# INTER-SOCIETY COLOR COUNCIL News Letter

#### NUMBER 139

January, 1959

News Letter Committee:

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28TH ANNUAL MEETING <u>Material Standards for Color Matching</u> is the theme for the 28th Annual Meeting April 1, 1959. Three well qualified speakers will lead a symposium on this theme at the afternoon sessions. Two other events add to the meeting: the banquet speaker, Dr. Judd, and a visit to the Interchemical Corporation Color Center.

Monday, March 30, 9:30 a.m. Board of Directors Meeting

Tuesday, March 31 (All Day) Committee Meetings

Tuesday, March 31, 6:15 - 9:15 p.m. Visit to Interchemical Corporation Color Center

Wednesday, April 1, 8:30 a.m. Business Meeting

Wednesday, April 1, 2:00 p.m. Mr. A. J. Benjamin, Monsanto Chemical Company, will speak on "Material Color Standards; Practical Problems and Acceptance."

Mr. Harry J. Keegan, National Bureau of Standards, will speak on "Material Color Standards; The Instrumental Approach."

Messrs. Hugh Davidson and Henry Hemmendinger will speak on "Material Color Standards; the Visual Approach."

Wednesday Evening, April 1

Banquet. Guest speaker, Dr. Deane B. Judd, will speak of his personal experiences in the field of color and material color standards.

Advance registration blanks may be obtained by writing to the ISCC Secretary.

## PROBLEM 2 COMMITTEE REACTIVATED

At the meeting of the Board of Directors of the ISCC, November, 1958, it was decided to reactivate Problems Subcommittee 2, Color Names. This was

brought about by the demand for the production of the colors representing the centroids of the 267 ISCC-NBS color-name blocks. The Munsell renotation designations of these colors were published under the title Central Notations for the Revised ISCC-NBS Color Name-Blocks by Kenneth L. Kelly, J. Research NBS 61, 427-431 (Nov. 1958). The membership of this committee is Deane B. Judd; Kenneth L. Kelly, Chairman; and Miss Dorothy Nickerson.

When, after consultation with Davidson and Hemmendinger, it was found that these colors could be produced at a reasonable cost, it was decided that the Council should sponsor their production primarily for use by Committee 2 for illustrating the color names dictionary with color charts. It is hoped that these charts, seventeen in number, can be published in the form of a supplement to Circular 553 and will be made available for purchase separately until the present printing of this circular is exhausted after which time it would be suggested that it be bound with the circular. It is tentatively planned that the color samples in these charts be one inch square and that the ISCC-NBS color name and corresponding number be printed underneath each sample.

A second use of these centroid colors, is by ISCC Subcommittee 23 in color charts which are being designed for use by this committee in the collection of data illustrating color usage in industry.

It is interesting to note that Problem 2 was the first real color research problem undertaken in 1932 by the then newly formed Council. It is more interesting to note that the Inter-Society Color Council was born as a result of the search by Dr. E. N. Gathercoal of the Revision Committee of the United States Pharmacopoeia for a simple but accurate and understandable system of color names for use in the official books of drug standards and in pharmaceutical literature. The answer to this original problem is NBS Circular 553, The ISCC-NBS Method of Designating Colors and a Dictionary of Color Names published in 1955. It is hoped that in the next year or two, this dictionary will be obtainable with its own color charts.

#### Kenneth L. Kelly

By underwriting the cost of preparing the initial papers to meet the centroid specifications, the Board of Directors has demonstrated a strong conviction that publication of the color charts will contribute substantially to basic ISCC objectives. In order to finance this development, a limited number of sets composed of 6"xlO" glossy coated papers representing the centroid loci standards, will soon be made available. It is expected that a number of individuals and organizations may wish to explore applications of the system or make use of this collection in research during the year or two prior to final publication. Details concerning this offering will be covered in a prospectus which is being separately mailed to the ISCC membership. News Letter readers who are not members of the Inter-Society Color Council but are interested in procuring a set of the original papers may obtain a copy of the prospectus on request from the Secretary's office. FORMATION OF BIBLIOGRAPHY COMMITTEE ANNOUNCED The response to the ISCC Godlove Bibliography was certainly gratifying. When this excellent reference source was distributed to the ISCC, those who were responsible for putting it together must have ex-

perienced a great feeling of accomplishment. This feeling must certainly grow. In retrospect the job of collecting such a bibliography was monumental. The labors of Dr. Godlove will long be remembered.

