M. Balcom

INTER-SOCIETY COLOR COUNCIL
NEWS LETTER

NUMBER 172 July-August 1964

NEW MEMBERS The following applications for individual membership were accepted at the last meeting of the Board of Directors held in New York City on May 3, 1964.

Individual Members	Particular Interests
Mr. Edward P. Ancona, Jr. 3170 Lake Hollywood Drive Hollywood, California 90028	Color television equipment and practices, color film photography for television, color education.
Mr. Michael D. Asner 108 South Street Baltimore 2, Maryland	Its use in commercial interior design.
Mr. Erik F. Barkman Reynolds Metals Company Metallurgical Research Div. Fourth and Canal Streets Richmond 19, Virginia	Instrumental techniques for measuring small visual differences in chromatic, achromatic-specular-diffuse reflectance properties of metallic surfaces and coatings thereon.
Mr. George Biernson 53 Holden Wood Road Concord, Massachusetts	Understanding the processes of color vision for the purposes of applying them to electronic equipment.
Mr. Ward J. Boyce Armstrong Cork Company Liberty Street Lancaster, Pennsylvania	The measurement and specification of color; the formulation of colored plastics; the measurement of small color differences; and control of commercial production of colored materials.
Mr. C. George Chapman Hercules Powder Company Polymers Department Parlin, New Jersey 08859	Color measurement and matching, techniques and effects. Color as a sales tool.
Mr. Kenneth D. Chickering Kollmorgen Corporation Northampton, Massachusetts	Color and color difference specification as applied to color matching in industry.

Individual Members	Particular Interests
Mr. William J. Cunningham 3811 Chalfont Drive Philadelphia, Pennsylvania 19114	Color measurement, color specification, use of color in industry.
Mr. Joseph M. Foley Minnesota Mining & Mfg. Co. Printing Products Division 2501 Hudson Road St. Paul 19, Minnesota	Lithography in general. Research in related fields such as photography, color correction, colorimetry, color specification, and pigments.
Miss Ann Marie Furuholmen Research & Development Dept. Minute Maid Company Plymouth, Florida 32768	Measurement and color control of company products, base materials and packaging materials to establish standards and methods of formulation.
Mr. P. J. Fynn J. C. Penny Company Inc. 330 West 34th Street New York, New York	Color specification, color fastness, color control.
Mr. Robert J. Gans 621 East Third Street Los Angeles 13, California	Lecturing and selling printing ink and color lectures to the advertising and printing trade and lectures to schools, trade associations, and colleges.
Mr. Kasson S. Gibson 4817 Cumberland Avenue Chevy Chase, Maryland 20015	General.
Mrs. Abby J. Goell 37 Washington Square West New York, New York 10011	Color name and nomenclature; psychology of color in marketing; oil paint pigments and glazes for the fine artists; distortion of color film in photography for emotional content, etc.; relationship of music to color; custom coloring for interior fabrics and materials and its problems.
Dr. Boris Gutbezahl Color Laboratory Rohm & Haas Company P. O. Box 219 Bristol, Pennsylvania	Manufacture of colored plastic products and all attendant problems.
Mr. Alan O. Hage Neurosensory Center Depts. of Neurology and Ophthalmology State University of Iowa Iowa City, Iowa	How to use it advantageously and how to explain the phenomenon of color and color vision.

Individual Members	Particular Interests
Mr. Clifford L. Jewett Minnesota Mining & Mfg. Co. 2501 Hudson Road St. Paul, Minnesota 55119	Product development.
Mrs. Arlene Johner Container Corporation of America 38 South Dearborn Street Chicago 3, Illinois	Aesthetics of color, pigments, color standards systems and color matching.
Mr. William S. Laycock Plastic Products Division Owens-Illinois, Duraglas Center 333 14th Street Toledo, Ohio 43624	Establishment of standards, test methods for pigment evaluation and use of instrumentation for color control.
Mr. Frank Preucil 735 Sheridan Road Evanston, Illinois	Graphic arts reproduction.
Mrs. Frances R. Quinn University of California 2200 University Avenue Berkeley 4, California	Personal coloration of people. Currently conducting a study of over 300 people toward the development of consumer color charts on which I am working with Mr. Hale of Munsell Color Company. I shall study data further to determine color relationships found in personal coloration.
Mr. Frank J. Reilly 111 West 57th Street New York 19, New York	The use of color in color planning; the correct relationship of the equi-distance of hue, value, chroma; the making of hue, value and chroma charts; the use of a Universal Color Palette for the art of painting; the use of my Nine Neutral Values for practical chroma changes.
Mr. Wilbur D. Riddle G. E. Lighting Institute Nela Park Cleveland 12, Ohio	Architecture.
Mr. John B. Scouller 37 South Clinton Street Poughkeepsie, New York	Color problems in the graphic arts, especially litho printing.

Individual Members	Particular Interests
Mrs. Dorothea B. Warren E. I. duPont de Nemours & Co. Poromeric Products Division 350 Fifth Avenue New York, New York 10001	I do all color for duPont's F & F Corfam Division.
Mr. C. Paul Yake Color Engineering 2 John Street New York, New York 10038	As the Editor of Color Engineering Magazine, I am interested in all phases of color.
Mr. Fred A. Yoder 1610 Gage Drive Middletown, Ohio	Reproduction by painting - specifically gravure, color styling, instrumentation for specification and control, establishment and maintenance of standards, correlation of design and finished product.
Mr. Cliff Young 19 West 44th Street New York, New York 10036	Use of color in architecture, printing, interior decoration, industrial design, and any and all use of color (pigments) pertaining to fine and mural art, also ceramics and mosaics. Chemistry of color (acrylics).

GODLOVE AWARD NOMINATIONS SOLICITED

Chairmen of delegates from each Member-body of the ISCC are being solicited for nominations of candidates for the next Godlove Award. This is in accord with a recommended practice established this past year by the ISCC Board of Directors. The Award established in memory of Dr. I. H. Godlove is presented biennially for contributions to the subject of color, these contributions to be examined in light of the aims and purposes of the Inter-Society Color Council which are "...to stimulate and coordinate the work being done by various societies, organizations, and associations leading to the standardization, description, and specification of color by these various societies, organizations, and associations, and to promote the practical application of the results to the color problem arising in science, art and industry."

The merit of a candidate is judged by his contributions to any one of the fields of interest in color whether or not it is represented by the Member-bodies. The contribution to color may be direct; it may be in the active, practical stimulation of the application of color; or it may be an outstanding dissemination of knowledge in color by writing or lecturing. It is requested that nominations shall be accompanied by answers to a questionnaire prepared to obtain full information concerning the nominee and his contributions to color. To be considered for the 1965 Award, nominations should be received by the Godlove Award Committee by October 1, 1964. In future years, requests for nominations will be made in June of the year in which an Award is considered, and closed in June of the following year, the report of the Award Committee to be made to the Board of Directors no later than the month of November preceding the meeting at which the Award is to be given. This year the time is shorter in the hope that the Award may be made in 1965 in accord with the regular biennial schedule, yet provide sufficient time for Member-body delegations to provide a nominee if they wish to do so.

RECOMMENDED PRACTICES GOVERNING THE GODLOVE AWARD COMMITTEE*

1.0 Description

1.1 Historical

The Godlove Award Fund was established by Mrs. Margaret N. Godlove in memory of her husband, Dr. I. H. Godlove. The fund was presented to and accepted by the Inter-Society Color Council during the 25th Anniversary Meeting of April 6, 1956. The Award is usually but not necessarily presented biennially.

