Spring and Summer.

For wear with the important fashion palette of blues, especially medium tones, you will find the subtle misty Platinum Blue. Roseglint, a gleaming rosy iridescent shade will go well with the Red family. Blending well with orangy shades and burnished colors will be Blush Apricot. Greenglo is an illusive golden green that has a subtle color toning which will harmonize with the new Spring Greens, especially the misty golden sage, linden, sulphur and other yellow-tinted versions. Dream Gray is that gentle silvery gray, while Pearl Smoke is distinctively a shadowy taupe to complement the darker gray, taupe, black and violet. The warm animated shade of Spice Amber favors the important spring range of beige, blond and light browns. For summer wear Sun Radiance will be just right with all the new vibrant colors as well as pastels and white.

35TH ANNUAL MEETING FEDERATION OF PAINT AND VARNISH PRODUCTION CLUBS

The 35th FPVPC Annual Meeting was held at the Bellevue-Stratford Hotel, Philadelphia, October 30 through November 2. The keynote address was delivered by Dr. Roger H. Lueck, Vice President, Research and Technical Department, American Can Company. The Annual Joseph J. Matiello Memorial Lecture was presented by Dr. Albert C. Zettlemoyer, professor of chemistry, National Printing Ink Research Institute. The subject of Dr. Zettlemoyer's address is "Pigment Vehicle Interface."

Color played a prominent part in the program. The Philadelphia Paint and Varnish Production Club's offerings were "The Color Stability of Red Iron Oxide Pigments" and "Selection of the Optimum Source of Artificial Illumination for the Matching of Colors."

Mr. O. J. Hinz presented the Baltimore Club's paper "Instrumental Color Reproduction of paint." The following is an abstract of this paper as it appeared in the October issue of the Official Digest of the Federation of Paint and Varnish Production Clubs:

"The reproduction of colors from instrumental measurements was studied. Standard colors were selected and measured. Using measurements only, colors were reproduced to match standards. Metamerism was avoided by using the

same ingredients in the standards and matching samples. Thirteen instruments representing nine different types, were used. Colors ranged from high to low reflectance, from high to low chroma, and included hues distributed around the color solid. The closeness of match to standard was judged by both instrumental and visual means.

"Instrumental determinations of the 'closeness' of 'near matches' to a standard were also made. Both gloss and flat finishes were used. The 'near matches' were then judged visually by paint men experienced in approving paint matches. A comparison of visual judgments versus instrumental results is given."

THE COLOUR COUNCIL OF TORONTO COMMENTS

I was very happy to receive Colour Comments, the publication of the CC of T, just in time to use it as a source for this News Letter.

WLR

Windsor and Newton of London supplied a colour movie "A Touch of Magic" for the September meeting. The first part of the film was devoted to the manufacture of artists' brushes, the second to the manufacture of oil and water colour.

At the October meeting R. C. Fairfield of the firm of Roundthwaite and Fairfield, architects, discussed the new STRATFORD THEATRE. The reasoning behind the choice of colour used . . . The wonderful choice of Brick and Hemlock and Cedar . . . even to the roof finial . . . the ground to sky ideals . . . illustrated by some excellent coloured slides of the exterior . . . all combined to produce an evening of creative problems which we will long remember.

The Illuminating Engineering Society has asked the Colour Council of Toronto to undertake a project to prepare a "Sight and Lighting Conditioning Manual". Problem Committee Number Two has attacked the problem with four sub-committees:

Sub-Committee One - Psychological Problems
Sub-Committee Two - Colour Codes and Systems
Sub-Committee Three - Industrial Painting and Colour Coding
Sub-Committee Four - Interior Lighting

"COLOR AND STEELMAKING" AT THE 101ST SCIENCE MEETING OF THE PHYSICAL SOCIETY COLOR GROUP

Mr. B. O. Smith of the British Iron and Steel Association, London, lectured at the 101st Science meeting on October 9, 1957, at the Institute of Ophthalmalogy. Although the theory of colour has as yet little place in steelmaking technique, problems of an allied nature do occur. The specification of the optical characteristics of coloured protective goggles for different grades of operatives has been given much thought by the industry and other interested bodies. The assessment of the correct degree of heat treatment is often made on the basis of colour changes. The need for a protective coating on steel is allied

to the psychological problem of a pleasant colour appearance. The application of colour photography as an investigational tool was demonstrated with a short film showing the melting of scrap steel in a furnace.