A committee of the ISCC has been formed to continue the collection and compilation of a bibliography on color. The News Letter has carried on in an ineffective and sporadic manner, attempting to maintain some continuity to a published bibliography. The work of this committee will certainly improve the collection as well as broaden the scope. The membership of the committee is such that the important job of collecting the bibliography will have the widest possible representation and certainly result in the most comprehensive possible bibliography. The committee consists of:

| Mr. F. L. Wurzburg, Chairman               | Dr. S. M. Newhall  |
|--|--|
| Interchemical Corporation                  | Eastman Kodak Company  |
| Dr. I. A. Balinkin                         | Dr. Manfred Richter  |
| University of Cincinnati                   | "Die Farbe"  |
| Dr. S. K. Guth<br>General Electric Company | Mr. Francis Scofield<br>National Paint, Varnish and<br>Lacquer Association |
| Mr. N. M. Kromodromos                      | Mr. R. C. Stillman   |
| E. I. du Pont de Nemours & Company         | Procter and Gamble Company   |

Miss Gladys Miller Holt Magazines

Incidentally, there are still copies of the ISCC Godlove Bibliography obtainable at \$3.75 each from the Braden-Sutphin Ink Company, 3650 East 43rd Street, Cleveland 5, Ohio, attention Mr. G. L. Erikson.

| PHYSICAL SOCIETY | The Physical Society held a 109th Science meeting    |
|------------------|--|
| COLOUR GROUP     | Wednesday, December 10, 1958 at the Northampton      |
|                  | College of Technology. Mr. J. W. Perry, Group Chair- |

man, presided.

Mr. F. H. Ludlam of the Imperial College gave a beautifully illustrated talk on Colour and Meteorology.

Stressing the fact that colour had very little to do with his subject, he nonetheless gave an account of colour phenomena, associated particularly with sunsets. A time-lapse film, which took the audience from the Canary Islands to Italy, emphasised the advantages which colour films (of unspecified make) bestow on meteorological studies.

Mr. J. Hallett (Imperial College) gave an account of studies on artificial clouds. He showed interference colour photographs of the growth of crystals,

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which must have acted on any textile designers as magnificent sources of inspiration. The Chairman, and Messrs. Adams, Fletcher and Chamberlin took part in the subsequent discussion.

A number of fascinating colour atlases, the Farnsworth-Munsell 100 hue test, and allied matter were afterwards exhibited and discussed by the Chairman and Commander Farnsworth.

SPRING LECTURE SERIESThe Chicago Paint and Varnish Production Clubs and<br/>the Chicago Paint, Varnish and Lacquer Association<br/>jointly announced a lecture series sponsored by<br/>the Federation of Paint and Varnish Production ClubsISCC Committee according to Sam Huey, Committee Chairman. The series began<br/>February 25, 1959. The four lectures in the series will be completed by<br/>April 8, 1959.

The first lecture to be given by Warren B. Reese, Vice-President Macbeth Daylighting Corporation, was entitled "Light and Color." This lecture introduced the subject explaining psychological, physical, and physiological aspects of color perception. He included the definition of important color terms and introduced the theory behind tristimulus colorimetry. He also discussed the effect of light on the judgment of color matching.

ISCC President Walter Granville, will present the second lecture "Color Order Systems." Mr. Granville will discuss basic coordinate color scales. These scales are called hue, lightness, and saturation. A value for each of these is sufficient to describe a color and the position in color space. It denotes relations to other colors and enables a description of difference between a sample and the standard. Munsell and Ostwald systems will be explained, and some of the appropriate uses for each will be discussed.

Harry K. Hammond, III of the U. S. Bureau of Standards will conduct lecture number three, "Color Measurement and Specification." He will describe how color measurement is divided into two basic categories--fundamental measurement of the spectral characteristics and color difference measurements by means of tristimulus colorimetry. For the first, all that is required is a spectrophotometer in working order and any single white reflection standard. For the second, a colorimeter may be used together with a number of reflectance standards of nearly the same spectral character as the specimens to be measured. Mr. Hammond will introduce the notion of uncertainty in measurements and point out why laboratories may not agree exactly in measuring the same color.

Ralph Pike of the E. I. du Pont de Nemours and Company will wind up the series with "Practical Applications of Basic Color Principles to Paint Problems." This series will summarize the major points raised in the preceding lectures, describe the status of applied color technology, and outline reference sources for further information. Mr. Pike will also introduce the problems of color vision and aptitude qualifications of color workers.

Registration was limited, and the registration fee was \$10.

### FARNSWORTH LECTURES IN BRITAIN

The News Letter Foreign Correspondent, Commander Dean Farnsworth, lectured on November 4, 1958 to the Association of Printing Technologists. Comdr.

Farnsworth, who is Scientific Liaison Officer to the Office of Naval Research in England, lectured on the subject "Colour Vision and the Printer." A summary of the lecture was published in PATRA News (Printing and Allied Trades Research Association, Leatherhead, Surrey, England).

COLOR RESPONSE OF THE HUMAN EYE

To further the development of color standards and measurement methods, the National Bureau of Standards has been participating in an international study of

color vision. Purpose of the study sponsored by the International Commission on Illumination,<sup>1</sup> is to define the color response of the average human eye. Pertinent physical properties of color standards can be measured by strictly physical methods; however, to compute a valid numerical specification of a perceived color from the physical measurements requires a determination of the eye's color response, technically expressed as "color-mixture functions."