1.2 Award Fund

By authorization of the Inter-Society Color Council Board of Directors the Award fund is maintained in a special account by the Treasurer. No disbursement from this fund is to be made without authorization by the Board of Directors.

1.3 Award Design

The Godlove Award consists of a suitably engraved clear plastic prism in which is embedded a gold triangular ruled diffraction grating.

Note: By authorization of the Board of Directors, extra Godlove Award material is stored with Dr. Terry F. Godlove, 4812 Bennett Avenue, Washington 23, D. C.

At the discretion of the Board of Directors the design of the Award may be changed.

2.0 Organization of Committee

The Godlove Award Committee shall be a Standing Committee of the Inter-Society Color Council. In accordance with the By-Laws of the Council, it shall have a chairman and not more than five (5) committee members.

2.1 The chairman and members of the committee shall be appointed by the President with the approval of the Board of Directors. They shall be selected from the membership of the Member-Bodies to the Council. Officers of the Council are eligible to serve on this committee. At least one of the committee's membership shall be a person who has previously received an Award. At least two of the members of the committee shall be replaced every two years, at the time of change in officers of the Council.

*Approved by the Inter-Society Color Council Board of Directors October 15, 1963.

2.2 The members of the committee shall be carefully selected to represent the widest diversity of interests in the field of color.

3.0 Duties

The Award Committee shall solicit nominations for the Award, recommend a recipient and prepare a report justifying their recommendation.

3.1 The Award Committee shall solicit nominations for the Award from the Member-bodies but no more than one nomination shall be made from each Member-body.

3.2 A suitable form for presenting nominations follows.

3.3 Requests for nominations shall be made in June of the year of the Annual Meeting at which an Award was considered. Nominations shall be closed in June of the following year.

3.4 The Award Committee shall consider the submitted nominations on the basis of fulfilling the requirements listed in paragraph 4.0. The Committee shall not be limited to these nominations in its deliberations of a suitable candidate for the Award.

3.5 If in the judgement of the Committee no suitable candidate for the Award can be recommended to the Board, no further action need be taken until the next scheduled solicitation for nominations as described in paragraph 3.3.

3.6 A report shall be made to the Board of Directors no later than the month of November preceding the Annual Meeting at which an Award is to be given. The report shall justify the recommendation. The report need not be identical with the presentation speech described in paragraph 6.0.

3.7 The Board of Directors shall retain the right to disapprove the recommendation of the Award Committee, and in such instances where no agreement can be reached, the Award shall be omitted during the following Annual Meeting.

4.0 Basis of Judgement for Award

The Award is to be given for contributions to the subject of color. The contributions of an individual shall be examined in light of the Aims and Purposes of the Inter-Society Color Council given in Article II of the By-Laws.

4.1 The candidate shall be a citizen and resident of either the United States or Canada.

4.2 The merit of a candidate should be judged by his contributions to any one of the fields of interest in color whether or not it is represented by the Member-bodies. The contribution to color may be direct; it may be in the active practical stimulation of the application of color, or it may be an outstanding dissemination of knowledge in color by writing or lecturing.

4.3 The candidate need not have been active in the affairs of the Council.

4.4 The candidate must have had at least five years of experience in his particular field of interest in color.

5.0 Public Relations

5.1 Notice of the request for nominations shall be sent to the editor of the Newsletter and to the secretaries of the societies represented by the Member-bodies.

5.2 Notice of the Award and the individual to receive it shall be given in the Newsletter issue immediately prior to the Annual Meeting. An announcement of the intent to give an award and to whom shall be given to the public, trade, and scientific press prior to the Annual Meeting.

After the Award is presented, press releases shall be forwarded to the public, trade, and scientific press giving the reasons for the Award.

At the discretion of the Board of Directors, the report of the Award Committee and/or the presentation speech may be printed in the Newsletter.

6.0 Presentation of Award

The Award can but need not be presented by the chairman of the Award Committee or by any of its members. With the agreement of the Board of Directors, the Award may be presented by any member of the Inter-Society Color Council. It is desirable that it be presented during the banquet session of the Annual Meeting. When it is desired that the Award presentation be accompanied by special laudatory remarks, the prepared speech may differ from the report of the Award Committee in verbiage but shall not deviate from the intent of the report. If the recipient is to be the after-dinner speaker at the annual banquet, he should be notified immediately after the approval of the Board of Directors.

Nomination for the Godlove Award

(To recognize outstanding contributions to the knowledge of color and appreciation for fulfilling the aims and purposes of the Inter-Society Color Council)

1. a. Name
   b. Citizen and resident of the United States or Canada
2. Company affiliation, if any
   a. Present
   b. Recent (past 10 years)
3. Title
   a. Nature of duties
4. Member-Body delegation
5. Society affiliations
   a. Positions held

6. How long in the field of color
7. Inter-Society Color Council
   a. Administrative positions held
   b. Problem committee affiliations
8. Writing or speaking done in support of scientific, artistic, or industrial use of color
9. Evidence of the pattern he has set in encouraging the scientific, artistic, or industrial use of color
   a. His own company
   b. His own industry
   c. Other industries
   d. Nationally
   e. Internationally
10. Additional information
    a. General background
11. Nomination made by
    a. Member-Body
    b. Individual
    c. Award Committee
    d. Technical Society
    e. Trade Association

THE INTERNATIONAL INTERCOMPARISON OF PHOTOMETRIC AND COLORIMETRIC MEASUREMENTS ON FLUORESCENT LAMPS

Following the recommendation of the session of the C. I. E. in 1955, at Zurich, an international intercomparison of measurements of luminous flux and color coordinates of tubular fluorescent lamps was carried out by nine national laboratories including the National Physical Laboratory (Great Britain) as the central reference laboratory. Lamps in suitable batches were measured at N. P. L., sent for measurement to one of the other laboratories, then returned and remeasured at N. P. L. The lamps were of three colors, with British designations "color matching," "daylight," and "warm white" which are similar to U. S. designations "daylight," "cool white," and "warm white" respectively.

Photometry

The results of the photometric part of the intercomparison may be very briefly summarized by pointing out that the maximum spread between the mean results of the various laboratories was 3.4 percent with a root mean square variation of 1.2 percent. These figures may be considered in relation to the mean drift between first and second lumen measurements at N. P. L. (taking account of sign), which was + 0.3 percent. The indications are that the variation between laboratories is real, although lying within the currently accepted precision of measurement for fluorescent lamps. In the measurement of the luminous flux of fluorescent lamps by comparison with incandescent tungsten filament standard lamps or even with fluorescent standard lamps, it is usual and satisfactory to employ a physical receptor for this comparison which is corrected approximately to the spectral response of the standard observer, residual errors of correction being computed and allowed for. The E. T. L. (Japan) method of direct spectroradiometry within an integrating sphere is accurate and convenient, especially if the spectral power distribution of the fluorescent lamp is also required; corrections for selectivity of sphere paint and window are automatically avoided.

It is the unanimous opinion of the participating laboratories that only a very small proportion of their mutual discrepancies could be accounted for by the electrical measurements. Temperature control remains an uncertain factor, so also does the candela-lumen relationship. Both these factors should be subjected to further investigation.

The majority of the participating laboratories were strongly of the opinion that it would not be in the interests of future accuracy of measurement to set up an "international fluorescent lumen," although manufacturers might well have an "inter-factory fluorescent lumen" for reasons of commercial parity, such a lumen being maintained by their own testing laboratories.