The November 6th meeting was held at the Institute of Ophthalmalogy. Mr. E. A. Jobbins spoke about "Color and Geology" and Mr. B. W. Anderson's topic was "Gems."

Topics for the December 11th meeting are:

"Report on the Paris Meeting on Colour Television, 1957," Mr. L. C. Jesty

"Report on the Meeting of the CIE Working Party on Colorimetry, Teddington, 1957," Professor W. D. Wright

"Report on the Symposium on Visual Problems of Colour, Teddington, 1957," Dr. W. S. Stiles

In a previous Newsletter it was announced that "Proceedings of the Symposium on Visual Problems . . ."could be obtained by writing to Her Majesty's Stationery Office. The British Information Services suggests that those desiring the "Proceedings" should write direct to the National Physical Laboratory, Teddington, Middlesex, England.

The ISCC Secretary received the following letter:

Dear Mr. Evans:

I am sorry that I missed an error in the Colour Group Minutes for the 100th Science Meeting, which has, quite naturally, been reproduced in the ISCC News Letter No. 130, page 4. The dark adaptation in Mr. Clarke's experiments lasted 15 minutes and not 15 seconds.

R. A. Weale
Hon. Secretary, Colour Group.

RALPH EVANS AWARDED SMPTE PROGRESS MEDAL

The Society of Motion Picture and Television Engineers presented their highest award, the Progress Medal, to Ralph Evans for major contribution to progress of photography. Mr. Evans, Director of Color Technology Division of Eastman Kodak Company, is a pioneer in the study of visual effects in color photography. The medal was presented October 4th at the 82nd SMPTE Convention at the Sheraton Hotel, Philadelphia.

In addition to the job of secretary of the Inter-Society Color Council, Mr. Evans is Chairman of the Board of Fellows of the Illuminating Engineering Society, a member of the Colorimetry Committee of the Optical Society of America, and a fellow of the Society of Motion Picture and Television Engineers and of the Photographic Society of America. He was SMPTE Warner medalist in 1949, Rochester Institute of Technology Brehm Memorial medalist in 1951, and he received the Photographers Association of America award "for distinguished service to professional photography" in 1955.

COMMENTS ON THE REVISION OF THE AO H-R-R PSEUDO-ISOCHROMATIC PLATES

The following is a response to my letter to Dr. Gertrude Rand asking for information about the revision of the color blindness test:

WLR

"Dear Mr. Rhodes:

Dr. Rand is at present in the hospital, but I have been able to consult her about this reply to your letter of October 10th.

In the second edition of the AO H-R-R Pseudoisochromatic Plates the color plates used are those which were approved by the ISCC Sub-Committee on Color-Blindness. The only revisions for the original edition are in the written material and in the arrangement of the order of the plates in the screening series. In detail the changes made are: 1) Simplified and more detailed instructions to the examiner, 2) Revisicn of the score sheet which may make the administration of the test easier for the examiner, 3) Modification of the booklet accompanying the test and 4) Rearrangement of the plates in the screening series so that the B-Y precede the R-G.

We hope that this will give you the information that you wish for a note in the ISCC Newsletter.

Sincerely yours,

M. Catherine Rittler"

LIGHTING FOR VISUAL COLOR APPRAISAL IN THE GRAPHIC ARTS

Several years ago a joint committee was formed of working members of the graphic arts industry and the lighting industry to formulate standards for lighting in connection with visual appraisal of color by the graphic arts industry. The Committee has worked very hard to solve this problem and to give the graphic arts industry some standards in lighting suitable for their needs. The result is a Standard which has been approved both by the Council of the Illuminating Engineering Society and the Directors of the Research and Engineering Council of the Graphic Arts Industry.

The Standard specifies a primary and a secondary source in terms of the permissible deviation from the spectral distribution of a standard curve for daylight at a color temperature of 7400°K. The tolerance for the primary standard is very tight while that for the secondary source is made somewhat looser to admit lamps of high efficiency and lower cost. The tolerance limits are expressed in terms of a conformity index described in the text.

The Standard may be obtained either by writing the Technical Secretary of the Illuminating Engineering Society, 1850 Broadway, New York, New York or to the Secretary of the Research and Engineering Council of the Graphic Arts Industry, 5728 Connecticut Avenue, N.W., Washington 15, D. C.

The Co-Chairmen of the Committee were Philip Tobias, Edward Stern & Company, Philadelphia, Pennsylvania and Norman Macbeth, Macbeth Corporation, Newburgh, New York.