A recent Bureau experiment for this study provides an approximate method for measuring the pigmentation that affects color judgment. The experiment confirmed the belief that the amount of lens pigmentation increases as a person grows older, but it showed that macular pigmentation remains relatively constant with age.<sup>2</sup> Results of the experimental data evaluated by K. L. Kelly of the Bureau's colorimetry laboratory, are expected to be of value in determining the eye's color-mixture functions.

The pigmentation that affects color vision in the normal eye occurs only in the lens and macula. The macula is the so-called "yellow spot" in the center of the retina. The iris, which gives the eye its external color--for instance, brown, gray, blue--is opaque, and does not affect color judgment. It is well known that the lens becomes yellower as a person grows older, but no method has been available to estimate the amount of yellowing either in the lens or in the macula. By utilizing a pair of metameric gray plaques devised by W. C. Granville,<sup>3</sup> the NBS investigators were able to measure the pigmentation present in the eyes of 39 persons with normal color vision, ranging in age from 18 to 77 (see Table 1).

## The Experiment

One of the plaques, a "simplex" gray, was produced by a mixture of white and black pigments, and the other, a "complex" gray, by a mixture of yellow, green, purple, and white pigments. When a person of "average" color vision views these plaques in daylight from a near position, the simplex gray appears redder than the complex gray. The near position is one at which the plaques subtend a visual angle of  $10^{\circ}$ . When the observer steps back a few paces to a position from which the samples subtend a visual angle of  $2^{\circ}$ , the simplex gray then appears greener than the other.

This phenomenon occurs because the retinal image of the samples at the  $10^{\circ}$  position covers both the macula and a large portion of the surrounding retina, while at the  $2^{\circ}$  position the retinal image falls wholly within the eye's macular pigment, which is yellow. The effect is somewhat analogous to placing

a yellow filter in front of the eye for the  $10^{\circ}$  position, thus reducing the color temperature of the light source, that is, making it redder. Consequently the  $10^{\circ}$ -field results depend primarily on the lens pigmentation and the 2°-field results depend not only on the lens but to a large extent on the macular pigmentation.

In the Bureau's experiment, each observer viewed the two samples side by side at the  $10^{\circ}$  position. The color temperature of the light source was then reduced until neither sample appeared redder or greener than the other. This point was called the cross-over point, and was recorded as the reciprocal color temperature in micro-reciprocal degrees (µrd) of the source. The test was repeated at the  $2^{\circ}$  position. The reciprocal color temperature at each position was then plotted against age of the observer.

#### Results

The observers were classified into five groups: (1) red-red; (2) red-match; (3) red-green; (4) match-green; and (5) green-green. The youngest observers, considered to have the least lens pigmentation, described the simplex gray as redder than the complex gray at both the  $10^{\circ}$  and the  $2^{\circ}$  positions. These observers were put into group 1. Those in group 2, with a little more pigmentation, said the simplex appeared redder at the  $10^{\circ}$  position but that it matched the complex at the  $2^{\circ}$  position. Group 3, which included most of the observers, described the simplex as redder at the  $10^{\circ}$  position and greener at the  $2^{\circ}$  position than the complex gray. Group 4, with still more lens pigmentation, said the simplex matched the complex at the  $10^{\circ}$  position but that it was greener than the complex at the  $2^{\circ}$  position. Several of the observers, including the older ones, were considered to have the most pigmentation because they saw the simplex greener at both positions. They were put in group 5.

The reciprocal color temperature of the source required to produce a red-green balance between the Granville grays was found to vary widely from one observer of normal color vision to another. However, the cross-over value of reciprocal color temperature for any one observer serves to characterize his color vision in an approximate but useful way. The value (of reciprocal color temperature) required in a  $10^{\circ}$  field for red-green balance is tentatively taken as a measure of the yellow pigmentation in the lens of the observer's eye. Similarly, the value required in a  $2^{\circ}$  field for red-green balance of the Granville grays is a measure of both lens and macular pigmentation. The difference in these two values (value for  $2^{\circ}$ -field minus value for  $10^{\circ}$ -field) is tentatively taken as a measure of the macular pigmentation of the observer.

The tentative measure of lens pigmentation afforded by the Granville grays correlated well with the age of the observer, but the tentative measure of macular pigmentation showed no correlation with age. Neither measure showed significant correlation with the color of the iris or of the hair. Of the 39 persons studied, eleven were female.