Colorimentry, including Spectroradiometry

Owing to the two-coordinate nature of color specification, concise summarization of the results of the intercomparison is difficult and details must be sought in the full report. The following trends were noticeable, however.

a. Differences between color coordinates from the various laboratories were of the order of 1 unit in the second place of decimals in x, rather more in y.

b. All results obtained by any given laboratory tended to be approximately the same relative to the mean of all; i.e., all laboratories showed good internal consistency.

c. Where both direct colorimetry and calculation from spectroradiometry were used, the results always differed significantly.

These findings can only point to systematic errors in measurements by most, if not all, the participating laboratories, although the answers to an exhaustive questionnaire fail to indicate any obvious sources for these errors.

The existence of systematic errors is also apparent in the spectroradiometric measurements. These are included in the N. P. L. Report, although they were not an avowed part of the exercise. Three tendencies are discernible:

a. Small discrepancies in general slope of the spectral power curves, especially in the blue and green parts of the spectrum, attributable to differences in color temperature assigned to the incandescent lamps used as references standards.

b. Large discrepancies in the orange and red parts of the spectrum partly attributable to errors in wavelength measurement but largely unaccounted for at present.

c. In all parts of the spectrum, the laboratories differ from each other most for the lamps of high color temperature ("color matching" type), less for those of medium color temperature ("daylight" type), and least for those of low color temperature ("warm white" type).

As mentioned above, the presence of errors is obvious, the reasons for error are obscure, the only deduction is the necessity for patient, critical investigation to try and reveal the causes of error. It is proposed to circulate the full answers to the questionnaire to all interested parties to give the maximum chance of revealing these causes. The following suggestions for further investigations have already been made:

a. Effect of location on lamp surface of the area used for chromaticity measurement (all the participating laboratories adopted more or less different procedures).

b. Effect of polarization (although the P. T. B. has investigated this and found the effect to be very small).

c. Additivity of lines and continuum, investigation by making a simulated mixture and measuring the components separately and together.

d. Errors inherent in the double monochromator, which might be revealed if the same laboratory could use several types of instrument.

Mr. L. E. Barbrow, Secretary of the United States National Committee of the C. I. E., National Bureau of Standards, Washington, D. C. 20234, has a limited number of copies of the report discussed above. Anyone who has an interest in, and a need for, seeing the report is invited to so notify Mr. Barbrow who will arrange to lend a copy of the report to him.

Y = 100 ON CIE SCALE

The following official recommendation, from page 36, Vol. A, of the 1959 C. I. E. Proceedings, is brought to the attention of those who use C. I. E. specifications and scales.

"3. It is recommended that tristimulus values of object colors be expressed on a scale having tristimulus value Y = 100 related to the perfect diffuser under identical illuminating and viewing conditions in the case of opaque specimens, or to the perfectly transparent, non-diffusing filter in the case of transmitting specimens."

This new convention of assigning 100 instead of 1.00 for the Y value of the perfect diffuser, as had been the previous custom, will serve to reduce confusion between numbers representing tristimulus values X,Y,Z and those representing chromaticity coordinates x,y,z. Such confusion often occurs and can be particularly disconcerting to the beginner in this field.

The above proposal, made in 1959 by Dr. Manfred Richter, is an official recommendation of the C. I. E. that should be followed in future publications. Until the change-over is complete, one will need to make sure of the decimal point, not only when using previously available tabular data, but in using formulas, and instrument scales. Use of the recommended method is illustrated in the following table which provides C. I. E. data for Illuminant C and for a selection of five samples of listed Munsell notations.

Munsell Notation	For CIE Illuminant C				
	Tristimulus Values			Chromaticity Coordinates	
	X	Y	Z	x	y
	98.04	100.0	118.10	.3101	.3163
R 4/14	22.51	12.00	4.75	.5734	.3057
Y 9/14	74.35	78.66	8.55	.4602	.4869
G 5/10	10.63	19.77	15.25	.2329	.4331
B 4/10	8.45	12.00	3.54	.1098	.1785
P 3/14	12.70	6.56	27.66	.2707	.1397

SWEDISH COLOR GROUP

Mr. Anders Hård, Managing Director of Color Center AB and Treasurer of the Swedish Color Group, visited The Colour Group of Great Britain in February 1964 in connection with the printing of a new color atlas. Mr. Hård mentioned that the Swedish Color Group was only formed on 15th January 1964, with similar aims and objects to the British Group. He expressed the hope that there would be cooperation and interchange of ideas between the two groups in the future. He explained that the Color Center was set up in 1962 by an association of paint manufacturers to facilitate the spread of color ideas and to provide an atlas based on a perceptual system of color suitable essentially for use by architects.

The "Natural System of Colours" was first conceived by Ewald Hering and the Hesselgren Colour Atlas was based on it. Tryggve Johansson, about 1936, carried out much work on the Natural System. The work was not published, but the Color Center has discovered a compendium of his work and has used this as a basis for their work on the new color atlas. The new atlas is largely a renotation and extension of the Hesselgren Atlas.

In the Natural System of Colours, white, black, yellow, red, blue, and green are considered to be independent and act as the basic colors forming the "framework" of the atlas. White and black are not considered to be grays. Grays themselves have a similar relationship to white and black as does, say, orange to yellow and red. Observers were presented with a number of colored chips and were asked to choose the chip which was, say, yellow, that is neither greenish-yellow nor reddish-yellow. Observers were found to give very good agreement on their choice, with a well defined distribution curve of the spread of results about the mean. The tests were carried out at a number of different lightness levels for each color.

In the atlas the basic chromatic colors are arrayed at equal intervals round the hue circle; i.e., at 90° intervals. The atlas is presented in the form of a set of constant hue charts. On each constant hue chart lightness increases vertically and saturation increased radially through one quandrant about the zero lightness point. The arrangement is such that "Strength" (approximately Chroma) increases the horizontal distance from the lightness axis similarly to the Munsell array.

UNITED KINGDOM AUTOMATION COUNCIL SURVEY

The Colour Group received a letter from the Research and Development Panel of the U. K. Automation Council. The letter stated that the panel was "examining the problem of color measurement in industry with a view to defining needs for research and development into color measurement technique." Enclosed with the letter was a report on color measurement by Mr. S. P. Rose in which the main difficulties of applying color measurement to industrial problems were reviewed and in particular the need for more precise measurements was stressed. The group was invited to comment on this report. Mr. Rose was invited to address a meeting of the Colour Group so that members could question him directly and put points of view. The meeting between Mr. Rose and the Colour Group was arranged.

Mr. Rose indicated the ways in which he felt that color measurement systems in industry were falling short of the requirements. He emphasized that there was at present considerable waste involved in the necessity to carry out color matching stages at a distance from the production point. Methods which enabled suitable color measurement to be made at the point of production would reduce this waste. In addition to this he felt that the build up of color errors in a production process due to process variables necessitated high sensitivity color measurement. At present each process variable is controlled to a tolerance based on the color matcher's "just perceptible difference" limit. Mr. Rose suggested that this difficulty implied that visual control could not be the basis except as the arbiter of the final product, and that instrumental methods much more sensitive than the eye would have to be devised for control of process variables. Mr. Rose then described a survey which had been carried out by the Scientific Instrument Research Association. Comments had been received from most of the industrial research associations and also from a few other organizations. The report is a most valuable document as it gives the problems of different industries as seen by their research associations and also lists the research at present in progress at the research associations.