Norman Macbeth

The standard published by the IES-R&E Council establishes the spectral distribution of Abbot-Gibson at 7400°Kelvin as the standard, with a minimum luminance level of 100 foot-candles, a brightness variation not greater than 20 per cent over the viewing area, and the surround to be neutral (Munsell value N7/).

The standard points out that there are four essentially different kinds of tasks in viewing color. The illumination requirements are different for each: 1) original color selection (artists choice of colors), 2) color matching of basic materials (selection of pigments for printing inks), 3) visual appraisal of "color quality" of printed result as compared with original color selection (proofs versus copy), and 4) visual appraisal of "color uniformity" of production press sheets with O.K.'D press sheets or approved proofs (result versus proofs or O.K.)

The primary standard, which so far as we know is met at present only by tungsten light filtered through Macbeth filters (of Corning's No. 5900 glass) is for use in viewing when metamerism may be important, as in 2 and 3. The secondary standard can be achieved with a mixture of suitable fluorescent and incandescent lamps, and is meant for use in viewing when metamerism is not a consideration, as in 1 and 4.

From the beginning of color printing, the graphic arts has labored to satisfy customers. Many of the difficulties encountered in trying to do this can be traced directly to differences in light sources used at various stages in the chain of color reproduction events. Standardized illumination is long overdue! Thanks to IES and the R&E Council Committee for tackling the difficult job of resolving differences of opinion, thus making it possible to bring out this standard.

WLR

A REVIEW OF "TRICHROMATIC IDEAS IN THE SEVENTEENTH AND EIGHTEENTH CENTURIES"

BY R. A. WEALE

179, 648-651 (1957).

The sesquicentennial of the publication of Thomas Young's final views on color vision has been taken by Dr. Weale as the occasion for this arresting reappraisal of Young's contribution in the light of recent discoveries.

Until last year Young's origination of trichromatic theory was generally considered to be among the more definitely established facts of scientific history; but now we are inclined to feel that our knowledge of the origin of this theory is almost a matter of chance. Certainly, the complacent confidence of the recognized historical accounts has been completely upset.

It all began because Walls was trying to discover early cases of color blindness. If Helmholtz had not left a puzzling reference for Walls to track

down we might never have heard of the trichromatic theory of G. Palmer (possibly misnamed) which antedates Young by a quarter of a century. If Seidl had not been investigating three-component theory he might have overlooked Lomonosow's (or Lomonossow's) theory of a three-color mechanism which is dated twenty years before Palmer. If it were not for Lomonosow's mention of Mariotte (of blindspot fame), then Weale himself most likely would never have found the view of trichromacy which Mariotte described about a century before Lomonosow.

Without benefit of the original sources, it appears that the contributions of these several savants vary greatly in importance. According to Weale, Mariotte derived his three primary colors from examination of the spectrum, and he anticipated Müller's law of specific nerve energies by over 150 years. Though Mariotte's treatise on the nature of colors was not published until 1717, he lived from 1620 to 1684. Moreover he wrote like a modern scientist while Lomonosow who followed him so much later seemed like an alchemist. The latter's views were obtained from a Latin translation dated 1757. He wrote that three primary colors originate from three types of ethereal particles, and that a vital gyratory motion mixes these colors to produce others. Palmer's theory of color vision appeared in 1777 and Walls found it to be no less complete or satisfactory than Young's theory. Other publications in 1781 and 1786 show further that Palmer like Young explained color blindness in terms of the trichromatic theory.

As regards the residual contribution of Young himself, Weale emphasizes that Young never claimed any priority for the theory, and so far as we can tell he never knew of the earlier developments. Young differed from Mariotte, Lomonosow and Palmer regarding the particular hues considered to be primary; for all of them the so-called primaries were red, yellow and blue, but before the final 1807 publication Young had changed to red, green and violet. This was a contribution. Other contributions of Young's were bringing the theory to the attention of scientists and gaining it some acceptance.

It may be added, the reviewer believes, that half a century later Helmholtz rendered similar services on a far greater scale. He rediscovered the theory once again and gained it such wide acceptance and application that now it will probably never be forgotten.

Sidney M. Newhall

Editor's Note: Thanks to Mr. Newhall for his review of R. A. Weale's article which appeared in Nature, 179, 648-651 (1957).

BIBLIOGRAPHY FOR "PROBLEMS IN COLORIMETRY FOR COLOR CONTROL" BY ROLAND E. DERBY, JR.