The color of the eyes of all the observers ranged from blue through hazel, light brown, brown, dark brown, to almost black; hair color ranged from ash

Table 1.--Observers Classified According to Sex, Age, Eye and Hair Color; Description of Test Panels; and Recriprocal Color Temperatures Required for Red-green Balance

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| Ob-<br>server                               | Sex and age   | Eye Color   | Hair Color  | Color of simplex relative to complex  |  | Reciprocal color<br>temperature, urd of<br>match point   |  |   | • |
|---|---|---|---|---|--|--|--|---|---|
|   |   |   |   | 10°   | 2°   | 10°  | 2  | Diff.   |   |
| 1234567890112345678901223456789031233456789 | M55<br>M455<br>F56<br>M27<br>M439<br>M511<br>M3210<br>M550<br>M5210<br>M5210<br>M5210<br>M5210<br>M5210<br>M5210<br>M5210<br>M5210<br>M5210<br>M5210<br>M5210<br>M5210<br>M5220<br>F5322<br>F5322<br>F5322<br>F1288<br>M561<br>M510<br>F1288<br>M561<br>M510<br>F1288<br>M561<br>M510<br>F1288<br>M561<br>M510<br>F1288<br>M561<br>M510<br>F1288<br>M561<br>M570<br>M510<br>F128<br>M510<br>F127<br>M511<br>M510<br>F127<br>M511<br>M511<br>M511<br>M511<br>M511<br>M511<br>M511<br>M51 | blue<br>hazel<br>brown<br>hazel<br>blue<br>d. brown<br>blue<br>blue<br>blue<br>blue<br>blue<br>blue<br>blue<br>blue | brown<br>brown<br>d. brown<br>d. brown<br>black<br>blond<br>red<br>auburn<br>brown<br>blond<br>brown<br>brown<br>brown<br>brown<br>d. brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown<br>brown | red<br>red<br>red<br>pink<br>red<br>slightly pink<br>pink<br>pink<br>pink<br>pink<br>pink<br>pink<br>pink | green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green<br>green | 204<br>238<br>179<br>2196<br>213<br>250<br>2356<br>2572<br>213<br>268<br>288<br>222<br>268<br>278<br>225<br>278<br>255<br>278<br>255<br>278<br>255<br>278<br>255<br>278<br>255<br>278<br>255<br>278<br>255<br>278<br>255<br>278<br>255<br>278<br>255<br>278<br>255<br>278<br>255<br>278<br>255<br>278<br>255<br>278<br>255<br>278<br>255<br>278<br>255<br>278<br>255<br>278<br>255<br>255<br>278<br>255<br>255<br>278<br>255<br>255<br>255<br>255<br>255<br>255<br>255<br>255<br>255<br>25 | 91<br>103<br>47<br>196<br>132<br>149<br>16<br>135<br>149<br>16<br>135<br>149<br>16<br>149<br>17<br>16<br>16<br>198<br>17<br>18<br>15<br>199<br>17<br>18<br>15<br>199<br>17<br>18<br>15<br>199<br>17<br>18<br>15<br>199<br>17<br>198<br>198<br>198<br>198<br>198<br>198<br>198<br>198<br>198<br>198 | 113<br>135<br>132<br>82<br>112<br>81<br>135<br>107<br>90<br>154<br>67<br>71<br>54<br>73<br>128<br>135<br>107<br>90<br>154<br>71<br>54<br>71<br>54<br>71<br>128<br>129<br>129<br>124<br>135<br>129<br>129<br>124<br>135<br>132<br>87<br>142<br>135<br>132<br>87<br>142<br>135<br>132<br>87<br>142<br>135<br>132<br>87<br>142<br>135<br>132<br>87<br>142<br>135<br>132<br>87<br>142<br>135<br>132<br>135<br>132<br>135<br>132<br>135<br>132<br>135<br>135<br>135<br>135<br>135<br>135<br>135<br>135<br>135<br>135 |   |
| Averages 41.3                               |   |   |   | 214   | < <sup>114</sup>   | > 100  | ň  |   |   |

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blond through red, light brown, brown, dark brown to black. It was interesting to note that among the "red-red" observers--those with the least lens pigmentation--a number had heavily pigmented skin, irises, and hair.

Results of the tests were compared with four statistical definitions of a standard observer. The comparison showed that the three standard observers compiled in recent years were not superior for the 2<sup>°</sup> observation to the CIE standard observer recommended in 1931. However, data on a specific age group for the 10<sup>°</sup> standard observer developed by Dr. W. S. Stiles<sup>4</sup> of the National Physical Laboratory in England agreed very well with the average of the actual observers in the same age group in the present experiment.

Further work is scheduled to obtain color responses on textile and vitreous enamel samples. Data derived from these studies will be correlated with the work now being performed by Dr. Stiles in England and the combined results will be evaluated for a possible revision in the 1931 CIE standard observer.

<sup>1</sup> Frequently referred to as either the CIE or the Commission Internationale de l'Eclairage.

<sup>2</sup> For further technical details, see "Observer differences in color-mixture functions studied by means of a pair of metameric grays," by Kenneth L. Kelly, Journ. Research NBS 60: 97. 1958. RP 2825.

<sup>3</sup> "Metameric color and the macular pigment," by W. C. Granville and D. B. Judd, Journ, Opt. Soc. Amer. <u>39</u>: 632A. 1949.