Mr. Ellis of the Society of Dyers and Colourists emphasized the difficulties of instrumentsl control. The matter was mainly a subjective one. In industries such as textile dying process variables are controlled by other physical and chemical methods and not colorimetrically. Only the final stage involved the eye. A further comment from a member of the Davidson and Hemmendinger Company emphasized that even a modest improvement in the present capabilities for industrial color measurement would be welcome. Nevertheless, the phenomenon of metameric matches would always be a difficulty. The use of the C. I. E. diagram would be a questionable advantage since it was so widely misunderstood. One member said that the spread found in the color vision properties of the population introduced difficulties in high accuracy color control which could not be overcome when metameric matches were involved. Mr. Chamberlain pointed out that his experiences of industrial color measuring requirements showed that there was unlikely to be a single answer to all color control problems.

The Colour Group approved a working party to continue study of the problem.

INTERNATIONAL COLOR MEETING 1965

At the first organization session of the Executive Committee Professor Dr. Y. LeGrand (Paris), was unanimously elected first chairman. Dr. E. Ganz (Basle) was elected second chairman, and Professor Dr. M. Richter (Berlin) was elected secretary. The duty of the committee is to prepare an International Color Meeting for 1965. It is also the intention of the committee to promote closer international cooperation in the field of color. Professor Dr. H. König (Bern) invited the conference to be held in the Congress Hall in Lucerne. Probable date for the meeting has been established as the 2nd to the 5th of June. The title for the meeting is "Scientific and Practical Aspects of Color." Papers are to be distributed into four categories:

1. Color metrics, colorimetry, illuminants
2. Physiology, psychology, influence of the surrounding field, aesthetics
3. Applications (photography, color matching, tolerances, textiles, fashion, etc.)
4. Education: methods for demonstrations which allow "playing with color"

In addition to these papers, individuals' themes on such questions as theory of knowledge, precision in colorimetry, color rendering, and colorimetric formulation will be considered.

The Scientific Committee has the task of judging and selecting papers. The head of the Scientific Committee will be Mr. König. Other members are Professor LeGrand, Professor Richter, Dr. Judd, and Professor Wright. Professor Dr. V. Ronchi (Florence) may be called upon to judge Italian manuscripts. Those who plan to offer papers should announce the exact theme and send an abstract to the Scientific Committee. In general, twenty minutes will be provided for a paper and ten minutes for discussion. It was suggested that comprehensive lectures by invited speakers be presented each half day as an introduction to the papers for that session.

Official languages for the meeting will be French, German, and English. Papers in other languages will be permitted if the complete translation in one of the official languages is available to all participants. It has been suggested that an exhibition of colorimetric instruments, special literature, and slides be combined with the meeting.

JAPAN COLOR RESEARCH INSTITUTE PUBLISHES COMMEMORATIVE ISSUE OF MUNSELL RENOTATION COLOR BOOK

In his introductory address to a beautiful series of Munsell constant value charts laid out in forty hues, Dr. Sanzo Wada, artist and president of the Japan Color Research Institute, tells us that in the middle 1920's after returning home from abroad, he began thinking about the establishment in Japan of a research institute to standardize color. The Japanese government gradually became interested and appointed a Color Committee of the Japanese Industrial Standards Council in the Ministry of Commerce and Industry, which set up two sets of industrial standards. After the war, when international scientific contacts were again established, it was found that the Optical Society of America had completed its study of the Munsell Book of Color and had made recommendations for the Munsell renotation. This work was well received all over the world, but to Dr. Wada's regret the ideal values were indicated only in terms of CIE (Y,x,y) equivalents, rather than by color chips. He, therefore, decided to take advantage of the technical skills developed by the staff of the Japan Color Research Institute and provide color chips.

Dr. Wada got in touch with Dr. Deane B. Judd, then president of the Optical Society, about the project and was encouraged when Dr. Judd agreed to cooperate, both for the Optical Society and for the Munsell Color Foundation, of which he is the president, by putting Dr. Wada in touch with the Munsell Color Company and gaining their cooperation. It was Dr. Wada's intention to produce the renotation system in matte-finish papers within 1 NBS unit of color difference. This was almost ten years ago.

In a statement of policy issued in 1949 by the trustees of the Munsell Color Foundation, the Munsell renotation specification was declared the primary standard (until better data should become available) for Munsell material standards. Any completely new production of Munsell standards should be based upon this primary standard, and meanwhile, as it became necessary to replace the stock of papers existing in matte-finish, matches would be made to the existing papers but within tolerances that would allow for adjustments only in the direction of the renotation. It was expected that a gradual reduction of deviations and local irregularities could thus be made until the matte-finish papers would finally approach their renotation specifications. It was expected that it would take many years for this to occur, and that meanwhile a completely new series of materials would be made by the Munsell Color Company in a glossy finish. The Munsell Color Company therefore welcomed Dr. Wada's suggestion for producing Munsell papers to renotation in matte-finish.

Work began and there were exchanges of samples and measurements for many years with extensive research into details regarding technical improvements in color measurement. As Dr. Judd indicates in a preface to the book, as a result of cooperative work with the Japan Color Research Institute we have come to a better realization of the uncertainties of spectrophotometric techniques. While achievement of a complete set of samples, either by the Japanese or by the Munsell Company, conforming to Munsell renotations either within 1 NBS unit or within the Munsell AAA tolerance (2/C for hue, 0.05 for value, and 0.2 for chroma) still remains an unattained goal; nevertheless, by Japanese spectrophotometry the samples in the commemorative publication seem to favor the Japanese production, while for current Munsell production, spectrophotometry in the United States might favor the latter.

At any rate, the work of producing this close a fit to the renotation data has been difficult and expensive and has required so much time that in these years the Munsell Color Company has itself been able to approach its goal in matte as well as glossy-finish samples. Thus, when the Japanese project was completed, the Japanese Color Research Institute generously concluded that instead of adhering to their original object of distributing for sale a JCRI Munsell Renotation Color Sample Book, they would complete the project by preparing copies from the limited material available and present them as a commemorative issue to agencies and individuals throughout the world that are interested in the cause of color and in the study and development of a color system. Meanwhile, as Dr. Wada explains, the experience gained by the staff of JCRI (and, we might say, by the group in this country that cooperated in making detailed observations and comparisons of JCRI and Munsell samples) has helped to cultivate great self-confidence regarding the ability to provide color samples to specifications such as the Munsell renotations.

Prefaces to the book by several who were active in this cooperative venture, indicate something of the many facets of the work. There is an address by Dr. Wada and a preface by Dr. Judd from which much of the foregoing is extracted. In a preface by Dr. Yoshikazu Omoto, Tokyo Institute of Technology, JCRI is congratulated on its outstanding achievement in completing this book. He calls it a good example of international scientific cooperation, yet notes that it was an artist, Dr. Wada, who headed the work of producing the renotation of color scales invented by the artist Munsell.

A preface by Dr. Ryuichi Hioki, of Tokyo University, notes the history of a Munsell Color Study Group (Dr. J. Yamanouchi, Dr. T. Azuma, Mr. N. Adachi, Mr. S. Murakami, Mr. R. Mori, Mr. M. Kusakabe, Miss K. Kubo, and Prof. R. Hioki) that met, beginning in 1950, once a month for two years to study and inquire about the Ostwald and Munsell color systems. They concluded that the Munsell renotation system reported in the July 1943 Journal of the Optical Society of America was from the psychophysical point of view the best color system, and since no color books based on these renotations were yet available they wanted one as soon as possible. It was then that Dr. Wada, Head of JCRI, according to the suggestion of Mr. Adachi, undertook the difficult task. Admiration is also expressed (which is fully subscribed to by U. S. workers) for the efforts of Dr. Kawakami, Chief of the Technical Division of JCRI, who tried to hold the papers to a tolerance of 1 NBS unit.