When Mr. Derby's article was reviewed in the July, 1957 Newsletter, No. 130, the bibliography was inadvertently omitted. Several readers have asked for the bibliography, so here it is.

The Committee on Colourimetry, Optical Society of America "The Science of Colour", Thomas Y. Crowell Co. New York (1953)

Judd, D. B., J. Opt. Soc. America 45, 897 (1955)

MacAdam, D. L., J. Opt. Soc. America 33, 18, 675 (1943)

Nickerson, D., Amer. Dyestuff Reporter 39, 541 (1950)

Davidson, H. R. and Hanlon, J. J., J. Opt. Soc. America 45, 617 (1955)

Brown, D. J., J. Opt. Soc. America 46, 46 (1955)

Derby, R. E., Jr., Amer. Dyestuff Reporter 45, 406 (1956)

Tukey, J. W., Trans. N. Y. Acam. Science 16, 8 (1953)

Dixon and Massey, "Introduction to Statistical Analysis" McGraw-Hill Book Co. New York (1951)

EDITOR'S NOTE It is difficult to select material which is of interest to ISCC's diversified membership. Control of the color of manufactured products seems to meet this requirement about as well as most topics. Artists, designers, architects, and decorators are interested because they use the product. Manufacturing and production organizations are concerned with supplying a uniform product to keep customers happy. Scientists and technical people are interested in the technical aspects of the problem.

Here, for example, is a letter from one reader:

Dear Mr. Rhodes:

Since reading the July issue of the ISCC News Letter, I have wondered what response (News Letter readers would have to) Dr. Wright's "A Challenge to Colorimetry" . . .. It seems to me that the question, "Where do we go from here?" has vital significance to any industry whose conversion (or manufacturing) costs are a direct function of color tolerances. Our own experience indicates that if the tool, colorimetry, "still requires some sharpening," there are many occasions where intelligent use of the tool, however dull, would obtain substantial improvement in production control.

I trust that subsequent issues of the Newsletter will encourage and report responses to this challenge, particularly from those closely concerned with applying colorimetry to production control problems, and especially from those who can provide the dollar-savings obtainable from properly applied colorimetry.

George W. Ingle
Research Department, Plastics Division
Monsanto Chemical Company

Mr. Ingle, I heartily agree. So far none of the News Letter readers have risen to meet the challenge with pen, pencil or typewriter. Mr. Derby's article last month and the following article in this issue may be of some help. If other readers have an opinion or suggestion, let's hear them!

WLR

"APPEARANCE SPECIFICATION CONTROL METHODS" BY W. J. KIERNAN - A REVIEW

This article, the second to be used recently, is reviewed because it covers an important aspect of the problem - source material. It is reviewed with the permission of Alex. Javitz, Electrical Manufacturing magazine.

Mr. Derby's article is concerned with problems of color control and means for dealing with them. Mr. Kiernan extends the range a little to include gloss and texture.

Mr. Kiernan points out that the design engineer must specify appearance factors and devise means of checking the product to ascertain conformance with the specification. The American Standards Association and the American Society for Testing Materials, in cooperation with industries and other societies have stimulated the design and manufacture of instruments to measure these characteristics of appearance. It is also apparent from the efforts of the ISCC that improvements are being made in visual methods of appearance control.

The manufacturer must decide whether to base the control system on an inexpensive method such as visual control using a single visual standard or on a comprehensive instrumental analysis staffed with graduate level personnel.

Although it would probably be difficult to obtain an existing standard which contains all the desirable attributes, one might be found in:

Munsell Book of Color
Maerz & Paul Dictionary of Color
Color Harmony Manual
TCCA Standard Color Card of America, made by the Color Association of the United States, Inc.

A single standard could also be selected by reference to physical appearance standards developed by industry such as colors for:

Molded Urea Plastics CS147-47
Polystyrene Plastics CS156-49
RETMA Standard GEN-101-A Color Coding for Numerical Values (See also ASA, C83.1-1956)

Whether the standard is selected from one of these sources or produced under the manufacturing conditions, the design engineer will have the usual three difficulties associated with material standards:

1. Obtaining a sufficient quantity of standard samples and replacements,
2. Permanence and means for determining drift and,
3. Difficulty in establishing tolerance limits.

Number 3 is the most difficult to manage. Since acceptable limits are influenced by viewing conditions, training, experience, and often by the whims of an inspector; tolerances cannot be precisely defined. Acceptability varies from one inspector to another, and single inspectors may vary their judgments within the course of a day.