<sup>4</sup> "Interim report to the Commission Internationale de l'Eclairage, Zurich, 1955, on the National Physical Laboratory's investigation of colour-matching," by W. S. Stiles, Optica Acta 2: 168. 1955.

A METHOD OF COLOR DESCRIPTION FOR USE IN GROSS PATHOLOGY, AN ADAPTATION OF THE ISCC-NBS METHOD OF DESIGNATING COLORS The ISCC-NBS method of designating colors was first described in NBS Research Paper RP1239 which appeared in 1939, and in its revised form in NBS Circular C553, published on November 1, 1955. Since its inception, this method of designating colors has filled a great need for a simple, accurately defined system of color names and has been utilized for this purpose

in many fields throughout science and industry. The latest to come to this reviewer's attention is that of Dr. H. Richard Hellstrom of the Veterans Hospital in Pittsburgh under the above title.

Dr. Hellstrom has for some time been aware of the non-uniformity of color names in use in the description of gross pathological specimens in operating and dissecting rooms and in the medical literature. This is the same problem which existed in the pharmaceutical field and whose solution led in 1931 to the formation of the Inter-Society Color Council. The article "Decadent Descriptions in Dermatology," by Bernard Appel led Dr. Hellstrom to a study of the Munsell system and of the ISCC-NBS method of designating colors. A start was first made with a Munsell library edition but this soon became too cumbersome and several of the most used color charts were placed in a notebook with the appropriate ISCC-NBS color-name charts opposite each color chart. This arrangement was more efficient but still took too much time and resulted in more accuracy than was needed in the description of the colors of these specimens. The next and logical step was to make up a color chart containing the most used colored samples from these color charts and these were found to center around the moderate designation of each hue name. The colors lighter, darker, more saturated and more gray than the moderate hue name were next most used and when these five modifiers are placed together in the arrangement used in the color-name charts, a cross is formed. Whenever one of these samples is not producible in present pigments, its place is left vacant.

Dr. Hellstrom's finished chart contains twelve such crosses set in a circle around the ISCC-NES chart of modifiers taken from NES C553; the hues used being pink, red, yellowish pink, reddish brown, reddish orange, orange, brown, orange yellow, yellowish brown, yellow, olive, and purplish red. Munsell colored papers selected as being closest to the centers of each of these color-name blocks were used to illustrate the chart. Near the bottom of this chart are nine colors illustrating the approximate centers of the moderate color-name blocks of nine hues not used above; greenish yellow, yellow green, yellowish green, green, bluish green, greenish blue, blue, violet, and purple. Samples illustrating vivid and brilliant yellow are also shown.

It is found that the accuracy of match with this condensed type of color chart is sufficient for the descriptions of the colors of gross pathological specimens. The chart is mounted on the wall over the operating area and color matches are made by comparing the sample directly with the chart. The principal drawback to the use of such a simple color chart is the preconceived notions of what each color should be called by different observers.

Since this paper went to press, ISCC Problems Subcommittee 2 has been reactivated for the purpose of supervising the production of the colors representing the centroids of each of the 267 ISCC-NBS color-name blocks. In a year or two, it is hoped that these colors will be available for use in Dr. Hellstrom's color chart. This would be advantageous for two reasons: first, the colors would more closely represent the centroids of the color-name blocks used; and second they would be the same colors that will be used in a number of similar color charts used for other purposes. The latter will give added weight to their use and make intercomparisons with data in other fields possible and convenient.

This is a simple and most noteworthy application of the ISCC-NBS method of designating colors. As its utility is recognized the demand for the Hellstrom color chart with the centroid colors should increase so that its production and distribution will be undertaken by a company specializing in this work such as the Munsell Color Company.

Kenneth L. Kelly

BRILLIANCE FACTOR

In a paper presented at the 31st International Congress of Industrial Chemistry held at Liege,

Belgium in September, 1958, M. E. Edelmann, Secretary-General of the French Colorimetry Association, introduced the interesting visual concept of "brilliance factor." Following a short review of the trichromatic definition of color and monochromatic-plus-white systems of color representation, he points out that the concept of purity is not adequate for characterizing important visual properties of dispersed pigments. He refers to the fact that, as pigment concentrations are increased, purity increases and reflectance decreases. Although maximum pigment concentration may result in a color specified as falling on or near the spectrum locus, its reflectance is so low that visually it has only very weak saturation under typical commercial viewing conditions. The concept of brilliance (vivacite) is then introduced as a means of determining at what pigment concentration there is maximum visual saturation. Brilliance is defined as a relation between the reflectance of an ideal block-spectrum pigment and the purity and reflectance of a real pigment having a more extended spectral distribution.