A preface by Mr. Hidemitsu Seki, Managing Director of JCRI, notes that the JIS color book (JIS Z 8721 - 1958, established by the Japanese Standards Association as the Japanese Industrial Standard for "Specification of Colors According to Their Three Attributes," is based on renotation specifications.) is currently the best standard color book in Japan that covers the entire color solid. Yet because of the high cost and surface difference, and because it seldom contains the exact color we are looking for, it has not replaced the need for the several popular standard color sample books that cover particular ranges and include symbols unique to specific industries. The main uses concern accurate designation and provision for a representative sampling of color space from which to select colors suitable for a given purpose. With the possibility of discriminating as many as ten million object colors, books that contain only around 1,000 samples cannot be expected to do better, except when limited to specific purposes and ranges.

Many standard books are shown according to hue. With a 40-hue Munsell renotation book this requires 40 pages. The same number of samples, if mounted according to value can be mounted on eight or nine charts. Mr. Seki calls attention to the fact that while lightness and saturation appear to be equally spaced, there is some question about the spacing of hues, particularly in the vicinity of the bluish greens. (Note: This is a subject that the O. S. A. committee on Uniform Color Scales is now investigating. When their study is complete, we may have a further--and we hope final--renotation specification for samples to represent the Munsell system.) He also suggests that studies should be made to decide on the form of chart that may be most useful. (Removable chips, as in the Ostwald Color Harmony Manual, the D. I. N., and Munsell Cabinet Edition charts, are one very useful form.)

The several prefaces in the book are followed by a brief description of the Munsell system, with a comparison of Value 5 charts for book samples and the CIE renotation specification, then a brief description of the method of manufacture and objective techniques of color measurement. The original correction specification was intended to be 1 NBS unit for the sample match, and 2 NBS units for the production run. Finally, however, colors were controlled by tolerances of $\Delta H = 4.5/C$, $\Delta V = 0.1$, $\Delta C = 0.4$, equivalent to Munsell AA tolerances, which conform to tolerances Dr. Judd suggested as being more realistic if objective tests for conformity were to be based on spectrophotometric measurements in more than one laboratory. A final visual check, with the samples placed in H,V,C order, was made to correct colors that might still look out of line even though they were within instrument tolerances. The pigments used, and a table of fastness tests conclude the brief text.

The charts themselves, except for a hue and value scale, consist of 40 hues at all chromas within the pigment gamut used, mounted on eight white-background, constant-value charts, values 9 to 2. To allow for mounting 40 hues, a neutral center ring is extended to a diameter of about 8 inches, and rings of increasing chromas are mounted outward from this. Each chart is about 23" x 16", with a center fold. The graphic layout, printed in gray on a white background, with 1/2" x 5/8" mounted chips, makes a beautiful design. The edition is limited to 100 numbered books, bound in portfolio style.

Altogether it is a project in which the Japanese Color Research Institute and all who had a part in its production can well be proud. It is unfortunate that the cost of production and the present availability of Munsell-made charts in matte and glossy surface at lower costs than it would be possible to distribute these, make it impractical to carry out the original purpose of making these charts commercially available. Under these circumstances the thought of concluding this project by preparing a commemorative issue as gift copies was a most gracious and generous one.

Copies sent to the Munsell Color Foundation through Dr. Judd have been distributed to representatives of the Munsell Color Foundation, the Munsell Color Company, the Inter-Society Color Council, the Optical Society of America, the U. S. Department of Agriculture, and the National Bureau of Standards. It is expected that of these copies, several will be made available for loan circulation to qualified institutions, and will finally be deposited in suitable libraries. Meanwhile they may be seen at the Munsell offices in Baltimore; in Rochester, New York, by contacting either Ralph Evans or D. L. MacAdam at Eastman Kodak Company; in New York City by contacting A. E. O. Munsell; and in Washington at the office of the O. S. A. Secretary; or through Deane B. Judd at the National Bureau of Standards; or Dorothy Nickerson at the U. S. Department of Agriculture.

D. N.

INTERNATIONAL COMMISSION FOR FASHION-AND TEXTILE-COLOURS

The second meeting of the new international color group was held in Paris in March. The program was divided into two parts. The first session concentrated on perfecting the framework of the organization, including the decision to rotate officers and the determination of a name, specified in three languages:

English: International Commission for Fashion-and Textile-Colours

French: Commission Internationale pour la Couleur dans la Mode et le Textile

German: Internationale Kommission für Mode-und Textilfarben

To stress the international character of the organization it was agreed that meetings will alternate between Paris and other European countries. The third session will be held in September 1964.

The second part concerned the selection of a group of tendency colors for fall 1965. Each country participated by presenting a report of the current color picture for their country and then adding comments and suggestions which could be used as a background when selecting tendency colors. Miss Eloise Voss represented the Color Association and the United States. To give Miss Voss as much information and support as possible, the association held joint meetings of the color committees to study the current color picture and discuss developments which would influence the color picture for fall 1965. The tendency colors which were selected in Paris will be reported when the association issues its Color Forecast for Fall 1965. In the meantime, if any of the ISCC members are interested in specific color information we will be pleased to send swatches of colors comparable to those chosen at the meeting.

Not only is this young organization proving very valuable as a means of exchanging information on color trends, it also serves to increase the use of color in every field in every country. Although, at the present time, attention is given to colors for ready-to-wear only, it is anticipated that, as is the case in the United States, as European techniques in advertising, promotion and packaging expand, other countries will also find that the same colors are simultaneously important in all fields and that more and more industries may be expected to become allied with this color coordination activity. Because of our extensive experience in volume production and distribution and the emphasis we have placed on the young market for so many years, the United States leads Europe, so far as color trends are concerned. An excellent example is the cranberry range, which was of paramount importance in our market for fall 1963 and carried over into spring 1964 as a "city dark" shade. Paris featured the identical shade in its spring 1964 collection.

The association has already received requests from members to broaden the selection of tendency colors to include accessory items. The commission plans to broaden its scope to also include color trends for men's wear.

M. W.

EASTERN ANALYTICAL SYMPOSIUM TO INCLUDE COLOR MEASUREMENT

A half-day symposium session entitled "Analytical Aspects of Color Measurement" is planned for inclusion in the 1964 Eastern Analytical Symposium to be held at the Statler-Hilton Hotel, New York City, on November 11-13, 1964. The program, to be chaired by F. W. Billmeyer, Jr., is tentatively set as follows:

"Color and Analytical Chemistry" - F. W. Billmeyer, Jr.
"Spectrophotometry" - R. M. Johnston
"Colorimetry" - H. R. Davidson
"Colorant Identification" - M. Saltzman and A. M. Keay
"Analytical Color Matching" - E. Allen

It will be noted that each of the speakers is an ISCC member.

The Eastern Analytical Symposium, now in its sixth year, is jointly sponsored by the analytical groups of two sections of the American Chemical Society, by four sections of the Society for Applied Spectroscopy, and by the American Micro-chemical Society. Its symposia cover all fields of analytical chemistry, micro-chemistry, spectroscopy, and instrumental analysis. An instrument exhibit is held in connection with the technical sessions.