This difficulty may be overcome somewhat by the use of limit samples, although these are more difficult to prepare for color than for gloss and texture. The tolerance limits may be illustrated by the use of a hexagonal solid in color space with the desired color at the center. All limiting points are equidistant from the center.

The simplest control consists of light and dark limits, represented by the vertical axis. Adding hue limits provides more complete control. Better control still is obtained by adding hue limits in the light and dark zones. Establishing tolerance limits and determining the number of limit specimens usually require the services of an expert. The preparation of the specimens demand it.

Small variations in color have little effect on gloss judgments. A central standard with high and low limit specimens should suffice for visual control of gloss.

Either photographic reproduction or silica replicas may be suitable for control of texture. Dirt, grit and orange peel may be included in texture judgments. TAPPI Standard T437M-43, "Dirt in Paper," has been usefully employed for controlling foreign inclusions in plastics.

Instrumentation Requirements - Spectrophotometers

Instruments which are properly designed and used avoid interminable arguments resulting from differences in personal judgment. Instruments provide a permanent record of an appearance standard, and numerical values can be used to determine conformance to previously established limits.

The standard instrument for measuring color absolutely is the spectrophotometer. Test methods for spectrophotometers are as follows:

American Standards Association:
ASA Z58.7.1-1951 Spectrophotometric Measurement of Color.

American Society for Testing Materials:
ASTM D307-49 Spectral Characteristics and Color of Objects and Materials.

ASTM D791-54 Luminous Reflectance, Transmittance and Color of Materials.

Technical Association of the Pulp and Paper Industry:
T442M-47 Spectral Reflectivity and Color of Paper.

Blind use of the spectrophotometer may lead to erroneous conclusions. It should be emphasized that samples being compared for color must have the same surface gloss and texture. Specimens of materials that are not opaque should be of the same thickness. Surface haze, bloom, or finger prints can be the source of serious errors. The surface conditions of textured specimens should be identical and they should be oriented identically.

Spectrophotometry cannot be used directly for control. Small differences in reflectance at some wavelengths may indicate a large color difference. The converse is also true. To get some idea of the appearance of samples, spectrophotometric data should be converted into the CIE coordinate system.

One method of control which is popular today is accomplished by defining limiting values for dominant wavelength and excitation purity. Lightness limits are expressed separately. Hardy's "Handbook of Colorimetry" describes this method in detail.

Another method of control makes use of MacAdam ellipses (4) and Silberstein and MacAdam ellipsoids (5). These ellipsoids multiplied by an appropriate factor describe a solid in the CIE space which represent limits of acceptability. Rudick and Ingle (6) employ this method by plotting CIE coordinates in three views. This space configuration may not be suitable for a consumer who requires strict conformance to hue while permitting wider limits on saturation and lightness.

Color Difference Meters

ASTM Sub-Committee X has recently completed a study of such instruments as the Color Eye, the Hunter-Gardner Color Difference Meter, and the Colormaster. The Committee expects to publish test methods for all instruments. The two already issued are:

D1260-55T Color Difference with the Hunter Multipurpose Reflectometer.

D1365-55T Color Difference with the Hunter-Gardner Color Difference Meter.

Meters of this kind are very rapid and the data can be transformed into a single number indicating the color difference.

Gloss Measuring Instruments

Glossmeters are in common use in the ceramic, paper and paint industries. Sample selection and preparation are very important in gloss measurements. Also, materials of different refractive index may look alike although glossmeters give identical values. Reflectance measured at many angles with a goniophotometer gives more complete information about gloss characteristics

than fixed angle glossmeters. The Two-Parameter Gloss Method for wood finishes developed by ASTM Committee D-1, Sub-Committee X, may be useful on other materials.

Curved surfaces do not lend themselves to instrumental methods for determining gloss. Visual comparison, photographic methods and appearance phenomena of grid pattern are used for testing gloss (8).

ASTM has issued the following testing methods:

D523-53T--Method of Test for Specular Gloss (Note: This method primarily designed for paint-like materials, contain three procedures: (1) 20 deg; for high gloss finishes. (2) 60 deg; for intercomparing most finishes. (3) 85 deg; for low gloss finishes.)

D673-44--Mar resistance of Plastics

C346-54T--Specular gloss, 45 deg of porcelain enamels.

Texture

Uniform grained or frosted finishes can be controlled by a profilometer. Roughness and texture of metal surface may be tested by using ASTM physical standards. ASTM Committee E-12, Sub-Committee IV is studying methods of permanent texture records prepared photographically. Stereophotography is useful in showing depth.