The simplified formula deduced to represent the relationship is as follows:

$$\mathbf{V} = \mathbf{P} \cdot \mathbf{Y}_{\mathbf{m}} \cdot \frac{\mathbf{1} - \mathbf{Y}_{\mathbf{m}}}{\mathbf{1} - \mathbf{Y}}$$

where V = Brilliance

P = Colorimetric purity of the real pigment defined $as <math>\frac{Y_s}{Y}$  where  $Y_s$  is the luminance of the spectral

component in a monochromatic-plus-white mixture and.

Y = reflectance of the real pigment with reference to magnesium oxide.

 $Y_m$  = reflectance of the Ideal pigment

He reports a good qualitative correlation between V and variations in the visual saturation of printing inks. One of his graphs suggests strongly to this reviewer that if he had simply transformed CIE specifications to the Munsell renotation, the chroma specifications at various value levels would have given him a more accurate and quantitative indication of the same thing in a system embracing uniform visual intervals. This reviewer has translated the article and copies are available at the editorial office of the ISCC News Letter. (M. E. Edelmann, Contribution a l'application industrielle de la colorimetrie. Notion de "facteur de vivacite." Mimeographed manuscript presumably to be published in proceedings of the 31st International Congress of Industrial Chemistry.)

R. W. Burnham

SYSTEMS

OFTICS IN PAINT for detailed Evidence of a growing interest in the application of basic optical principles which can be related to the description and formulation of paint products is

shown in recent publications from the Research Laboratories of the National Lead Company. Two articles, recently published in the Official Digest of the Federation of Paint and Varnish Production Clubs, give a rather broad perspective and review of the more commonly recognized applications of optics to pigmented paint systems: While somewhat elementary in physical theory, they reflect an awareness of the need for more basic techniques to explain the quantitative relations between appearance attribute and the optical properties of paint ingredients. A review of these articles should be useful to paint or plastic technologists who are interested in orienting their thinking on more fundamental terms.

Mitton, P.B., and White, L.S., "Pigment Optical Behavior - Evaluation on a Physical Basis," Official Digest, 30, No. 406, 1259-1276 (1958)

This article describes briefly the general relationship of Kubelka-Munk scattering and absorption coefficients in a paint system as functions of hiding power; tinting strength; refractive index; particle size, shape and distribution; and degree of dispersion of the pigment.

Dunn, E.J., Jr., "Optical Classification of Pigment and Coatings," Official Digest, 30, No. 400, 466-489 (1958)

A general review of some of the most important qualities of pigmented films; i.e. whiteness, hiding power, tinting strength, gloss, color, and color difference as affected by the optical properties of the materials involved.

#### N. M. Komodromos

COLOR AND THE The Pollen Loads of the Honeybee, a Guide to their HONEYBEE identification by Colour and Form, by Dorothy Hodges, published in 1952 by the Bee Research Association,

Ltd., 678 Salisbury House, London Wall, EC2, was recently brought to Waldron Faulkner's attention by a friend who knew of his special interest in color. This fascinating book, containing seven color charts with about 300 different samples, illustrates carefully color matched pollen loads of the honeybee.

The book was so obviously a thorough and serious study, and the color samples so carefully prepared, often with very small color difference samples to illustrate the range of color found during the season for pollens of 120 bee plants common to Britain, that to this reader the book's author shone out through its pages like an old friend. The book is the result of five years' observations that are displayed not only in a color chart, but in a series of large scale drawings of pollen grains of some 140 species of British bee plants. "To those carrying out pollen analysis of honey these drawings are invaluable, especially because most of the classical works on the subject are in German, and are now difficult or impossible to obtain," is one of the Bee Research Association's references to the book.

Whatever its value to the beekeeper, which surely is considerable, the book is valuable also to the connoisseur of color charts, for here is an artist, a scientist, who has made painstaking observations of minute color samples and recorded and reproduced them for use by fellow beekeepers. The chapter on color indicates the method the author used for getting her first sample. The individual bee was caught as it worked on a plant, always after it had collected a large enough load of pollen to provide a satisfactory pellet. They were caught by the wings and held until the pellet was scraped off the legs "either with the point of a penknife or more often with the fingernail." The loads were recorded at once under conditions that "conformed to the recognized methods laid down for colour matching." These included "a good north light, avoiding the evening hours when the light is likely to be yellow." The author adds, "Fortunately, days suitable for bees to work also provide the good light necessary for painting." The matching was done with water color because the author was used to this medium, and "colour mixing needs experience to get exact results."

The color chart is the result of recordings made during five seasons, arranged in order of flowering time for the south of England, with three color squares (1/2 inch) to represent the lightest, darkest, and medium color, usually selected from several recordings. No two color ranges are exact duplicates, but frequently one or more squares in a range are identical with another series, and "it is this fact which makes color an unreliable guide to species whose color ranges are similar and whose flowering periods coincide." In fact the author emphasizes that the identification of pollen loads by color can be positively confirmed only by microscopical examination of the grains, and she gives as much, and as careful, attention to pollen grain drawings (30 plates of them) as to the color charts.