REACTIVATION OF ASA PH2.6 SUBCOMMITTEE

In the early 1950's, ASA PH2.6 Subcommittee was formed and was assigned the task to develop an ASA standard, which would achieve the following objectives:

1. Standard conditions for viewing photographic color transparencies

2. Standard conditions for viewing photographic reflection type color prints

3. Standard conditions for viewing photomechanical reflection type color reproductions

Objectives (1) and (2) above were achieved and an "American Standard Lighting Conditions for Viewing Photographic Color Prints and Transparencies" was approved September 8, 1961 (PH2.23-1961).

In 1961, Chairman W. R. Wilson retired and the subcommittee has remained inactive. Warren Reese, ISCC Director, has been appointed chairman and requested to reactivate the committee, which is assigned the task of achieving objective (3) above. Mr. Reese has polled the committee inviting those who wish to continue. He also invited some people to become new members of the committee.

He brought the following information to the attention of the committee. In the 1957 issue of Illuminating Engineering (Journal of the Illuminating Engineering Society) the joint committee of the IES and the Research & Engineering Council of the Graphic Arts, published a "Recommended Lighting Practice for the Color Appraisal of Reflection Type Materials in Graphic Arts." In 1960, ASTM issued D1729-60T, "Tentative Recommended Practice for Visual Evaluation of Color Differences of Opaque Materials." In 1964, ASTM dropped the word "tentative" and D1729-60 is now "recommended." A paper by Judd, MacAdam, and Wyszecki has been submitted to the Journal of the Optical Society, "Spectral Distribution of Typical Daylight as a Function of Correlated Color Temperature." Mr. Reese wrote to the committee, "Your help and contribution is greatly needed to resolve the knotty technical and psychophysical problems so that a badly needed standard can be evolved which will be acceptable to the vast graphic arts industry."

UNCONVENTIONAL PHOTOGRAPHIC SYSTEMS

The 1964 Annual Symposium of the Society of Photographic Scientists and Engineers on Unconventional Photographic Systems will be held October 29-31, 1964, at the Marriott Twin Bridges Motor Hotel, Washington, D. C. The Bureau of Naval Weapons is co-sponsor. For information contact:

William S. Dempsey
FMA, Inc.
4925 Fairmont Avenue
Washington 14, D. C.

Telephone: Area Code 301, OLiver 6-9324

SYMPOSIUM ON GLOSS MEASUREMENT

The Official Digest of the Federation of Societies for Paint Technology published the "Symposium on Gloss Measurement" with papers by S. Huey, R. S. Hunter, J. G. Schreckendgust, and H. K. Hammond, III. Mr. Hammond arranged with the FSPT to provide enough copies of a reprint for all members of ISCC.

So, thanks to Harry Hammond and FSPT a copy of the reprint is enclosed with this Newsletter.

Ed.

NORMAN MACBETH CHAIRMAN OF IES-ISCC JOINT COLOR SESSION

As chairman of IES delegates to the ISCC, Norman Macbeth has been asked by IES to serve as chairman to arrange with the ISCC for a jointly sponsored session on color to be held during the annual Technical Conference of the Illuminating Engineering Society in Miami, August 31 through September 3, 1964.

FRED BILLMEYER MADE PROFESSOR AT RENSSELAER

In September 1964, Dr. Fred W. Billmeyer, Jr. will assume the position of Professor in the Department of Chemistry, Rensselaer Polytechnic Institute, Troy, New York, where his duties will include teaching and research in both polymer science and the science of color measurement.

Dr. Billmeyer received his B. S. degree in chemistry from the California Institute of Technology in 1941, and his Ph.D. in physical chemistry from Cornell University in 1945. At Cornell he studied under Peter Debye on the measurement of molecular weight and particle size by light scattering.

From 1945 to 1964, Dr. Billmeyer has been associated with the Plastics Department of E. I. duPont de Nemours and Company, Wilmington, Delaware, his latest position being that of Research Associate. In addition, he held from 1951 to 1964 the position of Lecturer in High Polymers in the Department of Chemistry, University of Delaware, and in 1960-61 he was on leave from duPont to act as Visiting Professor in Chemical Engineering at the Massachusetts Institute of Technology.

Professor Billmeyer is a very active member, a director, of ISCC, and chairman of the important Problem Subcommittee 22. He is a member of Phi Kappa Phi and Sigma Xi honor societies, a Fellow of the American Physical Society and of the Optical Society of America, and a member of the American Chemical Society and the Society of Plastics Engineers. He is the author of over 45 technical papers in the fields of polymer chemistry and optics, and his book entitled Textbook of Polymer Science is widely used in classrooms.

Professor Billmeyer married the former Annette Trzcinski of Wilkes-Barre, Pa. They have three children and will reside at 2121 Union Street, Schenectady, New York.

With his course, Rensselaer will add its name to those very few colleges offering work in the science of color.

PHOTO SCIENCES CONSULTING ACTIVITY

Dr. LeRoy M. Dearing announced the incorporation of L. M. Dearing Associates, 12345 Ventura Boulevard, Studio City, California, a consulting and engineering group specializing in photo sciences, optics, sonics, and materials science.

Dearing, a delegate to ISCC representing the Society of Photographic Scientists and Engineers, pioneered in the introduction of Kodachrome and Kodacolor. He served in the Navy, during the war, as head of Photographic Research and then joined the Technicolor Corporation as Director of Research for a number of years, later becoming Technical Director of the Consumer Division when Technicolor entered the consumer products field.

INTERACTION OF COLOR
BY JOSEF ALBERS
A REVIEW

The unusual format of this work commands attention first. There is a text of 80 pages, with lavish margins and spacing. Illustrations are presented in a series of 81 individual folders (each 10" x 13" folded), and a commentary keyed to the illustrations is provided in a separate binding. The illustrations and commentary are housed in a sturdy covered box which is, in turn, housed in a rugged open box along with the text. This formidable array weighs 18.5 pounds (approximately) and costs $200.00 (exactly).

As characterized by the author, this book is "a record of an experimental way of studying color and of teaching color," placing "practice before theory." Accordingly, the illustrations are called "studies" and/or "solutions." The range of studies is indicated below by the titles provided for the commentary for each set of folders: IV -- one color looks like two; V -- Gradation - intensity - a test: VI -- Reversed grounds; VII -- Different colors look alike; VIII -- After-image; IX -- Mixture in paper; X -- Additive and subtractive mixture; XI -- Transparence and space; XII -- Optical mixture; XIII -- The Bezold Effect; XIV -- Transformation; XV -- Intersection; XVI -- Quantity; XVII -- Film and volume color; XVIII -- Free studies; XIX -- The Masters; XX -- The Weber-Fechner Law; XXI -- Warm-cool; XXII -- Vibrating boundaries; XXIII -- Equal light intensity; XXIV -- Color theories; XXV -- Leaf studies.

Paper, rather than paint, was used to produce the originals of the illustrations. Reproduction was accomplished by means of silk-screen, four-color separation, and photo-offset processes.

Many of the illustrations are excellent. For example, the contrast effects are often very striking, indeed, and must have required exceedingly careful selection. The "transformation" and "film and volume" studies are also very well executed. But most delightful, by far, are "The Masters" and "Leaf Studies." In the former, Albers presents a series of paintings by masters transferred "into color paper, in order to identify their color instrumentation." In the latter, he presents a series of "free studies" produced through combinations of pressed fall leaves and paper. The leaves "add innumerable tints and shades, with modulations and shapes that color papers do not have."

On the other hand, several illustrations were ineffective for me, the most notable ones being the brick walls illustrating what Albers calls the "Bezold Effect" and the yellow-black combination in the "Transparence and Space" studies. The few exceptions, however, detract but little from the general high quality of the illustrative material.