It should be obvious from this discussion that appearance control in industry, either visually or instrumentally, is a rapidly developing science. The design engineer should give constant attention to the activities of the ASA, ASTM and the Inter-Society Color Council in order to keep acquainted with the progress in this field. Only by this means can industry reap the benefits resulting from the cooperative efforts of the members of these societies.

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2. "Color Matching in Production," S. L. Davidson, Official Digest, Federation of Paint and Varnish Production Clubs, 27, 822 (1955).

3. "Interrelation of Color Specifications," D. Nickerson, Paper Trade Journal, 125, TS129 (1947).

4. :"Visual Sensitivities to Color Difference in Daylight," D. L. MacAdam, Journal Optical Society of America, 32, 274 (1942).

5. "Distribution of Color Matchings Around a Color Center," L. Silberstein and D. L. MacAdam, Journal Optical Society of America, 35, 32-39 (1945).

6. "Control of Small Color Differences in Plastic Manufacture," L. Rudick and G. W. Ingle, ASTM Symposium on Color Difference Specification (1952).

7. J. J. Hanlon and H. R. Davidson, Available from J. J. Hanlon, Mohawk Carpet Co., Amsterdam, New York.

8. "Gloss Evaluation of Materials," R. S. Hunter, ASTM Bulletin No. 186, December 1952.

Other References:

"An Introduction to Color," Ralph M. Evans, John Wiley & Sons, (1948).

"Handbook of Colorimetry," Arthur C. Hardy, Technology Press, (1948).

"The Science of Color," Committee on Colorimetry of the Optical Society of America, Thomas Y. Crowell Company, (1953).

"Color in Business, Science and Industry" Deane B. Judd, John Wiley & Sons, (1952).

MISCELLANY Response to the "Miscellany" section was so gratifying that I should like to continue it. Please remember that I depend on you for material. When you see something News Letter readers would be interested in, clip it out and send it to me.

WLR

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Dear Mr. Rhodes:

John T. McCutcheon, Jr., in reporting on the "Colorobot" (September News Letter), states that it is capable of producing 16 quadrillion colors.

This is chickenfeed, compared to what the trained colorist of tomorrow will be capable of, if present hopes are realized.

The project I have in mind (still in the drawing-board stage) is a keyboard of 88 colors, based on even intervals, as are the 88 tones of the piano keyboard.

Supposing such a color keyboard to be in operation: if the colorist composes all the possible color schemes of 8 tones each, he will emerge with 2 quintrillion, 590 quadrillion, all different.

Some people, of course, <u>like</u> automation. "The typewriter", a poet once wrote,

"when played with expression, is superior to the piano, when played by a younger sister, or other near relation".

Henderson Wolfe
2 Elm Street
Mystic, Connecticut

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Telling Time in Color Coming Next, Reading Pennsylvania, 10/10/57

Chicago (UP) Colored watch dials from "mandarin red" to "bamboo brown" will invade the jewelry field soon, a leading color processing firm predicts.

M. J. Silbert and Co. researchers said surveys have been made indicating the "public is ready" for colored watch dials, just as they were when the "pastel trend" hit the automobile industry.

Its developers said advantages of the colored watch dial are many. They said it was first a fashion accessory, with women preferring lighter shades and men darker ones.

It also could be repainted to go with a change in wardrobe or so it would not take on the "dirty and used look" that ordinary watch dials can acquire.

Harry K. Hammond III

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Shotguns Go Glamorous - Pick a Color and Go a-Hunting

Male hunters this fall may take one look at the hue--and cry. But their wives are going to be tickled pink.

Recently a survey showed that some 418,000 women per season go a-hunting. Harrington Richardson, Inc., an arms firm whose chivalry knows no bounds, instantly went into action to supply that spot of color so dear to the feminine heart--and incidentally to get more of the lovely creatures interested in the sport. They came up with a rainbow of .410 gauge shotguns--The regular walnut stock has a coat of special plastic paint.

This arsenal boasts six colors and is not all fashion folderol. Bright stocks show up in foliage better than standard brown and will become, like colored caps and shirts, a safety factor--helping hunters to spot each other in the woods.

The glamour guns make no promise to improve a lady's aim, but now the hunting life will still be bright even if the Mrs. misses.

* * * * *

Gracie Allen once told her husband George why she consistently ignored red traffic lights. "When you've seen one," she scoffed, "you've seen them all."

J. A. Meacham