The color differences are small in some of the groups, and how these could be reproduced so well, and at such a very low price as is asked for the book, intrigued this reviewer. So I wrote Mrs. Hodges, to congratulate her most warmly and to ask several questions of her about the book. From her reply, which was most gracious, I learned what I felt had to be true--that someone (she and her husband) had underwritten costs of the publication so that it might be available at a nominal cost to the beekeepers for whom it was written. They hope to cover their costs by the time the last volume is sold, but do not expect more. Her sample recordings were matched by A. E. Jackson & Co., Ltd., a company in Hull, Yorkshire, that produces color cards for the paint industry. Mrs. Hodges says that she found their men expert at color matching, that she checked all samples against her own, and only a very few had to be rematched, chiefly in the browns.

Copies of the book are still available, although only 500 remain. The price at present is \$4.50 per copy, and may be obtained by direct order to the Bee Research Association, 10 Barnett Wood Lane, Ashtead, Surrey. If anyone interested prefers to place the order in this country, I have arranged with Mrs. B. R. Bellamy of the Munsell Color Company, 10 East Franklin Street, Baltimore 2, Maryland, to hold an order for me 30 days after publication of this News Letter. If you will send her a check for \$5.00 (to cover costs of mailing, both here and abroad) she will pool the orders and send your copy along as soon as it comes.

It has been a stimulating and colorful experience to become acquainted with this book and its author.

Dorothy Nickerson

LETTER TO THE EDITOR In paying tribute to the spelndid achievements of the late Dr. Conrow, the field of permanent pigments for artists, Dr. Martin Fischer (NEWSLETTERS, JULY and DECEMBER, 1958) was perhaps unnecessarily hard on the Impressionists.

Arnold Bocklin (German rcmantic-realist, 1827-1901) quoted by Dr. Fischer wrote "Modern pictures have not lasted as many decades as those of the old masters have lasted centuries."

It is no doubt true that the Impressionists, in their search for "thrills" sometimes used chemical combinations which were not stable. Moreover, although Bocklin himself was conscientious in the use of pigments, his colleagues in the German School were not always so.

I quote from Hilaire Hiler's "Notes on the Technique of Painting" (London: 1948): "Writers on the subject all seem agreed that the material side of painting reached its lowest ebb between 1830 and 1900."

Hiler also says: "Do not judge of conservation, or base your discussions as to the permanence of materials, on pictures in museums. They have almost all been revarnished, rebacked and 'restored' - and how!"

In his Preface to Hiler's book, Sir William Rothenstein, prominent British painter, makes what seems a reasonable proposal: "It would be no ill thing if a period overmuch given to aesthetic experiment were followed by one devoted in part at least to rigid technical practice."

#### Henderson Wolfe

EXCHANGE NEWS LETTER WITH JAPAN STUDIES OF COLOR In response to our request, Dr. Sanzo Wada, Director of the Japan Color Research Institute has agreed to provide us with copies of his publication <u>Studies</u> of Color. This multication was first brought to

of Color. This publication was first brought to the attention of the News Letter by Dr. Judd. A list of titles was published in the July 1958, No. 136 News Letter. Although the articles are published in Japanese, abstracts are repeated in English translation. The response to the publication of these titles was so excellent we have decided to list the titles each time Studies of Color is received by the News Letter.

Following is the interesting letter from Dr. Wada:

"Mr. Warren L. Rhodes Editor of the ISCC News Letter

Dear Mr. Rhodes;

We are glad to learn your attention and interest shown to our publication. Ours are published four times per year regularly and they carry principally reports written by our researchers. Your proposal that you would like to publish the list from our publication is heartily welcomed. It is decided that we will send a copy of publication to you every time when it is published. We shall be very grateful if you would send us a copy of the ISCC News Letter when it is published in exchange for Studies in Color.

With the best wishes to Dr. Judd, and to all of your members,

Sincerely,

Sanzo Wada, Director of Japan Color Research Institute"

MISCELLANY How the Eye Detects Color (source unknown). University of Michigan Medical Center scientists have moved another step closer to the age old mystery of how humans and certain animals are able to see color.

Using animals they have succeeded in "wire-tapping" individual cells in the visual area of the brain and testing the cell reactions to various colors. Four classes of cells respond only to red, green, yellow or blue colors, and some cells react to color only in the absence of light.

The technical difficulty of isolating individual brain cells has been helped by a delicate micro-electrode--one 25-thousandth of an inch in diameter. Made of tungsten, the electrode is inserted into the visual areas of the brain with the help of a microscope. Once the electrode is in place, the subject is shown different colors. Cell response is detected in the form of an electrical impulse which is magnified by a hi-fi amplifier.

The scientists feel that they are much closer to an understanding of the function of the human eye and its defects and hope to be able to track down the cause of color blindness.