The text and commentary are another matter altogether. Albers' explanations and discussions are generally confused, incorrect, and illogical. It will not be possible in this review to present a complete and detailed examination of these shortcomings, so I shall deal only with a few representative ones.

The author's thesis is set forth in the introduction as follows:

> "In visual perception a color is almost never seen as it really is--
> as it physically is.
>
> "This fact makes color the most relative medium in art."

Interpreted on the basis of some later statements, the first sentence is to be taken, I believe, as proof that "color deceives continually." This approach can lead only to a poor understanding of the phenomenon of color. While Albers does admit that "knowledge and its application is not our [meaning his] aim," I fail to understand how dissemination of misconceptions can aid in developing "flexible imagination, discovery, invention," which is the stated objective.

Misconceptions initiated by such an approach are not at all relieved by the analogical argument used througout the book. Argument by analogy is dangerous at best, and in this case it is not at its best, as demonstrated in the following excerpts:

> "Just as the knowledge of acoustics does not make one musical
> --neither on the productive nor on the appreciative side--
> so no color system by itself can develop one's sensitivity for color.
>
> "This is parallel to the recognition that no theory of composition by itself leads to the production of music, or of art."

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"First, it is hard, if not impossible, to remember distinct colors. This underscores the important fact that the visual memory is very poor in comparison with our auditory memory. Often the latter is able to repeat a melody heard only once or twice."

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"We are able to hear a single tone.
But we almost never (that is, without special devices) see a single color unconnected and unrelated to other colors.
Colors present themselves in continuous flux, constantly related to changing neighbors and changing conditions.

"As a consequence, this proves for the reading of color what Kadinsky often demanded for the reading of art: what counts is not the what but the how."

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The picture of color is further distorted by a variety of errors, a few of which are found in the following:

"...the red of the Coca-Cola signs which is the same red all over the country..."

- - - - -

"...There are 2 kinds of physical mixture:
(a) Direct mixture of projected light,
(b) Indirect mixture of reflected light."

- - - - -

"By means of a prismatic lens, the physicist easily demonstrates that the color spectrum of the rainbow is a dispersion of the white sunlight. With this he proves also that the sum of all colors in light is white."

- - - - -

"...any reflected color--not just white--consists of all other colors."

- - - - -

There is also much that I am not able to assess because I cannot understand it. Following are some examples:

"Besides a balance through color harmony, which is comparable to symmetry, there is equilibrium possible between color tensions, related to a more dynamic asymmetry."

- - - - -

"Here we may point to a discovery made by a few contemporary painters, that the increase in amount of a color--not merely in size of canvas--visually reduces distance. As a consequence, it often produces nearness--meaning intimacy--and respect."

Describing one of the "studies":

"...there is at left a harmonious and sonorous assemblage of adjacent colors which makes the blues look warm, and at right a repetitious dissonance in hue and in light which makes the reds look cool."

There is more--much, much more--with which I would disagree. I believe it would be unfortunate, to put it mildly, if the prediction stated in the advertising material were to be fulfilled, to wit, that "Interaction of Color will unquestionably become the fundamental work in our time on the nature and use of color."

In the preceding comments I have attempted to assess Albers' book fairly as an aid for instruction in color. I have not attempted, nor will I attempt, to judge it as a work of art or as "a summation of the career of one of the most influential teacher-artists of the twentieth century." If it is to stand as a monument to a career, then perhaps it is justified. If it aids significantly in the production of accomplished artists, then perhaps its deficiencies do not matter. Unfortunately, there are no generally accepted criteria for assessing the work from these standpoints.

In conclusion, I feel that, in all fairness, I must report that I have been reminded, in writing this review, of my experience in industry some years ago, even though a dangerous analogy might be suggested. The company which employed me did many things poorly. Merit rating, product evaluation, job assessment, personnel selection, color instruction, etc., were unreliable and invalid in many cases. In fact, I could never understand how the company survived with all its deficiencies. Yet survive it did, and very successfully. If I were to venture into the same business, I should probably starve.

R. M. Hanes

ADDENDUM TO THE REVIEW OF INTERACTION OF COLOR BY JOSEF ALBERS

When asked to comment on the above review, D. B. Judd reported agreement with the general assessment of both the illustrations and the text but expressed reservations about the examples of error cited in the review. He suggested examples of confusion and error that he considered more striking, and he provided detailed explanations for his assessment. Judd also felt that explanatory comments should be provided to cover the examples of error that I had selected. With his permission, I shall quote at length from his remarks, both because his examples are well chosen and explained and because his reservations about my examples point up important differences between technical and non-technical language.

Judd wrote as follows:

"As a major example of confusion I would cite Chapter XX, The Weber-Fechner Law -- the measure in mixture, pages 58-60, in which Albers writes:

> 'In order to obtain a graduated scale of greys, M. E. Chevreul, the author of the famous book <u>The Laws of Contrast of Colour</u> gave the following instructions (from an English translation of 1868, page 5, paragraph 11):
>
> > Upon a sheet of cardboard divided into ten stripes, each about a quarter of an inch broad, lay a uniform tint of India ink. As soon as it is dry, lay a second tint on all the stripes except the first. As soon as the second is dry, lay a third one on all the stripes except the first and second, and so on all the rest, so as to have ten flat tints gradually increasing in depth from the first to the last.
>
> 'All this, of course, refers to volume color (one wonders how?) but, most important, it also leads to a new insight into color mixture -- after an unavoidable surprise is recognized.
>
> 'The surprise is that the gradual "increase in depth" promised above does not appear -- as most people will expect -- in a succession of equal steps...
>
> 'In this case a continued application of such layers would unavoidably lead to such a degree of decrease that the initial increase would disappear in a final, unsurpassable, and unchanging saturation...
>
> 'This leads to the question: what is necessary to produce a visually even progression in mixture?
>
> 'The answer was found by Weber (Wilhelm Eduard, 1804-91) and Fechner (Gustav Theodor, 1801-87). It is formulated in the so-called Weber-Fechner Law: The visual perception of an arithmetical progression depends upon a physical geometric progression.
>
> 'To demonstrate this surprising discrepancy between physical fact and psychic effect, and, more important, to become convinced of it through one's own experience, the following exercise is recommended:
>
> 'On a white paper, layers of very light transparent coats of a very thin color are placed on top of each other; first, as M. Chevreul suggests, in an arithmetical pro-

gression (1, 2, 3, 4, 5, etc., layers); then, in a second row, in a geometrical progression (1, 2, 4, 8, 16, etc., layers), on the same paper. In both rows, contiguous steps of equal width are required.'

"It is evident that by 'physical geometric progression' Albers means a geometric progression in number of light-absorbing layers. The Weber-Fechner law, however, refers to a geometric progression of what we now call luminance. It is rather droll to note that if the layers laid down in accord with Chevreul's direction, each absorb a constant fraction of the incident light, these directions are precisely those required to produce a geometric progression in luminance. For example, if the sheet of cardboard on which the absorbing layers are placed has a luminance of 1, the successive steps in the scale will have luminances of 1/2, 1/4, 1/8, 1/16 and so on, if on passage toward and away from the paper each layer absorbs 1/2 of the incident light. If the Weber-Fechner law were correct, this scale should appear evenly stepped. Albers correctly notes that usually such a scale is perceived to have much smaller steps at the dark end than at the light, but far from substantiating the Weber-Fechner law this should be taken as an indication that this law does not give correct predictions for ordinary viewing conditions such as provided by a uniform gray to white surround. Of the many studies of gray scales made since Fechner's time, culminating in the Munsell value functions, Albers seems to be as ignorant as he is of the meaning of the Weber-Fechner law that he cites.

"As an example of incorrectness I would cite on page 36 the passage: 'First, under normal conditions, a subtractive mixture is not as light as the lighter of the color parents nor as dark as the darker one.' The fact is, of course, that superposing one absorbing layer on top of another always produces a color darker than that of either layer provided the color of the ground shows through at all. This is correctly shown in illustration X-1. For colorant mixture, which is neither purely additive nor purely subtractive, the above statement sometimes holds and sometimes does not. Even for opaque layers of colorants the colorant mixture may be darker than either component; for example, red paint mixed with cyan paint produces a gray paint darker than either."

Referring then to the examples of error that I had selected, Judd stated his reasons for thinking that they required explanatory comment. Since his remarks indicate another point of view, I believe that a presentation of both viewpoints with respect to these examples might be useful to the reader.

In the case of the Coca-Cola signs, Albers says that the "red" of these signs "is the same all over the country." He cites this "fact" as an example of how physical aspects remain constant and the human response varies. Albers' use of terms is such that one cannot determine exactly what he means by "the red of the Coca-Cola signs" -- whether he means the spectral reflectance or transmittance characteristics of the media or the spectral distribution of the reflected or transmitted light. In either case, his statement is erroneous if "same" is taken to mean identical or not significantly different or not noticeably different. The variety of media employed in these signs and the variety of conditions under which the signs are viewed mean that the physical aspects of the "red" of these signs should be characterized as being very different rather than "the same." Whether it is the stimulus aspects or the response aspects which produce the greater variation in people's memory for "Coca-Cola red" is a matter for experimental determination.

Judd feels that Albers' statement about the Coca-Cola signs is acceptable if one adds the qualifying phrase "to a good approximation." But Albers does not qualify his statement in any way, and his failure to do so is representative of a fundamental difference between a technical and a non-technical approach.

With respect to the second error that I cited; i.e., the division of physical mixture into "direct mixture of projected light" and "indirect mixture of reflected light," Judd's classification of the statement is better than mine. Judd says that to speak of "indirect mixture of reflected light" is not wrong, but simply so unclear as to be meaningless.

As for Albers' statement that "...any reflected color...consists of all other colors" (the fourth statement listed as an error), Judd characterizes this as being not so much an error as it is "a breezy, non-technical way of saying that the light reflected from any diffusing surface consists of light of all parts of the spectrum of the source in various proportions, no one of which is zero." To me, these two statements say quite different things, and I must stick with my classification of Albers' account as erroneous. I consider the statement that "the sum of all colors in light is white" is in the same category and that it cannot be excused as being simply "breezy, non-technical" language. In fact, it is just this type of language that initiates and perpetuates misconceptions.

R. M. Hanes

BOOK REVIEW
<u>COLOR VISION</u>

(A paper-bound book by Richard C. Teevan and Robert C. Birney. Published by D. Van Nostrand, Princeton, New Jersey, 1961. 214 pages.)

Dear Editor: Thank you for sending me the book on "Color Vision" by Teevan and Birney for my comments. It is an admirable sampling of the literature under that title and, while designed as collateral reading for college classes, it is quite as applicable to the more occasional reader who would inform himself on the subject.

Since the selections have been chosen almost entirely from more extensive works that have achieved the status of classics, it would be gratuitous for me to further summarize the various excerpts. It is more to the point to urge that anyone with an interest in color get something of the flavor of the original writer by reading his own words. Perhaps the reader will be intrigued to peruse still more of the treatises from which the sections are taken.

Indeed it is to be hoped that a serious reader will inquire whether a complete picture of the fascinating study of color has been given. He may ask whether everyone working with color scientifically has limited himself to the puzzle of the sensing mechanism. While that is indeed a fascinating question, this little book indicated that in over 100 years of speculating, no satisfactory answer has been reached.

At the same time many researchers have directed their efforts to studying color as visual experiences and their varied ramifications. If someone else will sample this parallel exploration of color, he will be doing us a comparable service. Or if someone would like to go exploring on his own, Leonardo da Vinci had something to say about the looks of colors, and so also did Goethe. In the last half of the 18th century, the emerging experimental psychologists took color vision to be a part of their subject matter. A few of the stalwarts of that period should be consulted: Wundt, Ebbinghaus, Kuelps, Hering, G. E. Müller, Titchener, to name a few. Likewise Chevreul's observations on color will be found fascinating, and it is in English. A survey of this literature will be found in Boring's Sensation and Perception in the History of Psychology. If by calling attention to the paperback edition discussed above you lead our friends in ISCC to extend their reading and interest into other aspects of color vision, you will have done the group a service.

Forrest Dimmick

HARRY HELSON'S BOOK ON ADAPTATION-LEVEL THEORY

The complete title is Adaptation-Level Theory, An Experimental and Systematic Approach to Behavior (Harper & Row, 49 East 33rd Street, New York 16, New York, 1964), 732 pages. As the title implies, Helson's book deals with a wide variety of behavior, such as psychophysical judgments, perception, affectivity and motivation, learning and performance, cognition and thinking, personality, and interpersonal behavior. Less than 10 percent of the pages deal with problems of color. Still I think this book is worthy of the attention of many Newsletter readers. Professor Helson originated the concept of adaptation level as the basic principle on which to explain the results of experiments in color perception carried out between 1924 and 1940. In some of these experiments I was fortunate to be a collaborator.

To indicate the principle of adaptation level as applied to color perception I cannot do better than to quote the succinct statement 3.9.2 in Basic Elements of Color Education, a report of the Inter-Society Color Council Subcommittee for Problem 20 (John Wiley & Sons, New York, 1963) by Robert W. Burnham, Randall M. Hanes, and C. James Bartleson:

> "In every viewing situation an adaptation level is established such that objects having reflectances above that level arouse responses which tend to take on the hue produced by the illuminant; objects having reflectances below that level arouse responses that tend to take on the hue of the after-image complementary; and objects of low purity relative to the weighted mean chromaticity of the field and having reflectances about equal to that of the adaptation level tend to appear as neutral or achromatic. This has been called the Helson-Judd effect."

In his new book Professor Helson gives an extended summary (pp. 260-269) of these experiments and shows how the reflectance corresponding to adaptation level may be computed from the viewing situation. He also applies the concept of adaptation level to colored shadows, to lightness constancy, to contrast, to the Land demonstrations, to color preferences, to the Bezold "spread" phenomenon, and to the Gelb effect.

Professor Helson states the principle of adaptation level in general terms as follows (pp. 62-63):

> "In every situation confronting the organism there is established an adaptation level that is a weighted mean of focal, background, and residual stimuli. Adaptation level represents the zero of function, and, since it is always associated with positive values of stimulation, stimuli below as well as above level exert positive effects on behavior. Responses to stimulation are manifestations of positive or negative gradients from level."

That the results of experiments on lifted weights, discrimination of pitch, size perception, or even pain, should require the concept of adaptation level is perhaps not surprising; but Professor Helson also makes a good case for the usefulness of this concept in the assessment of personality and the understanding of group behavior. Adaptation level is indeed a general concept extending far from the field of color where it originated.

D. B. Judd

CIBA SYMPOSIUM The Ciba Foundation arranged a symposium on the Physiology and Experimental Psychology of Color Vision, under the chairmanship of Professor O. E. Lowenstein, in London during July. Membership of the symposium was restricted, but the proceedings are to be published by J. & A. Churchill Ltd., in the spring of next year as one of the books in the Ciba Foundation Symposium series.

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