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Taken from Grade Teacher magazine for February, 1959 -

COLOR

There is color in everything, In everyting we know, Yes, there is color in everyting, Even in the snow. And there are many colors, From black way down to white. And when you take your eyes off one, Another comes into sight.

--Larry Mylnechuk, Grade Four, Waverly School, Albany, Oregon

Martha E. Jungerman

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"Hurrah! Machines Have Limitations," by Connie Johnson, N.Y. Sun, 9/27/58. Appearances are supposed to be superficial, but how would you feel if you went to finish your half-painted living room and found that the second can of Azure Blue paint was different from the first? Perhaps you think the wrapper on a loaf of bread is superficial in every sense of the word, but the baker knows that you will buy the bread in the wrapper which looks glossiest, because glossiness and freshness are unconsciously associated in your mind.

A man who has made a very successful and unusual business out of designing instruments and tests for the appearance properties of materials is Dick Hunter, Director of Hunter Associates Laboratories. Mr. Hunter's firm, which specializes in light measurement, is employed by many manufacturers who need machines and tests to insure the uniformity of appearance of their products. Mr. Hunter, who is an optical engineer, has designed instruments to measure the hiding power of paints, the yellowing of white paint, the contribution of fluorescence to whiteness in soaps, the opacity of newsprint, the redness of tomato color, the transparency of plastics, and many other qualities of prime importance to manufacturers.

In addition to having a very unusual profession, Mr. Hunter is a rarity of another kind. He is a native of Fairfax County, having been born right in the house where he now has his business.

He also serves as the Washington Academy of Science's "contact man" at Williamsburg Junior High in Arlington. Along with other area scientists who have generously volunteered to work with our local public schools, Mr. Hunter helps with science fairs, arranges for guest lecturers to speak at the schools, finds local experts to help science students with their projects, and performs many other services which go toward giving young Northern Virginia scientists a first-rate educational background.

Mr. Hunter's degree is in psychology, which seems far removed from optical engineering. When asked about this, Mr. Hunter said, "This is not as farfetched as it might seem. The eye is the finest optical instrument ever devised--it can distinguish four million different colors. But though it is the eye which sees, perception takes place in the brain. Most of the machines and tests we design are for the purpose of reinforcing and identifying the impressions the eye receives! "The human eye, especially the young male one, can measure the prettiness of a girl in one glance," he added with a laugh, "but I doubt if anyone can ever break female attractiveness down into its components, write a mathematical equation, and design a machine which can measure this quality with anything like the same efficiency as the human eye!"

Isay Balinkin

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| LIST OF ARTICLES ON | "Comparison of Successive | With Simultaneous Color       |
|---------------------|---------------------------|-------------------------------|
| COLOR RECEIVED BY   | Matching," S. M. Newhall, | R. W. Burnham, and J. R.      |
| NEWS LETTER         | Clark, J. Opt. Soc. Amer. | , <u>47</u> , pp 43-56, 1957. |

"Concentrated Developer Replenishers for Eastman Color Film Processing," George A. Cummins, Jack A. Cogan and William R. Weller, SMPTE, <u>66</u>: pp 555-557, September 1957.

"A Continuous Rapid-Processing System for Side Looking Radar Mapping," Edgar D. Seymore, Photo. Sci. & Eng., 2, No. 2, pp 91-94 (August 1958).

"Contribution to Gloss Measurement," J. Jangy and W. Spund, Farbe u. Lack 62, 1956.

"Conversion Factors for Brightness Units," Photo Eng., pp 1, 149, (1950).

"Curve Tracing Densitometer for 'Average Room' Density," W. H. Carnahan, Photo Eng., 6, pp 237 (1955).

"Description and Measurement of White Surfaces," Richard S. Hunter, J. Opt. Soc. Amer., 48, No. 9, pp 597-695 (Sept. 1958).

"Design of a Luster-Meter for Quality Control," Smith, Thompson and Kaye, ADR, <u>46</u> pp 465, (1957).

"The Design of Projection Systems," B. S. Lee, Photo Eng., 1, pp 94, (1950)

"Distribution of Radiation from Elliptical and Parabolic Mirrors," Philip J. Hart, J. Opt. Soc. Amer., 48, No. 9, pp 637-642 (Sept. 1958).

"Dynamic Color in Table Setting," Georgina Newman, Amer. Cer. Soc. Bul. 36, (150) 1957.

"Effect of Light of Different Wavelengths on the Degradation of Clear Coatings," N. J. Marshall, Official Digest of the Fed. of Paint & Varnish Prod. Clubs, August 1957.

"Effect of Orientation on the Visibility of Fine Wires," John C. Ogilvie and Maurice M. Taylor, J. Opt. Soc. Amer., 48, No. 9, pp 628 (Sept. 1958).

"Electroluminescence of Zinc Sulfide Phosphors as an Equilibrium Process," Willi Lehmann, J. Opt. Soc. Amer., 48, No. 9, pp 647-653 (Sept. 1958).